TRUST
Air Conditioners

FLOODED TYPE WATER-COOLED SCREW CHILLER

TRUST AIR CONDITIONING EQUIPMENT CO.
Prepared By: Engineering & R & D Department.

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Contents

Installation

Safety considerations

Access to the unit must be reserved to authorized personnel, qualified and trained in monitoring and maintenance. The access limitation device must be installed by the customer.

After the unit has been received, when it is ready to be installed or reinstalled, and before it is started up, it must be inspected for damage. Check that the refrigerant circuit(s) is (are) intact, especially that no components or pipes have shifted. If in doubt, carry out a leak tightness check and verify with the manufacturer that the circuit integrity has not been impaired. If damage is detected upon receipt, immediately file a claim with the shipping company.

Strongly recommend employing a specialized company to unload the machine.

Safety is only guaranteed, if these instructions are carefully followed. If this is not the case, there is a risk of material deterioration and injuries to personnel.

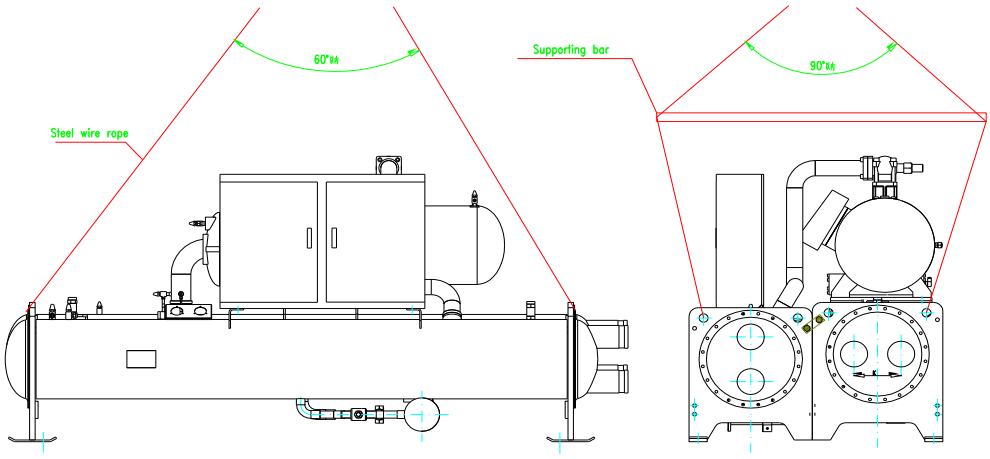
1. Unit installation

1) Lifting

①When transporting the unit, please make sure there is no any collision happens between the unit and other objects.

②Move the unit by placing a roller in the bottom of the unit to avoid damage.

③Choose a suitable crane according to the unit's weight（Buy an insurance for it if it is convenient）; Hoist the unit according to the following chart strictly. The steel rope shall wind the lifting hook one circle to prevent steel rope slipping and causing danger when the weight is unbalanced. Security guard circle should be set up when hoist the unit, and also abide by the local Safety Regulations when hoist the unit. Prohibit non-staff entering the job site or staying under the unit or the hoisting crane.



Any person is not allowed to stand below the unit when sling it.

2) Foundation

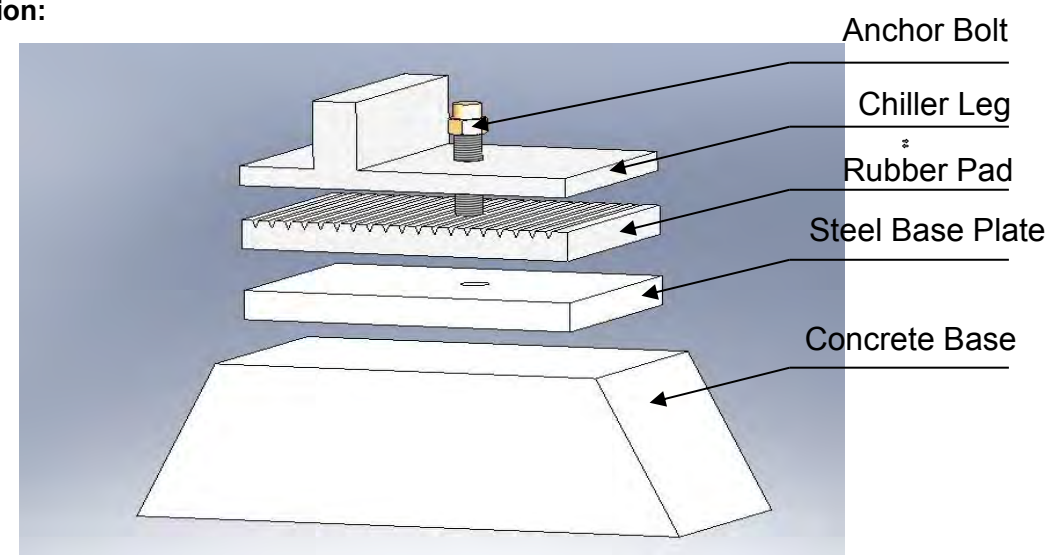
① Please take into account the construction of installation foundation. Attention should be especially paid to the intensity of the floor and noise elimination when installing the unit in interlayer or on the top floor. It is suggested to consult the building designer before installation.

② For convenient drainage, gutter way should be made around the basement to ensure the drainage unblocked.

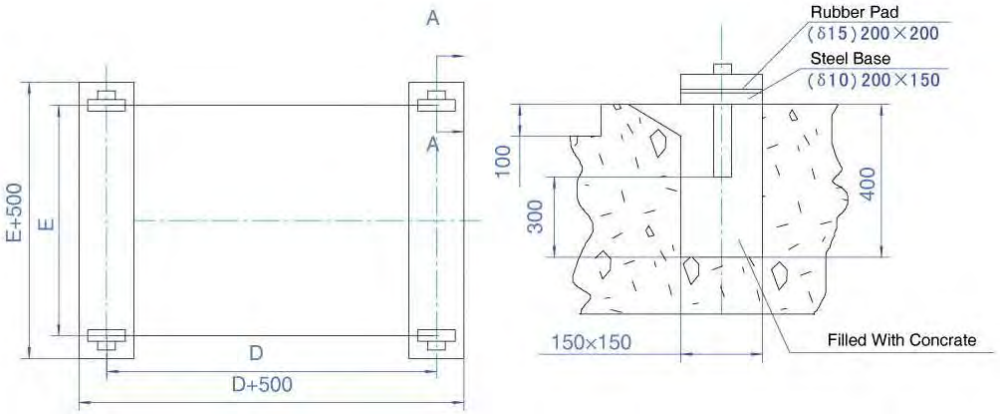
③ To eliminate the vibration and noise, put an absorber between the unit and basement and keep the unit in balance. Install a shockproof foundation when necessary.

④ Vibration isolators are recommended for all roof mounted installations or wherever vibration transmission is a consideration. Neoprene Isolation is optional, it is recommended for normal installations and provides good performance in most applications for the least cost. Spring isolator is level adjustable, spring and cage type isolators for mounting under the unit base rails. 1" nominal deflection may vary slightly by application.

Typical Isolation:



Foundation Dimensions

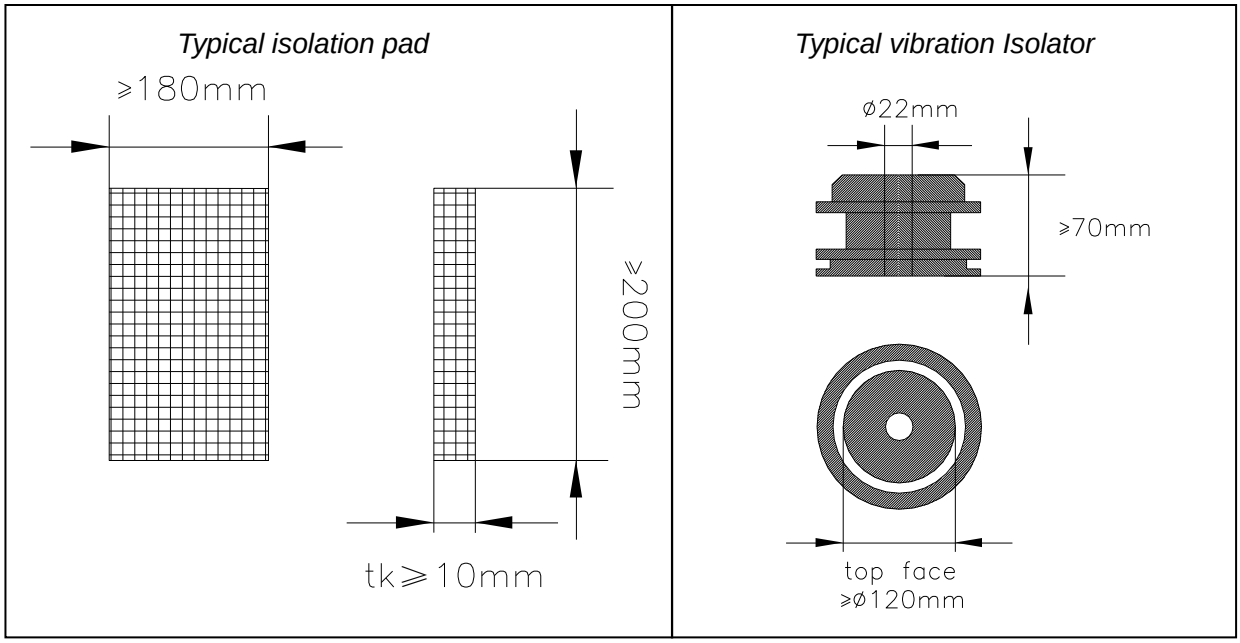


Foundation Bolt Installation Dimension Table

Model / Dimension	TMCUxxxxBO3/1WT1FA										
	340	440	540	690	805	890	1080	1200	1385	1620	1780
D(mm)	2850	2850	2850	2850	2850	2850	3850	3850	3850	3850	3850
E(mm)	1100	1100	1100	1300	1300	1300	1400	1400	1400	1500	1500

3) Vibration isolators

Put the absorbers under unit saddles before final positioned the unit. The quantity of absorber used for each unit is always decided by the elasticity or durometer value of the absorber. Below please refer to the typical isolation pad and vibration isolator for selection.



