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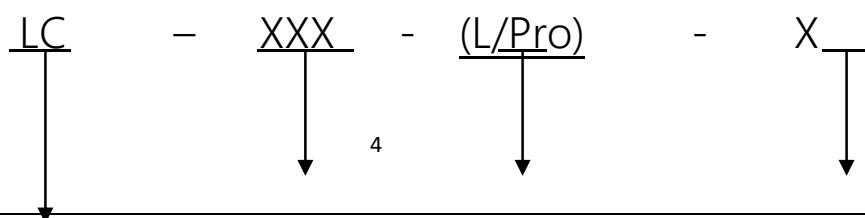
I. Overview

1.1 Product Introduction

In recent years, Hanbell Precision Machinery has integrated its application experience in the low-temperature field and customer needs, and has carefully developed a new generation of LC series low-temperature dedicated screw refrigeration compressors. This series of products integrates variable volume ratio, integrated oil circuit configuration, and tooth shape customized for low-temperature conditions. It can be widely used in many industries and fields such as refrigeration, industrial process cooling, and freeze drying. It is competitive and is another elite product of Hanbell Precision Machinery in the field of low-temperature applications in recent years.

This technical manual contains the size, installation, accessories, operation, application and basic troubleshooting of the compressor. It is recommended to read this technical manual carefully before designing, installing, operating and maintaining the LC series compressor to avoid unnecessary damage to the compressor.

1.2 Naming principles



Exhaust volume		Application Code	Motor Type
Single stage		Omit: standard	Omit: Standard motor
Cryogenic freezing	unit	L : Wide temperature range	V : Frequency
Special screw compressor	(m ³ /h)	Pro : Wide temperature range	conversion motor
		equipped with	
		Zhongxin Cloud Platform	

- Compressor rated power: 380V/50Hz. If customers need other special voltage and frequency, please contact HANBELL。
- The standard motor for LC products is a 3-phase 2-pole squirrel cage induction motor.
- Frequency conversion type is LC-V and LC-Pro-V

1.3 Design Specifications

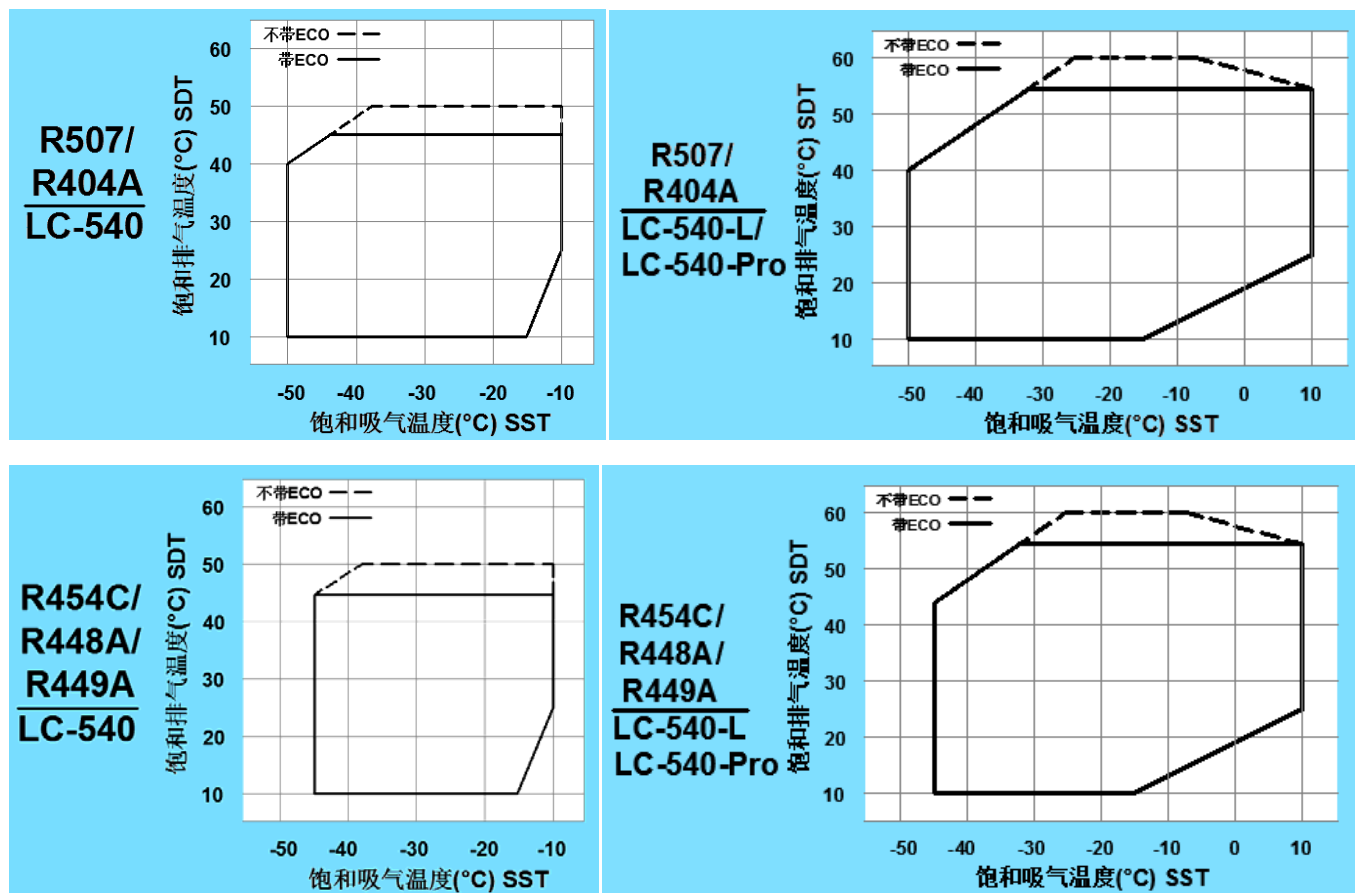
Table 1 Compressor design specifications

model	compressor			Motor				Strength
	Exhaust	Speed	Lubric	Categor	Startup	Voltage	Protect	test
	volum	50Hz	ation		metho	(V)		
	e50Hz	r/min	metho	y	d	50Hz		bar
	m ³ /h							

			d					
LC-100(-L/Pro)	105	2950	Differe ntial pressu re oil supply	3-phase 2-stage squirrel cage inductio n motor	Y-△	380	PTC+NT C	35
LC-140(-L/Pro)	145							
LC-180(-L/Pro)	180							
LC-200(-L/Pro)	205							
LC-230(-L/Pro)	230							
LC-250(-L/Pro)	255							
LC-280(-L/Pro)	285							
LC-320(-L/Pro)	325							
LC-360(-L/Pro)	355							
LC-410(-L/Pro)	415							
LC-540(-L/Pro)	535							
LC-620(-L/Pro)	625							
LC-730(-L/Pro)	735							
LC-830(-L/Pro)	825							
LC-930(-L/Pro)	925							
LC-1020(-L/Pro)	1025							

Note: Please confirm the rated current of the compressor under the design conditions according to the HANBELL machine selection program, and confirm the maximum operating current value according to the initial temperature/limit conditions to select the contactor, power cord and fuse protection element.

1.4 Operating range diagram



1.5 Design Features

- New tooth shape and structural design

LC model has greatly improved the compressor performance through the new tooth shape and structural design.

- Variable VI design
- LC-L & LC-Pro use VI adjustment technology to enable the compressor to always maintain high efficiency operation under different working conditions.
- Built-in check valve and built-in economizer stop valve design

Simplifies the system fluorine line piping configuration, making the shutdown

reversal time shorter and the unit configuration simpler

- Self-contained capacity adjustment structure

Adopts sliding valve to adjust the structure to match the end load demand at any time

- Integrated oil circuit accessories

System accessories with built-in oil filter, oil flow switch, and differential pressure switch, simplifying the system oil circuit piping configuration

Integrated Hanzhong Core Cloud Platform

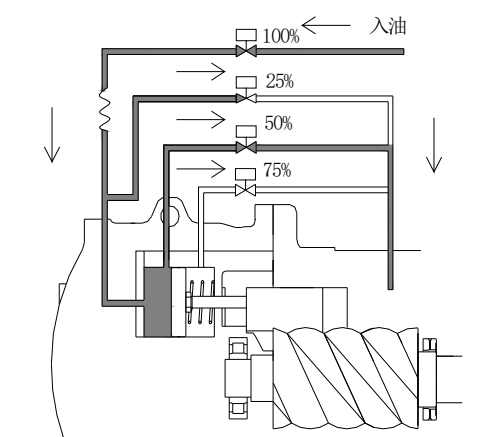
Adopts a new integrated cloud protection module with functions such as oil flow protection and pressure difference protection, simplifies the unit control system, and monitors the compressor operating status in real time to ensure the normal operation of the compressor

1.6 Capacity regulation system

LC series screw compressors continue to use the RC2 capacity adjustment system, equipped with a 4-stage capacity adjustment system or a continuous (stepless) capacity adjustment system. Both capacity adjustment systems are composed of an adjustment slide valve, a piston rod, a piston cylinder and a piston ring. The slide valve is connected to the piston through the piston rod, and the oil pressure is used to push the piston in the piston cylinder. As shown in the figure below, the lubricating oil flows out through the oil filter, and because the oil pressure is higher than the sum of the right-end spring force and the refrigerant pressure, the lubricating oil enters the piston cylinder. Under the action of the pressure difference, the piston moves to the right in the piston cylinder. When the slide valve moves to the right, the effective compression volume in the compression chamber increases. This also means that the exhaust volume of the refrigerant gas increases, resulting in an increase in cooling capacity. However, when any one of the step-capacity adjustment solenoid valves is energized, the high-pressure oil in the piston cylinder bypasses to the suction side, causing the piston and the slide valve to move to the left, and a part of the refrigerant gas bypasses from the compression chamber back to the suction port. This reduces the exhaust volume of the refrigerant and reduces the cooling capacity.

The piston spring is used to push the piston back to its starting position, such as the 25% load position, in order to reduce the starting current at the next start, because the compressor will generate overcurrent when starting at full load.

Before shutting down the compressor, it is recommended that customers unload at least 50% before shutting down. After shutting down, 25% is still powered on for 1 to 2 minutes, or 25% is powered on about 1 minute before starting.

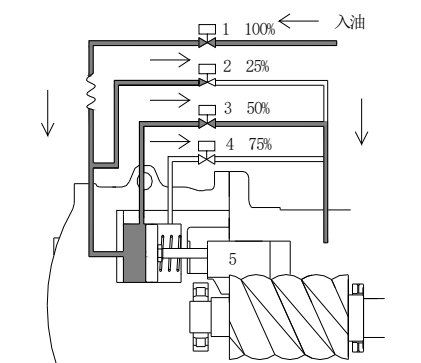


Segmented capacity adjustment system

The compressor is equipped with four solenoid valves, which can control the capacity of the compressor from 25% capacity to full load (100%). These four normally closed (NC) solenoid valves are used to control the required capacity.

The 4-stage capacity adjustment system loads the compressor through a continuous process of 25%-50%-75%-100% and unloads the compressor through a process of 100%-75%-50%-25%. If the compressor needs to run for a long time at 25% load, the problems of oil return, motor cooling, and high exhaust temperature should be considered and controlled by adding optional accessories, such as using a liquid spray device to cool the motor.

Since the compressor has its own VI adjustment function, the VI-solenoid valve needs to be controlled at partial load.



4 Segment capacity adjustment system

Serial number	Components
1	Solenoid valve (100%)
2	Solenoid valve (25%)
3	Solenoid valve (50%%)
4	Solenoid valve (75%)
5	Slide valve

4 Segment capacity adjustment system	25% (NC)	50% (NC)	75% (NC)	100% (NC)	VI- (NC)
100% load	Inactive	Inactive	Inactive	activation	activation
75% load	Inactive	Inactive	activation	activation	activation
50% load	Inactive	activation	Inactive	activation	activation
25% Load (startup)	activation	Inactive	Inactive	activation	activation

1.6.1 25% load

When the compressor is started, the solenoid valve is activated at 25%, and the piston is at the 25% load position. In this state, the high-pressure oil from the oil tank is continuously sprayed into the piston cylinder through the oil circuit, and the high-pressure oil in the piston cylinder is directly bypassed to the suction port, and all pistons remain in their initial positions.

Note: The 25% load state is only designed to shorten the starting time to avoid the motor starting current being maintained for a long time and causing the machine to trip. After the starting process is completed, do not run for a long time at 25% load state, and should directly load and run (especially in the case of large pressure difference/pressure ratio) to prevent the compressor exhaust temperature from being too high and causing damage to the rotor, bearings and other components.

1.6.2 50% load

When the 50% solenoid valve is activated by the temperature controller, the power is cut off and the 25% solenoid valve is closed. The high-pressure oil from the oil tank flows into the piston cylinder, pushing the piston to the right. When it moves to 50%, the high-pressure oil flows back from the oil unloading hole through 50% to the suction port, so the piston stops running at this position and the compressor remains in a 50% load state.

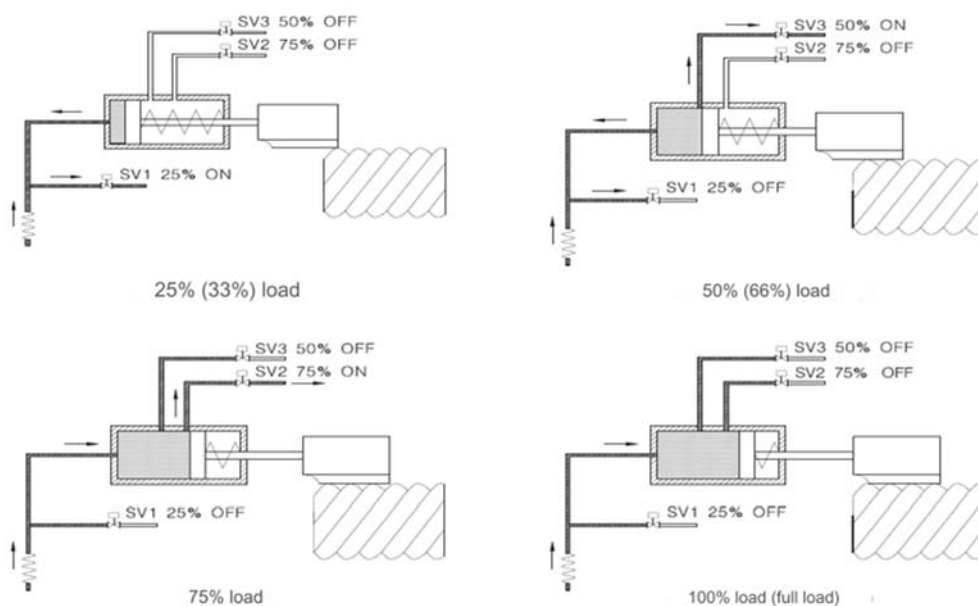
1.6.3 75% load

When the 75% solenoid valve is activated, the power is cut off and the 50% solenoid valve is closed. The high oil pressure pushes the piston to continue to move to the right. When it moves to 75%, the high-pressure oil flows back from the oil unloading hole through 75% to the suction port, so the piston stops running at this position and the compressor remains in a 75% load state.

