LG HVAC Solution

Centrifugal Chiller

LG Electronics

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Nomenclature

R : Korea origin (R134a)
M : China origin (R134a)

W: Water cooled Cooling only

Line up
H : 2-Stage Oil-lubricated
L : Oil-free
M : Modular

Evaporator code

R	C	W	F	H	DP	DB	DB

C: Chiller

F: Centrifugal compressor

Compressor code

Condenser code

Contents

Introduction

Line up

[usRT]

Model		500	1,000	2,000	4,000	5,000
	Conventional Chiller	1 Comp. 200 – 3,000				
		2 Comp. 1,000 – 5,000				
	Oil-free Magnetic Chiller	1 Comp. 200 – 1,100				
		2 Comp. 400 – 2,200				
	Ice-storage Chiller	300 – 1,900				
		Slurry 350 – 600				
	Centrifugal Heat pump	Heating Capacity 2,462 kW – 14,067 kW				

* The above range is based on the nominal tonnage.

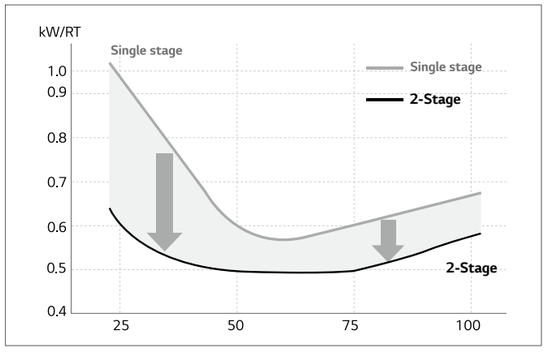
World class high efficiency

The advanced technologies of LG achieve the lowest energy consumption and preserve the environment.

LG chiller offers high-efficiency chlorine-free water-cooled centrifugal chillers using HFC-134a refrigerant. Over three decades of chiller manufacturing and experience in HVAC industry, it has significantly reduced the power consumption of centrifugal chiller with positive-pressure refrigerant HFC-134a, and introduces most cost effective & reliable solutions to all valuable customers. Decreasing hydraulic-head helps to minimize energy loss even further.

Advanced solution for saving energy

The chiller using a two stage compressor developed by the technology of LG increases energy efficiency by 10% ~ 13% at full load conditions as compared to the chiller with single stage compressor, and increases energy efficiency under partial load conditions by 24% or more.



Eco-friendly chiller

The LG chillers use chlorine-free HFC-134a refrigerant having zero ozone-depletion potential.

LG chiller will work as an excellent harmony with environmental friendly facilities.

Saving installation space

LG's optimized chiller design using positive pressure refrigerant minimizes the machine room space and so return a valuable extra space and a cost saving to the customers.

Simple bolting structure

The evaporator, condenser, and compressor are final-assembled with simple bolting and flange connections, LG chiller provides an excellent solution for the retrofit and replacement jobs where are critical difficulties in an installation works within a limited space.

High reliability

LG chillers are designed though 3-dimensional and various dynamic analysis and it increased the reliability.

All components were reliable test and also exclusively selected and manufactured. Factory-run-test are available for all chillers to make sure quality ensurance before factory out as an option by customers.

Optimized & user-oriented control

LG unit controller, Chiller AI Engine was developed based on advanced algorithm, convenient and reliable control concept. Also it provides various customer-oriented functions; graphical display of key data, operation scheduling, help menu for easy trouble shooting, three language support, various industrial standard interface protocols and more.

AHRI certification program

LG chillers has been certified to the air conditioning and refrigeration Institute(AHRI) as complying with the certification sections of the latest issue of AHRI Standard 550/590.

Under this certification program, chillers are regularly tested in strict compliance with this standard. This provides an independent, third-party verification of chiller performance.

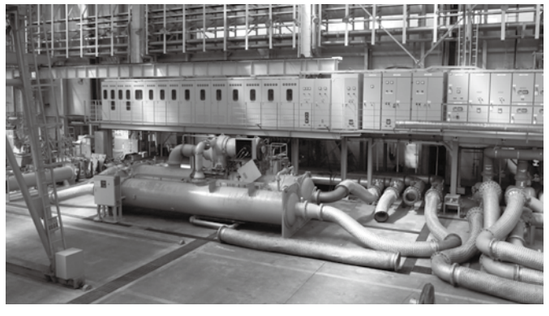
Standards and codes

- AHRI 550/590 - Water chilling packages using the vapor compression cycle.
- ANSI/ASHRAE 34 - Number designation and safety classification of refrigerants.
- ASME section VIII - Boiler and pressure vessel.
  (This code is only applied to product manufactured in Korea)
- CE - Conform to CE testing services for construction of chillers and provide CE listed mark
- KGS AA111/112 – Facility / Technical / Inspection code for manufacture of high pressure gas refrigerators.
  (This code is only applied to product manufactured in Korea)
- KS B 6270 - Manufacturing, testing and quality assurance procedures based KS standard in centrifugal chillers.
  (This code is only applied to product manufactured in Korea)
- GB/T 18430.1 - Water chilling(Heat pump) packages using the vapor compression cycle - Part 1: Water chilling(Heat pump) packages for Industrial & commercial and similar applications.
  (This code is only applied to product manufactured in China)
- GB25131 - Safety requirements for water chillers(Heat pump)using the vapor compression cycle.
  (This code is only applied to product manufactured in China)
- GB150/151 - Steel pressure vessels/tubular heat exchangers.
  (This code is only applied to product manufactured in China)
- ANSI/ASHRAE Standard 15 safety code.
- Manufactured in an EN ISO 9001 accredited organization.
- ETL – Conforms to ANSI/UL STD 1995 certified to CAN/CSA STO C22.2.
- N.E.C. – National electrical code.
- OSHAS 18001 - Occupational safety and health act.

Unit performance test

LG has established one of the largest chiller testing facility in the world. Each LG chiller is thoroughly tested prior to shipment, and is delivered to the customer with full test data included.

Performance test facilities are able to test up to 3,000RT, 13.8kV and also available to accurately recreate a wide variety of environmental conditions, helping the company to tailor its products to the greatest number of markets.

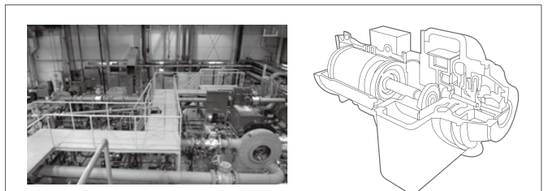


Performance test facilities

Equipment overview

Two stage compressor design

LG Chiller uses simple, compact and economic two stage design with two impellers, variable diffuser and economizer. When operating at light loads with high condensing temperatures, it happen unstable operation, called "surge". But two stage compressor is avoided with two stage design because two stage compressor has wide range of operation. Two stage compressor is possible to flash refrigerant gas at two intermediate pressures between the evaporator and condenser, significantly increasing chiller efficiency. The improvement of efficiency is not available for single stage chiller because all compression is done by single impeller.

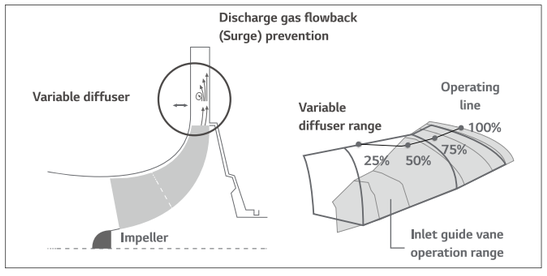


Compressor test facility

Inlet guide vanes

LG chiller adopts IGV(Inlet Guide Vanes) for the capacity control. However, the vane opening is precisely controlled by a modutrol motor. Precise and smooth control of the chilled water temperature can be provided with this simple device.

It adjusts the refrigerant mass flow rate taken through the compressor inlet to adjust the capacity of the chiller, and it adjusts the opening of the vanes using the external actuator. The amount of refrigerant taken in is adjusted according to the set of chilled water outlet temperature.



Variable diffuser

Provides wider operation range at a low-load condition, and prevents stall from discharge gas for stable operation.

Bearing

1. Compressor type : AA ~ EK
- Ball bearing is composed of isolated bearing on motor shaft and angular contact bearings on the impeller shaft.
- Ball bearing structure is subjected to a radial and axial load at the same time.
- Because of less oil flow rate for ball bearings, the rotor dynamic system can be designed with compact size.

2. Compressor type : F1 ~ G3
- Bearing is composed of bearing in motor shaft, radial bearings and thrust bearings on the impeller shaft.
- Bearings with white metal are used to achieve persistence and corrosion resistance. Lubrication system prevents bearings from Metal-to-Metal contact during operation.
- To increase the reliability of the journal bearings, Offset type and 3-Lobe type bearings are applied.

Aerodynamically-shaped impeller

Impellers that utilize 11 back sweep main blades and 11 splitters are aerodynamically shaped to improve compressor efficiency. The blade 3D profiles are designed by using 3D- CFD(Computational Fluid Dynamics) and design database based on compressor tests.

- The vane of impeller designed aerodynamically based on the 3D fluid analysis, guarantees the reliability in any operational condition.
- To minimize vibration, the impeller shall be balanced dynamically. Overall reliability of impellers shall be secured by taking the strength test, hardness test, non-destructive test, etc. for all impellers produced.

Low solidity airfoil diffuser

Using simple 2D airfoils, the low solidity diffuser increases compressor peak efficiency and widen operating range with no moving parts.

Robust rotor dynamic system and transmission

High speed rotating system including bearings are designed to secure the robust operating over the life of the machine at various load conditions.

Equipment overview

Oil pump

The oil pump is driven by an electric motor from the separate power source to prevent the lubrication failure due to abnormal compressor shutdown. It delivers fluent oil to the gears and the 4 bearings when compressor start-up and normal operation.

Oil heater

High speed rotating system including bearings are designed with oil heater installed in the oil sump which is mainly used to dry out the refrigerant mixed in the reclaimed oil from the transmission and the evaporator.

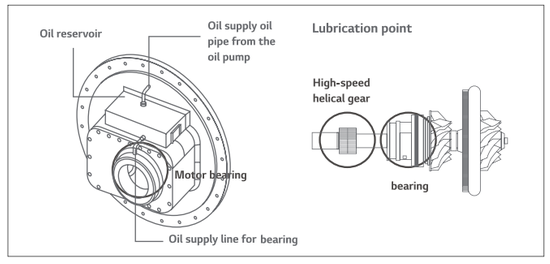
Also, the heater prevents the abrupt mix of oil and refrigerant while compressor shutdown and pre-heats the oil before start-up. All the operation of the heater is controlled by the microprocessor controller.

Oil cooler

A compact refrigerant-oil heat exchanger is used for the oil cooler. The liquid refrigerant can be a safe and effective cooling source in the system. A small amount of liquid refrigerant is extracted at the bottom of the condenser and it cools the hot oil(After lubricating the rotor dynamic system) at the heat exchanger and returns to the evaporator.

Oil reservoir

During the power failure, oil reservoir shall automatically supply oil for compressor bearings to prevent any compressor damage.



Refrigerant-cooled Semi-hermetic Motor

The motor is bolt-connected to the compressor gear housing and the shaft labyrinth seal prevents refrigerant leakage from the motor to the gear box. This semi-hermetic motor is more compact and makes less noise than the air-cooled motor. No heat is ejected to the machine room. No expensive mechanical seal is required. Using motor shaft as a bull gear shaft, no coupling is needed and it minimizes the shaft alignment problems. Like oil cooler, the motor is cooled by the condensed liquid refrigerant, so that the motor wiring can keep low temperature to improve motor efficiency. The liquid refrigerant is sprayed to the several stator locations of the motor for efficient cooling. The optimum locations and the liquid flow rate is designed by a lot of motor tests.

Heat exchangers

Heat exchanger of two-stage centrifugal chiller is composed of two shell type for easy separation into evaporator and condenser. The tubes are arranged so as to maximize the heat exchanging ability. It is also designed so that the refrigerant can be spread evenly on all tubes for the sake of surge prevention and the COP increase in part load operation. A relief valve for an abnormal situation is at the upper part of the heat exchanger.

High performance tubes

Heat transfer coefficients on inner surface are significantly enhanced by selecting optimal ridge size and angle without sacrificing pressure drop. In addition, Enhancement of heat transfer on outer surfaces are respectively designed and tested for easy condensation and evaporation.

Durable heat exchanger

Expansion of tube in double-grooved hole at tube sheet prevents leakage and increases durability of heat exchanger.

Isolation valves(Options)

This valve allows us to replace filter without pump-down of refrigerant. This is installed for less service time and less maintenance cost.

Expansion device and economizer

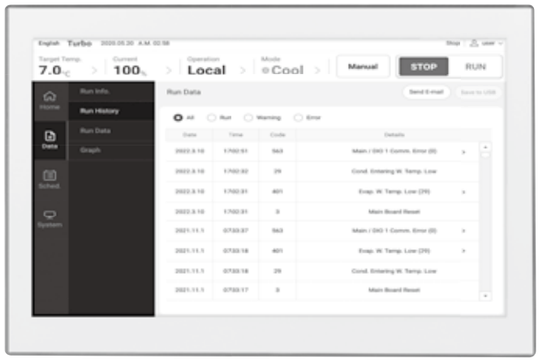
The condensed refrigerant liquid passed the 1st expansion device enters the economizer where refrigerant gas and liquid are segregated. The refrigerant gas is mixed with mid-temperature, mid-pressure gas compressed in the 1st impeller. The refrigerant liquid goes through 2nd expansion device to be taken into evaporator. The mid-temperature and mid-pressure gas between the 1st and the 2nd impeller become cool by mixing with the cool refrigerant gas supplied from economizer before sucked in to the 2nd impeller. As such, when the 2nd impeller discharge gas temperature is decreased by mixing gas from economizer with discharge gas from 1st impeller, power consumption required by compressor is decreased(Increasing cycle efficiency). The efficiency increase much higher than by the 1 Stage compressing method.