Expected load bearing value listed below:

Model	Isolation pad		Vibration Isolator		Running weight(kg)
	Minimum load bearing (kg/EA)	Minimum Quantity	Minimum load bearing (kg/EA)	Quantity	
340B3O3/1WT1FA	900	4	900	4	2700
440B3O3/1WT1FA	1000	4	1000	4	2820
540B3O3/1WT1FA	1200	4	1200	4	3220
690B3O3/1WT1FA	1400	4	1400	4	3870
805B3O3/1WT1FA	1800	4	1800	4	4420
890B3O3/1WT1FA	1800	4	1800	4	4550
1080B3O3/1WT1FA	2000	4	2000	4	7250
1200B3O3/1WT1FA	2200	4	2200	4	7490
1385B3O3/1WT1FA	2200	4	2200	4	7820
1620B3O3/1WT1FA	2200	4	2200	4	9200
1780B3O3/1WT1FA	2200	4	2200	4	9350

Note:

(1) Pads have to extend the full length of the saddle when isolation pad be used.

(2) Level the unit to within 5mm over through it's length and width after absorbers installed.

4) Spaces

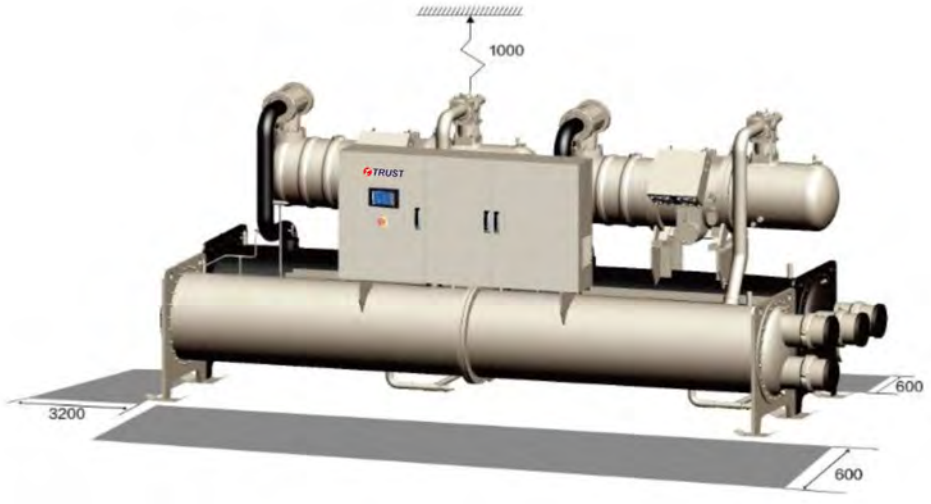
①Leave enough space above and around unit for operation and maintenance. For cleaning the copper pipes or exchanging pipes, there should be enough space reserved(for single compressor unit, it should be at least 3.5m, for dual compressor unit, it should be 5m), and the other end of the unit should have at least 2.0m space, use the hole on door or other holes with appropriate position; there should have the space of 0.7m in front of the unit (the side faces to the electric cabinet) for operation; the space in front and back of the unit should not less than 0.6m .

②Do not install the unit at the place exposed to sunlight or other heat sources.

③Near the power supply where it is convenient for wiring.

④The floor is solid enough and the location should not easily bring about resonance or noise.

⑤Put the unit indoors which should be well-ventilated with low humidity and little dust.



2. Water pipeline system installation

1) Water quality control

When industrial water is used as chilled water, little furring may occur; however, well water or river water, used as chilled water, may cause much sediment, such as furring, sand, and so on. Therefore, well water or river water must be filtered and softened in softening water equipment before flowing into chilled water system. If sand and clay settle in the evaporator, circulation of chilled water may be blocked, and thus leading to freezing accidents; if hardness of chilled water is too high, furring may occur easily, and the devices may be corroded. Therefore, the quality of chilled water should be analyzed before being used, such as PH value, conductivity, concentration of chloride ion, concentration of sulfide ion, and so on.

※ Applicable standard of water quality for the unit

PH value	Total hardness	Conductivity	Sulfide ion	Chloride ion	Ammonia ion	Sulfate ion	Silicon	Iron content	Sodium ion	Calcium ion
7～8.5	<50ppm	<20μV/cm(25℃)	No	<50ppm	No	<50ppm	<30ppm	<0.3ppm	No requirement	<50ppm

2) Performance adjustment factors

Ethylene and Propylene Glycol Factors

A glycol solution is required when the unit with condition as mentioned. The use of glycol will reduce the performance of the unit depending on concentration.

Ethylene Glycol

	Evaporator side					
	Quality of glycol（%）	Cooling capacity modification	Power modification	Water flow modification	Water resistance	Freezing point ℃
Ethylene glycol	30	0.972	0.99	1.013	1.215	-16
	35	0.971	0.984	1.04	1.267	
	40	0.965	0.977	1.074	1.325	-23
	45	0.96	0.967	1.121	1.389	
	50	0.946	0.955	1.178	1.458	-35
	Condenser side					
	30	0.991	1.02	1.013	1.164	-16
	35	0.989	1.027	1.04	1.212	
	40	0.986	1.032	1.074	1.261	-23
	45	0.984	1.037	1.121	1.309	
	50	0.98	1.044	1.178	1.362	-35

Note: the freezing point not shown here, please calculate according to interpolation method.

Propylene Glycol

	Evaporator side					
	Quality of glycol （%）	Cooling capacity modification	Power modification	Water flow modification	Water resistance	Freezing point ℃
Propylene glycol	30	0.968	0.969	1.01	1.16	-13
	35	0.964	0.955	1.028	1.287	
	40	0.955	0.937	1.05	1.4	-21
	45	0.945	0.914	1.078	1.502	
	50	0.929	0.89	1.116	1.604	-33
	Condenser side					
	30	0.969	1.023	1.01	1.227	-13
	35	0.959	1.029	1.028	1.276	
	40	0.944	1.039	1.05	1.329	-21
	45	0.923	1.054	1.078	1.388	
	50	0.896	1.078	1.116	1.453	-33

Note: the freezing point not shown here, please calculate according to interpolation method.

Units operating with glycol solutions are not included in the ARI Certification Program.

Altitude correction factors

Performance tables are based at sea level. Elevations other than sea level affect the performance of the unit. The decreased air density will reduce condenser capacity and reduce the unit's performance. For performance at elevations other than sea level refer to below table Maximum allowable altitude is 1800 meters.

Evaporator temperature drop factors

Performance tables are based on a 5°C temperature drop through the evaporator. Adjustment factors for applications with temperature ranges from 3℃ to 6℃ in follow table. Temperature drops outside this range can affect the control system's capability to maintain acceptable control and are not recommended.

Fouling Factor

ALTITUDE (m)	Fouling Factor							
	0.018m² ℃ /kW		0.044m² ℃ /kW		0.086m² ℃ /kW		0.172m² ℃ /kW	
	C	P	C	P	C	P	C	P
Sea level	1.042	1.028	1.029	1.020	1.000	**1.000**	0.977	0.995
600	1.027	1.037	1.014	1.029	0.986	1.009	0.964	1.004
1200	1.014	1.050	1.001	1.041	0.973	1.021	0.951	1.016
1800	1.000	1.060	0.987	1.052	0.960	1.031	0.938	1.026

C--Cooling capacity
P—Power

3) Design of the store tank in the system

a. kW is the unit for cooling capacity, L is the unit for (G) minimum water flow volume in the formula.

Comfortable type air conditioner

G= cooling capacity×2.6L

Process type cooling

G= cooling capacity×7.4L

b. In certain occasion (especially in manufacture cooling process), for conforming the system water content requirement, it's necessary to mount a tank equipping with a cut-off baffle at the system to avoid water short-circuit, Please see the following schemes:

