Service Manual

Commercial Air Conditioners

E Series Water-cooled Packaged Unit

Commercial AC R&D Department Ⅰ

Contents

I Engineering Data

1. Product Introduction

1.1 Model List

Model	Product Code	Main Unit	Controller
GWCP0032	/		
GWCP0049			
GWCP0065			
GWCP0080	/		
GWCP0098			
GWCP0105			
GWCP0116			
GWCP0130			
GWCP0145			
GWCP0160			
GWCP0196	/		

Note:1Ton =12000Btu/h = 3.517kW

1.2 Nomenclature

GWCP	X
1	2

No.	Description	Options
1	Unit code	Water-cooled packaged air conditioning unit R410A,380vac,3Ph,50Hz
2	Nominal cooling capacity	Ex. 0065 = 65 kW

1.3 Product Features

1.3.1 General

Featured with compact structure and high EER, it becomes more and more popular. Besides, thanks to high reliability, wide practicability, convenient installation and transport, friendly human-machine interface, wide cooling capacity of 32 to 196kW, this kind of unit is applicable to workshops, shopping malls, supermarkets, hotels, office buildings etc.

1.3.2 Detailed Description

(1) High energy efficiency and energy conservation

Simulation to the system and flow passage can optimize the operation performance. Its certified energy efficiency is far beyond the national standard.

(2) Stable operation

Thanks to the highly reliable components and advanced automatic control system, the unit can run stably in long term.

(3) Hermetic scroll compressor

Under the same cooling capacity, compared with other type of compressor, it has less component, smaller rotating moment, less vibration and noise, high reliability and energy efficiency.

(4) Complete protection

Multiple protections are available, such as compressor overload protection, fan overload protection, high/low pressure protection, high discharge protection, flow switch protection, antifreeze protection, as well as periodic maintenance alert and powerful self-diagnosis.

(5) Quiet operation

The hermetic design together with the low-noise centrifugal fan can realize stable operation and air supply. Through simulation analysis to vibration of pipes and the unit, this unit is widely applicable to all kinds of projects.

(6) Microcomputer intelligent control

Through the microcomputer control system, it can monitor and display each operation data for intelligent control, unattended monitoring, correct diagnosis, as well as remote start/stop.

(7) Remote monitoring

The reserved BMS interface allows the user to control the unit through a computer. In this way, the

user can realize central management to multiple units.

(8) Remote On/Off

The user can start or stop the unit remotely, with no attendance to the machine room.

(9) Wireless GPRS module

It can remotely monitor the running status of the unit.

(10) Equilibrium technology of the compressor

This technology can make sure runtime of each compressor is equal so as to extent their service life.

(11) Interlocked control to the water system

The reserved interface can interlock the unit with the water pump and the water cooling tower.

(12) Adjustable static pressure

The static pressure can be adjusted for ducts of different buildings to satisfy the customer to the most extent.

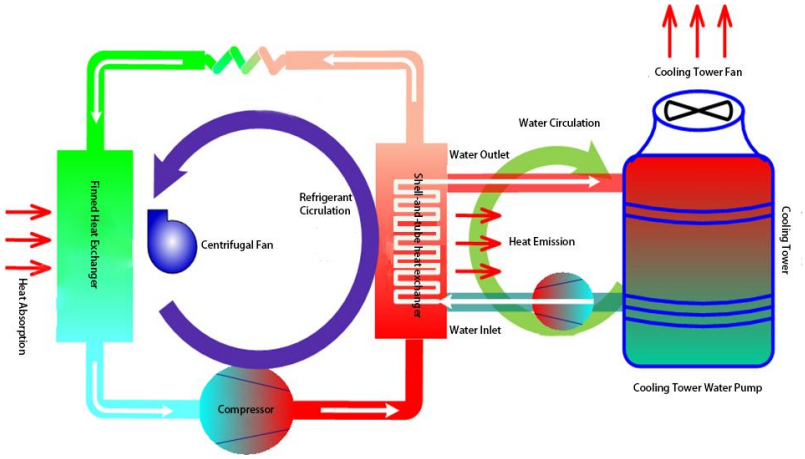
(13) Automatic maintenance alert

According to actual operation condition, automatic alerts will be raised to remind the servicemen of maintenance.

1.4 Diagram of Working Principle

1.4.1 Diagram of Working Principle

Each system of the E series packaged unit can be taken as a single and identic system. Let us take one for example.



After energized, the unit starts to run. Low-pressure refrigerant from evaporator absorbed into compressor is compressed into high-pressure gas and enters into shell and tube condenser. It becomes refrigerant liquid after heat exchange with cooling water, which will be throttled and depressurized by capillary. The refrigerant liquid becomes refrigerant gas after heat exchange with indoor air which needs to be conditioned. The cooling purpose is realized by recycling this process.

1.5 Product Data

1.5.1 Data under Nominal Conditions

Main unit	Model		–	GWCP0032	GWCP0049
	Product Code		–	/	/
	Cooling capacity		kW	32	49
	Airflow		m^3/h	5500	8500
	External static pressure		Pa	75	75
	Motor power		kW	1.1	2.2
	Non-standard static pressure		Pa	50~200	50~200
	Control temperature range		℃	16~30±2	
	Power supply		–	380V 3N～50Hz	
	Total cooling power		kW	8.0	12.9
Cooling system	Condenser	Mode	–	Horizontal, shell-and-tube	
		Water volume	m^3/h	6.9	10.6
		Water resistance	KPa	35	35
		Size	Inch	1-1/2	2
		Mode	–	Female thread	
	Evaporator	Mode	–	Finned	
		Pitch of fins	mm	1.6	1.6
Ventilation	Indoor fan	Mode	–	Centrifugal fan	
		Drive Mode	–	Belt drive	
	Filter		–	Nylon Filter	
Controller			–	Controlled by the computer	
Drain pipe	Condensate pipe		Inch	G3/4 (OD)	
Outline Dimensions	Width		mm	1250	1700
	Depth		mm	710	710
	Height		mm	1950	1950
Net weight			kg	415	515

Main unit	Model		–	GWCP0065	GWCP0080	GWCP0098	GWCP0105
	Product Code		–	/	/	/	/
	Cooling capacity		KW	65	80	98	105
	Airflow		m^3/h	11000	14000	16000	18000
	External static pressure		Pa	100	100	115	140
	Motor power		kW	3.0	3.0	4.0	4.0
	Non-standard static pressure		Pa	100~300	100~300	100~350	140~350
	Control temperature range		℃	16~30±2			
	Power supply		–	380V 3N～50Hz			
	Total cooling power		KW	16.2	19.4	24.3	25.5
Cooling System	Condenser	Mode	–	Horizontal, shell-and-tube			
		Water volume	m^3/h	14	17.2	21.1	22.6
		Water resistance	KPa	40	40	44	45
		Size	Inch	2			
		Mode	–	Female thread			
	Evaporator	Mode	–	Finned			
		Pitch of fins	mm	1.6	1.6	1.6	1.6
Ventilation	Indoor fan	Mode	–	Centrifugal fan			
		Drive Mode	–	Belt drive			
	Filter		–	Nylon filter			
Controller			–	Controlled by the computer			
Drain pipe	Condensate pipe		Inch	G3/4 (OD)			
Outline dimension	Width		mm	1880	1950	1950	1950
	Depth		mm	835	1060	1060	1060
	Height		mm	2000	1950	1950	1950
Net weight			kg	650	720	820	820

Main unit	Model		–	GWCP0116	GWCP0130	GWCP0145
	Product Code		–	/	/	/
	Cooling capacity		KW	116	130	145
	Airflow		m^3/h	19000	22000	23000
	External static pressure		Pa	140	140	140
	Motor power		KW	5.5	5.5	5.5
	Non-standard static pressure		Pa	140~400	140~450	140~450
	Control temperature range		℃	16~30±2	16~30±2	16~30±2
	Power supply		–	380V 3N ~ 50Hz		
	Total cooling power		KW	28.2	31.6	35.5
Cooling system	Condenser	Mode	–	Horizontal, shell-and-tube		
		Water volume	m^3/h	25	28	31.2
		Water resistance	KPa	45	45	50
		Size	Inch	2-1/2		
		Mode	–	Female thread		
	Evaporator	Mode	–	Finned		
		Pitch of fins	mm	1.8	1.8	1.8
Ventilation	Indoor fan	Mode	–	Centrifugal fan		
		Drive Mode	–	Belt drive		
	Filter		–	Nylon filter		
Controller			–	Controlled by the computer		
Drain pipe	Condensate pipe		Inch	G3/4 (OD)		
Outline dimension	Condensate pipe		mm	1950	2300	2300
	Width		mm	1060	1200	1200
	Depth		mm	1950	2000	2000
Net weight			kg	850	1060	1070

Main unit	Model		–	GWCP0160	GWCP0196
	Product Code		–	/	/
	Cooling capacity		KW	160	196
	Airflow		m^3/h	26000	32000
	External static pressure		Pa	190	190
	Motor power		KW	7.5	11
	Non-standard static pressure		Pa	190~450	190~500
	Control temperature range		℃	16~30±2	16~30±2
	Power supply		–	380V 3N～50Hz	
	Total cooling power		KW	39.0	47.7
Cooling system	Condenser	Mode	–	Horizontal, shell-and-tube	
		Water volume	m^3/h	34.4	42.4
		Water resistance	KPa	55	60
		Size	Inch	2-1/2	3
		Mode	–	Female thread	
	Evaporator	Mode	–	Finned	
		Pitch of fins	mm	1.8	1.8
Ventilation	Indoor fan	Mode	–	Centrifugal fan	
		Drive Mode	–	Belt drive	
	Filter		–	Nylon filter	
Controller			–	Controlled by the computer	
Drain pipe	Condensate pipe		Inch	G3/4 (OD)	
Outline Dimension	Width		mm	2300	2650
	Depth		mm	1200	1220
	Height		mm	2000	2150
Net Weight			kg	1090	1410

Notes:

① The product is designed in accordance with GB/T 17758-2010. All data listed in the table above are tested under normal conditions. Other unit required with non-standard static pressure can be customed.

② The rated total cooling power is sum of power of the compressor and the indoor fan, and water pump and fan of the cooling system as required by GB/T 17758-2010.

③ The heating capacity should be selected from the available options. Electric heating and heating coils are selectable. The former is defaulted. The rated power for electric heating is sum of the power of heating and the indoor fan.

④ These data are subject to change for technical improvement and other reasons. Please always see the name plate for correct and newest data.

1.5.2 Product Capacity Correction

Mode	Inlet Air of the Evaporator		Inlet and Outlet Water of the Condenser	
	DB Temp℃	WB Temp℃	Inlet Water Temp℃	Flow Rate $m^3/(h \cdot kW)$
Cooling	27	19	30±0.3	Cooling Capacity*0.215

1.5.3 Operation Range

Power Supply	Voltage (V)		Leaving Cooling Water Temp (℃)		Evaporating Coil DB Temp (℃)		Evaporating Coil WB Temp (℃)	
	Min	Max	Min	Max	Min	Max	Min	Max
380V 3Ph 50Hz	342	418	18	42	15	35	13	24

Note: If the application condition goes out the nominal operation range listed the table above. Please contact us.

1.5.4 Electric Data

Model	Data	Minimal Sectional Area			Air Switch (A)
		Live Line	Neutral Line	Ground Line	
GWCP0032	380 3Ph 50Hz	4	4	4	25
GWCP0049		6	6	6	32
GWCP0065		10	10	10	40
GWCP0080		10	10	10	40
GWCP0098		16	16	16	63
GWCP0105		16	16	16	63
GWCP0116		16	16	16	63
GWCP0130		35	35	16	80
GWCP0145		35	35	16	80
GWCP0160		35	35	16	80
GWCP0196		50	50	25	125

Notes:

① Sizes for the air switch and the power lines are determined based on the maximum power.

② Sizes of the power line indicate those for the single-core BV line inside the plastic pipe at 40℃ environmental temperature. The air switch should be used also at 40℃ environmental temperature. If application conditions change, please provide the User's Manual for proper use.

③ The power lines must be copper-conductor cables and the working temperature cannot exceed the recommended value.

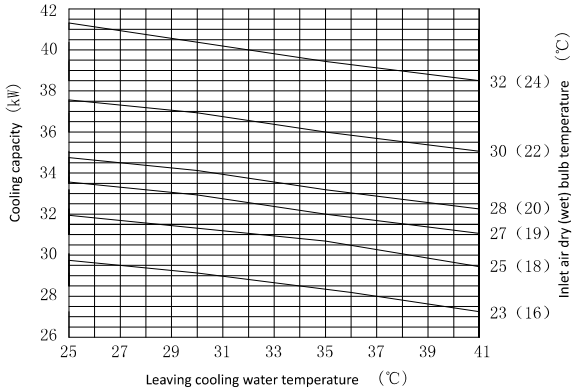
④ When length of the power line is longer than 15m, enlarge its sectional area properly so as to avoid overloading.

⑤ For the unit with the electric heater, selection of the air switch and the power line depends on the rated current for cooling.

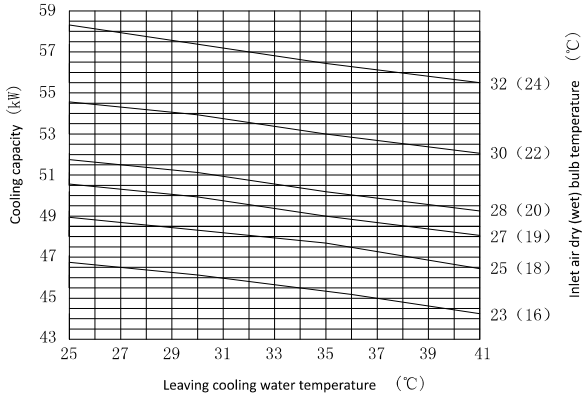
1.6 Correction of Capacities

Cooling capacity curves under different environment temperature and leaving chilled water temperature, as well as cooling capacity curves under different environment temperature and leaving hot water temperature.

GWCP0032



GWCP0049



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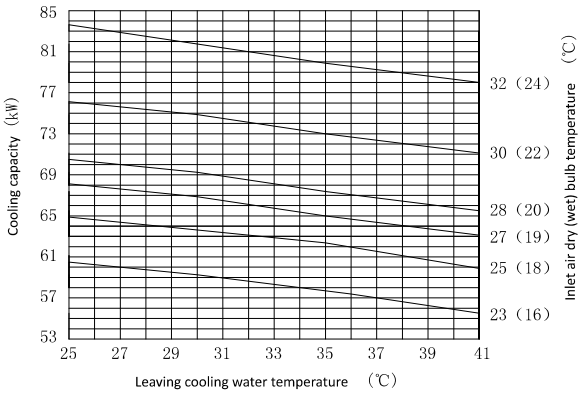

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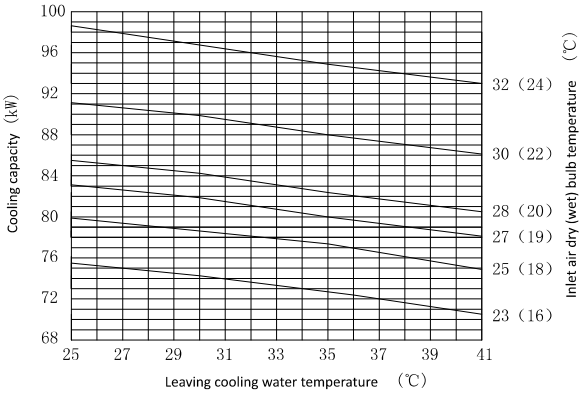

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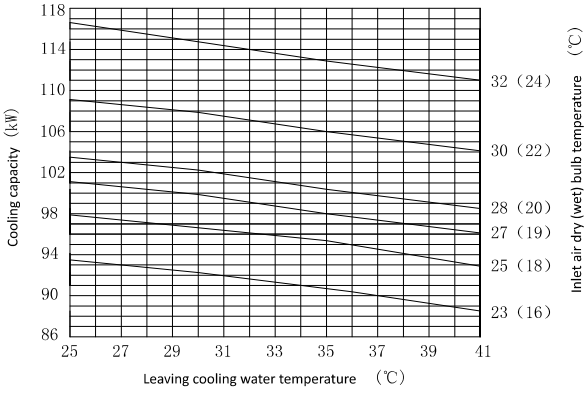

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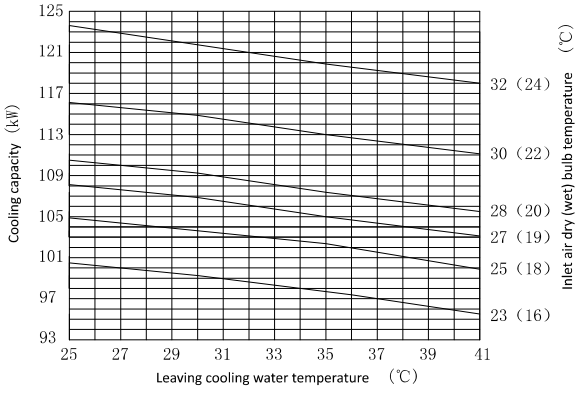

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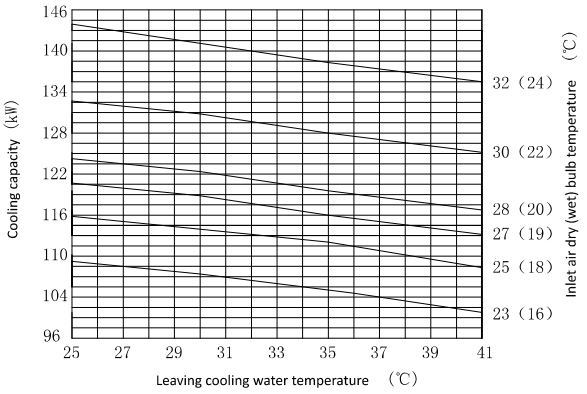
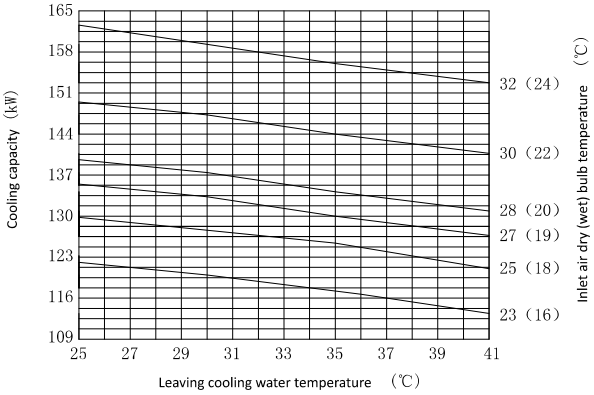
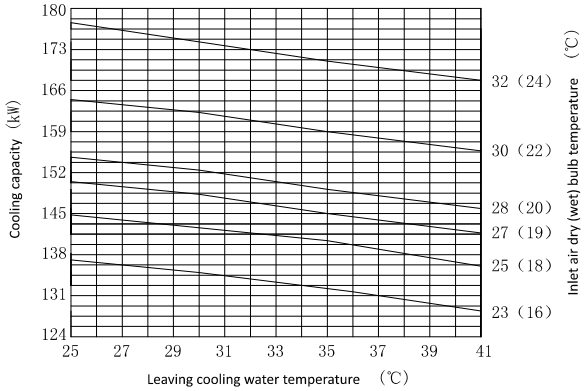


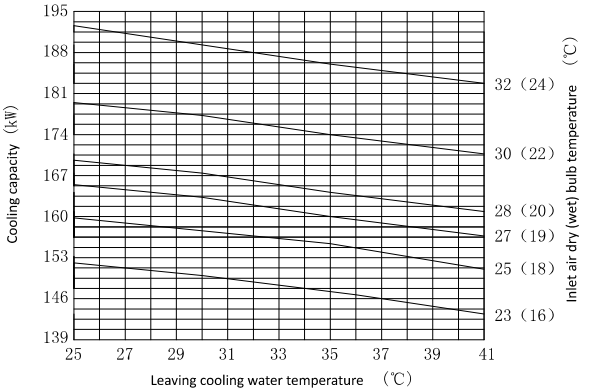
GWCP0130



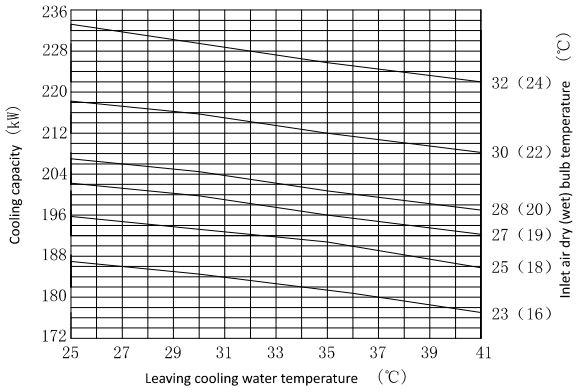
GWCP0145



GWCP0160

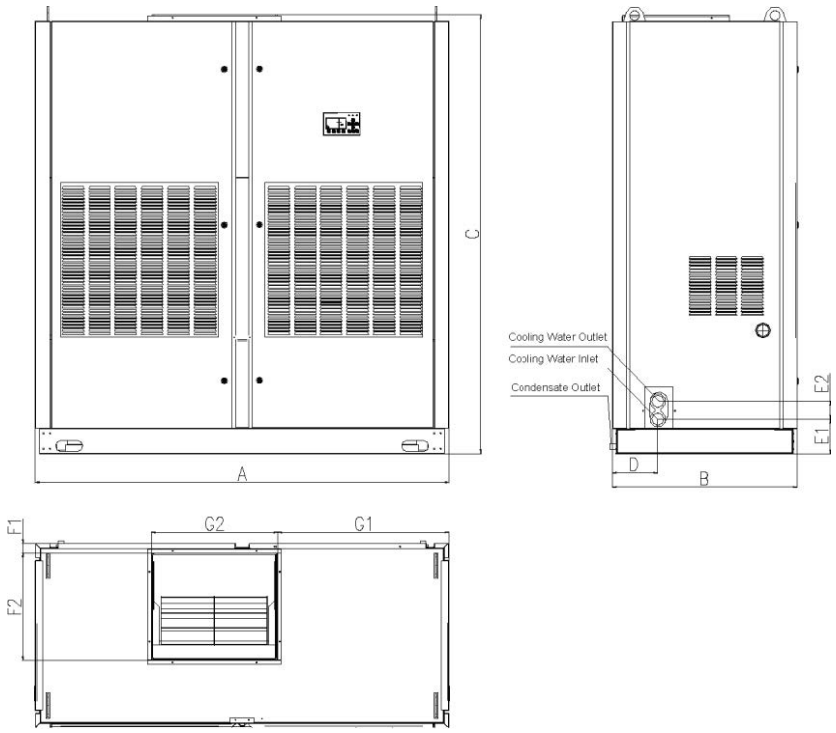


GWCP096



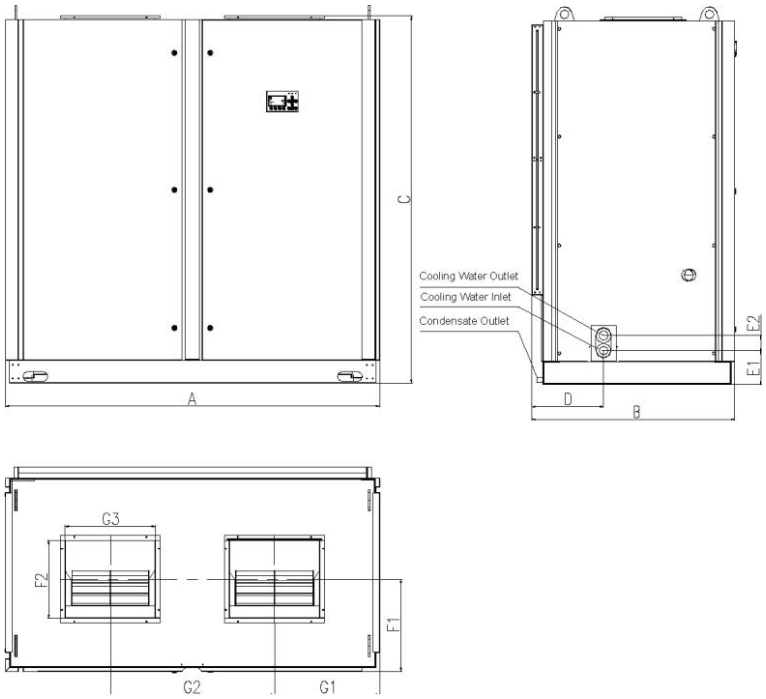
2. Outline Dimensions

(1) GWCP0032、GWCP0049、GWCP0065



Dimension / Model	A	B	C	D	E1	E2	F1	F2	G1	G2
GWCP0032	1250	710	1950	240	180	80	100	345	270	470
GWCP0049	1700	710	1950	205	175	80	50	410	710	480
GWCP0065	1880	835	2000	205	178	80	50	490	782	567

(2) GWCP0080 GWCP0098 GWCP0105 GWCP0116 GWCP0130 GWCP0145 GWCP0160, GWCP0196

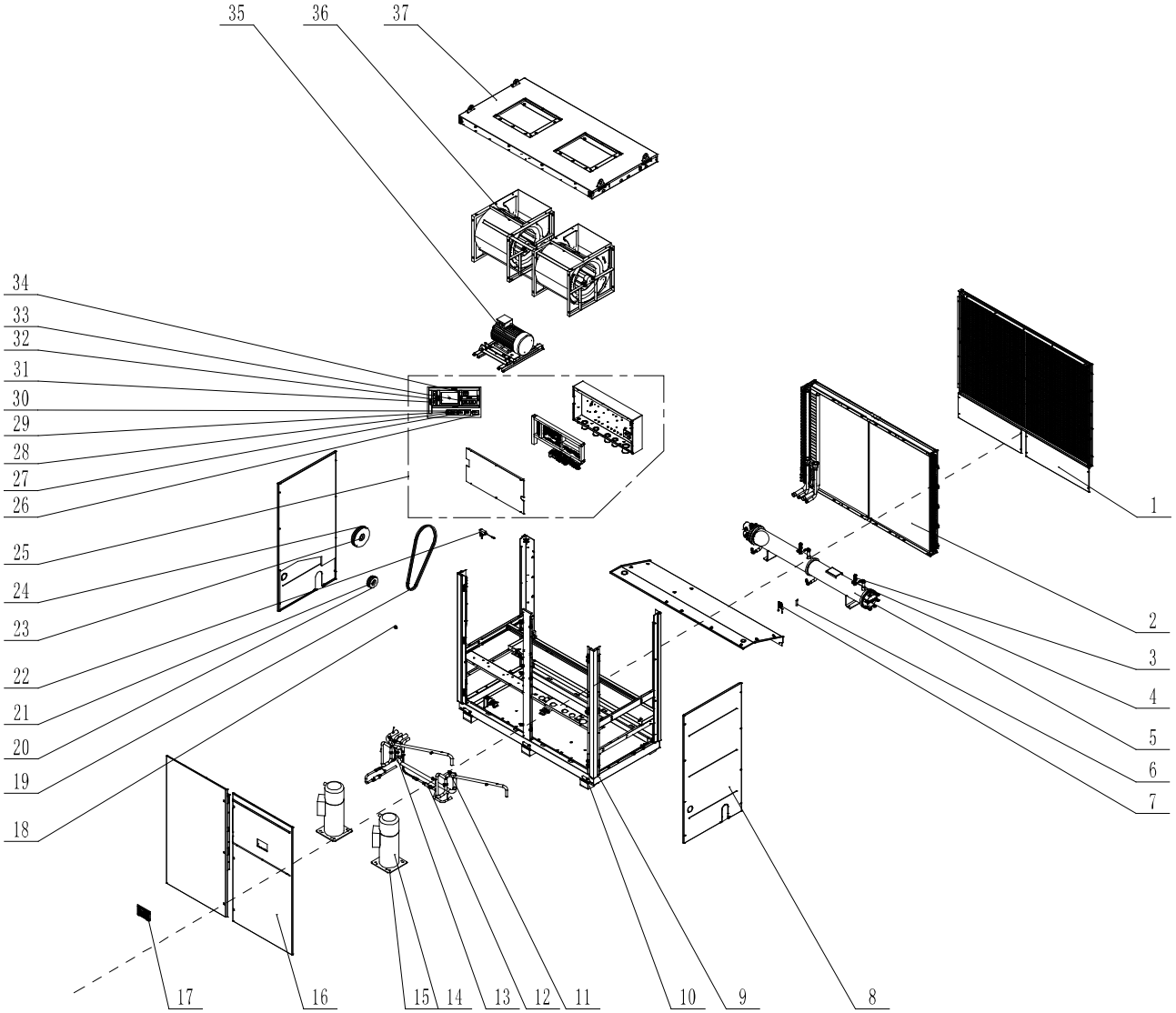


Dimension / Model	A	B	C	D	E1	E2	F1	F2	G1	G2	G3
GWCP0080	1950	1060	1950	373	178	80	480	410	310	855	475
GWCP0098	1950	1060	1950	373	178	80	480	410	310	855	475
GWCP0105	1950	1060	1950	373	178	80	480	410	310	855	475
GWCP0116	1950	1060	1950	373	192	100	480	410	310	855	475
GWCP0130	2300	1200	2000	410	192	100	570	485	645	1015	565
GWCP0145	2300	1200	2000	410	192	100	570	485	645	1015	565
GWCP0160	2300	1200	2000	410	192	100	570	485	645	1015	565
GWCP0196	2650	1220	2150	410	200	110	605	580	835	1020	580

Note:Height herein does not include the thickness of the rubber pad which is about 90mm thick.