Control

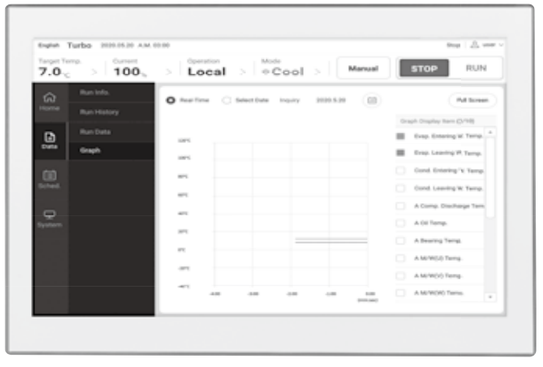
Chiller AI engine

- 15-inch color LCD and resistive touch screen
- Operation scheduling function
- Real time trend display
- Running data acquisition
- Easy-to-read display of operational data
- Communication supported: Modbus, RS485(Standard)
- Language: English / Chinese / Korean

Main Screen



Operation Schedule



Operation Graph

User Report

Microprocessor controls

The control feature optimized to the mechanical device by applying the high-performance microprocessor shall be implemented. The high resolution A/D convertor (Analogue/Digital) shall be applied to display on screen or control by measuring each kind of temperature sensor value in real time. Also, it makes the customer's building automation ease response because the RS-485 communication port to support the customer's remote monitoring control is embedded in a standard.

Safety control

The all safety control inputs and, if required, shuts down the chiller or limits the guide vanes to protect the chiller from possible damage from and of the following conditions:

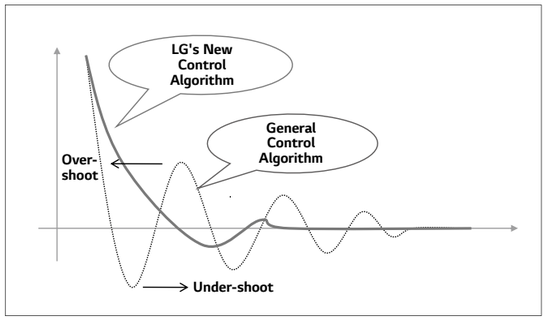
- High bearing temperature
- High motor winding temperature
- High discharge temperature
- Low oil pressure
- Low cooler refrigerant temperature/pressure
- Condenser high pressure or low pressure
- Inadequate water cooler and condenser flow
- Excessive motor acceleration time
- Excessive starter transition time
- Lack of motor current signal
- Excessive motor amps
- Excessive compressor surge
- Temperature and transducer faults
- Soft start system
- Soft stop system
- Control circuit fuse
- Control module fuse
- Oil heater fuse
- Oil pump motor fuse
- Safety relief valve

Basic display items

- Chilled water inlet & outlet temperatures(℃)
- Cooling water inlet & outlet temperatures(℃)
- Compressor discharge temperature(℃)
- Compressor bearing temperature(℃)
- Oil tank temperature(℃)
- Motor windings(R.S.T) temperatures(℃)
- Evaporator pressure(kg/cm^2)
- Condenser pressure(kg/cm^2)
- Oil tank pressure(kg/cm^2)
- Oil pump pressure(kg/cm^2)
- Amperes(A)
- Vane openings(%)
- Remote setting temperature(℃)
- Evaporator temperature(℃)
- Condenser temperature(℃)
- Differential pressure of oil(kg/cm^2)
- Hot-gas valve output(%)
- PID output(%)
- Control output(%)
- Real setting value(℃)

Basic control algorithm

By applying unique P(proportional), I(integral), and D (differential) algorithms to the control of chilled water temperature, optimal control has been achieved compared with the existing methods in virtue of minimized Undershoot and Over-shoot during initial start-up and automatic/ manual conversion of vane operation, remaining deviation, and the time required to approach the target value.



Soft loading

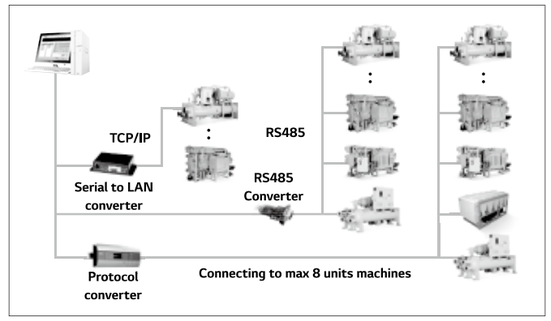
- Approach a control goal by soft operation.
- Resolved unnecessary emergency stop due to rapid guide vane opening which occur in operating.

Advanced control

- High precision control is realized by applying the far advance algorithm compared with existing PID control methods.
- Prevent temperature Cycling phenomenon due to Over-shoot/Under-shoot when converting from manual to automatic mode.
- Intensive Safety Control
  - Minimized unnecessary stops for abnormality of the Chiller by implementing preventive control before the Chiller starts to stop for abnormality.

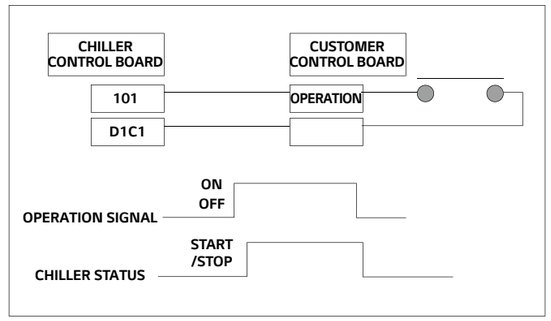
BMS support function

- Communication method
  - Basic: RS-485, Ethernet(Option)
- Protocol
  - Basic: Modbus
  - Option: BACnet, TCP/IP



Remote control signal and status signal connection

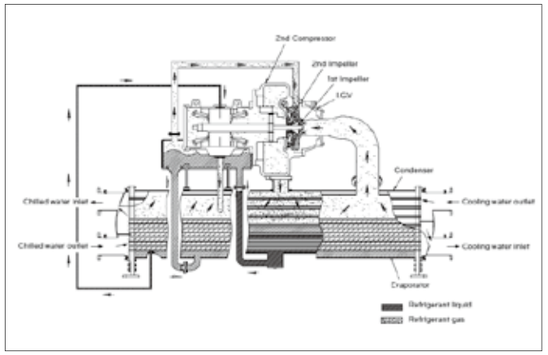
- Method of connecting remote operation/stop signals
  - No voltage contact continuous signal 2 wires



Refrigerant cycle

The two Stage Centrifugal chiller uses environment friendly high pressure refrigerant R-134a.

- In this cycle, as shown in the figure, the vaporized low temperature and low pressure refrigerant gas passes the Inlet Guide Vane, and enters the 1st impeller of the compressor. Since the inlet gas amount is dependent on the guide vane's opening, the chiller capacity can be controlled.
- Refrigerant gas that entered the 1st impeller is compressed to a mid-temperature and mid pressure, passes through the return channel, is mixed with low temperature gas from the economizer, and then enters the 2nd impeller.
- The refrigerant gas entered the 2nd impeller is compressed as high-temperature and high-pressured refrigerant gas, and discharged to the condenser. The gas loses its heat via cooling water in the heat transfer tubes and eventually condensed to liquid.
- The condensed refrigerant liquid passed the 1st expansion device, becomes mixed state and enters the bottom part of the economizer which divides into gas and liquid of refrigerant. The gas part is mixed with the mid temperature and mid pressured gas which was compressed in the 1st impeller, and then enters the 2nd impeller. The liquid part of the refrigerant enters the bottom part of evaporator via 2nd expansion device.
- The liquid refrigerant entered into the evaporator, is then spread into wider surface of evaporator by distributor. Finally the distributed refrigerant is evaporated by taking the heat from the chilled water inside the evaporator tubes and repeats the cycle.
- Some part of the sub-cooled refrigerant liquid in the condenser, flows through the valve, filter, moisture indicator, and enters the motor and oil cooling system individually.
- The refrigerant liquid flew into the motor is being sprayed so that it can cool the motor's coil and is returned to the evaporator.
- The refrigerant flew into the oil cooling system, flows through the plate type oil cooler. Refrigerant that left the oil cooler is then returned to evaporator.



Two stage centrifugal chiller

Lubrication system

Introduction

The discharged lubricating oil by the oil pump enters the oil filter to get rid of any unnecessary foreign substance. This oil becomes cooled to the temperature appropriate for operation condition after going through the oil cooler, part of it directly enters gear and high speed side bearings, and the remainder directly enters motor shaft bearings.

After the process, it will be drained into the oil tank. The above figure shows the lubrication system of two-stage compression type.

Lubrication cycle

Lubricating oil is pumped in through the manual oil charge valve to oil tank. Oil level can be checked through a sight glass on the oil tank. During the operation, the level should be able to be seen at least from one of the sight glasses. The temperature of the oil tank is indicated on the control panel and its temperature should be below 70°C while operating. What the oil pump does is to transfer oil from oil tank to the system and the adequate pressure difference would be more than 0.8kg/cm2. The differential pressure can be seen on the control panel from pressure transmitters on oil tank and oil pump.

There are oil filter and oil cooler in between the oil pump and compressor bearings.

RCWFH Series

Isolation valves are installed at both ends of oil filter ho-using so that no need to drain oil and refrigerant in case of oil filter replacing job. When lubricant oil is flowing to the oil cooler it is cooled by the refrigerant from the condenser.

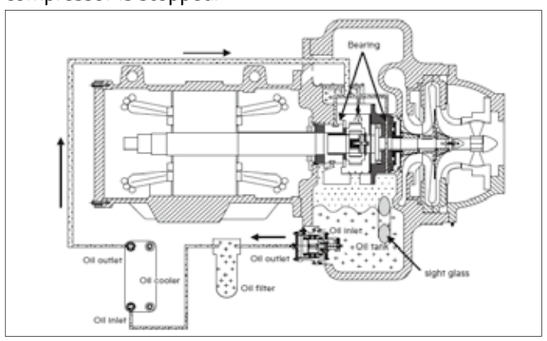
Refrigerant cools down the oil to keep oil temperature below 74°C. Part of the oil flows to the bearing and gear spray, whereas the rest lubricates motor shaft bearings and radial bearings.

Oil temperature in the oil tank is measured by temperature sensor and displayed on control panel. The timer automatically operates the oil pump for 120-180 seconds to maintain a constant pressure before starting compressor. 300-600 seconds of oil circulation is taken place after the compressor is stopped.

MCWFH Series

Isolation valves are installed at both ends of oil filter housing so that no need to drain oil and refrigerant in case of oil filter replacing job. When lubricant oil is flowing to the oil cooler it is cooled by the refrigerant from the condenser. Refrigerant cools down the oil to keep oil temperature below 70°C. Part of the oil flows to the bearing and gear spray, whereas the rest lubricates motor shaft bearings and radial bearings.

Oil temperature in the oil tank is measured by temperature sensor and displayed on control panel. The timer automatically operates the oil pump for 180 seconds to maintain a constant pressure before starting compressor. 300~600 seconds of oil circulation is taken place after the compressor is stopped.



Lubrication cycle

Oil reclaim system

Oil reclaim system provides the system to reclaim the oil from the heat exchanger and let it come back to the oil tank. Normally, it is reclaimed from evaporator, and IGV housing.

Maintenance

Most of the lubrication related deficiencies in rotating parts of the chiller are because of the oil itself. If adequate viscosity, pressure and flow are not obtained, lubricating performance will decrease. Impure substances that are present in the oil also are a cause for the deficiencies. Freon type refrigerant have chemical attraction with the oil.

The viscosity changes according to the temperature and pressure of oil. We have designed the chiller with these problems into consideration. An oil pump run by hermetic electro motor and a heater controlled by the controlling device are installed in the oil tank to prevent the trouble caused by the refrigerant inflow into the oil, decrease of the viscosity, damage of the pump caused by the cavitation(Vaporizing of water and foaming bubbles as becoming partially low pressurized when water or flow at high speed) and the oil inflow into the refrigerant by forming.

For these reasons the oil tank is maintained at a high temperature. The reason to start the oil pump for certain while before the startup of the chiller, is to prevent the compressor's initial unsteady operation because the left over oil in bearings or in the oil line may contain significant amount of refrigerant flow in during the stoppage. After the chiller has been shut down, oil pump will be operated until the compressor is totally stopped since the shaft will be still rotating due to inertia force. The only action that can be taken to prevent lubrication inferiority caused by blazing of the oil is replacing the oil itself. Thus before chiller operation, make sure that you do the oil replacing adequately.

Safety devices

Safety devices (RCWFH Series)

For the sake of safe operation and the protection of the chiller, safety devices are ready as the next table.