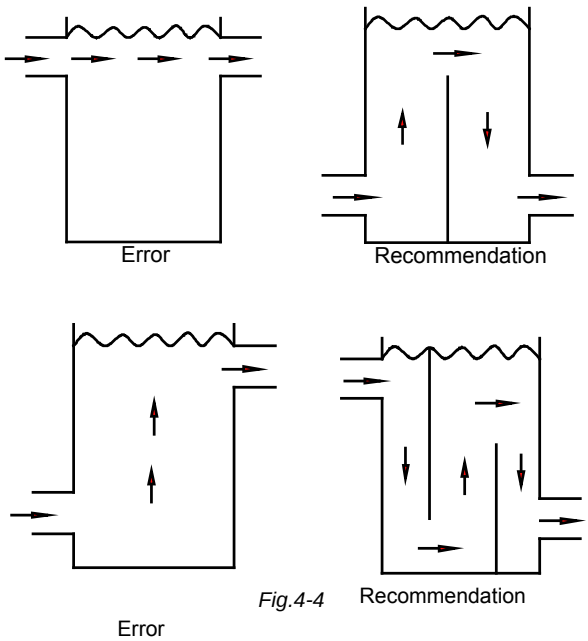


Fig.4-4

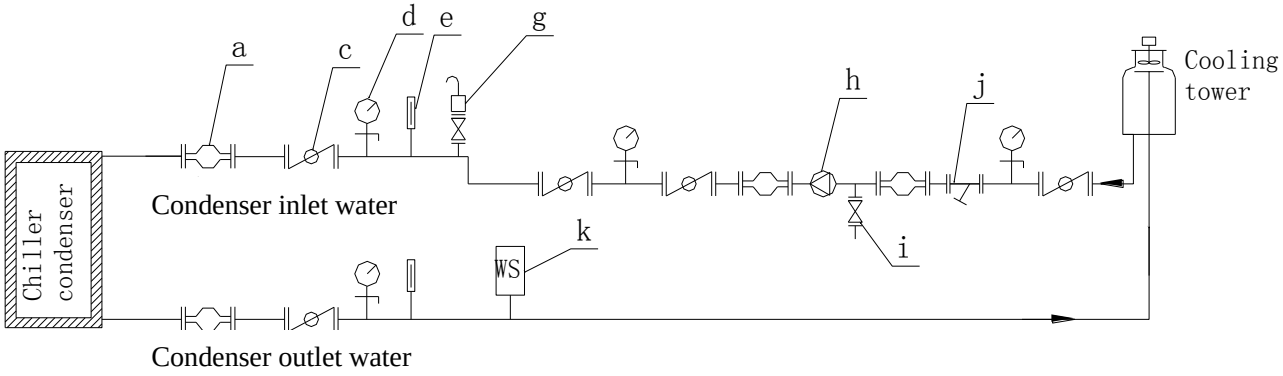
4) Water pipeline installation

Due to the variety of piping practices, it is advisable to follow the recommendations of local authorities. The installation and insulation of the water pipelines of the air conditioning system shall be designed and

guided by design professionals, and confirm to the corresponding provisions of the HVAC installation specifications.

Basically, the piping should be designed with a minimum number of bends and changes in elevation to keep system cost down and performance up.

1) Condenser, cooling water piping suggested piping as follow：

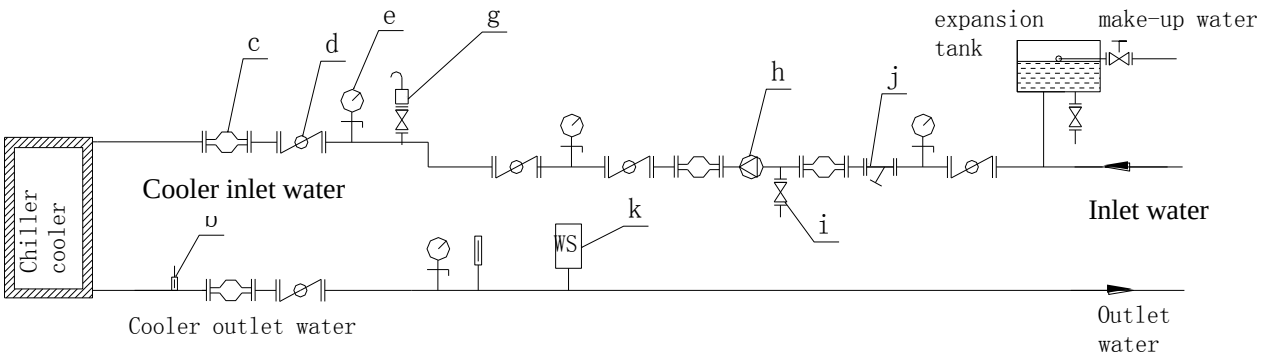


（Condenser, cooling water hose connection diagrammatic sketch）

a Flexible connection	k Flow switch
c Butterfly valve	d Pressure gauge
e Thermometer	f Platinum resistance thermometer
g Air vent	h Water pump
I Drain valve	j Y- shape strainer

Note: All of water pipe accessories and flow switch is provide by user.

2) Chilled water piping suggested piping as follow：



(Chiller cooler piping diagrammatic sketch）

c Flexible connection	b Pressure type temperature controller
e Pressure gauge	d Butterfly valve
g Air vent	h Water pump
i Drain valve	j Y- shape strainer
k Flow switch	

Note: All of water pipe accessories and flow switch is provide by user.

User must install flow switch in the outlet pipe of cooler and evaporator, the two sides must be level straight pipe which length longer than five times of pipe diameter.

3) The water inlet pipeline and drain pipeline shall be connected according to the requirements of markings on the unit. Generally, the refrigerant pipe side of the evaporator is the chilled water

outlet side.

4) The chilled water pipeline system must be provided with the soft connection, thermometer, pressure gauge, water filter, electronic scale remover, check valve, target flow controller, discharge valve, drain valve, stop valve, expansion tank, etc.

3) The water system must be fitted with the water pump with appropriate displacement and head, so as to ensure normal water supply to the unit. The soft connection shall be used between the water pump, unit and water system pipelines, and the bracket shall be provided to avoid stress on the unit. Welding work for installation shall avoid damage to the unit.

(1) Determination of water pump flow:

Flow (m3/h) = (1.1 ~ 1.2) * Unit Cooling Capacity (kW)/5.8

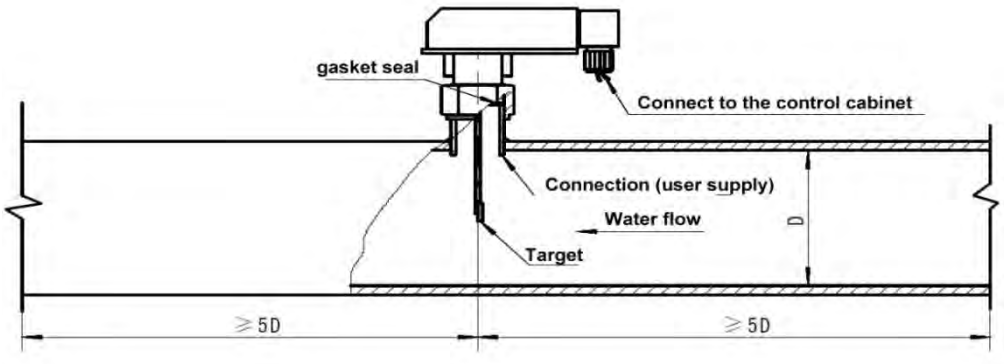
(2) Determination of water pump head:

Head (m) = (Unit Resistance (see product parameters) + Resistance at Maximum End of Pressure Drop (see product parameters) + Pipeline Resistance (length of the least favorable loop pipe * 0.05) + Local Resistance (length of the least favorable loop pipe * 0.05 * 0.5)) * (1.1 ~ 1.2)

4) The flow switch must be arranged on the drain pipe of the evaporator. The flow switch shall be interlocked with the input contact in the control cabinet. Its installation requirements are as follows:

(1) The flow switch shall be installed on the pipe vertically.

(2) The straight pipe section at each side of the flow switch shall have a length that is at least 5 times the pipe diameter; do not install it near the elbow, orifice plate or valve.



(3) The direction of the arrow on the flow switch must be consistent with the direction of water flow.

(4) In order to prevent vibration of the flow switch, remove all air in the water system.

(5) Adjust the flow switch to keep it in open state when the flow is lower than the minimum flow (the minimum flow is 70% of the design flow). When the water flow is satisfied, the flow switch shall keep in closed state.

5) The water filter must be installed before the water inlet pipeline of the unit, which shall be provided with a 25-mesh screen. This will aid in preventing foreign material from entering and

decreasing the performance of the evaporator.

6) A strainer should be placed for enough upstream to prevent cavitation at the pump inlet (consult pump manufacturer for recommendations). The use of a strainer will prolong pump life and help maintain high system performance levels

7) The flushing and insulation of the water pipelines shall be carried out before it is connected with the unit, so as to prevent dirt from damaging the unit.

8) The design water pressure of the water chamber is 1.0Mpa. Use of the water chamber shall be not exceeding this pressure in order to avoid damaging the evaporator.

9) Do not load the weight of water pipe onto the unit. When water inlet/outlet are connected with corresponding water pipe, soft connection such as rubber joint should be used to avoid the transmission and inter-disturbance of vibration and noise to avoid the vibration which may be transmitted to indoor side.

10) In close loop water system, to diminish the impact on water pipe because of the expansion or contraction of water volume and to avoid the influence caused by supplementing water pressure, water return side should be fitted with an expansion water tank. The expansion tank shall be installed 1~1.5m higher than the system, and its capacity accounts about 1/10 of the water amount in the whole system.

11) The drain connection is arranged on the evaporator cylinder. The drain outlet has been equipped with a 1/2'' plug.

12) In order to expel the air from water system, install an automatic discharge valve on the highest place of local water pipe and the horizontal pipe should be up tilted for about 1/250 degree.

13) The thermometer and pressure gauge are arranged on the straight pipe sections of the water inlet pipeline and drain pipeline, and their installation places shall be far away from the elbows. The pressure gauge installed shall be vertical to the water pipe, and the installation of the thermometer shall ensure that its temperature probe can be inserted into the water pipe directly.

14) Each low point shall be fitted with a drain connection so as to drain the remaining water in the system. Before operating the unit, connect the stop valves to the drain pipeline, respectively near the water inlet connection and drain connection. The by-pass pipeline shall be provided between the water inlet pipe and drain pipe of the evaporator, convenient for cleaning and maintenance. Use of flexible connections can reduce vibration transfer.

15) The chilled water pipeline and expansion tank shall be subjected to insulation treatment, and the maintenance and operation part shall be reserved on the valve connections.

