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RefComp

Piston Compressor

SPC Series Semi-hermetic Piston compressors

SPC Series Techinical manual V0.0

Commercial Screw
Advanced Technology

From Italy, advanced screw &
Piston compressor technology

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Version Number: 20202042

Content

Chapter 1 Overview

Introduction

There are 8 models of SPC4 series semi-hermetic piston compressors which including SPC4-19L, SPC4-19H, SPC4-23L, SPC4-23H, SPC4-27L, SPC4-27H, SPC4-33L,SPC4-33H (Check table 1-A).

This series adopts four-pole three-phase motor (1450rpm at 50Hz) and connects directly to the drive shaft.

The compressor has 4 displacements, and the displacement range is from 19.3 to 33.1 m^3/h at 50 Hz. Each displacement compressor has two different models: the first is a model with a large size motor, indicating that the compressor is for high evaporating temperature application (the model is marked with the letter "H"); the second is a model with a small size motor. indicating that the compressor is for medium and low evaporating temperature application (the model is marked with the letter "L").

Users can choose the right compressor based on the working conditions and application ranges (air conditioning or freezing).
The SPC4 series compressors are mature in structure and can be used with either R22 or HFC chlorine-free refrigerants such as R407C, R134a, R404A or R507 without any modification.
The SPC4 series compressors are filled with lubricant while delivery. When the compressor uses R22 refrigerant, please use mineral lubricant; when the compressor uses fluorine-free refrigerant, use synthetic ester lubricant (POE oil).

Item	SPC4-19 L	SPC4-19 H	SPC4-23 L	SPC4-23 H	SPC4-27 L	SPC4-27 H	SPC4-33 L	SPC4-33 H
Refrigerant	R22/R407C/R134a/R404A/R507etc.							
No. of cylinder	4							
Rated motor power [Hp]	5	6	5	6	6	8	8	10
Displacement at 50Hz [m3/h]	19.3	19.3	23.1	23.1	27.3	27.3	33.1	33.1

Table 1-A

The refrigeration regulation device is optioned for SPC4 series compressor.

The four-cylinder model can achieve 100-50% energy regulation by using a special cylinder head. Check chapter 3”Capacity regulation” for more details.

Figure 1-1 is the SPC4 series compressor with splash lubrication.

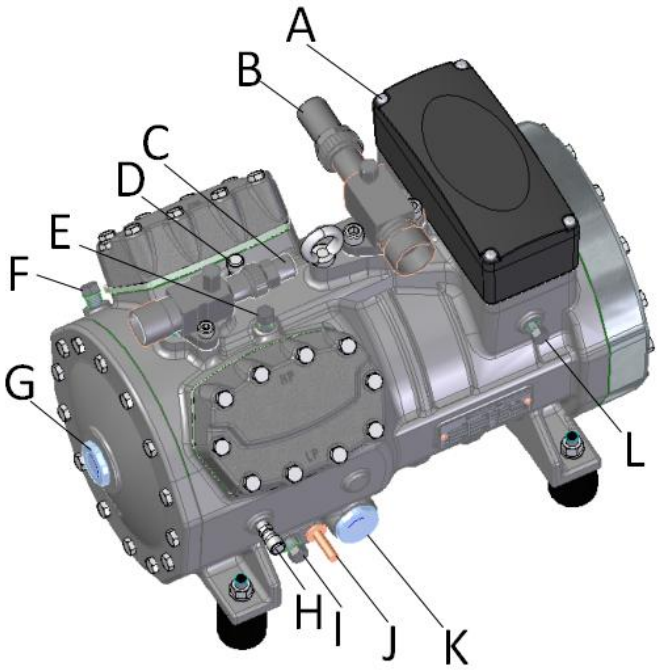


Figure 1-1 SPC4 series compressor (Splash lubrication)

Notes:

A）Electrical box　E）Discharge temperature connector　I）Oil drain plug
B）Suction stop valve　F）Oil injection port　J）Crankcase heater
C）Discharge stop valve　G）Oil level sensor (optional)　K）Oil level sight glass
D）HP needle valve connector　H）LP needle valve connector　L）LP connector

Figure 1-2 is the sectional diagram of SPC4 series compressor with splash lubrication;

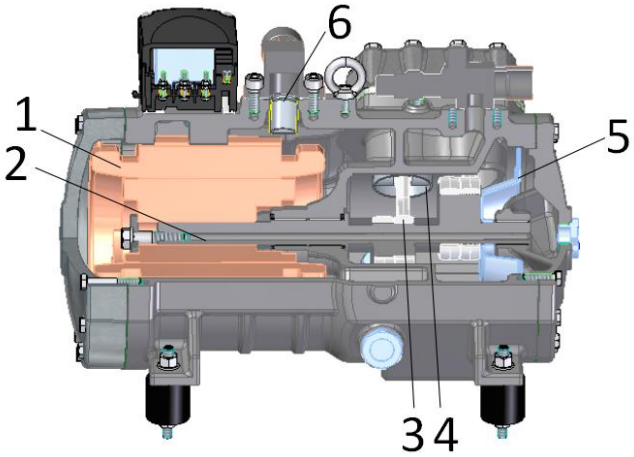


图 1-2 Sectional diagram of SPC4 series compressor (Splash lubrication)

Notes:

1）Motor　3）Connecting rod　5）Centrifugal oil flinger
2）Crankshaft　4）Piston　6）Suction filter

Chapter 2 Oil pipeline lubrication

2.1 Oil pipeline system

Lubricant function:

√Lubrication;
√Cooling;
√ Cleaning;
√ Damping;
√Compressor sealing.

SPC4 series compressor adopts splash lubrication.
The internal sectional diagram of splash lubrication system is shown at figure 2-1.

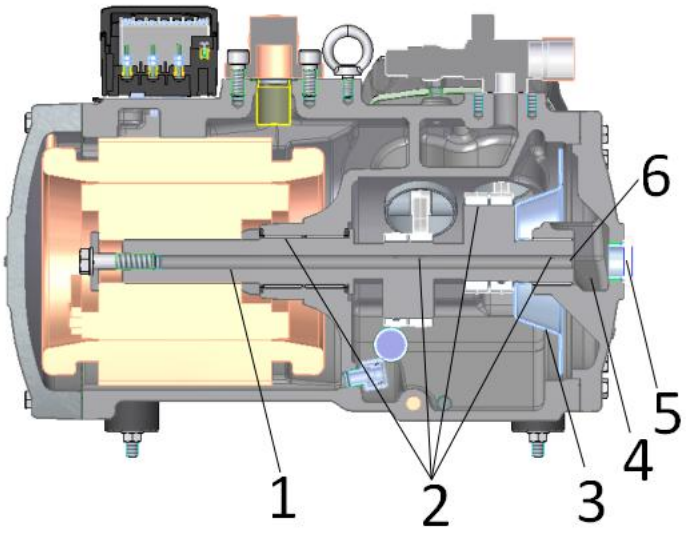


Figure 2-1 Splash lubrication system

1）Crankshaft
2）Oil flow pipeline
3）Centrifugal oil flinger
4）Oil tank
5）Electronic oil level switch connector
6）Oil inlet

The lubricant in the crankcase tank of the compressor reaches the oil tank inside the housing casting under the action of the oil centrifugal oil flinger driven by the crankshaft. There are two oil flow channels inside the crankshaft, the main channel and the crankshaft are concentrically connected to the oil tank, and the channel perpendicular to the crankshaft axis distributes the lubricant to the gap between the bearing and the housing casting and the gap between the crankshaft and the connecting rod (The crankshaft bearing at the end of the centrifugal oil flinger is directly supplied by the oil tank). The

oil in the main channel of the crankshaft, under the condition of the rotation of the crankshaft, directs the lubricant to the places where lubrication is required under the centrifugal force.

The low pressure oil supply in this way is relatively stable, and a stable lubricant film is formed under the optimized geometric shape design of the parts to lubricate the moving parts surface.

Splash lubrication has following characters:

- ✓ Less moving parts and simple structure;
- ✓ Safe and stable oil supply, even during the compressor start-up phase;
- ✓ Supply the lubricant as required, the lubricant resistance decreases as the oil flow decreases;
- ✓ The risk of oil blistering is greatly reduced by the effective reduction of gas dissolved in the lubricant.

2.2 Crankcase oil heater

SPC4 crankcase oil heater is PTC type with the automatic regulation function; The heater power consumption decreases as the crankcase oil heater temperature increases, the compressor size influence the power decrease ratio. The crankcase heater is isolated in a sleeve of the compressor bottom. As shown in figure 2-2.

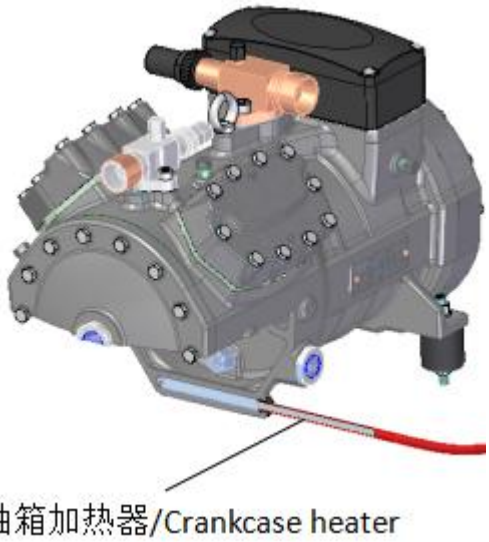


Figure 2-2 PTC crankcase heater of SPC4 series

This type of crankcase heater should be isolated with crankcase, oil doesn't need to replaced while replace the crankcase heater. Check chapter 8 "Overall dimension and packing" for specific position and size.

Check table 2-A for main technical parameters of crankcase heater. Check figure 2-3 for dimension parameters.

Compressor model	Crankcase heater code	Rated power （W）	Power（V-Hz）	IP Class
SPC4	303951(760539)	120(1)	230-50/60(2)	IP54
	303952(760540)	120(1)	110-50/60	IP54

(1) PTC heater

(2) Standard voltage

Table 2-A Electrical parameters of crankcase heater

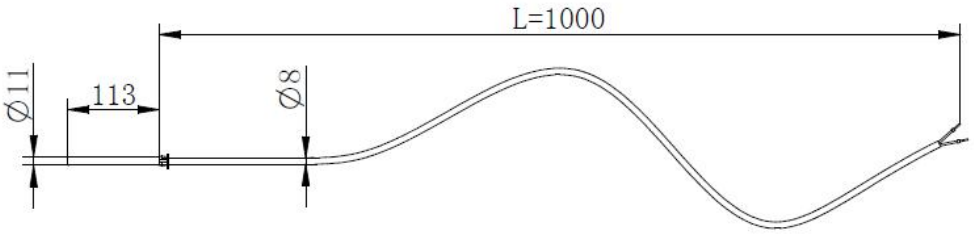


Figure 2-3 Overall dimension drawing of SPC4 series crankcase heater

Crankcase heater is applied during compressor shutdown, start the crankcase heater during the following situations:

- ✓ Compressor crankcase temperature lower than 10 °C;
- ✓ The temperature difference between crankcase temperature and standard evaporating temperature is lower than 10-15K;
- ✓ Long time shutdown;
- ✓ Large refrigerant injection;
- ✓ Refrigerant condensates in the compressor (The oil temperature is highest of the refrigeration system during shutdown phase).

Crankcase can not be applied during the following situations:

- ✓ The refrigerant injection amount of refrigeration system is relatively small;
- ✓ The normal running refrigeration system after check;
- ✓ Compressor negative pressure shutdown and the room temperature is above 10 °C;
- ✓ System shutdown in short time or the oil temperature of crankcase can’t be cooled down.

Check the above working conditions that no use crankcase heater for safe working condition.

	**Warning！** Start the crankcase heater 24 hours before the first start after compressor long time shutdown.

Ensure the lubricant temperature before compressor start should be 30K higher than room temperature or other components in the refrigeration system, check if crankcase heater working normally during refrigeration system maintenance.

Check table 2-B for crankcase heater assembly.

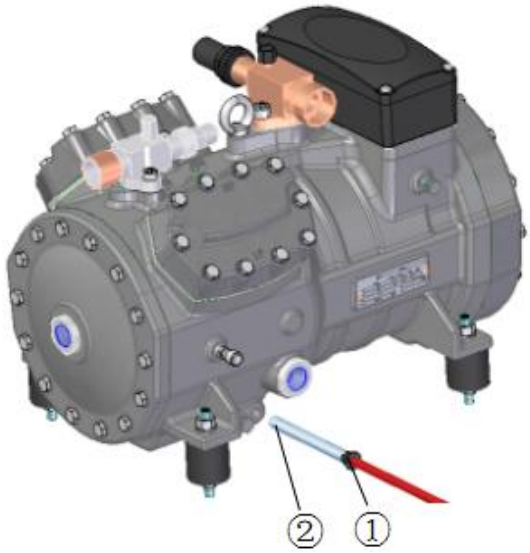
PTC heater	
	
Crankcase heater assembly procedures	Crankcase heater disassembly procedures
Step 1: Insert the crankcase heater ②	Step 1: Disassemble the plastic fixing plug①
Step 2: Assemble the plastic fixing plug ①	Step 2: Disassemble the crankcase heater ②

Table 2-B Assembly and disassembly diagram of crankcase heater

	**Warning!** Attention! Ground protection of electrical circuit.

2.3 Oil level

The standard compressor delivery is filled with lubricant, the compressor oil level can be observed by the oil sight glass beside the crankcase oil tank. SPC4 series is equipped with three oil sight glasses, two oil sight glasses at the body sides are horizontally symmetrically, the height from oil sight glass to the bottom is the same. Additionally, oil tank of discharge end cover is equipped with oil sight glass of same specification to observe the actual lubrication of compressor crankcase, the oil sight glass can be replaced by electronic oil level switch according to customer requirement.

Ensure the normal oil level during normal compressor operation, The Min. Oil level and Max. Oil level of compressor is shown in figure 2-4, the oil level of normal working condition can be observed through the oil sight glass.

There might be too much refrigerant inside the lubricant, check if refrigerant is too much at the additional cooling through the sight glass. (Check chapter 11 of “Additional cooling”).

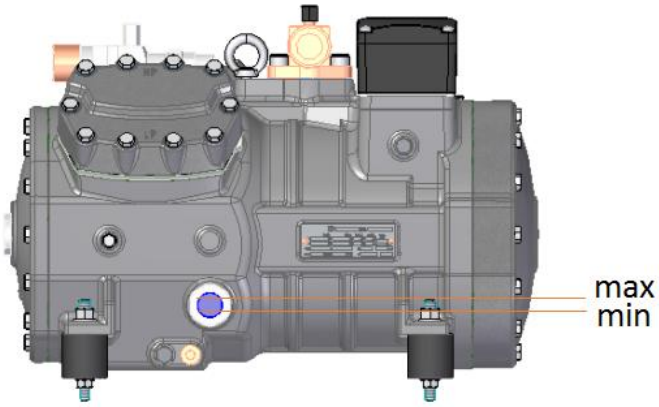


Figure 2-4 Oil sight glass

Oil sight glass overall dimension drawing is shown as figure 2-5 and fixes at the compressor through 1 1/8-18UNEF-2A thread and aluminum gasket.

	Warning! Charge the required lubricant for the refrigeration system under compressor initial oil injection if necessary.

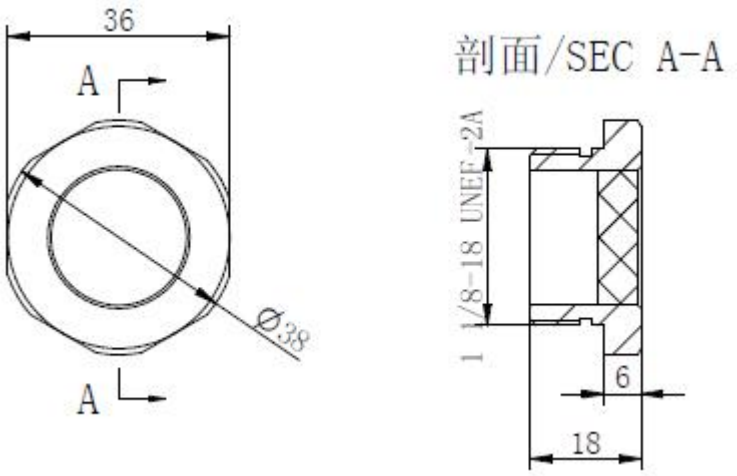


Figure 2-5 Overall dimension drawing of oil sight glass

2.4 Oil flow check valve

Oil flow check valve is installed between crankcase and motor housing of SPC4 series. The refrigerant will flow through the check valve to the crankcase when the oil level of motor chamber is higher than crankcase.When the oil level of crankcase is higher than motor chamber, the check valve flap will close to prevent lubricant flowing to motor chamber. Only small amount of lubricant will stays at the motor

chamber and decease the lubricant loss efficiently during compressor operation.

2.5 Lubricant

Lubricant should meet the following requirements:

- ✓ Enough bearing lubrication;
- ✓ The oil viscosity under nominal working condition;
- ✓ The intersolubility with refrigerant under low temperature.

Warning!
Never apply the lubricant not recommended by RefComp; prohibit contacting with humid air for the lubricant has high hygroscopicity.

Following table are the lubricants for different refrigerants of RefComp SPC series.
HCFC refrigerant R22:

Code	Chemical property	Viscosity @40℃ (mm^2/s)	Viscosity @100℃ (mm^2/s)	Flash point (COC℃)	Pour point (℃)	Ignition point (℃)	Specific gravity/density (g/cm^3)	Total acid value (mgKOH/g)	Water content (ppm)	Floc point (℃)
S008	mineral oil	29.5	4.31	178	-40	-	0.909	0.01	20	-53

According to the oil viscosity required by condensing temperature, two kinds of lubricants can be applied for HFC refrigerants R407C, R134a, R404A and R507.
HFC refrigerants R407C, R134a, R404A and R507.

Tc＜55°C

Code	Chemical property	Viscosity @40℃ (mm^2/s)	Viscosity @100℃ (mm^2/s)	Flash point (COC℃)	Pour point (℃)	Ignition point (℃)	Specific gravity/density (g/cm^3)	Total acid value (mgKOH/g)	Water content (ppm)	Floc point (℃)
S009	polyol ester（POE）	32.3	5.14	230	-35	-	0.956	0.01	35	-

Tc＞55℃

Code	Chemical property	Viscosity @40℃ (mm^2/s)	Viscosity @100℃ (mm^2/s)	Flash point (COC℃)	Pour point (℃)	Ignition poin (℃)	Specific gravity/density (g/cm^3)	Total acid value (mgKOH/g)	Water content (ppm)	Floc point (℃)
S010	Polyol ester （POE）	66.6	8.22	254	-40	-	0.960	0.01	35	-

2.6 Lubricant injection

Part of lubricant will stay at the refrigeration system during normal refrigeration system operation.

Generally, part of lubricant will stay at the refrigeration pipelines, so the oil level of compressor oil sight glass will decrease. Charge 10% more lubricant of lubricant injection amount to the refrigeration system according to the actual situation if required.

The lubricant for the oil separator should be considered if the refrigeration system is equipped with oil separator.

Regularly check the oil level through oil sight glass during initial operation.

At the previous chapter “Oil level”, check the compressor oil level when compressor running smoothly, the compressor oi level varies a lot for the mutual dissolution with refrigerant.

Lubricants of HCFC and HFC refrigerants are with strong hygroscopicity, lubricant shall not contact with air for a long time during oil replacement or other situations.

When the refrigeration system operation and oil level are stable, check if the lubricant property changed after 300 hours operation: lubricant color, odour and chemical composition, consider replacing the lubricant if lubricant changes. Check the following items:

- ✓ Kinematic viscosity;
- ✓ Humidity;
- ✓ System PH value;
- ✓ Lubricant composition.

Some lubricant properties are shown in table 2-C .

Replace the lubricant, oil filter etc, if the compressor lubricant property changed. Some refrigeration components will damage since there might be some acid inside the lubricant.

Look	Clear and transparent, no muddy	Clear and transparent, no muddy	Clear and transparent, no muddy
Color	L0.5(ASTM)	L0.5(ASTM)	L0.5(ASTM)
Kinematic viscosity (40℃)	29.5(mm^2/s)	32.3(mm^2/s)	66.6(mm^2/s)
Humidity	20(ppm)	35(ppm)	35(ppm)
Acidity	0.01(mgKOH/g)	0.01(mgKOH/g)	0.01(mgKOH/g)

Table 2-C

2.7 Oil temperature

The oil temperature shall not exceed 80 °C during normal working status, the temperature difference between oil temperature and condensing temperature is round 40K, the discharge temperature shall not exceed 140 °C.

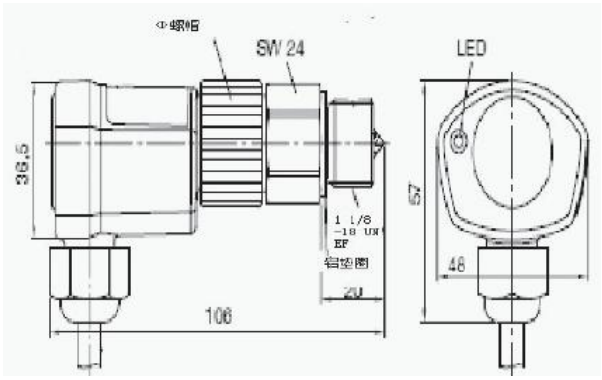
2.8 Electronic oil level switch

Monitor the compressor oil level by the electronic oil level switch to ensure enough lubrication for compressor working parts, it's applicable for SPC4 series piston compressor with splash lubrication, as shown in table 2-D and figure 2-6.