No.	Safety Devices	Installation Location	Measurement Item	Description	Quantity
1	Chilled Water Temperature Low	Chilled water outlet nozzle	Chilled water outlet temperature	Chiller stops operation if the chilled water outlet temperature below 3˚C to prevent freezing of the chilled water. Do not change this set value.	1
2	Evaporator Pressure Low (Temperature Low)	Evaporator shell	Vaporizing pressure (Temp.)	If the pressure inside of evaporator reaches below of the following table, then the chiller stops operation. Standard set value 1.95kg/cm^2	1
3	Condenser Pressure High (Temperature High)	Condenser shell	Condensing pressure (Temperature)	If the pressure inside of condenser reaches above of the following table, then the chiller stops operation. Standard setting value 10.00kg/cm^2	1
4	Motor Temperature High	Motor coil	Motor coil temperature	To prevent the motor of the compressor, temperature sensors were installed on each phase of coil and when the temperature exceeds 90˚C, the chiller stops operation.	3
5	Compressor Temperature High	Compressor outlet	Compressor discharge temperature	If the discharging gas temperature of the compressor exceeds over 70˚C, the chiller stops operation.	1
6	Bearing Temperature High	Thrust bearing	Bearing temperature	Temperature sensor is installed on the thrust bearing that holds the impeller's thrust. Chiller will stop operation if the temperature exceeds 85˚C.	1
7	Oil Differential Pressure Low	Oil tank, oil pump outlet	Differential pressure of supplied and intake oil pressure	If the differential pressure between the oil pressure supplied to the bearing and the oil pressure in the oil tank is below 0.8kg/cm^2„ the chiller will stop the operation.	1
8	Oil Temperature High	Oil tank	Oil temperature inside of oil tank	The chiller will stop if the oil temperature in the oil tank is above 74˚C.	1
9	Oil Temperature Low	Oil tank	Oil temperature inside of oil tank	The temperature should be over 30˚C as an initial operating condition to enable the chiller to operate.	1
10	Chilled Water Pump Abnormal	Chilled water header	Chilled water head loss	The chiller will stop if the head loss of the chilled water flow passing through the evaporator tubes decreases so much that the head loss becomes lower than the standard.	1
11	Cooling Water Pump Abnormal	Chilled water header	Cooling water head loss	The chiller will stop if the head loss of the cooling water flow passing through the condenser tubes decreases so much that the head loss becomes lower than the standard.	1
12	Current Limiting Function	Control panel	Current	It is a controlling function of Motor Amps that can be set freely in the range of 40 ~ 100% to adjust the current load to the motor of compressor.	1
13	Moisture Indicator	Refrigerant supply pipe	Moisture in the refrigerant	The moisture indicator changes the color depending on the amount of moisture in the refrigerant. When there is no moisture it will be green, but if not it will be yellow. It is the time to change into a new filter if you can see the yellow color.	1
14	Relief Valve	Evaporator & condenser shell	Relief valves	To prevent the accident by unexpected fire, and so on which can cause pressure increase in the chiller, the relief valve will be operated and exhaust the refrigerant into the air if the pressure exceeds more than the set value. If the chiller is used in a closed environment, please install a pipe that starts from the relief valve to the outer air.	1
15	Vane Full Close Interlock	Vane motor	Operability of temperature sensors	To minimize the starting current, it is a function to enable the compressor to operate only after full close of the guide vane installed at the inlet of the impeller.	1
16	Temperature Sensor Abnormal	6 locations including chilled water nozzle	Each temperature sensor	It alarms when temperature sensor is not connected or due to the sensor's own flaw.	1
17	Pressure Sensor Abnormal	4 locations including Evaporator shell	Each pressure sensor	It alarms when pressure sensor is not connected or due to the sensor's own flaw.	1
18	Overload relay	Control panel	Current	If overload is imposed on compressor motor or oil pump motor, it stops the motor.	1
19	Hot Gas Bypass Valve	Evaporator shell, Condenser shell	Guide vane / hot gas valve opening	It prevents frequent start ups at low load, and hot gas bypass valve opens proportionally when vane becomes 30% or lower. At this time, hot refrigerant gas from condenser goes to evaporator and makes certain chiller load to prevent surge and to prevent frequent stop / start-up of the chiller.	1

Safety devices

Safety devices (MCWFH Series)

For the sake of safe operation and the protection of the chiller, safety devices are ready as the next table.

No.	Safety Devices	Installation Location	Measurement Item	Description	Quantity
1	Chilled Water Temperature Low	Chilled water outlet nozzle	Chilled water outlet temperature	Chiller stops operation if the chilled water outlet temperature below 3˚C to prevent freezing of the chilled water. Do not change this set value.	1
2	Evaporator Pressure Low (Temperature Low)	Evaporator shell	Vaporizing pressure (Temp.)	If the pressure inside of evaporator reaches below of the following table, then the chiller stops operation. Standard set value 2.0kg/cm^2	1
3	Condenser Pressure High (Temperature High)	Condenser shell	Condensing pressure (Temperature)	If the pressure inside of condenser reaches above of the following table, then the chiller stops operation. Standard setting value 10.00kg/cm^2	1
4	Motor Temperature High	Motor coil	Motor coil temperature	To prevent the motor of the compressor, temperature sensors were installed on each phase of coil and when the temperature exceeds 70˚C, the chiller stops operation.	3
5	Compressor Temperature High	Compressor outlet	Compressor discharge temperature	If the discharging gas temperature of the compressor exceeds over 70˚C, the chiller stops operation.	1
6	Bearing Temperature High	Thrust bearing	Bearing temperature	Temperature sensor is installed on the thrust bearing that holds the impeller's thrust. Chiller will stop operation if the temperature exceeds 70˚C.	1
7	Oil Differential Pressure Low	Oil tank, oil pump outlet	Differential pressure of supplied and intake oil pressure	If the differential pressure between the oil pressure supplied to the bearing and the oil pressure in the oil tank is below 1.4kg/cm^2„ the chiller will stop the operation.	1
8	Oil Temperature High	Oil tank	Oil temperature inside of oil tank	The chiller will stop if the oil temperature in the oil tank is above 70˚C.	1
9	Oil Temperature Low	Oil tank	Oil temperature inside of oil tank	The temperature should be over 40˚C as an initial operating condition to enable the chiller to operate.	1
10	Chilled Water Pump Abnormal	Chilled water header	Chilled water head loss	The chiller will stop if the head loss of the chilled water flow passing through the evaporator tubes decreases so much that the head loss becomes lower than the standard.	1
11	Cooling Water Pump Abnormal	Chilled water header	Cooling water head loss	The chiller will stop if the head loss of the cooling water flow passing through the condenser tubes decreases so much that the head loss becomes lower than the standard.	1
12	Current Limiting Function	Control panel	Current	It is a controlling function of Motor Amps that can be set freely in the range of 40 ~ 100% to adjust the current load to the motor of compressor.	1
13	Moisture Indicator	Refrigerant supply pipe	Moisture in the refrigerant	The moisture indicator changes the color depending on the amount of moisture in the refrigerant. When there is no moisture it will be green, but if not it will be yellow. It is the time to change into a new filter if you can see the yellow color.	1
14	Relief Valve	Evaporator & condenser shell	Relief valves	To prevent the accident by unexpected fire, and so on which can cause pressure increase in the chiller, the relief valve will be operated and exhaust the refrigerant into the air if the pressure exceeds more than the set value. If the chiller is used in a closed environment, please install a pipe that starts from the relief valve to the outer air.	1
15	Vane Full Close Interlock	Vane motor	Operability of temperature sensors	To minimize the starting current, it is a function to enable the compressor to operate only after full close of the guide vane installed at the inlet of the impeller.	1
16	Temperature Sensor Abnormal	8 locations including chilled water nozzle	Each temperature sensor	It alarms when temperature sensor is not connected or due to the sensor's own flaw.	1
17	Pressure Sensor Abnormal	4 locations including Evaporator shell	Each pressure sensor	It alarms when pressure sensor is not connected or due to the sensor's own flaw.	1
18	Overload relay	Control panel	Current	If overload is imposed on compressor motor or oil pump motor, it stops the motor.	1
19	Hot Gas Bypass Valve	Evaporator shell, Condenser shell	Guide vane / hot gas valve opening	It prevents frequent start ups at low load, and hot gas bypass valve opens proportionally when vane becomes 30% or lower. At this time, hot refrigerant gas from condenser goes to evaporator and makes certain chiller load to prevent surge and to prevent frequent stop / start-up of the chiller.	1

Accessories and options

Centrifugal chiller standard summary

Items			Standard	Option
Compressor	*Power Supply		☐ 3,300V	☐ 380V ☐ 440V ☐ 6,600V ☐ 11,000V ☐ 13,800V ☐ etc(V)
	*Hertz		☐ 50Hz	☐ 60Hz
	Motor bearing temperature sensor		☐ N/A	☐ Yes
	Motor winding temperature sensor		☐ Single	☐ Dual
	Compressor bearing temperature sensor		☐ Dual	☐ Single
	Partial load Option	Comp. Code(Closed, AA~EP)	☐ I.G.V+HGBP	☐ I.G.V+HGBP+2nd I.G.V
		Comp. Code(Open, F1~G3)	☐ I.G.V+HGBP	☐ I.G.V+HGBP+V.D
Control Panel	Oil Pump		☐ 3Ø 380V	☐ 3Ø 220V ☐ 3Ø 400V ☐ etc( )
	Communication		☐ Modbus	☐ BACnet ☐ TCP/IP ☐ etc( )
	Auxiliary Power		☐ N/A	☐ Yes(UPS: V)
	International Protection		☐ IP41	☐ etc( )
	Controller		☐ Chiller AI Engine	☐ etc( )
Factory Wiring			☐ Duct & Flexible	☐ Open Wiring ☐ etc( )
Starter Panel	*Supplied by		☐ Factory	☐ Supplied by customer
	*Starter Type		☐ Y-Delta(Open)	☐ Soft starter ☐ Reactor ☐ Kondorfer ☐ Direct ☐ Inverter(VSD) ☐ etc( )
	*Mounted Type		☐ Stand alone	☐ Unit mounted
	Circuit Breaker Type	Low V(380V/440V)	☐ MCCB	☐ ACB(65kA) ☐ etc( )
		High V(3,300V~6,600V)	☐ FDS	☐ VCB(Fixed type) ☐ VCB(Draw out type)
			☐ 8kA	☐ 12.5kA ☐ 25kA ☐ 31.5kA
	Power Access		☐ From the top	☐ From the bottom ☐ etc( )
	International Protection		☐ IP41	☐ etc( )
	Power Factor Correction Capacitor		☐ N/A	☐ Yes
	Integrating Watt-meter		☐ N/A	☐ Yes ☐ etc( )
	Ground Fault Protection		☐ N/A	☐ ZCT(NGS) ☐ ZCT(GS)+OCGR ☐ GPT,SGR,ZCT(NGS)
	Momentary Power Loss Compensation		☐ N/A	☐ Yes
	Harmonic Filter		☐ N/A	☐ Passive Filter ☐ Active Filter
EVAP.	*Waterbox Type		☐ NIH(Rectangle)	☐ NIH(Circle) ☐ Marine ☐ Marine + hinged
	*Waterbox Pressure		☐ 150 psig(10kg/cm^2)	☐ 230 psig(16kg/cm^2) ☐ 300 psig(20kg/cm^2)
	Waterbox Coating		☐ Standard	☐ Epoxy Coating
	Nozzle Arrangement(Inlet)		☐ Motor End	☐ Compressor End
	*Nozzle Arrangement(Outlet)		☐ Motor End	☐ Compressor End
	*Nozzle Type		☐ ANSI-Flange	☐ ANSI-Victaulic(AGS) ☐ ANSI-Victaulic(OGS)
	Safety Valve type(Ref.)		☐ Relief V/V(Single)	☐ Relief V/V(Dual)
COND.	*Waterbox Type		☐ NIH(Rectangle)	☐ NIH(Circle) ☐ Marine ☐ Marine + hinged
	*Waterbox Pressure		☐ 150 psig(10kg/cm^2)	☐ 230 psig(16kg/cm^2) ☐ 300 psig(20kg/cm^2) ☐ etc( )
	Waterbox Coating		☐ Standard	☐ Epoxy Coating ☐ etc( )
	*Nozzle Arrangement(Inlet)		☐ Motor End	☐ Compressor End
	*Nozzle Arrangement(Outlet)		☐ Motor End	☐ Compressor End
	Nozzle Type		☐ ANSI-Flange	☐ ANSI-Victaulic(AGS) ☐ ANSI-Victaulic(OGS)
	Safety Valve type(Ref.)		☐ Relief V/V(Single)	☐ Relief V/V(Dual)
*Refrigerant(R134a)			☐ Separated shipping	☐ Customer Supplied ☐ Factory Charged
*Oil Charge			☐ Separated shipping	☐ Customer Supplied ☐ Factory Charged
Welding Method			☐ Standard	☐ etc( )
Packing			☐ Shrink film	☐ Wooden Packing
Insulation			☐ N/A	☐ 19mm ☐ 38mm ☐ etc( )
Sound Attenuator			☐ N/A	☐ Discharge Only ☐ Condenser + Discharge
Isolation			☐ Neoprene PAD	☐ Spring 1inch ☐ Spring 2inch
Anchor Bolt for Foundation			☐ N/A	☐ Yes(Set-Anchor) ☐ Yes(L-TYPE(M20*250L))
Level sensor(2stage, Economizer)			☐ N/A	☐ Yes
Counter Pipe Flange			☐ N/A	☐ Yes
*Certification			☐ Standard(KGS)	☐ ASME Ⅷ Only ☐ CE(PED) ☐ PED ☐ (C)UL(ETL) ☐ GB
Factory Performance Test & Process Inspection			☐ N/A	☐ Report Only ☐ Customer Witness ☐ Process inspection
Startup Commissioning			☐ N/A	☐ Supervising Only
Partial Load Test			☐ N/A	☐ 75% ☐ 50% ☐ 25%
Operating Training			☐ N/A	☐ Yes
Warranty-Compressor			☐ 1yr	☐ etc( )
Warranty-Ass'y			☐ 1yr	☐ etc( )
Labor Warranty			☐ N/A	☐ etc( )
Standard Specification			1) Color : Dawn Gray - Starter Panel : Warm Gray(Unit Mounted), RAL7035(Stand Alone) - Control Panel : Warm Gray 2) MICOM, Display : Chiller AI Engine 15inch 3) Standard provide Internal Inspection Lamp and Emergency stop switch 4) Standard provide VCS(Fixed Type) at high voltage 5) Flow proof type : DP Switch(Evaporator, Condenser)	

* Standard specifications is partially changed depending on the chiller origin.