16) After the air-tightness test is carried out, and the insulation layer is applied on the pipeline, so as to avoid heat transfer and surface condensation; the insulation layer shall be covered by moisture-proof seal.

17) Any water piping to the unit must be protected to prevent freezing. There are reserved terminals for the auxiliary electrical heater. Logic in PCB will transmit ON/OFF signal by

checking the leaving evaporator water temperature.

Note: The unit only supplies the ON/OFF signal, but not the 220V power. If a separate disconnect is used for the 220V supply to the cooler heating cable, it should be clearly marked so that it is not accidentally shut off during cold seasons.

18) If the unit is used as a replacement chiller on a previously existing piping system, the system should be thoroughly flushed prior to unit installation and then regular chilled water analysis and chemical water treatment is recommended immediately at equipment start-up.

19) Power on the chilled water pump, and inspect its rotation direction. The correct rotation direction shall be clockwise; if not, re-inspect the wiring of the pump.

20) Start the chilled water pump to circulate water flow. Inspect the water pipelines for water leakage and dripping.

21) Commission the chilled water pump. Observe whether the water pressure is stable. Observe the pressure gauges at the pump inlet and outlet, and the readings of the pressure gauges and the pressure difference between the inlet and outlet change slightly when the water pressure is stable. Observe whether the operating current of the pump is within the range of rated operating current; inspect whether the resistance of the system is too large if the difference between the operating current and rated value is too big; eliminate the system failures until the actual operating current is satisfied.

22) Inspect whether the water replenishing device for the expansion tank is smooth, and the auto discharge air valve in the water system enables auto discharge. If the discharge air valve is a manual type, open the discharge valve of the chilled water pipeline to discharge all air in the pipeline.

23) Adjust the flow and inspect whether the water pressure drop of the evaporator meets the requirement of the unit's normal operation. The pressure at the chilled water inlet and outlet of the unit shall be kept at least 0.2MPa.

24) The total water quantity in the system should be sufficient to prevent frequent "on-off" cycling. A reasonable minimum quantity would allow for a complete water system turnover in not less than 15 minutes.

3. Wiring installation

WARNING: In order to prevent any accident of injury and death during the site wiring , the power supply shall be cut off before the line is connected to the unit.

Wiring must comply with all applicable codes and ordinances. Warranty is voided if wiring is not in accordance with specifications. An open fuse indicates a short, ground, or overload. Before replacing a fuse or restarting a compressor , the trouble must be found and corrected.

Copper wire is required for all supply lines in field connection to avoid corrosion and overheat at the connection of terminals. The lines and control cables shall be separately paved and equipped with protective pipes to avoid intervention of supply line in control cable.

Power section: It is required to connect the power supply cable to the control cabinet of the unit, when it arrives at the jobsite. The power supply cable is connected to the terminals of L1, L2, L3, N and PE and the terminals need to be fixed again after 24h running (the minimum allowed time). Please seal the entering wiring hole after users installed the main power wires, in order to avoid the dust entering into electric control cabinet.

Caution: it is suggested that to use appropriate tools to make sure that a enough height to install the main power wires if the basement is higher than 200 mm. Breaking isolation switches should be added between the power cord of users and the unit. The capacities of the breaking isolation switches recommended are see electrical control .

(1) Attention: refrigerant selection: the previous software settings are replaced by the current hardware settings to avoid the possibility of improper operation of the software leading to wrongly selected refrigerant and damage to the unit.

(2) In order to avoid wrong control in field connection, the liquid control circuit (24 V) shall not be in the same conduit with the lead wire with voltage higher than 24 V.

(3) The control circuits of various units are all 220 V, and for the wiring ways of the control circuits, please refer to the wiring diagrams supplied along with the units.

(4) A unit consists of master compressor and slave compressor communicating via shield wire protected by sleeve and paved separate from supply line.

(5) The control output cable to be connected on site shall be AC250V-1mm2, and 0.75mm2 shield wire (24 V) shall be used for control signal line.

(6) Attentions: Read the electrical wiring principle diagram and connect the wires strictly according to the wiring terminal diagram. Three-core shield cable (3×0.75mm2) shall be used for the connection of the temperature sensor. Common two-core cable (2×0.75mm2) shall be used for the connection of flow switch to connect to the NO contact of the switch, i.e. the opening point when waterless. Two buttons can be connected to the external of remote start and stop.

(7) If the customer desires the linked control of the water pump, connect the water pump as shown in the diagram, where an intermediate relay is required. If the function of linked control of water pump is not needed, ensure that the water pump is started before starting the machine.

CAUTION: An independent power supply box needs to be equipped with the power supply of the water pump.

(8) The wiring ports for remote start/stop, flow switch, cool/warm switch, water pump linked control, alarm indication, etc. are reserved in the electrical cabinet of the unit.

(9) Passive inching button is used for remote start and stop, and the flow switch must be connected to the NO contact, or the machine cannot be started.

Passive holding switch is used for cool/warm switch, e.g. common selection switch. Controls of large power electrical appliances such as water pump and user electric heating must be interfaced with a relay, or the PCB might be burned. Other outputs can be directly connected to indicator lamps or alarms.

Commissioning

1. Pre start-up

(1) Electrical System Inspection

1) Inspect whether power distribution capacity is compliant with the power of the unit before the first start-up, and whether the diameter of the selected cable can bear the maximum working current of the master compressor.

The max economical conveying distance:

The max loading time in a year（h）	Copper core length(m)
<3000h	264
3000～5000h	294
>5000h	331

2) Inspect whether the electric mode is compliant with that of the unit, three-phase five-line (three phase lines, one zero line and one earth wire, 380V±10%).

3) Inspect whether the maximum phase voltage unbalance is compliant with the requirement, 2% for the maximum permissible phase voltage unbalance and 5% for the phase current balance. The machine must not be started up when the phase voltage unbalance exceeds 2%. If the measured unbalance% is excess, the power supply sector shall be informed of immediately.

4) Inspect whether the supply circuit is the compressor is firmly and properly connected, and tighten it if there is any looseness. The screws might be loose due to the factors such as long-distance transport and hoisting of the master compressor. Or, the electrical elements (e.g. air switch, AC contactor, etc.) in the control cabinet of the master compressor and the compressor might be damaged.

5) Carefully inspect all the electrical lines with a multimeter, and whether the connections are properly installed. Carry out measurement in mega ohm and ensure that there is no short circuit at the shell. Inspect whether the earth wire is properly installed, and whether the insulation resistance to ground exceeds 2MΩ. And inspect whether the supply line meets the requirement of capacity.

6) Inspect whether disconnection switch is installed to the supply line of the supply unit.

7) Carry out complete inspect for all connections of the main circuit in the control cabinet and all external connections of the control circuit before power connection (e.g. oil heater, compressor electronic protection, circulatory water temperature sensor, target-type flow switch connection, water pump linked control, communication line connection, etc.); inspect the bolts of the wiring terminal for looseness. Inspect whether various electric meters and appliances are properly installed, complete and available. Inspect the interior and exterior of the electrical cabinet, especially various wiring ports, for cleanness. If the communication lines of the PCB and control screen are damaged, refer to the diagram below.

8) After the inspection for all the above items is complete, connect the control cabinet and the supply indication lamp will light up, indicating that the oil heater is working. Observe whether the phase loss protection is in normal condition, if it is (green light on), close the single-pole switch in the control cabinet, then the control circuit begins working, and the touch screen and PCB control are put into operation.

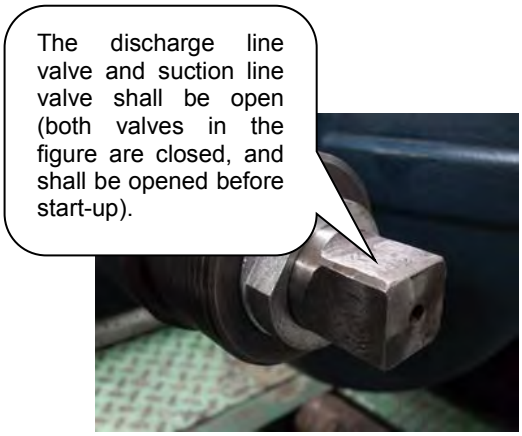
9) Before start up the machine, inspect whether the external system of the unit meets the conditions for start-up (e.g. whether the water cooling pump of the system is externally controlled or interlocked with the master compressor, and that the water pump must be started before starting up the master compressor via external control).

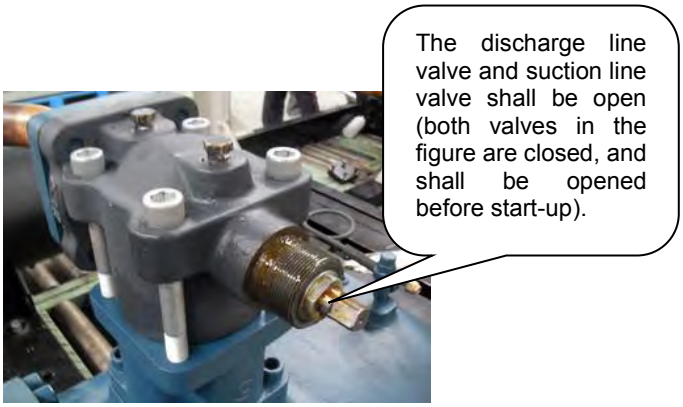
10) Inspect whether the compressor overload protection value, which shall not exceed the maximum compressor permissible current value indicated in the nameplate on the compressor, is set correctly. The compressor overload protection value generally equals to the set value of heat relay multiplied by variable ratio of current inductor, which is (250/5)50 in the following case.

11) Inspect whether the value of phase loss and reversal protection is set correctly. The over-/under-voltage protection value shall be ±10% of the rated voltage.