	**Warning!** Please equipped the SPC4 series piston compressor with electronic oil level switch to ensure the normal compressor working and extend compressor service life.

Electronic oil level switch has two parts:

- ✓ Pressure probe with thread, aluminum gasket;
- ✓ Circuit control module, reset button, signal light, control wiring.



Schematic diagram of electric oil level switch

		Electrical part	
		Power	AC 50/60Hz 230V±10%
		Activate point voltage (D1)	AC 50/60Hz 115V -15...+10%
		Working temperature	-30...+60℃
		Delays: -Power connection output delay -Activate point D1 connection output delay -Liquid level protection output delay -Fault alarm output delay -Power reset shut down time	 3s ±1s 5s ±2s 90s ±5s (blocked) 5s ±2s (blocked) ＞3s
		Power output	AC 240V 2.5A C300
Mechanical part		Mechanical service life	About 100000 times on-off
Working temperature	-30...+60℃	Housing material	A3XZG5
Max. temperature of glass cone	+100℃	IP class（Based on EN60529）	IP54 (Indoor status)
Max. Working pressure	42 bar	Installation	Connection thread M24x1
Housing material	1.0715 steel, nickel plating	Connection cable	6xAWG-18 (0.75mm^2) cable, L=1m
Connection thread	1 1/8″-18 UNEF	Weight	About 80g
Weight	About 75g	Certification	HL file No.E222056

Table 2-D Parameter table of electronic oil level switch

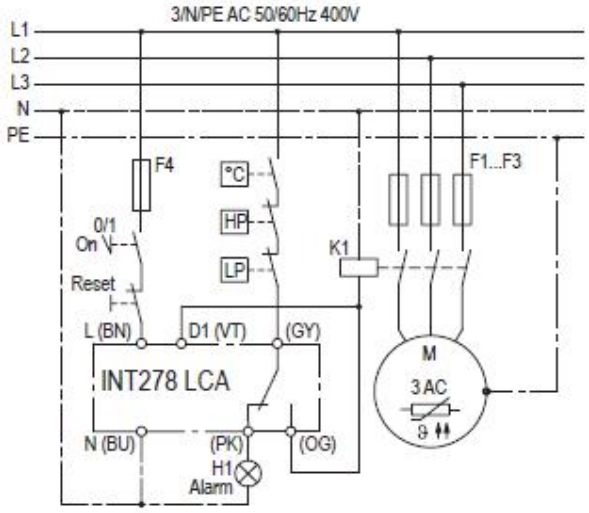
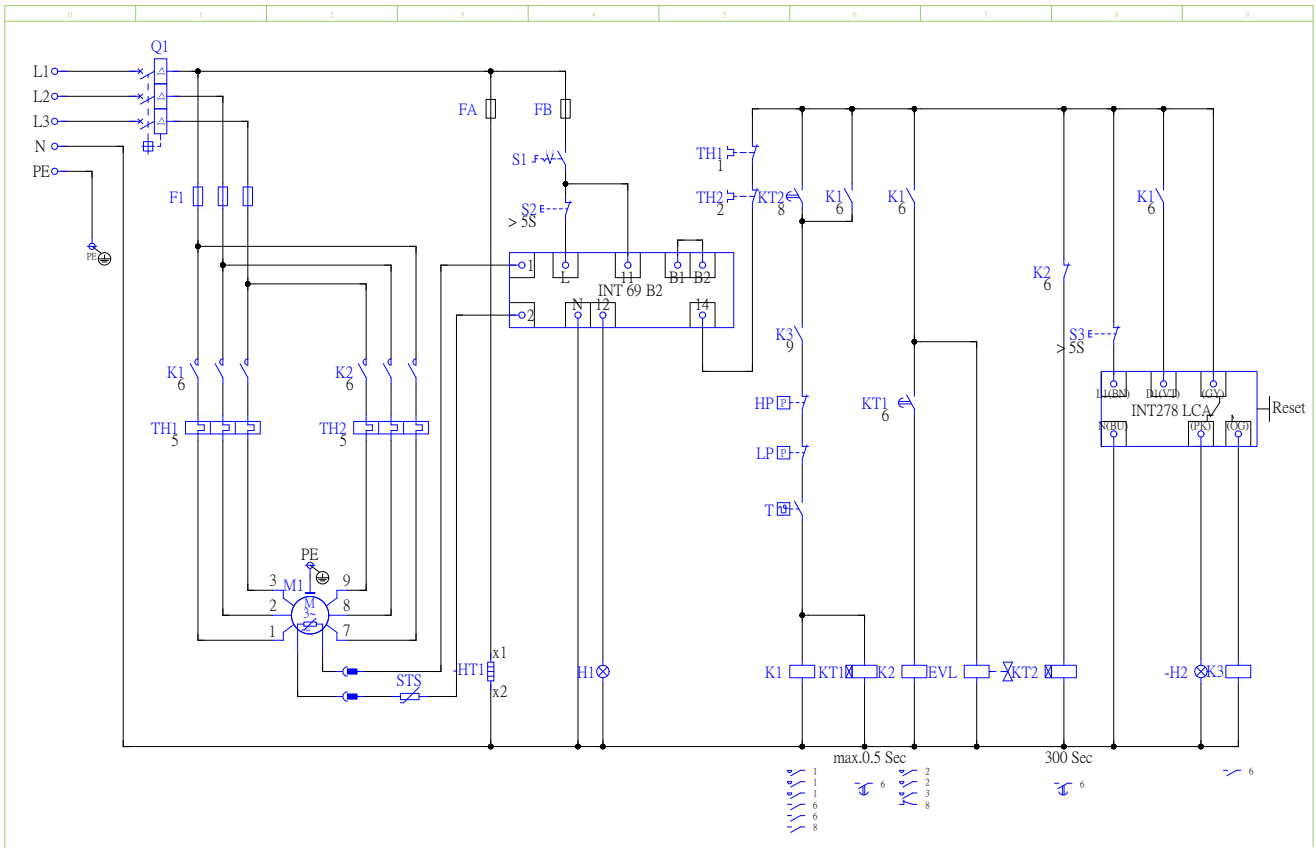


Figure 2-6 Wiring diagram of electronic oil level switch

No.	Terminal	Color	Function	Notes
1	L1(BN)	Brown	Power live wire	
2	N(BU)	Blue	Power neutral wire	
3	D1(VT)	Purple	Pressure difference protection after power on	
4	(GY)	Grey	Signal public end	
5	(PK)	Pink	GY connects with PK while alarming	Under normal condition, GY and PK disconnects, GY connects with OG after power on 3 seconds
6	(OG)	Orange	GY disconnects with OG while alarming	



Q1:Main switch F1: Compressor fuse FA: Heater fuse FB: Circuit control fuse
K1:Motor contactor 1 K2: Motor contactor 2 K3: Intermediate relay of oil pressure differential controller TH1: Thermal overload relay 1 TH2: Thermal overload relay 2
M1: Compressor motor STS: Discharge temperature sensor HT1: Electrical heater
S1: Control switch S2: Fault reset switch S3: Fault reset switch HP:High pressure switch
LP:Low pressure switch T: Temperature controller KT1:Time relay sub-coil
KT2:Time relay Operation time interval H1: Overload signal indication H2: Oil pressure differential alarm EVL: Liquid supply solenoid valve

Chapter 3 Capacity regulation

3.1 Capacity regulation

Many situations of refrigeration area require capacity regulation. Regulate the compressor capacity according to the actual requirement to avoid frequent start-ups, frequent start-ups not only damage the compressor motor and mechanical part, but also not energy efficiency.
RefComp SPC series compressor is available of the built-in capacity regulation device. A cylinder head with bypass suction can regulate the refrigeration capacity. The capacity regulation cylinder head has an internal on-off device to regulate compressor suction, this device is controlled by the external solenoid valve, so the compressor capacity can be linear regulated by the bypass number of compressor cylinders.

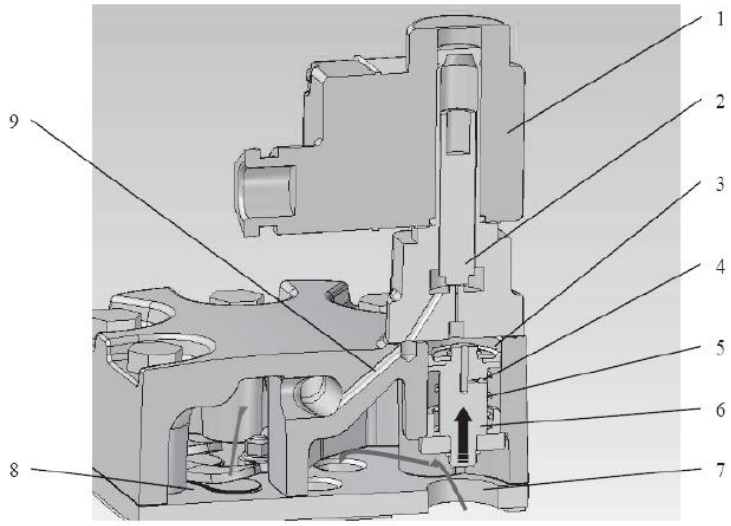
3.1.1 Capacity regulation cylinder head

Figure 3-1 is the schematic diagram of capacity regulation, capacity regulation cylinder head is also called CR cylinder head.
CR cylinder head is equipped with solenoid valve 1, solenoid valve 1 is not power on during 100% capacity. Valve element 2 of control solenoid valve isolates the discharge channel and suction channel. Spring 5 hold the on-off device by spring force to make the refrigerant steam directly go into the compressor suction port.Solenoid valve 1 power on during partial load. Valve element 2 of control solenoid valve connects the discharge channel with suction channel. The pressure at the on-off plunger 6 is stronger than spring force of spring 5, on-off plunger 6 prevent refrigerant steam flowing into the suction port of compressor cylinder, and bypass the discharge gas to the suction port.
Check table 3-A for SPC4 series compressor capacity regulation class.

No. of compressor cylinder	No. of CR cylinder head	Capacity regulation
4-cylinder	1	50%

Table 3-A Capacity regulation

Control solenoid valve power off



Control solenoid valve power on

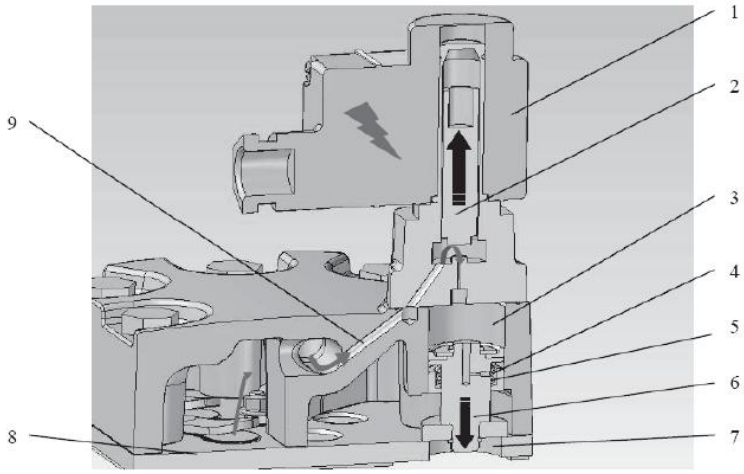


Figure 3-1 Schematic diagram of CR Cylinder head regulation

Notes:

1）Control solenoid valve coil　4）Discharge channel　7）Steam suction port

2）Valve element of control solenoid valve 5）On-off spring

8）Steam discharge port

3）Bypass on-off chamber　6）On-off plunger　9）Connection of bypass on-off chamber and discharge port

Compressor power consumption decrease is not proportionable with capacity regulation refrigeration decrease: compressor consumption decay factor is related with evaporating temperature and capacity regulation steps, check table 3-B for specific relations.

For example: The capacity regulation is 50% , but power consumption is 53% when two cylinders working of four-cylinder compressor.

Compressor model	No. of CR cylinder head	Capacity regulation	Compressor power consumption factor
4-cylinder	0	100%	1

	1	50%	0.53

Table 3-B Compressor power consumption factor

3.1.2 Capacity regulation cylinder head position

CR capacity cylinder head position is shown in figure 3-2.

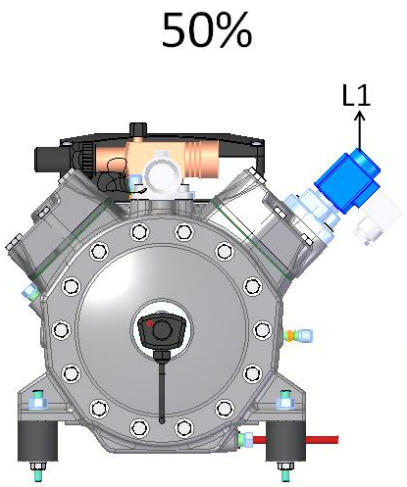


Figure 3-2 Schematic diagram of SPC4 series CR capacity cylinder head

3.1.3 Working range under partial load

Compressor discharge temperature will increase under partial load because the compressor suction decrease, the suction cooling motor increase the steam superheat, the total efficiency of compressor decreases. Please pay attention to the application limit of the chapter 10 “Application range” during partial load.

3.1.4 Additional cooling under partial load

Different compressors are equipped with different additional cooling devices, check chapter 11 “Additional cooling ” for more details.

3.1.5 Cautions under partial load

In the refrigeration system design, generally, at the gas return side, the flow rate of vertical pipeline shall not lower than 7m/s, horizontal pipeline shall not lower than 4m/s, the oil return might be influenced of compressor suction side if lower than these speeds. Generally, two gas return pipelines are required at the gas return pipeline design of partial load refrigeration system, the refrigerant steam go through the small size pipeline during partial load and go through big size pipeline during full load. Oil separator is required for the refrigeration system if the pipeline is too long. The expansion valve selection of evaporator should also consider the working condition under partial load.

	Warning! LCM liquid injection module and capacity regulation device can't be applied at the same time, or the compressor mechanical parts will damage.

3.1.6 Start under partial load

The solenoid valve that controls the CR capacity regulation controls the regular working condition according to the temperature, pressure and humidity etc. of the refrigeration system, but avoid frequent start-up for the regulation variation.

3.1.7 Partial load components

Partial load components are based on compressor model and solenoid valve voltage.
Partial load components are shown in figure 3-3.

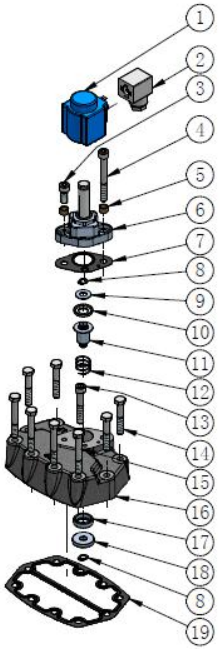


Figure 3-3 CR Components

No.	Description	Components code	Components code	Components code
		G535291-1	G535291-2	G535291-2
		Code	Code	Code
1	230V AC 50/60Hz solenoid valve coil	760525	/	/
	110V AC 50/60Hz solenoid valve coil	/	760526	/
	24V AC 50/60Hz solenoid valve	/	/	760527

	coil			
2	Coil connector	760519	760519	760519
3	Hexagon socket head cap screw (full thread) M8*20	616116	616116	616116
4	Hexagon socket head cap screw (half thread) M8*70	616212	616212	616212
5	Capacity regulation solenoid valve gasket	593136	593136	593136
6	Solenoid valve	760529	760529	760529
7	Solenoid valve gasket	593135	593135	593135
8	Snap ring	614230	614230	614230
9	On-off plunger plate	519656	519656	519656
10	Unloading piston ring	592821	592821	592821
11	Capacity regulation piston	519657	519657	519657
12	Unloading piston spring	519658	519658	519658
13	Hexagon socket head cap screw (half thread) M8*50	614543	614543	614543
14	Hexagon bolt (half thread) M8*50	614895	614895	614895
15	Hexagon bolt (half thread) M8*60	611250	611250	611250
16	Capacity regulation cylinder cover	535291	535291	535291
17	Capacity regulation spring plate	519659	519659	519659
18	Suction sealing plate	519660	519660	519660
19	Cylinder cover gasket	593131	593131	593131

3.2 Start unloading

During compressor start-up phase, it's necessary to reduce the starting current for the protection of compressor motor and grid impact. SU system of compressor is equipped for decreasing the compressor starting load, the system composes of special design cylinder head and control solenoid valve etc., starting unloading is controlled by the on-off of control solenoid valve. The SPC4 series is small power compressor with small starting current, so the SU components are not optional for RefComp SPC4 series compressors.

Chapter 4 Components

4.1 Suction filter net

As shown in figure 4-1, the suction filter net is built-in under suction stop valve, disassemble the suction stop valve while cleaning the suction filter net.

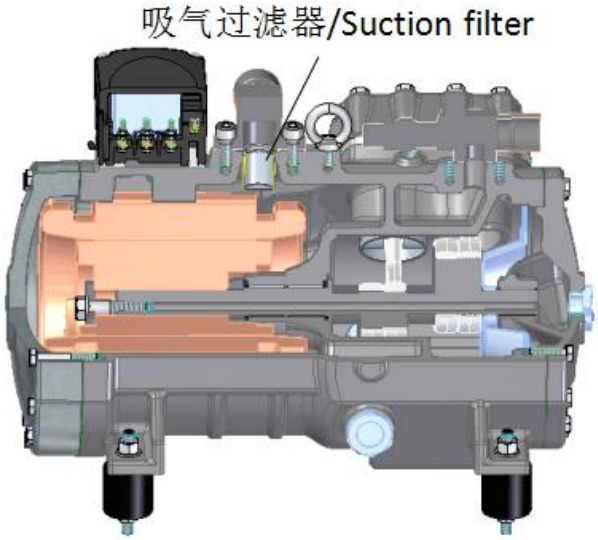


Figure 4-1 SPC4 series compressor suction filter net position

4.2 Stop valve

Both suction stop valve and discharge stop valve of SPC4 series are the similar structure as shown in figure 4-2.

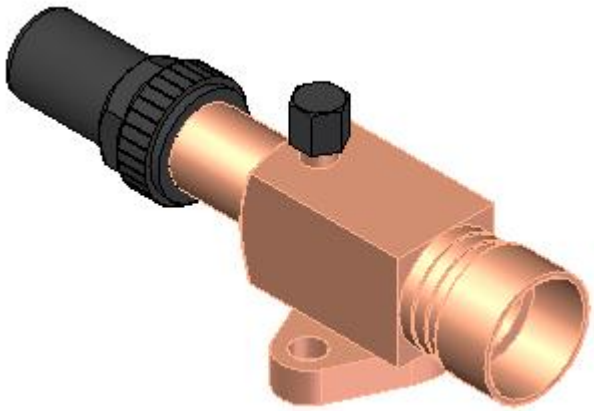


Figure 4-2 Schematic diagram of SPC4 series suction and discharge stop valve

4.3 Crankshaft

As shown in figure 4-3, the crankshaft of SPC4 series piston compressor is combined with motor rotor for balance weight.

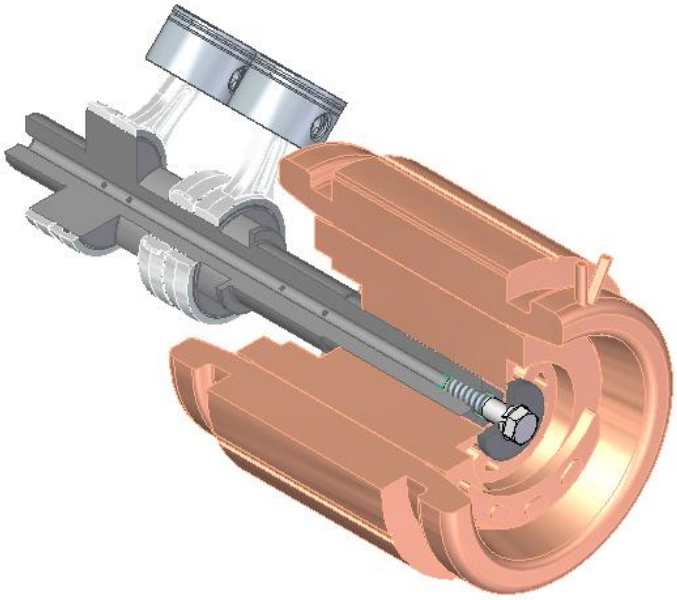


Figure 4-3 Schematic diagram of SPC4 series crankshaft connecting rod piston

4.4 Connecting rod piston

The connecting rod and crankshaft connection, the connecting rod and piston connection of SPC4 series piston is shown as figure 4-4. Consider the assembly lubrication between connecting rod and piston before use.