Specification

RCWFH Series

Model		Units	RCWFHAL	RCWFHAM	RCWFHAN	RCWFHAP	RCWFHBM	RCWFHBN
Cooling Capacity		usRT	200	250	275	300	400	450
		kW	703.3	879.2	967.1	1055.1	1406.7	1582.6
Weight	Shipping	kg	5,100	5,100	5,200	5,200	6,700	6,800
	Operating	kg	5,700	5,800	6,000	6,000	7,700	7,900
Compressor	Type	-	2-stage Centrifugal Compressor					
	No.	EA	1	1	1	1	1	1
Power Supply			3 Ph / 380 ~ 440 V / 50(60)Hz					
Power Supply (Oil Pump)			3 Ph / 220 ~ 400 V / 50(60) Hz					
Evaporator	Nozzle Connection	A	150	150	150	150	200	200
	Flow Rate	m^3/h	109.0	135.9	149.5	163.1	217.5	244.7
	Fouling Factor	m^2℃/kW	0.018	0.018	0.018	0.018	0.018	0.018
	Pressure Drop	mH2O	4.16	3.41	9.46	3.45	3.31	3.45
	Pass Number	EA	2	2	3	2	2	2
Condenser	Nozzle Connection	A	150	150	150	150	200	200
	Flow Rate	m^3/h	137.8	171.5	188.4	205.4	272.9	306.3
	Fouling Factor	m^2℃/kW	0.044	0.044	0.044	0.044	0.044	0.044
	Pressure Drop	mH2O	4.98	4.95	4.21	5.00	5.02	4.85
	Pass Number	EA	2	2	2	2	2	2
Dimension	Length	mm	3,500	3,500	3,700	3,500	3,500	3,500
	Width	mm	2,010	2,010	2,010	2,010	2,240	2,240
	Height	mm	2,020	2,020	2,020	2,020	2,230	2,230

Model		Units	RCWFHBP	RCWFHCM	RCWFHCN	RCWFHCP	RCWFHDM	RCWFHDN
Cooling Capacity		usRT	500	550	600	700	800	900
		kW	1758.4	1934.3	2110.1	2461.8	2813.5	3165.2
Weight	Shipping	kg	6,900	7,600	8,500	8,700	10,100	11,500
	Operating	kg	8,000	8,900	10,000	10,200	11,900	13,800
Compressor	Type	-	2-stage Centrifugal Compressor					
	No.	EA	1	1	1	1	1	1
Power Supply			3 Ph / 380 ~ 440 V / 50(60)Hz					
Power Supply (Oil Pump)			3 Ph / 220 ~ 400 V / 50(60) Hz					
Evaporator	Nozzle Connection	A	200	200	250	250	250	300
	Flow Rate	m^3/h	271.9	299.1	326.2	380.6	435.0	489.4
	Fouling Factor	m^2℃/kW	0.018	0.018	0.018	0.018	0.018	0.018
	Pressure Drop	mH2O	3.44	3.43	3.45	3.98	6.22	6.77
	Pass Number	EA	2	2	2	2	2	2
Condenser	Nozzle Connection	A	200	200	250	250	250	300
	Flow Rate	m^3/h	339.9	375.3	409.8	475.0	545.3	612.2
	Fouling Factor	m^2℃/kW	0.044	0.044	0.044	0.044	0.044	0.044
	Pressure Drop	mH2O	5.04	4.91	4.90	4.83	8.40	7.37
	Pass Number	EA	2	2	2	2	2	2
Dimension	Length	mm	3,500	3,500	3,500	3,500	4,150	4,150
	Width	mm	2,240	2,330	2,330	2,330	2,660	2,660
	Height	mm	2,230	2,470	2,470	2,470	2,800	2,800

Note:
1. 1 usRT = 3,024 kcal / hr = 3.517 kW, 1mH$_2$O = 9.8 kPa
2. Fouling factor of water in condenser is 0.0440 m^2 · ℃ / kW, in evaporator is 0.018 m^2 · ℃ / kW
3. Cooling water temperature outlet is 34.61 ℃, inlet is 29.44 ℃
   Chilled water temperature outlet is 6.67 ℃, inlet is 12.22 ℃
4. Due to our policy of innovation some specifications may be changed without prior notification.
5. All data in this table is rated in accordance with AHRI Standard 550 / 590.

Specification

RCWFH Series

Model		Units	RCWFHDP	RCWFHEM	RCWFHEN	RCWFHEP	RCWFHF1	RCWFHF2
Cooling Capacity		usRT	1,000	1,100	1,300	1,500	1,600	1,800
		kW	3516.9	3868.5	4571.9	5275.3	5627.0	6330.3
Weight	Shipping	kg	11,800	13,900	19,300	18,300	20,700	21,800
	Operating	kg	14,100	16,300	23,600	22,100	25,100	26,500
Compressor	Type	-	2-stage Centrifugal Compressor					
	No.	EA	1	1	1	1	1	1
Power Supply			3 Ph / 380 ~ 440 V / 50(60)Hz		3 Ph / 3,300~13,800 V /50(60)Hz			
Power Supply (Oil Pump)			3 Ph / 220 ~ 400 V / 50(60) Hz					
Evaporator	Nozzle Connection	A	300	300	400	400	400	400
	Flow Rate	m^3/h	543.7	598.1	706.8	815.6	870.0	978.7
	Fouling Factor	$m^2℃/kW$	0.018	0.018	0.018	0.018	0.018	0.018
	Pressure Drop	mH2O	5.50	6.64	6.64	7.91	6.64	11.14
	Pass Number	EA	2	2	2	2	2	2
Condenser	Nozzle Connection	A	300	300	400	400	400	400
	Flow Rate	m^3/h	678.5	750.4	883.2	1015.4	1095.4	1228.6
	Fouling Factor	$m^2℃/kW$	0.044	0.044	0.044	0.044	0.044	0.044
	Pressure Drop	mH2O	8.16	8.24	6.77	10.29	9.33	14.71
	Pass Number	EA	2	2	2	2	2	2
Dimension	Length	mm	4,150	4,340	4,690	4,690	4,890	5,090
	Width	mm	2,660	3,190	3,190	3,190	3,740	3,740
	Height	mm	2,800	3,100	3,100	3,100	3,440	3,440

Model		Units	RCWFHF3	RCWFHG1	RCWFHG2	RCWFHG3	RCWFHHD
Cooling Capacity		usRT	2,000	2,150	2,350	2,500	3,000
		kW	7033.7	7561.2	8264.6	8792.1	10548.8
Weight	Shipping	kg	22,900	29,200	27,700	28,200	39,100
	Operating	kg	28,200	36,100	34,400	35,000	47,600
Compressor	Type	-	2-stage Centrifugal Compressor				
	No.	EA	1	1	1	1	1
Power Supply			3 Ph / 3,300~13,800 V /50(60)Hz				
Power Supply (Oil Pump)			3 Ph / 220 ~ 400 V / 50(60) Hz				
Evaporator	Nozzle Connection	A	450	450	450	450	500
	Flow Rate	m^3/h	1087.5	1169.0	1277.8	1359.3	1634.6
	Fouling Factor	$m^2℃/kW$	0.018	0.018	0.018	0.018	0.018
	Pressure Drop	mH2O	15.23	3.17	3.55	3.36	3.60
	Pass Number	EA	2	1	1	1	1
Condenser	Nozzle Connection	A	400	450	400	450	500
	Flow Rate	m^3/h	1363.3	1462.5	1598.0	1699.8	2034.4
	Fouling Factor	$m^2℃/kW$	0.044	0.044	0.044	0.044	0.044
	Pressure Drop	mH2O	2.38	3.10	4.66	4.66	3.80
	Pass Number	EA	1	1	1	1	1
Dimension	Length	mm	5,900	6,400	7,400	7,400	7,840
	Width	mm	3,740	3,850	3,850	3,850	4,210
	Height	mm	3,440	3,920	3,920	3,920	4,150

Note:
1. 1 usRT = 3,024 kcal / hr = 3.517 kW, 1mH_2O = 9.8 kPa
2. Fouling factor of water in condenser is 0.0440 $m^2 \cdot ℃$ / kW, in evaporator is 0.018 $m^2 \cdot ℃$ / kW
3. Cooling water temperature outlet is 34.61 ℃, inlet is 29.44 ℃
   Chilled water temperature outlet is 6.67 ℃, inlet is 12.22 ℃
4. Due to our policy of innovation some specifications may be changed without prior notification.
5. All data in this table is rated in accordance with AHRI Standard 550 / 590.

Specification

MCWFH Series

Model		Units	MCWFHAL	MCWFHAM	MCWFHAN	MCWFHAP	MCWFHBM	MCWFHBN
Cooling Capacity		usRT	200	250	275	300	400	450
		kW	703	879	967	1,055	1,407	1,582
Weight	Shipping	kg	6,050	6,100	6,150	6,200	8,300	8,600
	Operating	kg	7,000	7,050	7,100	7,150	9,450	9,850
Compressor	Type		2-stage Centrifugal Chiller					
	No	EA	1	1	1	1	1	1
Power Supply			3 Ph / 380V / 50(60) Hz					
Power Supply (Oil Pump)			3 Ph / 220 V ~ 460 V / 50(60) Hz					
Evaporator	Nozzle Connection	A	200	200	200	200	200	200
	Flow Rate	m^2/hr	121	151	166	181	242	272
	Fouling Factor	$m^2°C/kW$	0.018	0.018	0.018	0.018	0.018	0.018
	Pressure Drop	mAq	4.0	4.1	4.1	4.0	4.1	4.3
	Pass Number	EA	2	2	2	2	2	2
Condenser	Nozzle Connection	A	200	200	200	200	200	200
	Flow Rate	m^2/hr	144	179	196	214	284	320
	Fouling Factor	$m^2°C/kW$	0.044	0.044	0.044	0.044	0.044	0.044
	Pressure Drop	mAq	6.1	6.1	6.2	6.1	6.4	6.3
	Pass Number	EA	2	2	2	2	2	2
Dimension	Length	mm	3,620	3,620	3,620	3,620	3,706	3,706
	Width	mm	2,025	2,025	2,025	2,025	2,160	2,160
	Height	mm	2,296	2,296	2,296	2,296	2,280	2,280

Model		Units	MCWFHBP	MCWFHCM	MCWFHCN	MCWFHCP	MCWFHDM	MCWFHDN
Cooling Capacity		usRT	500	550	600	700	800	900
		kW	1,758	1,934	2,110	2,461	2,813	3,165
Weight	Shipping	kg	9,000	9,500	10,500	11,000	12,000	12,500
	Operating	kg	10,300	11,100	12,200	12,800	14,100	14,900
Compressor	Type		2-stage Centrifugal Chiller					
	No	EA	1	1	1	1	1	1
Power Supply			3 Ph / 380V / 50(60) Hz					
Power Supply (Oil Pump)			3 Ph / 220 V ~ 460 V / 50(60) Hz					
Evaporator	Nozzle Connection	A	200	250	250	250	300	300
	Flow Rate	m^2/hr	302	333	363	423	484	544
	Fouling Factor	$m^2°C/kW$	0.018	0.018	0.018	0.018	0.018	0.018
	Pressure Drop	mAq	4.0	4.0	4.0	4.4	6.2	6.2
	Pass Number	EA	2	2	2	2	2	2
Condenser	Nozzle Connection	A	200	250	250	250	350	350
	Flow Rate	m^2/hr	354	391	426	494	567	637
	Fouling Factor	$m^2°C/kW$	0.044	0.044	0.044	0.044	0.044	0.044
	Pressure Drop	mAq	5.9	5.9	5.9	6.3	9.7	8.2
	Pass Number	EA	2	2	2	2	2	2
Dimension	Length	mm	3,706	3,706	3,870	3,870	4,520	4,165
	Width	mm	2,160	2,252	2,450	2,450	2,490	2,635
	Height	mm	2,280	2,630	2,630	2,630	2,630	2,630

Note:
1. 1 usRT = 3,024 kcal / hr = 3.517 kW, 1mH_2O = 9.8 kPa
2. Fouling factor of water in condenser is 0.0440 $m^2 \cdot ℃$ / kW, in evaporator is 0.018 $m^2 \cdot ℃$ / kW
3. Cooling water temperature outlet is 34.61 ℃, inlet is 29.44 ℃
   Chilled water temperature outlet is 6.67 ℃, inlet is 12.22 ℃
4. Due to our policy of innovation some specifications may be changed without prior notification.
5. All data in this table is rated in accordance with AHRI Standard 550 / 590.

Specification

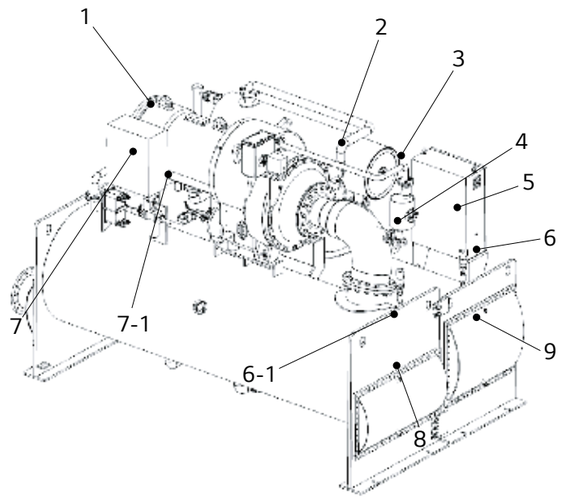
MCWFH Series

Model		Units	MCWFHDP	MCWFHEM	MCWFHEN	MCWFHEP	MCWFHF1
Cooling Capacity		usRT	1,000	1,100	1,300	1,500	1,600
		kW	3,516	3,868	4,571	5,274	5,626
Weight	Shipping	kg	13,000	15,000	19,000	24,200	26,200
	Operating	kg	15,600	17,900	22,500	28,000	30,600
Compressor	Type		2-stage Centrifugal Chiller				
	No	EA	1	1	1	1	1
Power Supply			3 Ph / 10kV / 50(60) Hz				
Power Supply (Oil Pump)			3 Ph / 220 V ~ 460 V / 50(60) Hz				
Evaporator	Nozzle Connection	A	300	350	350	350	400
	Flow Rate	m^2/hr	605	665	786	907	968
	Fouling Factor	m^2°C/kW	0.018	0.018	0.018	0.018	0.018
	Pressure Drop	mAq	6.2	9	8.4	8.7	8.7
	Pass Number	EA	2	2	2	2	2
Condenser	Nozzle Connection	A	350	400	400	400	450
	Flow Rate	m^2/hr	707	781	919	1,056	1,135
	Fouling Factor	m^2°C/kW	0.044	0.044	0.044	0.044	0.044
	Pressure Drop	mAq	9.7	12.3	12.1	12.1	12.1
	Pass Number	EA	2	2	2	2	2
Dimension	Length	mm	4,165	4,155	4,640	4,640	4,685
	Width	mm	2,735	2,750	2,750	2,955	3,440
	Height	mm	2,890	3,035	3,035	3,035	3,510