(2) Refrigeration System Inspection

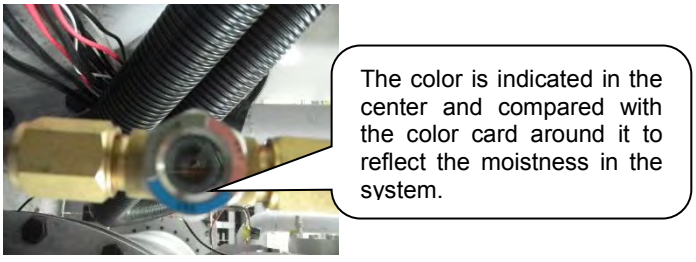
1) The discharge line valve and suction line valve of the compressor must be fully open (turn anticlockwise to open) and the cores shall be tightly locked to prevent leakage of refrigerant.





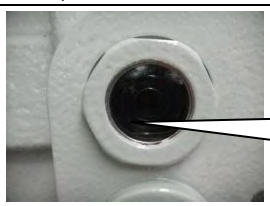
2) Inspect whether moisture content of the system exceeds the limit

Excessive moisture content in the refrigerant system of the unit might cause ice block, copper plating, etc. that would seriously affect the safety of the unit. Therefore, the dryness of the refrigerant system of the unit shall be inspected from the sight glass before and during operation of the unit, purple indicating dry, and pink moist, as shown in the right figure. When the color turns red, the filter core in the unit shall be replaced with a dry one.



3) Sufficient lubricating oil in the oil tank (not lower than 1/2 of the oil level in the high oil immersion lens), and no deterioration (blackness).

Inspect the oil level and quality before start-up for the two factors have direct impact on the performance and reliability of the unit. There must be sufficient lubricating oil in the unit. And during the shutdown of the unit, the high oil immersion lens must be full of oil.



When the unit is in stable operation, the oil level in the high oil immersion lens should be at least above the 1/2 position. And there shall be no deterioration (blackness) of the lubricating oil, or else, qualified lubricating oil shall be changed before operating the unit.

6) Inspect whether the pressure sensor stop valve, dry filter front/rear angle valve and liquid/air sampling stop valve etc. are all opened.

When the unit stops, the high and low voltages shall be almost the same. After the start-up, the low voltage decreases, and the high voltage increases. If there is no voltage change certain time after the start-up, inspect whether the liquid/air sampling stop valve is open.

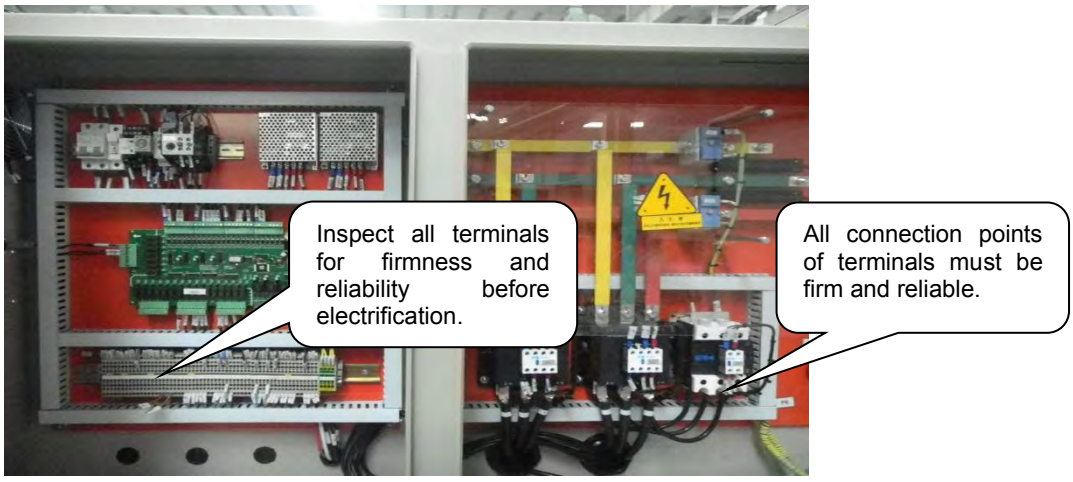
7) After the unit is installed and before connected, it is principle required to tighten the connections in the electrical cabinet of the unit one by one.

8) Inspect the bolts of the unit for looseness.

After the unit is transported and installed, it is required to inspect whether the fixing bolts of the unit (e.g. fixing bolts at compressor base angle, at post and beam of the unit, and at pipe clamp, etc.) and of the electrical elements (e.g. fixing bolts of PCB and of insulating transformer, and connection bolts of upper/lower terminals of AC contactor, etc.) are firmly fixed.

9) Inspect the connections in the electrical cabinet for looseness, especially the electric part in the cabinet. The parts connected by bolts might be loose due to transportation. If there is any looseness, tighten it to avoid burnout of circuit or element caused by poor contact.

Inspect the terminals for looseness and poor contact caused by vibration and collision during transportation and installation (especially the electric part; ensure the connection points of all terminals are firm and reliable before electrification).



Inspect whether there is poor contact and short circuit caused by dust, moisture, etc. in the electrical cabinet, and whether the values of all temperature sensors are normal. During the shutdown of the machine, the indicated temperatures of discharge, fin, and the environment shall be almost the same,

and the entering and leaving chilled water temperatures shall be almost the same.

10) Before the unit leaves the factory, the control cabinet is well connected with main motor, electrical actuator, and sensor elements of pressure temperature, etc. Therefore, the wiring on site for the user is very simple. Only the chilled water flow switch line and chilled water pump linked control line (control contact is active) need to be connected. For the detailed connection way, please refer to the circuit wiring diagram in the operation manual for the unit. (The attached circuit diagram represents the case of air-cooled heat pump unit for user's reference, as for the details, the operation manual supplied with the unit shall be final.)

11) Target-type flow control is set on the chilled water pipeline which shall be installed at the chilled water outlet of the unit. The NO contact of the target-type flow control in the chilled water system shall be connected to the control circuit as per the wiring diagram.

Note: Disordered water flow may lead to wrong action of the flow switch; therefore, the control cabinet will command the unit to stop after receiving continuous disconnection signals during 10 s.

12) The tube where the temperature sensing probe is installed shall be filled with lubricating oil or other grease that will not freeze at the temperature of the leaving chilled water for the convenience of heat transfer. Thermostatic insulation and enclosing measures shall be taken for the temperature sensing device.

Inspect whether there is temperature deviation for the entering and leaving water temperature sensor caused by insufficient heat transfer oil in the thermostatic pipe.

For later armored dip-type temperature sensor, no lubricating oil is required for heat transfer.

2. Start-up

Before start-up of the unit, the following performance parameters need to be inspected:

(1) High/low voltage value of the system. For the unit shut down and waterless in a long term, the liquid and gas of the system shall be equivalent and close to the saturation pressure corresponding to the current ambient temperature. The correlation of saturation temperatures and pressures (the pressures in the list are gage pressures, among which, the atmospheric pressure is 0.1MPa) of R22 and R134a refrigerant is shown in table 1:

In shutdown status, the high and low voltages shall be the same and equal to the saturation pressure corresponding to the current temperature.

In the pressure gauge scale, taking the right figure for example: the values outside of the black circle are pressure values (unit: bar), and the values of the red, blue and green circles indicate saturation temperatures of refrigerants R404A, R22 and R134a respectively under the relative pressure. The types of refrigerants indicated in different pressure gauges might differ.

[Table 1]

Refrigerant Temperature ℃	R134a Refrigerant Pressure (Gage Pressure) MPa
0	0.19
5	0.25
10	0.32
15	0.39
20	0.47
25	0.57
30	0.67
35	0.79
40	0.92

If the high/low voltage deviates much from the saturation pressure corresponding to the current temperature (more than 2bar), leakage or insufficient refrigerant is likely in the system.

(2) Inspect the unit for normal heating

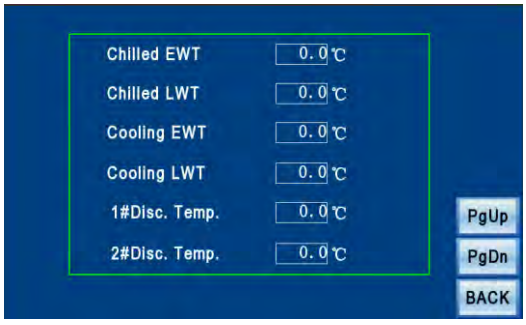
Before start-up, it is necessary to inspect whether the oil heating in the unit is available, and whether the oil heater does not work when there is oil for heating but no power supply. It is particularly important in winter when the temperature is low and the failure of oil heating might lead to poor lubrication of the unit. The optimum working temperature for current types of lubricating oil is generally around 40℃.

(3) Inspect whether there is alarm for trouble of the display screen. if there is, the trouble must be corrected.

(4) Inspect the electronic expansion valve control module for alarm trouble.

(5) Inspect whether various temperature points displayed on the display screen are within the normal range.

Before the operation of the unit, the showed temperatures of discharge and fin and the ambient temperature are close to the current actual ambient temperature, and whether the entering and leaving water temperatures are close to the water temperature at the user side. If there is any obvious deviation of the above temperatures, inspect whether the temperature sensor is in normal condition and whether the connection is firm and reliable.



(6) Inspect whether the flow in the water pump meets the requirements of the unit.

(7) Inspect whether the power supply of the unit is stable.

