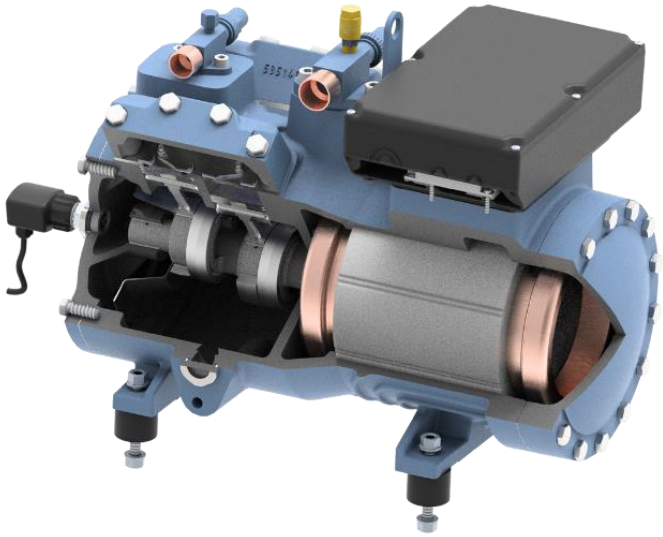
SRM TEC
COMPRESSORS

User and Maintenance Manual
SP1 Series



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1 Safety instructions

1.1 Importance of the manual

This manual contains the description of the operation and the necessary instructions to properly execute the main operations of use, ordinary and periodic maintenance of the machine.

A prerequisite to ensure safe working conditions is compliance with all safety warnings and all instructions contained herein. It must also ensure compliance with the local safety regulations currently in force in the installation location of the machine as well as the general safety regulations. The information contained herein is intended for professional users who must have specific knowledge of how to use the machine, must be authorized, trained and properly instructed.

We recommend the use of original parts and accessories. The non-original parts will invalidate the warranty and may also be dangerous, reducing the life and performance of the machine.

This manual, in case of transfer or sale, must always be delivered with the machine. If it becomes lost or damaged, you have to ask for a copy to the manufacturer of the machine or to the previous owner.

The manual is considered an integral part of the machine.

1.2 Responsibility limitations

All indications and warnings given in this manual have been prepared taking into account the rules and regulations in force, the current state of the art of the technology and the skills and knowledge acquired.

The manufacturer assumes no responsibility for any damage caused by:

- failure to follow instructions contained in this user manual;
- usage outside of the intended purposes;
- use of non-specialized personnel;
- unauthorized modifications;
- technical changes;
- use of non-original spare parts and wearing parts.

If special versions have been requested, additional options have been ordered or technical updates have been applied, it is possible that the components actually supplied are changed with respect to the descriptions and illustrations in this manual. The obligations agreed in the supply contract, the general terms and conditions and the conditions of supply of the manufacturer and the legal provisions in force at the time of signing the contract are intended as valid.

1.3 Simbols on the manual

The following **symbols** are used in this manual to get your attention how they should behave in all operating situations:

RECOMMENDATIONS: contains advice and recommendations as well as useful information for safe and trouble-free operations.

CAUTION!: indicates a potentially hazardous situation which, if neglected, can lead to material damages. Carefully follow the instructions and work carefully to avoid accidents, injuries and material damages.

The warnings are accompanied by signal words that identify the severity of the danger.

ADVICE!: indicates a potentially hazardous situation which, if neglected, may cause minor or moderate injury.

WARNING!: indicates a potentially hazardous situation which, if left untreated, can cause death or serious injury.

RISK!: indicates a situation of imminent danger that, if left untreated, can cause serious injury or death. Carefully follow the instructions and work carefully to avoid accidents, injuries and material damages.

MECHANICAL OPERATOR: the indicated steps must be carried out by specialized mechanical operator that operates respecting the rules of national security and any specific rules of the workplace.

ELECTRICAL OPERATOR: the indicated steps must be performed by a specialized electrical operator that operates in compliance with the safety regulations concerning energized equipment.