Model		Units	MCWFHF2	MCWFHF3	MCWFHG1	MCWFHG2	MCWFHG3
Cooling Capacity		usRT	1,800	2,000	2,150	2,630	3,000
		kW	6,329	7,033	7,560	9,248	10,549
Weight	Shipping	kg	28,500	30,000	33,000	36,000	38,500
	Operating	kg	33,200	35,000	38,000	42,500	45,000
Compressor	Type		2-stage Centrifugal Chiller				
	No	EA	1	1	1	1	1
Power Supply			3 Ph / 10kV / 50(60) Hz				
Power Supply (Oil Pump)			3 Ph / 220 V ~ 460 V / 50(60) Hz				
Evaporator	Nozzle Connection	A	400	400	450	450	450
	Flow Rate	m^2/hr	1,089	1,210	1,300	1,591	1,814
	Fouling Factor	m^2°C/kW	0.018	0.018	0.018	0.018	0.018
	Pressure Drop	mAq	8.7	8.7	4.3	4.0	4.0
	Pass Number	EA	2	2	1	1	1
Condenser	Nozzle Connection	A	450	450	500	500	500
	Flow Rate	m^2/hr	1,274	1,412	1,527	1,865	2,121
	Fouling Factor	m^2°C/kW	0.044	0.044	0.044	0.044	0.044
	Pressure Drop	mAq	12.1	12.1	5.7	5.2	5.3
	Pass Number	EA	2	2	1	1	1
Dimension	Length	mm	4,685	4,685	5,908	6,408	6,408
	Width	mm	3,440	3,440	3,640	3,640	3,640
	Height	mm	3,510	3,510	3,732	3,732	3,732

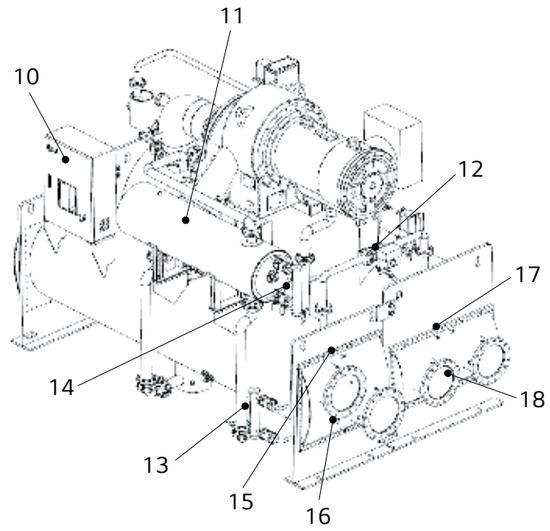
Note:
1. 1 usRT = 3,024 kcal / hr = 3.517 kW, 1mH_2O = 9.8 kPa
2. Fouling factor of water in condenser is 0.0440 $m^2 \cdot$ °C / kW, in evaporator is 0.018 $m^2 \cdot$ °C / kW
3. Cooling water temperature outlet is 34.61 °C, inlet is 29.44 °C
   Chilled water temperature outlet is 6.67 °C, inlet is 12.22 °C
4. Due to our policy of innovation some specifications may be changed without prior notification.
5. All data in this table is rated in accordance with AHRI Standard 550 / 590.

Machine components



Front view

1. Terminal box for compressor motor
2. Actuator(vane motor)
3. Oil separator
4. Evaporator safety valve
5. Condenser safety valve
6. Air vent(for cooling water)
6.1 Air vent(for chilled water)
7. Oil cooler
7.1 Oil filter
8. Drain(for chilled water)
9. Drain(for cooling water)

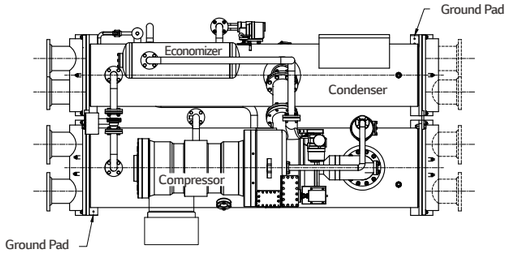


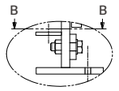
Rear view

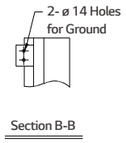
10. Control panel
11. Economizer
12. Hot gas bypass
13. Condenser level sensor
14. Economizer level sensor(Option)
15. Air vent(for cooling water)
16. Drain(for cooling water)
17. Air vent(for chilled water)
18. Drain(for chilled water)

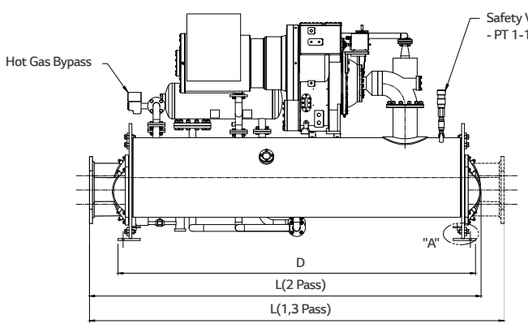
Note:
1. This image may not be same with real.
2. To improve the performance, some specification can be changed without notice.

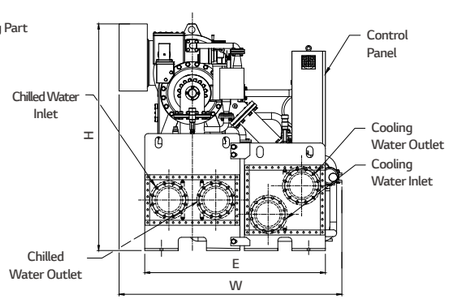
Outline drawing









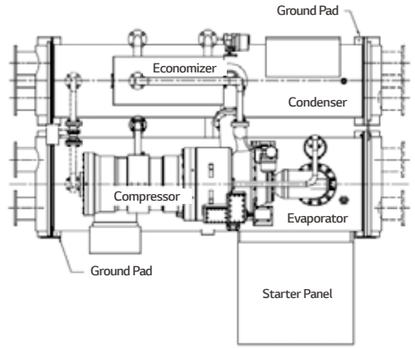


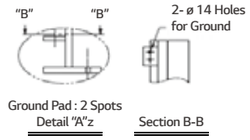
Unit : mm

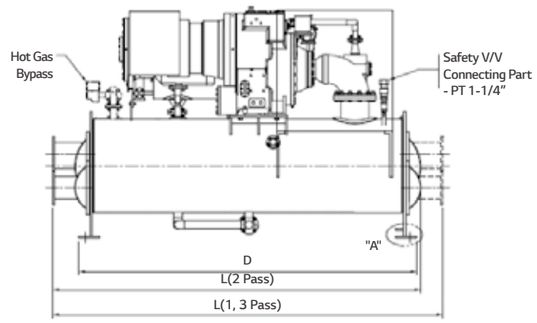
Model		Dimension					
		L		W	H	D	E
		2 Pass	1,3 Pass				
RCWFH	AL~AP	3,500	3,700	2,010	2,020	3,200	1,620
	BM~BP	3,500	3,700	2,240	2,230	3,200	1,900
	CM~CP	3,500	3,700	2,330	2,470	3,200	2,070
	DM~DP	4,150	4,350	2,660	2,800	3,850	2,390
	EM	4,340	4,550	3,190	3,100	3,850	2,820
	EN~EP	4,690	4,900	3,190	3,100	4,200	2,820
	F1	4,890	4,900	3,740	3,440	4,200	3,020
	F2	5,090	5,300	3,740	3,440	4,680	3,020
	F3	5,690	5,900	3,740	3,440	5,200	3,020
	G1	6,190	6,400	3,850	3,920	5,700	3,160
	G2~G3	7,190	7,400	3,850	3,920	6,700	3,160
MCWFH	AL~AP	3,620	3,790	2,030	2,300	3,230	1,660
	BM~BP	3,710	3,930	2,160	2,280	3,230	1,900
	CM	3,710	3,870	2,250	2,630	3,230	1,900
	CN~CP	3,870	4,080	2,450	2,630	3,230	2,170
	DM	4,520	4,730	2,490	2,630	3,880	2,170
	DN	4,170	4,370	2,640	2,630	3,880	2,350
	DP	4,170	4,370	2,740	2,890	3,880	2,470
	EM	4,160	4,360	2,750	3,040	3,880	2,440
	EN	4,640	4,840	2,750	3,040	4,230	2,440
	EP	4,640	4,840	2,960	3,040	4,280	2,750
	F1~F3	4,690	4,910	3,440	3,510	4,300	3,030
	G1	5,690	5,910	3,640	3,730	5,340	3,160
	G2~G3	6,190	6,410	3,640	3,730	5,840	3,160

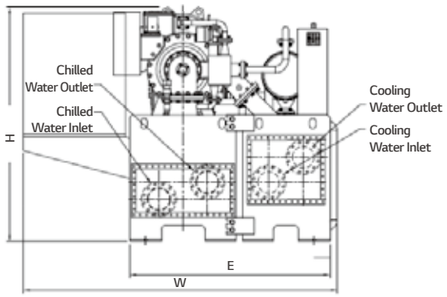
Note:
1. The height is measured from the bottom of the heat exchanger bed. This value does not include the height of the foundation and the vibration-absorbing pedestal.
2. All of the chilled water and cooling water connection flanges are of ANSI 150lb.
3. The water pipe facility shall be designed to preventing external force to the chiller.
4. To improve the performance, some specification can be changed without notice.

Outline drawing (Unit mounted)









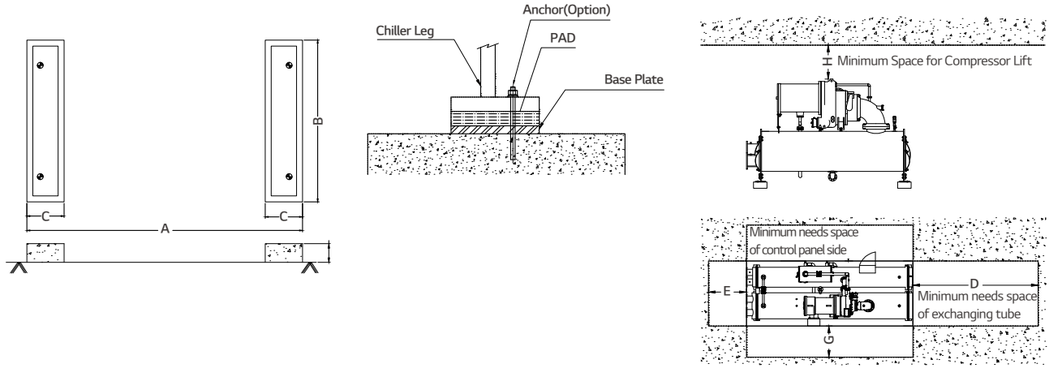
Unit : mm

Model		Dimension					
		L		W	H	D	E
		2 Pass	1,3 Pass				
RCWFH	AL~AP	3,500	3,700	2,720	2,020	3,200	1,620
	BM~BP	3,500	3,700	2,880	2,230	3,200	1,900
	CM~CP	3,500	3,700	3,450	2,470	3,200	2,070
	DM~DP	4,150	4,350	3,750	2,800	3,850	2,390
MCWFH	AL~AP	3,620	3,790	2,030	2,300	3,230	1,660
	BM~BP	3,710	3,930	2,160	2,280	3,230	1,900
	CM~CP	3,710	3,870	2,250	2,630	3,230	1,900
	DM	4,520	4,730	2,490	2,630	3,880	2,170
	DN	4,170	4,370	2,640	2,630	3,880	2,350
	DP	4,170	4,370	2,740	2,890	3,880	2,470
	EM	4,160	4,360	2,750	3,040	3,880	2,440
	EN	4,640	4,840	2,750	3,040	4,230	2,440
	EP	4,640	4,840	2,960	3,040	4,280	2,750

Note:
1. The height is measured from the bottom of the heat exchanger bed. This value does not include the height of the foundation and the vibration-absorbing pedestal.
2. All of the chilled water and cooling water connection flanges are of ANSI 150lb.
3. The water pipe facility shall be designed to preventing external force to the chiller.
4. To improve the performance, some specification can be changed without notice.

Foundation drawing

Foundation drawing



Unit : mm

Model		A	B	C	D	E	F	G	H
RCWFH	AL~AP	3,400	1,820	400	3,100	2,000	1,500	1,500	1,500
	BM~BP	3,400	2,100	400	3,100	2,000	1,500	1,500	1,500
	CM~CP	3,400	2,270	400	3,100	2,000	1,500	1,500	1,500
	DM~DP	4,050	2,590	400	3,800	2,000	1,500	1,500	1,500
	EM	4,050	3,020	400	3,800	2,000	1,500	1,500	1,500
	EN~EP	4,400	3,020	400	4,100	2,000	1,500	1,500	1,500
	F1	4,400	3,220	400	4,100	2,000	1,500	1,500	1,500
	F2	4,880	3,220	400	4,600	2,000	1,500	1,500	1,500
	F3	5,400	3,220	400	5,100	2,000	1,500	1,500	1,500
	G1	5,900	3,380	400	5,600	2,000	1,500	1,500	1,500
	G2~G3	6,900	3,380	400	6,600	2,000	1,500	1,500	1,500
MCWFH	AL~AP	3,480	1,760	500	3,700	2,000	1,500	1,500	1,500
	BM~BP	3,480	2,000	500	3,700	2,000	1,500	1,500	1,500
	CM	3,480	2,000	500	3,700	2,000	1,500	1,500	1,500
	CN~CP	3,480	2,500	500	3,700	2,000	1,500	1,500	1,500
	DM	4,130	2,500	500	3,700	2,000	1,500	1,500	1,500
	DN~DP	4,130	2,700	500	3,700	2,000	1,500	1,500	1,500
	EM	4,130	2,750	500	3,700	2,000	1,500	1,500	1,500
	EN	4,480	2,750	500	4,200	2,000	1,500	1,500	1,500
	EP	4,420	3,000	500	4,200	2,000	1,500	1,500	1,500
	F1~F3	4,420	3,120	500	4,200	2,000	1,500	1,500	1,500
	G1	5,460	3,260	500	5,500	2,000	1,500	1,500	1,500
	G2~G3	5,960	3,260	500	6,000	2,000	1,500	1,500	1,500

Note:
1. Using the installation equipment, level the chiller and attach the vibration proof pad to the chiller plate.
2. The operating weight shall be equally distributed on the 4 supports.
3. The foundation height shall be approximately 150-200mm to work piping and drainage easily.
4. This drawing is the foundation drawing of the standard model. It is possible to differ depend on site conditions.