2) Parameters Inspections during Start-up and Operation

(1) The maximum range of parameters for normal operation of R134a refrigerant unit

See table 2 for the maximum range of performance parameters of R134a refrigerant:

[Table 2]

Working Condition	Refrigeration
Discharge temp. ℃	40~50℃
Suction temp. ℃	5~9℃
Suction super-heating degree ℃	1~3℃
Discharge super-heating degree ℃	10~15℃
Discharge pressure MPa	0.8~0.9MPa
Suction pressure MPa	0.2~0.25MPa

(2)Keep good record of unit data during commissioning.

Maintenance

ATTENTION:

All installation parts must be maintained by the personnel in charge, in order to avoid material deterioration and injuries to people. Faults and leaks must be repaired immediately. The authorized technician must have the responsibility to repair the fault immediately. Each time repairs have been carried out to the unit, the operation of the safety devices must be re-checked.

Do not use oxygen to purge lines or to pressurize a machine for any purpose. Oxygen gas reacts violently with oil, grease, and other common substances.

The necessary protection equipment must be available, and appropriate fire extinguishers for the system and the refrigerant type used must be within easy reach.

Do not siphon refrigerant. Avoid spilling liquid refrigerant on skin or splashing it into the eyes. Use safety goggles. Wash any spills from the skin with soap and water. If liquid refrigerant enters the eyes, immediately and abundantly flush the eyes with water and consult a doctor.

Never let an open flame or live steam close to a refrigerant container. Dangerous overpressure can result. If it is necessary to heat refrigerant, only use warm water.

Do not re-use disposable (non-returnable) cylinders or attempt to refill them. It is dangerous and illegal. When cylinders are empty, evacuate the remaining gas pressure, and move the cylinders to a place designated for their recovery. Do not incinerate.

Ensure that you are using the correct refrigerant type before recharging the unit. Charging any refrigerant other than the original charge type (R-22) will impair machine operation and can even lead to a destruction of the compressors. The compressors operating with this refrigerant type are lubricated with a synthetic

Do not climb on a machine. Use a platform, or staging to work at higher levels. Use mechanical lifting equipment (crane, hoist, winch, etc.) to lift or move heavy components. For lighter components, use lifting equipment when there is a risk of slipping or losing your balance. Use only original replacement parts for any repair or component replacement. Consult the list of replacement parts that corresponds to the specification of the original equipment.

1. Daily maintenance

Annual Startup

This is a good time to check all the motor winding resistance to ground. Semi-annual checking and recording of this resistance will provide a record of any deterioration of the winding insulation. All new units have well over 100 MΩ resistances between any motor terminal and ground.

1. The control circuit must be energized at all times, except during service. If the control circuit has been off and oil is cool, energize oil heaters and allow 8 hours for heater to remove refrigerant from the oil before starting.
2. Check and tighten all electrical connections.

3. Replace the drain plug in the cooling tower pump if it was removed at shutdown time the previous season.
4. Install fuses in main disconnect switch (if removed).
5. Reconnect water lines and turn on supply water. Flush condenser and check for leaks.

Annual Shutdown

Where the chiller can be subject to freezing temperatures, the condenser and chiller must be drained of all water. Dry air blown through the condenser will aid in forcing all water out and decreasing the corrosion. Water permitted to remain in the piping and vessels can rupture these parts if subjected to freezing temperature.

If the chiller is used in areas where the ambient temperature will fall below 0℃, forced circulation of antifreeze through the water circuits is one method of avoiding freeze up.

1. Take measures to prevent the shutoff valve in the water supply line from being accidentally turned on.
2. If a cooling tower is used, and if the water pump will be exposed to freezing temperature, be sure to remove the pump drain plug and leave it out so any water that can accumulate will drain away.
3. Open the compressor disconnect switch, and remove the fuses.
4. Check for corrosion and clean and paint rusted surfaces.
5. Clean and flush water tower for all units operating on a water tower. It should be recognized that atmospheric air contains many contaminants that increase the need for proper water treatment. The use of untreated water can result in corrosion, erosion, sliming, scaling or algae formation. It is recommended that the service of a reliable water treatment company be used.
6. Remove condenser heads at least once a year to inspect the condenser tubes and clean if required.

Recommended maintenance schedule

This chapter shows the preventive maintenance of Trust screw chiller. Correct maintenance and timely service will make the chiller in the best condition and with best performance, beside, it can prolong the lifespan of chiller.

The customer has responsibility to appoint qualified equipment management engineer and specially-assigned operator to do the daily and scheduled maintenance. The repair work should be done by big maintenance agency that is qualified to do the job. It's better to make maintenance agreement with local customer service centre of Trust after chiller out of warranty, to keep the chiller always under effective service and guarantee reliable operation.

Note: Repair work caused by incorrect maintenance within warranty will lead to extra charges.

Daily maintenance

The basic work of unit maintenance is to truly record the operation parameters of unit at certain intervals (e.g. 2hours) everyday. Fill the operation parameter table which contains such key parameters as high/low pressure, suction/discharge temperature, degree of sub-cooling/overheat degree. True and complete records of operation parameters are useful for analyzing and forecasting the trend of unit

operation. It's good for finding and forecasting the problem that may occur and taking measures in time.

For example, by analyzing the record of a whole month, you may find that the temperature difference of condensing temperature and leaving cooling water temperature may become bigger. It means that the cooling water is dirty or water hardness is big, and it is scaling constantly. So it's compulsory to perform softening process or clean the tubes.

Note: Keeping the normal operation parameters of initial unit commissioning is very useful. It can be used for comparative analysis to find out the trend of problem.

Scheduled maintenance

General

Take notice of the noise at any time by standing 1m from the unit. Watch the vibration amplitude at all times to see whether it's within permitted. Check the voltage of power supply whether it's within ±10% of rated voltage at any time.

➢ Visual inspection

Keep the unit clean, if there's rust, do scaling with iron brush and cover it with antirust paint. Pay attention to the oil traces (sign of a refrigerant leak) and water traces on pipeline. Check the threaded connection joints carefully, fasten any loose screw in time. Any time seeing the insulating material flakes off, stick them with adhesive.

➢ Compressor

For insulation resistance, check it yearly and it should be over 5MΩ when measuring with ohmmeter of DC 500V. When touching the shockproof rubber, it should be elastic, or it means the rubber gets ageing. Every 3000 hours, make middle inspection of vibration and oil level; every 6000 hours, check the safety device and protective device to guarantee the normal operation.

Important: The normal oil level is at the middle of sight glass. Adding lubricating oil if the oil level decline obviously. Inspect the oil quality monthly to see if there's dirt or deterioration, otherwise, replace the oil and filter core if necessary by specialized technicians. Make chemical analysis of the lubricating oil, if emulsification phenomenon occurs, change the oil of same brand.

➢ Heat exchangers

Adjust the water flow to keep the high/low pressure within normal range (high pressure 0.6~1.2MPa/low pressure 0.1~0.4,If the temperature difference between leaving cooling water temperature and refrigerant temperature in condenser is larger than 6 °C, it means the condenser is scaling and cleanness work is in urgent need. When the chiller stops for a long time, water in heat exchangers and pipe system should be drained thoroughly. For newly installed chiller, the filters in water system should be cleaned after running for 24 hours and then clean the filters quarterly.

➢ Valves and pressure controllers

▲ Safety valves

Inspect the integrity and performance of valves every year. The maintenance of safety valves should be done by specialized technicians. Take apart the connecting pipe of safety valve, and check it to see

whether there is corrosion, rust, scaling, leakage phenomenon internal (if necessary, replace the safety valve). And also check other operating valves to see whether it's smooth when opening or closing them.

▲ High/low pressure switch

Check their performance whether they are in good condition according to "performance of protection device" monthly, and change the broken one in time. Or the chiller may get damaged when over high pressure or too low pressure happens.

➢ **Chilled water cycling**

Seek the possible leakage on the unit and the pipe joint with leak detector. Expel the water from condenser and evaporator to see whether there's leakage on water inlet and outlet. Leak can be found with electronic detector, torch detector or soap water. The work looking for refrigerant leakage should be carried out at least once/month.

➢ **Electrical control system**

For insulation resistance, check it monthly and it should be over 1MΩ when measuring with ohmmeter of 500VDC. Check the running current and compare with the rated value (refer to Table.9). Check the conductibility of wire and verify whether it's intact and well connected. Fasten the loose bolts. Check other components such as electromagnetic contactor, rotary switch, auxiliary relay, time relay and thermostat whether they are all normal monthly.

Training User Operator

The commissioning process includes training user operators in the following aspects:

1) Stress the safety in shutdown and operation processes.

2) Require the users to carefully read the operation manual of the unit.

   Explain to the users that operation of the unit shall be carried out strictly as per the steps and methods specified in the operation manual. If anyone has any problems about descriptions in the manual, he shall enquire after-sale personnel or professionals in the factory and carry out the operation only when he understands it. Any deviation in the installation of the unit from the requirements in the manual shall be pointed out to the part responsible for installation, and the after-sale personnel or professionals in the factory will determine whether change is necessary.

3) Short-connection is forbidden when all protection functions of the unit are normal. Ensure all protection functions are available and reliable.

   Various protection switches in the unit are for safety of the unit or user, and are not permitted to be short connected in principle. If short-connection is required for commissioning, the operation shall be done by the after-sale personnel or professionals in the factory on site. After the commissioning, connect the protection switches to the system before starting up the unit for long-time running.

4) Open the water pump and wait until the water flow is stable before starting up the master compressor. For shutdown, the water pump must be closed in a delayed time. It is not allowed to forcibly close the water pump when the master compressor is still running. If the water pump fails, and the flow switch does not jump, the unit must be emergently shut down.

5) The unit must be disconnected from the power supply during inspection or replacement of the lines of the unit.