3. Explosive Views and Part Lists

- GWCP0160

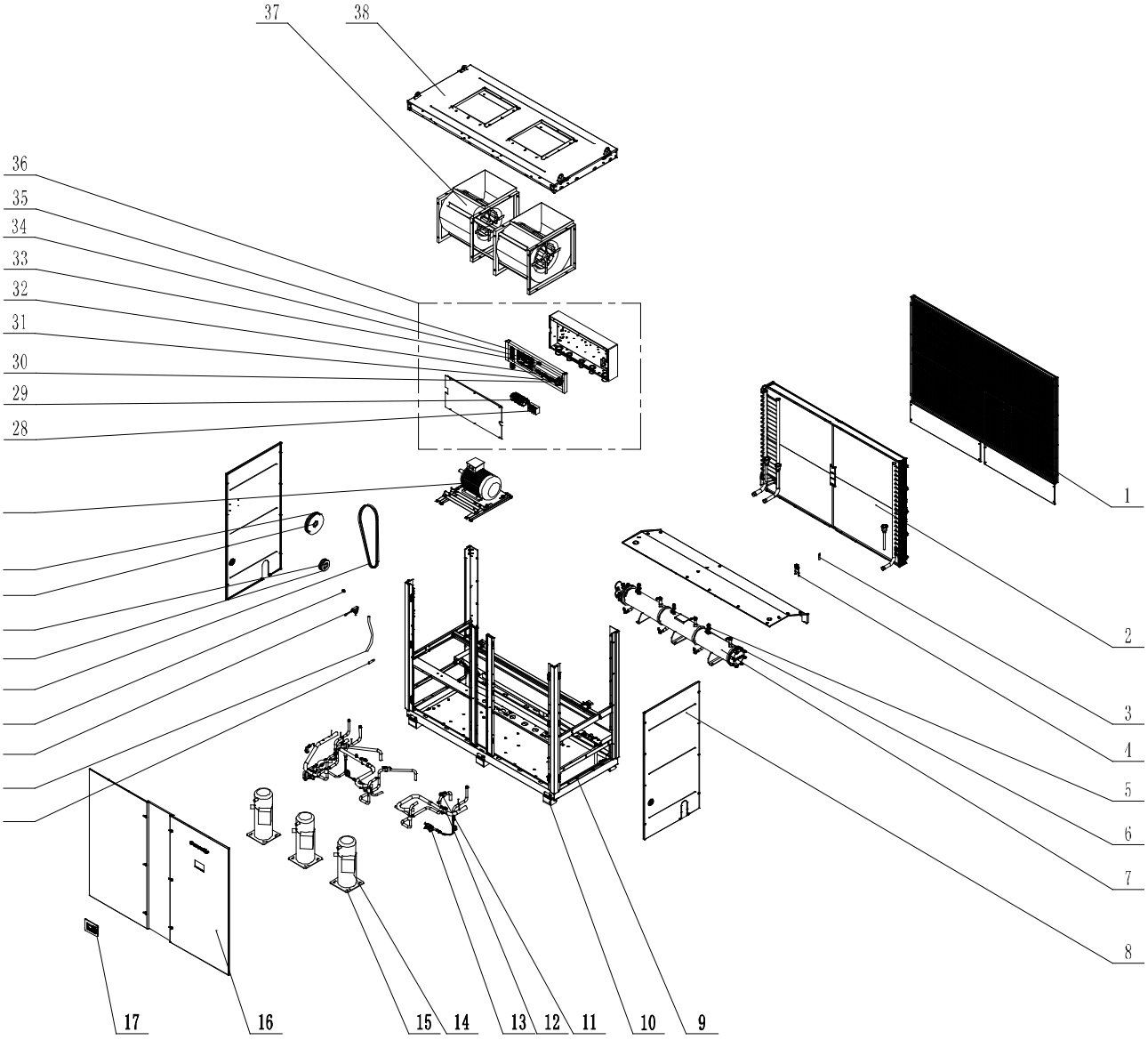


GWCP0160

No	Name of part	Part code
1	Front Panel(Rear)	01543200135P
2	Evaporator Assy	011001000008
3	Relief Valve	071002000006
4	Taper Thread Valve	0713083401
5	Horizontal Shell and Tube Condenser	011103060010
6	Sensor Sub-assy	390002060012
7	Temperature Sensor Support	26905202
8	Right Side Plate	01313200099
9	Base Frame Sub-Assy	017033060024
10	Rubber cushion	76318388
11	Pressure Protect Switch	46020006

12	Gas Tube Filter	07219051
13	Pressure Protect Switch	460200048
14	Compressor and Fittings	009001000119
15	Compressor Gasket	02118049
16	Front Panel Sub-assy 2	01543200134P
17	Display Board	3029300004
18	Magnetic Ring	49010104
19	Belt	76416056
20	Belt Wheel	73010226
21	Taper Sleeve	10548222
22	Steam current Switch	4502800000902
23	Taper Sleeve	10548227
24	Belt Wheel	73018251
25	Electric Cabinet Assy	100003060063
26	Terminal Board	420102471
27	AC Contactor	44010235
28	AC Contactor	44010213
29	Single-phase Air Switch	45020203
30	Phase Reverse Protector	430055000003
31	Terminal Board	422000000010
32	Main Board	30223000071
33	Over Current Protector	46028000010
34	Terminal Board	42011103
35	Fan Motor	150101000079
36	Motor for Centrifugal Fan	10453700001
37	Top Cover Board Assy	000132060010

◆ GWCP0196



GWCP0196

No	Name of part	Part code
1	Return Air Frame Sub-Assy	017026000001
2	Evaporator Assy	011001000253
3	Sensor Sub-assy	390002060011
4	Temperature Sensor Support	26905202
5	Relief Valve	071002000006
6	Taper Thread Valve	0713083401
7	Horizontal Shell and Tube Condenser	011103060011
8	Right Side Plate	012056000001P
9	Base Frame Sub-Assy	017033060023
10	Rubber cushion	76318388
11	Pressure Protect Switch	46020006
12	Pressure Protect Switch	460200048
13	Gas Tube Filter	07219051
14	Compressor and Fittings	009001060031
15	Compressor Gasket	02118049

16	Front Panel Sub-assy 2	017067000018P
17	Display Board	3029300004
18	Drainage Hose	04363206
19	Drain Hose	05232044
20	Steam current Switch	4502800000902
21	Magnetic Ring	49010104
22	Belt	76319212
23	Belt Wheel	10549216
24	Taper Sleeve	10548226
25	Belt Wheel	10548167
26	Taper Sleeve	10548227
27	Fan Motor	150101000084
28	Terminal Board	42010247
29	AC Contactor	44010214
30	Single-phase Air Switch	45020203
31	Phase Reverse Protector	430055000003
32	Over Current Protector	46028000009
33	Terminal Board	42011103
34	Main Board	30223000071
35	Terminal Board	422000000010
36	Electric Cabinet Assy	100003060062
37	Blower	15218311
38	Top Cover	012148060014P

4. Scope of Supply

S=Standard, O=Field Supplied, P=Optional

Scope of Supply	Type
Water-cooled Packaged Unit	S
Manometer	O
Thermometer	O

II Design & Selection

1. Selection Steps

1.1 Application Location

The water-cooled packaged unit can be widely used for light industries, hotels, shopping malls, tourism etc. This unit features the integral design, compact structure, condensation of refrigeration by heat absorption of cooling water, and high operation efficiency.

1.2 Calculation of Load

The cooling load can be estimated based on the design reference value listed in the table below.

(1) Cooling Load per Unit Air Conditioning Area

Building Type	Room Type	Cooling Load (W/m^2)	Building Type	Room Type	Cooling Load (W/m^2)
Hotel	All	70～95	Hospital	All	105 ~ 130
	Augest Room	70～100		VIP Ward	80 ~ 120
	Cafe	80～120		General Ward	70 ~ 110
	Dining Room (Western Food)	100～160		Diagnostic Room	75 ~ 140
	Dining Room (Chinese Food)	150～250		X-ray, CT, MRT Room	90 ~ 120
	Store	80～110		Delivery Room	100 ~ 150
	Service Hall	80～100		Clean Operation Room	180 ~ 380
	Atrium	100～180		Hall	70 ~ 120
	Small Meeting Room	140～250	Shopping Mall	First Floor	160 ~ 280
	Large Meeting Room(No smoking)	100～200		Intermediate Floor	150 ~ 200
	Hairdressing Room	90～140		Top Floor	180 ~ 250
	Gym	100～160		All Stores	210 ~ 240
	Bowling Alley	90～150	Cimena and Theatre	Auditorium	180 ~ 280
	Billiard Room	75～110		Lounge Smoking (Smoking)	250 ~ 360
	Swinging Pool	160～260		Boudoir	80 ~ 120
	Ball Room	180～220		Hall and WC	70 ~ 100
	Disco	220～320	Stadium	Arena	100 ~ 140
	Karaoke	100～160		VIP Room	120 ~ 180
	Office	70～120		Lounge Room (Smoking)	280 ~ 360
	WC	80～100		Lounge Room (No Smoking)	160 ~ 250
Bank	Service Hall	120～160		Rest Room	100 ~ 140
	Offfce	70～120	Office Building	VIP Office	120 ~ 160
	Machine Room	120～160		General Office	90 ~ 120
Museum		150～200		Machine Room	100 ~ 140
Auditorium		160～240		Meeting Room	150 ~ 200

Multi-functional Room		180～250		Loung Hall (Smoking)	180～260
Library	Reading Room	100～160	Office Building	Hall and WC	70～110
	Hall	90～110		General Office	95～115
	Stack Rom	70～90		High-rise Office	105～145
	Special Collection Room	100～150	Apartment	Multi-layer Building	88～150
Restaurant	Hall	200～280		High-rise Building	80～120
	VIP Room	180～250		Villa	150～220
Supermarket	Hall	160～220			
	Meat and Fish Room	90～160			

Note: it is cited from the Practical Design Manual for the Cooling and Heating Air Conditioners

1.3 Calculation of Load

Taking a 400m^2 restaurants in Bruno for example, considering the initial investment and maintenance cost, see the following statement for model selection procedures.

It is a restaurant. Based on 250W/m^2 for model selection, a 100kW unit is required and a set of GWCP0098 can meet this requirement.

(2) Duct Design

1) According to GB50019-2003, for the metallic duct, the design air speed for the main is 5m/s and 4m/s for the branch. Both the round and rectangular (the ratio of the longer and shorter sides cannot exceed 4) duct can be used. For the GWCP0098 unit, the design outlet air speed is 5m/s and the square diffuser is selected.

2) Insulation no less than 15mm thick is required. The fire-protecting rating should comply with corresponding requirements covered in GB50016-2006.

(3) Diffuser Design

According to requirements covered in GB50019-2003, the outlet air speed should be 3~5m/s. Square diffuser is selected. Quantity of the diffusers depends on the actual need.

(4) Design Static Pressure

1) According to GB17758, if full pressure is provided, it should be converted to static pressure as per the formula: Pj=Pq-Pd. See the table below for more details.

Model	Outlet Dynamic Pressure Pd（Pa)	Outlet Static Pressure Pq（Pa)
GWCP0032	60	Pq-60
GWCP0049	90	Pq-90
GWCP0065	90	Pq-90
GWCP0080	60	Pq-60
GWCP0098	90	Pq-90
GWCP0105	120	Pq-120
GWCP0116	120	Pq-120
GWCP0130	90	Pq-90
GWCP0145	90	Pq-90

GWCP0160	120	Pq-120
GWCP0196	120	Pq-120

Note:

① if not converted, it would lead to higher noise, higher energy consumption and damage to the belt.

② Duct resistance loss△P=Pm*L(1+k). Wherein, Pm is the on-way pressure loss and is figured out to be 1Pa/m in Section a. K is the ratio of the local pressure loss and the on-way pressure loss and is recommended to be 1~5 , and considering there quite few tee joints, K can be 3 herein. The total length of the duct is 40m.

△ Ptotal=Pm*L（1+k）+ρ ν 2/2=1*40*（1+3）+1.2*5*5/2=175Pa

③ According to GB50019-2003, the pressure should be the calculated pressure loss plus 10%~15%. Therefore, the pressure for the unit is 175*1.15=201Pa.

④ The design flow rate at the outlet is 12m/s. The dynamic pressure Pd= ρ ν 2/2=1.2*12*12/2=86.4Pa, the static pressure is 201-86.4=114.6Pa. Therefore, the static pressure for the unit can take 115Pa.

(5) Selection of the Water Pump

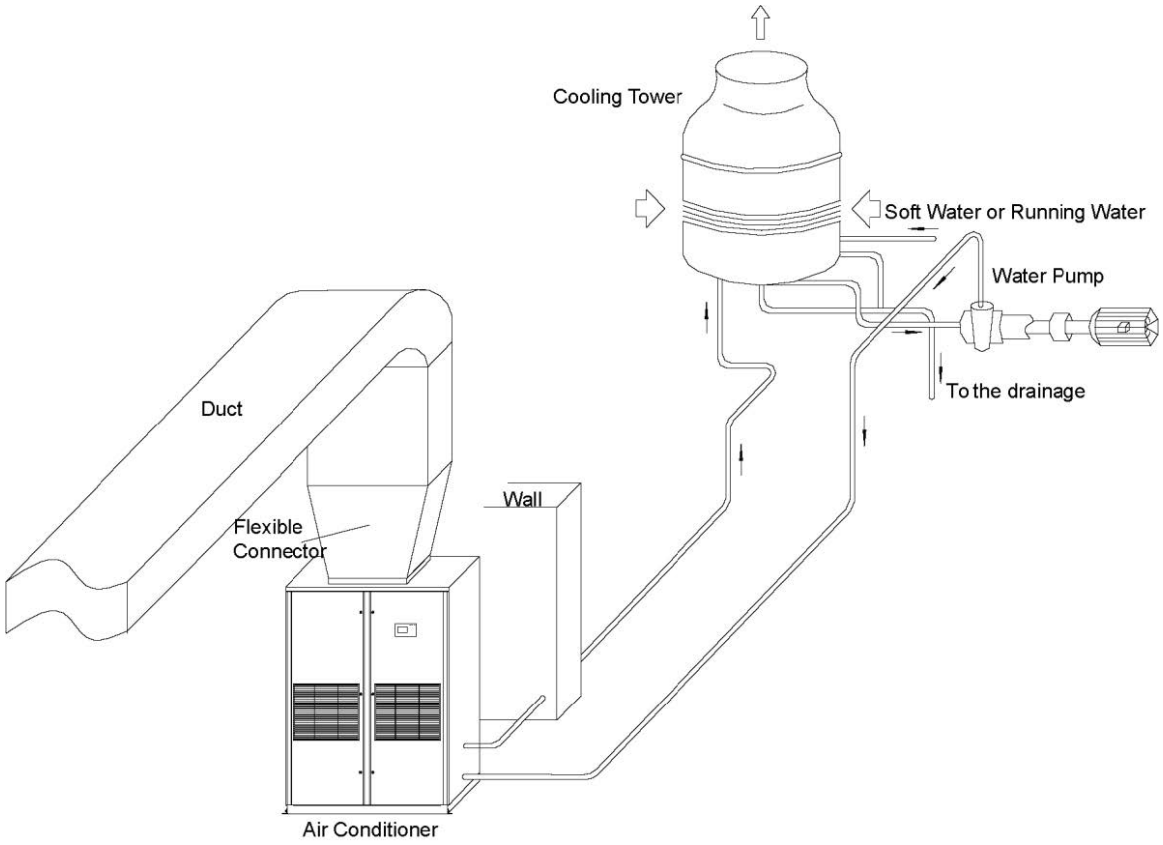
1) The flow rate of the water pump should be the rated flow rate 21m^3/h for L98S/L and plus 10~20%. Therefore, the flow rate should be 21*1.2=25.2m^3/h.

2) The water pump head involves the resistance of the unit, tubes, valves, filters and other accessories, fall height between the cooling tower nozzles and the drain pan, and necessary dynamic pressure for the cooling tower outlet.

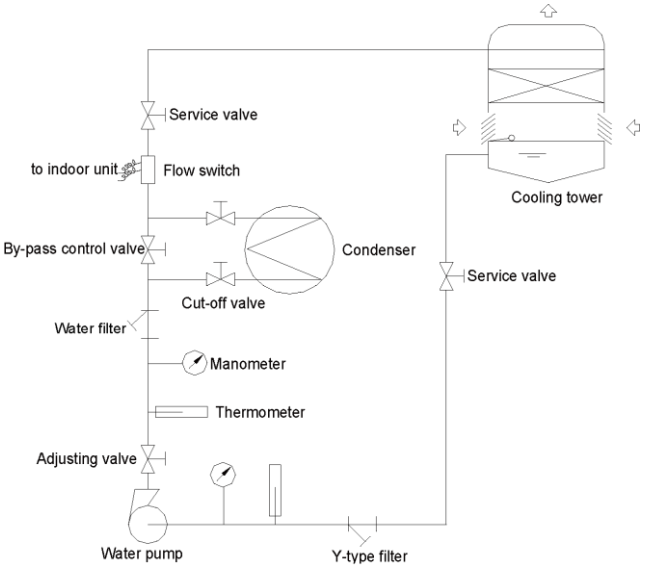
3) The resistance of the unit is 60KPa and 300Pa/m for the tube . Total length of the tube is 80m. Valves, Resistance filters and other accessories is 1.5 times of that the tube. Fall between the cooling tower nozzles to the drain pan is 2m.The necessary dynamic pressure for cooling tower outlet is 30KPa.That is ,water pump head =300*80*（1+1.5）+60000+20000+30000=170KPa

4) As per 20% allowance, the total water pump head is 170*1.15=204KPa.

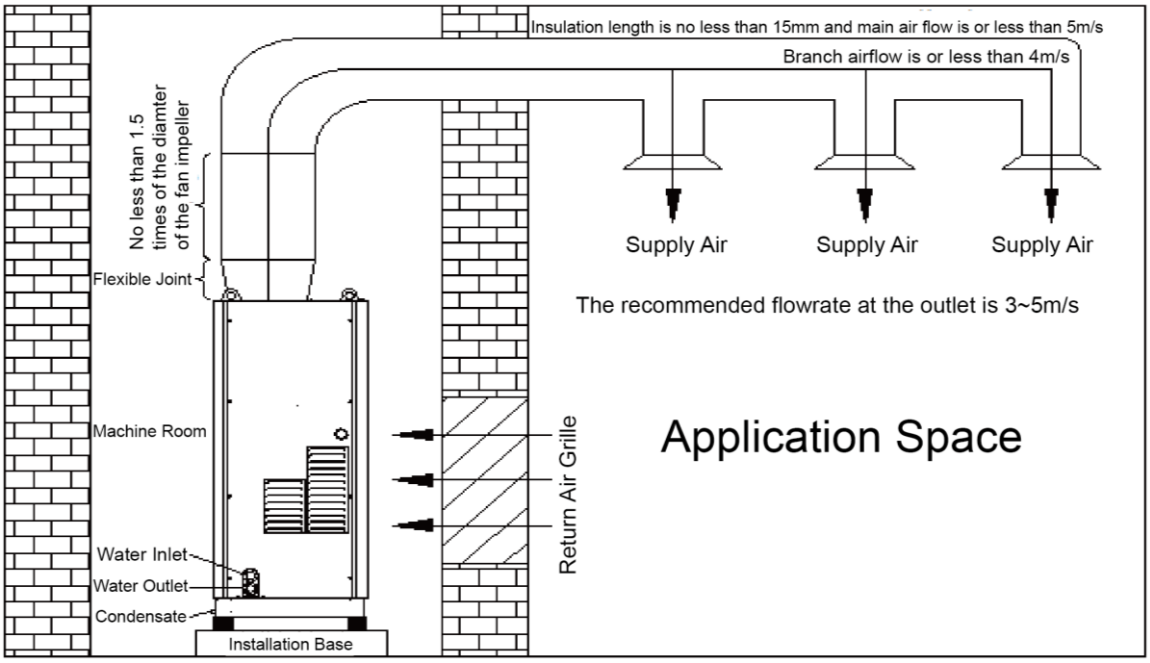
◆ Diagram of Installation



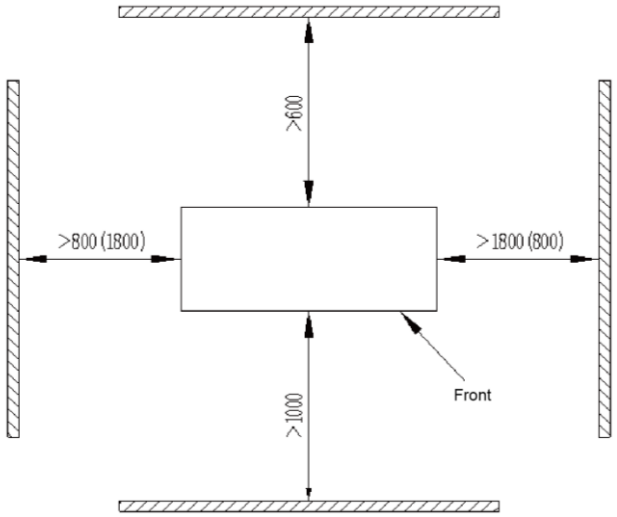
◆ Diagram of the Water Circuit System



◆ Diagram of the Duct System



◆ Diagram for Installation Dimensions



Note: during installation, at least a distance of 1800mm should be kept at one side of the condenser for cleaning and maintenance.

2. Selection of Power Lines and Air Switches

Model	Power Supply	Minimal Sectional Area (mm^2)			Air Switch(A)
		Live Line	Neutral Line	Grounding Line	
GWCP0032	380V 3Ph 50Hz	4	4	4	25
GWCP0049		6	6	6	32
GWCP0065		10	10	10	40
GWCP0080		10	10	10	40
GWCP0098		16	16	16	63
GWCP0105		16	16	16	63
GWCP0116		16	16	16	63
GWCP0130		35	35	16	80
GWCP0145		35	35	16	80
GWCP0160		35	35	16	80
GWCP0196		50	50	25	125

Notes:

① Specification of the power line and the air switch in the table above are determined based on the maximum power supply (maximum amps) of the unit.

② The specifications of the power lines listed in the table above are applied to the BV single-wire copper cable in plastic conduit used at 40℃. The specifications of the air switch listed in the table above are applied to the air switch with the working temperature at 40℃. If the working condition changes, they should be modified according to the related national standard.

③ The power lines must be copper cable and the working temperature cannot exceed the rated value.

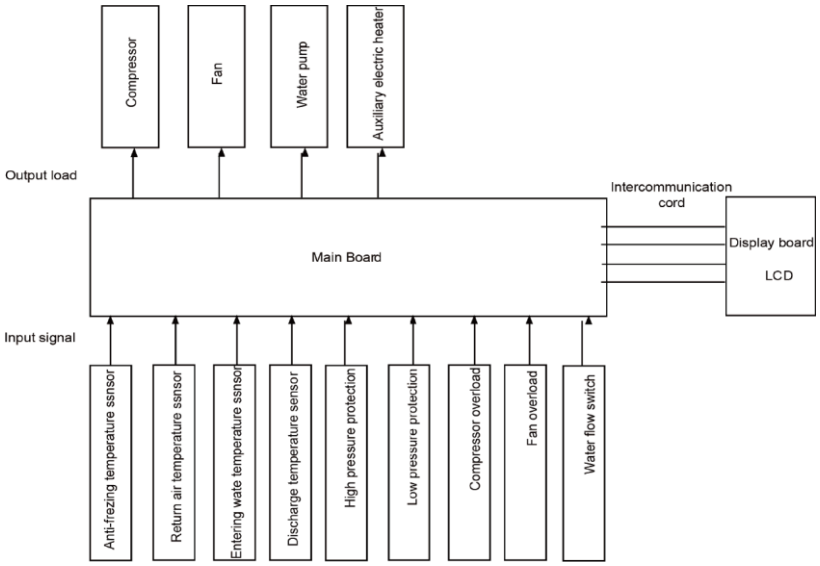
④ When length of the power line is longer than 15m, please properly enlarge the sectional area so as to avoid overload.

⑤ For the unit with the auxiliary heater, selection of the air switch and the power line should be based on the rated ampere for cooling.

III Unit Control

1. General Control Design

1.1 Schematic Diagram



Note: the controller can control the unit through data exchange with the main board of the outdoor unit. The auxiliary electric heater is unavailable for the cooling only unit.

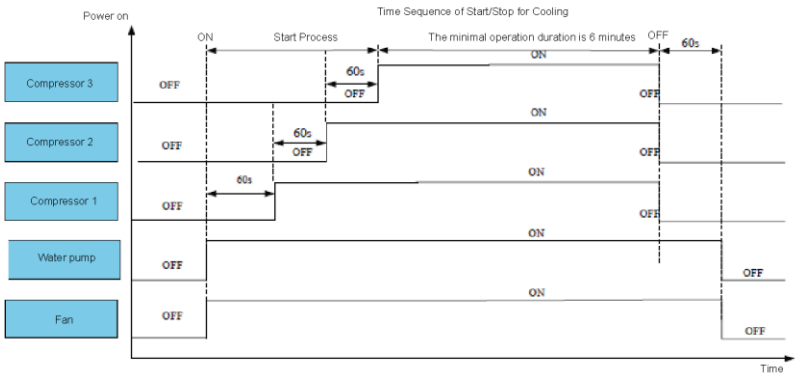
Startup sequence: fan→water pump→compressor.

Shutdown: main unit→fan 15 seconds later→water pump 60 seconds later. If one compressor stops against malfunction, error codes will be displayed and the unit keeps normal operation. When two or three compressors stop, the whole unit will stop. Upon power on again, the unit will resume previous status, including the run mode and data.

1.2 Main Control Logic

Start: the fan will run as soon as the unit is powered on. The compressor will run until all operation conditions are satisfied. The water pump will run 60 earlier than the compressor. The startup interval between compressors A, B and C is 60 seconds.

Stop: the stop interval between compressors A, B and C is 60 seconds. The fan will stop 15 seconds delayed. The water pump will stop 60 seconds delayed. The minimal operation duration is 6 minutes. The minimal startup interval is three minutes.



2. Introduction to the Main Control Logic

2.1 Cooling

2.1.1 Control to the compressor

(1) Control based on runtime

The compressor with longer runtime will be started later. If their runtime is the same, the compressor with smaller system number will start firstly.

The compressor with shorter runtime will be stopped later. If the runtime is the same, the compressor with smaller system number will stop firstly.

Compressors in parallel will start and stop at the same time.

The minimal operation duration for the compressor is six minutes (except automatic stop, timed stop, remote stop etc.) and the minimal startup inverter is three minutes.

(2) Control based on return air temperature

The unit will start or stop based on difference between the return air temperature and the set point.

2.1.2 Stop

Automatic and timed stop: the fan will delay to be stopped after the compressor. When all compressors have been stopped, the water pump will stop.