MAINTENANCE OPERATOR: the indicated steps must be carried out exclusively by the operator in charge of the maintenance of the machinery. As such he has to:

- integrally read and understood the contents of this manual;
- operate respecting the rules of national security and any specific rules of the workplace.

HANDLING OPERATOR: the indicated steps must be carried out exclusively by the operator enabled to handle loads that operates respecting the rules of national security and any specific rules of the workplace.

COMPANY SAFETY MANAGER: the company responsible for safety must be informed of any residual risks present in the machine and has to take care of any application to local safety regulations or specific of workplace and environment.

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1.4 Safety signals

On the machine are affixed pictograms that identify any dangerous areas

It is mandatory of the operator to keep in perfect status and replace them when they are no longer legible.

	DANGER - VOLTAGE: indicates hazardous situations due to electrical voltage. In case of failure to follow safety instructions, there is a risk of serious injury or death.
	DANGER – HIGH TEMPERATURE: indicates hazardous situations due to machine parts at high temperature. In case of failure to follow safety instructions, there is a risk of minor injuries and burns.
	DANGER – RISK OF EXPLOSION: indicates hazardous situations due to objects in pressure and the possible intervention of the safety valves. In case of failure to follow safety instructions, there is a risk of serious injury or death.
	DANGER - CRUSHING: indicates hazardous situations due to parts of the machine under rotation. In case of failure to follow safety instructions, there is a risk of serious injury.
	DANGER – MOVING PARTS: indicates hazardous situations due to parts of the machine under rotation. In case of failure to follow safety instructions, there is a risk of serious injury.
	DANGER – AUTOMATIC RESTART: indicates hazardous situations to automatically restart the machine. In case of failure to follow safety instructions, there is a risk of serious injur. In case the automatic restart is enabled, it is mandatory to affix appropriate warnings.

Tab. 1 Pictograms

1.5 Machine switched-off status

Defines the condition of safety of the machine, to be applied before any maintenance and/or adjustment operations.

It provides for the compulsory execution of the following steps:

1) Turning off the machine using the stop button.

2) Rotation of the main switch of the compressor to position 0 and padlocked.
3) Main switch turned to position OFF or 0.
4) Close the outlet valve of the air compressor or tank (mounted versions).
5) Release of the residual pressure in the compressor and the tank (mounted versions).

1.6 Responsibilities of the operator

The machine is intended for industrial purposes and uses.
The operator of the machine is therefore subject to the legal obligations concerning safety in the workplace. In particular, the operator must:

- identify, through a risk assessment, the possible dangers arising from particular working conditions existing at the place of use of the machine;
- ensure that all employees who use the machine have read and understood the user manual. Also instruct regularly the personnel on how to use the machine and inform them of the possible dangers;
- implement, trough operating instructions, the behavioral requirements necessary for the operation of the machine at the place of use;
- establish clear responsibilities for installation, operation, maintenance and cleaning of the machine;
- check regularly, for all duration of use of the machine, if the operating instructions correspond to the current version of the regulations;
- adjust, if necessary, the operating instructions to the new rules, regulations and conditions of use.

1.7 Misuse

Below are listed the actions required in order to prevent improper use of the machine:

- Use the machine only if it is in perfect technical condition. Promptly repair faults that can compromise security.
- It is not permitted to make changes to the machine that may compromise its security of the same.
- Disconnect the power supply before performing regular maintenance, cleaning and repair work and ensure that it is an impossible machine against restarting (disconnect the controls).
- Do not by-pass the safety devices or put them out of order.
- All operations on the machine and/or on electrical equipment must be carried out by specialized personnel.
- Repairs and maintenance operations must be carried out only when the machine is off. Make sure that it is impossible an accidental restarting of the machine!
- When performing operations on the machine, the machine must not be under pressure. Close the air outlet valve and vent piping between the machine and the air receiver. Manually release the overpressure of the compressor from the safety valve. Observe the indication of the pressure gauge!