1.6.4 100% load

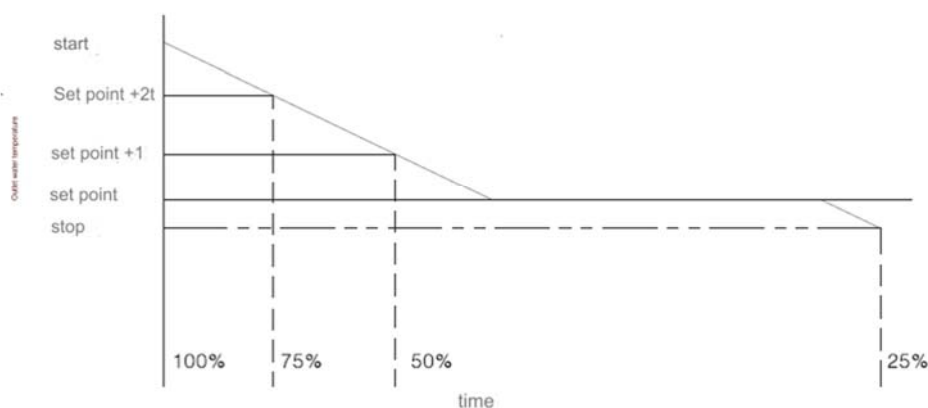
When 100% of the solenoid valves are activated and the other solenoid valves are powered off and closed, high oil pressure continues to flow into the piston cylinder, gradually pushing the piston to the suction side. When the slide valve contacts the dead point of the compression chamber, the piston also reaches its dead point position, and no compressed gas bypass occurs. At this time, the compressor reaches full load operation

● Load schematic diagram



●Description:On: Solenoid valve energized OFF: The solenoid valve is de-energized and not activated

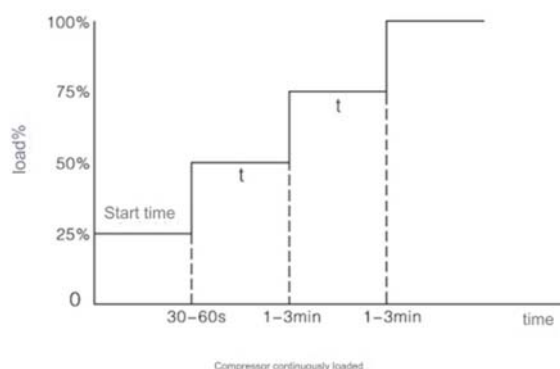
● Outlet water temperature and capacity control curve



1.6.5 Continuous loading of the compressor

Since it takes a long time for the system to run to the required working condition, the compressor is heavily loaded under air cooling and heat pump conditions, especially at the start-up state. The compressor should be started at 25% load. Then, the compressor is gradually loaded to 50% within time "t", and then loaded to 75% within time "t" until it is fully loaded. The time "t" is determined according to different working conditions and application

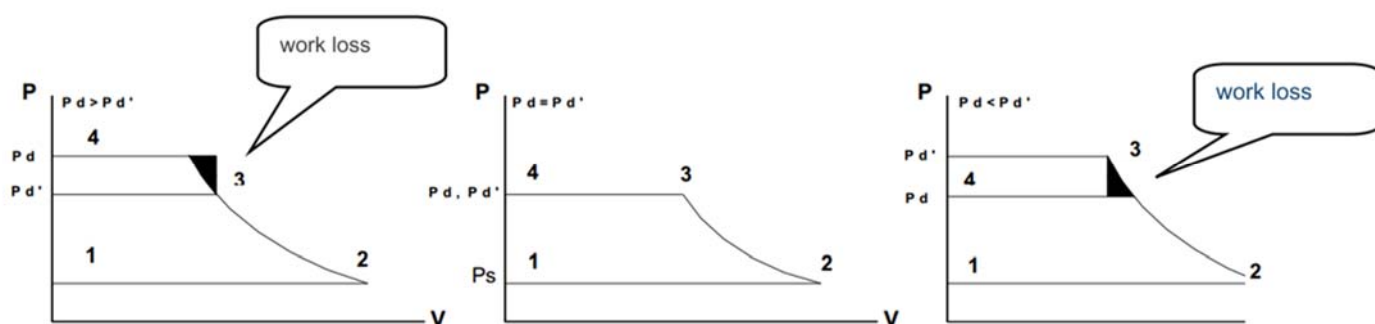
conditions.



1.7 Content volume ratio adjustment system

1.7.1 Volume ratio introduction (Vi)

The volume ratio (Vi) of a compressor is defined as the ratio of the intake volume to the exhaust volume. This volume ratio is directly related to the internal compression ratio (Pi) of the compressor. A compressor with a low volume ratio corresponds to a low compression ratio compressor. Similarly, a compressor with a high volume ratio corresponds to a high compression ratio compressor. The following equation shows that in order to avoid under-compression or over-compression, the system compression ratio (CR) should be equal to the compression ratio (Pi) inside the compressor. Please refer to the following pressure-volume diagram for the relationship.



Insufficient compression($CR > P_i$)

$CR = P_i$

Overcompression($CR < P_i$)

$$CR = P_d/P_s$$

$$P_i = V_{ic}$$

$$V_i = V_s/V_d$$

Pressure-Volume Diagram

illustrate:

R: System compression ratio P_i : Internal compression ratio V_i :
Internal volume ratio

P_d : System pressure (absolute pressure) P_d' : Exhaust pressure (absolute pressure)

P_s : Inlet pressure (absolute pressure)

V_s : Intake volume V_d : Exhaust volume K: Refrigerant specific heat

Remark :

1. Please use Hanbell's machine selection program to calculate the appropriate V_i .
Inappropriate V_i will result in higher power consumption, vibration or exhaust temperature.

1.7.2 Volume ratio adjustment

Appropriate volume ratio (V_i) can avoid efficiency loss caused by over-compression or under-compression of the compressor.

Volume control mode description

LC-L Content volume ratio adjustment	Solenoid valve (normally closed) V_i+	Solenoid valve (normally closed) V_i-
High Pressure Ratio V_i	activation	Inactive
Low pressure ratio V_i	Inactive	activation

2. Application

2.1 Lubricating oil system application

2.1.1 The role of lubricating oil

- An oil film seal is formed between the rotor and the compression chamber and between the male and female rotors to reduce the leakage

of refrigerant gas from the high-pressure side to the low-pressure side during the compression process.

- Absorb and take away the compression heat generated by the gaseous refrigerant during the compression process and the friction heat generated by the mechanical movement of the bearings, thereby ensuring the long-term normal operation of the compressor and reducing the exhaust temperature
- Form an oil film in the bearing to ensure the bearing operates under normal conditions

2.1.2 LC Product Specified Lubricant

Lubricant technical parameters

refrigerant	R22	R404A/R507
Oil model	HBR-B03	HBR-B05
proportion	1.01	0.957
Specific Heat 40°C (Kcal/kg K)	0.43	0.43



Notice

- HANBELL advocates the use of the above lubricants to improve the compatibility of products
- The minimum starting oil temperature of the compressor is 20°C
- The lubricating oil used for other refrigerants must be confirmed with Hanzhong Precision Machinery before use, so as to avoid product failure or reduced product efficiency due to unsuitable lubricating oil.

2.2 Lubricating oil replacement requirements

When adding lubricating oil to the compressor, the system should be kept clean. It is recommended to refill the system after 2000 hours of initial operation to ensure long-term normal operation of the compressor.

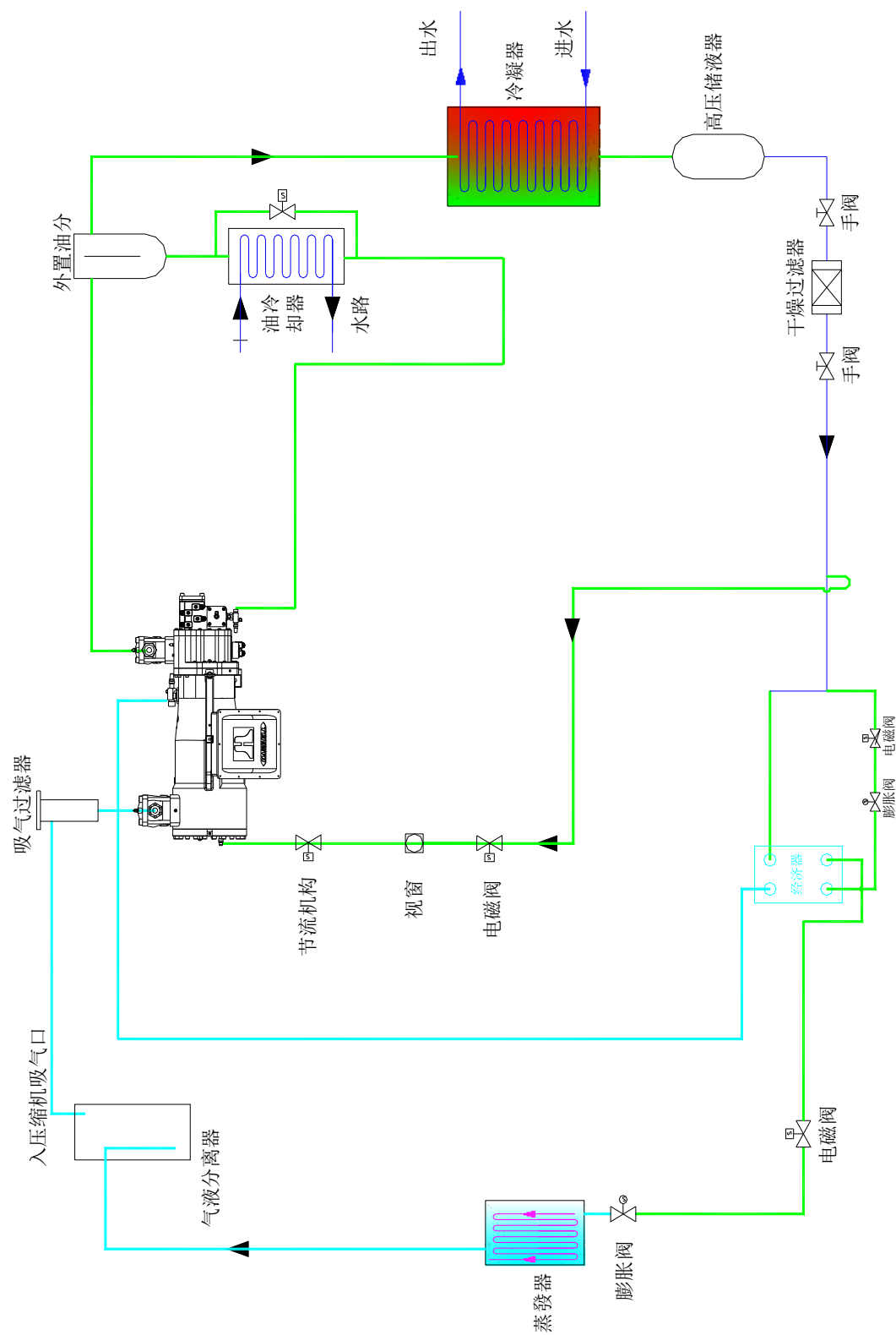
- Lubricating oil easily absorbs moisture in the air, so avoid exposing lubricating oil to the air for a long time.
- In order to ensure that the water content in the system is reduced, it is recommended to heat and evacuate the system as long as possible after the new oil is replaced.
- Foreign matter contamination of lubricating oil can cause oil circuit blockage, so the external oil circuit system must be equipped with an oil filter, and a pressure differential switch must be installed before and after the filter. When the pressure differential reaches the set value (1.5 bar), the oil filter must be replaced or cleaned.
- Long-term operation of the compressor at high exhaust temperature (95~110°C) can easily accelerate the deterioration of the lubricating oil. Please check the chemical properties of the lubricating oil regularly and shorten the oil change interval appropriately.
- Lubricating oil acidification will directly affect the life of the motor. When the lubricating oil $\text{PH} \leq 6$, it should be replaced. (Please also replace the system drying filter at the same time to ensure the system is dry)
- If the compressor motor burns out, it will produce acidic harmful substances

and burnt debris, which will be brought into the system. The maintenance should be carried out according to the procedures mentioned above. The oil filter element and lubricating oil must be replaced several times until the cleanliness and acidity of the oil circuit meet the standards. The lubricating oil status must be tracked regularly. If it exceeds the standard range, please replace it in time. At the same time, please pay attention to the cleanliness and dryness of the system.