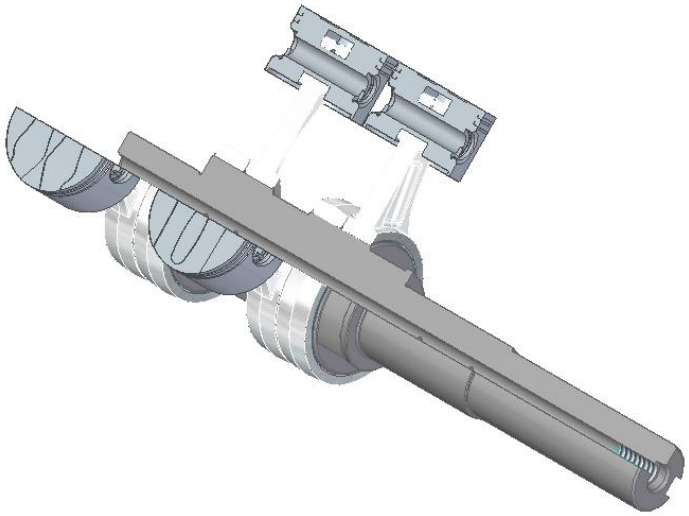


Figure 4-4 Schematic diagram of SPC4 series connecting rod, crankshaft and piston

As shown in figure 4-5, scraper ring 4 and gas ring 5 are directional, the surface with “TOP” should be upwards, and the opening of scraper ring and gas ring should have 180° difference during assembly.

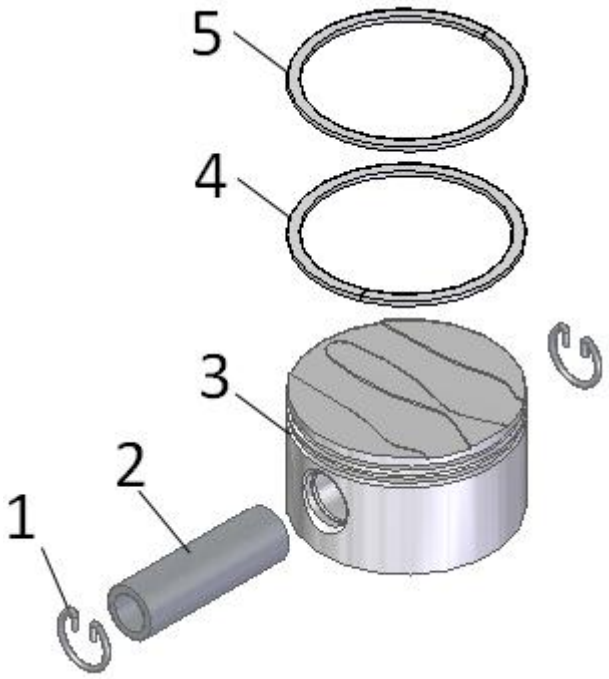


Figure 4-5 Piston

Notes

1）Seeger ring　　3）Piston

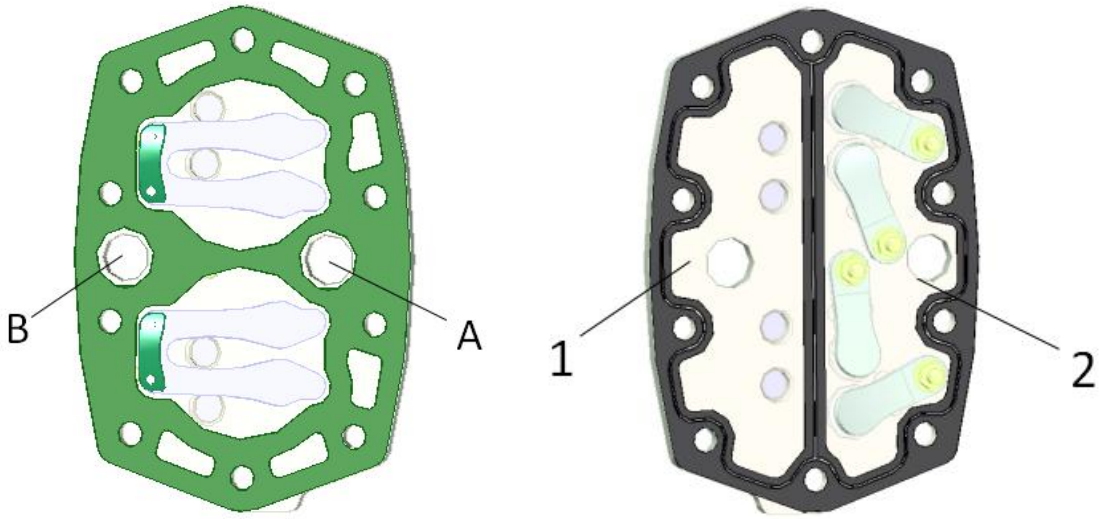
2）Piston pin　　4）Scrapper ring　　5）Gas ring (chrome plated surface)

4.5 Valve plate

As shown in figure 4-6, hole A is the suction hole, hole B is the discharge hole, No.1 is suction side, No.2 is discharge side.

The assembly procedures of valve plate:

1. Assemble the sealing gasket between body and valve plate;
2. Follow the direction as shown in figure 4-6 to assemble the valve plate;
3. Assemble the valve plate according to the holes at the body;
4. Generally no maintenance required for valve plate and valve sheet.



Downwards **Upwards**

Figure 4-6 Schematic diagram of SPC4 series valve plate

	Warning! Pay attention to the right assembly of valve plate and it's accessories. Prevent valve plate from collide with other metal part while clean the valve plate.

4.6 Bushing

Two bushings are fitted between crankshaft and body motor, the assembly method is shown as figure 4-7, bushing of discharge end cover side is shown as figure 4-8.

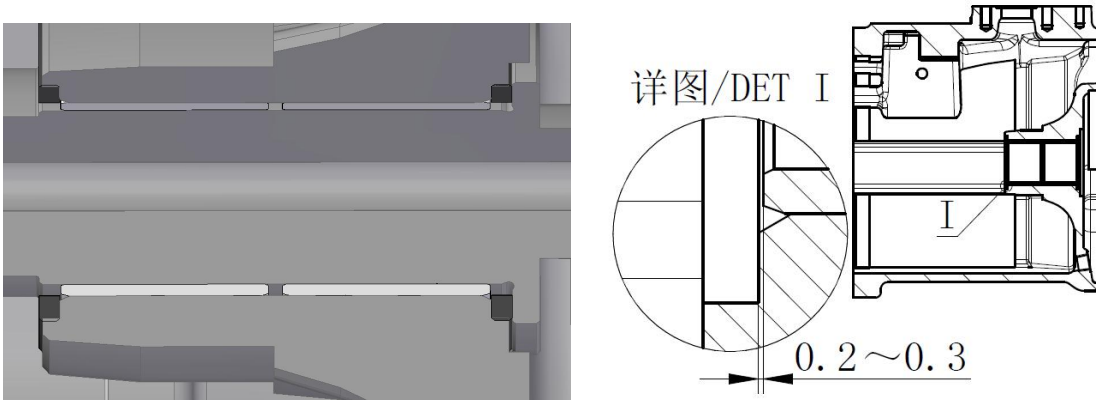


Figure 4-7 Schematic diagram of body motor bushing

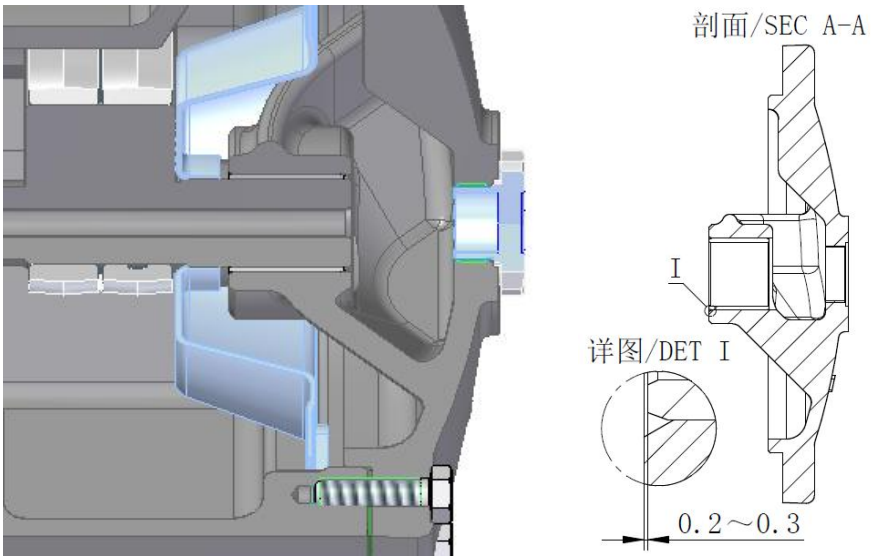


Figure 4-8 Schematic diagram of discharge end cover bushing

Pay attention to the following instructions during bushing assembly:

- PTFE thrust washer is applied at the SPC4 series bushing end surface SPC4.
- The distance between bushing and assembly hole is 0.2-03mm.
- After assembling the body motor bushing, the internal hole size is Φ=36（+0.065/-0.01)mm.

After assembling the discharge end cover side bushing, the internal hole size is Φ=32（+0.065/-0.01)mm.

Note:

While replacing the body motor side bushing, it's applicable if the body bushing assembly hole is smaller than Φ40.025mm, please contact with RefComp if the hole size is bigger than Φ40.025mm.

While replacing the discharge end cover side bushing, it's applicable if the discharge end cover bushing assembly hole is smaller than Φ36.025mm, please contact with RefComp if the hole size is bigger than Φ36.025mm.

Chapter 5 Electrical devices

5.1 General

The SPC4 series motors are three phase four-pole asynchronous motors (50Hz, 1450r/min or 60Hz,1750 r/min).
One SPC4 series compressor is equipped with two starting method, such as the standard 50Hz motor, it's star connection start when the voltage is 400V/3/50Hz, delta connection when the voltage is 230V/3/50Hz. For the 60Hz motor, it's star connection when the voltage is 380V/3/60Hz, delta connection when the voltage is 220V/3/60Hz.

5.1.1 Direct star motor

Figure 5-1 is the schematic diagram of direct start motor. The 1-4 is one winding, 2-5 is one winding, 3-6 is one winding.

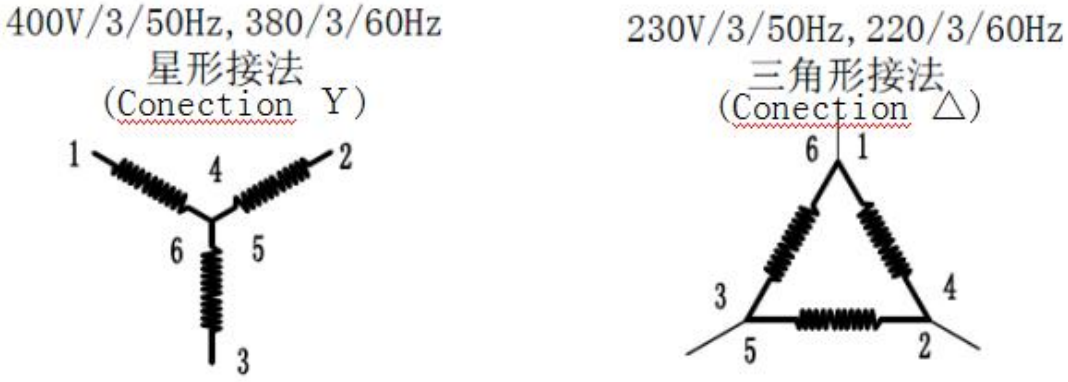


Figure 5-1 Schematic diagram of direct start motor

5.1.2 Motor insulation

The ground insulation, measured in factory before the shipping, is higher than 300MΩ (tested with Megger at 1000Vcc).
The moisture and acidity of the compressor will influence the electrical insulation. The insulation degree is also influenced by the motor temperature: higher is the temperature, lower will be the correspondence motor insulation. The Min. insulation resistance is 2MΩ, or the compressor motor operation might be risky. Check the dry filter and replace the lubricant under this situation.

	**Warning!** Prohibit testing the motor insulation level when the refrigeration system is in a vacuum.

5.2 Motor protection device

5.2.1 Motor thermistor

To protect the motor, three PTC thermistors are equipped into the compressor motor of SPC4 series piston compressor: three thermistors are installed near the compressor discharge side of motor, the activation temperature is 120°C .
When the temperature is lower than 40 ° C, the resistance value of the thermistor chain should not exceed 1800Ω. If the temperature of one thermistor exceeds a critical value, the resistance value of the resistor will increase exponentially. The compressor motor power is cut off by the protection module. The resistance value of the resistance chain can be measured according to the resistance terminals T1 and T2 in the electrical cabinet.

	**Warning!** When testing the resistance value of the resistance chain, the voltage used should not exceed 3V.

5.2.2 Motor protection module

SPC4 series piston compressors use INT69 B2 protection module to protect the compressor motor, INT69 protection module also can be customized, motor protection module also can be connected with oil temperature sensor and discharge temperature sensor to protect the oil circuit and discharge temperature.
The electrical parameters of INT69 B2 protection module (up) and INT 69 protection module (down) is shown in table 5-A.
The wiring diagram of SPC4 series protection module is shown in figure 5-2.

	Mechanical life	Approx. 1 million switching cycles
	IP class (based on EN60529)	IP00
	Housing	PA66 glass-fibre-reinforced
	Mounting	Screw mounted or snapped onto 35mm standard rail according to EN 60715
	Test loop	
	-Type	PTC (Based on IN44081/082）

		-No. of sensor	1-9 (In series)
Supply voltage	AC 50～60Hz 115～230V ±10% 3VA	-R25	<1800Ω
Working temperature	-30～+70℃	Reset of lock-out	Power off>5s
Output capacity	MAX. AC 240V 2.5A C 300 MIN. AC/DC>24，>20mA	Weight	Approx. 170g

		Mechanical life	Approx. 1 million switching cycles
		IP class (based on EN60529)	With thermal cover: IP20 Without thermal cover: IP00
		Housing	PA6 GF25
		Mounting	Base mounted
		Test loop	
		-Type	PTC（Based on DIN44081/082）
		-No. of sensor	1-9 (In series)
Supply voltage	AC 50～60Hz 240V ±10% 3VA	-R25	<1800Ω
Working temperature	-30～+70℃		
Output capacity	AC 240V，2.5A，360VA ind.	Weight	160g

Table 5-A Electrical parameters of INT69 B2 protection module (Up) and INT69 protection module (down)

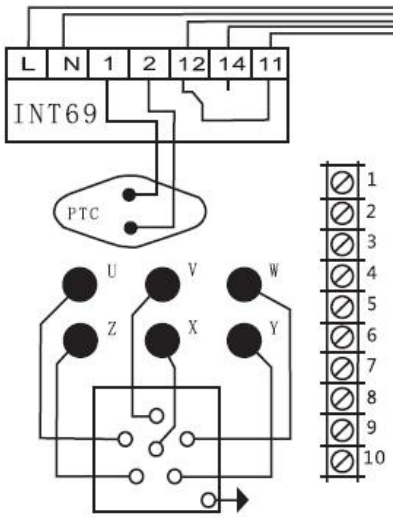


Figure 5-2 Wiring diagram of SPC4 series protection module

When the motor thermal protection triggers, manual reset the INT69 B2 protection module, start the compressor after confirming motor failure solved. INT69 protection module is automatically reset, it will reset automatically with manual shutdown as long as the resistance decrease.

	**Warning!** Shutdown and reset the INT69 b2 after motor cooling from motor overheating. Prohibit power supply of terminal 1-2, B1-B2, T1-T2.

Cut off motor power supply if the resistance of thermistor resistance chain of INT69 B2 exceed 4.5KΩ, and reset when the resistance less than 2.75KΩ. The default set of compressor protection module INT69 B2 from RefCmop is **B1-B2** connection, the alarm reset of the protection module is automatically lock-out, automatically reset the module while take out the **B1-B2** connection wire, RefComp recommends to keep the factory default.
Compressor should start after 30 minutes of motor overheat protection, it provides enough time to cool compressor motor, or the compressor motor might burn.
Generally, protection module will install at the compressor terminal box or the control cabinet, but the thermistor cables should be twisted and keep far away from power supply cable to prevent the false alarm and interference.

5.3 Power supply

- ✓ Two-cylinder standard motor is 400V-3-50Hz-Y/230V-3-50Hz-△ (Other motor supplied by order);
- ✓ Allowable voltage variation range: Rated voltage±10%;
- ✓ Allowable voltage unbalance of L1-L2-L3:2%;
- ✓ The Max. Voltage drop of compressor start-up phase:10% of rated voltage;
- ✓ Allowable frequency variation range:2% of rated frequency;

- ✓ Allowable current unbalance: three-phase current unbalance lower than 5%, current unbalance value of six terminal lower than 12% .

Calculate as follows:

Current of the first contactor: **I1 - I2 - I3**

Current of the second contactor: **I7 - I8 - I9**

Current of each power supply phase:

IR=I1+I7

IS=I2+I8

IT=I3+I9

Unbalance of the three R-S-T currents:

$$I_M = \frac{I_R + I_S + I_T}{3}$$

$$SB_3^{\%} = \frac{MAX\left|(I_R, I_S, I_T) - I_M\right|}{I_M} \cdot 100$$

$$SB_3^{\%} < 5\%$$

Six unbalance currents 1-2-3-7-8-9:

$$I_M = \frac{I_1 + I_2 + I_3 + I_7 + I_8 + I_9}{6}$$

$$SB_6^{\%} = \frac{MAX\left|(I_1, I_2, I_3, I_7, I_8, I_9) - I_M\right|}{I_M} \cdot 100$$

$$SB_6^{\%} < 12\%$$

Power supply of compressor accessories

The standard power supply for other compressor accessories (crankcase heater, solenoid valve, etc.) is 230V, 50/60Hz; Following power supply are also available.

- ●110V 50/60Hz;
- ●24V 50/60Hz.

5.4 Motor accessories

Refer to the compressor FLA for the selection of compressor power supply cable, fuse etc.

5.5 Motor size

There are two kinds of motors.

- High temperature compressor: Large size motor “H”.
- Low temperature compressor: Small size motor “L”.

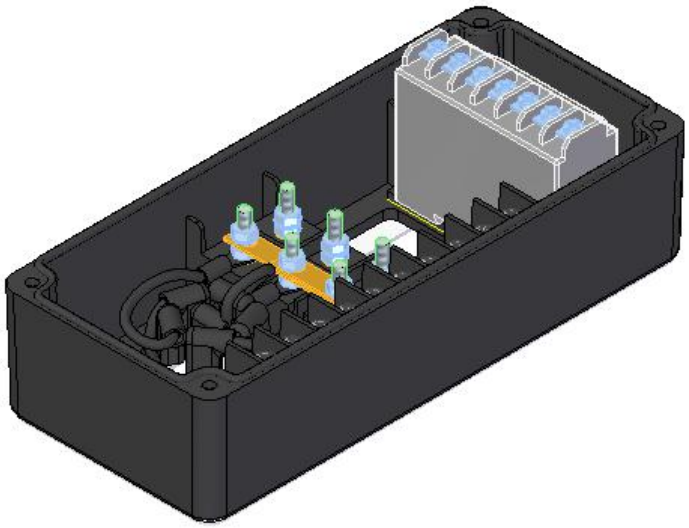
Check chapter 10 “Application range” for motor size and application range.

5.6 Motor data

Check chapter 6 “Model and technical data”.

5.7 Terminal box

IP54 is the electrical standard of compressor terminal box. As shown in figure 5-3.



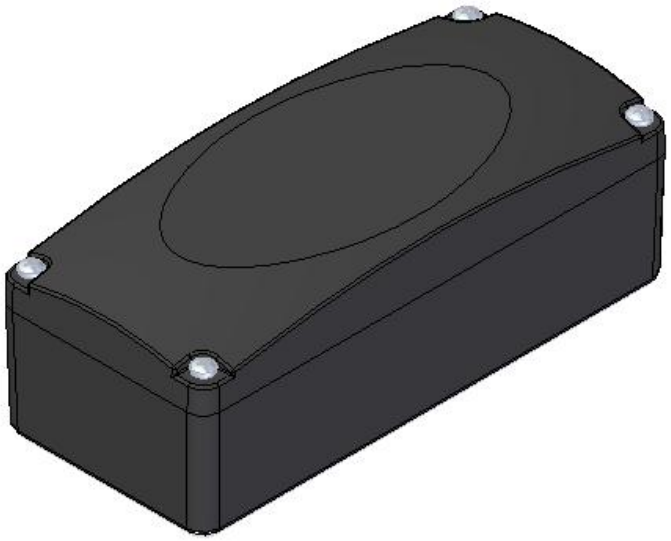


Figure 5-3 Schematic diagram of terminal box

5.8 Terminal board

There are six terminals of motor coil at the terminal board, terminals are insulated with ceramics, rubber cover is outside the ceramics to prevent short circuit caused by the condensing water. Check if the rubber cover damage and the tightness of terminal cable during maintenance.

Check the three-phase electricity connection method of compressor:

- Terminal U-X (or 1-4) is A winding
- Terminal V-Y (or 2-5) is B winding
- Terminal W-Z (or 3-6) is C winding

When SPC4 series piston compressor uses star connection 400V/3/50Hz or 380V/3/60Hz, three DOL connect as X-Y-Z, U,V,W are the terminal of M4, ensure the wiring tightness and enough contact area of customer side wiring, as shown in figure 5-4.

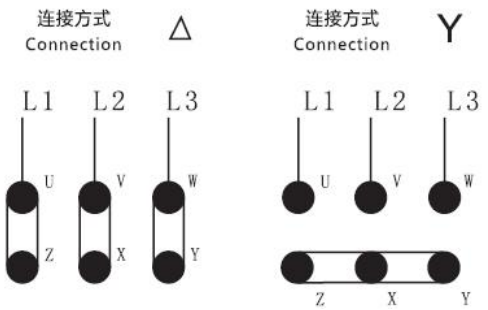


Figure 5-4 Schematic diagram of SPC4 series star connection

Similarly, three DOL connect with U-Z,V-X,W-Y while use delta connection 230V/3/50Hz or 220V/3/60Hz.