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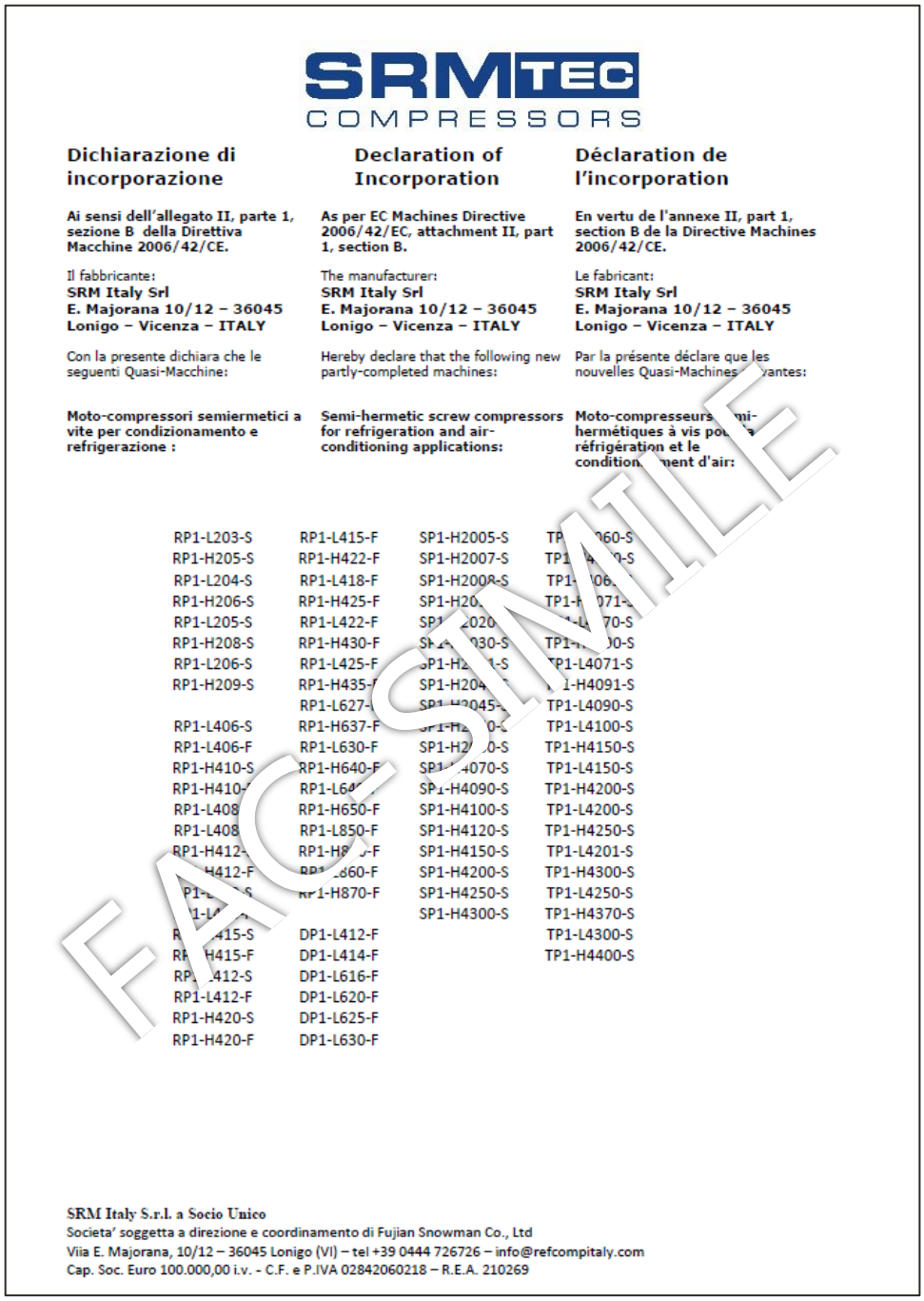
- The protective devices of the starter must be removed only when the machine is turned off and must be reassembled correctly at the end of the operations. Remove the touch guard only when the machine and the pressure line have cooled down.
- The provisions relating to environmental protection require that all fluids handled during the maintenance operations (eg. Oil) are collected and disposed in accordance with current regulations.