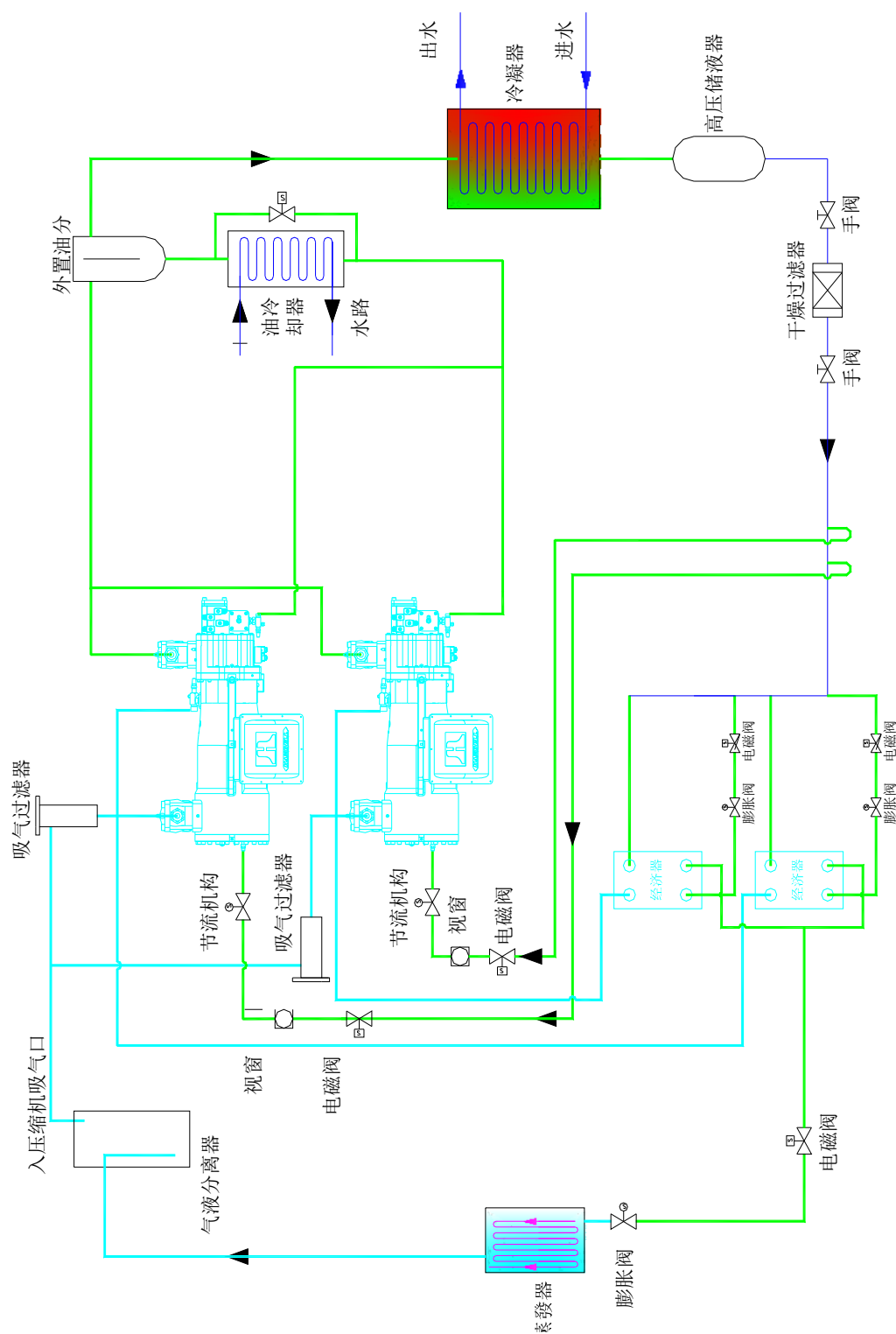
Warning: HANBELL will not be held responsible for any problems caused by poor lubricants, such as compressor jamming, motor burnout or reduced cooling capacity, if it is found that the customer does not use the lubricants recommended in the HANBELL technical manual and uses other lubricants that have not been confirmed by HANBELL before, or mixes two or more lubricants at the same time.

2.3 System Application

LC stand-alone application system flow chart



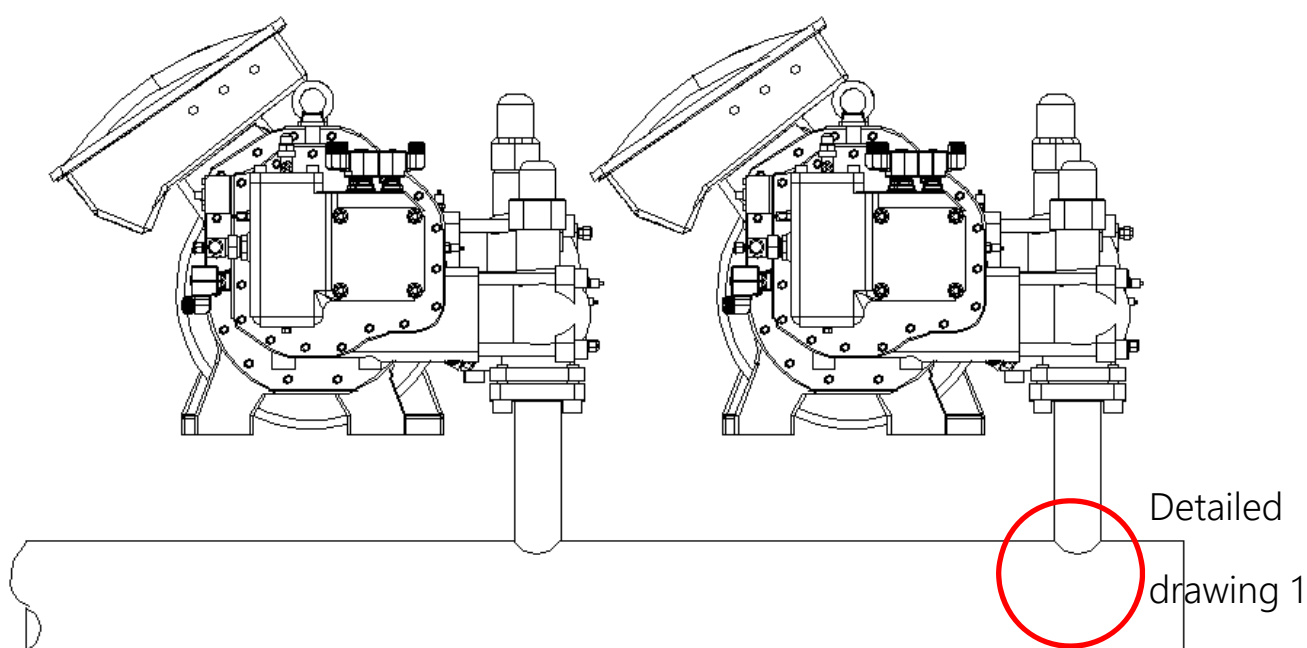
LC parallel application system flow chart



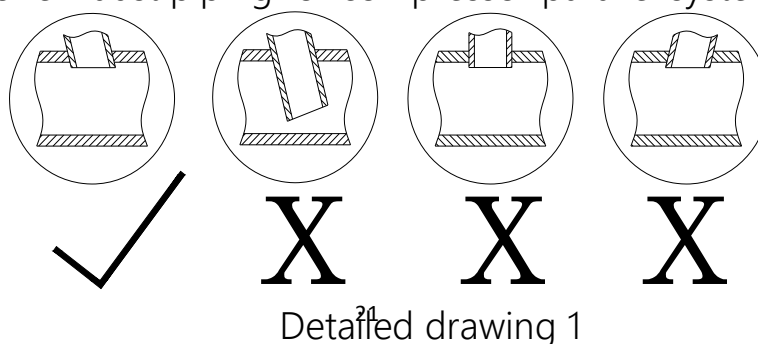
Note: The motor fluid spray pipes of each machine in parallel should be independently drawn from the main fluid pipe to avoid fluid grabbing

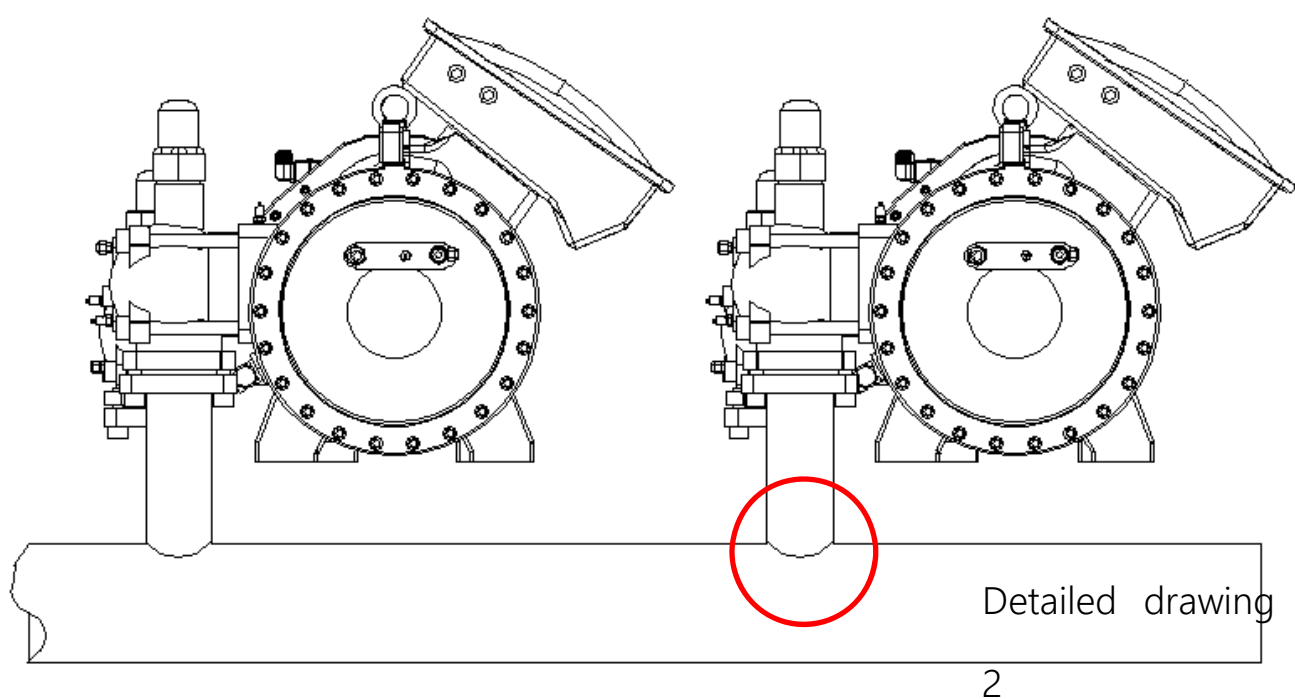
2.3.1 Requirements for the configuration of the suction and exhaust pipes

Since the vibration of the compressor is small during normal operation, the suction and exhaust pipes do not need flexible connection components, but the pipes must have sufficient flexible length and ensure that the suction and exhaust pipes will not cause stress to the compressor. It is recommended to use copper pipes as suction and exhaust pipes, which can play a better role in reducing pipe vibration when the compressor is running.

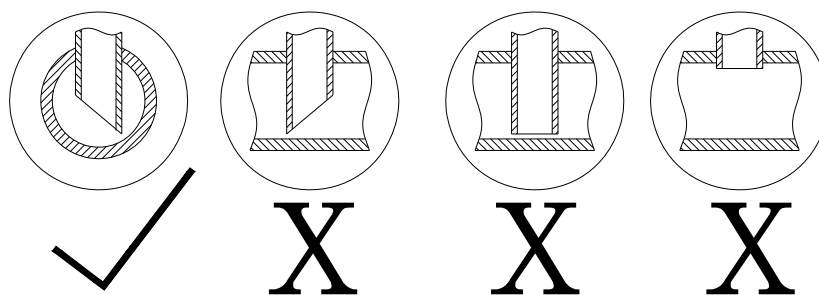


Schematic diagram of exhaust piping for compressor parallel system



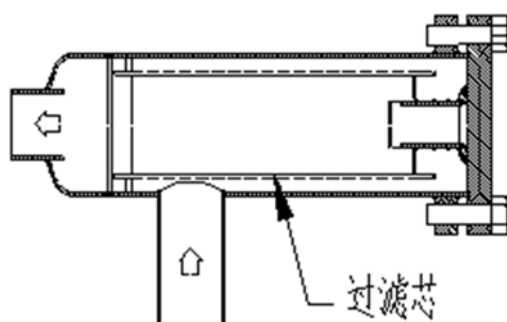


Schematic diagram of suction piping for compressor parallel system



Detailed drawing 2

The compressor itself comes with an air intake filter, but we recommend that customers install an air intake filter on the air intake pipe and clean it regularly to facilitate cleaning and replacement, and also provide double protection. When the system is first used, if the pressure drop is greater than 0.1 bar, please clean it in time until the system is clean. If the filter is damaged, it needs to be replaced in time, and the impurities in the pipe should be cleaned. Ensure that the filter is in the correct direction during installation. It is recommended to add a shut-off valve at the inlet and outlet for easy maintenance.



2.3.2 External oil system description

Generally speaking, if the compressor is running under low temperature conditions, if the lubricating oil is not cooled auxiliaryly, it will not meet the operating requirements due to the high oil temperature. In this case, it is recommended that customers configure an external oil cooler, which can reduce the exhaust temperature of the compressor and extend the service life of the system.

Note: The compressor oil inlet temperature must not be higher than 60°C.

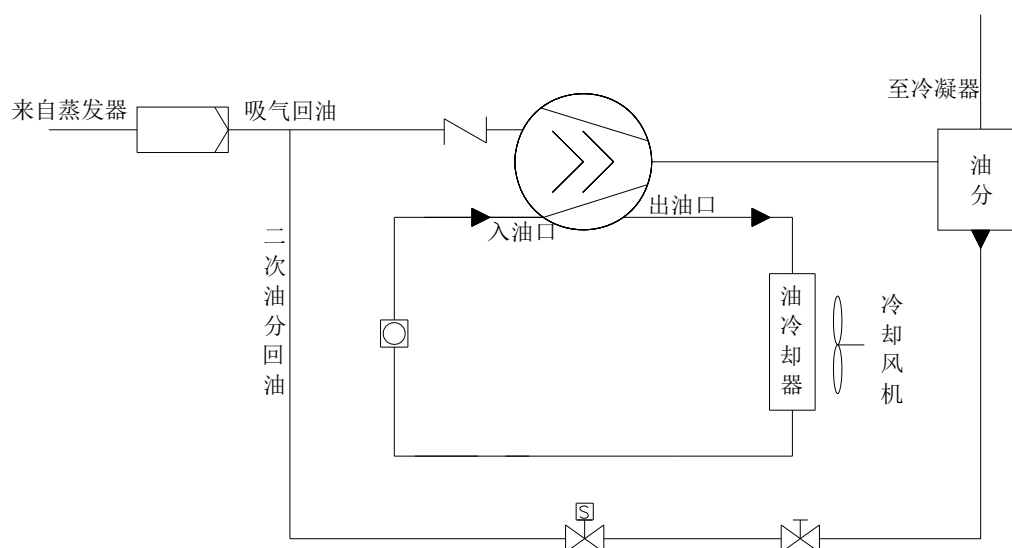
The oil cooling system is mainly divided into three categories: 1. Air cooling; 2. Water cooling; 3. Refrigerant cooling.