   If it is required to tighten the line bank screw or replacing the wire and element in the electrical cabinet during commissioning and maintenance, it shall be down when the power supply is disconnected. Similar operations by the user in later maintenance and service shall also be done when the power supply is disconnected.

6) The non-user parameters in the touch screen of the unit and electronic expansion valve control module are forbidden to be changed.

   The non-user parameters in the touch screen of the unit and electronic expansion valve control module are directly related to the performance and reliability of the unit, and are not allowed to be changed in principle. Even if it is required to adjust some parameters due to special local climate, it shall be done by or under the instructions of after-sale personnel or professionals in the factory.

7) If any exceptional case occurs to the unit, it is forbidden to forcibly start up the unit unless under the instructions of professionals.

   Exceptional temperature, pressure, sound, or vibration, etc. of the unit during the running shall be clearly recorded in details, and reported to after-sale personnel or professionals in the factory. It is forbidden to forcibly start up the unit unless permitted.

2. Maintenace

If the problem is much more serious, contact your local Trust or your local representative for assistance.

Cleaning Heat Exchangers

Check the chiller tightness and whether there's leak of heat exchange tubes. It is necessary to do nondestructive inspection for the principal weld (longitudinal and circumferential weld of evaporator/condenser barrel) of pressure vessel. Inspect and clean cooler tubes at the end of the first operating season. Tube condition in the exchanger will determine the scheduled frequency for cleaning, and will indicate whether water treatment is adequate in the water circuit. Too much scale will cause big loss of capacity and efficiency.

Refer to the following pressure-temperature curve for condition in heat exchangers:

High pressure-cooling water temperature (high pressure beyond 0.6~1.2MPa is abnormal)

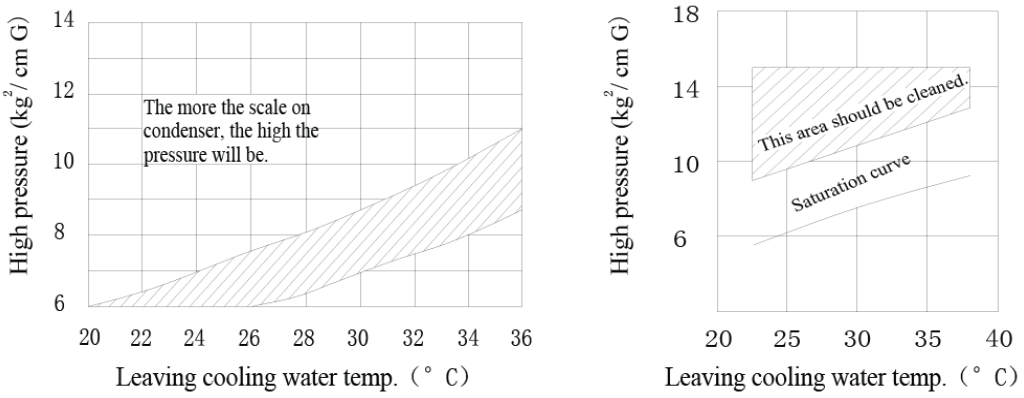


Fig.26 High pressure at full load (standard unit)

Low pressure-chilled water temperature (low pressure beyond 0.14~0.37MPa is abnormal)

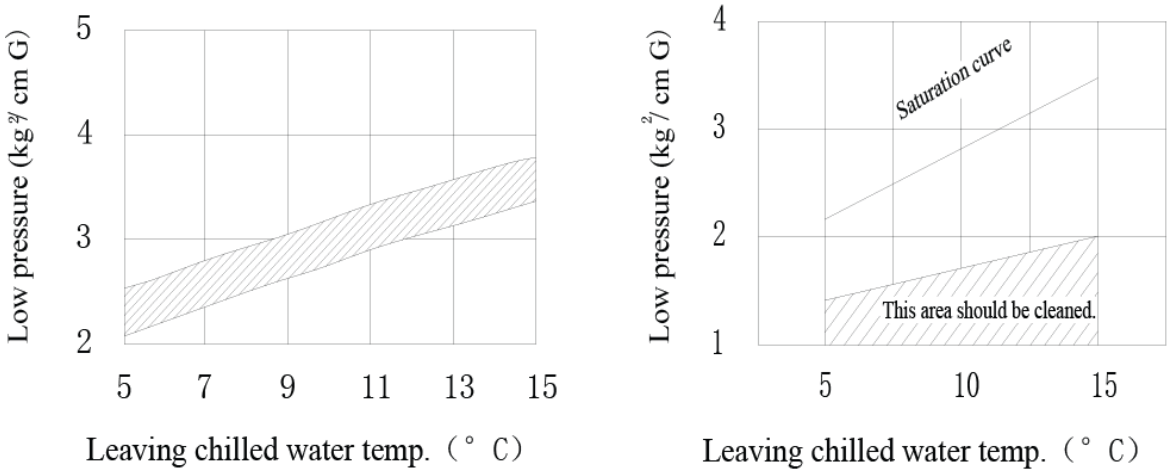


Fig.27 Low pressure at full load (standard unit)

Cleaning work must be done when too much scale found. Physical and chemical cleaning can be chosen according to the device you have. Generally, chemical cleaning is much easier to carry out. Methods are as below and the services of a qualified water treatment specialist should be obtained to develop and monitor a treatment program.

a) Cycle under normal temp. (A):

(Volume of condenser+ volume of pipes+ volume of container)×1/3

Note: concentration of detergent ——33%

b) Cycle under normal temp. (B):

(Volume of cooling tower flume + volume of condenser+ volume of pipes)×1/10

Note: concentration of detergent ——10%

Warning: When doing cleaning with unit stops, volume of cooling tower flume can be 1/2 or 1/3 of rated value; but if doing cleaning with unit is runs, the volume of cooling tower flume should keep rated value.

Trust assumes no responsibility for pressure vessel damage resulting from untreated or improperly treated water.

Requirement for cleaning and maintenance

	Water quality	Scale	Corrosion	Remark
1	PH≤6 Acid water	Hard	Strong	Generates insoluble $CaSO_4$
2	PH≥8 Alkali water	Soft	——	Soft fluid deposit may be caused by ions iron or aluminum
3	Water with much Ca^{2+} and Mg^{2+}	Hard	——	Easily generates hard scale.
4	Water with much Cl^-	Dirt	Ultra-strong	Corrosive to copper and iron.
5	Water with much SO_4^{2-} and SiO_2^{2-}	Hard	Strong	Generates hard $CaSO_4$ and $CaSiO_2$
6	Water with much Fe^{3+}	Large quantity, hard	Strong	Generates deposits $Fe(OH)_3$ and Fe_2O_3
7	Odorous water	Large quantity	Ultra-strong	Generates sulfide, ammonia and marsh gas, especially H_2S which has great corrosion to copper.

8	Water with organic substance	Large quantity	——	Easily generates scale
9	Exhaust gas from auto, chemical factory, plating factory, sewage plant, ammonia refrigeration plant and fiber factory		Strong	Copper tubes of condenser may be eroded and perforated.
10	Dusty places such as plastic plant	Large quantity		
11	Sulfurous gas in the air		Ultra-strong	
12	Natural pollution such as damp air near the coast or insects in the field goes into cooling tower.	Large quantity	Strong	

Cycle under normal temp. (A):

(Capacity of condenser+ Capacity of pipe+ Capacity of container)×1/3(Thickness of detergent 33%)

Cycle under normal temp. (B):

(Capacity of flume of cooling tower+ Capacity of condenser+ Capacity of pipe)×1/10(Thickness of detergent 10%)

In case doing cleaning after the unit stops, the capacity of flume of cooling tower can be 1/2 or 1/3 of rated value; if doing cleaning as the unit is running, the capacity should achieve rated value.

Precautions on usage of detergent

When doing cleaning, please wear rubber gloves and do not expose your skin or your clothes to the detergent. In case touching the detergent, please wash it with clean water.

The container for detergent should be made of plastic or glass rather than lead. The used detergent should be neutralized with lime or soda before draining

Detergent is harmful to human; please keep it away from children.

Turn on the unit after cleaning to ensure it is clean. If necessary, please do cleaning again.

c) Precautions of chemical cleaning

- ✓ When doing cleaning please wear rubber gloves and do not expose your skin or your clothes to the detergent. In case of touching the detergent, please wash with clean water immediately.
- ✓ The container for detergent should be made of plastic or glass rather than lead.
- ✓ The used detergent should be neutralized with lime or soda before draining.
- ✓ Detergent is harmful to human body; please keep it away from children.
- ✓ Turn on the unit to check the effect after cleaning work done. If necessary, please do cleaning again.

Water Treatment

Before every start-up, clean and flush the cooling water circuit. Make sure tower blow-down or bleed-off is operating. It should be recognized that atmospheric air contains many contaminants that increase the need for proper water treatment. The use of untreated water can result in corrosion, erosion, sliming, scaling or algae formation. Trust assumes no responsibility for the results of untreated or improperly treated water.

See appendix 1 for water quality requirements.

Refrigerant Circuit

Leak testing

Units are factory-charged with refrigerant R-22 (Refer to the Physical Data tables supplied in the IOM manual book). Leak test must be done under sufficient pressure. This can be done by charging enough refrigerant into the system to build the pressure up to approximately 70 kPa and adding sufficient dry nitrogen to bring the pressure up to a maximum of 850 kPa. Leak test with an electronic leak detector. Water flow through the vessels must be maintained anytime refrigerant is added or removed from the system. If any leaks are found in welded or brazed joints, or it is necessary to replace a gasket, relieve the test pressure in the system before proceeding. Brazing is required for copper joints. After leaks are repaired, system must be evacuated and dehydrated.