Chapter 6 Model and technical data

6.1 Model

SPC 4 - 19 L
SPC 4 - 19 H

Series	
SPC	Small semi-hermetic piston compressor

Number of cylinder
SPC series:4

Delimitador	
-	Delimitador to distinguish the number

Theoretical displacement(@50Hz)	
19	19/23/27/33 m^3/h

Motor type	
H	High temperature compressor motor
L	Low temperature compressor motor

6.2 Technical data

Model		SPC4							
		19L	19H	23L	23H	27L	27H	33L	33H
Compressor nominal power	[Hp] /[kW]	5 /3.7	6 /4.4	5 /3.7	6 /4.4	6 /4.4	8 /5.9	8 /5.9	10 /7.4
Displacement 50/60Hz	[m^3/hr]	19.3 /23.2	19.3 /23.2	23.1 /27.7	23.1 /27.7	27.3 /32.8	27.3 /32.8	33.1 /39.7	33.1 /39.7
No. of cylinder		4	4	4	4	4	4	4	4
Weight	[Kg]	78	79	78	79	79	85	84	87
Lubricant charge amount	[dm^3]	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Electrical parameter of crankcase heater		230V-120W-PTC-50/60Hz							
Discharge connector	[mm]/ [inches]	19- 3/4″	19- 3/4″	22- 7/8″	22- 7/8″	22- 7/8″	28- 1 1/8″	28- 1 1/8″	28- 1 1/8″
Suction connector	[mm]/ [inches]	28- 1 1/8″	28- 1 1/8″	28- 1 1/8″	28- 1 1/8″	28- 1 1/8″	28- 1 1/8″	35- 1 3/8″	35- 1 3/8″
Capacity regulation level		100,50%							
Electrical parameter of standard motor		400V/3/50Hz-Y(230V/3/50Hz-D)							
Start current Y/D	[A]	54/94	60/104	54/94	60/104	60/104	85/148	85/148	108/188
FLA	[A]	12/21	14/24	12/21	14/24	14/24	16/28	16/28	24/42

6.3 Nameplate

Compressor nameplate is shown as figure 6-1.

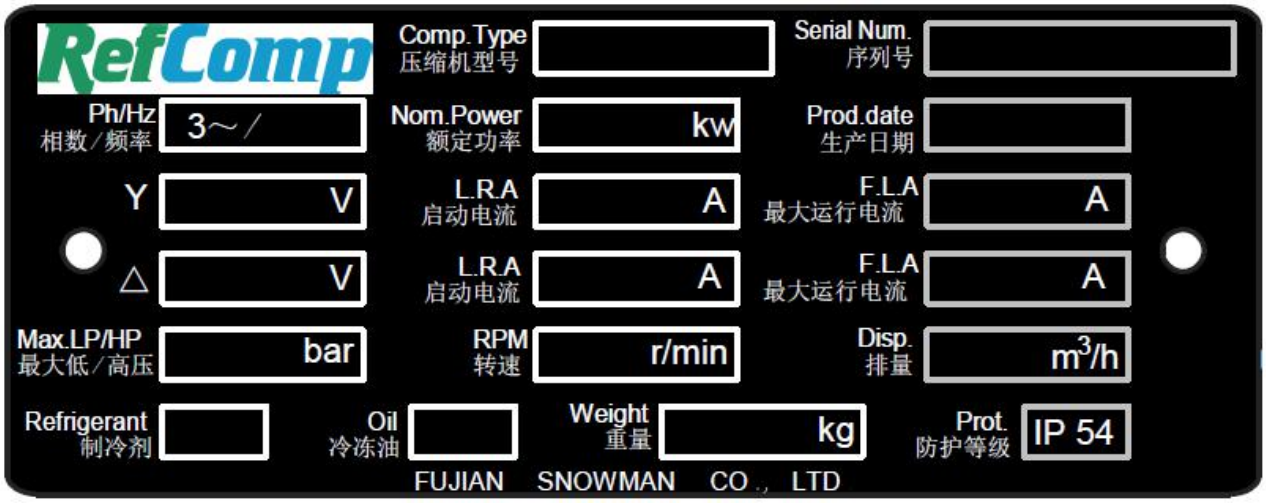


Figure 6-1 **Nameplate parameters of Y-△ direct start compressor**

Chapter 7 Scope of supply

7.1 Components of SPC4 series compressor can be supplied by requirements

7.1.1 Standard components

●SPC series star connection motor (400V / 3 / 50Hz) or delta connection motor (230V / 3 / 50Hz);
● Crankcase heater;
●Discharge stop valve;
● Suction stop valve;
●Rubber shock pad;
●Direct-on-line (DOL);
●Oil sight glass;
●Charging the oil;
●PTC thermistor
●INT69B2 protection module(230V/1/50-60Hz)；
●IP54 electrical box;
●Nitrogen protection;

7.1.2 Optional accessories

●SPC star connection motor (380V/3/60Hz) or delta connection motor (220V/3/60Hz);
●Photoelectric oil level switch components;
●CR components;
●Fan components;
● Discharge temperature probe components;
● Special packing.
The standard voltage of the compressor electronic parts (electronic protection module, crankcase heater, CR solenoid valve coil) are 230V AC 50 / 60Hz. For special electrical parts, please consult RefComp.

7.2 Accessories can be packed separately while compressor delivery

● Crankcase heater；
● Photoelectric oil level switch components;

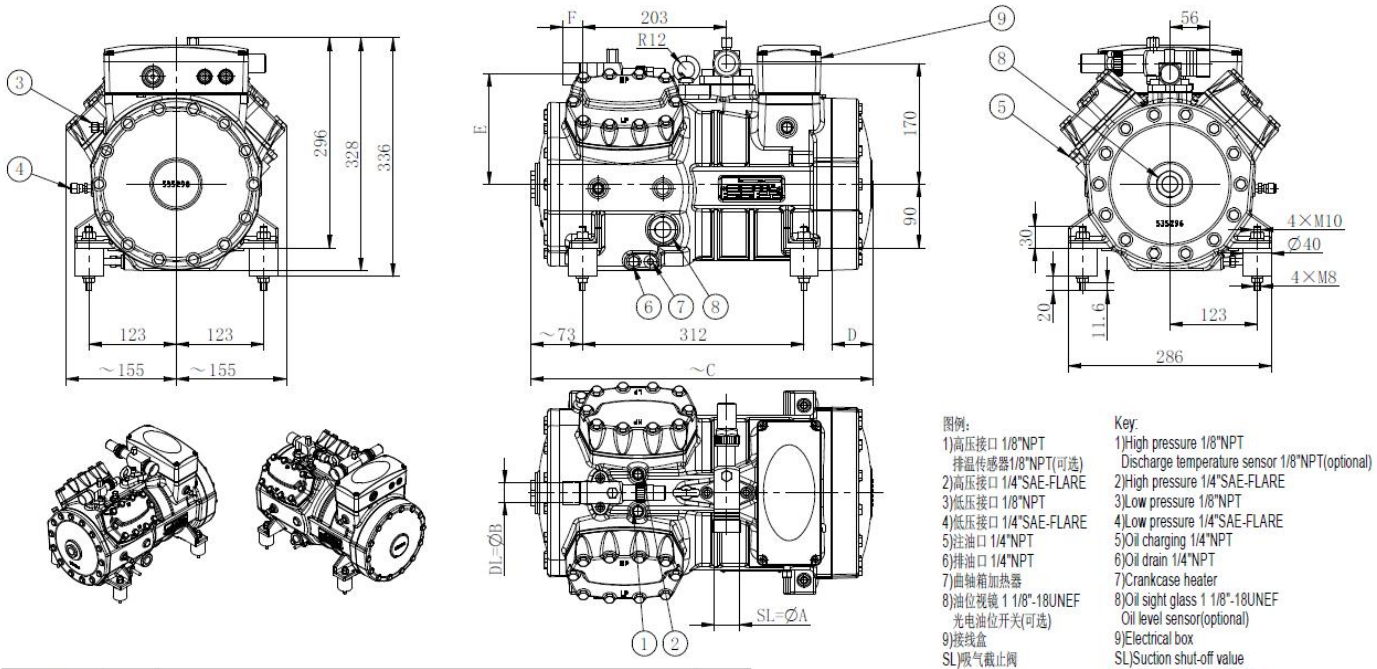
7.3 Accessories can be supplied by separated package

● Fan components

	Warning! Generally, compressor is charged with protection Nitrogen of 1-2bar/15-30PSI while delivery, ensure release the Nitrogen while disassemble compressor parts, ensure both high pressure and low pressure are under normal pressure.

Chapter 8 Overall dimension and packing

8.1 Overall dimension



项目 Item	单位 Units	参数 Parameter								备注 Note
机型/Type	/	SPC4-19L	SPC4-19H	SPC4-23L	SPC4-23H	SPC4-27L	SPC4-27H	SPC4-33L	SPC4-33H	
外形尺寸/Dimensions	mm	452.5×310×336	452.5×310×336	452.5×310×336	452.5×310×336	452.5×310×336	482×310×336	482×310×336	482×310×336	
尺寸A/size A	mm/inch	28.65/ 1 1/8"	28.65/ 1 1/8"	28.65/ 1 1/8"	28.65/ 1 1/8"	28.65/ 1 1/8"	28.65/ 1 1/8"	35.5/ 1 3/8"	35.5/ 1 3/8"	
尺寸B/size B	mm/inch	19.35/ 3/4"	19.35/ 3/4"	22.45/ 7/8"	22.45/ 7/8"	22.45/ 7/8"	22.45/ 7/8"	28.65/ 1 1/8"	28.65/ 1 1/8"	
尺寸C/size C	mm	452.5	452.5	452.5	452.5	452.5	482	482	482	
尺寸D/size D	mm	29	29	29	29	29	58.5	58.5	58.5	
尺寸E/size E	mm	149	149	149	149	149	149	155	155	
尺寸F/size F	mm	10.5	10.5	17	17	17	17	28	28	

Figure 8-1 Overall dimension drawings of SPC4 series

8.2 Packing

As shown in figure 8-2, wooden pallet, plywood boards, wooden reinforcing rids and cover plate are applied for SPC 4 series compressor and strengthen the packing strength.
Fix the compressor body to the wooden pallet by 4 screws. As shown in figure 8-3.
The overall dimension of packing box is shown as follows:

Model	Length A（mm）	Width B（mm）	Height C（mm）
SPC4	661	527	511

（a） 3D model of packing box

（b） Pallet structure of packing box

Figure 8-2 Standard packing box of SPC4 series compressor

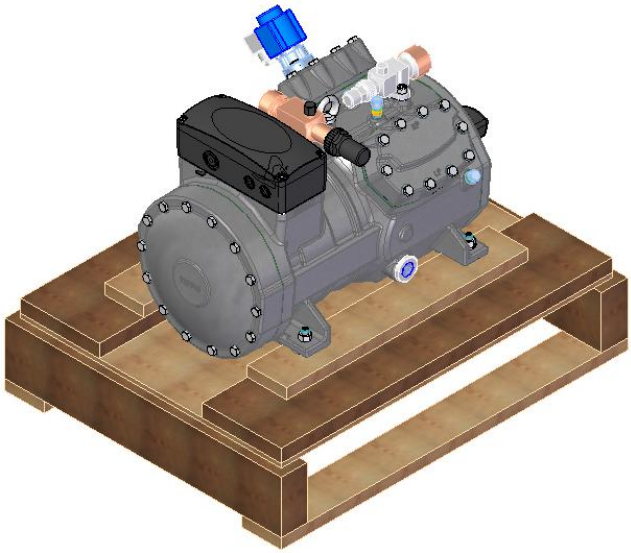


Figure 8-3 Schematic diagram of SPC4 series compressor packing

Warning ！

The compressor moving or lifting must be operated by forklift and the operator should be trained. Following table is the transportation weight (with standard configuration) of SPC 4 series models. Check chapter 7 “Scope of supply ” for specific configurations.

Model	Weight（kg）	Model	Weight（kg）
SPC4-19L	98	SPC4-19H	99
SPC4-23L	98	SPC4-23H	99
SPC4-27L	99	SPC4-27H	105
SPC4-33L	104	SPC4-33H	107

8.3 Inspection tests

Please check if packing and compressor has obvious damages while receive compressor. Please contact with RefComp or local dealers if confirm severe damage.

Some parts, especially those need to installed at the compressor at site, will packed separately (such as additional fan), check chapter 7 “Scope of supply”.

8.4 Storage notices

Carefully control the stacked layer: Accidents might happen if exceed the Max. Layers (Check figure 8-4).

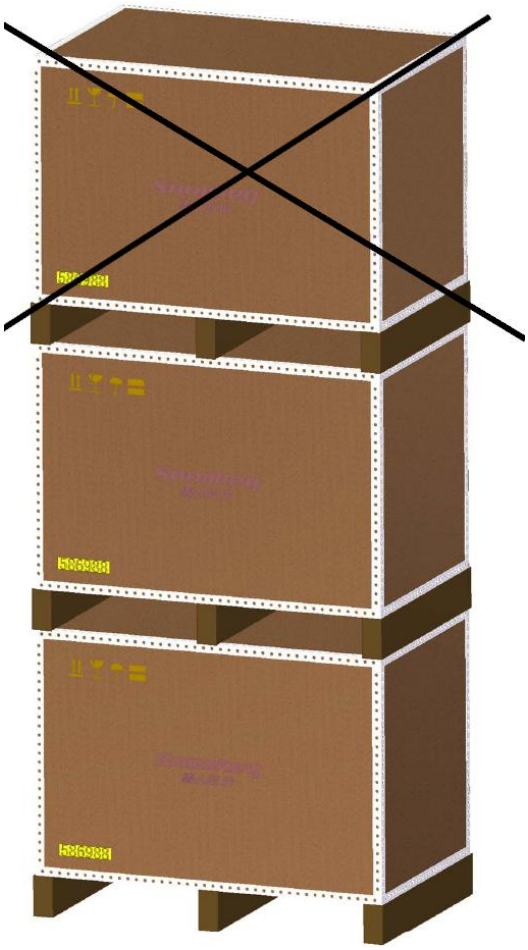


Figure 8-4 Two layers are the Max. layer

The storage environment should not have big variations in temperature and humidity, the storage time should not exceed one year, consider storing at cold place.

- ✓ Humid environment or direct sunshine will damage packing material, especially when many compressors stack together, it's more dangerous.
- ✓ Compressor mechanical part or plastic parts will damage if the temperature has severe periodically variations, which will increase the start risk of next start.

8.5 Handling and hoisting

Professional equipment should applied to ensure the safe operation as the compressor is heavy, recommend using the lifting device as shown in figure 8-5.

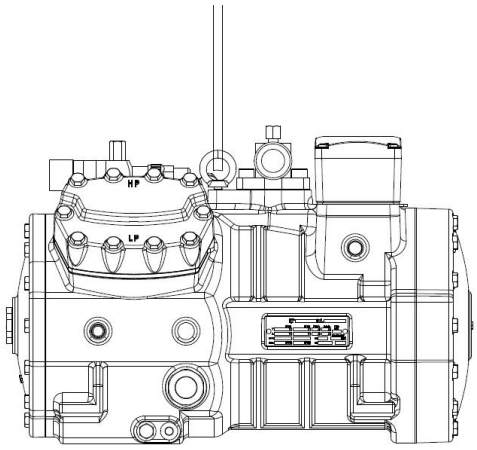


Figure 8-5 Schematic diagram of SPC4 lifting position

8.6 Compressor transportation

Generally, there are two kinds of compressor transportation method: Individual compressor packing; or compressor installed at the refrigeration system with shock pad at feet.

8.6.1 Individual compressor packing

Protect compressor from impact and vibration while transporting such packing, or the compressor might fall from pallet. Packing box and compressor might all damage if transport at the bad roads.

8.6.2 Compressor installed at the refrigeration system with shock pad

Shock pad will minimize the vibration and stress to system structure and refrigeration pipelines, especially when compressor starts and shuts down.Compressor can directly installed at the system structure if the vibration-proof measures are not required. Check the inlet and outlet pipelines and ensure no big stress during compressor operation.
Compressor installed at the refrigeration system and transport with shock pad, the long vibration transfer might cause pipelines breaking and refrigerant leaking. Please fix the compressor system to prevent this.
Rubber shock pads are the standard configuration for SPC4 series piston compressor.

8.7 Rubber shock pad

Rubber shock pad parts are placed in a special Nylon bag, figure 8-6 shows the diagram of overall dimensions and installation. Compressor can be transported as installed to the system with rubber shock pad. Tighten the shock pad during operation and transportation to prevent nuts loose.

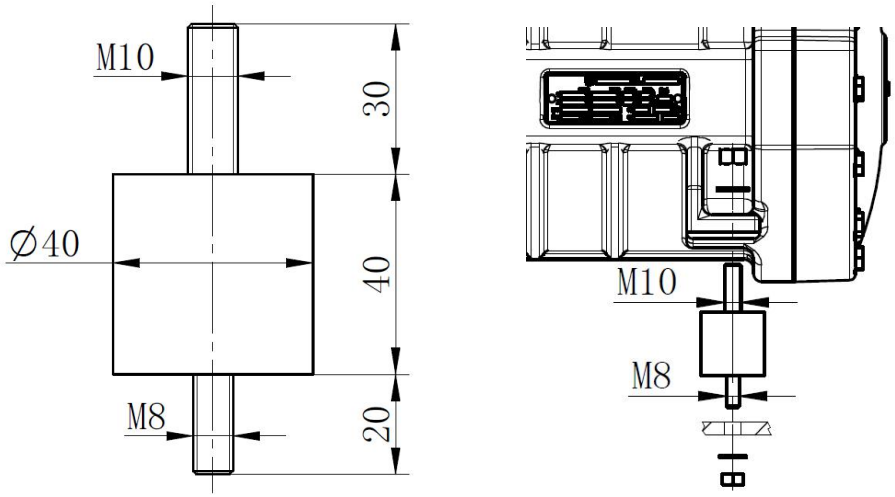


Figure 8-6 The rubber shock pad of SPC4 series piston compressor

Chapter 9 Performance parameter

SPC4 series compressor performance parameter, calculated with following working conditions.

√ Gas superheat: SH=10K；

√Liquid subcooling: SC=5K；

√Three-phase frequency: f=50Hz；

√Rated supply voltage: V=400V；

√Refrigerant : R22, R407C, R134a, R404A and R507；

√Without economizer.

Warning！

- ✓ Use RefComp selection software to calculate compressor performance under different working conditions (Check the RefComp website for the most updated release).
- ✓ The working condition parameter for calculation should be the same with the pressure tested at the compressor suction port and discharge port (check chapter 8).
- ✓ Even for multi-component refrigerants blends characterized by “glide” phase change (R407C, R404A, R507), temperatures are intended as readings in dew point.
- ✓ The suction superheat is referred to dew point.

Chapter 10 Application range

General

The evaporating temperature of SPC4 series compressor normal working is -40° C~+20 °C.
Application range will be influenced by following factors:

- ✓ Refrigerant type;
- ✓ Suction temperature;
- ✓ Cooling method;
- ✓ Power supply;
- ✓ Motor size: Compressor with small size motor (L) can't work under high evaporating temperature. Improper motor size will cause overload. Apply the compressor with big size motor (H) for high evaporating temperature condition.

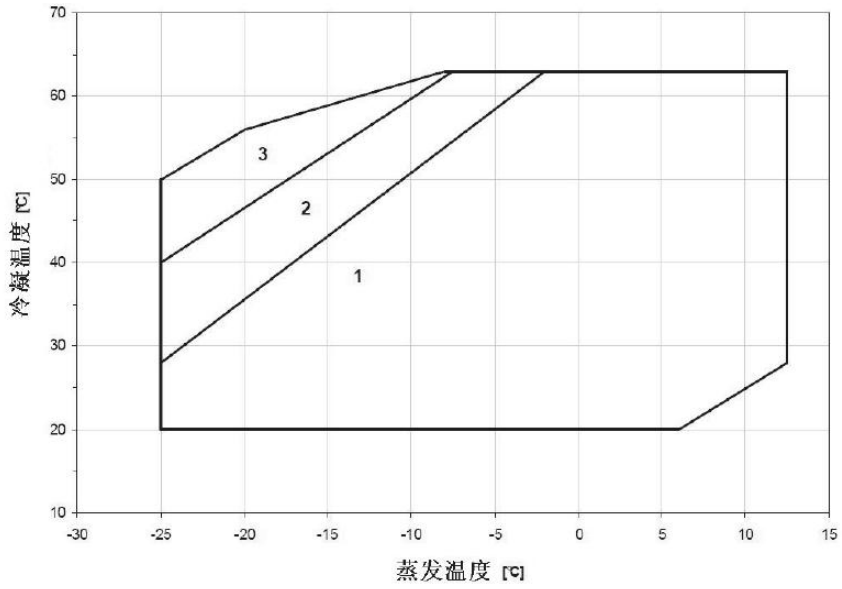
Following diagrams show the application range of SPC4 series compressor according to following information:

- ✓ Refrigerants and working temperatures;
- ✓ Suction temperature;
- ✓ Compressor type (motor size);
- ✓ Cooling method.