The heat exchange capacity of the oil cooler can be calculated by the HANBELL machine selection program. The extreme operating conditions should be taken into account: such as the maximum pressure difference (high condensing temperature

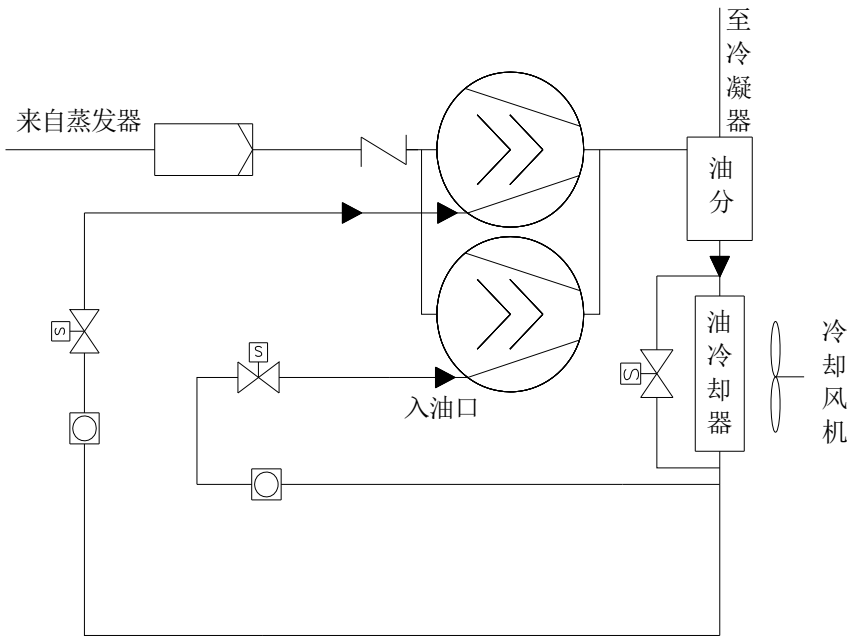
and low evaporating temperature).

■ Air-cooled oil cooling

The fan accelerates the air flow, passing through the fins of the oil cooler to cool the lubricating oil in the pipeline. The recommended system flow is shown in the figure below.



Schematic diagram of air-cooled oil cooler



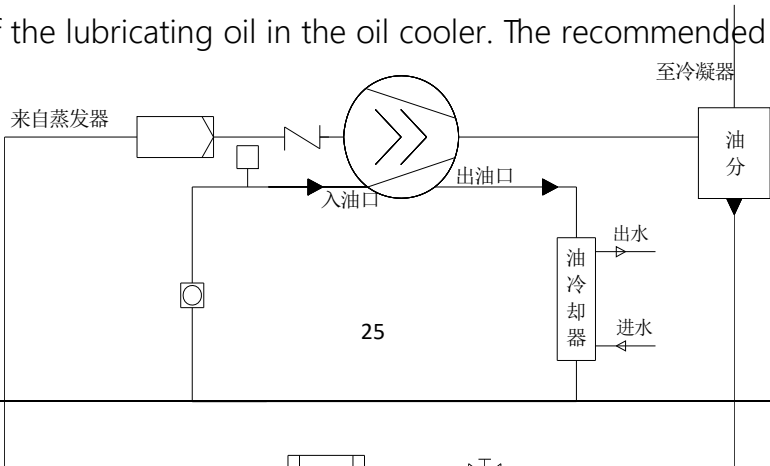
Air cooling and oil cooling parallel diagram

Picture world	name	Picture world	name
	air intake filter		oil cooler
	compressor		oil separator
	Check valve		Oil sight glass
	hand valve		Solenoid valve

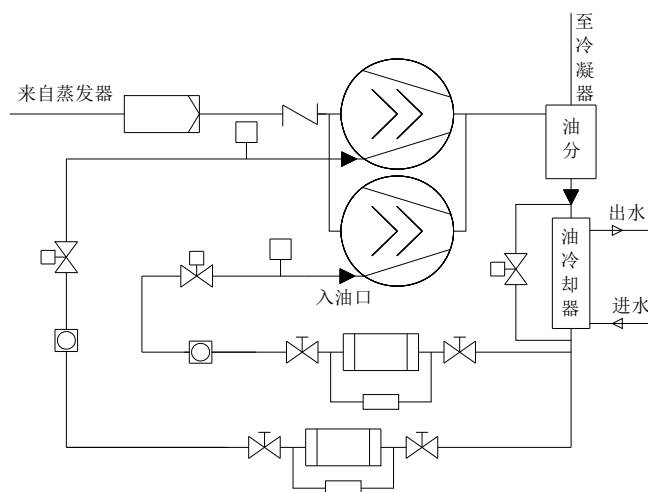
Illustration

■ Cooling water cooling

The cooling water circulates through the water pump and exchanges heat with the pipeline to remove the heat of the lubricating oil in the oil cooler. The recommended system flow is shown in the figure below.



Schematic diagram of water-cooled and oil-cooled single machine



Schematic diagram of water cooling and oil cooling in parallel

2.3.3 External oil circuit configuration requirements and use of external oil circuit

1. It is recommended that the oil cooler be installed near the compressor. The oil cooler should be located lower than the oil level of the compressor and oil separator to prevent the lubricating oil from flowing back to the compressor or oil separator when the compressor is shut down, causing the oil level in the startup liquid compressor and oil separator to be too high and cause overflow.
2. The oil cooler must have an oil return temperature control device to ensure that the oil return temperature is controlled at 40°C ~ 60°C.
3. Oil cooler must be used in the following working conditions.
 Low evaporation temperature (-20°C ~ -50°C)
 High suction superheat (> 15K)

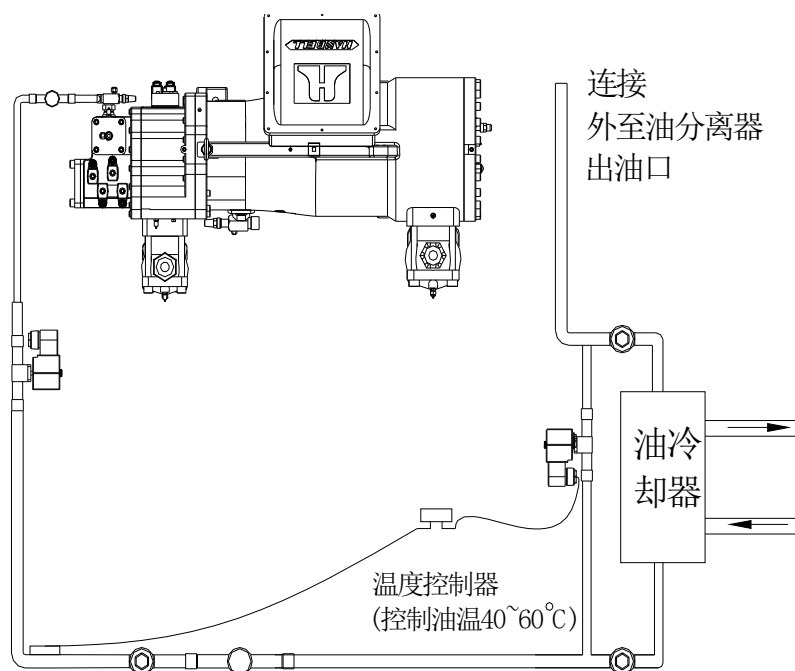


Note: Please refer to the HANBELL machine selection data for the load of the oil cooler. When selecting, you must take into account the maximum oil cooling load within the operating conditions and comprehensively consider the size of the oil cooler.

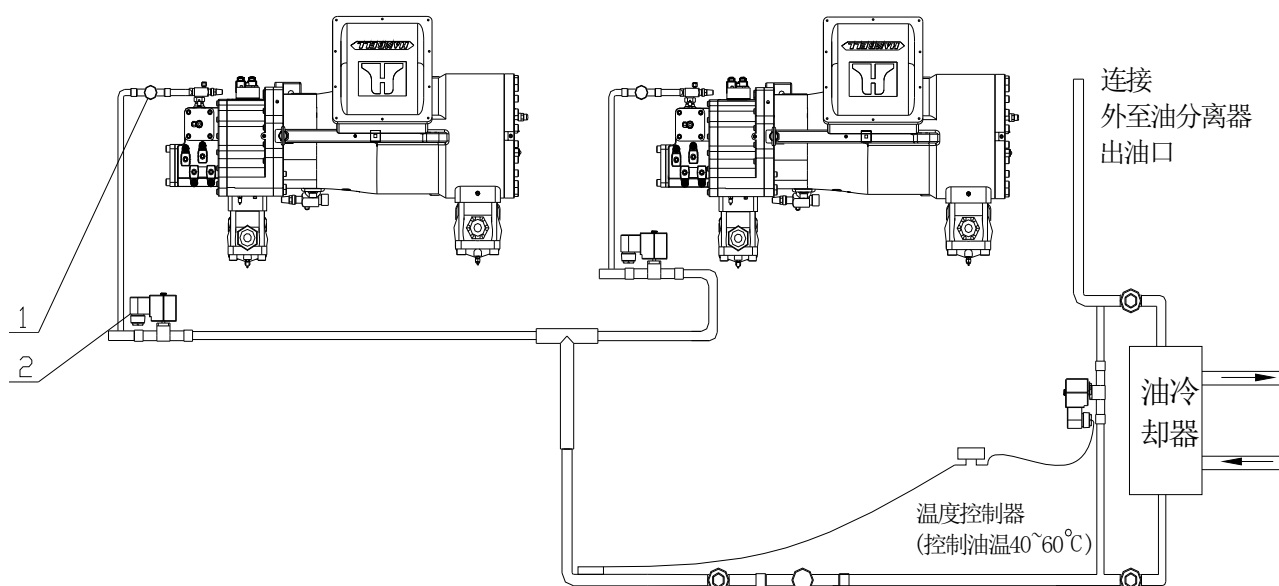


■ Configuration suggestions :

- 1) When the system is operating normally, the high and low pressure difference shall not be less than 4 bar (if the oil supply pressure difference cannot be established for a long time due to the system working environment, it is recommended to use Hanbell pressure maintenance valve);
- 2) In order to ensure that the return oil temperature is within the specified range, an oil circuit with solenoid valve control can be short-circuited between the inlet and outlet pipes of the oil cooler. If the oil temperature is too low during the operation of the compressor, open the bypass solenoid valve to quickly heat the oil temperature. At the same time, it can also effectively adjust the load of the oil cooler under different working conditions.
- 3) The oil circuit solenoid valve is recommended to be installed near the oil inlet of the compressor to prevent oil from continuing to flow into the compression chamber when the compressor is shut down.
- 4) It is recommended not to have too many bends in the oil line, which may cause excessive oil pressure drop and poor oil flow.



LC Schematic diagram of the piping for the external oil cooling of a single machine



LC Schematic diagram of the oil circuit piping for the parallel external oil cooler

serial number	Accessory Name
1	Oil mirror
2	Solenoid valve

Oil circuit configuration diagram

2.3.4 Economizer Configuration Requirements

By using an economizer to further subcool the refrigerant before the system expansion valve, the cooling capacity and efficiency of the system will be improved, especially under the condition of high condensation and low evaporation temperature.

Economizer operation of subcooling cycle:

This operation mode generally uses a heat exchanger as a liquid subcooler to achieve the purpose of subcooling the liquid refrigerant. A part of the refrigerant is drawn from the condenser pipeline and enters the subcooler through the economizer expansion valve throttling to absorb heat and exchange heat with the countercurrent liquid refrigerant. The superheated saturated vapor after absorbing heat enters the intermediate compression section through the economizer interface of the compressor. This mode effectively increases the unit mass cooling capacity of the liquid refrigerant and effectively reduces the exhaust temperature.

- Economizer selection:

Both shell and tube and plate heat exchangers can be used as economizers. Please select the load of the economizer according to the relevant technical parameters in the HANBELL machine selection software.

- Economizer expansion valve selection:

Please contact HANBELL for more selection guidance on economizer expansion valves.

- Economizer control method: It is recommended to open the economizer cycle after the system is started and running stably, when the high-low pressure ratio is greater than 3 or the low-pressure side pressure reaches the set value. Avoid the lubricating oil in the compressor from flowing back to the economizer, causing additional vibration and noise, or even pipeline vibration and cracking.

■ Economizer piping recommendations

1. The economizer (subcooler) should be installed below the compressor to prevent the liquid refrigerant in the economizer from flowing back to the compressor during shutdown.
2. When the operating conditions are unstable or when the economizer circuit is closed, part of the oil and refrigerant will flow back into the economizer

- pipeline. Therefore, it is recommended to make a U-shaped bend near the economizer outlet pipeline, with a distance of about 150mm for the upstream pipeline.。
3. Under low pressure ratio conditions, the pulsating airflow in the compressor will recoil and cause abnormal vibration and noise. It is recommended to install a buffer tank (muffler) and a one-way valve near the economizer inlet pipeline.。
 4. Please use the corresponding pipes according to the economizer interface size of the LC series compressor.。
 5. In addition to the insulation requirements, the pipeline to the evaporator should be fixed to prevent vibration to prevent the hidden danger of leakage at the welding point due to vibration.。

2.3.5 Condensing pressure regulation

The suction and exhaust of the compressor must reach a pressure difference of 4 bar within 30 seconds after startup. If the pressure difference is too small, it will cause insufficient oil supply, and the compressor will fail to shut down after a period of startup (oil flow and high and low pressure difference protection). At this time, condensing pressure control is required to ensure that after the compressor is started, sufficient high and low pressure differences can be established in a short time to ensure the oil supply of the compressor. It is recommended that customers use the HANBELL optional pressure maintenance valve. Please contact HANBELL for relevant information on the pressure maintenance valve.

The following situations will cause the pressure difference to be too low:

- The ambient temperature is low, the condenser is installed outdoors, and it is shut down for a long time.
- Startup of a single compressor in a parallel system.
- Hot gas defrosting, reverse cycle.
- Low-pressure compressor in a two-stage system.

2.3.6 Parallel system operation requirements

- · When the parallel system is started, each compressor is started one by one (two compressors are not allowed to be started at the same time), and

the time interval is more than 30 seconds.

- · After all the compressors are started and run stably, pay attention to whether the lubricating oil in the external oil separator is clear and full, and ensure that the oil level is at the high-level sight glass. The return oil temperature is controlled between 40~60°C.
- · After the compressor has been running for a period of time, if the pressure drop before and after the external oil filter is greater than 1.5bar, the external oil filter element needs to be cleaned or replaced.
- · Multiple compressors in the parallel system can share one external oil separator. It is recommended that the oil filter and oil flow switch be configured separately for each compressor.



Notice :

- Install a level switch on the external oil separator of the parallel unit to prevent the oil level from being too low and affecting the oil return of the compressor.
- Install an oil heater on the external oil separator of the parallel unit. The start and stop of the oil heater is controlled by the oil temperature sensor in the oil separator.
- The external oil separator of the parallel unit should be equipped with a refueling port and an oil drain valve to facilitate the replenishment and replacement of the lubricating oil.
- The system cannot be started when the lubricating oil temperature is lower than 20°C or higher than 60°C.

For more guidance on oil circuit configuration, please contact HANBELL

2.4 Electrical parameters and design

2.4.1 Motor Design

The standard starting method of HANBELL's LC series screw compressors is Y-Δ starting.