1.8 Copyright

The content, texts, drawings, pictures and any other representation are protected by copyright and trade mark rights. Any violation is punishable.
It is forbidden the reproduction, even partial and by any means, and the use and/or disclosure of the content without prior written declaration by the manufacturer.

1.9 CE Conformity Declaration

The following is an example of the conformity declaration and the information contained in. The original document is delivered in hard copy with the product.



SRM

COMPRESSORS

Dichiarazione di incorporazione	Declaration of Incorporation	Déclaration de l'incorporation
Ai sensi dell'allegato II, parte 1, sezione B della Direttiva Macchine 2006/42/CE.	**As per EC Machines Directive 2006/42/EC, attachment II, part 1, section B.**	**En vertu de l'annexe II, part 1, section B de la Directive Machines 2006/42/CE.**
Il fabbricante: **SRM Italy Srl** **E. Majorana 10/12 – 36045** **Lonigo – Vicenza – ITALY**	The manufacturer: **SRM Italy Srl** **E. Majorana 10/12 – 36045** **Lonigo – Vicenza – ITALY**	Le fabricant: **SRM Italy Srl** **E. Majorana 10/12 – 36045** **Lonigo – Vicenza – ITALY**
Con la presente dichiara che le seguenti Quasi-Macchine:	Hereby declare that the following new partly-completed machines:	Par la présente déclare que les nouvelles Quasi-Machines [illegible]vantes:
Moto-compressori semiermetici a vite per condizionamento e refrigerazione :	**Semi-hermetic screw compressors for refrigeration and air-conditioning applications:**	**Moto-compresseurs [illegible]mi-hermétiques à vis po[illegible] réfrigération et le condition[illegible]ment d'air:**

RP1-L203-S	RP1-L415-F	SP1-H2005-S	TP[illegible]60-S
RP1-H205-S	RP1-H422-F	SP1-H2007-S	TP1[illegible]0-S
RP1-L204-S	RP1-L418-F	SP1-H2008-S	TP1-[illegible]06
RP1-H206-S	RP1-H425-F	SP1-H20[illegible]	TP1-H[illegible]071-S
RP1-L205-S	RP1-L422-F	SP1[illegible]2020	[illegible]L[illegible]70-S
RP1-H208-S	RP1-H430-F	SP1[illegible]030-S	TP1-[illegible]00-S
RP1-L206-S	RP1-L425-F	SP1-H2[illegible]1-S	TP1-L4071-S
RP1-H209-S	RP1-H435-[illegible]	SP1-H204[illegible]	[illegible]1-H4091-S
	RP1-L627-[illegible]	SP1-H2045-[illegible]	TP1-L4090-S
RP1-L406-S	RP1-H637-F	SP1-H2[illegible]0-S	TP1-L4100-S
RP1-L406-F	RP1-L630-F	SP1-H2[illegible]0-S	TP1-H4150-S
RP1-H410-S	RP1-H640-F	SP1-[illegible]4070-S	TP1-L4150-S
RP1-H410-[illegible]	RP1-L64[illegible]	SP1-H4090-S	TP1-H4200-S
RP1-L408[illegible]	RP1-H650-F	SP1-H4100-S	TP1-L4200-S
RP1-L408[illegible]	RP1-L850-F	SP1-H4120-S	TP1-H4250-S
RP1-H412-[illegible]	RP1-H8[illegible]-F	SP1-H4150-S	TP1-L4201-S
[illegible]H412-F	RP1-[illegible]860-F	SP1-H4200-S	TP1-H4300-S
P1-[illegible]S	RP1-H870-F	SP1-H4250-S	TP1-L4250-S
[illegible]1-L[illegible]		SP1-H4300-S	TP1-H4370-S
R[illegible]415-S	DP1-L412-F		TP1-L4300-S
RP[illegible]H415-F	DP1-L414-F		TP1-H4400-S
RP1-[illegible]412-S	DP1-L616-F		
RP1-L412-F	DP1-L620-F		
RP1-H420-S	DP1-L625-F		
RP1-H420-F	DP1-L630-F		