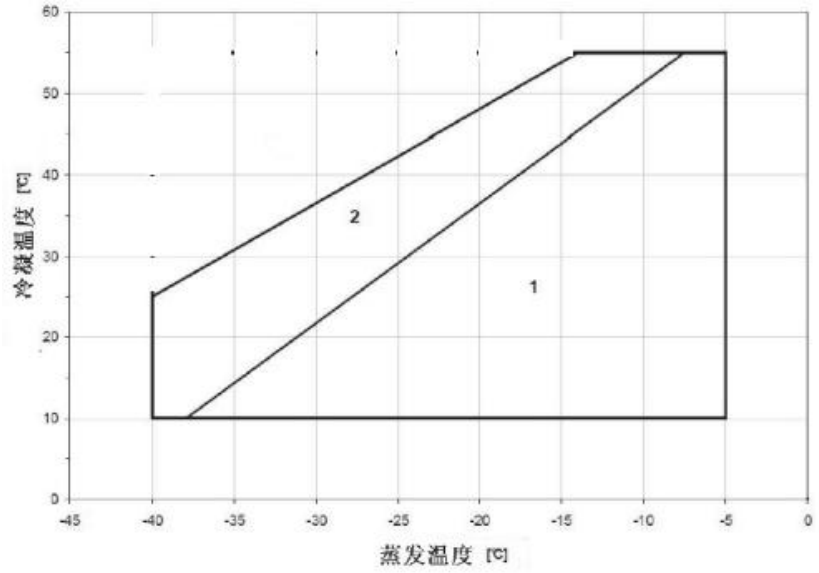
10.1 Application range of refrigerant R22

The application range refers to compressor running at full load with power supply frequency of 50Hz.
The application range also differ from motor size “L”or “H”.
Areas in the diagrams refer to following working conditions.
1= standard application range, suction temperature at 25 °C ;
2= additional cooling application range of compressor;
3=application range of additional cooling+Max. superheat 10K.

10.1.1 High temperature compressor “H”



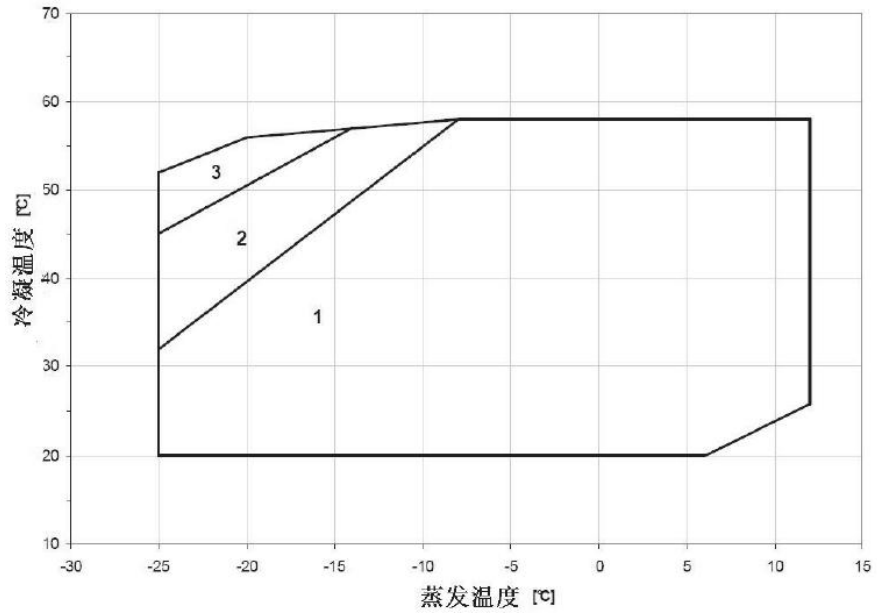
10.1.2 Low temperature compressor “L”



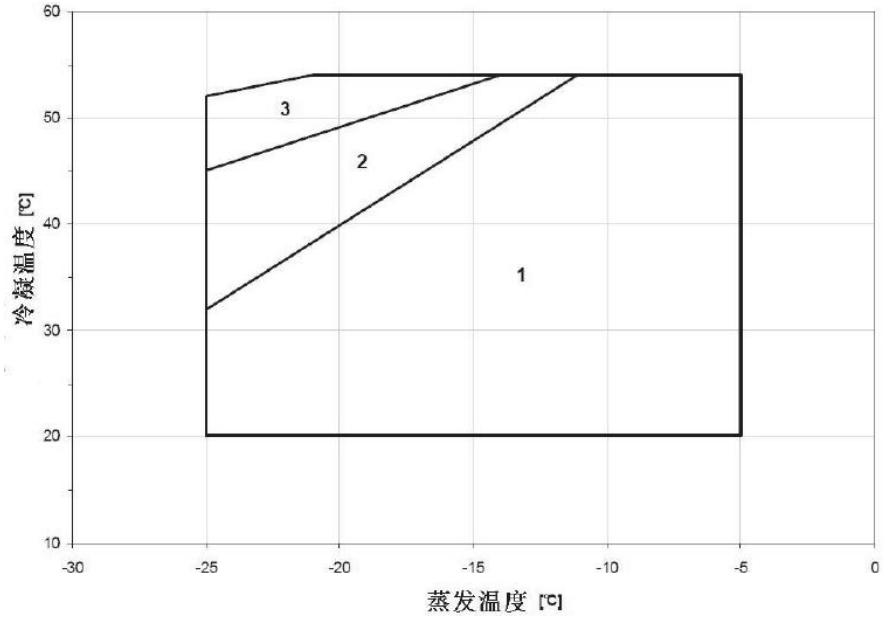
10.2 Application range of refrigerant R407

The application range refers to compressor running at full load with power supply frequency of 50Hz.
The application range also differ from motor size “L”or “H”.
Areas in the diagrams refer to following working conditions.
1= standard application range, suction temperature at 25 °C ;
2= additional cooling application range of compressor;
3=application range of additional cooling+Max. superheat 10K.

10.2.1 High temperature compressor “H”



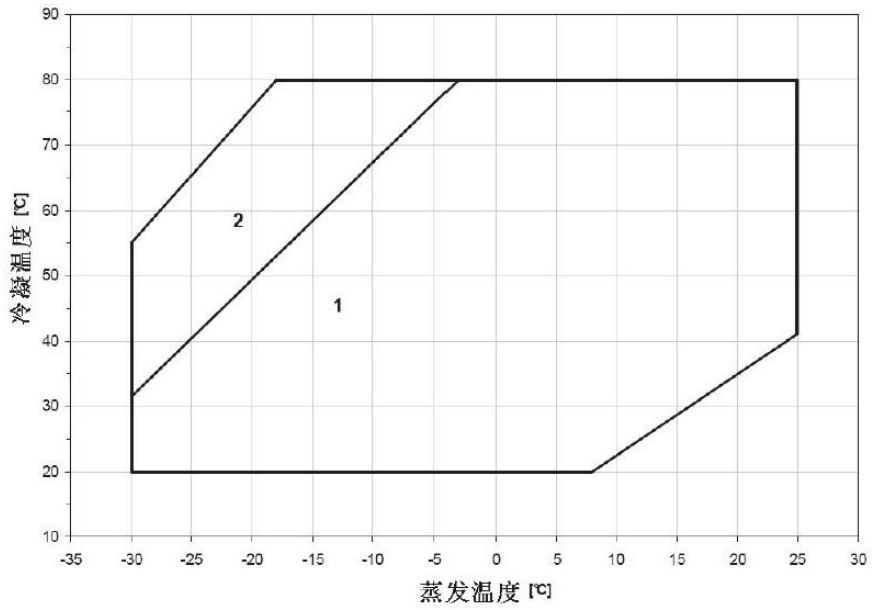
10.2.2 Low temperature compressor “L”



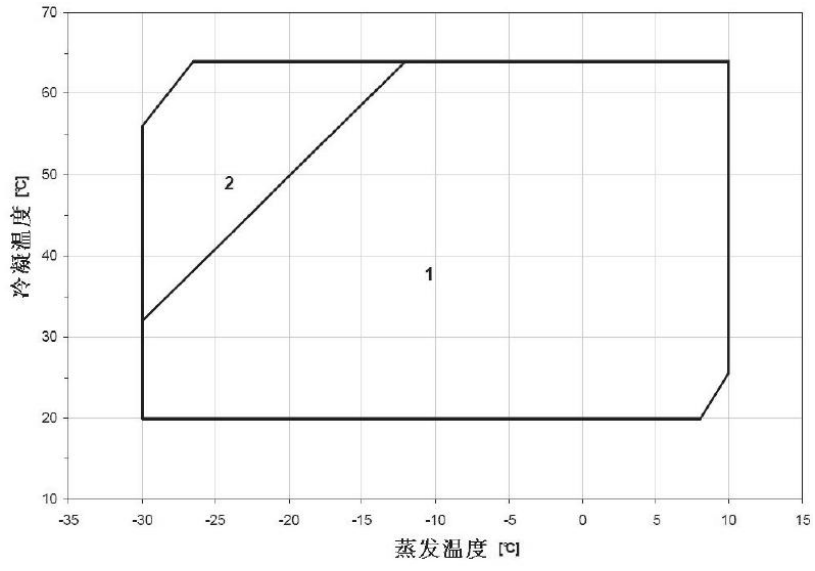
10.3 Application range of refrigerant R134a

The application range refers to compressor running at full load with power supply frequency of 50Hz.
The application range also differ from motor size “L”or “H”.
Areas in the diagrams refer to following working conditions.
1= standard application range, suction temperature at 25 °C ;
2= additional cooling application range of compressor;
3=application range of additional cooling+Max. superheat 10K.

10.3.1 High temperature compressor “H”



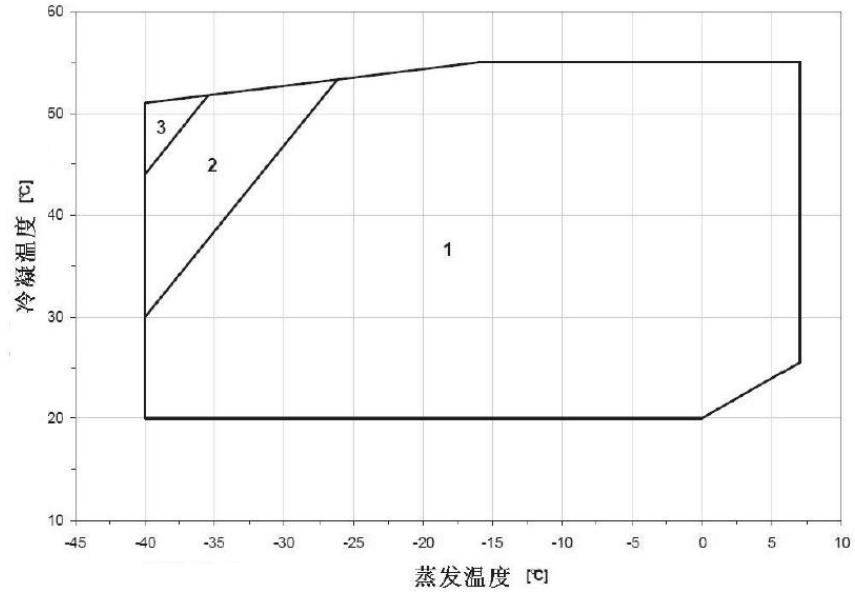
10.3.2 Low temperature compressor “L”



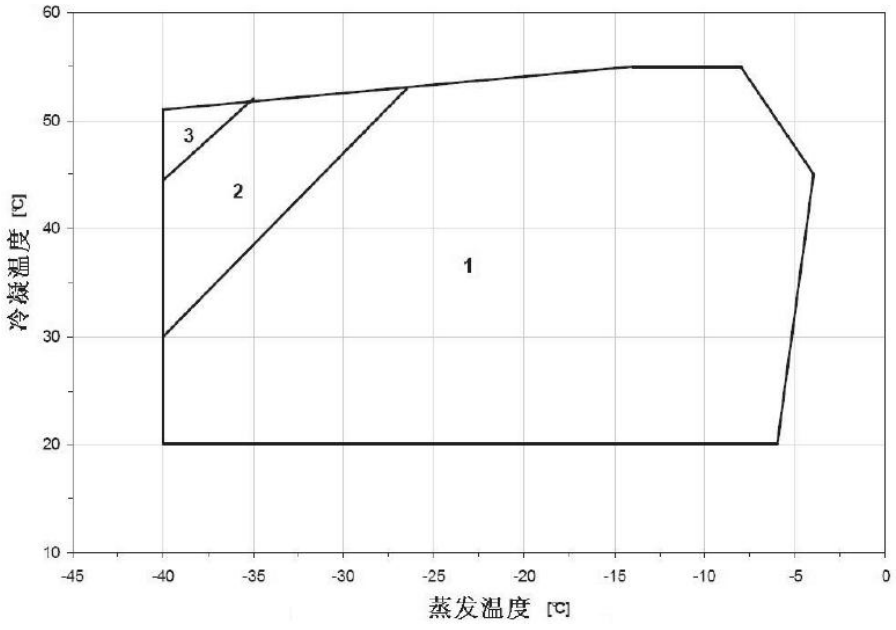
10.4 Application range of refrigerant R404A/R507

The application range refers to compressor running at full load with power supply frequency of 50Hz.
The application range also differ from motor size “L”or “H”.
Areas in the diagrams refer to following working conditions.
1= standard application range, suction temperature at 25 °C ;
2= additional cooling application range of compressor;
3=application range of additional cooling+Max. superheat 10K.

10.4.1 High temperature compressor “H”



10.4.2 Low temperature compressor “L”



10.5 Application range of part load

10.5.1 Power variation

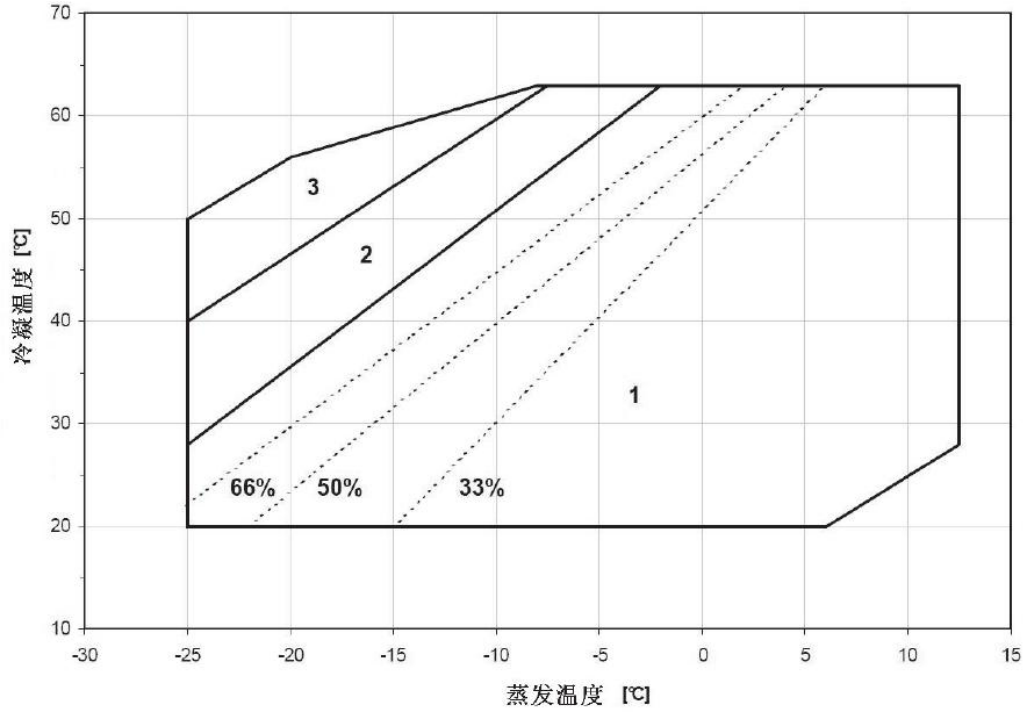
Using multiple compressors in parallel compounding offers the opportunity to better adapt the cooling capacity to the requirements of the system, saving energy as well as reducing wear on the compressors. However, as in all installations where the cooling capacity is reduced, it must be grant that the return oil is also effective when operating at part load.
The maximum reduction in cooling capacity is therefore limited by the compressor oil return and motor cooling.
The minimum gas velocity must be respected in both the vertical and in horizontal sections, thermostatic expansion valves must ensure proper heating of suction gas to enable a smooth operation of the compressor.

10.5.2 Application range with capacity regulation cylinder heads

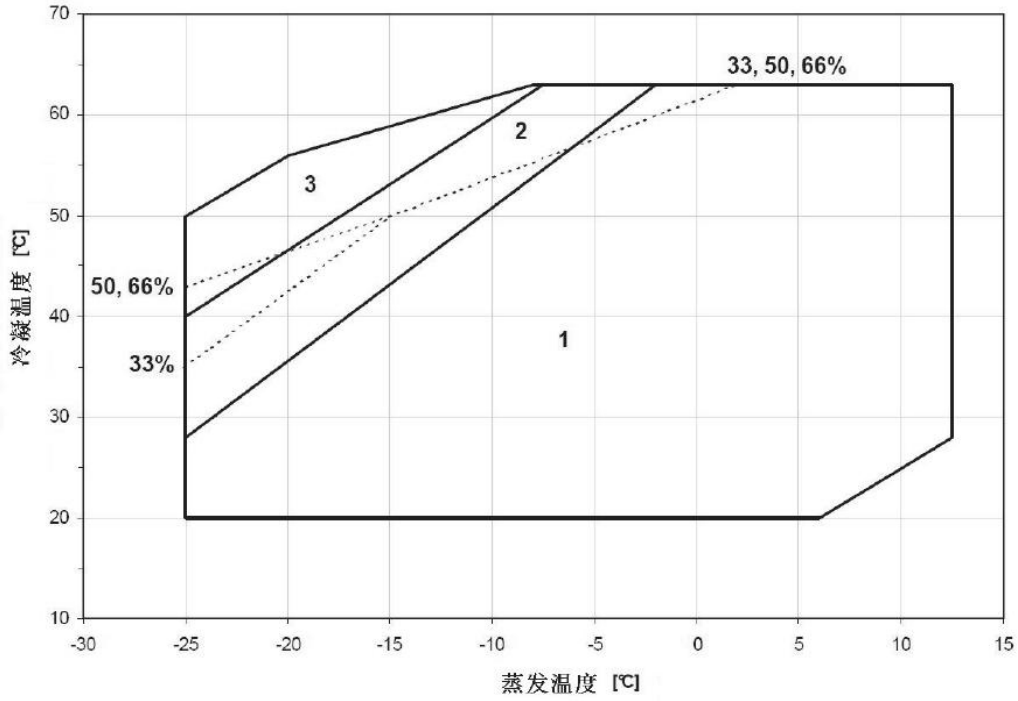
When refrigeration capacity decreases, the refrigerant flow decreases, so the cooling capacity of motor is reduced. Also due to the efficiency decrease of compressor, the discharge temperature increases. Therefore, part load of different CR steps, the corresponding application ranges vary as bellow:

10.6 Part load application range of refrigerant R22

10.6.1 High temperature compressor “H”

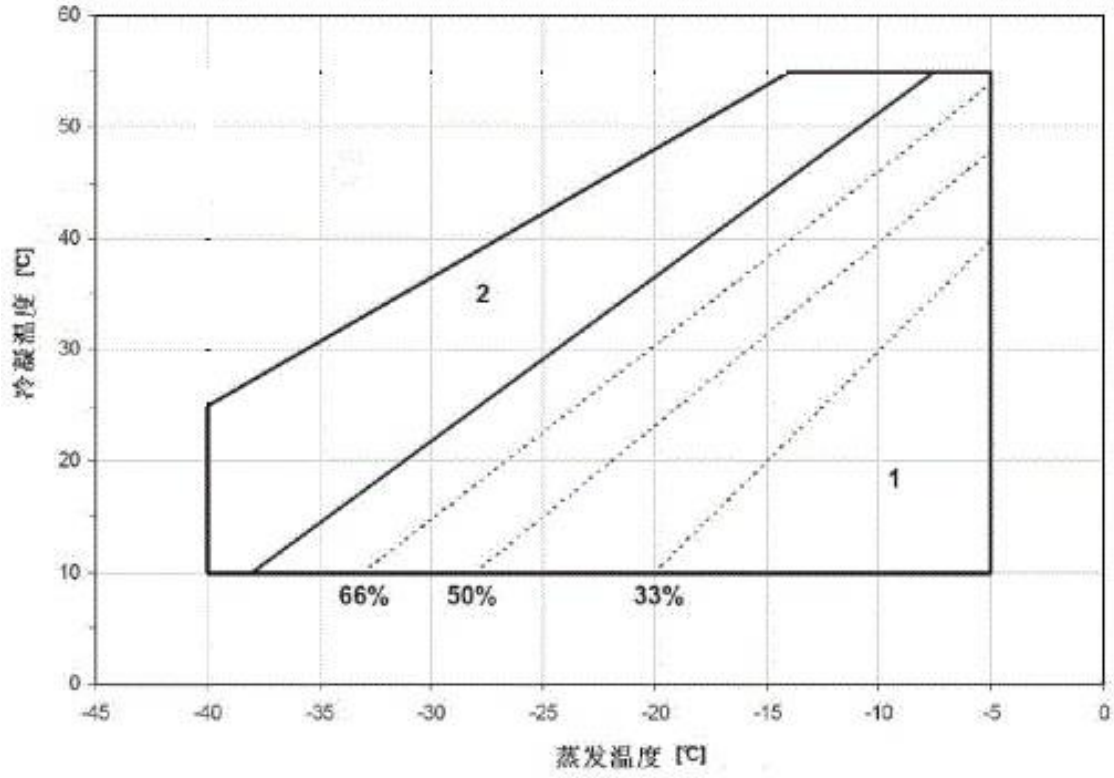


10.6.2 High temperature compressor with additional cooling “H”

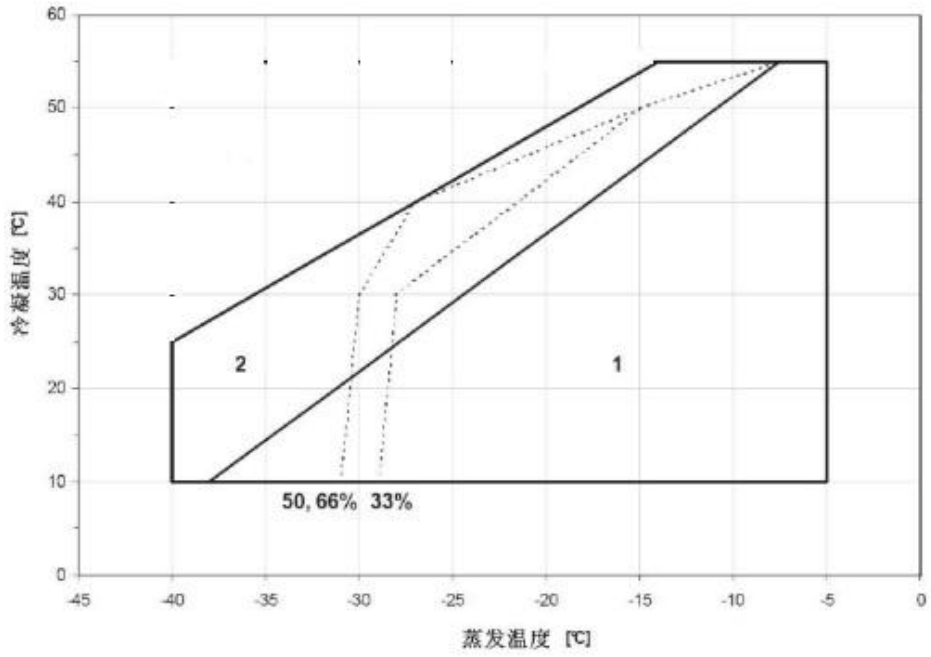


10.7 Part load application range of refrigerant R22

10.7.1 Low temperature compressor “L”

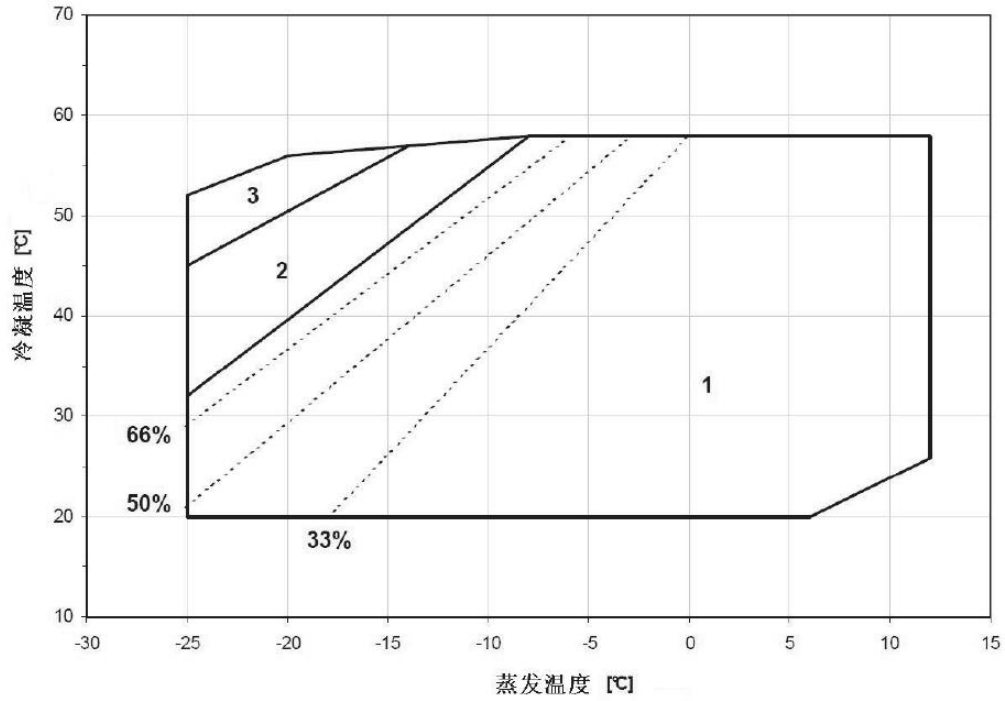


10.7.2 Low temperature compressor “L” with additional cooling

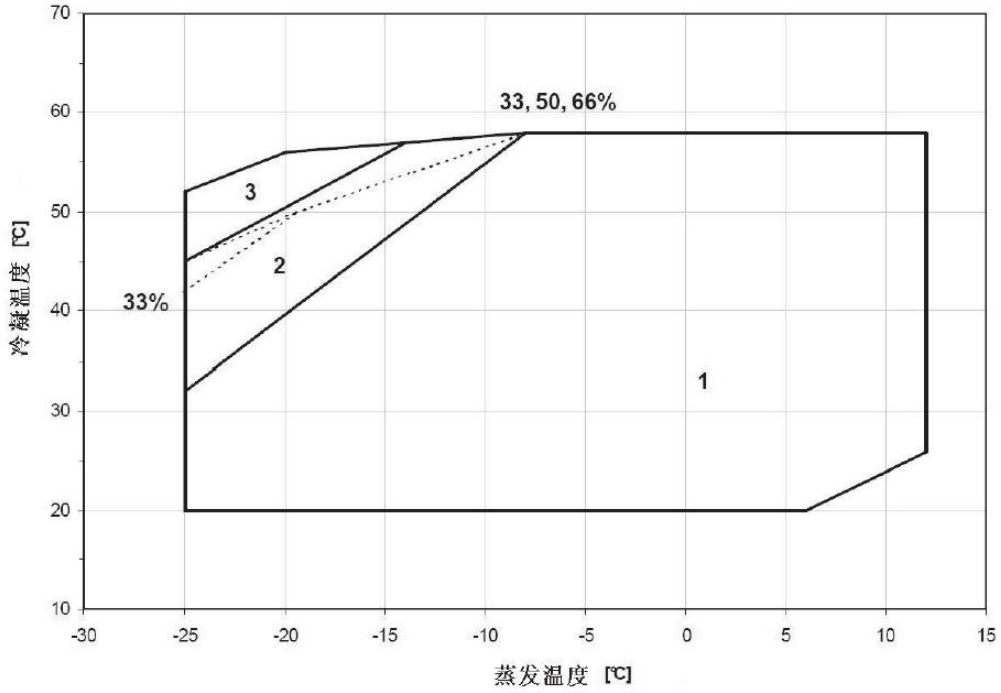


10.8 Part load application range of refrigerant R407C

10.8.1 High temperature compressor “H”

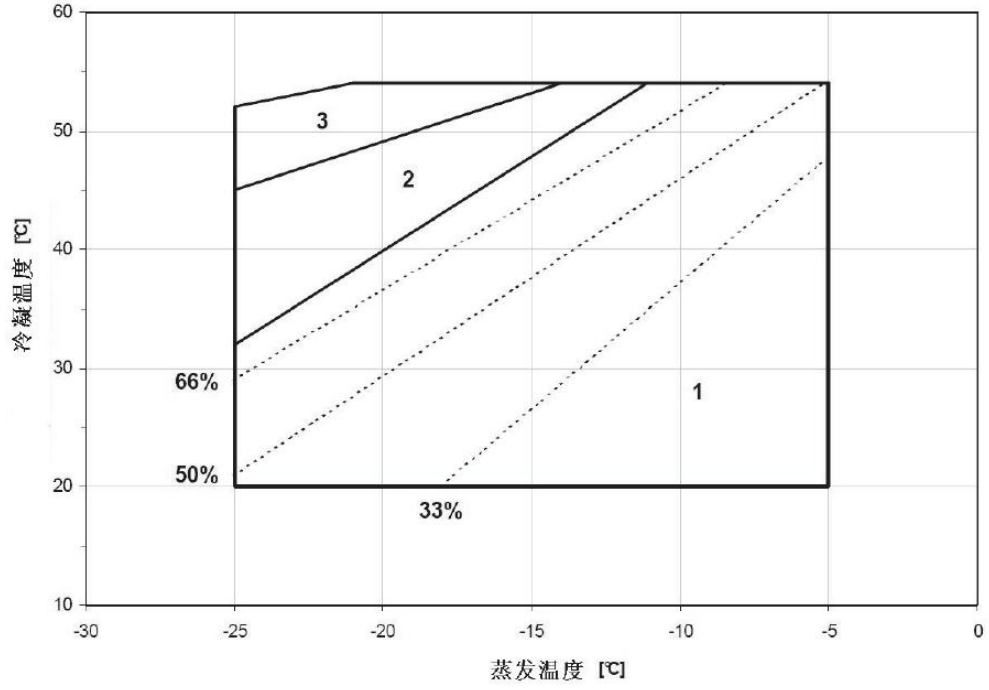


10.8.2 High temperature compressor “H” with additional cooling

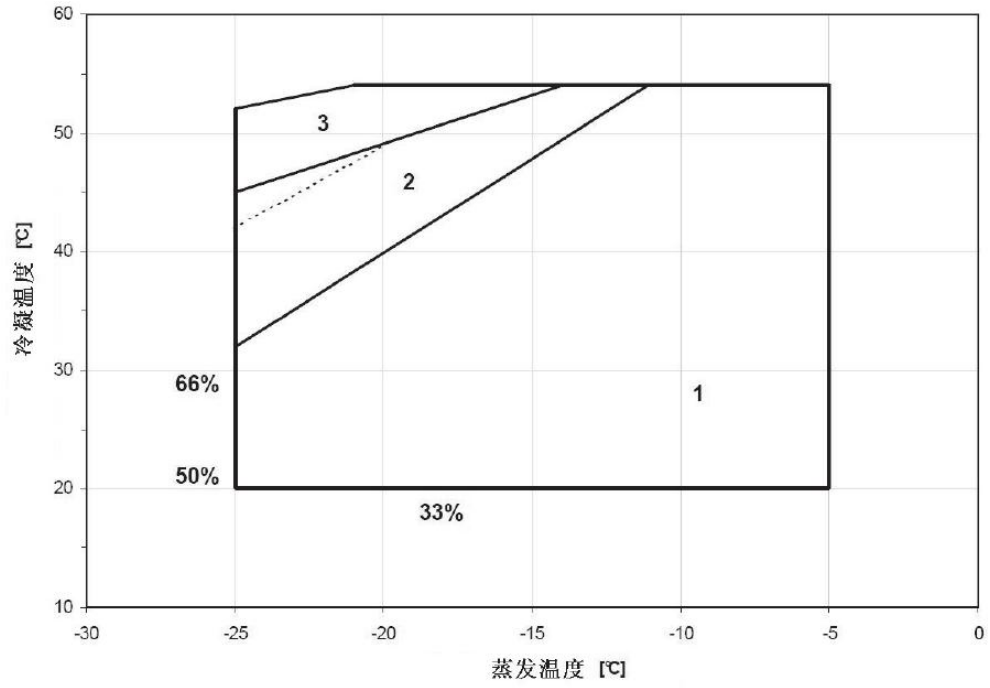


10.9 Part load application range of refrigerant R407C

10.9.1 Low temperature compressor “L”

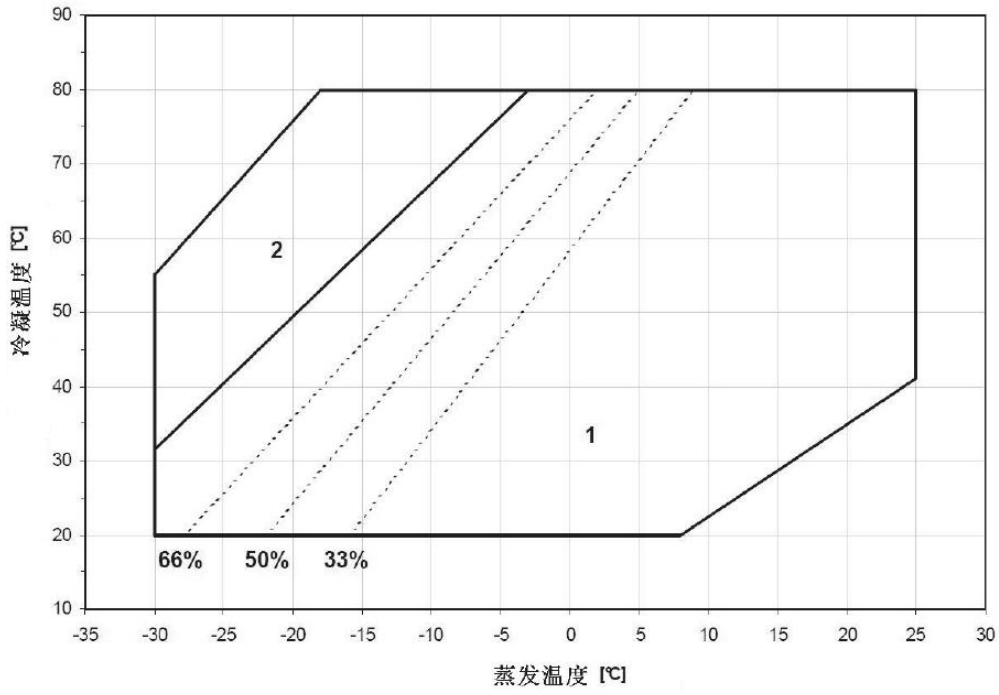


10.9.2 Low temperature compressor with additional cooling “L”

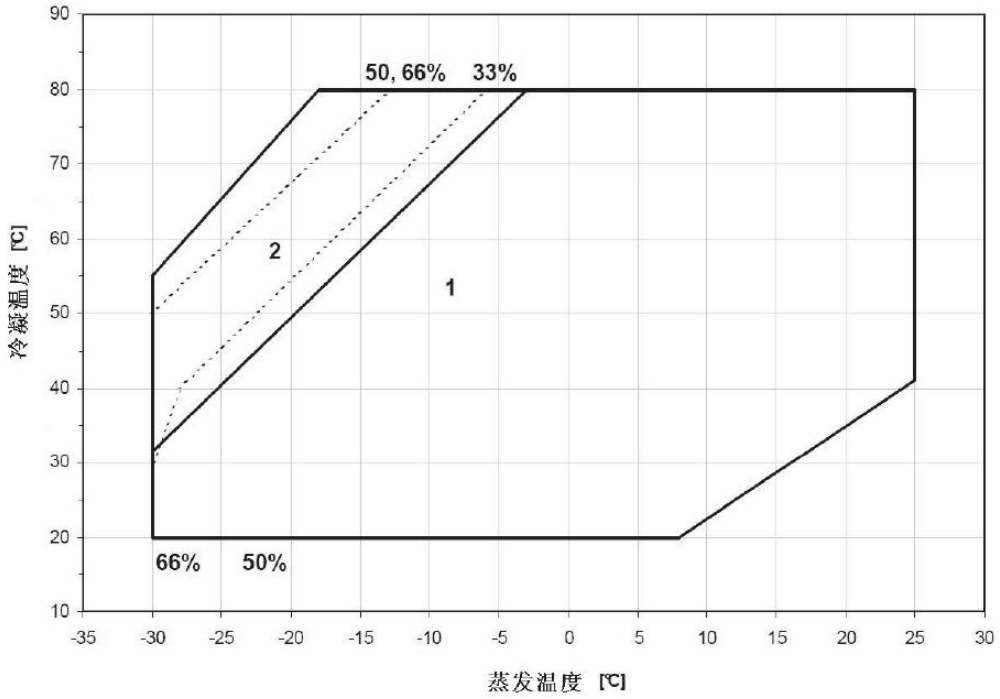


10.10 Part load application range of refrigerant R134a

10.10.1 High temperature compressor “H”

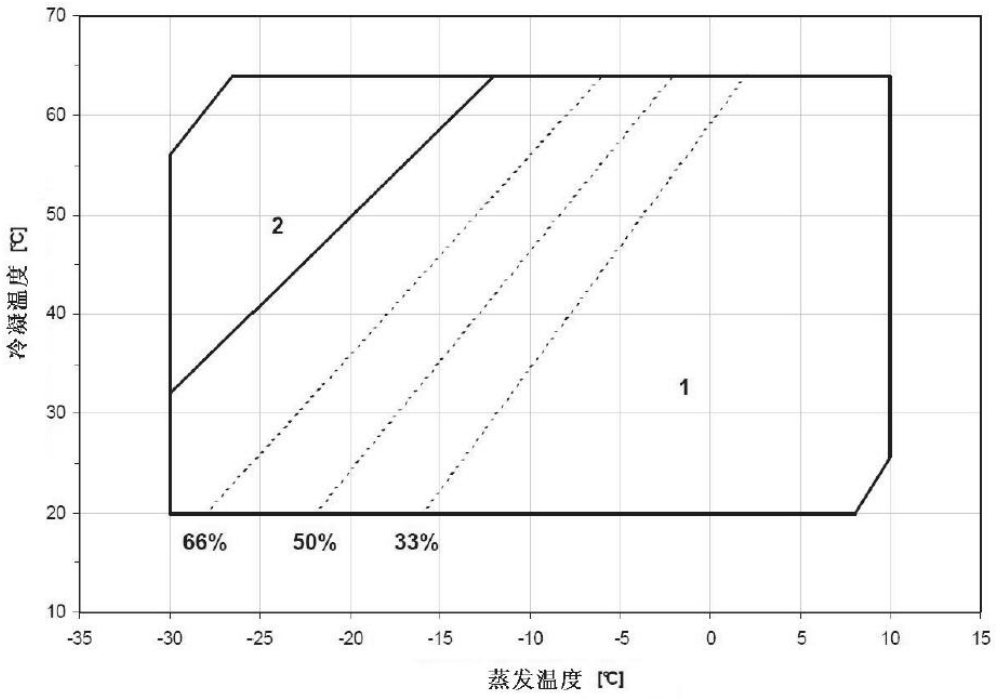


10.10.2 High temperature “H” compressor with additional cooling

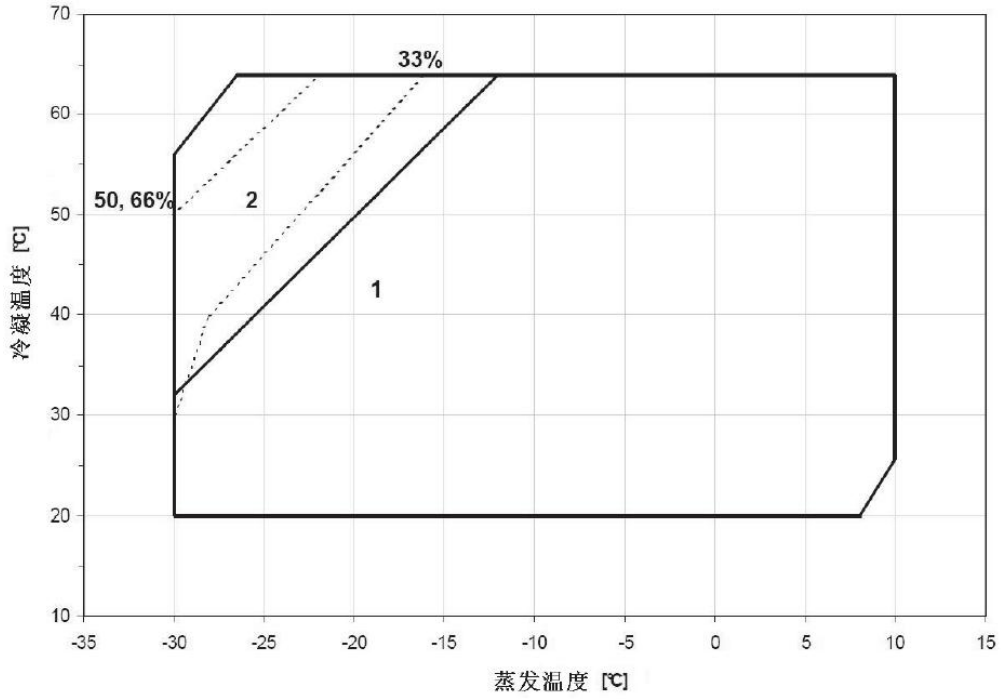


10.11 Partial load application range of refrigerant R134a

10.11.1 Low temperature compressor “L”

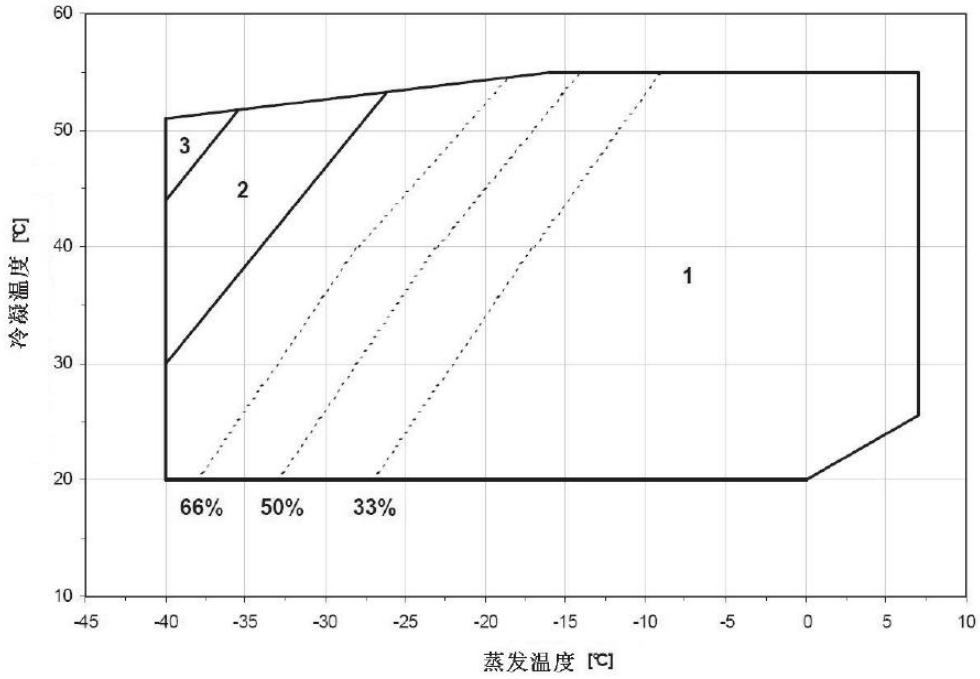


10.11.2 Low temperature compressor with additional cooling “L”

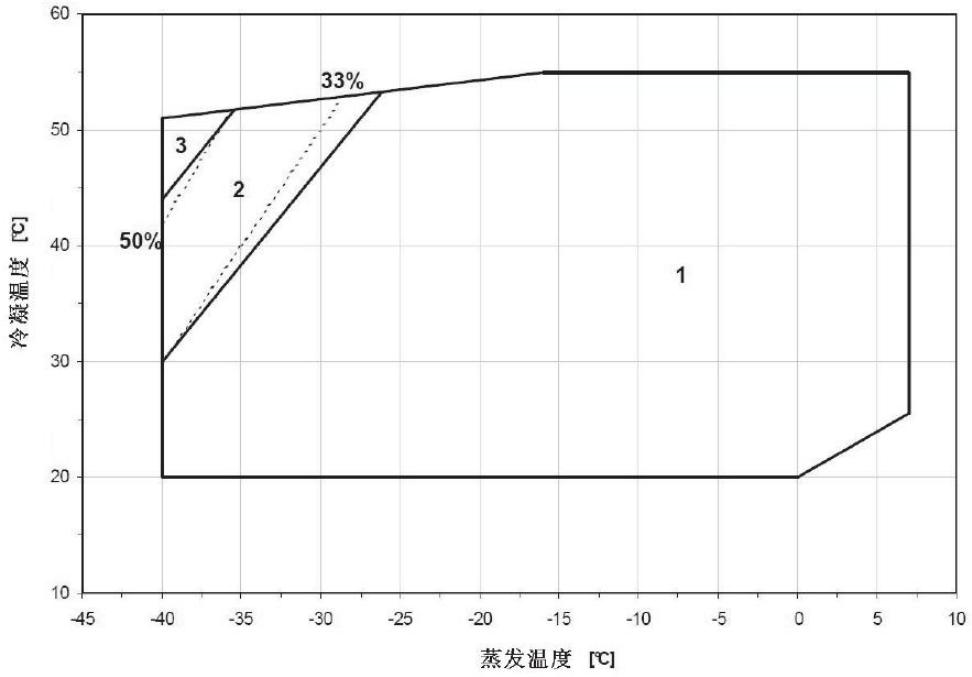


10.12 Part load application range of refrigerant R404A/R507

10.12.1 High temperature compressor “H”

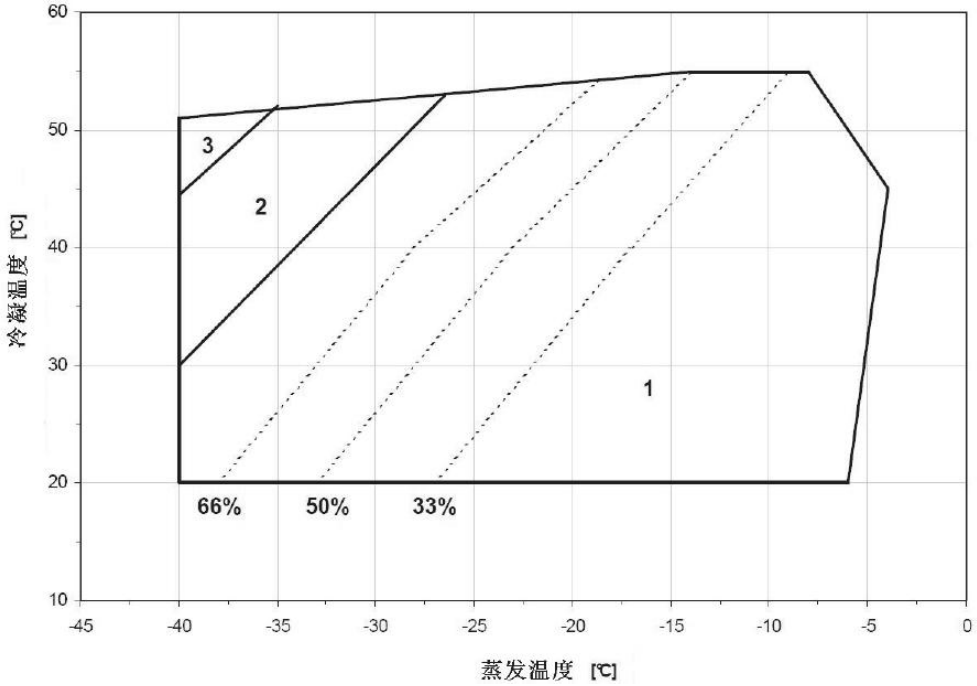


10.12.2 High temperature compressor “H”with additional cooling

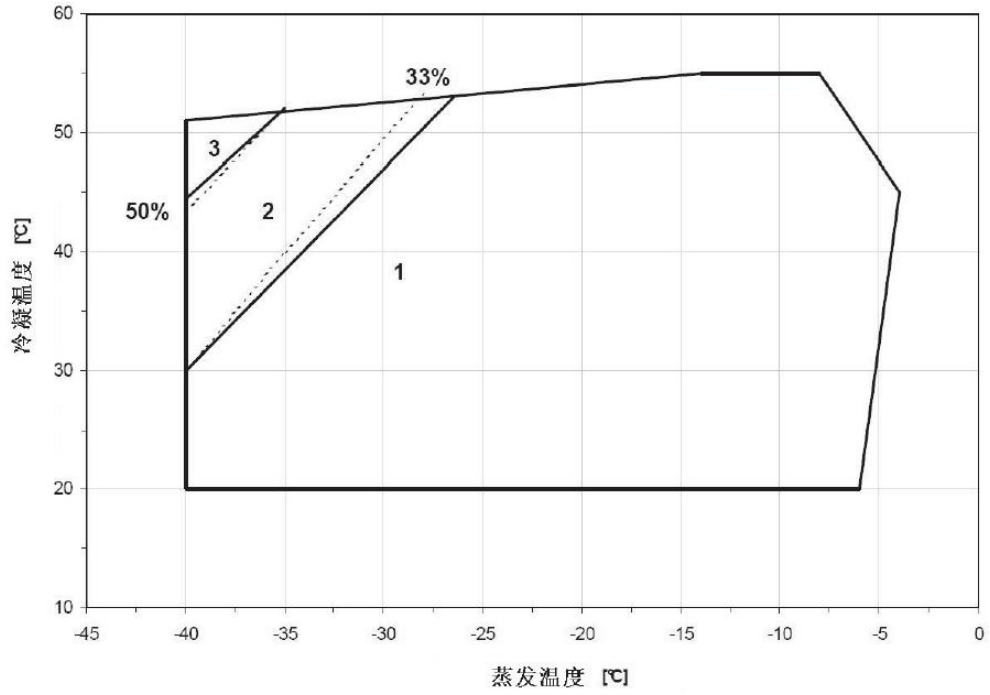


10.13 Part load application range of refrigerant R404A/R507

10.13.1 Low temperature compressor “L”



10.13.2 Low temperature compressor“L”with additional cooling



Chapter 11 Additional cooling

11.1 Allowable discharge temperature

The discharge temperature is due to the following factors:

- ✓ Suction decrease and part load operation will decrease the refrigerant for motor cooling;
- ✓ Compressor working pressure ratio;
- ✓ Refrigerant superheat of suction side;
- ✓ Refrigerant character,such as specific heat capacity;
- ✓ Character of lubricant mixed together with refrigerant.

Too high discharge temperature will cause:

- ✓ Possible carbonization and deterioration of lubricant with a reduction of its service life;
- ✓ Reduction of kinematic viscosity with consequent loss of lubrication capacity of compressor;
- ✓ Most lubricant will dissolve in the refrigerant under high temperature and high pressure and hard to volatilize from refrigerant.

Too dilute lubricant will cause:

- ✓ Too high pressure drop in oil circuit;
- ✓ Excessive dilution of lubricant by refrigerant;
- ✓ Lubricant flow changes inside the compressor;
- ✓ Lubricant performance decrease;
- ✓ Refrigerant gas bypass to suction (by oil circuit) in the compression process, which will cause refrigeration capacity decrease.

The Max. allowable discharge temperature is 125°C . Lubricant Min. temperature of compressor start after compressor shutdown is 30°C .

Following is calculation method of the additional cooling power if the additional cooling is required:

11.2 The calculation of additional cooling

Required additional cooling power (Poc)：

$$Poc=m\times(h-h_{125℃}) \quad [kW]$$

Notes：m: Mass flow of evaporator (kg/s);
h: Enthalpy value without additional cooling (kJ/kg) ;
The discharge pressure enthalpy value (kJ/kg) under $h_{125℃}$

It’s recommended to consider the worst working condition (Min. Te, Max. Tc and Max. Superheat)

during cooling power calculation. The ReComp selection software can also calculate automatically.

11.3 Additional cooling fan

As shown in figure 11-1, additional cooling fan is installed at the compressor top:

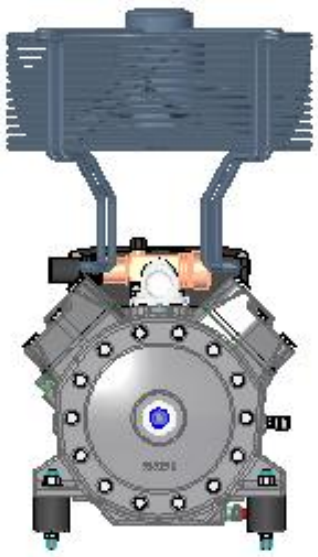


Figure 11-1 Schematic diagram of SPC4 series additional cooling fan

Additionally, if the air flow speed meets 3m/s, compressor can be cooled by air, but the whole compressor must be at the well-ventilated place.
Table 11-A are codes of cooling kit design of SPC4 series compressor, fan characters are also included.

Compressor series	Fan components	Voltage（Volt-ph-Hz）	Current（A）	Power（W）	Air（m^3/h）
SPC4	305174	230/440-3-50/60Hz	0.50（50Hz） 0.29（60Hz）	120（50Hz） 180（60Hz）	2200（50Hz） 2650（60Hz）

Table 11-A Technical and electrical parameter of additional cooling fan

If the power supply voltage of additional cooling and compressor is same, connect the fan terminal directly to the compressor motor terminal, or the separated power supply.

11.4 LCM module for liquid injection control

The LCM module is not equipped in SPC4 series to decrease the liquid injection of compressor discharge temperature.

Chapter 12 Operation instructions

Use of compressor

For the RefComp piston compressors, only use the refrigerants approved by RefComp, prohibit air or any other gases compression.

Prohibit starting the compressor while the suction and discharge stop valve are not fully open.

Do not start up the compressor if the terminal box cover is not properly installed and fixed.

Prohibit any operations for suction and discharge valves or open terminal box while compressor running.

Only nitrogen or carbon dioxide gas is allowed for air-tight test in the refrigeration circulation system, oxygen or acetylene is prohibited.

Prohibit starting the compressor without connecting to refrigeration circulation system.

Attention! Compressor surface temperature may exceed 100°C or under 0°C during starting.

12.1 Installation

Compressor must be installed horizontally. To reduce the vibration from compressor to the unit while install the compressor, the vibration-absorption components are required.

The pipes for connection must be completely cleaned and dry, rusted, phosphated surface or waste pipes are not allowed for connection.

The working ambient temperature and storage temperature of the compressor should be maintained between -20 ° C and + 50 ° C, the relative humidity should not higher than 90% and the clean environment of dust-proof and water-proof; Compressor installation site should avoid fume, heat radiation, moisture and other adverse environmental effects;Compressor installation site should avoid seawater, wind, rain, sun and other direct invasion places, take preventive measures if necessary. If the compressor is operated under extreme conditions (such as extremely low ambient temperature or harsh environment), please take reasonable measures after contacting with RefComp.

Pump-down

If the evaporator or suction pipe of the compressor may be a little hot during the compressor shutdown, then a pump-down cycle is recommended. Please confirm that there is no repeating start-ups, as the maximum start of pump-down cycle is two times per hour.

Heat pump system

	**Warning!** Reverse circulation or thermal defrosting systems require appropriate precautions to ensure that compressors are not affected by either of the following conditions:

	√ The liquid refrigerant flows back to the compressor √ Too much oil is taken out of the compressor, which makes the oil level of the compressor decrease too much

To protect the compressor from liquid hammer, it is recommended to install a gas-liquid separator on the suction side.A pressure regulating valve is installed after the compressor to limit excessive pressure reduction when the heat pump circulates.When the compressor starts for 20 seconds, the compressor should enter the specified application range and ensure that the compressor protection is in effect.