1) 、Y-Δ start

Y-Δ connection start mode, when just starting up, it is Y-shaped connection, at this time, the voltage on the winding is reduced to 1/3 of the input voltage, and after the start is completed, it is reconnected to Δ connection. By starting in this way, we can reduce the starting current by reducing the starting voltage. This starting method is also called step-down starting. Y-Δ connection method is shown in Figure 4-1 :

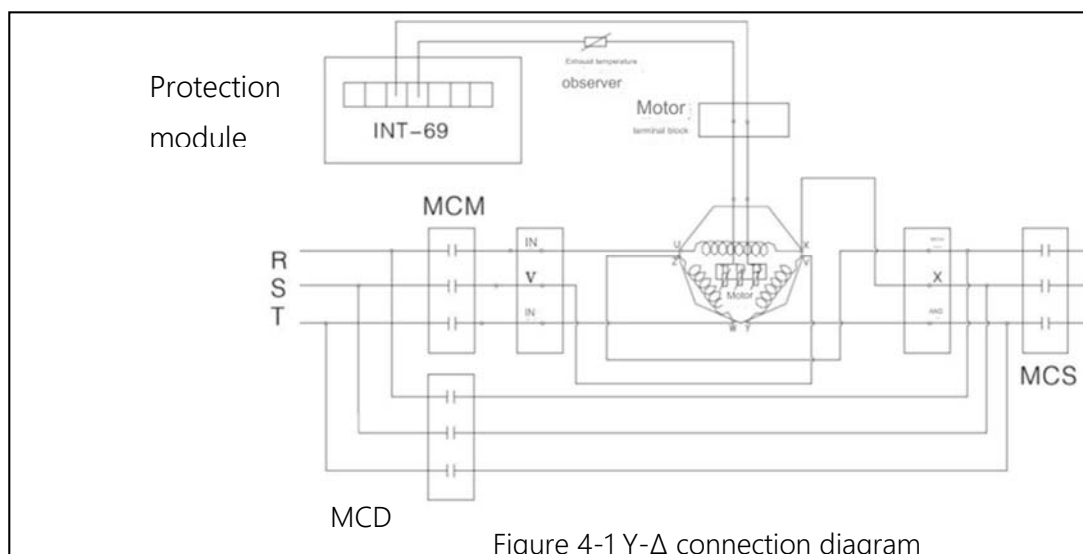


Figure 4-1 Y-Δ connection diagram

⚠ Note: After Y-start, MCM & MCS conversion is completed 0.25 seconds before MCM & MCD are powered on for Δ operation. Within 0.25 seconds, a false short circuit may occur due to improper contactor operation, causing the compressor to trip. When this happens, it is recommended to use an adjustable Y-Δ time relay or delay to extend the MCM and MCD conversion. The power-on time is approximately within 0.25 to 0.5 seconds. Please refer to the Y-Δ conversion time chart for specific information.

In Y-shaped connection, MCM and MCS are energized to make Z, X, and Y points together to form the center point of the Y-shaped connection. After a few seconds (3 to 5 seconds are recommended), MCM and MCS are disconnected. About 0.25 seconds later, MCM and MCD are energized and the connection is converted to Δ-shaped connection. The Y-Δ conversion time diagram is shown in Figure 4-2: :

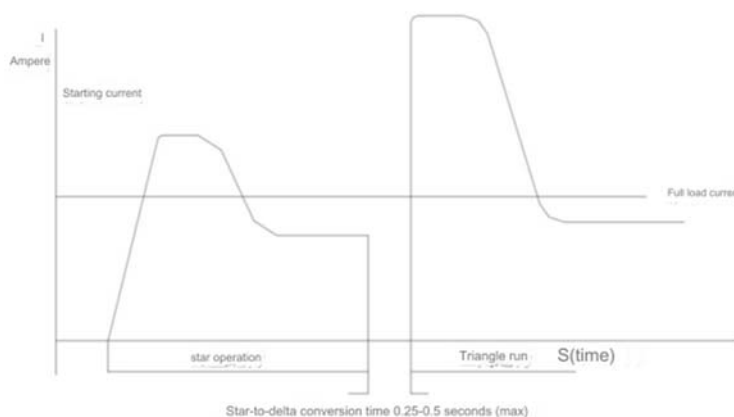


Figure 4-2 Y-Δ conversion time diagram

2, Y-Δ starting characteristics

- The starting current of the Y-type connection is 1/3 of the stall current, and the torque is 1/3 of the stall torque.
- The acceleration of the electrode rotation is reduced during heavy-load starting, so the compressor needs to be started under light load.

Note: In addition to Y-Δ starting, if you need soft starting or reactance step-down starting, please contact HANBELL.

2.4.2 Compressor permissible start conditions

Hanbell screw compressors use Y-Δ starting, and the compressor must be under 25% load when starting.

1, compressor start

- The compressor motor should not start more than 6 times per hour.
- The compressor is at the lowest load (25% capacity adjustment state) when starting.
- In the case of low ambient temperature, the oil heater should be powered on for 6 hours to maintain the oil temperature.
- The Y connection time at startup is generally 4 ~ 1 seconds, and the maximum allowable time for Y to switch to Δ connection is 40 milliseconds. The actual Y ~ Δ conversion time can be adjusted according to the actual working conditions on site,

but the maximum $Y \cdot \Delta$ conversion time shall not exceed 7 seconds.

- At startup, the power supply voltage shall not exceed $\pm 10\%$ of the rated voltage of the motor.

2) , Operation power limit

- Long-term operating voltage: within $\pm 5\%$ of rated voltage.
- Instantaneous operating voltage: within $\pm 10\%$ of rated voltage.
- Frequency: within $\pm 2\%$ of rated frequency.
- Voltage imbalance of each phase: $\cdot 1\%$

Note: If the power supply voltage is unstable, high and low voltage protectors must be installed to set the rated voltage within $\pm 5\%$.

3) , voltage imbalance

Voltage imbalance is usually caused by load changes. When the loads of the phases are different, voltage imbalance will occur, which may cause serious damage to the motor. NEMA stipulates voltage imbalance as follows :

$$\text{Voltage Unbalance} = \frac{\frac{\text{The difference between the average voltage and the maximum voltage in the three-phase voltage}}{\text{Voltage average value}} \times 100\%}{}$$

- NEMA stipulates that the best conditions for multi-phase motor operation are: the motor voltage imbalance does not exceed 1%. In addition, it is recommended not to start the motor when the voltage imbalance exceeds 5%, otherwise it may cause serious damage to the motor.

4) 、 Contactor selection: Please select the appropriate contactor according to AC3 specifications, compressor selection procedure and system design conditions.

5) 、 Grounding requirements: There is a grounding connector in the wire box. Please connect it accurately to the grounding terminal of the system control board.。

Note: a. The conventional leakage protector setting value should be higher than 50mA; in a humid environment, 25mA is better.

b. The grounding voltage should not exceed 50V; in a humid environment, it is limited to 25V.

c. The grounding resistance should not exceed 500Ω.

d. Air circuit breakers are generally equipped with electronic leakage protection. Please refer to the relevant settings to ensure that it can operate normally.

e. If the electronic leakage protector alarms, please check whether the insulation device is normal and whether its circuit and settings are correct. Make sure everything is correct before turning on the power.

If you find any problems, please contact the supplier of the equipment.

2.4.3 Compressor starting current MCC&LRA

Starting current definition (LRA): When the rated frequency and rated voltage are applied to the motor coil, the motor rotor is blocked or restrained so that it does not rotate. At this time, the line current of the motor is called the starting current (also called the locked rotor current).

Definition of Maximum Operating Current (MCC): Maximum load current of the compressor motor.。

Compressor starting current MCC&LRA

frequency : 50HZ ; Voltage : 380V					
model	MCC	LRA	model	MCC	LRA
LC-100	50	175	LC-100-L	67	230
LC-140	70	230	LC-140-L	93	310
LC-180	90	310	LC-180-L	120	465
LC-200	100	480	LC-200-L	133	600
LC-230	115	600	LC-230-L	153	690
LC-250	125	600	LC-250-L	167	690

LC-280	140	690	LC-280-L	187	780
LC-320	160	780	LC-320-L	213	1035
LC-360	180	780	LC-360-L	240	1035
LC-410	205	1035	LC-410-L	273	1200
LC-540	270	1200	LC-540-L	360	1350
LC-620	310	1085	LC-620-L	413	1430
LC-730	365	1185	LC-730-L	487	1565
LC-830	415	1785	LC-830-L	553	2355
LC-930	465	1785	LC-930-L	620	2355
LC-1020	510	1990	LC-1020-L	680	2625

Note: The MCC in the above table may vary due to different voltages and frequencies..

2.4.4 Wiring diagram of wiring cover

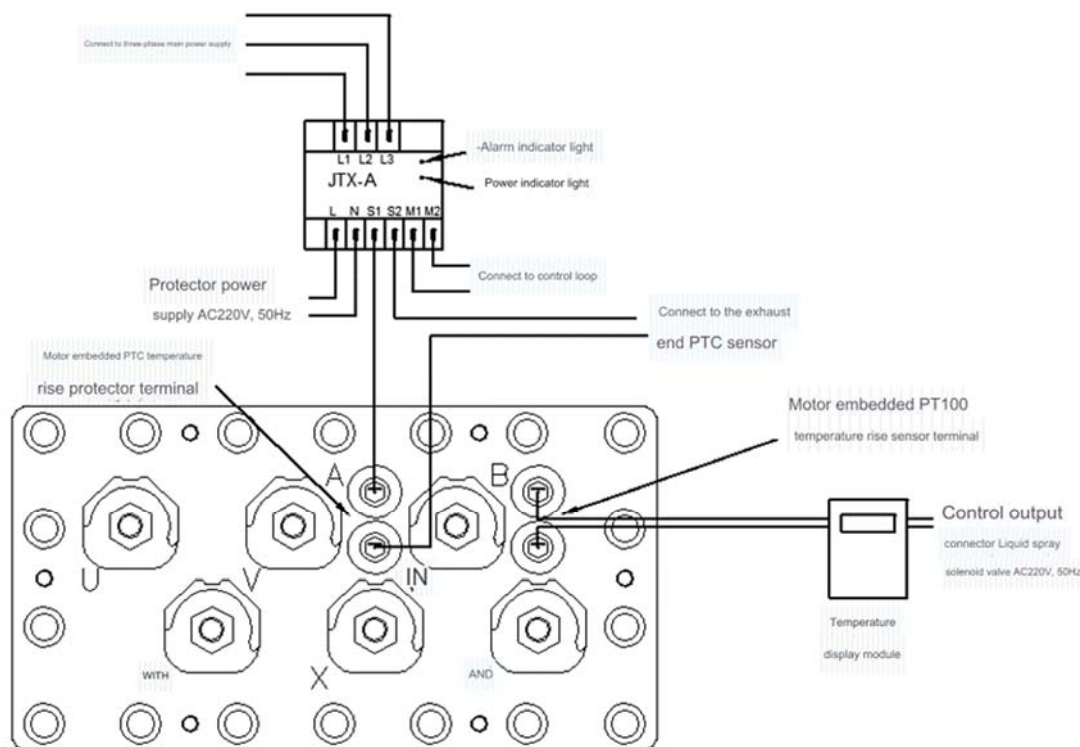


Table 4-2 Specifications of terminal nut for wiring cover

model	Specification	Torque setting value (N.m)
LC-100~540	M12 Nut	35
LC-620~1020	M16 Nut	50

Note: When the compressor surface temperature is lower than the air dew point temperature, condensation will occur. Therefore, it is recommended that customers completely wrap the exposed wiring parts with electrical insulation tape to improve reliability.

2.4.5 Grounding

There is a grounding connector in the junction box, please make sure it is connected to the grounding wire.

Recommendations:

- The normal setting of the leakage protector should be greater than 50mA; in humid areas, it is more appropriate to change the setting to 25mA.
- The grounding voltage of the junction box should not be greater than 50V; in humid

areas, it should be 25V.

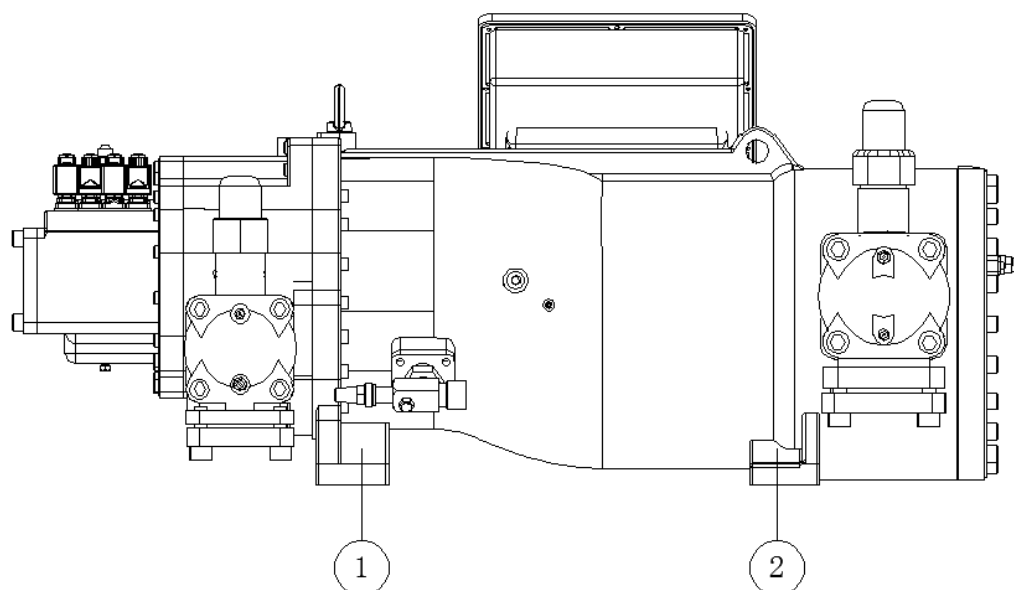
c. The grounding resistance cannot be greater than 50 ohms.

d. Air cut board (ACB) is usually installed together with the leakage protector, please refer to the relevant operation settings.

e. Once the leakage protection is activated, please check whether the insulation of each equipment is normal and whether the circuit and setting are correct. Please turn on the power after confirming that everything is correct. If you have any questions, please contact the equipment supplier.

2.5 Installation and Fixing

- · When used in conventional systems, the compressor must be installed horizontally
- · It is recommended that the compressor should not be installed directly on the heat exchanger. If it must be installed in this way due to conditions, please ensure that the load-bearing structure is designed with sufficient strength.
- · It is recommended to use a fixed steel structure support frame to install the compressor and use vibration damping pads to reduce the impact of compressor vibration on the system.
- · For marine systems, the compressor should be installed along the axial direction of the ship and needs to be equipped with an external oil tank and pressure maintenance valve. For more configuration and installation suggestions, please contact HANBELL。



Installation position of compressor vibration damping pad

- · When installing the vibration damping pad, the four bolts at the bottom corners should be evenly stressed, and the nuts should be tightened until the vibration damping pad is slightly deformed. Use spring washers to ensure that the compressor will not loosen during long-term operation.
- · Installation location recommendations
 1. Avoid being close to other heat sources to prevent heat radiation.
 2. Be close to the electric control cabinet for easy wiring.
 3. The compressor installation position and direction are convenient for observing the oil level and daily maintenance.
 4. The installation location is strong enough to avoid resonance and noise.
 5. Avoid installing in places with high humidity and poor ventilation.
 6. Reserve enough service space.