Stop based on the temperature set point: the compressor stops but the fan keeps running. When all compressors have been stopped, the water pump will stop.

Stop for errors: the compressor stops but the fan keeps running (the fan will stop on condition that the fan is overloaded.). When all compressors have been stopped, the water pump will stop.

2.2 Control to the Fan

2.2.1 Cooling

Upon fan on, the fan will start before the compressor. When all compressors have been stopped, the fan will stop. When the unit is under operation or standby status (all compressors have been stopped), the fan will keep running.

2.3 Control to the Water Pump

The water pump will start before the compressor. When all compressors have been stopped, the water pump will stop.

2.4 Protection Control

2.4.1 Recoverable Protection

(1) Antifreeze Protection

When it is detected that the evaporating temperature is lower than the freeze protection set point, freeze protection will be activated and the corresponding compressor will be stopped immediately. In this case, the controller will not display the error name, the indicating lamp will not light on, but the main board will show the error codes. Other loads will keep normal operation. When it is detected that the evaporating temperature is higher than the set point, this error will disappear automatically.

Freeze protection is unavailable under the heating and air supply modes.

(2) Anti Over-temperature Protection

When it is detected that the leaving cooling water temperature is higher than the set point for over-temperature protection, all compressors will be stopped immediately. In this case, the controller will not display the error name, the indicating lamp will not light on, but the main board will show the error codes. When it is detected that the leaving cooling water temperature is lower than the set point, this error will disappear automatically.

2.4.2 Unrecoverable Protection

(1) Low Pressure Protection

When it is detected that the low pressure switch is off, it indicates the unit is under low pressure protection. In this case, the corresponding compressors will be stopped, the controller will display the error name, the indicating lamp will light on, and the main board will show the error codes. All other loads will keep normal operation. When it is detected that the low pressure switch is picked up, the error will disappear by pressing the “Reset” key (In one hour, this error will automatically disappear for the first and second time, but for the third time it should be removed by pressing the “Reset” key.).

(2) High Pressure Proteciton

When it is detected that the high pressure switch is off, it indicates the unit is under high pressure protection. In this case, the corresponding compressors will be stopped, the controller will display the error name, the indicating lamp will light on, and the main board will show the error codes. All other loads will keep normal operation. When it is detected that the high pressure switch is picked up, the error will disappear by pressing the “Reset” key.

(3) High Discharge Protection

When it is detected that the discharge temperature is higher than115℃, it indicates the unit is under high discharge protection. In this case, the corresponding compressors will be stopped, the controller will display the error name, the indicating lamp will light on, and the main board will show the error codes. All other loads will keep normal operation. When it is detected that the discharge temperature is lower than 75℃, the error will disappear by pressing the “Reset” key (In one hour, this error will automatically disappear for the first and second time, but for the third time it should be removed by pressing the “Reset” key.).

(4) Refriterant Loss Protection

When the compressor is off and it is detected that any low pressure switch is off, the unit will go to refrigerant loss protection. In this case, the corresponding compressors will be stopped, the control will display the error name, the indicating lamp will light on and the main board will show the error codes. All other loads keep normal operation. When it is detected that the low pressure switch is closed, the error will disappear automatically.

(5) Compressor Overload Protection

When it is detected that the compressor overload switch is off, it indicates the unit is under compressor overload protection. In this case, the corresponding compressors will be stopped, the controller will display the error name, the indicating lamp will light on, and the main board will show the error codes. All other load keeps normal operation. When it is detected that the compressor overload switch is closed, the error will disappear by pressing the “Reset” key.

(6) Fan Overload Protection

When it is detected that the fan overload switch is off, it indicates the unit is under fan overload protection. In this case, all loads will be stopped, the corresponding compressors will be stopped, the controller will display the error name, the indicating lamp will light on, and the main board will show the error codes. When it is detected that the fan overload switch is closed, the error will disappear by pressing the “Reset” key.

(7) Auxiliary Electric Heater Anti-welding Protection

When the auxiliary electric heater is off and it is detected that its AC contactor is welded together, the fan will run with the high speed, the trip-off signal will be output, the beeper will raise alarms, and other load will be stopped immediately. At the same time, the controller will display the error name, the indicating lamp will light on, and the main board will display the error code. This error can be removed upon power on again.

(8) Flow Switch Protection

When it is detected that the flow switch is off, all compressors will stop immediately, and the water pump will stop after the compressor. The controller will display the error name, the indicator lamp will light on, and the main board will display the error codes. This error is recoverable by pressing the “Reset” key.

Detection is unavailable when the cooling water pup is closed.

(9) Communication Error

When this error occurs, all loads will be stopped and the controller will display the error codes and the indicator lamp at the main board will light on. The unit will return the previous status after communication is recovered.

(10) Phase Reversal/Loss Protection

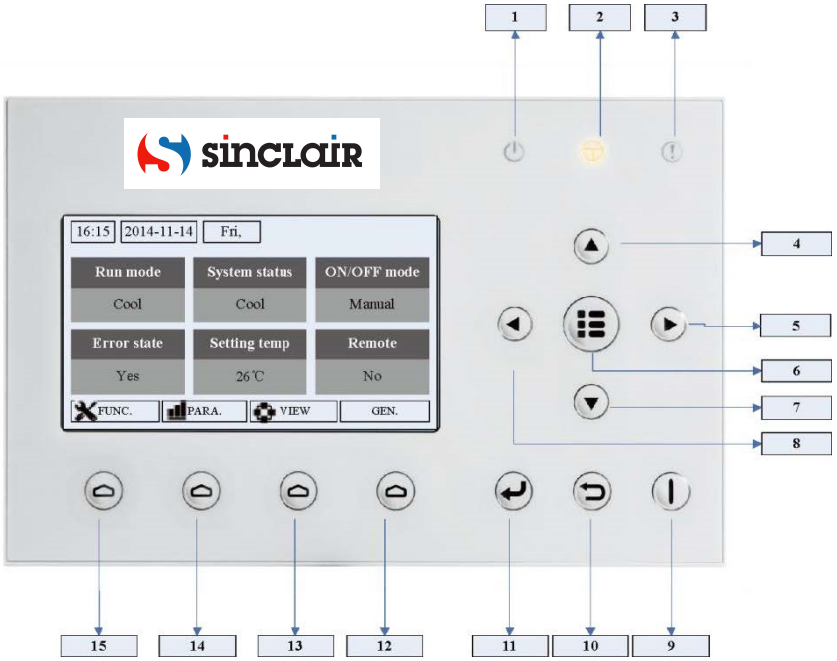
When this error occurs, power supply for the main board will be cut off and no corrective measure is required.

3. Controller

The controller is responsible for controlling and displaying each running data in real time. It also can be integrated into the remote monitoring system

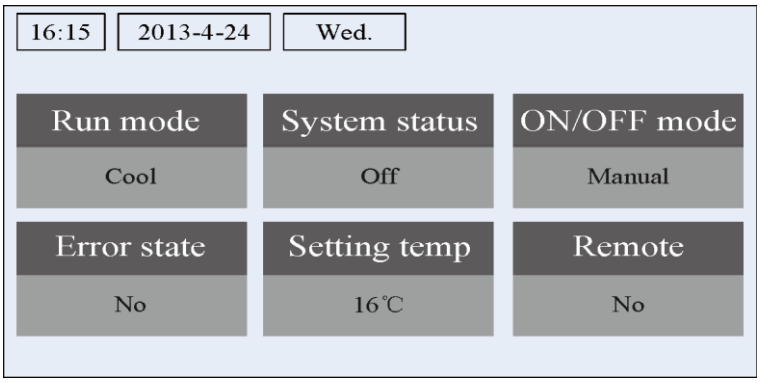
3.1 Introduction to the Controller

3.1.1 Outline Drawing

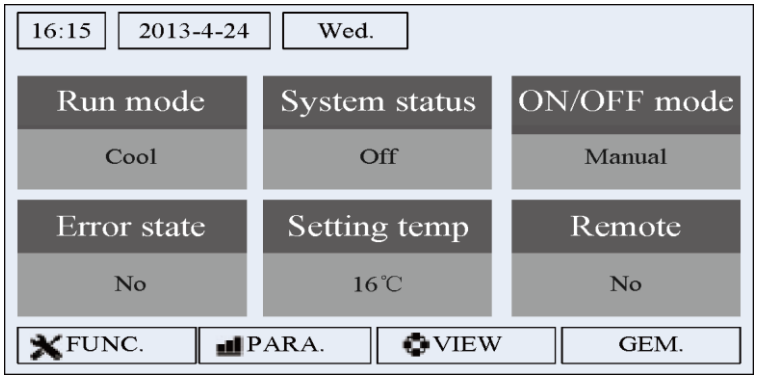


No.	Icon	Description	No.	Icon	Description
1		Operation indicator	9		ON/OFF
2		Power indicator	10		Cancel/Return
3		Error indicator	11		Confirm
4		Up	12		Function 4
5		Right	13		Function 3
6		Menu	14		Function 2
7		Down	15		Function 1
8		Left			

3.1.2 Standby Page and Main Page



Standby page



Main page

3.1.3 Introduction of Buttons

No.	Button description	Instruction of button function
1	ON/OFF	Control the ON/OFF of unit.
2	Confirm	Save the set parameter or enter the next step.
3	Cancel/Return	Return to the last step.
4	Menu	Call out the main page or return to the main page from other page.
5	Left / Right	Move cursor: The cursor will move leftwards when pressing “Left”; the cursor will move rightwards when pressing “Right”.
6	Up / Down	Adjust the status or parameter at the position of cursor.
7	Function 1 ~ Function 4	Achieve the function at the corresponding position of LCD; its function may be various in different pages.

3.1.4 Indicators

No.	Description of indicator	Instruction of indicator
1	ON/OFF indicator (green)	It indicates that if the unit is on. If the indicator is on, it means the unit is on.
2	Power indicator (yellow)	It indicates that if the power is connected. If the indicator is on, it means the power is connected.
3	Error indicator (red)	It indicates that if the unit has error. If the indicator is on, it means the unit has error.

3.2 Operation Instruction

3.2.1 ON/OFF Setting

Operation method:

(1) Under unit on status, press “ON/OFF” button to turn off the unit; press “ON/OFF” button again to turn on the unit.

(2) When the unit is turned on, the green indicator at the right upper side of wired controller is on; when the unit is turned off, the green indicator is off.

Note:

① The unit is defaulted to be off in the first energization.

② ON/OFF button is only invalid in the selection page of operation mode.

③ In the first energization, unit on/off status will be memorized. You can select unit on/off status shall be memorized or not in “General setting” page. If memory of unit on/off status is on, when power resumes after power failure, the unit on/off status will be the status before power failure; If memory of unit on/off status is off, when power resumes after power failure, the unit will be in off status.

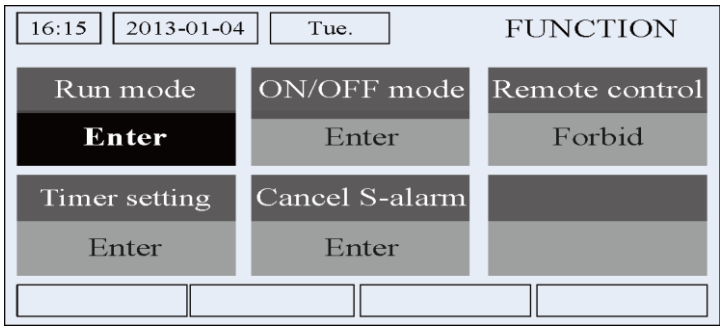
④ Function 1 to Function 4 buttons are corresponding to “function setting”, “parameter setting”, “unit viewing” and “general setting”. Press corresponding button to enter the relevant page.

⑤ In standby page: press Menu button to display the main page; pressing ON/OFF button can turn on or turn off the unit when unit on/off condition is met and other buttons are invalid.

⑥ If it isn’t in standby page, the wired controller will automatically return to the standby page if no button is pressed for continuous ten minutes.

3.2.2 Function Setting

Operation method: In the home page, press Function 1 button to enter function setting page, as shown below.



Function setting page： After entering function setting page, move the cursor through “Left” or “Right” button. Pressing “Up” or “Down” button to change the option box status at which the cursor is located. When function setting is finished, press Menu button to return to the main page directly or press Return button to return to the last menu.

Note:

① When the cursor moves to a certain option box, if next menu can be entered through this item box, “Enter” will be displayed at this item box. In this case, user can press Confirm button to enter the next menu.

② After changing any function status in function setting page, if this function needs memory function, the system will automatically save the changed status value. Energize the unit after power failure, the status value will be the value before power failure.

Parameters of function setting:

No.	Function name	Display name	Setting range	Default	Function instruction
1	Setting of run mode	Run mode	Cool/Heat/Fan	Cool	Press Confirm button to enter the page and then can set according to your requirement.
2	Setting of ON/OFF mode	ON/OFF mode	Manual/Timer	Manual	Press Confirm button to enter the page and then can set according to your requirement.
3	Remote control	Remote control	Allow/Forbid	Forbid	If it is allowable, Run mode is forced to be remote mode.
4	Weekly timer setting	Timer setting	Enter	/	/
5	Cancel S-alarm reminder	Cancel S-alarm	Enter	/	/

3.2.3 Setting of Run Mode

Operation method: After turning off the unit, enter function setting page.Press “Left” or “Right” button to move the cursor to the option box of “Run mode”. In this case, the option box of operation mode is displayed reversely.Press Enter button to call out pop-up box. Press “Left” or “Right” button to select operation mode and press Confirm button to save and exit. Press Cancel button to exit without saving.

Note:

① Cooling is defaulted in the first energization.

② Press Confirm button to call out option box for operation mode switchover only after turning off the unit; option box for operation mode switchover cannot be called out after turning on the unit.

③ If the model is cooling only, cool or fan mode can be set; if the model is heat pump, cool, heat or fan mode can be set.

④ This function is with power-off memory.

3.2.4 Setting of ON/OFF Mode

Operation method: Enter function setting page.Press “Left” or “Right” button to move the cursor to the option box of “ON/OFF mode”. In this case, the option box of ON/OFF mode is displayed reversely.Press Enter button to call out pop-up box. Press “Left” or “Right” button to select Run mode and press Confirm button to save and exit. Press Cancel button to exit without saving.

Note:

① Manual mode is defaulted in the first energization.

② Setting box of Run mode can be entered only when Remote control is forbided. If Remote control is allowable, it is forbided to enter the setting box of Run mode and pop out the indication box. In Remote control mode, it is forbided to enter the setting of Run mode.

③ When Remote control is allowable, Run mode is forced to be remote mode. If set Remote control to be forbided, Run mode will get back to the selected mode in the option box of Run mode.

④ This function is with power-off memory.

3.2.5 Setting of Remote control

Operation method: Enter function setting page. Press “Left” or “Right” button to move the cursor to the option box of “Remote control”. In this case, the option box of Remote control is displayed reversely. Press “Up” or “Down” button to allow or forbid Remote control.

Note:

① It is defaulted to be forbidden in the first energization.

② This function is with power-off memory.

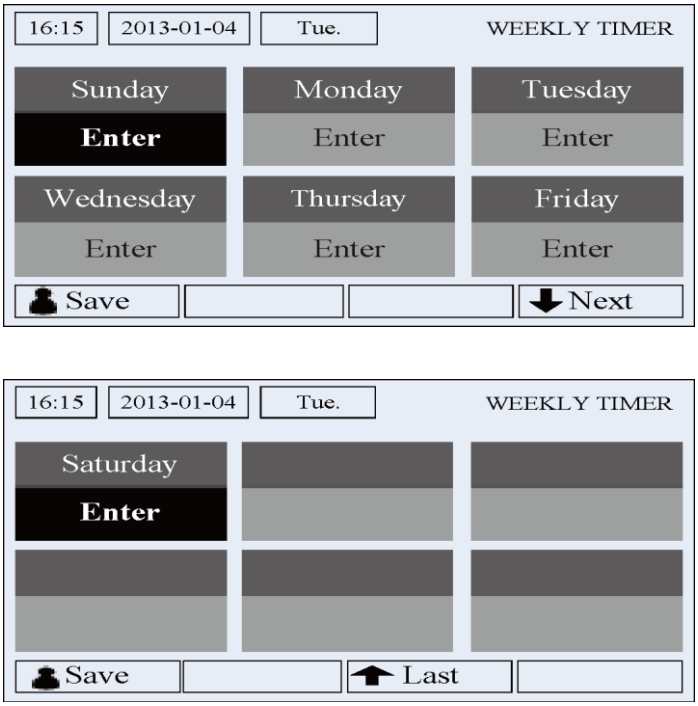
③ It cannot be set under unit on status.

3.2.6 Setting of Timer

Operation method:

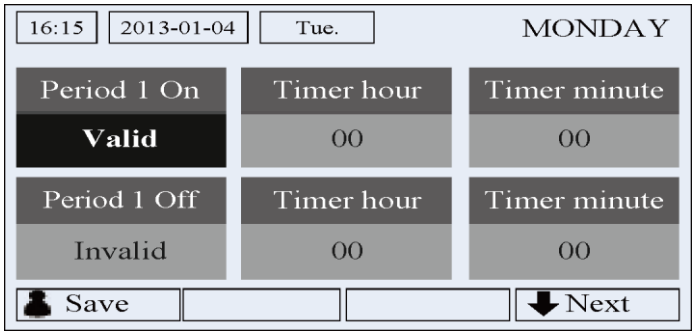
(1) In the main page, press Function Setting button to enter the page of function setting. Press “Left” or “Right” button to move the cursor to the option box of “timer time setting”; press Confirm button to enter weekly timer setting page;

(2) Week selection. After entering the setting page of weekly timer, press “Left” or “Right” button to move the cursor to the required week option, as shown below. Press Confirm button to enter the parameter setting of this day;



Timer setting page

(3) After entering the setting page of Monday to Sunday, four periods of a day can be set. These four periods can be set as “valid” or “invalid”. Besides, the ON time and OFF time of each period can be set individually, as shown below:

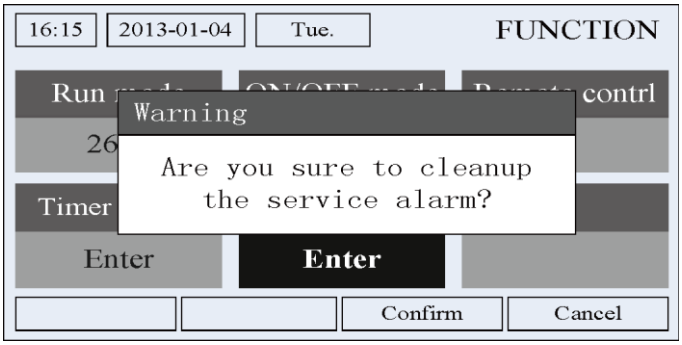


Timer setting page of Monday

(4) After finishing setting, press Function 1 button to save the current page setting. Press Return button to turn back to the page of weekly timer setting. Press Function 1 button in weekly timer setting page to save all weekly timer settings.

3.2.7 Cancelation of Service Alarm

Operation method: Enter function setting page.Press “Left” or “Right” button to move the cursor to the option box of “Cancel S-alarm”.Press Confirm button to call out the warning box of clearing maintenance reminder, as shown below. Press Function 3 button (confirm) to confirm clearing maintenance reminder and exit the warning box. Press Function 4 button (cancel) to cancel clearing maintenance reminder and exit the warning box.



Clear error reminder page

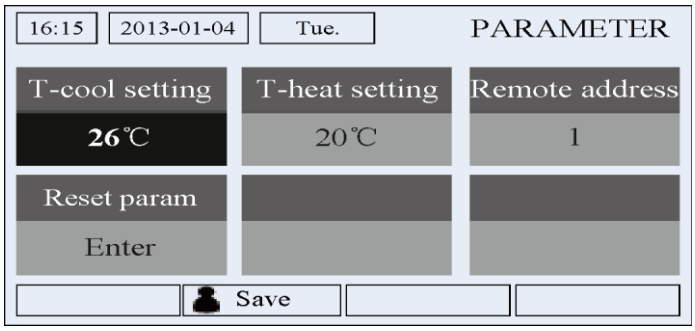
3.3 Parameter Setting

Operation method:

(1) In the main page, press Function 2 button to enter parameter setting page.

(2) Enter parameter setting page. Press “Left” or “Right” button to move the cursor; press “Up” or “Down” button to change the value in current option box. If hold on pressing “Up” or “Down” button continuously, the value will increase or decrease continuously.

(3) After finishing setting parameters, press save button. In this case, an indication box for saving setting will be pop out. Press Confirm button to save the set parameter. The unit will operate according to the saved set parameter. Pressing Cancel button will not save the set parameter.

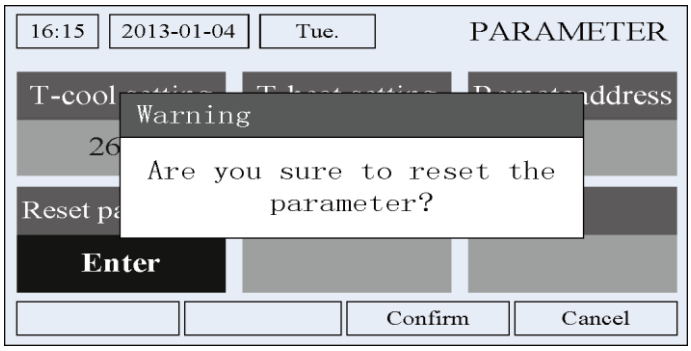


User parameter setting page

No.	Function name	Display name	Setting range	Default
1	T-cool setting	T-cool setting	16~30℃	26℃
2	T-heat setting	T-heat setting (cooling only model is without this option)	16~30℃	20℃
3	Remote address	Remote address	1~255	1

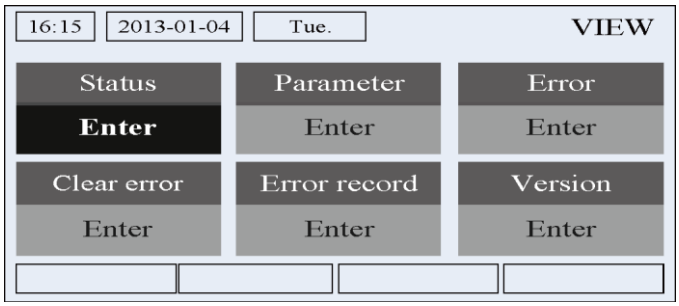
3.3.1 Default Parameter

Operation method: Enter parameter setting page.Press “Left” or “Right” button to move the cursor to the option box of “Invoke default parameter” and press Confirm button to call out the warning box of invoking default parameter, as shown below. Press Function 3(confirm) button to confirm invoking default parameter and exit warning box. Press Function 4(cancel) button to cancel invoking default parameter and exit warning box.



3.4 Parameter Viewing

Operation method: In the main page, press Function 3 button to enter parameter viewing page. In this page, press “Left” or “Right” button to select data and press Confirm button to enter the corresponding page, as shown below:



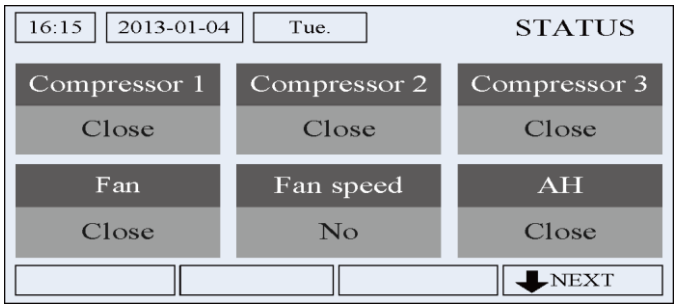
Viewing page

3.4.1 Status

Operation method:

(1) After entering unit viewing page, select parameter viewing option box and press Confirm button to enter parameter viewing page.

(2) After entering parameter viewing page, you can view the operation parameter.



Unit status viewing page

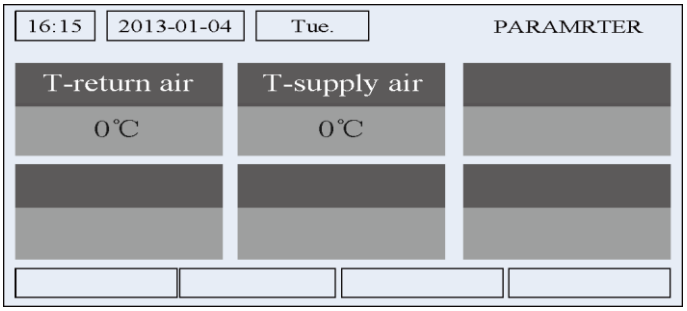
Status can be viewed is as follows:

No.	Full parameter name	Display name	Status
1	Compressor of system 1	Compressor 1	Open/Close
2	Compressor of system 2	Compressor 2	Open/Close
3	Compressor of system 3	Compressor 3	Open/Close
4	Fan	Fan	Open/Close
5	Fan speed	Fan speed	High speed/low speed/No
6	Air conditioner auxiliary electric heating	AH	Open/Close
7	System status	System status	Cool/heat/fan/OFF
8	Pump status	WP status	Open/Close
9	Fan of cooling tower	C-Tower fan	Open/Close

3.4.2 Parameter

Operation method: After entering unit viewing page, select parameter viewing option box and press Confirm button to enter parameter viewing page.

After entering parameter viewing page, you can inquire the operation parameter of unit.



Unit temperature viewing page

Parameters can be viewed

No.	Parameter name	Display name	Status
1	Air return temperature	T-return air	Display specific value
2	Air outlet temperature	T-supply air	

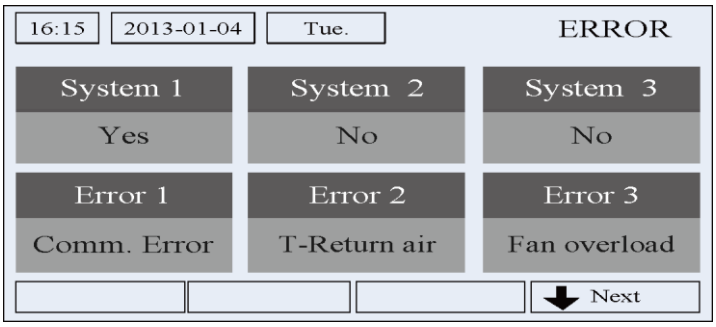
3.4.3 Error

Operation method:

(1) After entering unit viewing page, select error viewing option box and press Confirm button to enter error viewing page.

(2) After entering error viewing page, you can inquire the error of unit.

(3) There are three kinds of system error, which are put in the error viewing page of system 1, system 2 and system 3 individually. Error of the complete unit can be viewed directly in the error viewing page.



Unit error viewing page

Notes:

① The wired controller can display error in real time. Take the above figure for example: current “Comm. error” is shown in the option box of error 1. If “Comm. error” is eliminated, the error in the option box of error 2(Comm. error) will move to the option box of error 1 automatically. All errors will move to the option box of previous error automatically.

② For example, there are three kinds of high-pressure protection, which are system 1 high-pressure protection/system 2 high-pressure protection/system 3 high-pressure protection. These errors are classified into the error of system 1/system 2/system 3. If system 1 has got error, “Yes” will be displayed in the option box. If system 1 has no error, “No” will be displayed in the option box. You can choose the option box of system 1 error and pressure Confirm button to enter the error viewing page of system 1 in order to view the error of system 1.

③ If error quantity exceeds three or six, you can press “last page” or “next page” to turn the page for viewing errors.