12.2 Pressure

Air-tight test and working pressure value as follow:

	Air-tight test	Working pressure
HP	≥30bar	30bar
LP	≥19bar	19bar

The Max. balance pressure of compressor starting is 13 bar.
To prevent motor overload, the working pressure must be within the application range to prevent motor overloading, (Check chapter 10 “Application range”, consider various refrigerants). M.O.P. (Max. operating pressure) expansion valve or pressure regulating valve is recommended if necessary.
This may occur sometimes, such as starting after the compressor defrosting, overloading when the goods in the storage house is hot, freezing tunnels, or the start-up phase when hot water is defrosting.

12.3 Temperature

Discharge temperature：Max.: 140℃;
Min.: Above condensation saturation temperature 30K.
Suction temperature：Max.：Refer to chapter 10 Application range;
Min. : For R22, R404A and R507,the Min. superheat is 8K.
The Max. suction superheat is 30K. For oil temperature, please check chapter 2 “Oil pipeline lubrication”.

12.4 Running time

Number of start-up:	No more than 6 times per hour
The minimum interval between two starts:	10 minutes
Minimum running time:	3 minutes

12.5 Test

Sealing / vacuuming/ lubricant charge testing

	**Warning!** The RefComp compressor is protected by nitrogen (0.5-1bar above atmospheric pressure) to prevent air from entering the compressor.

Follow the instructions below for lubricant injection:

a. Please use dry N_2 for testing the air-tightness refrigeration circulation system, the compressor must be excluded if air is used for circulation system.
b. Vacuum the gas in the entire refrigeration circulation system, including the gas that is isolated in the compressor by the suction and discharge valves of the compressor;
c. Connect the oil separator to the corresponding oil return inlet of the compressor; (Check chapter 8 “Overall dimension and packing ” for sizes of connectors)
d. Control the amount of lubricant in the range of the horizontal position as shown in Figure 12-1;
e. Close or tighten the lubricant connection plug.

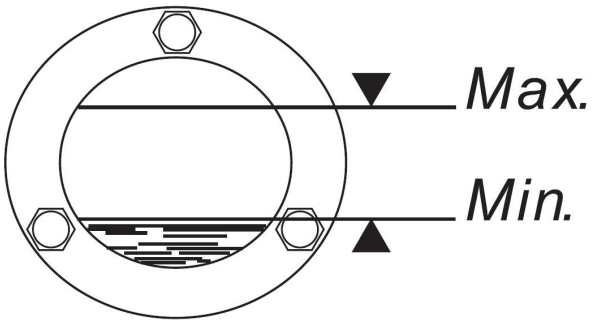


Figure 12-1 Oil level range

The compressor has passed the relevant pressure tests, so the user does not need to do the relevant pressure tests. If the user need to test by himself, please not exceed the design pressure value on the nameplate (Please refer to chapter 6.3 of “Pressure”).

	**Warning!** ✓ Prohibit operating the compressor if a pressure value higher than indicated on the compressor nameplate. ✓ Prohibit starting the compressor under vacuum condition.

Refrigerant charge

Flush the liquid refrigerant into the condenser or directly into the refrigerant receiver, complete the refrigerant injection during compressor operation. If charge the liquid refrigerant (R407C), the discharge temperature is at least 30K higher than the condensing temperature to avoid liquid backflow, and control the injection speed a little bit to avoid liquid hammer. Insufficient refrigerant charge will result in low suction pressure or excessive degree of superheat. Please use RefComp selection software to calculate the correct discharge temperature value for reference.

12.6 The start-up of compressor

The compressor start-up procedures are as follow:

a. Release the N2 inside the compressor, connect the compressor with refrigeration circuit to ensure there is no air inside the suction and discharge stop valve. Compressor internal (such as lubricant)and air shall not contact more than 30 minutes;
b. Refer to the wiring diagram in chapter 5 “Electrical devices” for electrical connection;
c. Perform the following preliminary inspections:

✓ Correctly set the start time timer;
✓ Confirm the oil level;
✓ Check if the settings and functions of safety and protection equipment are normal;
✓ Check if the high-pressure and low-pressure pressure protection switches are normal;
✓ Confirm that there is no leakage in the system.

d. The crankcase heater must be turned on 24 hours before the compressor is turned on, and the oil temperature must be at least 15°C above the ambient temperature;
e. Charge Min. refrigerant into the condenser;
f. Open the suction and discharge shut-off valves and starts the compressor;
g. Complete the refrigerant injection of the whole system;
h. Restart the compressor and open the suction stop valve slowly;
i. Ensure the discharge temperature is at least 30K higher than condensing temperature (Check RefComp selection software for the accurate value);
j. Check if the pressure switch is working properly;
k. Check the working parameters (Please refer to chapter 14)

12.7 Trouble-shooting

Failures	Possible causes	Solutions
1）Compressor can't start	a）The start switch is not open;	a）Open the start switch;
	b）Fuse burning;	b） Check the circuit to confirm if there is short circuit or proper grounding, and check if the motor is overloaded. Replace the fuse after confirming the cause;
	c）Superheat protection；	c）Check item（12）;
	d）Contactor failure;	d） Repair or replace;
	e）Expansion valve not open;	e） Repair or replace;
	f）The motor is faulty;	f）Check the connection or insulation of the terminals (Check chapter 5.7), check if there is any burnt insulation material;
	g）The terminals are loose;	g）Check all electrical connections and tighten the contact parts;
	h）Compressor safety protection;	h）Confirm and eliminate any safety protection action, restart the motor;
	i） The temperature set of the thermostat is too high.	i）If necessary, lower the setting temperature of the thermostat and set a temperature 15 ° C higher than the outdoor temperature.
2）Compressor noise is too loud	a）Unreasonable pipeline supports design;	a）Change, reduce or increase the fixed points of pipeline;
	b）Insufficient buffer gap;	b）Maintenance and replacement of unmatched accessories;
	c）Compressor leaking;	c）Select the proper expansion valve and control the openness.
	d）The motor stator is not fixed properly;	d）Adjust the fixing points and bolts;
	e） Sound insulation, improper vibration;	e）Check the fixing condition of compressor feet (Check chapter 12.6)
3）Compressor discharge pressure is too high	a）The discharge valve is partially closed;	a）Open the discharge valve;
	b）The refrigerant charge is too large;	b）Discharge excess refrigerant;
	c）The capillary problem;	c）Clean the garbage at the nozzle of the capillaries;
	d）The refrigerant circuit is mixed with non-condensable	d）Discharge the non-condensable gas;

	gas;	
	e）The capillaries are too small or malfunctioning.	e）Adjust the condensing flow or adjust the throttle.
4）Compressor discharge pressure is insufficient	a） The condensing temperature is set incorrectly;	a） The condensing temperature is set incorrectly;
	b）The suction valve is partially closed;	b）Fully open the suction valve;
	c） Insufficient refrigerant;	c）Leak detection and fill the refrigerant;
	d）The suction pressure is unreasonable;	d）Refer to item (6);
	e）No compressor upload；	e）Check CR or SU components, refer to item (8);
	f）Too big condenser;	f）Review the system design parameters;
	g）Sealing ring or discharge valve failure.	g）Repair compressor.
5）Compressor suction pressure is too high	a）The compressor load is too large;	a）Decrease compressor load, or increase refrigeration system capacity;
	b）Too much liquid refrigerant;	b）Check the ball valve, adjust the superheat, and check the size of the expansion valve;
	c）No compressor upload；	c）Check CR or SU components, refer to item (8);
	d） Unreasonable compressor selection;	d）Review the design parameters;
	e）The evaporator is not large enough.	e）Review the design parameters.