3. Accessories

3.1 Accessories List

project	type	Model (standard ●; optional △)	
		quantity	
1	Exhaust shut-off valve	1 individual	●

2	Suction shut-off valve	1 indivual	●
3	Economizer Shutoff Valve	1 indivual	●
4	Intake and exhaust sleeve	1 set	●
5	Vibration damping pads	4 indivual	●
6	Built-in oil filter pressure differential	1 indivual	●
7	Intelligent integrated protection	1 indivual	●
8	PTC exhaust temperature sensor	1 indivual	●
9	Motor coil temperature sensor	1 set	●
10	Built-in oil filter	1 indivual	●
11	Oil flow switch	1 indivual	●
12	Suction filter	1 indivual	●
13	Economizer Filter	1 indivual	●
14	Oil circuit solenoid valve	1 indivual	△
15	Oil path mirror	1 indivual	△
16	Pressure maintaining valve	On Demand	△
17	Hanzhong special oil	On Demand	△

Table 5 Compressor Configuration Table

Notice :

1. The final right of interpretation of the above accessories belongs to HANBELL;
2. ●: indicates standard configuration △: indicates optional configuration
3. The above accessories are subject to the contract.

3.2 Oil circuit accessories

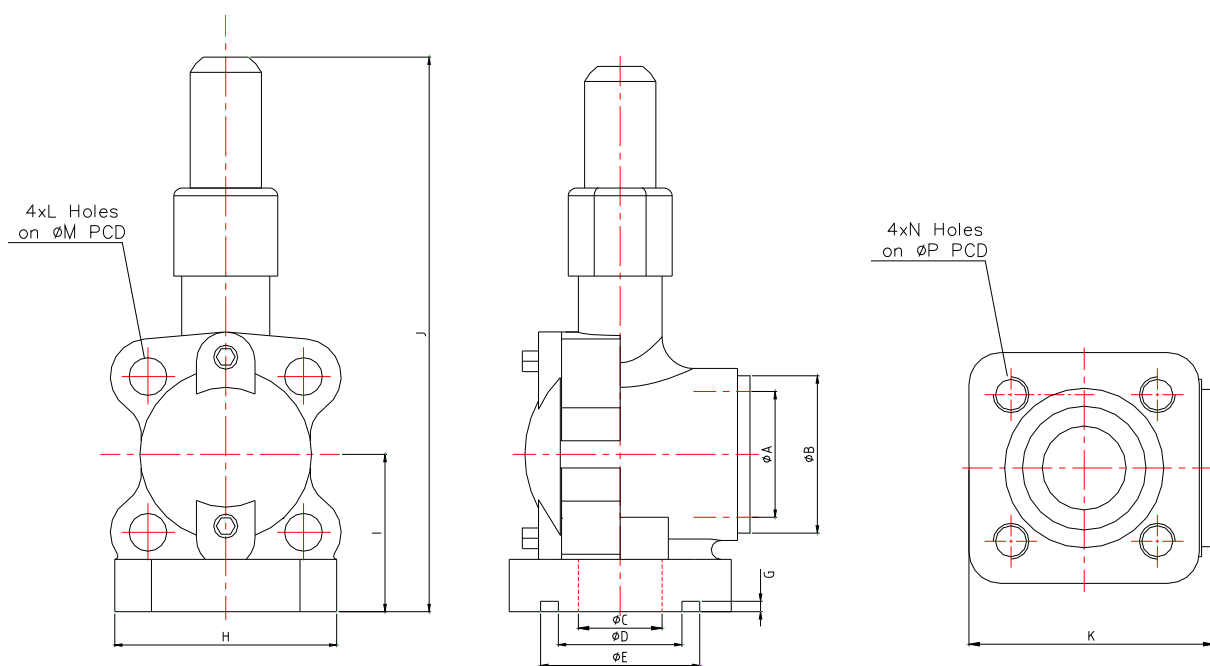
The LC series oil flow switch, differential pressure switch, and external oil filter are

3.3 System accessories

3.3.1 Suction and exhaust shut-off valve

In order to facilitate the repair and maintenance of the compressor, it is recommended to install suction and exhaust shut-off valves for the compressor.

Please refer to the table below to learn about HANBELL shut-off valves.



3.3.1.1 Shut-off valve dimensions

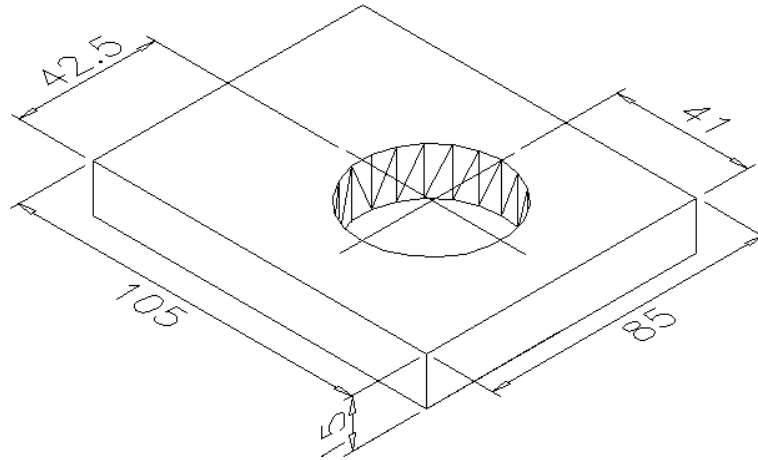
规格	标准尺寸											单位: mm			
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	P
1 1/2"	60	75	40	59	76	6	5	108	75	256	115	18	105	M16x2	105
2"	70	90	60	69	91	6	5	122	86	280	128	18	120	M16x2	120
2 1/2"	90	110	67	89	111	6	5	137	95	307	153	18	140	M16x2	140
3"	100	120	80	99	121	6	5	154	117	398	177	22	160	M20x2.5	160
4"	125	145	105	124	146	6	5	171	130	445	201	22	185	M20x2.5	185

*Shut-off valve specifications

Maximum working pressure	Strength test (air pressure)	Temperature range
28 bar	35 bar	-50 ~ 150°C

3.3.2 Anti-vibration pads

Function: Reduce the extra vibration and noise generated when the compressor is running。



Compressor vibration damping pad specifications (unit: mm)

3.4 Electrical accessories

3.4.1 INT69 HBY Diagnose Protection module

a) a) Application Description :

The protection module INT69 HBY Diagnose is an advanced product in the protection module series, a microcontroller for

compressor protection. The flexible response function of the additional input in the phase sequence monitoring improves practicality and extends the life of the refrigeration system. INT69 HBY Diagnose automatically saves the working and error data in a memory. Only through a specific transmission line can the data be read on a personal computer and used for diagnostic analysis.

b) Functional description :

- · Connect the PTC thermistor in series to the signal input of the protection module.
- · If the resistance of any thermistor rises above its trip value, the protection module trips and disconnects. When the PTC resistance drops below the reset resistance, the module automatically resets after a 5-minute reset time. Within 24 hours of the first trip, if the PTC resistance rises above the reset resistance for the second time, the reset time is 60 minutes. If the PTC resistance rises above the reset resistance for the third time within 24 hours, the module will lock and cannot automatically reset.
- · The motor phase monitoring function is activated 1 second after the motor starts and continues to monitor for 5 seconds. Motor phase abnormality or motor phase loss will cause the protection module to disconnect and lock.
- · In order to avoid tripping due to reverse rotation after the compressor stops, the phase monitoring function is only maintained for 20 seconds after the motor stops.
- · LED (light emitting diode) (red/green/orange) displays its working information.
- · The motor protection module cannot be used in variable frequency drive devices.

- PTC short circuit will cause lock, and short-term circulation will cause reset delay.
 - After the temperature drops or the error is eliminated, the reset delay resets the module; after the reset, the compressor restarts.
- ⚠ Installation, maintenance and operation must be performed by electronic professionals. The current European and national standards for electronic equipment connections and refrigeration equipment must be followed. Sensor connections and connecting wires outside the junction box must have at least one basic insulation.

c) 、 Technical Parameters

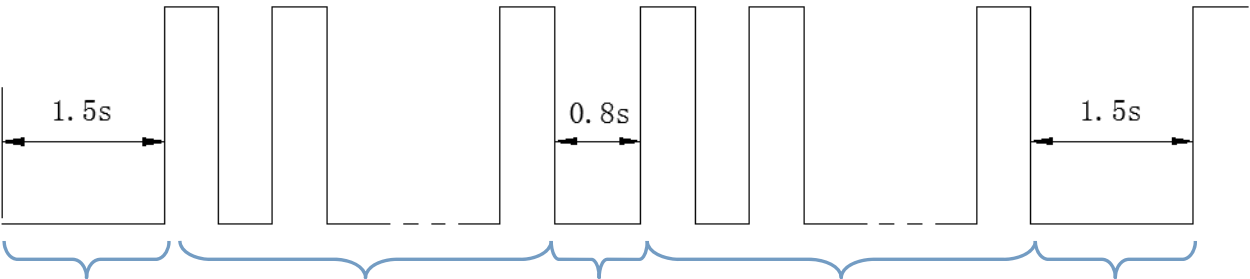
project	Technical Parameters	project	Technical Parameters
Supply voltage	AC 50/60HZ 115/240V ± 10% 3VA	System PTC short circuit monitoring	T
Motor voltage	3 AC 50/60Hz 200/690V ±10%	Over frequency operation	Not supported
— Sensor type — R25, all — Maximum connection length	Optional 1-2 AMS sensors, 1-9 PTCs can be connected in series. The series connection standard meets DIN 44081 and DIN 44082 <1.8KΩ	—Motor static trip 1Second-rate/24h 2Second-rate/24h 3Second-rate/24h —Switching frequency —Wrong phase	5min±1min 60min±12min Lock 5min±1min Locked Locked Power off reset

	30M	—Lost phase Cancel lock or reset delay	
Ambient temperature	-30...70°C	Maximum switching frequency	30SInternal switch 3 times
Phase monitoring —Phase sequence — Phase loss — Deactivation	Activates 1s after the motor starts, and monitors for 5s Activates 1s after the motor starts, and monitors until it stops About 20s after the motor stops	Delayed reset relay —Power supply —Mechanical life	AC 240V 2.5A C300 At least AC/DC 24V 20mA 1 million switching cycles

d) 、Signal light flashing

The signal light display is convenient and quick for maintenance; the light signal consists of periodic red and orange flashes; the current light flashing state depends on the number of pulse flashes.

The signal is as follows :



Pause 1 time

red

Pause 2 times

orange color

Pause 1 time

(1-5 Secondary pulse)

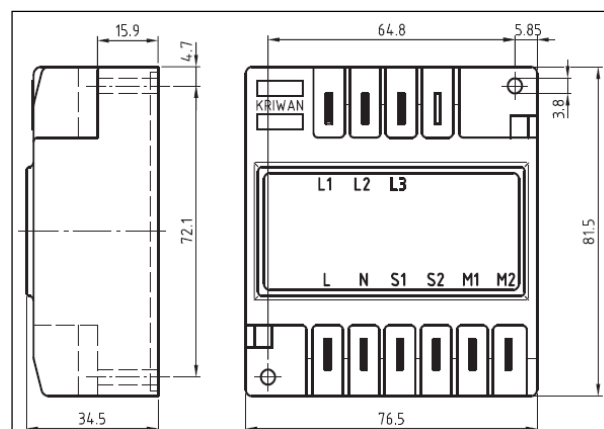
(1-5 Secondary pulse)

Traffic Light Overview	Green Light	Compressor Operation
	Green flashing light	Compressor operation
	Flashing red/orange	If a fault occurs, the relay trips and the compressor stops; see the table below for description

Flashing sequence 1 (red light)	Second flash sequence (orange light)	describe
1	1	Motor temperature: Static trip, winding temperature is too high
	3	Motor temperature: Reset delay after static trip
	4	Motor temperature: The temperature sensing element detects an open circuit or a short circuit
2	1	Motor voltage: wrong phase sequence

	2	Motor voltage: wrong phase/three-phase asymmetry
3	1	Power supply voltage: The power supply connected to the module is too low
The green light is always on but the unit cannot be started: Use the resistance range of the multimeter to measure the continuity between M1 and M2. If M1-M2 is not conductive, replace the protector		

e) 、Appearance and wiring



picture 3.4.1.1 INT69 HBY Diagnose Appearance

NTC is an embedded temperature sensor installed inside the motor coil. It is connected to the electronic expansion valve to display the temperature of the motor and accurately control the liquid injection to protect the compressor motor temperature (refer to Figure 4.2.1).

3.4.2 NTC Sensor temperature and impedance value table

Experience value formula : $R = 10 * e^{3435 * (\frac{1}{273+T} - \frac{1}{273+25})}$, Where 10 is the impedance value at 25°C, and R is the impedance value at temperature T.