Error code list is shown as below:

Code	Name	Code	Name
E1	High pressure protection of system 1	E1	High pressure protection of system 2
E1	High pressure protection of system 3	E3	Low pressure protection of system 1
E3	Low pressure protection of system 3	E3	Low pressure protection of system 2
E4	High discharge temperature protection 1 for system 1	E4	High discharge temperature protection 2 for system 1
E4	High discharge temperature protection 1 for system 2	E4	High discharge temperature protection 2 for system 2
E4	High discharge temperature protection 1 for system 3	E4	High discharge temperature protection 2 for system 3
E5	Compressor overload protection for system 1	E5	Compressor overload protection for system 2
E5	Compressor overload protection of system 3	E8	Fan overload protection
Fo	Refrigerant loss protection for system 1	Fo	Refrigerant loss protection for system 2
Fo	Refrigerant loss protection for system 3	dP	Discharge temperature protection between compressors in parallel
E2	Freeze protection for system 1	E2	Freeze protection for system 2
E2	Free protection for system 3	Ec	Flow switch error
F0	Return air temperature sensor error	FJ	Supply air temperature sensor error
F4	Discharge temperature sensor 1 error of system 1	F4	Discharge temperature sensor 2 error of system 1
F4	Discharge temperature sensor 1 error of system 2	F4	Discharge temperature sensor 2 error of system 2
F4	Discharge temperature sensor 1 error of	F4	Discharge temperature sensor 2 error of system 3

	system 3		
F1	Evaporating temperature sensor error of system 1	F1	Evaporating temperature sensor error of system 2
F1	Evaporating temperature sensor error of system 3	E6	Communication error
Ed	Over-temperature protection	EH	Auxiliary electric heater welding protection
F8	Entering cooling water temperature sensor error	F9	Leaving cooling water temperature sensor error
eF	Unit type error	C5	Jumper error

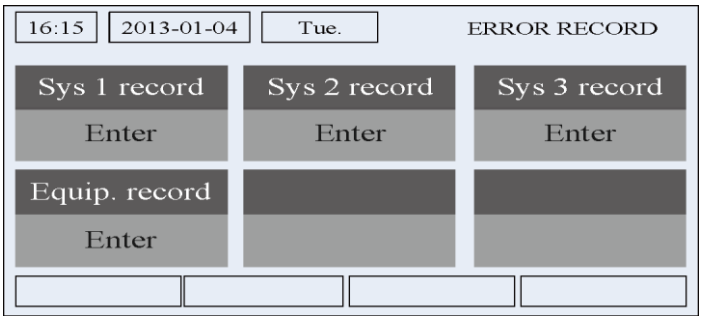
3.4.4 Error Record

Operation method:

(1) After entering unit viewing page, select error record viewing option box and press Confirm button to enter error record viewing page.

(2) After entering error record viewing page, you can inquire the error of unit.

(3) There are three kinds of system error, which are put in the error viewing page of Sys 1 record, Sys 2 record, Sys 3 record and Equip. record individually. Error of the complete unit can be viewed directly in the error viewing page. Press Confirm button to enter corresponding page for viewing the error record of each system.



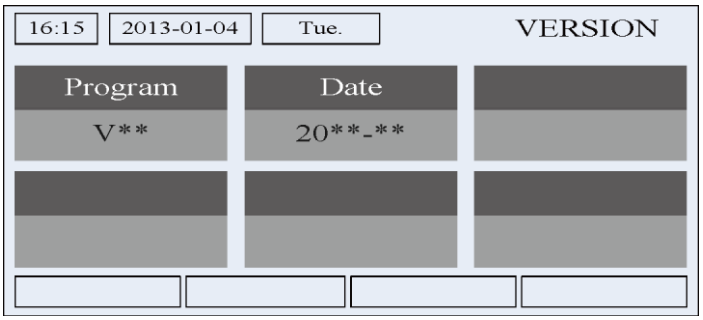
Error record viewing page

3.4.5 Version Information

Operation method:

(1) After entering unit viewing page, select version information option box and press Confirm button to enter version information viewing page.

(2) After entering the page, you can view the current program version and protocol version.

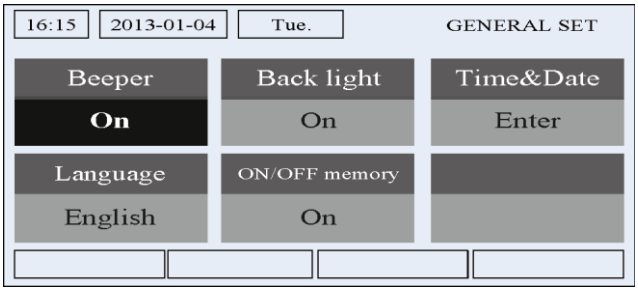


Program version information

3.5 General Setting

Operation method:

In the main page, press “General setting” button to enter general setting page; after entering general setting page, you can set the general functions such as language selection, N/OFF memory, Time&Date, beeper, back light, as shown below:



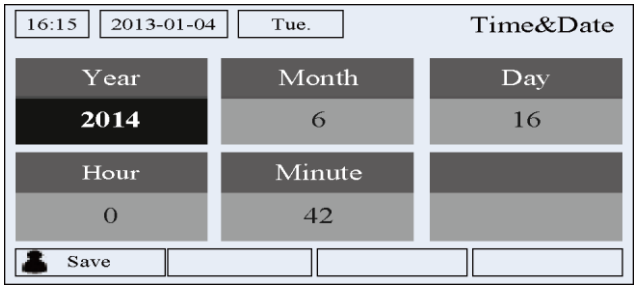
General setting page

3.5.1 Clock Setting

Operation method:

(1) In the main page, pressure “General setting” button to enter general setting page; after entering general setting page, select Time&Date option box and press “Confirm” button to enter clock setting page, as shown below:

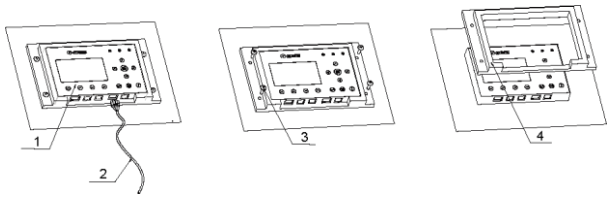
(2) Press “Up” or “Down” button to change the value in current option box. After finishing setting, press Save button to save the set time. The time at the left upper corner will be updated to the saved time automatically.



Clock setting page

3.6 Precautions

Install the wired controller as shown below:



No.	1	2	3	4
Name	Wired controller	Communication wire	Tapping screw ST4.2X16	Rubber cushion

Removal steps:

(1) Pull out the communication wire from the wired controller;

(2) Remove the four tapping screw;

(3) Remove the rubber cushion.

4. Remote Monitoring

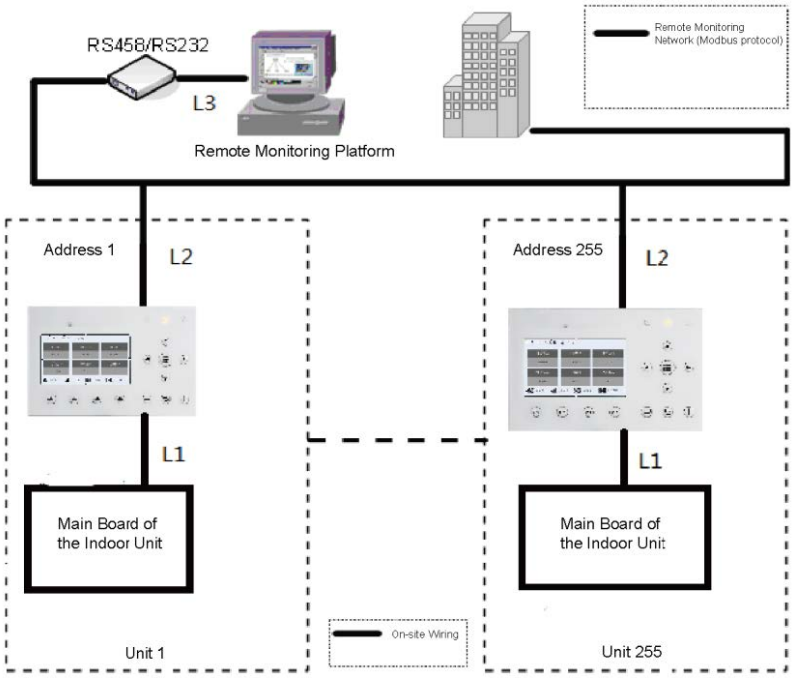
4.1 Brief Introduction

This long-distance monitoring system allows users through a computer to remotely monitor up to 255 water-cooled packaged chillers, including turning on/off the units, setting parameters, giving alarms for malfunctions, which is an efficient tool for management of intelligent air conditioning systems for modern buildings.

4.2 Net Structure

4.2.1 Net Topological Diagram

(1) Integration with the Remote Monitoring Center or BMS System



(2) Communication Line

S=Standard; O=User prepared; P= Purchased optionally

Code	Description	Type
L1	A (two) pair of category-5, twisted pairs with the four-wire port.	S
L2	A (two) pair of category-5, twisted pairs with RJ-11 connectors	O
L3	DB9 serial port cable	S

4.3 Hardware

S=Standard; O=User prepared; P= Purchased optionally

Name	Model	Code	Type	Remarks
Optoelectronic isolated repeaters	RS485	LN02200010	P	A repeater is required every 800m communication distance or every 30 communication modules.

Long-distance monitoring kit	FG30-00/A(M)	MC200027	S	It is required for the long-distance monitoring system but not for BMS. Main parts: software CD, optoelectronic isolated converter.

4.4 Model Selection

4.4.1 Guides for Selection

(1) Scope of Supply

S=Standard; O=User prepared; P= Purchased optionally

Scope of Supply	Model	Class	Remarks
Computer	\	O	CPU: Pentium 4 or above RAM: 512M or above Hard Disc: 30G or above Serial port: 1 or above Operation system: Windows XP/ Windows 2003/ Windows Vista/ Windows 7
Long-distance monitoring kit	FG30-00/A(M)	S	It is required for the long-distance monitoring system but not for BMS. Main parts: software CD, optoelectronic isolated converter.
Optoelectronic isolated repeaters	LN02200010	P	A repeater is required every 800m communication distance or every 30 communication modules.
One (two) category-5 twisted pair	\	O	Length and quantity depend on the demand of the actual project.

(2) Selection Solution

Model	Display	Long-distance Monitoring Kit	Optoelectronic Isolated Repeaters
Water-cooled packaged unit	Controller	1.one FE30-00/A(M) long-distance monitoring kit; 2. either BMS or the long-distance monitoring kit	A repeater is required every 800m communication distance or every 30 communication modules

4.4.2 Examples of Model Selection

(1) Example 1

This project consists of one set of water-cooled packaged unit and the communication distance between the computer and the unit is within 800m.

Part Name	Code	Qty
Water-cooled packaged unit	\	1

(2) Example 2

This project consists of 29 sets of water-cooled packaged unit and the communication distance between the computer and the unit is beyond 800m.

Part Name	Code	Qty
Water-cooled packaged unit	\	29
Computer	\	1
Long-distance monitoring kit FG30-00/A(M)	MC200027	1
Optoelectronic isolated repeaters LN02200010	LN02200010	1

(3) Example 3

This project consists of 35 sets of water-cooled packaged unit and the communication distance between the computer and the unit is beyond 800m.

Part Name	Code	Qty
Water-cooled packaged unit	\	29
Computer	\	1
Long-distance monitoring kit FG30-00/A(M)	MC200027	1
Optoelectronic isolated repeaters LN02200010	LN02200010	2

IV Installation Guides

WARNING

(1) Installation should be performed by Sinclair appointed servicemen, or improper installation would lead to unusual operation, water leakage, electric shock or fire hazard.
(2) The unit should be installed on the foundation which is capable of supporting the unit, or the unit would fall off or even lead to personal injury.
(3) All electric installation should be done by electrician in accordance with local laws and regulations, as well as the User's Manual and this Service Manual. Besides, the special power lines should be used, as any improper line would lead to electric shock or fire hazard.
(4) All electric lines should be safe and secured reliably. Be sure the terminal board and electric lines will not be affected by any external force, or it would lead to fire hazard.
(5) The electric lines between the indoor and outdoor units should run properly to make the cover of the electric box secured tightly, or it would cause the terminal board overheated or cause electric shock or fire hazard.
(6) Cut off the power supply before touching any electric element.

CAUTION:

(1) The unit should be grounded properly and the ground line is not allowed to connect with the gas line, water line, lightning rod or phone line.
(2) The breaker should be installed, or it would lead to electric shock.
(3) The drain pipe should be installed in accordance with the User's Manual and this Service Manual to ensure free drainage, and the drain pipe should be insulated against condensation. Once the drain pipe is installed improperly, it would lead to water leak which then will damps the ceiling and furniture.
(4) Do not place the unit where there is oil fog, like kitchen, or the plastic would be aged, broken off or the polluted evaporator would lead to water leak and poor performance.
(5) Do not place the unit where there is corrosive gas (like sulfur dioxide), or the corroded copper tubes or welded joint would lead to refrigerant leakage.
(6) Do not place the unit where there is inflammable gas, carbon fiber, inflammable dust or volatile combustible, as they would lead to fire hazard.

SAFETY:

(1) Always use safety outfits at the construction site.
(2) No smoking and no drunken operation are allowed at the construction site.
(3) Wear no gloves and tighten the cuff when operating the machinery and electrical equipment. Do not maintain it during operation.
(4) Use the abrasive-disk cutter and stand at the side of the rotating abrasive disk.
(5) Clean the opening when installing the riser pipe, and then cover it tightly. Do not throw down any material.
(6) The use of the electric and gas welders should be approved firstly. Once used, a fire distinguisher should be prepared and a service man should be there always. There should be no inflammable and explosive substances around the welding site.
(7) A platform should be set up when working high above the ground.

EXECUTIVE STANDARDS:

(1) Fire Protection Design of Tall Buildings GB50045-95.
(2) Code of Design on Building Fire Protection and Prevention GB50016-2006.
(3) Code for Electric Design of Civil Buildings JGJ16-2008.
(4) Technical Specification f or Construction of Air Conduct JGJ141-2004.
(5) Unified Standard for Constructional Quality Acceptance of Building Engineering GB50300-2001.
(6) Code of Acceptance for Construction Quality of Ventilation and Air Conditioning Works GB50243-2002.
(7) Code for Acceptance of Construction Quality of Water Supply Drainage and Heating Works GB50242-2002.
(8) Code for Construction and Acceptance of Refrigeration and Air Separating Equipment Installation Engineering GB 50274-2005.

1. Material for Installation

Requirements on Material:

Models, specifications and material of pipelines, pipe fittings, and valves of the water system should comply with the corresponding design codes.

Specifications of the galvanized carbon steel tubes also should comply with the corresponding design and production codes: evenly galvanized internal and external tube walls, no rust, no burrs, and no unmatched thread etc. All tubes should have got the qualification certificates and other necessary quality certificates.

1.1 Pipelines

Tube Types

Application	Type
Water (t＞95℃) Tubes	Welded steel, seamless steel, galvanized steel
Water (t≤95℃) Tubes	Welded steel, seamless steel, galvanized steel, nodular cast iron, composited aluminum and plastic (PAP1, XPAP2, RPAP5), PB, PE-X
Water (t≤60℃) Tubes	Welded steel, seamless steel, galvanized steel, PP-R, composited aluminum and plastic (PAP1, XPAP2, RPAP5), PB, PE-X, PE-RT
Cooling Water Tubes	Welded steel, seamless steel, galvanized steel, nodular cast iron
Drain Tubes	PVC,UPVC
Condenation Tubes	Galvanized steel, PE, PVC, UPVC

1.2 Insulation

Typically the refrigerant copper tubes, air ducts, chilled water tubes and condensation tubes should be thermally insulated by the commonly used plastic insulation rather than glass wool, PE or PEF.

Insulation Thickness

Diameter(mm)	Gas-expanded Rubber		Glass Wool	
	Zone Ⅰ	Zone Ⅱ	Zone Ⅰ	Zone Ⅱ
DN15-DN25	above 15mm	above 20mm	above 30mm	above 30mm
DN32-DN50	above 25mm	above 30mm	above 35mm	above 35mm
DN65-DN80	above 30mm	above 35mm	above 35mm	above 40mm
DN100	above 35mm	above 40mm	above 40mm	above 45mm
Note: under the tropical climate, the insulation should be thickened or doubled.				

Thickness listed in the table above all is larger than the required thickness.
Special adhesives for insulation should be used, as shown in the figure below.

1.3 Sectional Material

(1) Angle Steel
(2) I steel
(3) Channel Steel
(4) Squire Steel
(5) Rectangular Steel
(6) H Steel

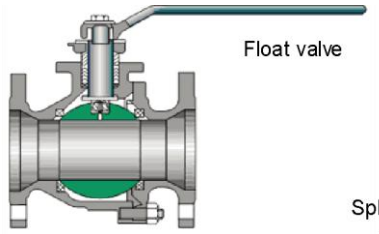
1.4 Valves

The usually used valves incudes: gate valves, shut-off valves, throttling valves, gauge valves, plunger valves, diaphragm valve, plug valves, ball valves, butterfly valve, check valves, safety valves, drain valves, regulating valves, foot valves, and sewer valves etc.

(1) Gate Valve: its nominal diameter generally is or larger than 50mm and is mainly used to cut off the tube flow.

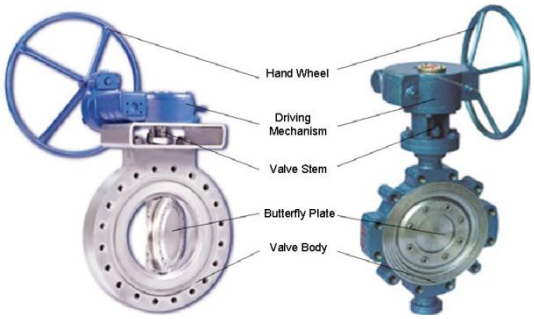
(2) Shut-off Valve and Throttling Valve: its nominal diameter is limited to 200 or below. The shut-off valve is used to cut off the tube flow and the throttling valve is mainly used to throttle the tube flow.

(3) Ball Valve: it is mainly used to cut off or distribute the tube flow or change its direction.



Split ball valve (large caliber)

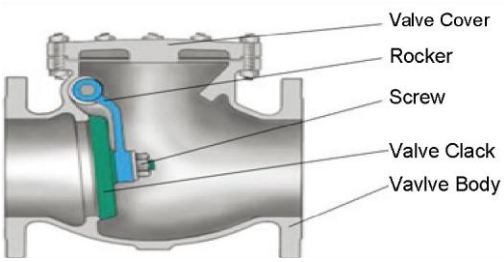
(4) Butterfly Valve: it is widely applicable to all kinds of fluids under 2.0MPa and 200℃.



(5) Plug Valve: it is mainly used to cut off or distribute the tube flow or change its direction.

(6) Check Valve: it mainly used to stop the fluid flow back.

Balance Valve: it is capable of controlling the flow rate and is mainly used to balance the hydraulic pressure of the pipeline system.



Check Valve

Balance Valve

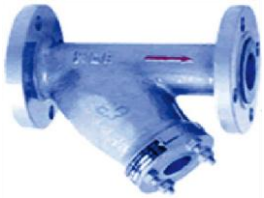
(7) Selection of Valves

Item	No	Selection Principle
Design	1	Butterfly valves for the inlet and outlet of the chilled water and cooling water tubes.
	2	Butterfly valves for the water pump inlet; check and butterfly valves for the water pump outlet.
	3	By-pass valves between the water header and the distributor.
	4	Butterfly valves for the inlet or return water tubes.
	5	Butterfly valves for the horizontal main tubes.
	6	Gate valves, filters, electric 2-way valves or electric 3-way valves for the air handling units.
	7	Gate valves (or with electric 2-way valve) for the fan coil units.
For butterfly valves, the one which diameter less than 150mm is the hand-wheel type; the one which diameter is large than 150mm is the worm-gear drive type.		
Precuations	1	The reducing valves and balance valves should work together with by-pass valves.
	2	Ball valves and gate valves are the best choice for the full-open and full-close type valves.
	3	The shut-off valves should be avoided to the most extent.
	4	Pay much attention to the calculation of the resistance of the valves.
	5	Choose the proper electric valves.
Valves for Water Supply Pipes	1	Regulating and shut-off valve are good choices when the water flow and pressure should be regulated.
	2	Gate valves are good choices when the water resistance is required to be small.
	3	Butterfly and ball valves are good choices when the installation space is small.
	4	Shut-off valves should be used when fluid flows in two directions.
	5	Multi-function valves are good choices for the water pump with large diameter.
Setup Location of Check Valves		
Setup Location	1	at Influent pipes
	2	at the inlet pipe of the closed water heater or water treatment equipment.
	3	at the outlet pipe of the water pump.
	4	at the outlet pipe used also as the inlet pipe of the water tank, water tower and high-level water pool.
	Note: the check valve is not required for the pipe with the backflow preventer	
Type Selection of Check Valves	It depends on the installation location, upstream water pressure, sealing performance and size of the water hammer etc.	
	1	Swing, ball and shuttle-type check valves are good choices when pressure upstream is small.
	2	Spring-type check valves are good choices when there is high requirement on the sealing performance.

	3	Quick-closing check valves or slow-shut check valves with damping devices are good choices when the water hammer is required to be reduced.
	4	The valve clack should be automatically closed with force of gravity or spring force.
Release Valves Required for the Water Supply Pipes	1	at the end and the highest point of the water supply network.
	2	at the peak of some pipe section in the water supply network where a huge amount of air is trapped.
	3	at the highest point of the water supply network equipped with an automatic pneumatic water tank.

1.5 Filters for the Water System

The most commonly used filter is the Y-shaped filter which is usually installed at the inlet of the water pump, reducing valve, locating valve, or other equipment. It is used to remove impurities in the water system so as to protect valves and make the unit run normally. Its mesh number generally is 8～30.



(1) e.g. 1: YBY350Ⅱ-4.0/40B: it indicates YBY series, 350 nominal diameter, 4.0MPa, Ⅱ, stainless steel, 40 meshes/inch.

(2) e.g. 2: YBY250Ⅲ-1.6/60A : it indicates YBY series, 250 nominal diameter, 1.6MPa, Ⅲ, stainless steel, 40 meshes/inch

1.6 Water Softeners

Water at the construction site is likely to be hard, which would cause heavy scale on the pipes. Therefore, a water softener should be installed in the unit. Generally, an automatic softener is preferred.

Electric Water Treating Equipment: it is used to remove impurities, hydrocarbonate, bacterial, algae etc. in the cooling water.

2. Tools

2.1 Cutting and Finishing Tools

It mainly includes: abrasive-disc cutter, hand abrasive wheel, chain blocks, electric drill, threading machine, pressure test device, handsaw, pipe wrench, box wrench, monkey wrench, hammer, and electric welder etc.

2.2 Measuring Tools

It mainly includes: steel band tape, level bar, angle square, U-shaped pressure gauge etc.

Name	Picture	Usage
Electrc Welder		to weld tubes
Abrasive-disc Cutter		to cut steel tubes
Chain Blocks		to install tubes
Pipe Wrench		to install tubes
Percussion Drill		to install brackets
Thread Taper		to draw threads
Hand Mill		to install tubes

Hand Electric Drill		to drill holes
Steel Band Tape		to measure length
Leval Bar		to judge the levelness
Booster Pump		to pressurize tubes
Oxygen Lance		to cut steel tubes

3. Installation

3.1 Preparations

(1) The unit should be installed in the dedicated machine room and measures should be taken to remove heat produced by the unit so as to keep the indoor temperature at or below 40℃.

(2) The unit should be installed at the non-deformable rigid base or concrete foundation which also should be smooth and capable of supporting the weight of the unit.

(3) There should be a drain channel around the unit so as to drain the discharged water during seasonal closedown or maintenance.

(4) There should be enough clearance around the unit for installation and maintenance and there also should be enough space for pipe drawing. Besides, there should be no pipe or wire above the compressor.

(5) It is recommended to reserve enough space for installing the vibration isolating rubber pipe before installing water pipes.

(6) Do not place the unit where there is heavy dust, corrosive smog and high humidity in consideration of the normal operation of electric elements. If so, correct it.

(7) Necessary tools and materials include: flexible joint, vibration-isolating pad, lifting equipment, lifting beam, lifting chain, jack, skid, crow bar etc.

Note
Any modification or retrofit to the unit during installation is not allowed without Sinclair written consent, or guarantee repair will cease to be available.

3.2 Space for Installation and Maintenance

Be sure there is enough space around the unit for operation and maintenance, air flow is unhindered, drainage is available, piping and wiring are convenient, and installation surface is smooth and level. See the figure below for more details.

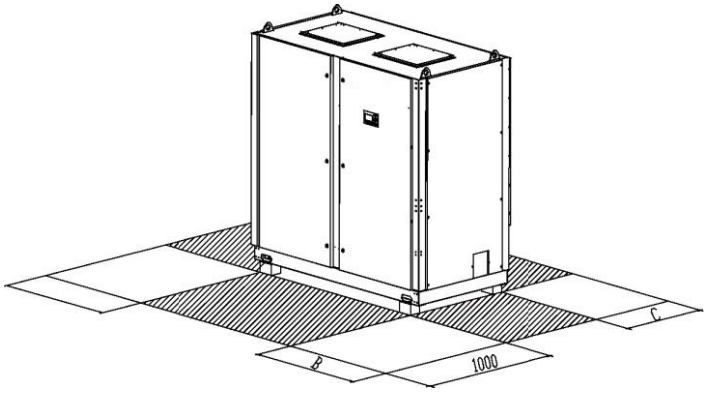


Diagram of Installation Space for the Unit with Upward Discharge

Dimensions of the Installation Space

Model	A(mm)	B(mm)	C(mm)
GWCP0032 GWCP0049 GWCP0065 GWCP0080 GWCP0098 GWCP0105 GWCP0116 GWCP0130 GWCP0145 GWCP0160 GWCP0196	800(800)	800(1800)	600

Figures above is just for reference and is not in actual protection.

(1) When the unit is installed where air flows dramatically, like rooftop, it can be taken into consideration to use a stub wall or blinds.

(2) If a stub wall is used, its height is not allowed to exceed that of the unit. If blinds are used, then the total static pressure loss should be smaller than the external static pressure.

(3) If the unit is required to run in winter and snow is probably accumulated at the installation site, then the unit should be higher than the snow cover so as to ensure air freely pass through the condenser.

3.3 Installation Foundation

(1) The installation foundation should be designed by the professional designers.

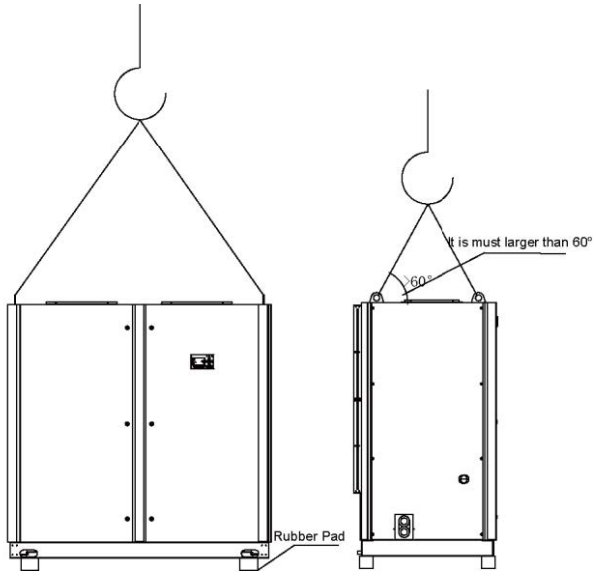
(2) The installation foundation should be made of concrete or steel structure and capable of supporting the running weight of the unit.

(3) The unit should be fastened securely and the footing should be smooth and horizontal.

(4) There should be a drain channel around the installation foundation.

3.4 Main Unit

(1) Each unit will undergo a series of strict factory inspections and tests to guarantee the expected performance and quality. Care must be exercised during installation and transport to prevent the control system and pipelines from being damaged.
(2) It is best to unpack the unit at the installation location and keep the chiller upward.
(3) When the unit is unpacked during handing, please follow the lifting instructions stated below.



3.4.1 Handling and Lifting

(1) Refrigerant has been charged into the unit before transport. Therefore, care should be exercised in transport to avoid any damage caused by imprudent operation.
(2) Make sure the lifting cable is strong enough before lifting.
(3) Keep the unit balanced during lifting or handling. Do not lift or let it down sharply.
(4) Use the lifting crane or roller to move the unit but not drag the unit forcibly.
(5) Do not remove the skid during lifting or handling until the unit has been placed properly.
(6) The unit should be lifted with the lifting equipment.
(7) During long-distance transport, the unit should be protected with packing fastened by cables to prevent the unit from being damaged.
(8) Make sure package is intact before installation and do not keep the unit outdoor.