Typical piping & Wiring

Chilled/cooling water piping

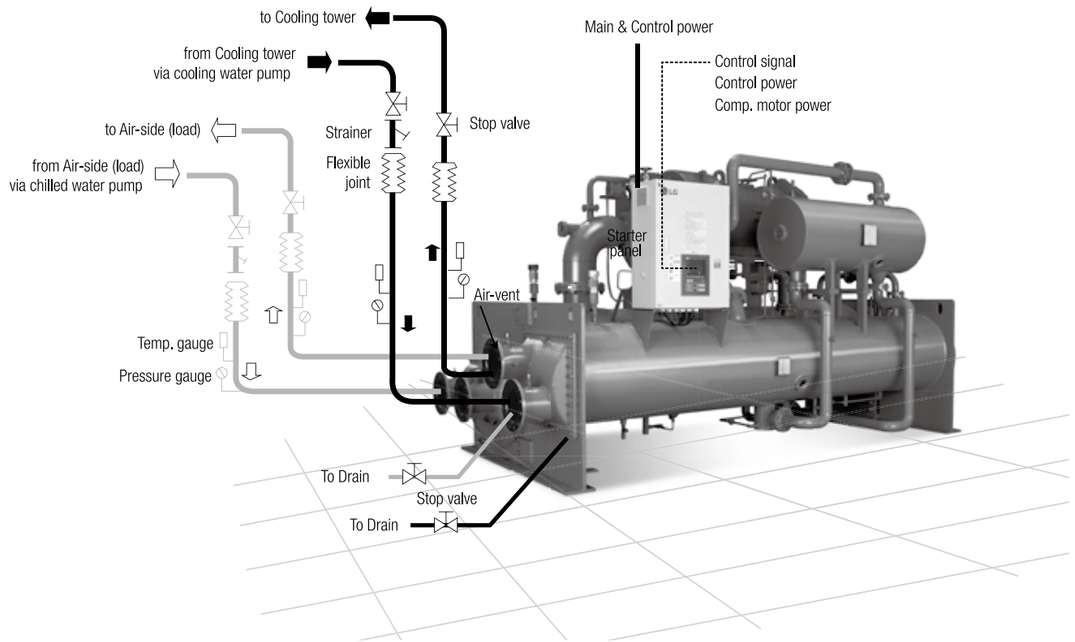
- As a standard, 10 kg/cm^2 of flange is adopted for evaporator and condenser nozzles.
- The inlet nozzle is located on the lower side and the outlet is positioned on the upper side as a standard.
- All piping should be supported independently in order not to convey any stress and vibration onto the Chiller and have sufficient space for maintenance purpose.
- On each water box of evaporator and condenser, it is requested to install air-vent cock, drain valve and piping as well.
- It is strongly to install strainers on each inlet of evaporator and condenser in order to filter foreign materials. If the foreign materials are flowed into the heat exchanger, there is high possibility of decreasing performance.
- It is recommended to install thermometer, pressure gauge and flow meter to measure the chiller operational condition.

Control of cooling water temperature

As a standard, 10 kg/cm^2 of standard flange is adopted for evaporator and condenser nozzles. In general, if the atmospheric temperature falls lower than design temperature condition cooling water from the cooling tower decrease as well.

Therefore, for whole-year-operation chillers, it is strongly recommended to control the cooling tower fan according to outlet temperature of cooling tower and adopt by-pass system in parallel. The by-pass system is positioned on the outlet of cooling water and bypass the cooling water through 3-way control valve working at condensation pressure.

The 3-way control valve can be alternated with 2 units of butterfly valve. The system should maintain min. 14 degree C of temperature difference between cooling water outlet and chilled water outlet.

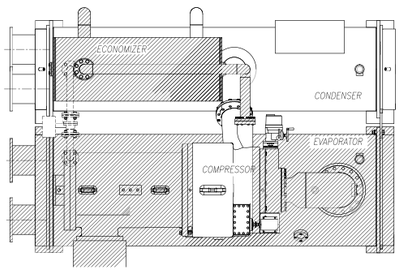


Notes:
1. Control power - 3Phase/220V/50Hz(60Hz) - should be provided by the customer apart from main power source.
2. The Main power wiring to the starter and 2nd wiring between the chiller and starter must be done based on local regulation. And the work scope is purchaser's.

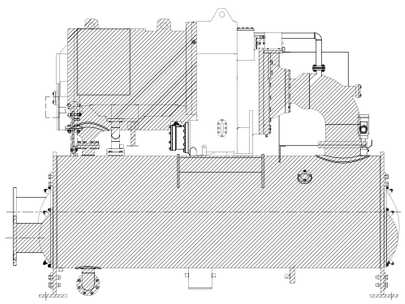
Insulation

Insulation material

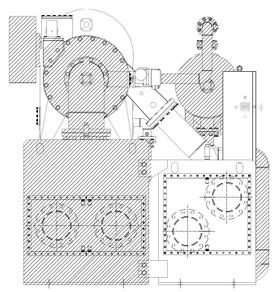
- Acrylonitrile-Butadiene Rubber (NBR), Black, Thickness : 19mm↑



Top View



Front view



End view

Insulation Work Scope

Insulation work scope

- Compressor Motor, Suction refrigerant pipe, Evaporator, Economizer, Water box, Chilled inlet/outlet nozzle, Low pressure liquid refrigerant pipe, Refrigerant charging pipe and so on..

Caution for insulation work

1) Be careful not to cover the operating part (Vane starter, valve, handle etc.) with the insulation material or touch the insulation material.
2) Set up the insulation so that the insulation material can be removed at the part where the bolts are tightened in the water box so that the water box can be opened when cleaning the tube of the heat exchanger. Also consider keeping the cover of the water box easy to separate. (Also install the flange for the water pipe so that it is easy to separate.)
3) For the part where the compressor and main pipe bolts are located, set up the insulation so that it is easy to remove the insulation material during overhaul or check.
4) Be careful not to block the liquid level gauge and window with the insulation material.
5) Set up the insulation so that it is easy to separate and replace the temperature sensor etc.
6) For the insulation material, use product with thermal conductivity and quality or higher than specified in the specification provided LG Electronics.
7) Install the insulation material firmly using adhesive and completely close the gap between insulation material and the insulating part so that air does not go in.
8) For the thickness and specification of the insulation material, follow the construction drawing of insulation approved by LG Electronics and the standard design condition is as follows.
   - Dry bulb temperature
   - Relative humidity
9) After the insulation, be careful not to expose to excessive sunlight or cause any damage while working. Deformed or damaged part causes dew drops to form and must be reworked.

Memo

Guide specification

2Stage Centrifugal Chiller
RCWF H Series

Contents

LG
Life's Good

1. Range of application

This specifications is applied to all the models of the two-stage HFC-134a centrifugal chillers(RCWFH***) manufactured and supplied by LG Electronics.

2. Equipment features

2.1. System structure

1) The high efficiency centrifugal chiller apply the two-stage compression and two-stage expansion cycle and be designed to allow capacity change by applying an inlet guide vane(IGV) in the inlet of the compressor.
2) The economizer makes the maintenance convenient with external type.
3) By Controlling the refrigerant level of condenser and economizer, so that achieve high efficiency in the full load and partial load condition.
4) The compressor should secure the reliability of refrigerant leakage by applying the semi-hermetic type. The motor should guarantee the stability of the product by applying the cooling method using the refrigerant of the system itself.

2.2. Performance and quality

1) The product should be evaluated complying with the standard of AHRI(Air Conditioning, Heating And Refrigeration Institute) Standard 550-590/551-591, the international authorized certified institute.
2) The refrigerant, R-134a, environmental refrigerant with Ozone Depleting Potential(ODP) of zero, shall be applied.
3) The pressure vessel should be designed, produced, tested, complying with KGS Code, and certified in related authorized institute. On the top of evaporator and condenser, the safety valve should be installed according to KGS Code.

2.3. Equipment specification

2.3.1. Equipment composition

The Chiller consists of the compressor and motor, evaporator, condenser, economizer, lubrication system, refrigerant control device, capacity control device, refrigerant pipe, control panel, stater panel, safety device, cold insulation & vibration isolator device for insulation and vibration-proof. The starter panel is supplied by the manufacturer with chiller.

2.3.2. Compressor and motor

1) The compressor is a high-efficiency semi-hermetic and centrifugal 2-stage type for HFC-134a. The impeller is made of high-strength special aluminum alloy. The return channel installed between 1-stage impeller and 2-stage impeller is designed in structure that can optimize flow loss, so it should have structure that minimizes efficiency loss and easy service.
2) The motor shall be liquid refrigerant-cooled type and the outside of the motor should be insulated with anti-humidity insulation to prevent condensation.
3) The motor shaft should be a both-end support structure with high efficiency. Motor winding temperature should be monitored at the control panel in real-time when running by embedding the motor winding temperature sensor.
4) The motor winding should have special insulation to keep refrigerant resistance about the HFC-R134a and oil resistance in lubrication.
5) It should be applied the ball bearing. And when the oil pump and compressor are stopped at the same time due to the power failure, by the compressor has independent oil storage sump, oil should be supplied to the bearings for a certain time of remaining rotation, so that the bearings are lubricated.
6) The IGV controlling the compressor capacity has the structure with multiful vane, and should be able to minimize the flow loss in the impeller inlet.
7) To manage the stable operation of high-speed radial and axial bearing, it should be able to monitor and manage temperature in real time by installing the two(One spare included) bearing temperature sensor.

2.3.3. Lubrication system

1) A trochoid type semi-hermetic oil pump should be adopted for constant and stable oil supply with low noise / vibration. And it should be able to control the oil volume by the control valve.
2) The motor of oil pump should have special insulation to keep refrigerant resistance about the HFC-R134a and oil resistance in lubrication. It should be embedded type and structured to supply oil always stably from the oil tank to suction of oil pump.
3) The oil filter should be a structure replaceable by installing the valve on the inlet/outlet for service.
4) The oil cooler should apply the external plate type heat exchanger which is durable and easy for maintenance, and it should be installed after the filter.
5) The oil heater should be controlled to maintain the appropriate temperature of the oil. And It should be structured that only the oil heater can be replaced for service.
6) The external oil separator should be installed on the refrigerant gas pipe returned from the oil tank. And heat exchange performance of heat exchanger should be optimized by minimizing the oil inflow to the heat exchanger so that minimizing solubility of oil in refrigerant at the heat exchanger.

2.3.4. Evaporator, condenser and economizer

1) The evaporator and condenser should be applied with the structure of the shell & tube type and high-efficiency heat-transfer tubes. The heat-transfer tubes shall be combined with mechanical expansion on the tube sheet so that it can be replaced for service. The tube sheet holes for the assemble of heat-transfer tubes should secure the long-term safety of leakage.
2) In the evaporator, a distribution plate with perforated sheet type should be installed at the liquid refrigerant inlet so that the refrigerant distribution can be uniformly supplied.
3) The condenser should have an anti-collision plate installed at the gas inlet, and the anti-collision plate must have a structure that allows noise reduction and stable diffusion of flow paths.
4) The heat-transfer tubes shall be machined to improve heat transfer performance inside and outside the tube and parts in contact with tube sheets and tube support plates shall not be machined.
5) The pressure vessel should be designed, produced, tested, complying with KGS Code, and certified in related authorized institute. On the top of evaporator and condenser, the safety valve should be installed according to KGS Code.
6) The design pressure on the chilled water side of the evaporator is 10k g/cm^2(150 psig).
7) The design pressure on the chilled water side of the condenser is 10k g/cm^2(150 psig).
8) It should be a structure available for air vent on top of the water box and drain at the bottom of the water box.
9) The economizer is the external type and able to manage the service and operation state. It is manufactured with structure that has the function of separating the liquid and gaseous phases inside.
10) The water box of the evaporator applies the Head (Rectangle) type.
11) The chilled water inlet nozzle of the evaporator is installed in the direction of the compressor motor side.
12) The water box of the condenser applies the Head (Rectangle) type.
13) The cooling water inlet nozzle of the condenser is installed in the direction of the compressor motor side.

2.3.5. Refrigerant level and flow control device

1) The level detecting sensor should be attached to maintain the optimal cycle on the condenser and economizer at the full load or partial load. By controlling two automation valves for controlling the refrigerant flow rate installed in the liquid refrigerant pipe, the optimal refrigerant level in each cycle should be maintained. The refrigerant level control sensor installed in the condenser and econimiser should make it possible without extracting refrigerant in case of inspection because the isolation valves are installed to make the service and maintenance easy.
2) It should make stable motor cooling and oil cooling possible even when the cooling water is operated at a low temperature by securing the appropriate refrigerant level in the condenser at the partial load condition.

2.3.6. Control panel

1) The composition of the control panel

The control panel should compose the micom module(main module, input/output module, display and operation key, or touchpad module), power supply system to supply the stable power, breaker to perform the other control or secure the safety, electromagnetic contactor, and control relay.

The protection grade of the control panel is IP41.

2) Main module

The control feature optimized to the mechanical device by applying the high-performance micro-processor shall be implemented. The high resolution A/D convertor(Analogue/Digital) shall be applied to display on screen or control by measuring each kind of temperature sensor value in real time. Also, it makes the customer's building automation ease response because the RS-485 communication port to support the customer's remote monitoring control is embedded in a standard.

3) Display and touchpad module

The display and touchpad module is composed of ① the display part to display the various kinds operation data, setting value important for equipment operation and the abnormal data with the letter, ② the touch input part to input the various kinds data and select the menu, ③ the display part to display equipment run/stop state important for equipment run, compressor run, chilled water/cooling water flow, abnormal occur state, refrigerant valve manual selection states with the letter. Especially as for the operational function to use often by the operator when equipment is operating, it should be improved operator's convenience by operating with direct touch and other operation by choosing the menu. Especially, the operator's convenience should be improved by allowing the operator to directly touch and control the frequently used control functions while the equipment is operating, and for other function to control by selecting the menu.

The touchpad should offer the operation and monitoring convenience by composing the letter display part and menu choosing button on display.

Also, the display part should display by choosing the operating state such as inlet/outlet temperature of chilled/cooling water, compressor discharge temperature, motor bearing temperature, condenser and evaporator pressure, operating current, refrigerant valve opening rate into Korean, Chinese, English.

4) Input/output module

The input/output module should be composed of the digital input part to check the operation state of various kinds of switches and the digital output to control the equipment operation. Also, the input/output port has a photo coupler blocking each kind of noise. Since all data is transmitted and received with the main module through communication, it secures high reliability by preventing the malfunction caused by electromagnetic wave to happen when transmitting and receiving the data of general cable.