Evacuation

After it has been determined that there are no refrigerant leaks, the system must be evacuated using a vacuum pump with a capacity that will reduce the vacuum to at least 130Pa (=1mmHg). A mercury manometer, or an electronic or other type of micron gauge, must be connected at the farthest point from the vacuum pump. For readings below 130Pa, an electronic or other micron gauge must be used. The triple evacuation method is recommended and is particularly helpful if the vacuum pump is unable to obtain the desired 130Pa of vacuum. The system is first evacuated to approximately 660Pa (=5mmHg). Dry nitrogen is then added to the system to bring the pressure up to zero.
Then the system is once again evacuated to approximately 230Pa(=2mmHg). This is repeated three times. The first pull down will remove about 90% of the non-condensable, the second about 90% of that remaining from the first pull down and, after the third, only 0.2% non-condensable will remain.

Checks on refrigerant charge

To verify if the unit is operating with the correct refrigerant charge, perform the following checks.
1. Run the unit at maximum operating load.
2. Check the leaving chilled water temperature to be between 6~8°C.
3. Check the entering cooling water temperature to be between 25 and 32°C.
4. Under the above mentioned conditions verify the following items.
a) The sub-cooling to be between 4 and 6°C
b) The difference between leaving water temperature and evaporating temperature to be in 4~6°C range.
c) The difference between condensing temperature and condenser leaving water temperature to be in 0.2~3°C range.
e) The evaporator refrigerant level slightly laps last tubes row by checking the sight glass installed on each evaporator for a visual inspection.
f) The condenser refrigerant level to be included between the condensing and the sub-cooling sections by checking the sight glass installed on each condenser for a visual inspection.
5. Verify the sight glass on the liquid piping to be fully charged. If one of the above parameters exceeds the limits, unit may require an additional refrigerant charge.
Note: Refrigerant removing and drain operation must be performed by qualified personnel using correct material. Inappropriate maintenance could lead to refrigerant or pressure loss. Do not discharge the refrigerant or the lubricant oil into the environment. Always use a proper recovery system.

Refer to Physical Data tables supplied in the IOM manual book). Immediately ahead of orifice baffle (see Fig.) is a factory-installed liquid line service angle valve. Each angle valve has a1 5/8-in. threaded connection for charging liquid refrigerant. Connect the refrigerant drum to the gauge port on the liquid line shutoff valve and purge the charging line between the refrigerant cylinder and the valve. Then open the valve to the mid-position.

Turn on both the cooling tower water pump and chilled water pump and allow water to circulate through the condenser and the chiller.

IMPORTANT: When adding refrigerant to the unit, circulate water through evaporator continuously to prevent freezing and possible damage to the evaporator. Do not overcharge, and never charge liquid into the low-pressure side of system.

If the system is under a vacuum, stand the refrigerant drum with the connection up, and open the drum and break the vacuum with refrigerant gas to a saturated pressure above freezing.

With a system gas pressure higher than the equivalent of a freezing temperature, invert the charging cylinder and elevate the drum above the condenser. With the drum in this position, valves open, water pumps operating, liquid refrigerant will flow into the condenser. Approximately 75% of the total requirement estimated for the unit can be charged in this manner.

After 75% of the required charge has entered the condenser, reconnect the refrigerant drum and charging line to the service valve on the bottom of the evaporator. Again purge the connecting line, stand the drum with the connection up, and place the service valve in the open position.

Before replacing electronic expansion valve or thermal expansion valve of the system, pressure sensor sampling shut valve, low pressure pipeline, etc. force the refrigerant in the liquid part of the system.

The particular steps are: (take careful consideration before continuing with the following steps)`

a Close the dry filter angle valve of the system.

b Start up the unit, and emergently stop the unit when the gas in the system is below 0.5bar.

c Close the liquid/air valve of the compressor.

d Discharge the residual refrigerant in the gas system.

e Carry on replacement of the parts of the system.

f After the replacement, extract vacuum in the gas part.

g After the vacuum extraction, keep the negative voltage until the resumed vacuum in the unit meets the requirements.

h Open the angle valve of liquid system and compressor liquid/air stop valve to ensure the loop of the entire system is unobstructed.

i Add proper amount of refrigerant, generally 5~10k.

Compressor Oil System

Each compressor/circuit has its own oil system which includes an oil filter, oil solenoid valve, Venturi tube, oil separator heater, and an oil shut-off valve. A typical oil system is shown in Fig. 34. See Table 33 for oil

charge Quantities.

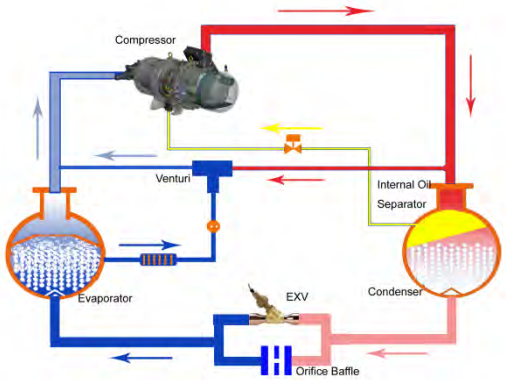


Fig. 34.

Each screw compressor is connected to a tank (oil separator) separating and collecting the oil from discharge gas. The discharge gas pressure pushes the oil back into the compressor for compressor seal and lubrication of all moving parts. During the compression, the oil joints the discharge gas before being conveyed again into the oil separator and re-start the cycle. The oil flow is granted by the pressure difference created between the condenser and the evaporator. This difference depends on the cooling water and evaporator water temperatures. During the start-up it is vital to establish rapidly the appropriate temperature difference, by checking the right cooling water temperature. The head of cooling water pump at zero flow rate should not exceed the maximum working pressure of condenser and plant water side.

- **Oil recovery system**

Each compressor includes a system to recover the oil accumulated inside the evaporator during the normal operation. This system consists of a jet pump able to collect continuously all the oil from the evaporator preventing from the accumulation due to the low speed refrigerant gas. The high-pressure discharge gas feeds the jet pump that creates a depression, which allows the suction of the oil refrigerant mixture from the evaporator into the compressor to re-establish the oil level inside the lubrication system. On the oil recovery piping a sight glass allows to check the oil-gas mixture flow to the compressor. If flow is insufficient or the unit continuously stops for “Low Oil Level” alarm, verify the correct operation of the corresponding circuit.

- **Oil Charging/Low Oil Recharging**

➢ **Pre-cautions in changing of oil**

1. Use only qualified oil and do not mix different brand of oil together. Different kinds of refrigerant should match different kinds of oil, note that some synthetic oil is incompatible with mineral oil.
2. When using the synthetic oil for the chiller system, be sure not to expose the oil to atmosphere for a long time, it is also necessary to vacuum the system completely when installing the compressor.
3. In order to ensure no moisture inside the system, it is suggested to clean the system by charging it with dry Nitrogen and then vacuum the system repeatedly as long as possible.
4. It is essential to change for new oil especially after the motor burns out; the acidity debris still remain inside the system so clean work must be done to overhaul the system. Check the oil acidity after 72 hours of operation and then change it again until the oil acidity is in the standard value.
5. Contact local distributor/agent for concerning unqualified oil to be used.

➢ **Oil change**

1. Change oil periodically: Check the lubrication oil for every 10,000 hours of continuous running. For the first operation of the compressor, it is recommended to change oil and clean oil filter after running at 2,000 hours. Check the system whether clean or not and then change the oil every 20,000 hours or after 3 years of continuous running while the system is operated under good condition.
2. Avoid the debris or swarf clogging oil filter, this may caused bearings failure. The oil pressure differential switch will trip when the oil pressure differential reaches the critical point (default: 150kPa). The compressor will automatically shut down to prevent the bearings from getting damaged due to the lack of lubricating oil.

Caution

Compressor oil is pressurized. Use proper safety precautions when relieving pressure.

➢ **Oil Filter Maintenance**

Each compressor has its own internal oil filter and each circuit also has an in-line external filter located under the external oil separator. The internal oil filter pressure drop should be checked and filter changed (if necessary) after the initial 2000 hours of compressor operation. Oil line pressure loss is monitored by the control and reported for each compressor as the oil filter pressure drop.
Normally the pressure differential (discharge pressure minus oil pressure) is typically less than 150kPa for a system with clean internal and external filters. To determine the oil pressure drop due to the oil lines and external filter only, connect a gage to the oil pressure bleed port. Compare this value to the discharge pressure read at the touch screen. If this value exceeds 150 kPa, replace the external filter.

Moisture-Liquid Indicator

Clear flow of liquid refrigerant indicates sufficient charge in the system. Note, however, that bubbles in the sight glass do not necessarily indicate insufficient charge. Moisture in the system is measured in parts per million (ppm), changes of color of indicator are:
Green—moisture is below 80 ppm;
Yellow-green (chartreuse)—80 to 225 ppm (caution);
Yellow (wet)—above 225 ppm.
Change filter drier at the first sign of moisture in the system.
IMPORTANT: Unit must in operation for at least 12 hours before moisture indicator can give an accurate reading. With the unit running, the indicating element must be in contact with liquid refrigerant to give true reading.

Relief Devices

➢ **Pressure relief valves**

Relief valves are installed on evaporator, condenser and oil separator. These valves are designed to relieve if an abnormal pressure condition arises. Relief valves on condenser relieve at 2.07MPa. These valves should not be capped. If a valve relieves, it should be replaced. If not replaced, it may relieve at a lower pressure compared to the set point, or leak due to trapped dirt from the system which may prevent resealing.

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