3.4.2 Placement

(1) Lift the unit at the foundation where rubber pad has been put on. There should be no clearance between the foundation and the rubber pad. The foundation should be stable enough.
(2) After that, be sure the horizontal slope of the unit can’t exceed 1/1000. If so, take an adjustment by stuffing spacers into the clearance between the foundation and the baseboard of the unit until the slope is satisfactory.

3.4.3 Removal of Footers

Footers are used to protect the compressor and pipes. When installation has been finished, they should be removed.

3.4.4 Removal of the Front Door

The front door should be removed for service. Firstly, open the door with the door key, and then lift the door bolt of the door hinge. For installation, align the door and the door hinge and then insert the door bolt.

3.5 Water System

3.5.1 Installation of Cooling Water Pipes

(1) The cooling water pipe can be installed when the main unit is ready in place. Installation should comply with corresponding codes and regulations so as to ensure highest operating efficiency. No foreign matters are allowed inside the pipe. All pipes should meet local codes and regulations of pipe works.

(2) At any time, the flow rate at the shell-and-tube exchanger cannot be lower than 70% of the rated value.

(3) Rinse all pipes before installation to ensure there is no foreign matters inside. Do not allow any foreign matters into the shell-and-tube heat exchanger.

(4) There should be a flow switch at the outlet pipe of the evaporator in case that there is a need to cut off the flow.

Note
The flow switch is just a safety device and can't start or stop the unit.

(5) Pipes and pipe fittings should be supported separately but not supported by the unit itself.

(6) Pipes and pipe fittings should be easily detachable so as to facilitate operation and cleaning.

(7) A bypass pipe and a bypass valve are required for the evaporator to reduce impact resistance and facilitate maintenance.

(8) A flexible joint is required between the joint of the evaporator and the joint at the construction site so as to reduce the spread of vibration to the building.

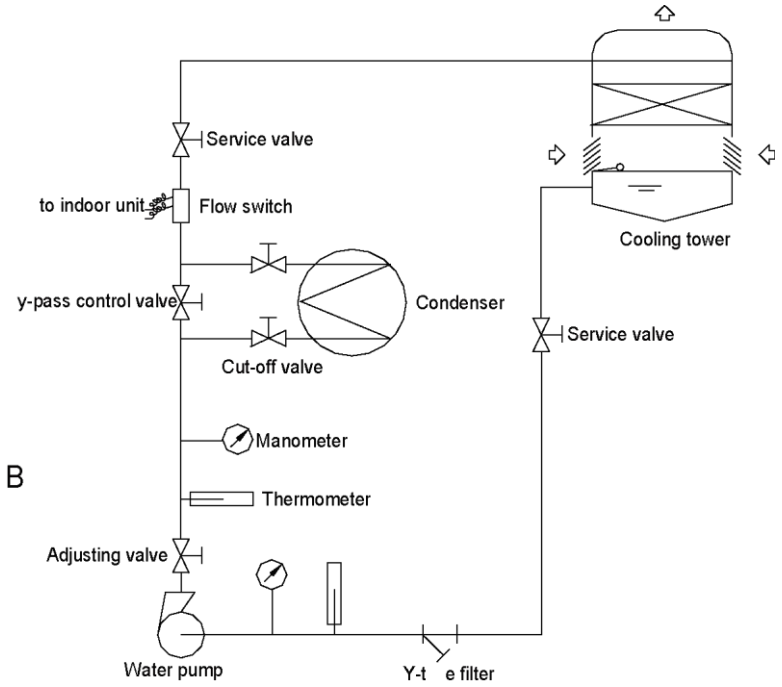
(9) A thermometer and manometer should be installed at the inlet and outlet pipes for convenient maintenance. They should be prepared by the user.

(10) There should be a drain outlet at the lowest point of the water system to drain the water system. There should be an exhaust valve at the highest point to exhaust all air inside the system. The exhaust valve and the drain outlet are not required to be insulated in consideration of convenient maintenance.

(11) Under subzero climates, the water system of the unused unit should be drained completely so as to prevent the unit from being frozen up, or take other measures to keep the water temperature no less than 0℃.

WARNING

The installer/user should ensure the water quality as scaling will damage the heat exchanger and water pipes, and also ensure no air enters the water system as air will oxidize the steel elements.



Installation Diagram of the Cooling Water Pipes

3.5.2 Requirements on Installation

(1) The piping slope should meet design and construction regulations and the flexible pipe is not allowed to be longer than 150mm.

(2) Pipes which go through the dilatation joint and the settlement joint should be protected with the flexible joint.

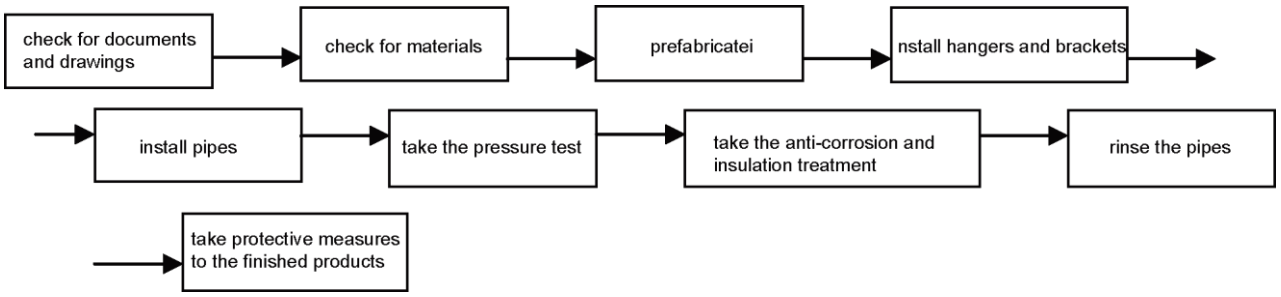
(3) No matter which connection is used, welding, threaded connection or flange connection, the connection joint can't be in the wall, floor or sleeve pipe.

(4) The riser pipe should be installed vertically. When the floor height is or less than 5m, a pipe clip is required. When the floor height is or larger than 5m, at least 2 pipe clips should be required. The installation height of the pipe clip is 1.8m. For the main riser pipe, it should be secured with the fixed bolster to support the weight of the riser pipe.

(5) See the table below for the installation standards of the pipes.

Item		Allowable Deviation	Inspection Method
Straightness	DN≤100m	2L‰,max.40mm	By the ruler, tape measurement
	DN100mm	3L‰,max.60mm	
Verticality		25L‰, max.25mm	By the ruler, tape measurement
Interval of Parallel Pipes		15mm	By the ruler, tape measurement
Parallelism of Parallel Pipes		3mm	By the ruler, tape measurement

Installation Flowchart of the Pipes:



3.5.2.1 Check for Documents and Drawings

(1) Check the process flow, construction procedures and quality requirements in accordance with drawings and technical data.

(2) Check the installation location, installation height, arrangement, and installation space of pipes in accordance with equipment drawings and building drawings.

3.5.2.2 Check for Materials

(1) Before installation, check for the mode of the valves, clean them and then take the strength and air-proof tests.

(2) Pipes should be cleaned with a steal brush or abrasive paper. After that, seal the pipe ends and keep both the internal and external surface dry.

(3) Pipes should be painted with anti-rust paint without any curtaining and holiday.

3.5.2.3 Prefabricating

(1) Make out the installation drawing which clearly indicates the branch pipes, pipe diameter, reduced pipes, location of valves, installation dimensions etc. Then, prefabricate pies in accordance this installation drawing. Pipes should be processed with dedicated cutting machine, leaving no burrs at the pipe ends. After that, pipes should be cleaned to prevent sands and dusts from damaging the joint.

(2) Pipe supports should be prefabricated in accordance with design requirements. The contact part between supports and pipes should be separated with wood blocks which has taken anti-corrosion treatment and is as thick as the insulation.

3.5.2.4 Installation of Pipe Brackets

(1) The supporting beam should be fastened to the wall, pillar or other building structure. It should be placed horizontal horizontally with the top surface parallel with the center line of the pipe.

(2) Pattern, installation, interval and standard height of supports for metal pipes should meet corresponding design requirements and codes.

(3) Supports should be installed securely and contact the pipe closely. Separate supports are required at the connection joint between the pipe and the equipment.

(4) Supports for chilled and cooling water pipes as well as main and branch pipes in the machine room should be anti-vibration. When a single-bar hanger is used, anti-vibration hangers should be set up every 15m and at the pipe ends, valves, tee joints and elbows.

(5) See the table below for the interval of brackets.

Diamter (mm)		**15**	**20**	**25**	**32**	**40**	**50**	**70**	**80**	**100**	**125**	**150**	**200**	**250**	**300**
Max Interval between Brackets (m)	Insulated Pipe	1.5	2	2.5	2.5	3	3.5	4.0	5.0	5.0	5.5	6.5	7.5	8.5	9.5
	Non-insulated Pipe	2.5	3	3.5	4	4.5	5.0	6	6.5	6.5	7.5	7.5	9.0	9.5	10.5

Note: it is applicable to the pipes with working pressure less than 2.0 and insulation density less than 200kg/m^3 or without any insulation.



3.5.2.5 Installation of Pipes

(1) Threaded Connection

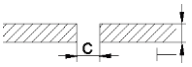
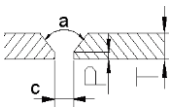
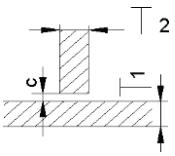
Supply and return water pipes with the diameter of being or being less than DN32 should be thread connected, and pipes with the diameter of being or larger than DN40 should be welded. Those which must be detachable should be flange connected. Before installation, foreign matters inside the pie should be removed.

1) Threads should be processed by the threading machine.
2) Use marnen as stuffing material and remove those outside of the threads after pipes have been installed.
3) Threads should be clean and at least 90% threads should be intact. Exposed threads at the connection joint after installation should be 2-3 without any exposed stuffing. Galvanized pipes should be protected and local damage should take anti-corrosion treatment.

(2) Welding

1) See the table below for types and sizes of grooves for welding which should be processed by the facing machine.

Types and Sizes of Grooves for Welding

Item	Thickness T(mm)	Name	Type	Groove			Remarks
				Clearance C(mm)	ShoulderP(mm)	Angle A(º)	
1	1 ~ 3	I-shaped		0.1 ~ 1.5	—	—	Misalignment for the inner wall should be≤0.1T and≤2mm, and should be ≤3mm for the external wall.
	3 ~ 6 Doule Welding			1 ~ 2.5			
2	6 ~ 9	V-shaped		0 ~ 2.0	0 ~ 2.0	65 ~ 75	
	9 ~ 26			0 ~ 3.0	0 ~ 3.0	55 ~ 65	
3	2 ~ 30	T-shaped		0 ~ 2.0	—	—	

2) When pipes with the same diameter and thickness are butt connected, their inner walls should be aligned within a deviation of 1/1000. Length of the groove for welding can't be larger than 10mm.

3) The groove for welding should be as far as away from the unit and should not be parallel with the center line of the equipment interface. The welding seam should keep a distance of at least 50mm with the hanger and bracket.

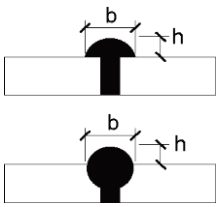
4) Welding should be done by the qualified welder. In welding, there should be a wind, rain, or snow guard. The environmental temperature for welding can't be lower than -20℃. A 250mm groove for welding should be preheated to 100℃ .

5) The welding height can't be lower than the surface of the parent metal. There should be no crack and poor welding at the welding seam and the heat-affected zone. There should be no slag inclusion, crater and pore at the welding zone.

6) Distance of two neighboring butt-jointed seams should be no less than the external diameter of the pipe and can't be less than 180mm. No butt-joint seam is allowed at the elbow. The welding seam should keep a distance of at least the external diameter of the pipe from the elbow and can't be less than 100mm. No branch pipe is allowed to be welded at the elbow and welding seam. The hanger and bracket should keep a distance of at least 80mm with the welding seam.

7) Surface of the welding seam should be cleaned and be visually inspected. Quality of the welding seam should meet requirements listed the table below.

Reinforced Height and Width of the Welding Seam

Welding Seam	Pipe Thickness (mm)		2～3	4～6	7～8
	Without grooves	Reinforced Height h(mm)	1～1.5	1.5～2	-
		Width b(mm)	5～6	7～9	-
	With grooves	Reinforced Height h(mm)	-	1.5～2	2
		Width b(mm)	About 2mm over the groove		



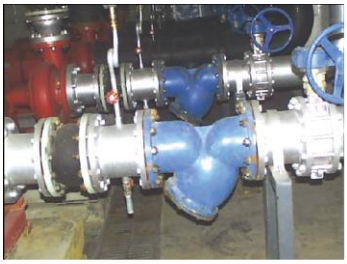
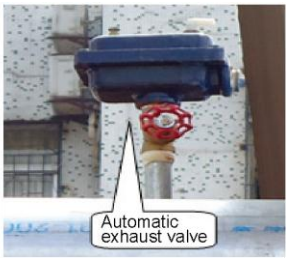

(3) Flange Connection

1) The flange should keep vertical with the center line of the pipe. Flange screws should have the same length and same direction. Length of the bolt out of the nut should be a half of the diameter of the bolt.
2) Flange screws should be fastened along the diagonal to form an even seam.
3) The flange is not allowed to be directly welded to the elbow but used for the straight pipe at least 100mm long.
4) When a flange is connected with another, they should match each other naturally to avoid pipes or equipment from producing extra stress.
5) The flange at the branch should keep a distance of at least 100mm from the main pipe, and the flange at the thru-wall pipe should keep a net distance of at least 200mm with the wall.
6) When a flange is connected to the unit, a wash should be placed at the center of the flange without any deviation. Except for design requirements, do not used dual-layer, multi-layer, or tilted washers.

3.5.2.6 Installation of Valves and Water Filters

(1) Installation location, height and direction of valves should be correct. And they should be arranged orderly within a deviation of 3mm in the same plane.
(2) The valve stem can't be downward but toward the direction which will facilitate its operation.
(3) Attention should be paid to the arrow which indicates the direction of fluid in the valve.
(4) Installation of electric valves and solenoid valves should be guided by electricians. They should be commissioned prior to installation.

(5) The water filter is usually installed at the inlet pipe of the water pump and other equipment. Pay attention to the water flow direction.
(6) The automatic exhaust valve should be installed at the highest point of the system. In order to facilitate maintenance, a gate valve should be installed upstream of the automatic exhaust valve.
(7) A drain pipe or drain valve should be installed at the lowest point of the water system. For the closed-circuit system, an exhaust valve should be installed at the highest point of the system and where a large amount of air may be trapped.
(8) The water filter should be installed at the inlet pipe in correction direction and easily be cleaned. Material of the filter screen should meet the design requirements.


3.5.2.7 Pressure Test

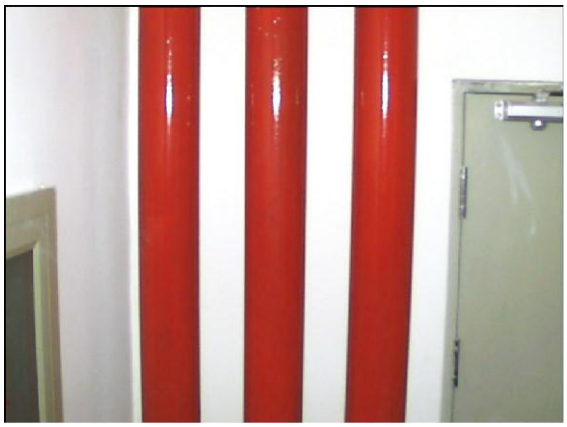
The pressure test includes single item pressure test and whole system pressure test. The former is done when the main pipes or concealed pipes have been installed. The latter is done when all main pipe and riser pipes have been installed. The pressure test should be taken prior to the insulating procedure and done in accordance with the following statement.

(1) The pressure test should be done one section by another. The manometer should be installed at the lowest point of the testing pipes.
(2) Water should be charged from the lowest point. During charging, close all inlet valves and drain valves, but open the manifold valve and each valve at the branch pipes. During the pressure test, it can’t be put into normal use. Special attention should be paid that the exhaust valve should be opened until air inside the system is removed completely.
(3) For the heat pump system, when the working pressure is or less than 1.0MPa, the test pressure should be 1.5 times of the working pressure but no less than 0.6MPa; when the working pressure is larger than 1.0MPa, the test pressure is the working pressure plus 0.5MPa.

(4) Raise the pressure to the test pressure and the test pressure should be kept for 10 minutes. Then, lower the pressure to the working pressure and the working pressure should be kept for 60 minutes. No leakage through the visual inspection indicates it is satisfactory.
(5) The filling water test is taken for the condensate water system. No leakage through the visual inspection indicates it is satisfactory.

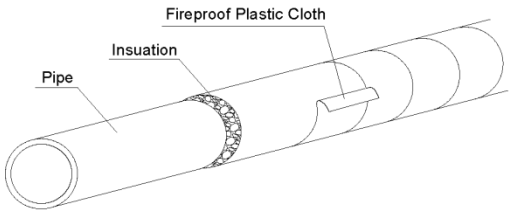
3.5.2.8 Anti-corrosion and Insulating

(1) Anti-corrosion: supply water and return water pipes, branch pipes, and pipe brackets should be painted with anti-rust paint twice. The damaged galvanized condensate pipes and pipes with exposed thread also should be touched up with anti-rust paint.



1) Pipes should be painted evenly and the paint thickness should meet relative requirements.
2) Pipes should be painted without curtaining and holidays.

(2) Insulating: PEF (δ=30mm) is taken as the insulating material.



1) The insulation should be arranged evenly and smoothly .
2) Flanges should be insulated separately.
3) Seams of the insulation should be airproof.

4) Insulation for the stainless iron sheet should be smoothly and the seams should be airproof.
5) Flanges should be insulated separately.
6) Seams of the iron sheet should be at the downstream of the drain water.

Note: for the riser pipes, when the floor height is or less than 5m, there should be a bracket tray for each floor; when the floor height is larger than 5m, there should be at least two bracket trays 200mm ahead of the riser pipes. The diameter of the bracket tray can't be larger than the thickness of the insulation. Expansion seams should be left for the insulation of the brackets. A 5mm expansion seam should be left every 5-7m on the branch pipes. Also 30mm seams should be left for elbows. Clearance between the insulation and the pipe sleeve should be stuffed with non-inflammable material.

(3) Pipes should be labeled with legible fonts and the direction of the fluid. The paint color should be selected properly. Once color circles are used, their intervals should be even. Labels listed in parallel should be arranged reasonably.

1) The typeface on the label matches with the diameter of the pipes.
2) The label indicates the name and direction of the fluid.
3) The label is eye-catching and struck reliably.

3.5.2.9 Cleaning of Pipes

After the pressure test, the system should be rinsed one section by another with the maximum allowed flow or the flow no less than 2m/s until leaving water is as clean and transparent as entering water. For the heat pump system, it can be put into normal use until it has been rinsed (leaving water is as clean and transparent as entering water.) and has taken a trial run for about 2 hours.




3.5.2.10 Protection for the Finished Product

(1) Prefabricating, anti-corrosion treatment, setup, and pressure test procedures go closely one by once. If interrupted, the open mouth of pipes should be closed to prevent foreign matter entering.
(2) Installed pipes can't be taken as the lifting center, and also can't be stepped on.
(3) Pipe repair should be finished prior to external decoration and do not damage any wall and floor finished product after external decoration.
(4) During external decoration, installed pipes, valves, gauges etc. should be guarded by appointed personnel to prevent them from being damaged in other construction procedure.

3.6 Water Quality Management

3.6.1 Management of Water

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

(1) Situation of Circulating Water

There is less suspended solid material and organic matter in tap water and industrial water, which is favorable for preventing block and incrustant of the pipe. However, with cooling tower, the pollutant (sulfurous acid from car and chimney, alkaline or hepatic gas from high build, sewage treatment plant and chemical plant etc.) from air is dissolved in water and produce erosive circulating water, which damages the pipe. Even though there is not so much pollutant content, it will accumulate during circulation and finally lead to erosion. Tap water and industrial water from different areas are also different. Therefore, it is necessary to manage the water condition (incrustant content) and take suitable actions, for example, material management, cooling tower water overflowing, changing water, and so on.

(2) Situation of Uniflow Water

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

3.6.2 Method of Water Quality Management

3.6.2.1 Frequency of Water Quality Analysis

Analyze the water quality at the beginning of the usage season, next do the analysis again in 7-10 days and then once every month from then on.

3.6.2.2 Analysis of water quality

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

a. Sample the water during running of the unit

b. The container used for sampling should be new, without air. The volume should be more than 2 L. Besides, do not clean the container while sampling.

3.6.2.3 Standard of Water Quality

The material of heat transfer tube in evaporator and condenser is copper. The requirement of water used in the copper pipe is as below (GB/T 18430.1-2007):

The cooling water quality of condenser is shown in Sheet 6.3.

The cooling water in evaporator is circulating, so the quality should be higher than the chilled water. It is advised to use soft water.

Sheet 6.3 Quality Requirement of Cooling Water.

Item		Unit	Circulating Water	Makeup Water	Trend	
					Corrosion	Scaling
Standard item	PH value PH (25℃)	—	6.5～8.0	6.0～8.2	O	O
	specific conductance	μs/cm	＜800	＜300	O	O
	chloride ion Cl^-	mg/L	＜200	＜50	O	
	sulfate radical ion SO_4^{2-}		＜200	＜50	O	
	acid depletion (PH4.8)		＜100	＜50		O
	full hardnessl		＜200	＜70		O
Reference item	Fe	mg/L	＜1.0	＜0.3	O	O
	S		—	—	O	
	NH_4^+		＜1.0	＜0.3	O	
	SiO_2		＜50	＜30		O
Note: O indicates factors related to corrosion or scaling.						

3.6.2.4 Maintenance of Water Quality

(1) Flow Adjustment

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

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

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

(2) Replacement of Water

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

In area where there is sulphur dioxide pollution nuisance, change the water once every 5 days. In general area, change the water once every 10 days. If there is automatic spray water and manual spray water: In area where there is sulphur dioxide pollution nuisance, change the water once every month. In general area, change the water once every 3 months.

(3) Treatment during Long-term Stop During long-term stop, affecting by the environment and water quality, the bacteria in heat transfer pipe will increase, which leads to erosion of the pipe.

If the unit stops for more than 15 days, the water should be released completely. If the ambient temperature ≤0℃, release the water in evaporator and condenser during stop of the unit.

(4) Chemical Treatment of Circulating Water

The chemical treatment of circulating water includes sterilization

1) Clean monthly and add chemical. Before adding the chemical, observe the water quality.
2) If the bottom of cooling tower is covered with lichen or there is too much rust in water, it means that the chemical added last time is not enough. It is necessary to increase the quantity. Clean the system before adding chemical. Steps are: clean the cooling tower with high pressure washer (plastic besom is also acceptable).Clean tower manually, open blow down valve in the bottom of tower after cleaning tower dirt loose, clean and discharge. Use plastic pipe slow move in tower bottom if can't stop unit for cleaning, If there is deposition pool, it must be cleaned. If there is much dust accumulation, clean it according to the above method. If water quality is good, add the original amount of chemical. The amount of chemical should accord with the specification from the supplier. Generally add 30-100g corrosion inhibitor and 10-30g germicide and algicide for each ton of water. (Chemical should be increased in from July to September) Observe the blister after adding the chemical. If the blister cannot cover the whole surface of water in 10 min, it is necessary to increase the chemical. Inversely, the chemical is enough.
3) Add remover when cleaning the unit. After it is circulating in the system for 12h, discharge it for eliminating dirt and rust-eaten of tower and pipe, and then charge fresh tap water. Add suitable

corrosion inhibitor, germicide or algicide according to the specification.

4) Record the added chemical and water quality test for analysis and comparison.
5) Safety protection: chemical is harmful to human body in some degree. Therefore, it is a must to take actions for safety protection. Chlorine is strongly smelly and corrosive. Too much intake will lead to death. When dealing with and using biocide, take care to protect the skin, eyes and respiratory system from hurt. When adding chemicals, it is required to wear clothes covering hands and legs, rubber glove and goggles.

WARNING

When adding chemicals, it is required to wear clothes covering hands and legs, rubber glove and goggles, in order to protect the skin, eyes and respiratory system from hurt.

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

3.7 Installation of Condensate Pipes

Setup-Insulating-Fastening

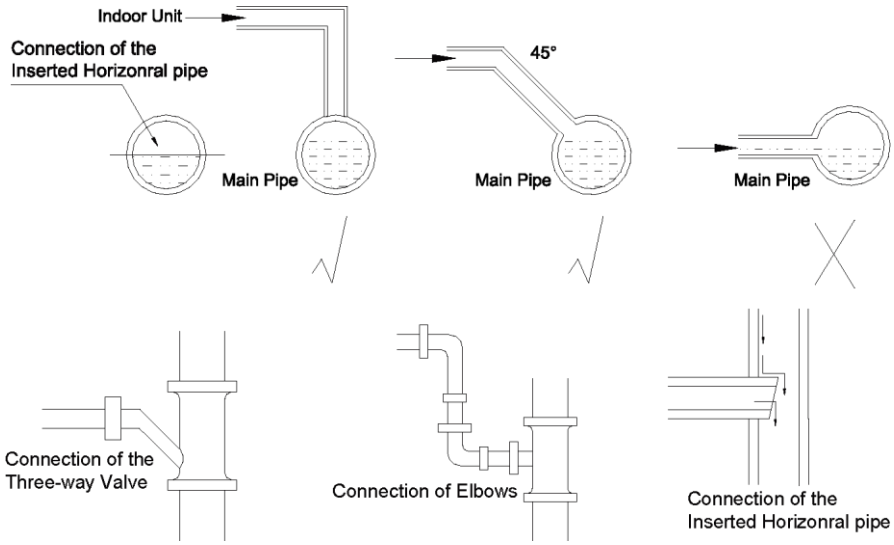
Precautions

(1) Adverse slope is not allowed for the slope larger than 1%.
(2) It can't connect with the rain water pipe, sewage pipe or other pipes.
(3) The elbow ventilator should be installed at the highest point of the condensate pipe to prevent foreign matters coming into the drain pipe.
(4) The S-shaped trap and flexible joint are necessary.
(5) The diameter of the pipes should be suitable.
(6) The wall-thru or floor-thru pipes should be protected by the steel sleeve. Do not put seams inside the sleeve. The steel sleeve should keep flush with floor, or 20mm above the floor for the floor-thru pipes. The steel sleeve is not allowed to affect the slope of the pipe and can't be used as the support of the pipe. Clearance between the pipe and the sleeve should be stuffed by flexible non-inflammable material.

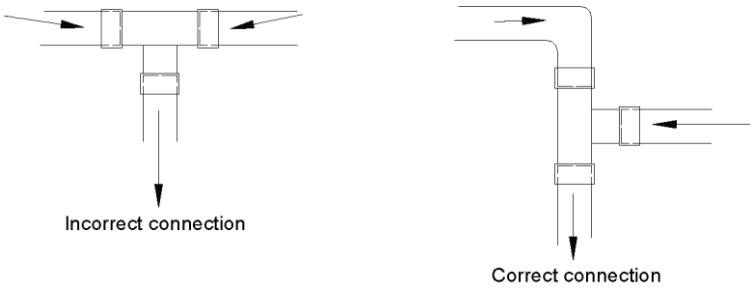
3.7.1 Setup

The condensate pipes should be at least 300mm away from the electric box of the unit. For special space, its installation location should be approved by the corresponding designers.

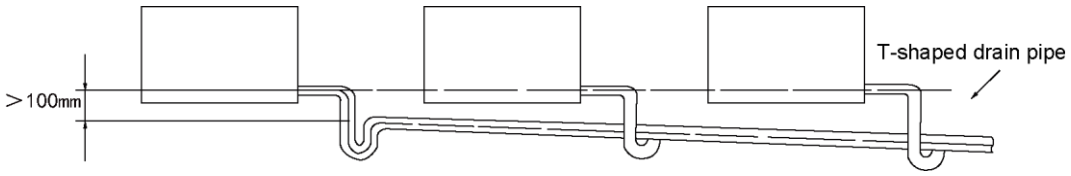
Connection of the Main Pipe and the Branches:



When the three-way valve is used for the condensate pipe, its straight two connectors should be kept at the same level as shown in the right figure.