2.3.7. The feature of control function

1) Convenient operation data management

The controller makes any operation information check on one screen simultaneously by applying the big graphic liquid crystal display(15 inches). In addition, It also makes analog data(ex: temperature data) saved in every 5 second up to one year times and operation/error history(ex: run, stop) saved until 300 times are used when recording operation reports and maintaining the management. In addition, the trend identification of temperature and operation current change by marking the graphical information such as chilled water outlet temperature and operation current of the compressor motor should be easy. This graph should be checked in real time, and possible to call and check the saved operation data on a daily basis.

2) Self-diagnosis and save of abnormality history

Micom monitors the chiller state during chiller stop or running, makes notice to operator using a text, alarm lamp, buzzer, makes auto-saving of failure data and occurring time which can be utilized in repairing conveniently. Especially, the types of failures are classified into minor failure and major failure, and when a minor failure occurs, the contents of the minor failure are displayed in text and the operation continues to minimize unnecessary chiller stop.

3) It should be control the chiller by applying the optimized AI control algorism as follow.

a. Soft start

It should be control the vane gradually to prevent machinery shock such as surging caused by sudden increase in load when starting.

b. Digital PID control

When starting or changing the operating mode from manual to automation, by perceiving the optimized PID control point automatically and reflecting it in the control equation, the digital PID control that combined with soft start makes unnecessary machinery stop minimize and makes more stable and precised temperature control.

c. Preventive operation

By measuring each part temperature and pressure during the operation in real-time and performing the primary and secondary preventive operation according to measurement result, It should prevent the chiller stop caused by abnormality such as overload, high pressure of condenser, low pressure of evaporator, surging in advance.

d. Scheduled operating function

Scheduled operating function is available to choose the operation mode, set temperature, limit of motor current, which makes the convenience on chiller operation by applying the scheduled operating function one time or by day or by time within the selected period. It should be possible to choose the exception day of(reservation operating) scheduled operating and to register the overlapped schedule on the same day.

e. Service function

It makes the maintenance convenient by supporting the service function of the below content.

- The automatic sensor setting function that automatically sets each sensor by software.
- The function to display the number of starts and total operation time of the pump and motor attached to the main body.
- The function to send the operation data or abnormal data by email.

4) Strong customer support function

a. Help function

If the breakdown occurs, it makes the operator's convenience by recording failure details, and showing clarification of how to respond if the operator selects the type of failure from the menu.

b. Communication function for building automation and remote monitoring control

It is equipped with the Modbus communication function available to conveniently connected with the customer's monitoring system.

The zero voltage input/output should be provided to run/stop in the remote or to monitor the operating state of the chiller using the simple electric wiring.

5) Indications
All Indications are displayed as text on LCD.
a. Chiller run/stop
b. Compressor operation
c. Oil pump operation
d. Oil heater operation
e. Chilled water flow normal
f. Cooling water flow normal
g. Vane manual
h. Oil pump manual

2.3.8. Starter panel
1) It is the steel plate cubicle type. It is installed with motor protection relay that protects against overcurrent, short circuit, phase loss, reverse phase, unbalance, restrictions, etc. The voltmeter, ammeter, current selection switch, power indicator, run lamp, abnormality lamp, stop lamp, breaker for circuit protection, reset switch used in case of abnormality should be attached to the panel.
2) Protective relay
a. Motor protection relay should be attached. (Overcurrent, short circuit, phase loss, reverse phase, unbalance, lock protection)
b. The low voltage, high voltage, SAG protective device by interlocking the control panel display should be provided.
c. Electric power monitoring should be possible by interlocking the control panel display.
3) Operation and instrument panel
Indicator lamp, breaker for circuit protection, voltmeter, ammeter, voltage and current phase conversion switch
4) Indicator lamp: The Indicator lamp turns on in the following three cases.
a. Power indicator lamp(White)
b. Operation indicator lamp(Red)
c. Stop indicator lamp(Green)
5) The starter panel is separately and exclusively installed from the chiller.
6) The Starter panel power cable is supplied from the top of panel.

2.3.9. Safety device
1) Chilled Water Low Temperature [temperature sensor at chilled water outlet] _ Protect the evaporator from freeze.
2) Evaporator Low Pressure [evaporator pressure sensor] _ Protect evaporator from abnormal low pressure.
3) Condenser High Pressure [condenser pressure sensor] _ Protect chiller from abnormal high pressure of condenser.
4) Bearing High Temperature [bearing temperature sensor] _ Protect compressor from abnormal temperature of bearing.
5) Oil Differential Low Pressure [oil tank & discharge-side pressure sensor] _ Protect compressor from abnormal oil supply differential pressure.
6) Oil Differential High Pressure [oil tank & discharge-side pressure sensor] _ Protect compressor from abnormal oil supply differential pressure.
7) Oil High Temperature [oil tank temperature sensor] _ Protect compressor from high oil temperature.
8) Oil Low Temperature [oil tank temperature sensor] _ Protect compressor from low oil temperature.
9) Chilled Water Pump Abnormal [interlock with chilled water pump] _ Protect chiller from chilled water pump.
10) Cooling Water Pump Abnormal [interlock with cooling water pump] _ Protect chiller from abnormal cooling water pump.
11) Chilled Water Flow Rate Abnormal [chilled water differential pressure switch] _ Protect chiller from abnormal chilled water flow rate.
12) Cooling Water Flow Rate Abnormal [cooling water differential pressure switch] _ Protect chiller from abnormal cooling water flow rate.
13) Surge Abnormal [control panel] _ Protect compressor from surges.
14) Oil Pump Over-Current [over-current relay] _ Protect compressor from motor/oil pump over-current.
15) Motor Reverse Phase/Phase Loss/Over-Current _ Protect chiller from motor reverse phase / phase loss / over-current.
16) Safety Valve [evaporator] _ Discharge refrigerant to protect the chiller in case of the pressure is abnormally high.
17) Safety Valve [condenser] _ Discharge refrigerant to protect the chiller in case of the pressure is abnormally high.
18) Current Limiting Function [control panel] _ Operation current limited operation, compressor protection/ user convenience
※ The temperature of the cooling water shall be adjusted to keep the temperature difference 14°C or higher between the chilled water outlet and the cooling water outlet.

2.3.10. Isolator
The sandwich-type vibration-proof pad(Material : rubber and cork) for vibration isolator device is supplied.

2.3.11. Cold insulation
1) The cold Insulation is excluded from the supply range of the manufacturer(LG Electronics).

2.3.12. Start-up commissioning
1) LG engineer or designated engineer for the start-up commissioning shall carry out start-up commissioning and provide the operation training.

3. Scope of construction

Items	Supplied by	Notes
Painting	LG Electronics	Main body: Dawn Gray Control panel: Warm Gray Starter panel: RAL7035
Transportation and installation	LG Electronics	According to customer's demand, chiller will be transported and installed at the installation place or foundation.
Leaking test, Insulation test, Put the refrigerant	LG Electronics	The work doing before start-up commissioning at the installation place
External piping	Customer	Mean the external pipe construction such as chilled water, cooling water and drain
Power system wiring (on the first side)	Consumer	Power wiring between customer MCC and stater panel
Control system wiring (on the first side)	Consumer	Supplies the 3Ph, 440V/ 400V/380V/ 220VAC of control power to control panel.
Grounding	Customer	Grounding wiring construction of ground Pad installed in the main body of the chiller
Power system wiring (on the second side)	Customer	Power and grounding wiring construction between the chiller and starter panel
Control system wiring (on the second side)	Customer	Means the control wiring between starter panel and control panel
Building and foundation	Customer	Prepare the basis construction for chiller installation before its installation
Chiller horizontality work	LG Electronics	This work will be proceeded when installing chiller according to customer's demand.
Start-up commissioning and operating guidance	LG Electronics	Conduct 1 time a day (8 hours) (Supply the necessary electricity, chilled water, cooling water)
Interlock wiring work for chilled water, cooling water pump	Customer	Wiring between control panel and pump control panel
Oil	LG Electronics	Oil is a polyester series and uses the chiller exclusive oil of LG Electronics.

4. Scope of supply

Items	Whether if supply or not	Notes
Chiller body	LG Electronics	Refers to the body components
Refrigerant (R-134a)	LG Electronics	Separate delivery
Vibration proof pad	LG Electronics	The pad for vibrational absorption.
The chiller instruction manual	LG Electronics	Installation and operation manual
Horizontal plate	LG Electronics	Parts used to horizontal level of chiller (Provided if request)
Starter panel	LG Electronics	Starter system of compressor motor.
Packing	LG Electronics	Shrink film

5. The warranty and service

5.1. Standard warranty period is 12 Months from date of commissioning or 18 Months from the date of shipment(STD) from factory whichever comes first. It's valid only if start up & commissioning work is carried out by certified LG Electronics service. Also, warranty shall not apply, if the Products have been subjected to misuse, abuse, negligence, improper installation, improper maintenance, improper transportation, accident, alteration or design change by anyone other than LGE.

5.2. Failure, caused by a defect in the parts, material, or operation during the warranty period, will be inspected by LG ELECTRONICS and fixed free of charge if it is agreed that it is defective.

5.3. For the following, LG ELECTRONICS don't fix free of charge.
1) If a failure occurs after the product is repaired at the shop that is not designated by LG ELECTRONICS.
2) If the failure is caused by user's mistakes in using and handling the equipment.
3) The monopoly or handover to other places during the warranty period.
4) If a failure is caused by a fire or a natural disaster.

6. General details

6.1. Before producing the chillers, getting the approval is required by submitting all the details about production to the customer and the production should be implemented after getting a permit in the negotiation with the customer, as for the details not included marked in these specifications.

6.2. Before the disposal of the product, if you monopoly or hand it over to others, you should inform LG electronics.

7. Caution details

7.1. In case of drain work is progressed after completing the hydraulic pressure test or the circulation test of chilled/cooling water before the start-up and commissioning of the chiller, the chiller should be kept with opening each drain valve of pipe because the freeze and burst can occur by remaining water under the environmental condition of below 0°C outdoor temperature.(Until filling up the make-up water)

Guide specification

2Stage Centrifugal Chiller
MCWF H Series

Contents

LG
Life's Good

1. Range of application

This specifications is applied to all the models of the two-stage HFC-134a centrifugal chillers(MCWFH***) manufactured and supplied by LG Electronics.

2. Equipment Features

2.1. System structure

1) The high efficiency centrifugal chiller apply the two-stage compression and two-stage expansion cycle and be designed to allow capacity change by applying an inlet guide vane(IGV) in the inlet of the compressor.
2) The economizer makes the maintenance convenient with external type.
3) By Controlling the refrigerant level control device installed in the condenser with micom, and installing gravity type of variable expansion device on the economizer, so that achieve high efficiency in the full load and partial load condition.
4) The compressor should secure the reliability of re-frigerant leakage by applying the semi-hermetic type. The motor should guarantee the stability of the product by applying the cooling method using the refrigerant of the system itself.

2.2. Performance and quality

1) The product should be evaluated complying with the standard of AHRI(Air Conditioning, Heating And Refrigeration Institute) Standard 550-590/551-591, the international authorized certified institute.
2) The refrigerant, R-134a, environmental refrigerant with Ozone Depleting Potential(ODP) of zero, shall be applied.
3) The pressure vessel should be designed, produced, tested, complying with GB Code, and certified in related authorized institute. On the top of evaporator and condenser, the safety valve should be installed according to GB Code.

2.3. Equipment specification

2.3.1. Equipment composition

The Chiller consists of the compressor and motor, evaporator, condenser, economizer, lubrication system, refrigerant control device, capacity control device, refrigerant pipe, control panel, stater panel, safety device, cold insulation & vibration isolator device for insulation and vibration-proof.

The starter panel is supplied by the manufacturer with chiller.

2.3.2. Compressor and motor

1) The compressor is a high-efficiency semi-hermetic and centrifugal 2-stage type for HFC-134a. The impeller is made of high-strength special aluminum alloy. The return channel installed between 1-stage impeller and 2-stage impeller is designed in structure that can optimize flow loss, so it should have structure that minimizes efficiency loss and easy service.
2) The motor shall be liquid refrigerant-cooled type and the outside of the motor should be insulated with anti-humidity insulation to prevent condensation.
3) The motor shaft should be a both-end support structure with high efficiency. Motor winding temperature should be monitored at the control panel in real-time when running by embedding the motor winding temperature sensor.
4) The motor winding should have special insulation to keep refrigerant resistance about the HFC-R134a and oil resistance in lubrication.
5) It should be applied the ball bearing. And when the oil pump and compressor are stopped at the same time due to the power failure, by the compressor has independent oil storage sump, oil should be supplied to the bearings for a certain time of remaining rotation, so that the bearings are lubricated.
6) The IGV controlling the compressor capacity has the structure with multiful vane, and should be able to minimize the flow loss in the impeller inlet.
7) To manage the stable operation of high-speed radial and axial bearing, it should be able to monitor and manage temperature in real time by installing the two(One spare included) bearing temperature sensor.

2.3.3. Lubrication system

1) A trochoid type semi-hermetic oil pump should be adopted for constant and stable oil supply with low noise / vibration. And it should be able to control the oil volume by the control valve.
2) The motor of oil pump should have special insulation to keep refrigerant resistance about the HFC-R134a and oil resistance in lubrication. It should be embedded type and structured to supply oil always stably from the oil tank to suction of oil pump.
3) The oil filter should be a structure replaceable by installing the valve on the inlet/outlet for service.
4) The oil cooler should apply the external plate type heat exchanger which is durable and easy for maintenance, and it should be installed after the filter.
5) The oil heater should be controlled to maintain the appropriate temperature of the oil. And It should be structured that only the oil heater can be replaced for service.
6) The external oil separator should be installed on the refrigerant gas pipe returned from the oil tank. And heat exchange performance of heat exchanger

should be optimized by minimizing the oil inflow to the heat exchanger so that minimizing solubility of oil in refrigerant at the heat exchanger.