	Impedance			temp	Impedance			temp	Impedance		
	maxi	typica	Mini		maxi	typic	Mini		maxi	typic	Mini
-10	43,52	42,47	41,43	31	8,11	8,01	7,92	72	2,15	2,10	2,05
-9	41,55	40,57	39,60	32	7,83	7,73	7,63	73	2,09	2,04	1,99
-8	39,69	38,77	37,86	33	7,55	7,45	7,36	74	2,03	1,98	1,93
-7	37,92	37,06	36,21	34	7,29	7,19	7,10	75	1,98	1,92	1,87
-6	36,25	35,44	34,64	35	7,04	6,94	6,85	76	1,92	1,87	1,82
-5	34,66	33,90	33,15	36	6,79	6,70	6,61	77	1,87	1,82	1,77
-4	33,15	32,44	31,73	37	6,56	6,47	6,37	78	1,81	1,77	1,72
-3	31,72	31,05	30,39	38	6,34	6,25	6,15	79	1,76	1,72	1,67
-2	30,36	29,73	29,11	39	6,12	6,03	5,94	80	1,72	1,67	1,62
-1	29,06	28,48	27,89	40	5,92	5,83	5,74	81	1,67	1,62	1,58
0	27,83	27,28	26,74	41	5,72	5,63	5,54	82	1,62	1,58	1,53
1	26,65	26,13	25,62	42	5,53	5,44	5,35	83	1,58	1,53	1,49
2	25,52	25,03	24,55	43	5,34	5,26	5,17	84	1,54	1,49	1,45
3	24,44	23,99	23,54	44	5,17	5,08	4,99	85	1,49	1,45	1,41
4	23,42	23,00	22,57	45	5,00	4,91	4,83	86	1,45	1,41	1,37
5	22,45	22,05	21,66	46	4,83	4,75	4,67	87	1,42	1,37	1,33
6	21,53	21,15	20,78	47	4,68	4,59	4,51	88	1,38	1,34	1,30
7	20,64	20,30	19,95	48	4,52	4,44	4,36	89	1,34	1,30	1,26

Table 6
NTC sensor temperature and
impedance value table

8	19,81	19,48	19,15	49	4,38	4,30	4,22	90	1,31	1,27	1,23
9	19,01	18,70	18,39	50	4,24	4,16	4,08	91	1,27	1,23	1,19
10	18,25	17,96	17,67	51	4,10	4,03	3,95	92	1,24	1,20	1,16
11	17,51	17,24	16,97	52	3,97	3,90	3,82	93	1,21	1,17	1,13
12	16,81	16,56	16,30	53	3,85	3,77	3,70	94	1,17	1,14	1,10
13	16,14	15,90	15,67	54	3,73	3,65	3,58	95	1,14	1,11	1,07
14	15,50	15,28	15,06	55	3,61	3,54	3,46	96	1,12	1,08	1,04
15	14,89	14,69	14,48	56	3,50	3,43	3,35	97	1,09	1,05	1,02
16	14,31	14,12	13,92	57	3,39	3,32	3,25	98	1,06	1,02	0,99
17	13,75	13,58	13,39	58	3,28	3,22	3,15	99	1,03	1,00	0,97
18	13,22	13,06	12,89	59	3,18	3,12	3,05	100	1,01	0,97	0,94
19	12,72	12,56	12,40	60	3,09	3,02	2,95	101	0,98	0,95	0,92
20	12,24	12,09	11,94	61	2,99	2,93	2,86	102	0,96	0,92	0,89
21	11,77	11,63	11,50	62	2,90	2,84	2,77	103	0,93	0,90	0,87
22	11,32	11,20	11,07	63	2,82	2,75	2,69	104	0,91	0,88	0,85
23	10,90	10,78	10,66	64	2,73	2,67	2,61	105	0,89	0,86	0,83
24	10,49	10,38	10,27	65	2,65	2,59	2,53	106	0,87	0,84	0,81
25	10,10	10,00	9,90	66	2,57	2,51	2,45	107	0,84	0,82	0,79
26	9,73	9,63	9,53	67	2,50	2,44	2,38	108	0,82	0,80	0,77
27	9,38	9,28	9,18	68	2,42	2,36	2,31	109	0,80	0,78	0,75
28	9,04	8,94	8,84	69	2,35	2,30	2,24	110	0,79	0,76	0,73
29	8,72	8,62	8,52	70	2,28	2,23	2,17				
30	8,41	8,31	8,21	71	2,22	2,16	2,11				

4. Maintenance

4.1 Power-on check items

Inspection items	Key points for testing	Corresponding confirmation method
1.Exterior inspection of compressor and parts	1. Refrigeration oil level; 2. Lubricating oil temperature; 3. Inlet and outlet shut-off valves fully open; 4. Motor liquid spray angle valve fully open;	1. The high oil level window is full; 2. Before the test run, the oil temperature must be heated to about 40°C/heating time is about 8 hours; 3. Open the dustproof nut of the shut-off valve to check; 4. Open the dustproof nut of the motor liquid spray angle valve to check.
2. Electrical System	1. Main power supply voltage value 2. Control circuit voltage value 3. Motor phase-to-phase and ground insulation resistance 4. Power supply and wire	1. The voltage fluctuation range of the main power supply is controlled within the rated voltage of $380V\pm 5\%$, and the instantaneous voltage drop at startup is less than 10%; 2. The standard voltage value of the control circuit is $220V\pm 10\%$. If you have other requirements, please contact

	connection 5. Ground wire installation 6. Switch, sensor and controller settings	Hanbell Company; 3. The insulation value must be higher than 5MΩ; 4. The power supply is connected to the junction box and should have good insulation. The power cord should be kept away from heat sources and angular metal objects to avoid damage to the insulation skin. It should be equipped with a junction box and junction box bolts; 5. Confirm the installation;
3. Pipeline system	1. Check whether the pipe is fixed firmly 2. Check whether there is any leakage in the pipe	1. Visual or manual inspection; 2. Check with a leak detector or soapy water, especially at welds and joints.
4. Protective device	1. 1. Coil temperature protection 2. 2. Exhaust temperature protection 3. 3. Oil level switch	1. No action (closed circuit) 2. No action (closed circuit) 3. Full oil level (closed circuit)

Pre-startup inspection list

4.2 Run Check Items

- · Start the compressor (about 0.5-1 second) to monitor the suction and exhaust pressures to determine whether the compressor is turning normally. (Normal compressor turning judgment method: suction pressure drops immediately, while exhaust pressure rises).
- · After starting, check whether the lubricating oil in the liquid mirror on the external oil circuit is full. If there is a problem, please check the high and low pressure difference of the system (oil supply pressure difference), whether the filter is blocked (oil pressure difference alarm), whether the external oil return solenoid valve is open, check whether the oil circuit outlet is blocked, check whether the motor temperature rises too fast, and whether the liquid injection pipeline is supplied with liquid (please refer to 2.1.1 for control logic).
- · When the compressor is started, the lubricating oil in the oil separator will produce foam for a short time, but the lubricating oil foam will disappear when the compressor works under rated conditions.
- · The operating conditions of the compressor should be adjusted as follows: the exhaust temperature should be higher than the condensing temperature by more than 30K, and the suction superheat should be within 15K.
- · The entire equipment, especially the pipeline, must undergo abnormal vibration testing. If there is abnormal vibration or noise during the operation of the compressor, please contact HANBELL.

- · When the compressor is in long-term operation, the following items need to be checked daily: the machine's operating data (such as: three-phase voltage, compressor line current, etc.), check the oil temperature and oil level of the lubricating oil, all the sensor parts of the compressor, check the connection and tightness of the wires, and check the oil circuit sight glass.
- · When the condensing unit is in operation on site, special attention should be paid to its auxiliary equipment and the maintenance cycle of the unit after the initial start-up.
- · In order to ensure the normal viscosity of the lubricating oil at a lower ambient temperature and smooth lubrication of the bearings, it is recommended to keep the oil heater on the external oil separator turned on after the compressor is shut down to prepare for the next start-up.

 Notice :

If the exhaust temperature is too low or the lubricating oil temperature in the oil separator is too low when the machine is started, a large amount of refrigerant will dissolve in the lubricating oil, which will not only damage the compressor bearings, but also make the compressor lose oil. If it is a full liquid system, please check whether the oil return solenoid valve is opened according to the set control logic to return oil.

 Emergency stop operation

- · Cut off the power supply and stop the compressor. If a major accident occurs, cut off the main power switch of the compressor to stop all compressors.

- · Close all liquid supply valves on the system as soon as possible, and close the suction valve and exhaust valve of the compressor.
- · Find out the cause of the fault or accident and eliminate it.
- · In case of a sudden power outage, in addition to closing the compressor suction and exhaust valves and the evaporator liquid supply valve in time, the power switch should also be cut off, and the cause of the power outage should be found out.。

4.3 Failure Analysis

Fault Condition	Possible Causes
Compressor motor coil temperature protection tripped	1. The motor load is too large, the cooling is insufficient or the motor liquid spray solenoid valve fails. 2. The coil protection switch is faulty. 3. The electrical system is bad or faulty. 4. The motor coil is bad, the temperature rise is too high. 5. The electronic expansion valve controller fails and there is no current output.

Motor insulation is poor	1. The compressor motor connector is damp and condensed. 2. The compressor motor is defective. 3. The compressor motor terminal is defective. 4. The electromagnetic contactor insulation is poor. 5. The system is acidified and the insulation is corroded. 6. The coil is operated at high temperature for a long time, and the insulation is deteriorated. 7. Frequent starting, coil deterioration. 8. The water content of the refrigerant is too high.
The motor will not start or will not switch	1. The voltage is too low or the voltage is wrong. 2. The starting voltage drop is too large, and the electromagnetic contactor cannot be attracted. 3. Motor failure. 4. Phase loss, reverse phase, or phase loss operation. 5. The motor protection switch is activated. 6. The motor coil wiring is wrong. 7. The Δ-Δ start timer is bad. 8. The overcurrent setting is too small or the circuit breaker is improperly selected. 9. The electromagnetic contactor is bad.
Unusual vibration or noise	1. Bearing damage. 2. Compressor fluid compression. 3. Rotor overheating and friction with each other or the casing. 4. Oil loss and poor lubrication. 5. Internal parts loose. 6. Machine resonance caused by poor piping and no elastic expansion. 7. Foreign matter enters the compression chamber.

Exhaust temperature is too high	1. The superheat of the inhaled refrigerant is too high (insufficient refrigerant, abnormal expansion valve). 2. The high pressure is too high (poor cooling, air intrusion into the system, too high cooling water temperature, insufficient cooling water flow, poor heat exchange effect of the condenser). 3. The compression ratio is too large and there is no auxiliary cooling. 4. The bearing is damaged and the rotor is rubbed. 5. Oil loss or oil level is too low.
System low pressure alarm	1. 1. Insufficient refrigerant. 2. 2. Severe frost on the evaporator affects heat exchange. 3. 3. The expansion valve is too small, the temperature sensor is loose, and there is no insulation. 4. 4. The air intake filter is blocked by ice or dirt. 5. 5. The evaporator is too small. 6. 6. Problem with the low pressure protection setting.
System high pressure alarm	1. 1. Too much refrigerant. 2. 2. The condenser is dirty or mixed with air, resulting in poor heat exchange. 3. 3. The exhaust temperature is too high. 4. 4. The expansion valve is dirty or iced. 5. 5. The condenser is too small. 6. 6. High pressure protection setting problem.
Oil flow alarm	1. 1. Oil flow switch failure 2. 2. The condensing pressure cannot be established when the machine is turned on, and the oil supply pressure difference is insufficient. 3. 3. The oil circuit is blocked

	4. 4. The oil circuit solenoid valve fails
Exhaust temperature is too low	1. 1. The compressor suction contains liquid 2. 2. The return oil temperature is too low 3. 3. The system liquid pipe expansion valve is opened too much 4. 4. The economizer expansion valve is opened too much
Insufficient oil supply to the compressor	1. 1. Exhaust temperature is too low 2. 2. Oil separator filter failure 3. 3. Oil temperature in the oil separator is too low (the oil heater is not turned on before startup) 4. 4. Liquid in the suction air/liquid in the replenishment air 5. 5. Excessive opening of the economizer expansion valve 6. 6. Insufficient suction oil return 7. 7. Excessive pressure drop in the external oil circuit, poor oil supply

5. Appearance and Function

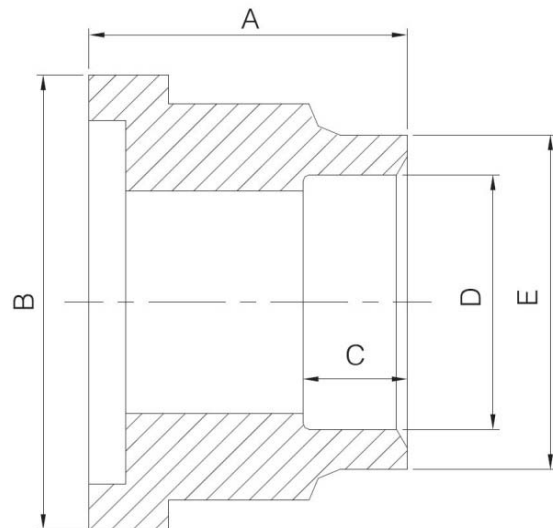
5.1 LC Model interface

Connect steel pipe	Inlet	Connect copper pipe	Connect steel pipe	Energy Saver Interface	Oil inlet	Motor fluid nozzle
Φ61.3	2"	Φ55	Φ61.3	7/8" Welding joint (Φ22.8)	3/8"Flare	3/8"Flare
	2"			7/8"焊口 (Φ22.8)	3/8"Flare	3/8"Flare
	2.5"	Φ68	Φ77.2	7/8"焊口 (Φ22.8)	3/8"Flare	3/8"Flare
Φ77.2	3"	Φ80.5	Φ90.2	7/8"焊口 (Φ22.8)	3/8"Flare	3/8"Flare
	3"			7/8"焊口 (Φ22.8)	3/8"Flare	3/8"Flare
	3"			7/8"焊口 (Φ22.8)	3/8"Flare	3/8"Flare
	3"			7/8"焊口 (Φ22.8)	3/8"Flare	3/8"Flare

Φ90.2	4"	Φ93	Φ110	1-3/8"焊口 (Φ35.2)	5/8"Flare	5/8"Flare
	4"			1-3/8"焊口 (Φ35.2)	5/8"Flare	5/8"Flare
	4"			1-3/8"焊口 (Φ35.2)	5/8"Flare	5/8"Flare
	4"			1-3/8"焊口 (Φ35.2)	5/8"Flare	5/8"Flare
Φ110	5"	Φ106	Φ135	1-5/8"焊口 (Φ41.5)	5/8"Flare	5/8"Flare
	5"			1-5/8"焊口 (Φ41.5)	5/8"Flare	5/8"Flare
	5"			1-5/8"焊口 (Φ41.5)	5/8"Flare	5/8"Flare
Φ135	6"	/	Φ159	1-5/8"焊口 (Φ41.5)	5/8"Flare	5/8"Flare
	6"			1-5/8"焊口 (Φ41.5)	5/8"Flare	5/8"Flare