When there are several indoor units at the same floor, their condensate is usually drained out through one main pipe. In this case, the branches pipe for each unit should be located higher than the main pipe. The size of the condensate pipe is determined by the capacity and number of the indoor units.



The T-shaped drain pipe should meet the running capacity of the unit.

When the negative pressure at the pipe outlet is too large, elbows should be fitted to the drain pipe.

A=P+25mm

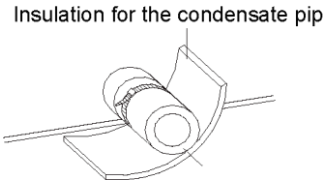
B=P/2+25mm

P—negative pressure mmH_2O

Pipe Size≥32mm

3.7.2 Insulating

The extended drain pipe should be insulated and special care must be paid to the elbows. See the table below for the thickness of the insulation.



Drain Pipe(mm)	Thickness of Insulation (mm)
As required	≥15

The insulation should be thickened at the humid area.

3.7.3 Fastening

The insulating tube is just required to be bundled and fastened at the supporting bracket.

3.8 Wiring of Power Lines

(1) Sizes of the power lines and breakers have close relationship to the local climate, soil and wiring method. They are selected usually by the designing institute in accordance with the maxim power (ampere).

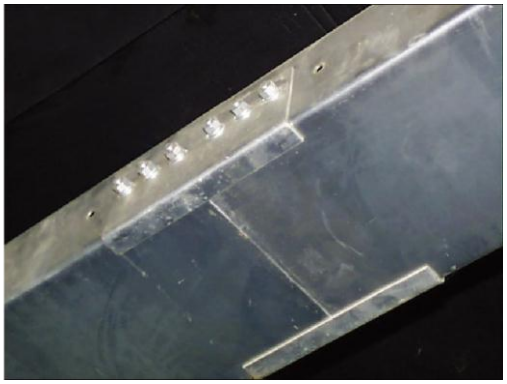
(2) All field-supplied conductors, equipment, and conductor joints should meet corresponding regulations and requirements.

1) All wiring should be done by the qualified electrician.
2) Cut off the power supply prior to wiring.
3) The installer should take responsibilities for losses caused by improper external wiring.

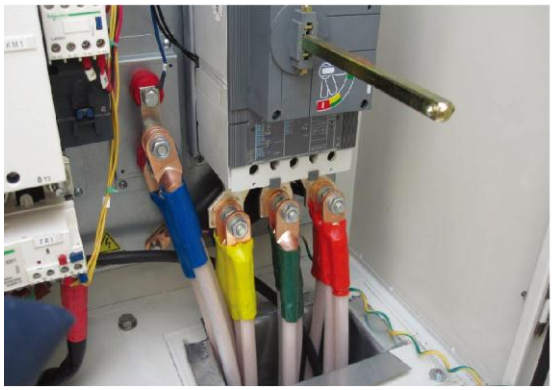
WARNING-only copper conductors are allowed.

(3) Wiring and Protection of the Power Lines

1) The power lines should run in the wireways or wire conduits.
2) Wires entering the electric box should be protected with rubber or plastic to prevent them from being damaged by the sharp edge of the metal sheet.
3) Wires close to the electric box should be fastened securely so that the terminal board in the electric box won't be affected by external force.
4) Power line should be grounded reliably and never connect with the gas lines, water lines, lightening rod, or phone lines.








3.9 Wiring of Control Lines

3.9.1 Requirements on Control Lines

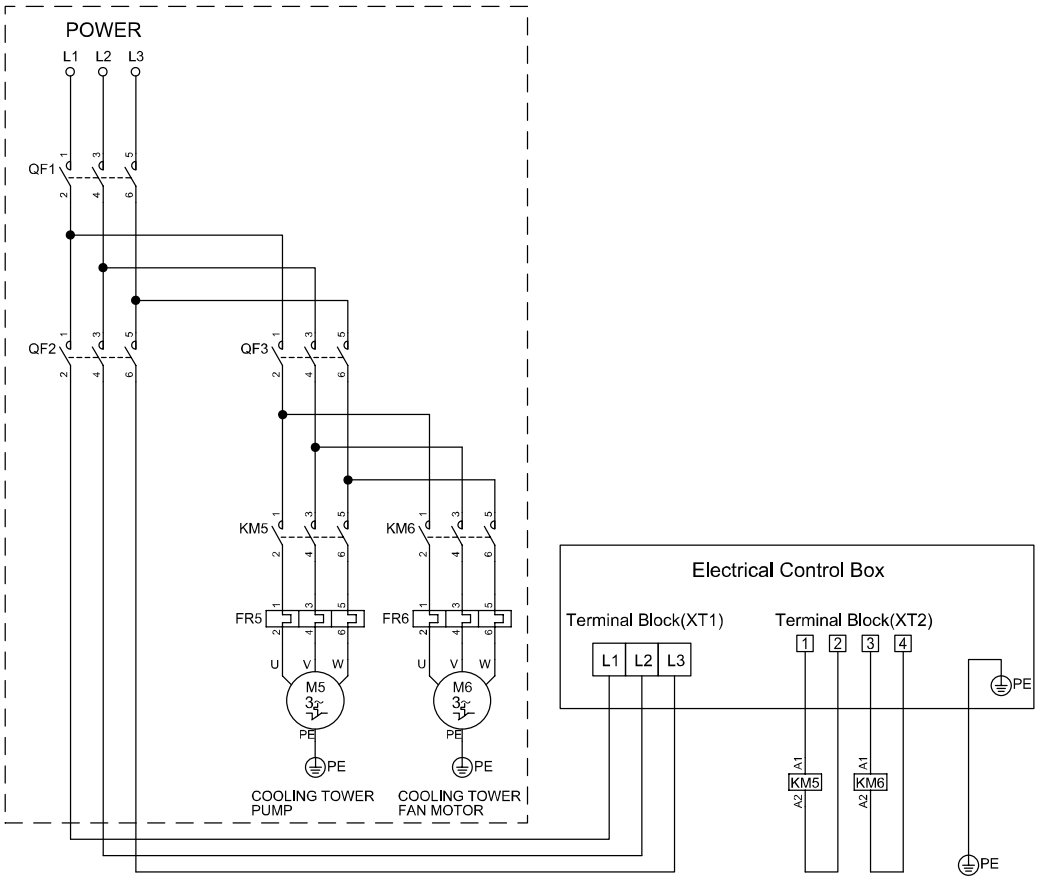
(1) The minimal size of the field supplied control line should be 1mm^2.

(2) Never let 50v or higher lines go parallel with the control lines of the flow switch. If inevitable, they should be kept away with a distance of at least 150mm.

(3) The control signals (220VAC, 5A) of the chilled water pump and auxiliary electric heater can drive their contactors respectively and never drive the chilled water pump and auxiliary electric heater directly.

(4) Length of the control line inside the electric box should be proper, and never bundle it and then stuff it into the electric box.

3.10 External Wiring of Control Lines



Notes: The marginal line is for customers field electrical connection. Wiring should be performed according to the circuit diagram attached on the body of the unit.

(1) All supplied components, materials, and electric operation should comply with local regulations.
(2) Only rated voltage and specialized electric circuit are required for power supply.
(3) All electric operation should be done by qualified
(4) A main break should be installed which is capable of cutting off the power supply of the whole system.
(5) Wiring should comply with national standards.
(6) See the wiring diagram attached to the unit body for on-site wiring.

CAUTION:

The unit should be grounded reliably, or it would lead to electric shock or fire hazard.

3.11 Commissioning

When the main body, water pipes, power lines are ready in place, commissioning can be done and supervised by Sinclair appointed personnel.

WARNING

The unit is able to control the water pump, but the unit is not allowed to prior to commissioning. Instead the unit should be controlled through the temporary wiring.

3.11.1 Preparation

3.11.1.1 Documents

(1) User's Manual
(2) certificates
(3) wiring diagram
(4) saturated temperature and pressure

3.11.1.2 Tools

(1) refrigeration tools
(2) digital volt-ohmmeter
(3) clip-on mete
(4) electric leak detector
(5) megohmmeter

3.11.2 Check before Commissioning

3.11.2.1 Check for Installation of the Main Unit

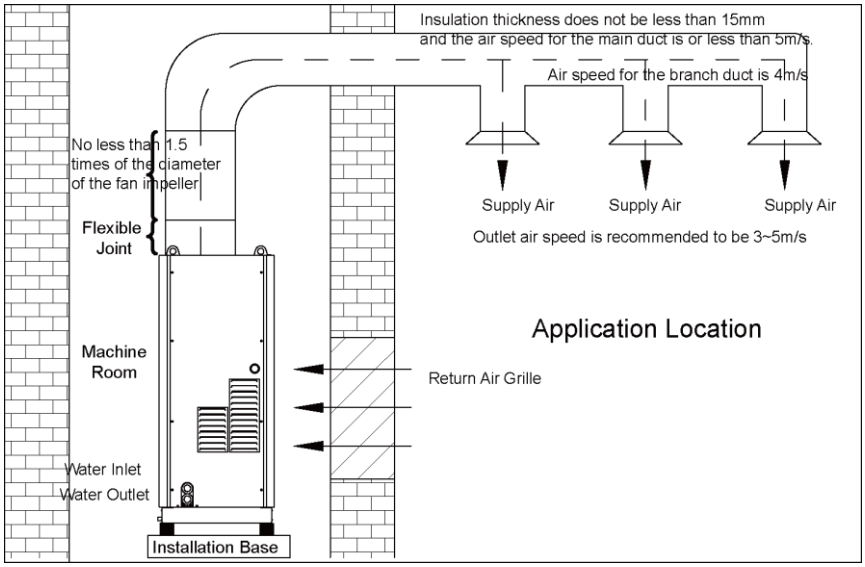
Check the installation location, installation foundation, and maintenance space etc.

3.11.2.2 Check for the Water System

(1) Is the water flow direction in the condenser and evaporator correct?
(2) Are the chilled water pipes clean? Is there any foreign matter trapped in the joints? Is the water quality satisfactory?
(3) Is the insulation of the chilled water pipes in good condition?
(4) Are the manometer and thermometer connected correctly (Is the manometer at a right angle with the water pipe, and is the thermometer's probe inserted into the water pump)? Do the initial values of the manometer and thermometer comply with requirements before commissioning?
(5) Is the leaving water flow switch installed correctly? Is this flow switch correctly wired to the electric control cabinet? Start the chilled water pump through the contactor and see: does the chilled water pump run in the correct direction (clockwise)? If not, check the wiring of the water pump.
(6) Run the chilled water pump and see: is the water pressure stable? do the reading values of water pressure change slightly? Is the running ampere in the rated range? If not, figure out and eliminate it.
(7) Does the water makeup device of the expansion water tank work well? Does the automatic exhaust valve work well? For the hand exhaust valve, open it to exhaust air inside the system.

3.11.3 Check for the Air System

(1) Is rotating direction of the fan at the air supply mode?
(2) Is there any foreign matter inside the air damper? Does the air damper get ready?
(3) Is the air duct insulated?
(4) Is design of the air duct proper?



3.11.4 Check for the Load

Is the supply air outlet blocked? Are air flow rates at each air inlet/outlet equal? Does enclosement and Insulation conditions meet requirements? Does the load match with the selected unit?

3.11.5 Check for Wiring

WARNING

Do not check the power supply without any proper detection device and preventive measures, or it would lead to severe injuries or even death.

Each unit should be supplied with dedicated power lines. After wiring, check the following items one by one.

(1) Is the size of the air switch proper?
(2) Does all electric installation meet corresponding electric standards or codes?
(3) Is all wiring correct?
(4) Are all interlocks work well?
(5) Do contacts of all contactors work well?
(6) Are the power supply and insulation in good condition?
(7) Is the set point of the control and protection elements correct?

3.11.6 Commissioning

(1) Following inspections above, the unit is allowed for commissioning.
(2) Power the unit at least 8 hours before the unit is going to be started up so as to preheat the crankcase of the compressor.
(3) Adjust the flow control valves or shutoff valves of the chilled water system to make the flow meet application requirements.
(4) Check if there is any error with the control panel. If so, figure out and eliminate it before restarting the unit.
(5) Start up the unit when the set point of each parameter is correct.
(6) Check the rotating direction of the compressor. If reversed, exchange two phase lines. And also check the lubricating oil which is required to be kept at the visible position.
(7) 30 minutes later, set the entering water temperature in accordance with the user's load demand. The unit should be restarted with an interval of at least 10 minutes.

Notes:

① Do not start the unit when rinsing the water system.

② Do not start the unit when the water system has not yet drained completely.

4. Typical Problems and Impacts

No.	Typical Problem	Impact
1	Insuffcient installation space	Inconvenient maintenance, impeded discharge, reduced heat exchange efficiency, or even abnormal operation.
2	Improper piping	Startup failed
3	Improper cleaning to the water system	Scaling
4	Incorrect wiring	Damage to elements
5	Incorrect or incorrectly wired communication line	Abnormal communication or disordered control
6	Communication line under improper protection	Broken communication line and failed communication
7	Improper insulation on the chilled water pipe	Reduced heat exchange efficiency
8	Improper vibration isolation treatment	Gradually raised vibration and noise, or even abnormal operation
9	Thru-wall water pipe without the outer protection tube	Water leakage
10	unreasonably arranged equipment and pipelines	Disorder

Before installation, the servicemen should have a good knowledge of special requirements. Only the qualified servicemen are allowed to do the installation. For special workers, like welders, electricians, refrigeration mechanics, they should have got corresponding certificates.

V Test Operation & Troubleshooting & Maintenance

1. Commissioning

1.1 Check for Communication

Upon power on, check if the controller can function normally. If so, it indicates communication is satisfied; if not, take further check as stated below.

(1) Is it powered on normally?

(2) Is the communication of the main board unqualified itself or wired correctly?

1.2 Check for Commissioning

(1) When the unit starts the run normally, check for the compressor and fan. Do they run normally without abnormal noise?

(2) Unbalance of power voltage of three phases cannot be higher than ±2%.

Voltage unbalance = (difference of average voltage and maximum voltage /average voltage) ×100%

1.3 Check for the Water Flow

In order to prevent the unit from being stopped for too low water flow, be sure all valve are open. Observe and record pressure difference and water temperature at the inlet and outlet (3~8℃ temperature difference is reasonable). Besides, make sure water flow of the water pump is satisfied through pressure difference of the inlet and outlet pressure manometer and curves of the water pump (water flow of the water pump should be higher than 70% of the nominal value).

1.4 Check for Air Volume

When the air volume is too large, it would lead to motor overloading and heavy noise; when the air volume is too small, it would lead to too low evaporating temperature which then would degrade operation performance of the unit. Therefore, the air volume should be controlled within the reasonable range. During operation, test the ampere of the fan with a multi-meter. If it is lower than 90% of the rated, it is proper. The temperature difference between the inlet and outlet air should be within 12~15℃.

1.5 Check for Operation Performance

(1) During operation, the inlet and outlet water temperature difference should be satisfied. If not, see if capacity of the water pump is inadequate or not.

(2) During operation, see if the inlet and outlet air temperature difference is satisfied. If not, see if the external static pressure is proper or not.

(3) Observe and record the inlet and outlet water temperature, inlet and outlet air temperature, condensing pressure and evaporating pressure according to the commissioning and operation data sheet.

(4) When the unit is stopped by triggering the protection device, find out, analyze and eliminate the cause.

2. Errors

2.1 Error List

Code	Name	Signal Source	Interpretation
E1	High pressure protection of system 1/2/3	Pressure switch	The discharge pressure can affect the performance and reliability of the unit. When the condensing pressure is too high, the discharge temperature and compressor ratio also would correspondingly go up with the cooling capacity decreased and the power consumption increased. Meanwhile if the unit works in the high discharge temperature for a long time period, it would probably cause the carbonization of the grease oil resulting in some damage to the compressor. When the discharge pressure is beyond the safety limit, the high pressure protection would be activated, the error code would be displayed on the controller and the unit would stop. When the error causes have been eliminated, clear the error by pressing the “Reset” button.
E2	Anti-freezing protection of system 1/2/3	Anti-freezing temperature sensor	When it is detected that the evaporating temperature is lower than the preset value continuously for some time, the compressor would stop and the control panel would display the error name. Then, after the evaporating temperature is higher than the preset value, the error could be cleared and the control runs as the set mode, that is, one system is under protection and others run normally.
E3	Low pressure protection of system 1/2/3	Pressure switch	When the suction pressure is too low, it would not only affect the running performance of the unit but also probably cause defrosting on the surface of the evaporator. The defrosting is a vicious cycle which would cause insufficient evaporation and make the compressor absorb the refrigerant liquid in. Even worse, too low suction and discharge temperature would degrade the fluidity of lubricating oil and further affect the lubrication condition or even damage the compressor. When the suction pressure is beyond the safety limit, the low pressure protection will be activated, the error code will be displayed on the control and the will stop. Then, after some time, if the suction pressure is higher than the set point, the system resumes normal operation. However, if low pressure protection occurs several times, this error would be irrecoverable. In this case, only when the error causes have been eliminated, clear the error by pressing the “Reset” button.
E4	High discharge protection 1/2 of system 1 High discharge protection 1/2 of system 2	Discharge temperature sensor	The high discharge temperature would degrade the grease oil and carbonize it, which would affect the service life of the unit and cause the high discharge pressure. When the compressor starts and it is detected that the discharge temperature is higher than the preset value continuously for some time, the compressor would stop. Then the system would back to the normal running after the discharge temperature goes down than the preset value. However, if this protection occurs several

	High discharge protection 1/2 of system 3		times, it would fail to work but other compressor keeps working normally. When the error causes have been eliminated, clear the error by pressing the “Reset” button.
E5	Compressor overload protection of system 1/2/3	Overcurrent protector	When current of the compressor motor winding goes up, temperature of the motor winding would increase and at least would be burnt out. Meanwhile, lubricating oil would be carbonized and consequently the unit would fail to operate. When the unit is overloaded for some time, the compressor of the corresponding system would stop immediately and the control panel would display the error name. When the error causes have been eliminated, clear the error by pressing the “Reset” button.
E8	Fan overload protection	Thermal relay	When the actual external static pressure demand is smaller than the rated, the fan current would become larger and heat radiation would increase. When the current exceeds the set point, the thermal relay would act so as to prevent the motor from burnt out. When overload protection is detected, the unit would stop, which is irrecoverable, and the control panel would display the error name. When the error causes have been eliminated, clear the error by pressing the “Reset” button.
Fo	Refrigerant loss protection of system 1/2/3	Pressure switch	Operation with insufficient refrigerant would damage the compressor. When the suction pressure is lower than the safety limit, refrigerant loss protection would be activated, the compressor of the corresponding system cannot be started and the control panel would display the error name. Then, after the suction pressure is higher than the set point, the compressor resumes the normal operation. In this case, only the compressor under refrigeration loss protection cannot be stared, but the others will run normally.
dp	Discharge temperature sensor error of system 1/2/3 with compressors connected in parallel	Discharge temperature sensor	When suction volume is unbalanced among compressors connected parallel, it would affect the normal operation of compressors. When refrigerant is over charged, suction with liquid refrigerant would damage the compressors. If it is detected that the discharge temperature difference of two compressors in parallel in one system is higher than some set point, the corresponding compressor would stop and the control panel would display the error name. However, other compressor will keep normal operation. When this error occurs for several times, it would be irrecoverable. After the error causes have been eliminated, clear the error by pressing the “Reset” button.

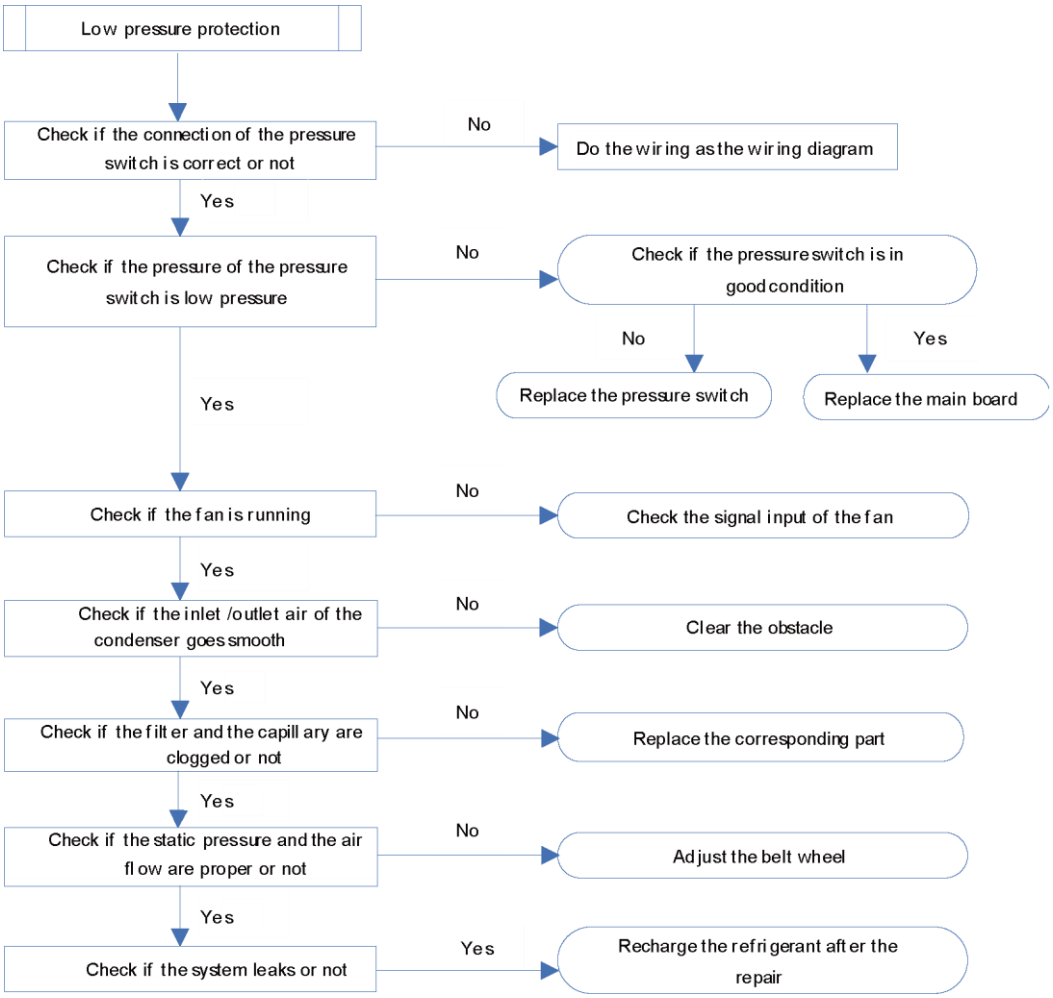
Code	Name	Signal Source	Interpretation
Ec	Water flow switch error	Water flow switch error	After the water pump starts, if the water flow switch keeps open for some time, the unit would stop. When the error causes have been eliminated, clear the error by pressing the “Reset” button.
F0	Return air temperature sensor error	Return air temperature sensor	When return air temperature sensor error is detected, all loads would stop (except the fan) and the control panel would display the error name. When the error causes have been eliminated, clear the error by pressing the “Reset” button.
FJ	Supply air temperature sensor error	Supply air temperature sensor	When supply air temperature sensor error is detected, all loads would stop (except the fan) and the control panel would display the error name. When the error causes have been eliminated, clear the error by pressing the “Reset” button.
F1	Anti-freezing temperature sensor error of system 1/2/3	Anti-freezing temperature sensor	When anti-freezing temperature sensor error is detected, the compressor of the corresponding system would stop and the control panel would display the error name. When the error causes have been eliminated, clear the error by pressing the “Reset” button.
F4	Discharge temperature sensor 1/2 of system 1 Discharge temperature sensor 1/2 of system 2 Discharge temperature sensor 1/2 of system 3	Discharge temperature sensor	When discharge temperature sensor error is detected, the compressor of the corresponding system would stop and the control panel would display the error name. When the error causes have been eliminated, clear the error by pressing the “Reset” button.
E6	Communication error	Wired controller	When communication error is detected for a period, the unit would stop and the control panel would display the corresponding error code. This error is recoverable when error causes have been eliminated.
Ed	Over-temperature protection	Leaving cooling water temperature sensor of the condenser	When it is detected that the leaving cooling water temperature is higher that the safety limit, all compressor would stop immediately but the control panel would not display the error name. This error would disappear when the temperature is lower than the set point.
EH	Auxiliary electric heater welding protection	Auxiliary electric heater	When it is detected that the intermediate relay is open, the unit would go to the auxiliary electric heater protection, the control panel would display the error code, the beeper would sound, the fan would be started forcibly, trip-off signal is output and the compressor would stop. This error is irrecoverable. This error can be cleaned only by repowering the unit. The error code would be displayed under both ON and OFF statuses.

F8	Entering cooling water temperature sensor error	Entering cooling water temperature	When entering cooling water temperature sensor error is detected, all loads would stop (except the fan) and the control panel would display the error name. When the error causes have been eliminated, clear the error by pressing the “Reset” button.
F9	Leaving cooling water temperature sensor error	Leaving cooling water temperature	When leaving cooling water temperature sensor error is detected, all loads would stop (except the fan) and the control panel would display the error name. When the error causes have been eliminated, clear the error by pressing the “Reset” button.
eF	Unit type error	Unit type sensor	Upon power on, when the unit type sensor error is detected, the unit would fail to start and the control panel would display the error name. Do not repower the unit until the error causes have been eliminated.
C5	Jumper error	Jumper	Upon power on, when the jumper error is detected, the unit would fail to start and the control panel would display the error name. Do not repower the unit until the error causes have been eliminated.