2.3.4. Evaporator, condenser and economizer

1) The evaporator and condenser should be applied with the structure of the shell & tube type and high-efficiency heat-transfer tubes. The heat-transfer tubes shall be combined with mechanical expansion on the tube sheet so that it can be replaced for service. The tube sheet holes for the assemble of heat-transfer tubes should secure the long-term safety of leakage.
2) In the evaporator, a distribution plate with perforated sheet type should be installed at the liquid refrigerant inlet so that the refrigerant distribution can be uniformly supplied.
3) The condenser should have an anti-collision plate installed at the gas inlet, and the anti-collision plate must have a structure that allows noise reduction and stable diffusion of flow paths.
4) The heat-transfer tubes shall be machined to improve heat transfer performance inside and outside the tube and parts in contact with tube sheets and tube support plates shall not be machined.
5) The pressure vessel should be designed, produced, tested, complying with GB Code, and certified in related authorized institute. On the top of evaporator and condenser, the safety valve should be installed according to GB Code.
6) The design pressure on the chilled water side of the evaporator is 10k g/cm^2(150 psig).
7) The design pressure on the chilled water side of the condenser is 10k g/cm^2(150 psig).
8) It should be a structure available for air vent on top of the water box and drain at the bottom of the water box.
9) The economizer is the external type and able to manage the service and operation state. It is manufactured with structure that has the function of separating the liquid and gaseous phases inside.
10) The water box of the evaporator applies the Head (Circle) type.
11) The chilled water inlet nozzle of the evaporator is installed in the direction of the compressor motor side.
12) The water box of the condenser applies the Head (Circle) type.
13) The cooling water inlet nozzle of the condenser is installed in the direction of the compressor motor side.

2.3.5. Refrigerant level and flow control device

1) To achieve high efficiency in the full load and partial load condition, The refrigerant level control device shall be installed in the condenser with micom, and gravity type of variable expansion device on the economizer, so that maintain optimal refrigerant level in each cycle.
2) The gravity type automatic expansion device that controls the refrigerant level by buoyancy without the electric control signal should be installed inside the economizer as a level control device.
3) It should make stable motor cooling and oil cooling possible even when the cooling water is operated at a low temperature by securing the appropriate refrigerant level in the condenser at the partial load condition.

2.3.6. Control panel

1) The composition of the control panel

The control panel should compose the micom module (main module, input/output module, display and operation key, or touchpad module), power supply system to supply the stable power, breaker to perform the other control or secure the safety, electromagnetic contactor, and control relay.

The protection grade of the control panel is IP41.

2) Main module

The control feature optimized to the mechanical device by applying the high-performance microprocessor shall be implemented. The high resolution A/D convertor (Analogue/Digital) shall be applied to display on screen or control by measuring each kind of temperature sensor value in real time. Also, it makes the customer's building automation ease response because the RS-485 communication port to support the customer's remote monitoring control is embedded in a standard.

3) Display and touchpad module

The display and touchpad module is composed of ① the display part to display the various kinds operation data, setting value important for equipment operation and the abnormal data with the letter, ② the touch input part to input the various kinds data and select the menu, ③ the display part to display equipment run/stop state important for equipment run, compressor run, chilled water/cooling water flow, abnormal occur state, refrigerant valve manual selection states with the letter. Especially as for the operational function to use often by the operator when equipment is operating, it should be improved operator's convenience by operating with direct touch and other operation by choosing the menu. Especially, the operator's convenience should be improved by allowing the operator to directly touch and control the frequently used control functions while the equipment is operating, and for other function to control by selecting the menu.

The touchpad should offer the operation and monitoring convenience by composing the letter display part and menu choosing button on display. Also, the display part should display by choosing the operating state such as inlet/outlet temperature of chilled/cooling water, compressor discharge temperature, motor bearing temperature, condenser and evaporator pressure, operating current, refrigerant valve opening rate into Korean, Chinese, English.

The touchpad should offer the operation and monitoring convenience by composing the letter display part and menu choosing button on display. Also, the display part should display by choosing the operating state such as inlet/outlet temperature of chilled/cooling water, compressor discharge temperature, motor bearing temperature, condenser and evaporator pressure, operating current, refrigerant valve opening rate into Korean, Chinese, English.

4) Input/output module

The input/output module should be composed of the digital input part to check the operation state of various kinds of switches and the digital output to control the equipment operation. Also, the input/output port has a photo coupler blocking each kind of noise. Since all data is transmitted and received with the main module through communication, it secures high reliability by preventing the malfunction caused by electromagnetic wave to happen when transmitting and receiving the data of general cable.

2.3.7. The feature of control function

1) Convenient operation data management

The controller makes any operation information check on one screen simultaneously by applying the big graphic liquid crystal display(15 inches). In addition, It also makes analog data(ex: temperature data) saved in every 5 second up to one year times and operation/error history(ex: run, stop) saved until 300 times are used when recording operation reports and maintaining the management. In addition, the trend identification of temperature and operation current change by marking the graphical information such as chilled water outlet temperature and operation current of the compressor motor should be easy. This graph should be checked in real time, and possible to call and check the saved operation data on a daily basis.

2) Self-diagnosis and save of abnormality history

Micom monitors the chiller state during chiller stop or running, makes notice to operator using a text, alarm lamp, buzzer, makes auto-saving of failure data and occurring time which can be utilized in repairing conveniently. Especially, the types of failures are classified into minor failure and major failure, and when a minor failure occurs, the contents of the minor failure are displayed in text and the operation continues to minimize unnecessary chiller stop.

3) It should be control the chiller by applying the optimized AI control algorism as follow.

a. Soft start

It should be control the vane gradually to prevent machinery shock such as surging caused by sudden increase in load when starting.

b. Digital PID control

When starting or changing the operating mode from manual to automation, by perceiving the optimized PID control point automatically and reflecting it in the control equation, the digital PID control that combined with soft start makes unnecessary machinery stop minimize and makes more stable and precised temperature control.

c. Preventive operation

By measuring each part temperature and pressure during the operation in real-time and performing the primary and secondary preventive operation according to measurement result, It should prevent the chiller stop caused by abnormality such as overload, high pressure of condenser, low pressure of evaporator, surging in advance.

d. Scheduled operating function

Scheduled operating function is available to choose the operation mode, set temperature, limit of motor current, which makes the convenience on chiller operation by applying the scheduled operating function one time or by day or by time within the selected period. It should be possible to choose the exception day of(reservation operating)scheduled operating and to register the overlapped schedule on the same day.

e. Service function

It makes the maintenance convenient by supporting the service function of the below content.

- The automatic sensor setting function that automatically sets each sensor by software.
- The function to display the number of starts and total operation time of the pump and motor attached to the main body.
- The function to send the operation data or abnormal data by email.

4) Strong customer support function

a. Help function

If the breakdown occurs, it makes the operator's convenience by recording failure details, and showing clarification of how to respond if the operator selects the type of failure from the menu.

b. Communication function for building automation and remote monitoring control

It is equipped with the Modbus communication

function available to conveniently connected with the customer's monitoring system.

The zero voltage input/output should be provided to run/stop in the remote or to monitor the operatingstate of the chiller using the simple electric wiring.

5) Indications

All Indications are displayed as text on LCD.

a. Chiller run / stop
b. Compressor operation
c. Oil pump operation
d. Oil heater operation
e. Chilled water flow normal
f. Cooling water flow normal
g. Vane manual
h. Oil pump manual

2.3.8. Starter panel

1) It is the steel plate cubicle type. It is installed with motor protection relay that protects against overcurrent, short circuit, phase loss, reverse phase, unbalance, restrictions, etc. The voltmeter, ammeter, current selection switch, power indicator, run lamp, abnormality lamp, stop lamp, breaker for circuit protection, reset switch used in case of abnormality should be attached to the panel.
2) Protective relay
   a. Motor protection relay should be attached. (Overcurrent, short circuit, phase loss, reverse phase, unbalance, lock protection)
   b. The low voltage, high voltage, SAG protective device by interlocking the control panel display should be provided.
   c. Electric power monitoring should be possible by interlocking the control panel display.
3) Operation and instrument panel
   Indicator lamp, breaker for circuit protection, voltmeter, ammeter, voltage and current phase conversion switch
4) Indicator lamp: The Indicator lamp turns on in the following three cases.
   a. Power indicator lamp(White)
   b. Operation indicator lamp(Red)
   c. Stop indicator lamp(Green)
5) The starter type of compressor motor is reactor.
6) The starter panel is separately and exclusively installed from the chiller.
7) The Starter panel power cable is supplied from the top of panel.

2.3.9. Safety device

1) Chilled Water Low Temperature [temperature sensor at chilled water outlet] _ Protect the evaporator from freeze.
2) Evaporator Low Pressure [evaporator pressure sensor] _ Protect evaporator from abnormal low pressure.
3) Condenser High Pressure [condenser pressure sensor] _ Protect chiller from abnormal high pressure of condenser.
4) Bearing High Temperature [bearing temperature sensor] _ Protect compressor from abnormal temperature of bearing.
5) Oil Differential Low Pressure [oil tank & discharge-side pressure sensor] _ Protect compressor from abnormal oil supply differential pressure.
6) Oil Differential High Pressure [oil tank & discharge-side pressure sensor] _ Protect compressor from abnormal oil supply differential pressure.
7) Oil High Temperature [oil tank temperature sensor] _ Protect compressor from high oil temperature.
8) Oil Low Temperature [oil tank temperature sensor] _ Protect compressor from low oil temperature.
9) Chilled Water Pump Abnormal [interlock with chilled water pump] _ Protect chiller from chilled water pump.
10) Cooling Water Pump Abnormal [interlock with cooling water pump] _ Protect chiller from abnormal cooling water pump.
11) Chilled Water Flow Rate Abnormal [chilled water differential pressure switch] _ Protect chiller from abnormal chilled water flow rate.
12) Cooling Water Flow Rate Abnormal [cooling water differential pressure switch] _ Protect chiller from abnormal cooling water flow rate.
13) Surge Abnormal [control panel] _ Protect compressor from surges.
14) Oil Pump Over-Current [over-current relay] _ Protect compressor from motor/oil pump over-current.
15) Motor Reverse Phase/Phase Loss/Over-Current_ Protect chiller from motor reverse phase/phase loss/over-current.
16) Safety Valve [evaporator] _ Discharge refrigerant to protect the chiller in case of the pressure is abnormally high.
17) Safety Valve [condenser] _ Discharge refrigerant to protect the chiller in case of the pressure is abnormally high.
18) Current Limiting Function [control panel] _ Operation current limited operation, compressor protection/ user convenience

※ The temperature of the cooling water shall be adjusted to keep the temperature difference 14°C or higher between the chilled water outlet and the cooling water outlet.

2.3.10. Isolator

The sandwich-type vibration-proof pad(Material : rubber and cork) for vibration isolator device is supplied.

2.3.11. Cold insulation

1) The cold Insulation is excluded from the supply range of the manufacturer(LG Electronics).

2.3.12. Start-up commissioning

1) LG engineer or designated engineer for the start-up commissioning shall carry out start-up commissioning and provide the operation training.

3. Scope of construction

Items	Supplied by	Notes
Painting	LG Electronics	Main body: Dawn Gray Control panel: Warm Gray Starter panel: RAL7035
Transportation and installation	LG Electronics	According to customer's demand, chiller will be transported and installed at the installation place or foundation.
Leaking test, Insulation test, Put the refrigerant	LG Electronics	The work doing before start-up commissioning at the installation place
External piping	Customer	Mean the external pipe construction such as chilled water, cooling water and drain
Power system wiring (on the first side)	Consumer	Power wiring between customer MCC and stater panel
Control system wiring (on the first side)	Consumer	Supplies the 3Ph, 440V/ 400V/380V/ 220VAC of control power to control panel.
Grounding	Customer	Grounding wiring construction of ground Pad installed in the main body of the chiller
Power system wiring (on the second side)	Customer	Power and grounding wiring construction between the chiller and starter panel
Control system wiring (on the second side)	Customer	Means the control wiring between starter panel and control panel
Building and foundation	Customer	Prepare the basis construction for chiller installation before its installation
Chiller horizontality work	LG Electronics	This work will be proceeded when installing chiller according to customer's demand.
Start-up commissioning and operating guidance	LG Electronics	Conduct 1 time a day (8 hours) (Supply the necessary electricity, chilled water, cooling water)
Interlock wiring work for chilled water, cooling water pump	Customer	Wiring between control panel and pump control panel
Oil	LG Electronics	Oil is a polyester series and uses the chiller exclusive oil of LG Electronics.

4. Scope of supply

Items	Whether if supply or not	Notes
Chiller body	LG Electronics	Refers to the body components
Refrigerant (R-134a)	Customer	Separate delivery
Vibration proof pad	LG Electronics	The pad for vibrational absorption.
The chiller instruction manual	LG Electronics	Installation and operation manual
Starter panel	LG Electronics	Starter system of compressor motor.
Packing	LG Electronics	Shrink film

5. The warranty and service

5.1. Standard warranty period is 12 Months from date of commissioning or 18 Months from the date of shipment(STD) from factory whichever comes first. It's valid only if start up & commissioning work is carried out by certified LG Electronics service. Also, warranty shall not apply, if the Products have been subjected to misuse, abuse, negligence, improper installation, improper maintenance, improper transportation, accident, alteration or design change by anyone other than LGE.

5.2. Failure, caused by a defect in the parts, material, or op-eration during the warranty period, will be inspected by LG ELECTRONICS and fixed free of charge if it is agreed that it is defective.

5.3. For the following, LG ELECTRONICS don't fix free of charge.

1) If a failure occurs after the product is repaired at the shop that is not designated by LG ELECTRONICS.
2) If the failure is caused by user's mistakes in using and handling the equipment.
3) The monopoly or handover to other places during the warranty period.
4) If a failure is caused by a fire or a natural disaster.

6. General details

6.1. Before producing the chillers, getting the approval is required by submitting all the details about production to the customer and the production should be implemented after getting a permit in the negotiation with the customer, as for the details not included marked in these specifications.

6.2. Before the disposal of the product, if you monopoly or hand it over to others, you should inform LG electronics.

7. Caution details

7.1. In case of drain work is progressed after completing the hydraulic pressure test or the circulation test of chilled/cooling water before the start-up and commissioning of the chiller, the chiller should be kept with opening each drain valve of pipe because the freeze and burst can occur by remaining water under the environmental condition of below 0°C outdoor temperature. (Until filling up the make-up water)

Memo

Memo