Note: The pipe sizes in the above table are for configured casing

5.2 LC Machine pipe size and diameter specifications



casing

model	Location	Selected pipe diameter and material		Casing size				
				A	B	C	D	E
LC-100(-L)	exhaust	Copper Tube	2 1/8"	50	90	30	55	65
		Steel pipe	2"				61.3	74
	Inhale	Copper Tube	2 1/8"	50	90	30	55	65
		Steel pipe	2"				61.3	74
LC-140(-L)	exhaust	Copper Tube	2 1/8"	50	90	30	55	65
		Steel pipe	2"				61.3	74
	Inhale	Copper Tube	2 1/8"	50	90	30	55	65
		Steel pipe	2"				61.3	74
LC-180(-L)	exhaust	Copper Tube	2 1/8"	50	90	30	55	65
		Steel pipe	2"				61.3	74
	Inhale	Copper Tube	2 5/8"	60	110	35	68	77
		Steel pipe	2 1/2"				77	90
LC-200(-L)	exhaust	Copper Tube	2 5/8"	60	110	35	68	77
		Steel pipe	2 1/2"				77	90
	Inhale	Copper Tube	3 1/8"	66	120	45	80.5	90
		Steel pipe	3"				90.2	103
LC-230(-L)	exhaust	Copper Tube	2 5/8"	60	110	35	68	77
		Steel pipe	2 1/2"				77	90
	Inhale	Copper Tube	3 1/8"	66	120	45	80.5	90
		Steel pipe	3"				90.2	103
LC-250(-L)	exhaust	Copper Tube	2 5/8"	60	110	35	68	77
		Steel pipe	2 1/2"				77	90
	Inhale	Copper Tube	3 1/8"	66	120	45	80.5	90
		Steel pipe	3"				90.2	103

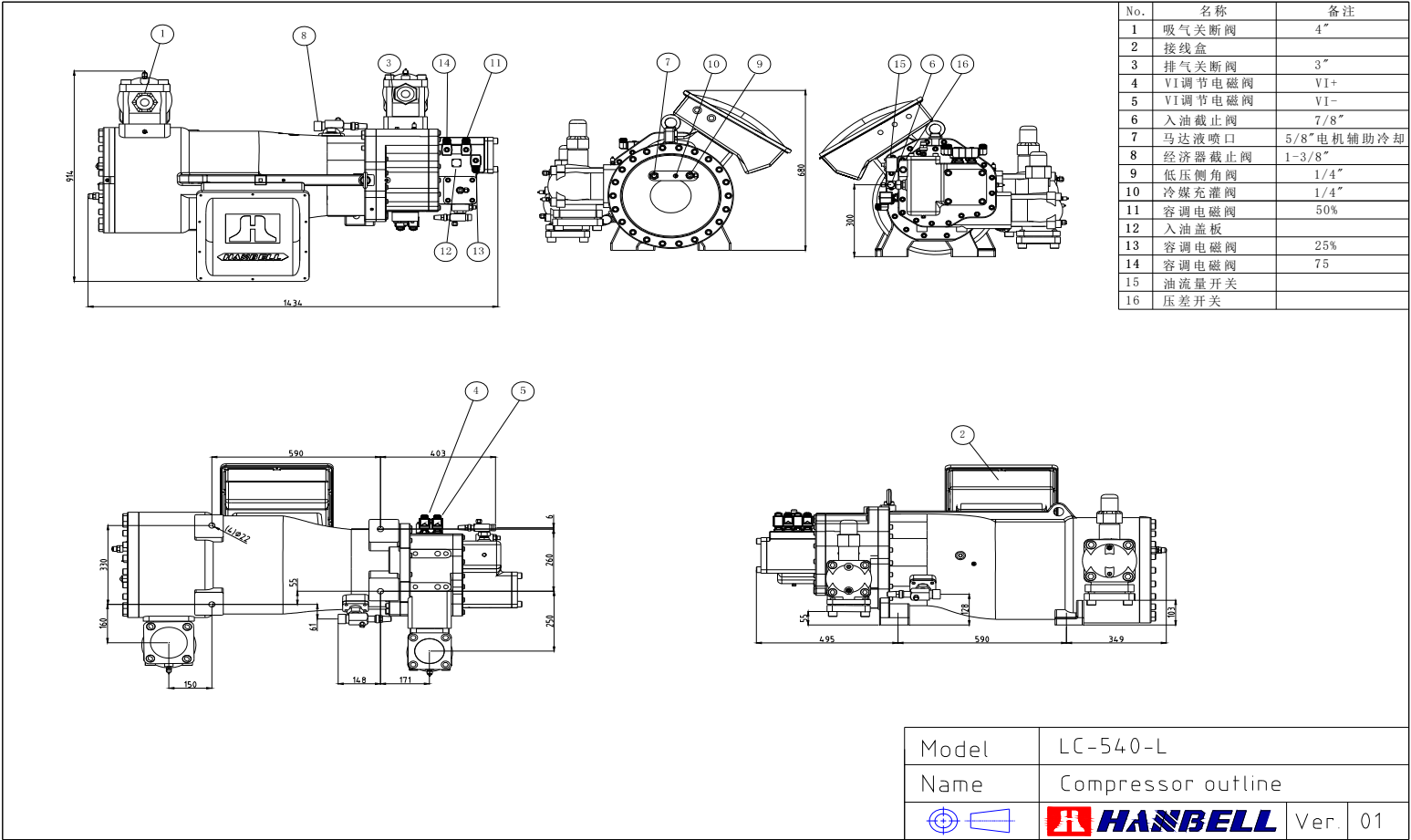
LC-280(-L)	exhaust	Copper Tube	2 5/8"	60	110	35	68	77
		Steel pipe	2 1/2"				77	90
	Inhale	Copper Tube	3 1/8"	66	120	45	80.5	90
		Steel pipe	3"				90.2	103
LC-320(-L)	exhaust	Copper Tube	3 1/8"	66	120	45	80.5	90
		Steel pipe	3"				90.2	103
	Inhale	Copper Tube	3 5/8"	76	145	50	93	103
		Steel pipe	4"				110	128
LC-360(-L)	exhaust	Copper Tube	3 1/8"	66	120	45	80.5	90
		Steel pipe	3"				90.2	103
	Inhale	Copper Tube	3 5/8"	76	145	50	93	103
		Steel pipe	4"				110	128
LC-410(-L)	exhaust	Copper Tube	3 1/8"	66	120	45	80.5	90
		Steel pipe	3"				90.2	103
	Inhale	Copper Tube	3 5/8"	76	145	50	93	103
		Steel pipe	4"				110	128

model	Location	Selected pipe diameter		Casing size				
		And material		A	B	C	D	E
LC-540(-L)	exhaust	Copper Tube	3 1/8"	66	120	45	80.5	90
		Steel pipe	3"				90.2	103
	Inhale	Copper Tube	3 5/8"	76	145	50	93	103
		Steel pipe	4"				110	128
LC-620(-L)	exhaust	Copper Tube	3 5/8"	76	145	50	93	103
		Steel pipe	4"				110	128
	Inhale	Copper Tube	4 1/8"	80	174	35	106	121
		Steel pipe	5"	75			135	154
LC-730(-L)	exhaust	Copper Tube	3 5/8"	76	145	50	93	103

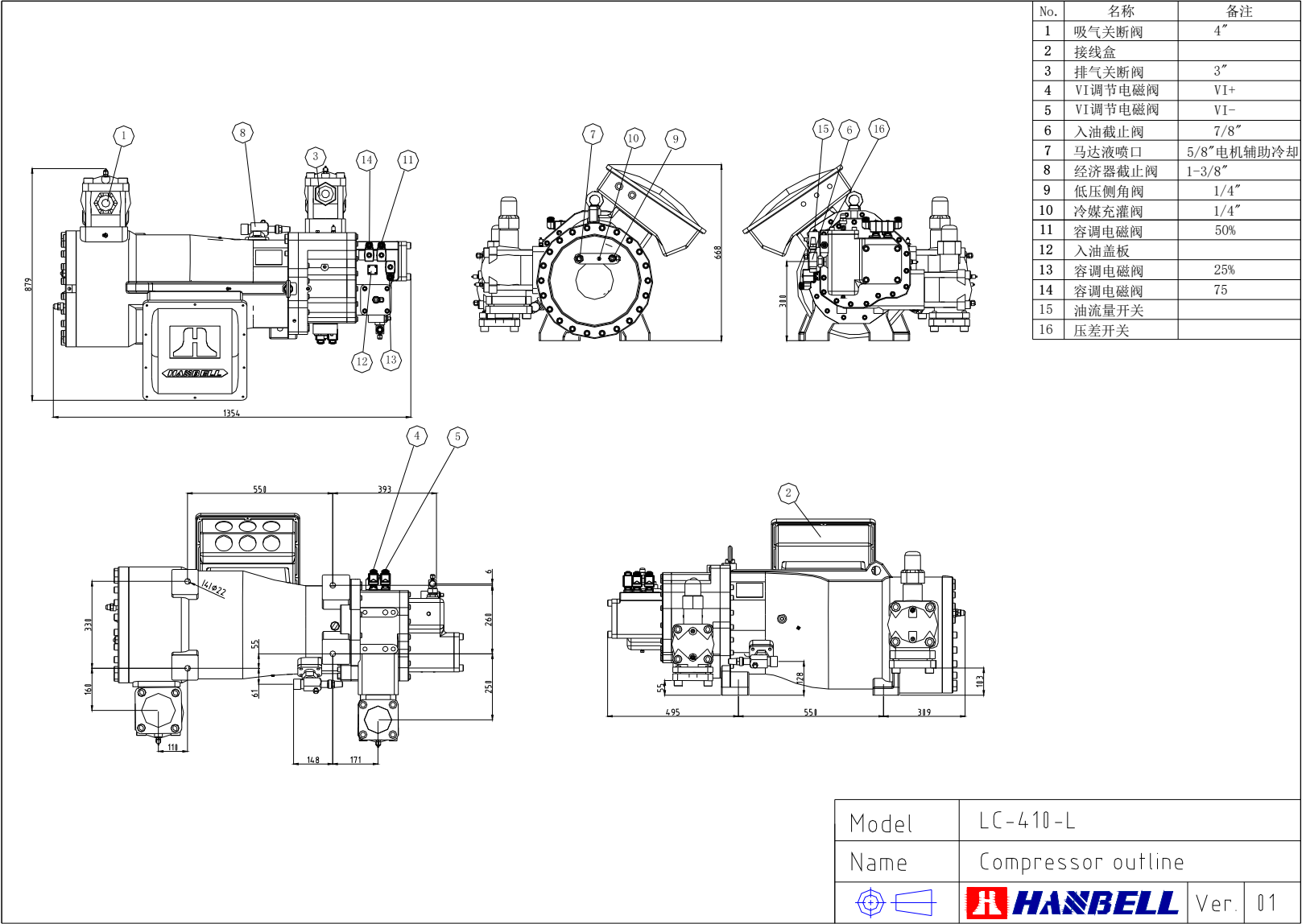
	Inhale	Steel pipe	4"				110	128
		Copper Tube	4 1/8"	80	174	35	106	121
		Steel pipe	5"	75			135	154
LC-830(-L)	exhaust	Copper Tube	3 5/8"	76	145	50	93	103
		Steel pipe	4"				110	128
	Inhale	Copper Tube	4 1/8"	80	174	35	106	121
		Steel pipe	5"	75			135	154
LC-930(-L)	exhaust	Copper Tube	4 1/8"	80	174	35	106	121
		Steel pipe	5"	75			135	154
	Inhale	Steel pipe	6"	75	215	40	159	196

5.3 LC 外观尺寸图

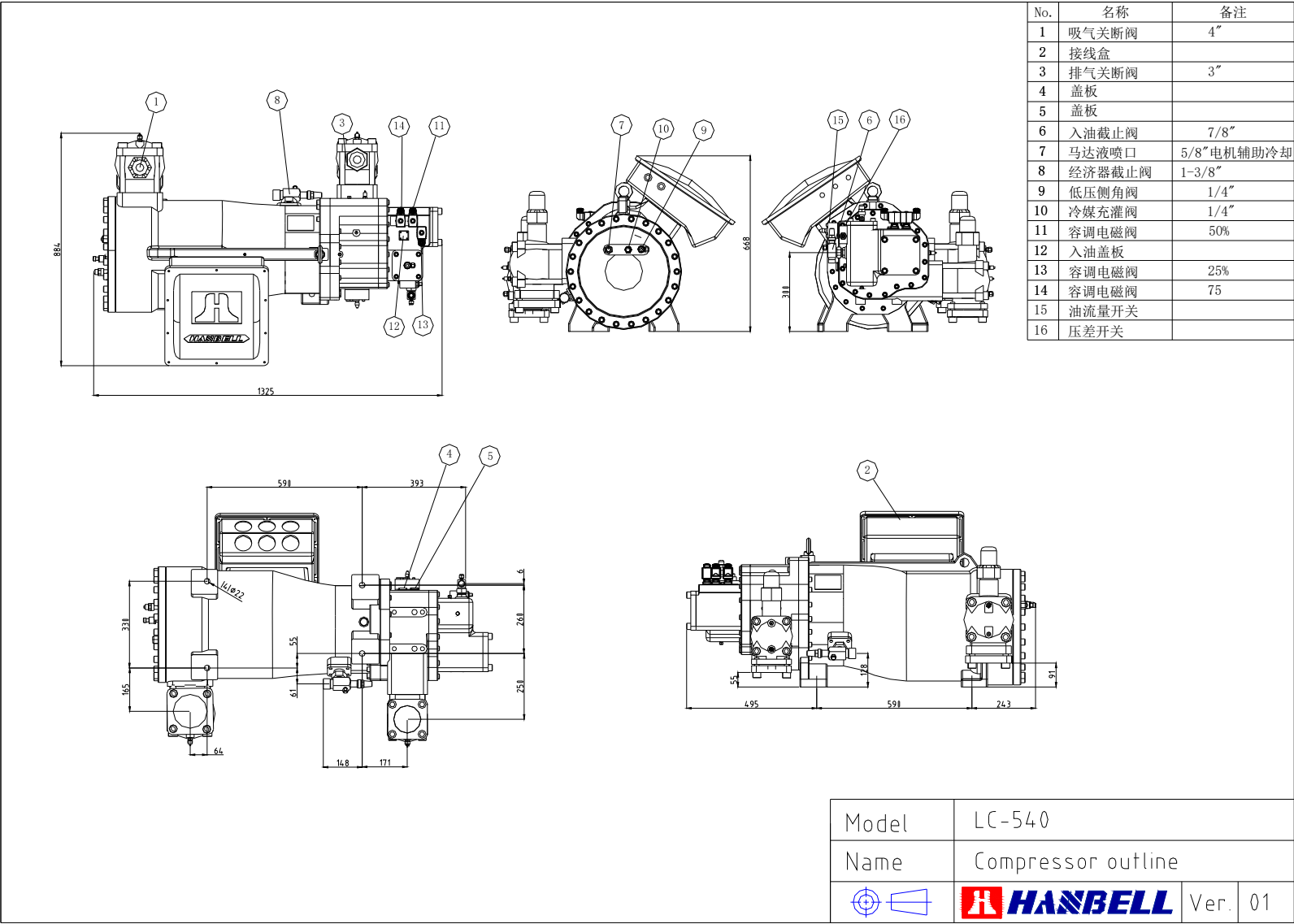
LC-540-L 外观图



LC-410-L 外观图



LC-540 外观图



LC-410 外观图