Failures	Possible causes	Solutions
6）Compressor suction pressure is insufficient	a）Refrigerant leakage;	a）Leak detection and fill refrigerant;
	b）The evaporator is dirty or ice-block;	b）Clean the evaporator or defrost;
	c）The filter on the system circuit is blocked;	c）Replace the filter cartridge;
	d）The suction circuit filter or compressor suction filter is blocked;	d） Clean the filter;
	e）Expansion valve failure;	e）Check or reset the expansion valve to a suitable superheat degree, repair or replace the expansion valve
	f）The condensing temperature is too low	f）Check the condensing temperature control equipment;
	g） Compressor internal blow-by;	g）Refer to item (7)
	h）The water pump or evaporator fan is not working.	h）Check and start.
7）Compressor not working at partial load	a）Capacity regulation components failure;	a）Replace;
	b）Capacity regulation components internal blocked.	b）Replace.
8）Compressor can’t load	a）Capacity regulation components failure;	a）Replace.
9）Compressor load or unloading is too fast	a）Excessive expansion valve causes excessive suction pressure.	a）Change a proper expansion valve.
10）Compressor lubricant pressure is low	a）No Lubricant	a）Refer to item (11)
	b）Too much liquid refrigerant inside the compressor;	b）Install crankcase heater; set expansion valve to increase superheat; check the check valve of liquid circuit;
	c）Pressure drop between pipeline and pressure probe;	c）Check and the oil pressure probe should close to the filter;
	d）Oil pressure probe internal	d）Clean the oil line accessories and

	blocked;	components;
	e）Incorrect oil pump sealing ring assembly;	e）Check the oil pump sealing ring to ensure proper sealing ring assembly;
	f）Oil pressure gauge failure;	f）Check or replace, ensure the right reading;
	g）Oil pump transmission valve failure;	g）Repair or replace;
	h）Oil pump reverse rotation;	h）Reverse connection two-phase power supply;
	i）Oil pressure switch failure;	i）Repair or replace the oil pressure switch;
	j）Oil pump damage;	j）Replace oil pump;
	k）Oil pump shaft key damage;	k）Replace the damage part;
	l）Compressor bearing damage;	l）Repair the compressor;
	m）Partial failure of CR components	m）Replace the damage part.

Failures	Possible causes	Solutions
11）Compressor lack of lubricant	a）Lubricant stays at the system pipelines or evaporator;	a）Confirm the refrigerant flow speed;
	b）Oil leakage of CR components;	b）Replace the damage parts of the CR components;
	c）Too slow flow rate at the suction pipeline;	c）Check the suction pipeline size;
	d）Leakage at the piston scraper ring.	d）Repair the compressor.
12）The current is too large and the contactor is in open circuit	a）Condensing temperature too high	a）Refer to item (3)
	b） Open circuit caused by fuse single phase operation;	b） Find out the cause of the open circuit of the contactor, and then repair or replace the fuse;
	c）The voltage is too low at full load;	c）Check the voltage and confirm if the voltage drop of the supply voltage in each phase is too large;
	d）Loose contact of power supply cable;	d）Check and tighten the terminal;
	e）Contactor failure;	e）Repair or replace the contactor;
	f）The overload contactor is faulty;	f）Refer to the compressor nameplate and select an appropriate contactor;
	g）The contactor temperature is too high due to overload current;	g）Strengthened the ventilation of the electrical cabinet of the relay;
	h） The power supply cable is damaged or the wire hits the ground;	h）Repair or rewire;
	i)The voltage of each phase is unstable, leading to lack of phase or single-phase operation;	i）Check the power supply voltage, and it is not allowed to start until the fault is resolved;
	j）The motor wiring mode (star-delta or part-winding method) is wrong;	j）Repair / replace contactor or timer;
	k）The wire hits the ground, causing trip protection;	k）Repairing or rewiring the motor;
	l）The compressor parts are stuck.	l）Repair the compressor.

13）Compressor starts and stops frequently	a）The temperature values set by the thermostat are too close to each other;	a）Check the temperature setting of the evaporator and regulate it properly.Caution! Avoid ice blockage;
	b）The solenoid valve fails;	b）Replace solenoid valve;
	c）Too much refrigerant;	c）Release excess refrigerant;
	d）Lack of refrigerant;	d） Check the system for leakage, repair and fill refrigerant;
	e）The relevant control valves of the refrigerant flow in the evaporator and condenser fails.	e）Check the temperature setting of the control valve. Clean, repair or replace the control valve if necessary.

12.8 Safety guidelines

	**Warning!** Operator must wear reasonable protective equipment (safety shoes, overalls, gloves, goggles and mask).

	**Warning!** Be careful while operating the electrical equipment, and only certified electrician can perform the operation.

	**Warning!** All maintenance operation must be performed with standstill compressor without power supply.

	**Warning!** The maintenance, inspection and regulation should be performed only by qualified personnel with reasonable personal protective equipment(safety footwear, overalls, gloves, glasses and mask).

	**Warning!** The repair and maintenance of all mechanical parts must be operated under power off.

	**Warning!** The machine and the work area must be secured against access by outsiders!

	**Warning!** Prohibit operating with power on.

	**Warning!** If operations of circuit breakers(motor circuit breakers, circuit breakers or others) occur repeatedly, it is essential to be warned and call a qualified electrician. In cases of burns fuses and circuit breakers work is always suggested to identify and eliminate the cause that caused the trouble, since the replacement or repair indiscriminate, in most cases does not solve the problem.

	**Warning!** Prohibit cleaning electrical equipment using compressed air:danger of damage to electrical components.

	**Warning!** The cleaning and troubleshooting must be done with compressor powers off and standstill.

	**Warning!** The reset switch should be performed only by a qualified electrician, with appropriate personal protective equipment, tools and proper auxiliary equipment.

	**Warning!** Restore operations of tripped breaker must be with standstill compressor and power off.

	**Warning!** If the circuit breaker in the circuit continues to act, it must be paid attention and ask the maintenance engineer to solve it.

Operation	Protective clothing 	Safety shoes 	Gloves 	Goggles 	Hearing protector 	Mask 	Helmet 
Transportation	★	★	★	△	◆	△	◆
Handling	★	★	★	△	◆	△	◆
Unpacking	★	★	★	△	◆	△	△
Assembly	★	★	★	△	◆	△	△
General use	★	★	★	△	◆	△	△
Commissioning	★	★	★	△	◆	△	△
Cleanness	★	★	★	★	◆	△	△
Maintenance	★	★	★	△	◆	△	△
Disassembly	★	★	★	★	◆	△	◆
Scrap	★	★	★	△	◆	△	◆

★： Necessary
◆： Operate according to the actual situation
△： Unnecessary

Chapter 13 Design and application of parallel compounding

13.1 Unit character

Parallel compounding has following advantages:

- ✓ Increase refrigeration capacity comparing to single compressor;
- ✓ High efficiency in capacity regulation;
- ✓ Start the compressor unit by unit to decrease inrush transient current;
- ✓ System can keep running even one compressor failures;
- ✓ Simple and economic circulation system

13.2 Design and installation

In a system of compressors in parallel compounding, the amount of oil which each compressor drags in the circuits must be balanced by the amount of oil coming back to ensure proper lubrication.

0.01 bar pressure difference in crankcase will cause 10cm difference of level height. Therefore, it's essential to keep the pressure balance of crankcase of each compressor in parallel compounding.

There are two main systems to connect in parallel for Refcomp piston compressor: the system of equalizing oil and gas (for compressors of the same size) or the system with oil level regulators(for more than two compressors and when compressors are of different sizes).

13.3 Oil and gas equalization system

This system is suitable to connect in parallel, maximum two compressors of the same size.
Through the creation of two pipes of equalization for the oil and gas, it's possible to keep the pressure of the crankcase to the same value, thus providing the balance of the amount of oil returning to each compressor.

13.4 Oil level regulating system

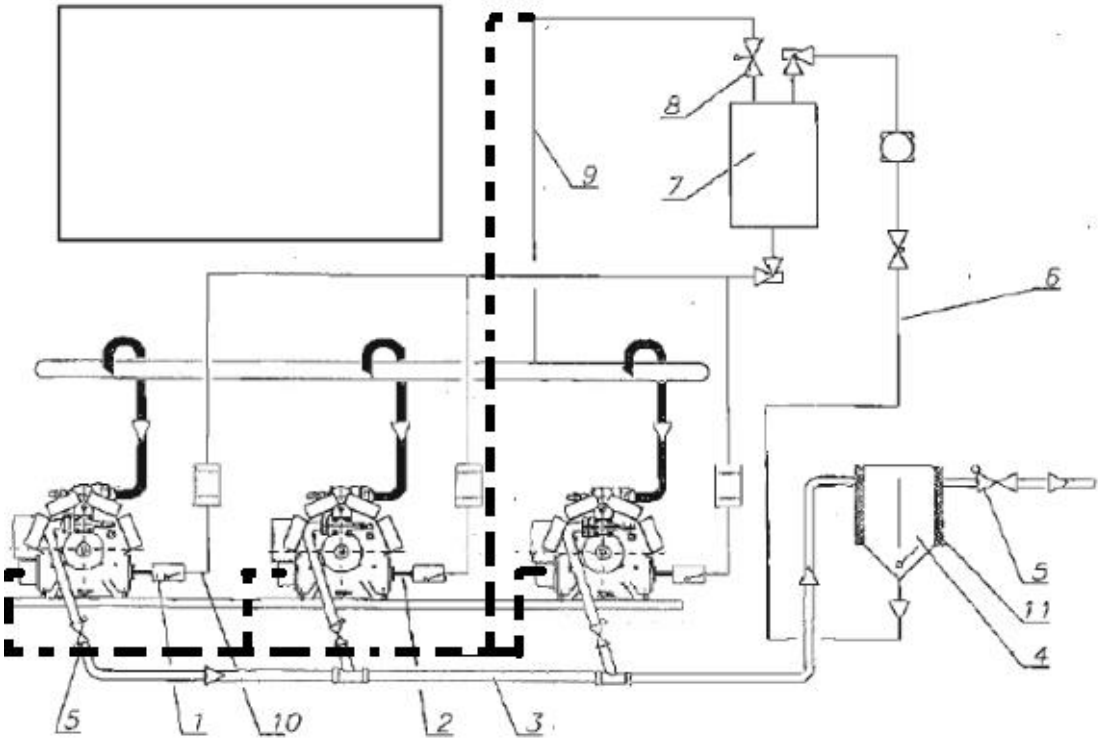


Figure13-1 Parallel compounding with oil level regulators and single oil separator

1 Oil level balancer 2 Adapter 3 Discharge pipeline 4 Oil separator 5 Stop check valve 6 Oil pipeline 7 Oil tank 8 Oil pressure differential check valve 9 Oil balance tube
10 Oil pipeline 11 Strainer

As shown in figure 13-1. this system is suitable for parallel compounding of two or more compressors even of different sizes and also shown an high reliability. The working principle is the following:

Oil drawn from the compressors is separated from the refrigerant in an oil separator, and from there piped in a tank maintained at an intermediate pressure between the suction and discharge pressures. From the oil tank is led to compressor crankcases through the oil level balancer, positioned in place of the oil sight glass which introduces a certain amount of oil each time when the preset level is lowered.

Notes:

- ✓ It's suggested to use oil balancer which allow to regulate the level in a certain range (from 1/2 to 1/4 of the oil sight glass);
- ✓ It' suggested each oil balancer is provided with balanced connection, which prevent risk of make a siphon of oil inside the crankcase during the shut-off procedure or to full the balancer with oil ;
- ✓ The oil pressure has to be maintained to a value between suction and discharge ones to grant a safety return of oil.

13.4.1 Suction pipeline

The suction pipes have to be designed so that a standstill compressor can not be flooded with oil or liquid refrigerant; it's suggested to connect each suction pipes to the suction manifold trough an elbow. The diameter of manifold has to be choosen so that the refrigerant gas speed is lower that 4 m/s (horizontal section) or 7m/s (vertical section) when the system is full load.

13.4.2 Gas-liquid separator

It's suggested to use a gas-liquid separator for each suction pipes.

13.4.3 Suction filter

It's strongly recommended to use a suction filter. The cartridge can be removed once the circuit has been cleaned from impurities. The filter casing can be used for the installation of antiacid cartridges in the case of acid burn of the electric motor.

13.4.4 Discharge pipeline

The discharge manifold should have a section at least equal to the sum of individual sections of the discharge lines, which must be descended from the discharge shut-off valve to the manifold. If it is used an oil separator for each compressor, it's necessary to install a check valve between each oil separators and discharge manifold, in order to prevent the refrigerant accumulation in the oil separators of the standstill compressors.

13.4.5 Oil separator

The oil separator is always necessary to low temperature systems and flooded evaporators. The selection has to be made considering the maximum evaporating temperature. After the oil separating, it's necessary to use a check valve to avoid the condensed refrigerant flowing back to the oil separator. The minimum section of connecting manifold should have a section at least equal to the section of discharge shut-off valve. When the outside temperature is low, the oil separator is insulated to prevent condensation of the refrigerant in the oil separator.

13.4.6 Condenser

Because of the wide range of capacity resulting from the parallel compounding, it is necessary to equip with a regulation valve of the condensing pressure.

13.4.7 Evaporator

To protect the compressor from liquid hammer in the starting phase, the suction line at the evaporator outlet should be ascending. The pump-down is recommended.

13.5 Starting and maintenance

At the time of starting the unit, the following precautions should be observed:

- ✓ Check the safety devices, with special attention to devices concerning the oil;
- ✓ Loading the liquid receiver with an initial base charge;
- ✓ Start a compressor for a time and accurately control the pressure and oil level in all operating conditions, taking full charge of refrigerant;
- ✓ Check the temperature of the oil separator and oil return. The oil return should operate at intervals. The continuous flow of a warm mixture of oil and gas indicates a malfunction, which may be due to oil overcharging, or to a too small separator or failure of the oil regulator.

Chapter 14 Maintenance

14.1 Information of maintenance

For motors, in addition to confirming insulation and current condition, you also need to:

- ✓ Control the environment and temperature of the cable from the contactor to the motor terminal;
- ✓ Check if the cable is tightly fixed to the terminal.

14.2 Lubricant of refrigeration system

If the operating conditions of the system are correct, the entire refrigeration system and lubricant will not be contaminated. When the lubricant circulation and the motor insulation are in a very good condition, then the compressor can work for a long time and stay reliable.
The system working status is depend on the following aspects:

- ✓ Reasonable suction superheat degree;
- ✓ Work within application range;
- ✓ Reasonable refrigerant charge of the system;
- ✓ The compressor running smoothly (the compressor does not start and stop for a short time, the oil return is normal, and the compressor does not start up frequently). In the actual operation, any leakage and wrong flow of the refrigerant must be avoided, and at the same time, prohibit compressor oil shortage.

In the refrigeration cycle, most of the hazardous pollutants are:

- ✓ Air;
- ✓ Water;
- ✓ Rust(such as Fe_2O_3，Fe_3O_4);
- ✓ Verdigris(such as Cu_2O，CuO）；
- ✓ Solid particles, metal dust or dust.

The following substances should also be prevented from entering the refrigeration system:

- ✓ Antifreeze;
- ✓ Welding material;
- ✓ Chlorinated solvent;
- ✓ Lost debris;
- ✓ Nitrogen or other non-condensable gases.

Oil contamination, corrosion, copper sediment and ice blockage are more serious pollution, so we need to prevent them from damaging the compressor.

14.2.1 Oil contamination

Causes

Oil contamination is generated from composition that are easily decomposed in the lubricant. Oil contamination is caused by acidification from exposure to air at high temperature. Acidification will lead to the decomposition of refrigerant, further increasing the oil contamination. When acidic substances are produced, they react with metal elements to produce insoluble metal salts in refrigerant and lubricant. Crystalline salts of mineral acid is easily adhere to surfaces and more corrosive in wet environments.

How to avoid oil contamination

The oil contamination is avoided by keeping the machine clean and dry, preventing air entering refrigeration system and using high quality lubricant recommended by RefComp.

14.2.2 Corrosion

Causes

Compressor corrosion in a relatively clean environment is caused by the high operating temperature. However, even if the temperature is well controlled, the pollutants in the environment will cause severe corrosion to the compressor, even more severe than in high temperature operation without pollutants. High humidity air can cause rust. If there is acidification in the system, ferric oxide (Fe_2O_3) will be generated, which will further cause the iron salts and water.

Unclean welding materials can also lead to the formation of metal salts.

When used as antifreeze, methanol may react with aluminum and cause corrosion.

Improper welding methods will lead to various sludge (pickling agent, welding slag etc.) entering the system, and due to the influence of high temperature, copper oxide and iron oxide will form on the internal surface of the compressor.

How to avoid corrosion

To keep the system in a satisfactory cleanliness, various contaminants must be prevented from entering the system.

Use the refrigerant from qualified supplier, refrigerant must be kept in original container, packaged directly by manufacturer, and use lubricant specified by Fujian Snowman.

Avoid too high discharge temperature during operation. If you have any questions, please contact the manufacture.

14.2.3 Copper sediment

Causes

The copper sediment is occurred when the pollutants (Such as water, air etc.) dissolve copper in the lubricant under high temperature, sediment occurs when the dissolved copper of the lubricant meets the high temperature metal parts. Copper sediment is often occurred around crankshaft and valves for these parts normally have high temperature.

How to avoid copper sediment

The copper sediment is occurred when the pollutants (Such as water, air etc.) dissolve copper in the lubricant under high temperature, sediment occurs when the dissolved copper of the lubricant meets the high temperature metal parts. Copper sediment is often occurred around crankshaft and valves for these parts normally have high temperature.

Avoid machine running under high temperature, or the lubricant and refrigerant will go bad, and more acidic compounds that corrode the copper will form. The recommended Max. temperature is 120°C. 30°C higher than peak temperature is acceptable under some circumstances, don't running under high temperature for safety reason.

Use the recommended lubricants and ensure their viscosity meets the requirements. Avoid welding, chlorinated compounds and other pollution factors, directly or indirectly cause the formation of copper-containing salts. When using R22, avoid oil filter containing paper or fiber material. For pipes selection, it is recommended to use clean copper pipes and prevent metal oxidation during welding or brazing.

14.2.4 Ice blockage

Causes

If the water content of the refrigerant exceeds the maximum allowable value, it will cause ice blockage of the expansion valve or the suction filter, which will eventually affect the refrigerant circulation.

If the expansion valve is blocked, the continue alternation between the formation and melting of ice will cause strong fluctuations in the evaporating pressure.

If the suction filter is blocked, a high pressure difference will be generated in the filter area, which may blow out the filter, and there is a risk of burning the motor.

How to avoid ice blockage

Follow the installation instructions completely to prevent moisture from entering the refrigeration system. Use refrigerant from qualified supplier, and the refrigerant must be stored in the original container and repacked by the manufacturer. Only use the lubricant oil specified by RefComp. Avoid using opened lubricant. Install a dry filter on the liquid circuit.

14.3 Maintenance suggestion

It is recommended to use the operation recorder to record date, time, capacity level, suction pressure, suction temperature, discharge pressure, discharge temperature, oil pressure, oil temperature, voltage, current (overall current of compressor), oil level, oil acidity, electrical insulation (compressor is in a shutdown status).

For the frequency of detection, please refer to the table below:

No.	Checklist	Weekly	Monthly	Every two months	Annually
1	Read and record the refrigerant pressure	√			

2	Read and record the oil pressure value, Calculate the oil pressure difference (1)	√			
3	Read and record the motor supply voltage	√			
4	Read and record the supply current	√			
5＊	Check the compressor oil level	√			
6＊	Check the refrigerant charge amount by the lubricant flash	√			
7	Check if the superheat degree is properly		√		
8	Check all safety protection devices		√		
9	Check all contactors and electrical plugs		√		
10	Check the humidity indicator of refrigerant		√		
11	Check whether the solenoid valve work normally		√		
12	Check the lubricant status inside the compressor			√	
13	Check the condition of the capillaries (including the unit and the heat exchanger)				√

Note: Item with ＊ means requiring replacement or supplement when necessary.

Comparing the running data, especially the discharge temperature, you may find some hidden failures or problems that will occur in the future from the date variation.
Some hidden failures are reflected from cleanliness and color changes. For example, oil strains on some parts tends to adhere to dust. If you don't clean for a long time, it will seriously affect the compressor operation. Sometimes they can be judged from the color changes of the parts: such as some parts work in high temperature for long time, the color will change.

Note:
The installation, operation and maintenance of compressors and refrigeration systems only can be carried out by qualified professionals.

14.4 Management procedures of lubricant

You can buy small barrels of lubricants only when you are in a hurry. Confirm the type and the viscosity of the lubricant match the application. Do not pour lubricant from one bucket into another, as this will contact the air and absorb moisture. Air is the main pollution source. The lubricant is generally stored in a sealed container, and the exposure time to the air should not exceed the time required to inject from the container into the compressor crankcase.Lubricants should be odorless. It is a better inspection method to smell the lubricant, because if the lubricant has a pungent odor, then there must be something wrong with the lubricant. Although the color change of the oil is not easy to judge, by comparing with new lubricant, if it appears blue, green, brown or black, then the oil must be changed. After filling new oil to the compressor, it is necessary to carefully track the quality changes (Observe the viscosity, acidity, humidity, etc.) of the newly added oil.Only professional chemical laboratories can test lubricant

authoritatively. The oil level should be checked daily to ensure that the normal oil return. If there is oil shortage, add some lubricant appropriately until it reaches the appropriate oil level (the reason for the oil leakage must be analyzed clearly before taking corresponding measures).