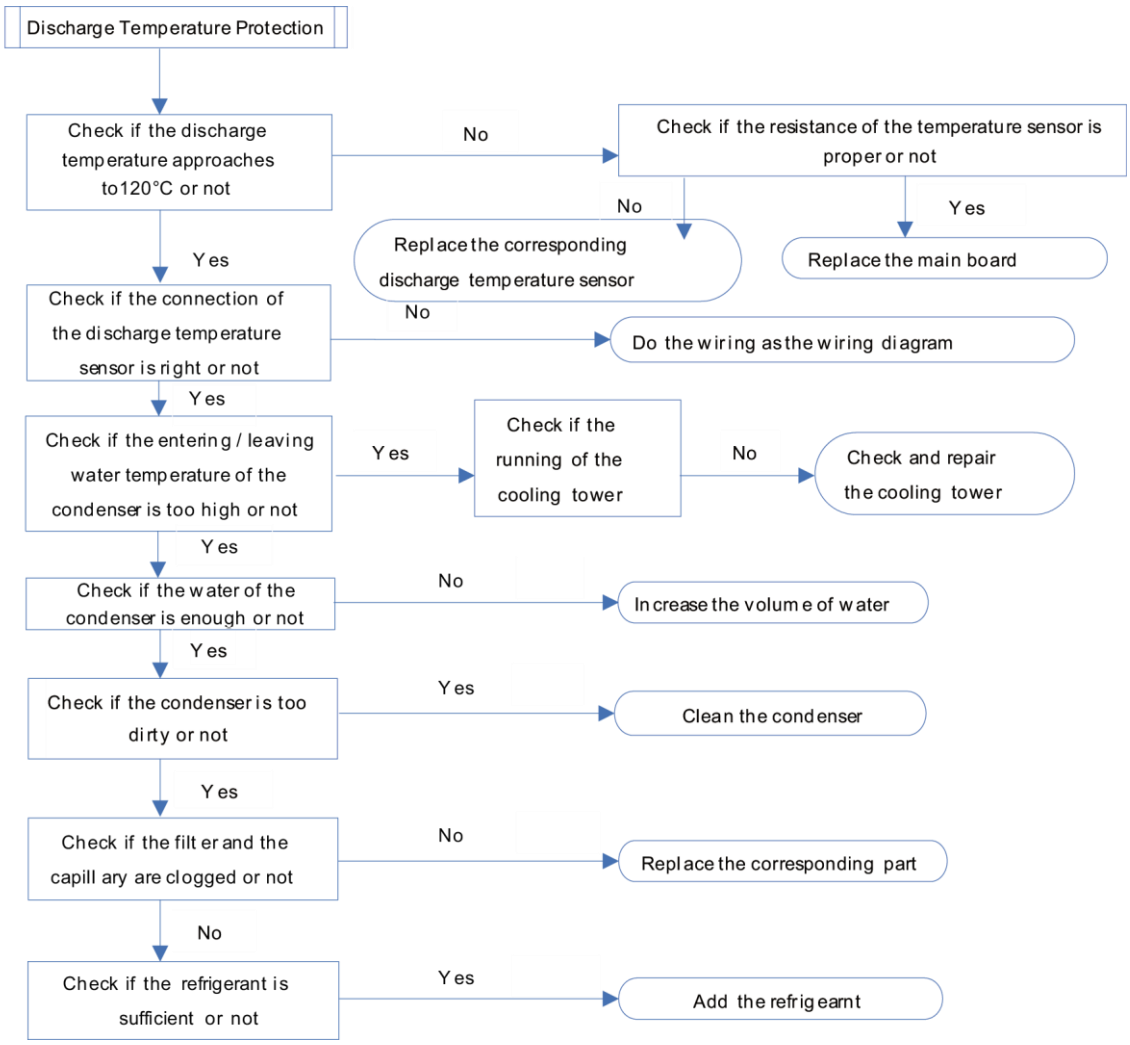
2.2 Flow Chart of Troubleshooting

(1) High pressure protection

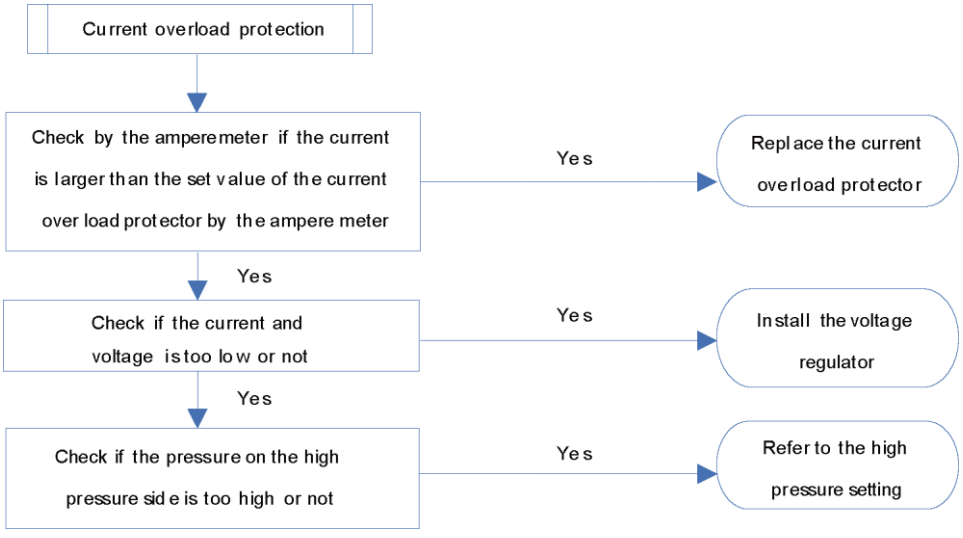
(2) Low pressure protection



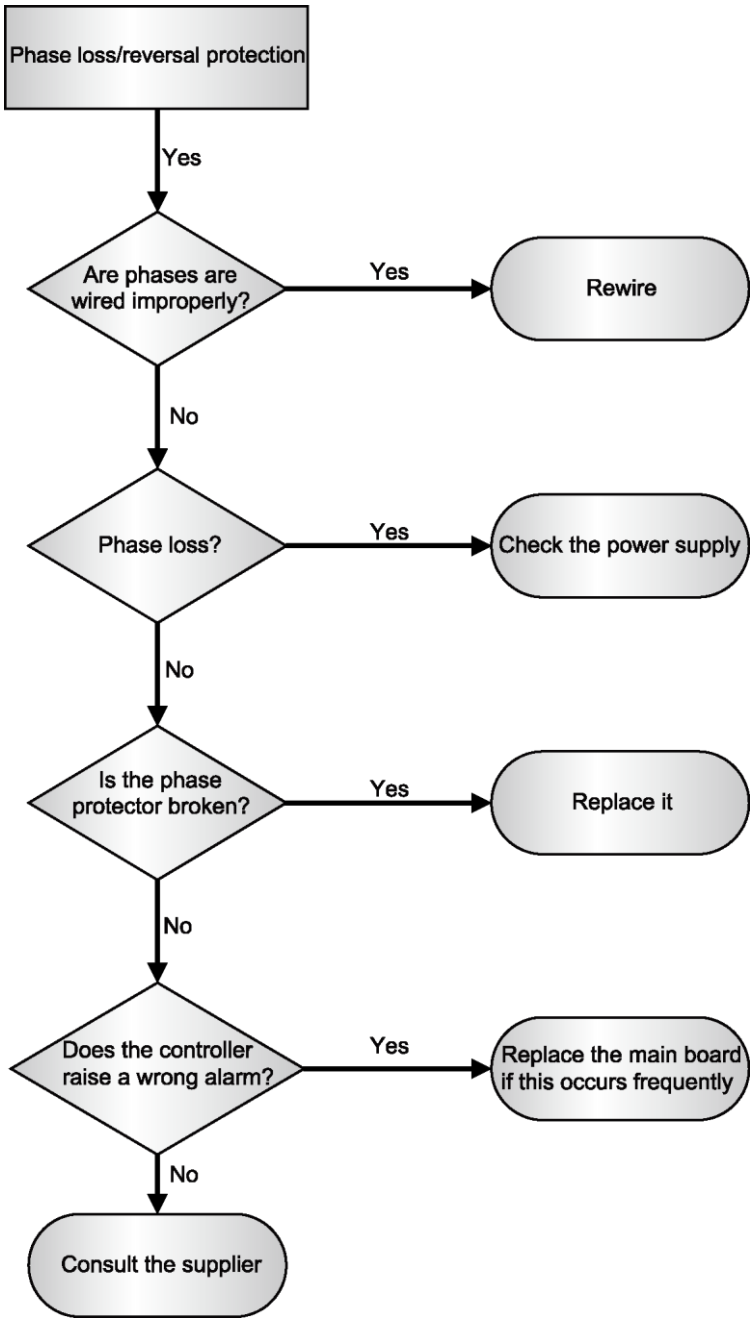
(3) High discharge protection



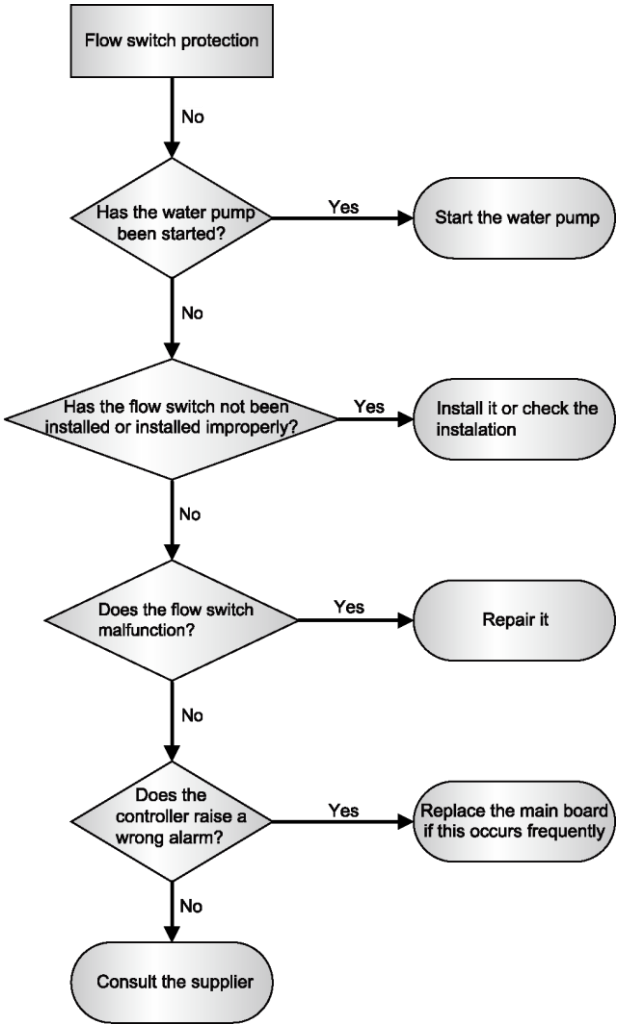
(4) Overcurrent protection



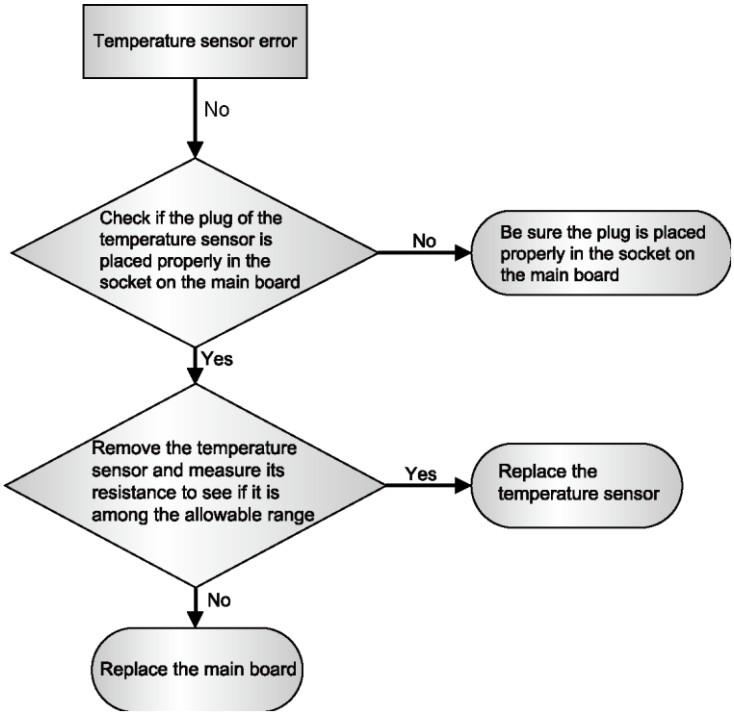
(5) Phase protection



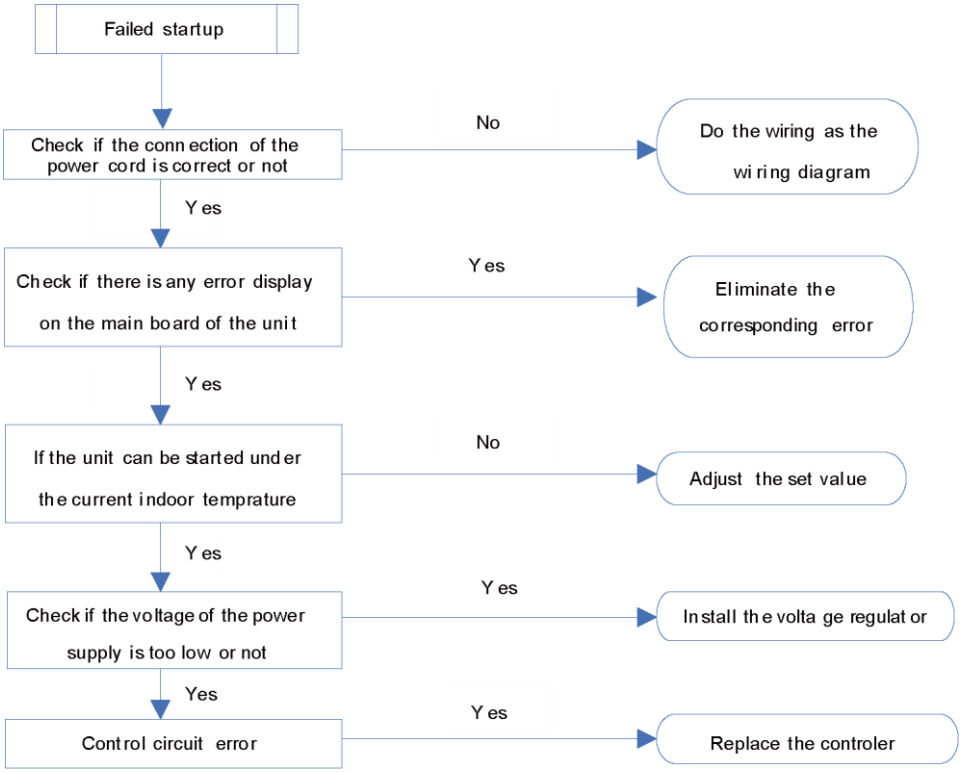
(6) Water flow switch protection



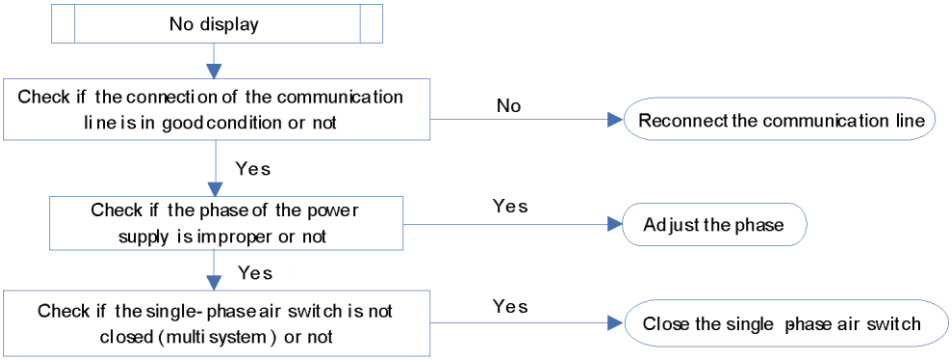
(7) Temperature sensor error



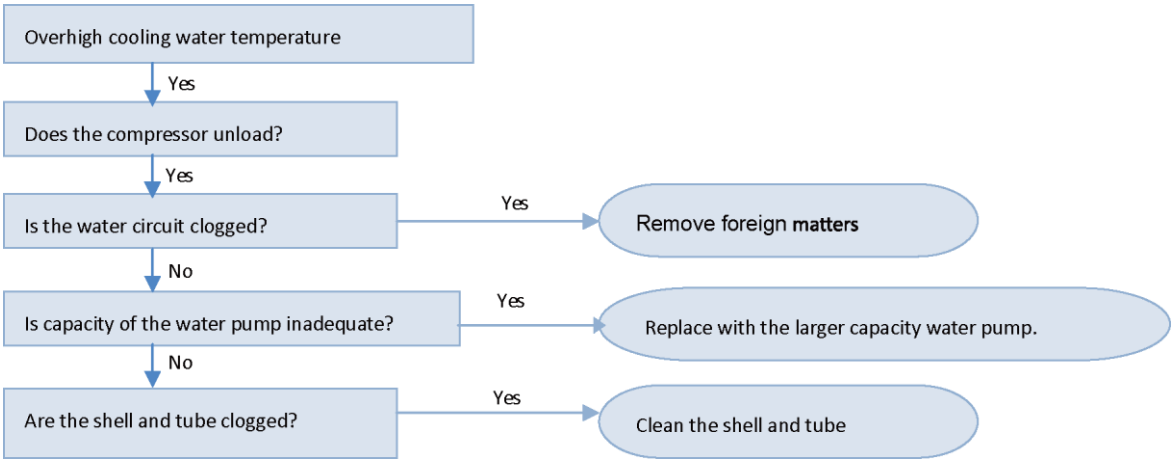
(8) Failed Startup



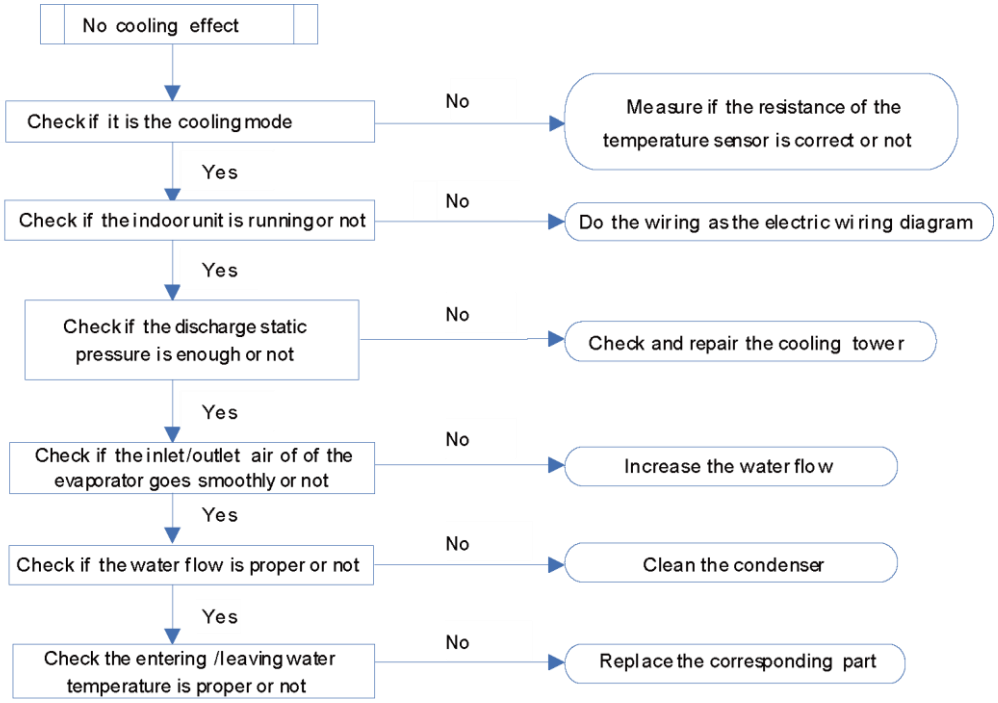
(9) No Display



(10) Over-high Cooling Water Temperature

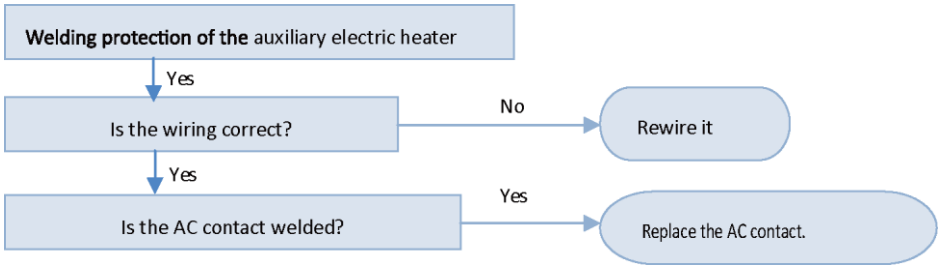


(11) No Cooling Effect

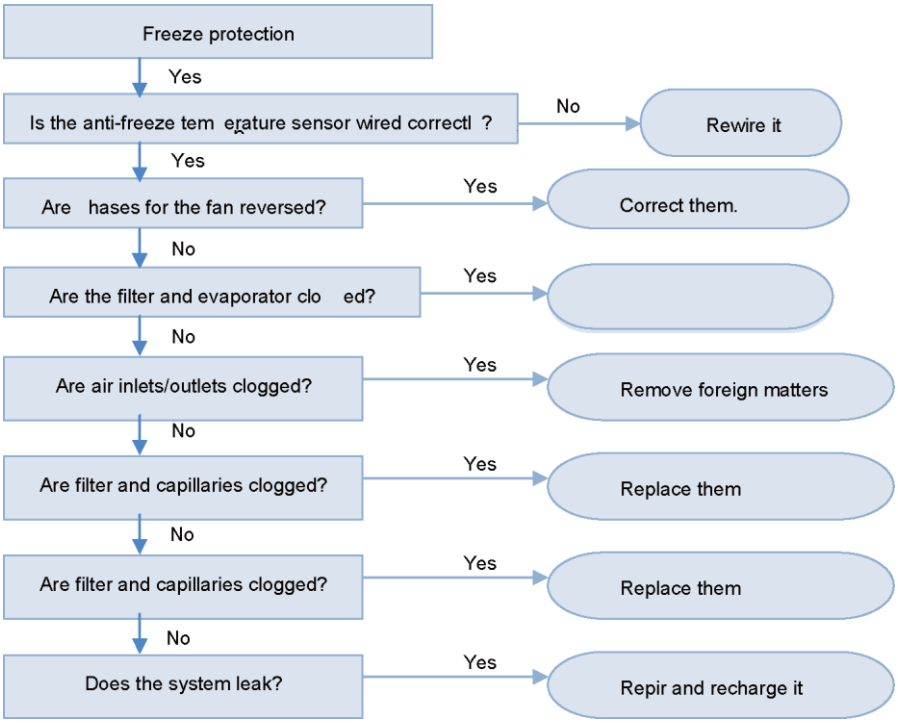


(12) Overmuch Noise

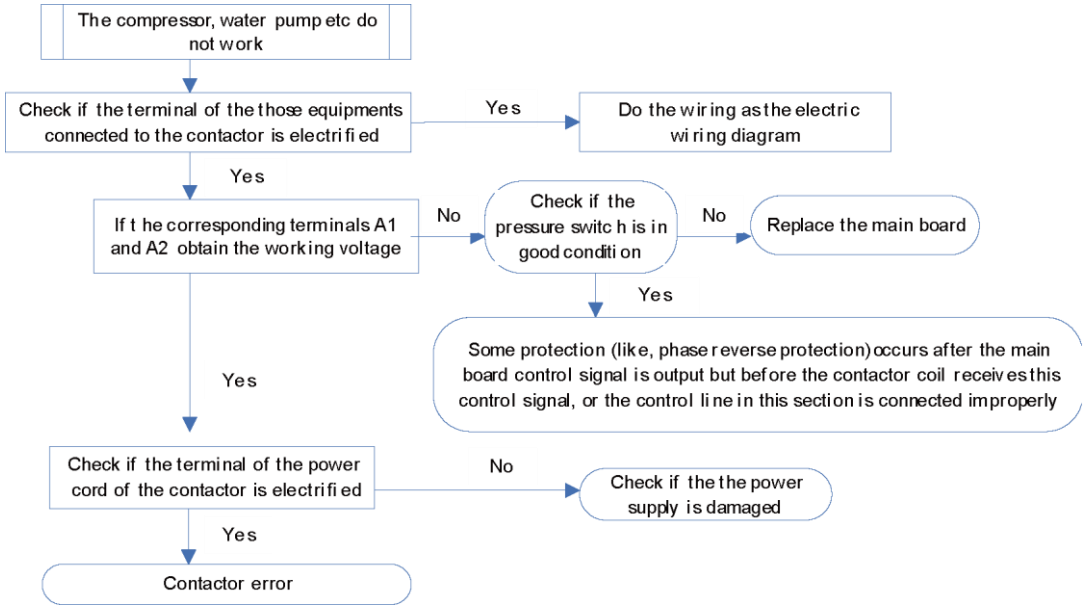
(13) Welding protection of the auxiliary electric heater



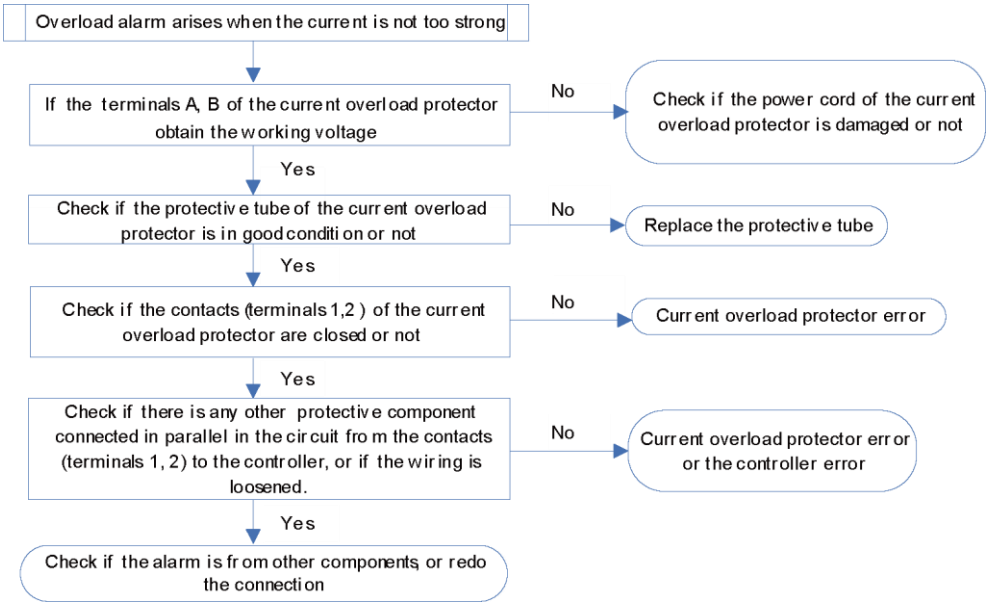
(14) Freeze protection



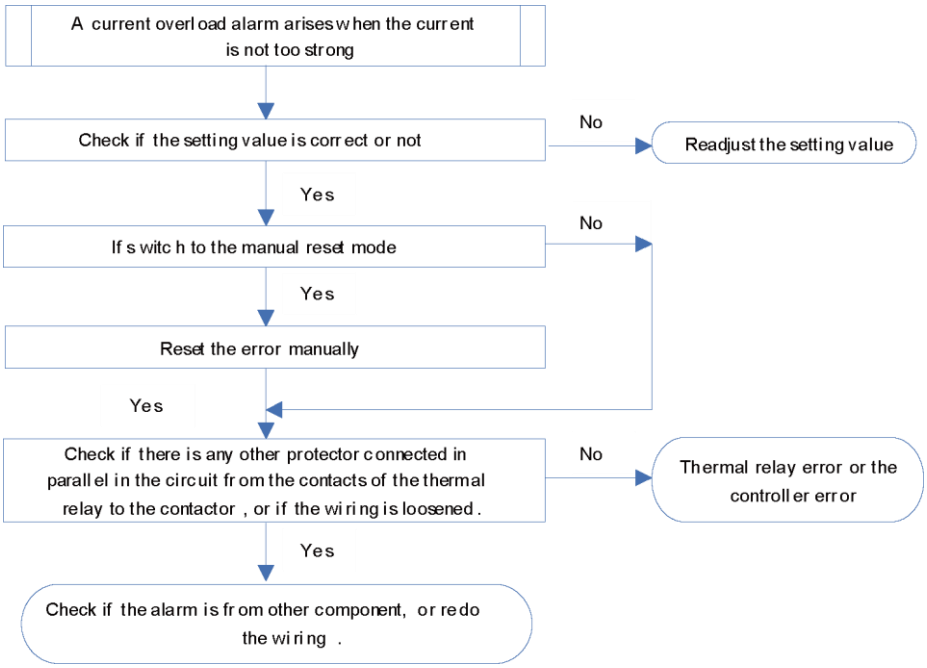
(15) Contactor error



(16) Overcurrent protector error



(17) Thermal relay error



(18) Fuse error

When it is wired to the electric circuit, if the controller does not raise an alarm but the electric heater does not work, it is likely that it has been damaged. In this case, test its two ends with a multi-meter see if it is conductive. It so, it indicates it has not been damaged. If not, it indicates it has been damaged.

(19) Thermostat error

When it is wired to the electric circuit, if the controller does not raise an alarm but the electric heater does not work and the fuse is in good condition, it is likely that it has been damaged. In this case, test its two ends with a multi-meter see if it is conductive. It so, it indicates it has not been damaged. If not, it indicates it has been damaged.

(20) Phase protector error

Supply with three-phase power supply and see if the output contact of the phase protector is closed. If so, it indicates the phase sequence is right. If not, it indicates the phase sequence is incorrect. For the latter, please change any two phases.

3. Maintenance

3.1 Significant of Maintenance

The unit has undergone a series of strict tests prior to delivery to ensure qualified performance, however, in order to keep reliable performance and extend its service life, the unit should be maintained routinely and periodically by the qualified servicemen.

3.2 Maintenance Items

3.2.1 Routine Maintenance Items

Routine Maintenance Items
Is there any unusual noise and vibration?
Is there any unusual noise and vibration for the compressor in operation? Is there any unusual smell?
Is the inlet air filter clogged?
Are the shell and tube clogged?
Do the operating pressure, voltage and current keep normal? If not, figure out the cause and then eliminate it?
Are all temperature sensors and pressure transducers installed securely?

3.2.2 Periodic Maintenance Items

Periodic Maintenance Items
Is any wiring loosened and insulated securely?
Is the belt wheel loosened?
Is tension of the belt wheel satisfactory?
Does any electric element work reliably? If not, change it timely.
Is the temperature set point proper?

3.2.3 Periodic Cleaning

Maintenance on the Condenser

Cleaning frequency of the condenser depends on variable factors. Some requires to be cleaned several times in a year. The shell-and-tube condenser cannot be cleaned manually but chemically. For chemical cleaning, the chemical agent should be prepared by the user. Anyhow.

(1) only agent with reliable source is allowed.

(2) Pay attention to the fluid direction. At last, flush it and take neutralizing treatment.

Proper operation of the cooling tower can obviously extent the cleaning period. Therefore, please check for spillway discharge frequently. If the cooling tower runs under the spillway discharge, minerals in water will increase and accumulate at the wall of the copper tube. In this case, frequent cleaning is required and severe corrosion will be resulted. In addition, it is allowable to purchase inhibiter, bactericide and algicide from reliable suppliers and use them strictly in accordance with the user's guides. Overtreatment is worse than undertrement, as it will bring damage to not only the condenser but also the cooling tower, water pump and pipes.

When heavy on-way pressure loss is detected, inspect it repeatedly to figure out causes. Scaling of the condenser is not the only reason for high on-way loss. Before cleaning, please take the following check as stated below.

(1) Is refrigerant overcharged?

(2) Is there air inside the system or is the manometer faulty (check for the backup manometer in accordance with the refrigerant property data sheet)

(3) Is the water control valve set correctly or faulty? (check for setting and operation of the water control valve)

(4) Is entering water temperature of the condenser too high? (check for the cooling tower fan and the system)

Management of Water Quality

◆ Management of Water

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

(1) Situation of Circulating Water

There is less suspended solid material and organic matter in tap water and industrial water, which is favorable for preventing block and incrustant of the pipe. However, with cooling tower, the pollutant (sulfurous acid from car and chimney, alkaline or hepatic gas from high build, sewage treatment plant and chemical plant etc.) from air is dissolved in water and produce erosive circulating water, which damages the pipe. Even though there is not so much pollutant content, it will accumulate during circulation and finally lead to erosion. Tap water and industrial water from different areas are also different. Therefore, it is necessary to manage the water condition (incrustant content) and take suitable actions, for example, material management, cooling tower water overflowing, changing water, and so on.

(2) Situation of Uniflow Water

There is more suspended solid material, organic matter, incrustant in well water and river water. Thus it must be treated with filter or chemicals, especially the water containing mud and sand. The accumulation of mud and sand will cause stagnation and erosion. Bacterium multiplication and incrustant will increase the erosion, so it must be strictly treated. In the well near the sea, there is polluted sea water intermingled in, so it contains more oxygen ion and sulfate radical ion, and the

water near trash treatment areas or toilet is also more erosive because of mixed of alkaline. As a result, it is necessary to take some actions, for example changing water gap position, chemical treatment, and so on. When use uniflow water, it must notice that the chlorine added to the water is one of the factors that cause erosion. (Free chlorine will disappear soon, so this problem does not exist in circulating water.)

◆ Method of Water Quality Management

(1) Frequency of Water Quality Analysis

Analyze the water quality at the beginning of the usage season, next do the analysis again in 7-10 days and then once every month from then on.

(2) Analysis of water quality

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

a. Sample the water during running of the unit

b. The container used for sampling should be new, without air. The volume should be more than 2 L. Besides, do not clean the container while sampling.

◆ Standard of Water Quality

The material of heat transfer tube in evaporator and condenser is copper. The requirement of water used in the copper pipe is as below (GB/T 18430.1-2007):

The cooling water quality of condenser is shown in Sheet 6.3.

The cooling water in evaporator is circulating, so the quality should be higher than the chilled water. It is advised to use soft water.

Quality Requirement of Cooling Water

Item		Unit	Circulating Water	Makeup Water	Trend	
					Corrosion	Scaling
Standard item	PH value PH (25℃)	—	6.5～8.0	6.0～8.2	O	O
	specific conductance (25℃)	μs/cm	＜800	＜300	O	O
	chloride ion Cl^-	mg/L	＜200	＜50	O	
	sulfate radical ion SO_4^{2-}		＜200	＜50	O	
	acid depletion (PH4.8)		＜100	＜50		O
	full hardnessl		＜200	＜70		O
Reference item	Fe	mg/L	＜1.0	＜0.3	O	O
	S		—	—	O	
	NH_4^+		＜1.0	＜0.3	O	
	SiO_2		＜50	＜30		O
Note: O indicates factors related to corrosion or scaling.						

◆ Maintenance of Water Quality

(1) Flow Adjustment

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

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

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

(2) Replacement of Water

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

In area where there is sulphur dioxide pollution nuisance, change the water once every 5 days. In general area, change the water once every 10 days. If there is automatic spray water and manual spray water: In area where there is sulphur dioxide pollution nuisance, change the water once every month. In general area, change the water once every 3 months.

Treatment during Long-term Stop During long-term stop, affecting by the environment and water quality, the bacteria in heat transfer pipe will increase, which leads to erosion of the pipe.

If the unit stops for more than 15 days, the water should be released completely. If the ambient temperature ≤0℃, release the water in evaporator and condenser during stop of the unit.

(3) Chemical Treatment of Circulating Water

The chemical treatment of circulating water includes sterilization

1) Clean monthly and add chemical. Before adding the chemical, observe the water quality.

If the bottom of cooling tower is covered with lichen or there is too much rust in water, it means that the chemical added last time is not enough. It is necessary to increase the quantity. Clean the system before adding chemical. Steps are: clean the cooling tower with high pressure washer (plastic besom is also acceptable).Clean tower manually, open blow down valve in the bottom of tower after cleaning tower dirt loose, clean and discharge. Use plastic pipe slow move in tower bottom if can't stop unit for cleaning, If there is deposition pool, it must be cleaned. If there is much dust accumulation, clean it according to the above method. If water quality is good, add the original amount of chemical. The amount of chemical should accord with the specification from the supplier. Generally add 30-100g corrosion inhibitor and 10-30g germicide and algicide for each ton of water. (Chemical should be increased in from July to September) Observe the blister after adding the chemical. If the blister cannot cover the whole surface of water in 10 min, it is necessary to increase the chemical. Inversely, the chemical is enough.

2) Add remover when cleaning the unit. After it is circulating in the system for 12h, discharge it for eliminating dirt and rust-eaten of tower and pipe, and then charge fresh tap water. Add suitable corrosion inhibitor, germicide or algicide according to the specification.
3) Record the added chemical and water quality test for analysis and comparison.
4) Safety protection: chemical is harmful to human body in some degree. Therefore, it is a must to take actions for safety protection. Chlorine is strongly smelly and corrosive. Too much intake will lead to death. When dealing with and using biocide, take care to protect the skin, eyes and respiratory system from hurt. When adding chemicals, it is required to wear clothes covering hands and legs, rubber glove and goggles.

WARNING

When adding chemicals, it is required to wear clothes covering hands and legs, rubber glove and goggles, in order to protect the skin, eyes and respiratory system from hurt.

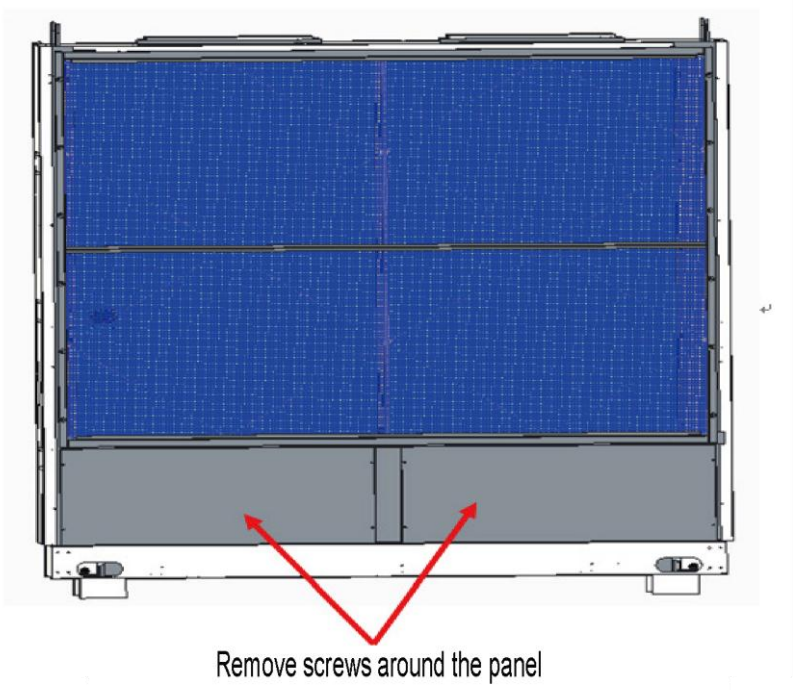
(4) The flow rate inside the heat transfer tube is closely related to the corrosion of the tube. The flow rate should be slower than 3m/s. When the flow rate reaches 3.5~4m/s, the tube may be corroded. Thus, it is required to control the water volume. It is possible to judge by differential temperature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

3.3 Freeze Protection in Winter

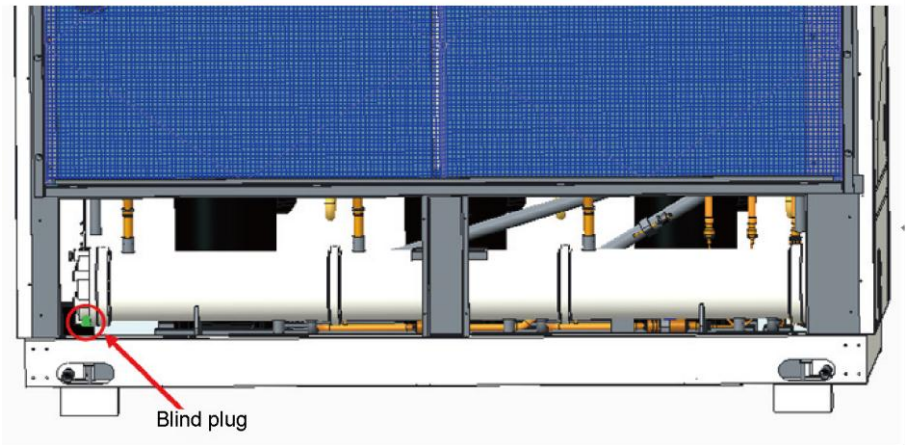
When the unit is not going to be used for a long time, clean and dry the internal and external surfaces of the unit, and then it would be better to wrap it. Under the subzero climate, the unused unit should be drained completely so that the shell-and-tube evaporator would not be frozen up. Instead, the other way is adding some antifreeze into water to keep the water temperature no less than 0℃.

See the following steps for how to drain water out.

(1) Loosen screws on the front panel and then remove the front panel.

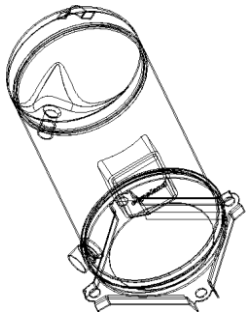
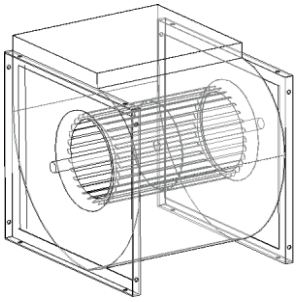
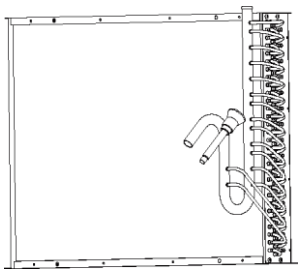
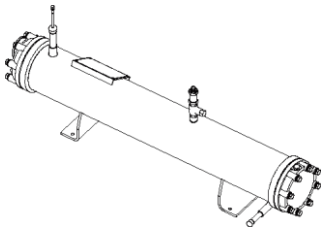
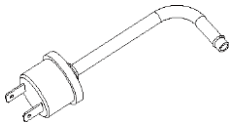
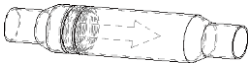


(2) Draw out the blind plug counter clockwise to let the cooling water flow out freely until no water stays in. After that, place the blind plug back. (Note: put the container for foul water beneath the drain pipe to prevent foul water from polluting the site).



3.4 Main Parts

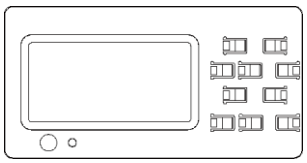
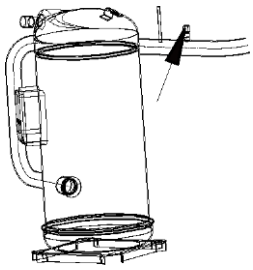
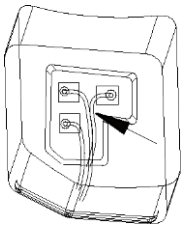
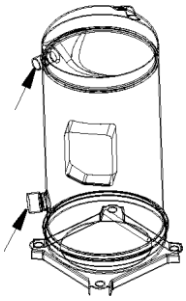
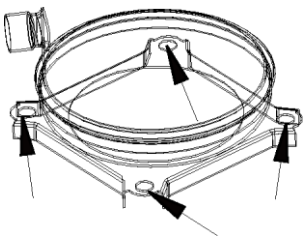
3.4.1 Introduction to Main Parts

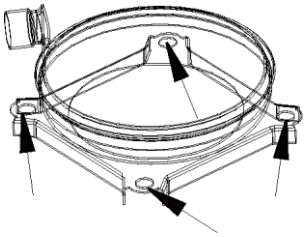
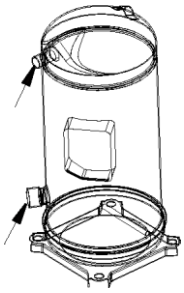
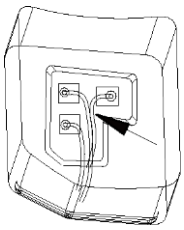
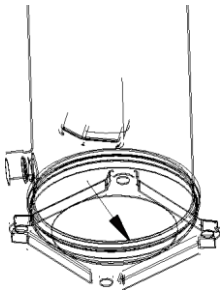
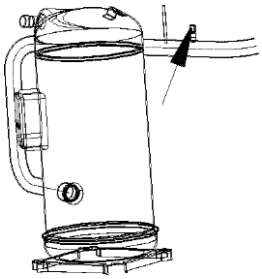
Name	Illustration	Function
Compressor		Compressor, the core part of the whole refrigeration system, is the driving system and aims to transport and compress the refrigerant gas.
Centrifugal Fan		Centrifugal fan is the power source to transport and distribute the indoor air. It transfers the mechanical power to the dynamic power through the high-speed rotating blade, and then transfers partial dynamical power to pressure power, eventually pressurizing and speeding up the air.
Evaporator		The evaporator, the main heat exchanger, is used to transfer the heat from the cooled medium (water, air or brine) to the refrigerant liquid
Shell-and-Tube Condenser		The shell-and-tube condenser, another main heat exchanger, is used to cool/sub-cool the high-temperature, high pressure refrigerant gas coming from the compressor and turn it to the refrigerant liquid.
High/low Pressure Switch		It is the important protective device. When the detected pressure is higher than the set value, the pressure switch will open to stop the compressor.
Filter		It is used to remove the inclusions and impurities in the system to prevent the system from clogged.

Capillary		It is the important throttling component. The refrigerant liquid from the condenser will turn to the low-temperature, low-pressure refrigerant liquid after going through the capillary so as to make some preparations for the upcoming evaporation.

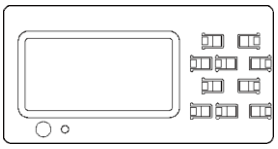
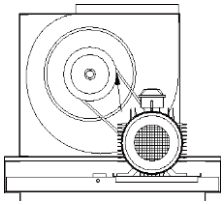
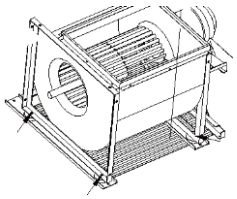
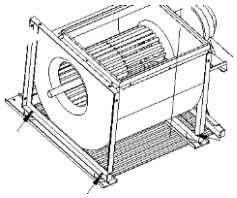
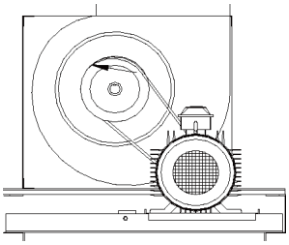
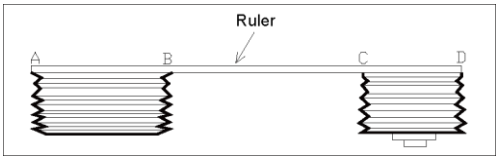
3.4.2 Removal and Installation of Main Parts

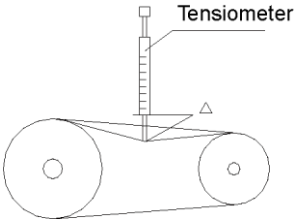
(1) Disassembly and Assembly of the Compressor

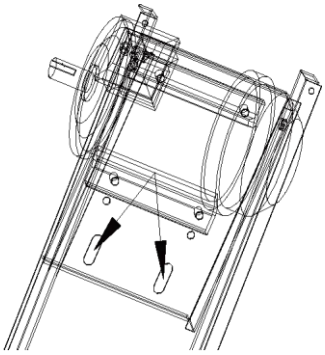
Disassembly and Assembly of the Compressor		
Steps	**Illustration**	**Operation Instruction**
1.Shut off the power supply of the unit		1. Shut off the power supply of the unit to let the unit stop immediately Note: the serviceman should pay much attention to the safety.
2. Reclaim the refrigerant		1. Connect the recovery tank with the refrigerant charging nozzle 2. Start the reclaim the refrigerant. Note: the refrigerant must be reclaimed completely and thoroughly as it is unfriendly to the environment and animals and it may burn up when meet flames. Thus, the operation man should pay mush attention to it.
3.Remove the power cord		1. Loosen the screws fixing the power cord with a screwdriver. 2.Remove the power cord Note: label the power cords and terminals to prevent misconnection of next time wiring.
4.Disconnect the compressor and the connection pipe		1. Disconnect the connection pipe by heating it with the flame Note: prevent the surrounding material to be burnt out during heating.
5.Remove the compressor from the base plate		1. Loosen the anchor screws on the base corner through a wrench. 2. Remove the compressor away from the holder. Note: take out the compressor horizontally and do not put upside down.

6.Reassemble the compressor after the maintenance and replacement		1. Put the compressor on the holder. 2. Tighten the screws on the base corners with a wrench. Note: assemble the compressor horizontally and do not put upside down.
7. Connect the suction and discharge ports with the system connection pipe		1. Connect the connection pipe by heating it with the flame Note: prevent the surrounding material to be burnt out during heating.
8. Connect the power cord of the compressor		1. Connect the power cords the screws as the disconnection order. 2. Tighten the screws with a wrench. Note: Do the wiring correctly.
9.Assembly the heating belt of the compressor		1. Assemble the heating belt of the compressor right where it is disassembled. Note: place it in the right place.
10. Recharge the refrigerant as system standard		1. Connect the charging machine with the refrigerant charging nozzle of the compressor. 2. Start to charge the refrigerant. Note: the refrigerant charge should be done as the standard, otherwise it would affect the cooling performance.

(2) Disassembly and Assembly of the Centrifugal Fan and Belt

Disassembly and Assembly of the Centrifugal Fan and Belt		
Steps	**Illustration**	**Operation Instructions**
1. Shut off the power supply of the unit		1. Shut off the power supply of the unit to let the unit stop immediately Note: the serviceman should pay much attention to the safety.
2. Remove the belt		1. Place a screwdriver or other similar tools to the meshing point (labeled with the arrow) 2. Rotate the belt wheel counter clock and push the screw outward to take off the belt. Note: Pay special attention to the operation of the hands and also safety.
3. Loosen the screws and remove the fan		1. Loosen the anchor screws on the base plate of the fan with a wrench 2. Remove the fan from the holder. Note: Draw much attention to the safety operation owing to its large-size body.
4. Repair or replace the fan according to the actual condition and then assemble the fan		1. Place the fan on the holder 2. Tighten the screws on the corners of the base plate with a wrench. Note: Draw much attention to the safety operation owing to its large-size body.
5. Assemble the belt		1. Let the belt get half meshed with the belt wheel, and then place a screwdriver or other similar tool to the meshing point (labeled with the arrow). 2. Rotate the belt wheel counter wise and then pull the screwdriver inward to le the belt in. Note: Pay special attention to the operation of the hands and also safety.
6. Adjust the installation location of the belt.		1. The fan and the motor must be placed in the same level so as to guarantee the stable running of the unit.

<table>
<tr>
<td>7. Adjust the tightness of the belt properly</td>
<td>


<table>
<tr><th rowspan="2">Code</th><th rowspan="2">Size Range of the Smaller Belt Wheel(mm)</th><th colspan="2">Tension(kg)</th></tr>
<tr><th>Min.</th><th>Max.</th></tr>
<tr><td>A</td><td>76~91.5,
96.5~122,
127~177.8</td><td>0.68</td><td>1.02</td></tr>
<tr><td>B</td><td>86~106.7,
111.8~142,
147~218</td><td>1.59</td><td>2.38</td></tr>
</table>
</td>
<td>1. Measure the tension of the belt with a tension meter as shown in the left figure. The displayed value, which approaches to quotient of the total belt length/64, is among the acceptable range.
2. Check twice the tightness of the new belt in the first 24 hours.
Note: Only the correct installation can ensure the stable running of the unit.</td>
</tr>
<tr>
<td>8. Fix the installation plate of the motor</td>
<td>  </td>
<td>1. Tighten the screws on the installation plate with a wrench.
2. The screws should be secure and tight so to guarantee the stable running of the unit.</td>
</tr>
</table>

4. Routine Maintenance

Routine maintenance shall be performed by the skilled and qualified servicemen.

◆ Refrigerant Leakage

Suds is usually used for the leakage test by applying it at the spot (soldering spots, valve pistols, connectors) where leakage is probably to occur. During the test, if soap bubbles pop up, it indicates leakage exists and repair is required. If suds fail to work, an electronic leakage detector is an alternative. Refrigerant charge can be checked by measuring the suction and discharge pressure. Leakage test should be performed wherever leakage occurs or some components of the refrigeration system are replaced.

There are two difference conditions for charging refrigeration stated as below.

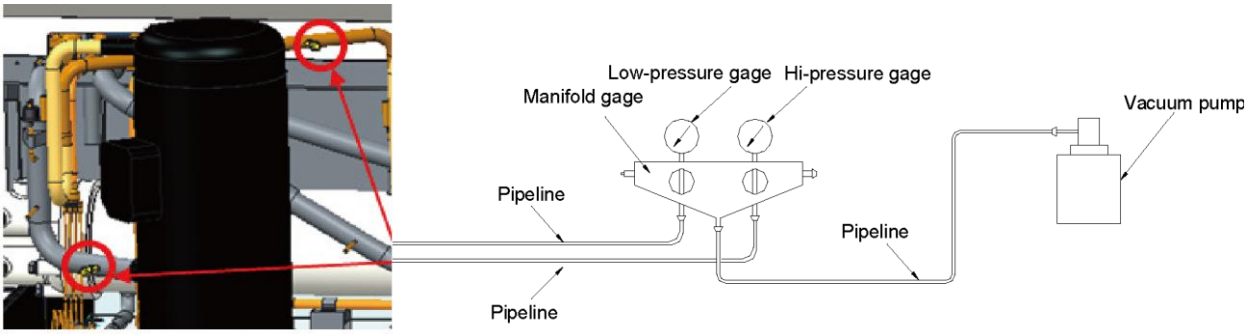
(1) Complete charging

In this case, take a leakage test by charging hi-pressure nitrogen (15～20kg) or refrigerant into the system. If soldering is required, note that gas inside the system must be expelled firstly. The whole system must be dried and vacuumed prior to charging.

1) Connect the manifold gage.
2) Vacuum the system with a vacuum pump.

Step 1: Expel the hi-pressure nitrogen for leakage test.

Step 2: Connect the pipeline at both the high and low pressure sides of the manifold gage as shown in the figure below. Note that vacuuming shall be taken at both sides. The degree of vacuum will refer to the reading of the manometer at the low side.



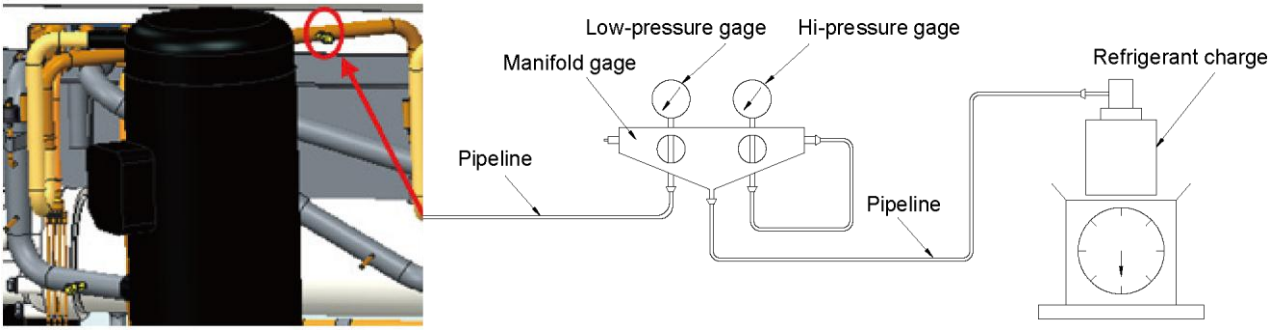
Step 3: Open the valves at both the high-pressure and low-pressure sides and then start the vacuum pump until the gage reading is below -1bar. After that, let the vacuum pump lasts for another 0.5～1.0 hour.

Step 4: Close the valves and stop the vacuum pump. Note that only the valves have been closed can the vacuum pump be stopped, otherwise air is possible to go into the system again.

Step 5: Take the leakage test. Be sure the vacuumed system keeps a pressure no higher than 80Pa and keeps little pressure rise in half an hour.

c. Refrigerant charging starts after the degree of vacuum reaches the expected range and lasts for 30 minutes. The amount of refrigerant charge shall comply with that specified on the nameplate or product data sheet.

(2) Adding



Refrigerant charge is determined through stringent tests, as excess or shortage of refrigerant would cause the compressor to run improperly. Thus, the refrigerant charge shall be consistent with that specified on the nameplate. If refrigerant charge is indeed insufficient, follow the steps below for adding.

Step 1: Weigh the refrigerant tank with an electronic scale and connect the refrigerant tank with the pressure gage through the pipeline.

Step 2: Expel the air inside the pipeline. Firstly half open the shutoff valve of the refrigerant tank and then loosen the connector connecting the pressure gage to expel the air until the connector hisses for five seconds and then tighten the connector.

Step 3: Return the electric scale to zero by energizing it again.

Step 4: Open all valves between the refrigerant tank and the unit to charge refrigerant as per the amount specified on the nameplate. Excessive refrigerant would dilute oil while insufficient refrigerant would lower the refrigeration capability and result in poor lubrication and high discharge temperature etc.

Note that only refrigerant vapor can be charged into the system at the low-pressure side when the unit is in operation. However, it is highly recommended to charge refrigerant at the hi-pressure side when the unit is shut down, otherwise it would cause slugging during startup.

(3) Air Purge

Prior to refrigerant charging, it is imperative to expel air inside the system and the system must be vacuumed.

1) Connect the manifold gage.
2) Vacuum the system with a vacuum pump.
3) Charge refrigerant at the low-pressure side as per the amount specified on the nameplate or product data sheet when the degree of vacuum approaches the expected range.
4) The refrigerant charge will be affected by the ambient temperature. When the charge is under the required amount, it is allowed to add refrigerant vapor after starting the water pump and the unit.