FAC-SIMILE

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Cap. Soc. Euro 100.000,00 i.v. - C.F. e P.IVA 02842060218 – R.E.A. 210269

2 General safety information

2.1 Directives and Standards Reference

The compressor in question has been designed and manufactured taking into account the feedback that emerged from a careful analysis of risks and tending to achieve, given the state of the art, the objectives set by the essential requirements of safety and health provided by European Directives. In the Tab. 2 are listed the referenced European Directives and Standards (EN):

Directive	Description
2006/42/EC	"Machinery Directive on the approximation of the laws of the Member States relating to machinery".
2014/35/EC	"Low Voltage Directive on the approximation of the laws of the Member States relating to electrical equipment designed for use within certain voltage limits".
2014/30/EU	"Electromagnetic Compatibility Directive on the approximation of the laws of the Member States relating to electromagnetic compatibility".
EN 12693:2008	"Refrigerating systems and heat pumps - Safety and environmental requirements - Positive displacement refrigerant compressors"
EN 60204-1	"Safety regulations concerning basic electrical equipment of machines".

Tab. 2 Reference standards and directives

2.2 Residual risks

We inform the authorized operators that, despite the manufacturer has adopted all the measures possible to make the construction of the compressor sure, remain potential residual risks described here below:

Residual risk n° 1	DANGER OF BEING AFFECTED BY GAS PRESSURE
Frequency of exposure	Low and accidental. There may be exposure if the operator decides to perform voluntarily impropriety, prohibited and not reasonably foreseeable.
Extent of the damage	Serious lesions (non reversible).
Solutions adopted	Respect of the correct procedure for maintenance operation. Safety signal.

Tab. 3 Residual risk

2.3 Identification of dangerous areas

Dangerous areas of the compressor are identified in the following images.

These areas have to be considered into the risk assessment of the machine were the compressor is installed and appropriate precautions must be taken to reduce residual risks (see chapter 2.2)

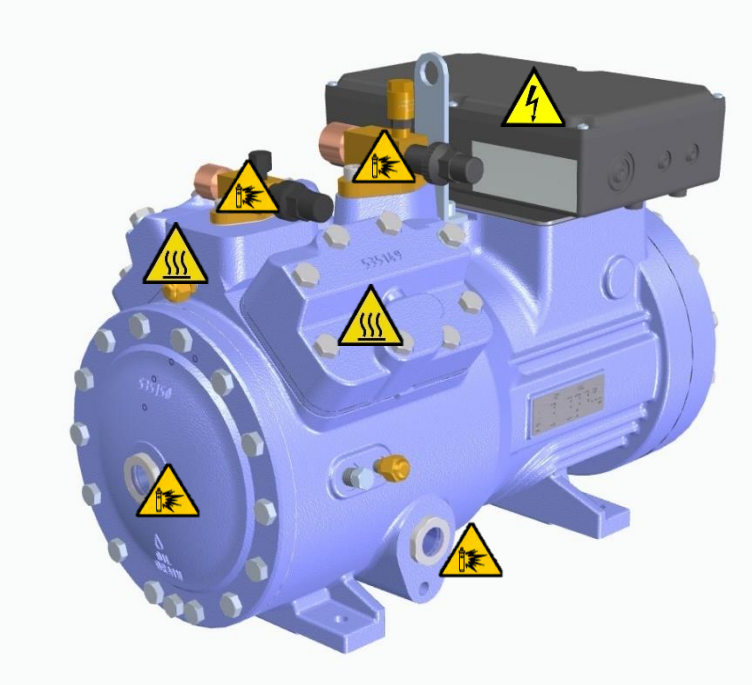

Fig. 1 Dangerous area identification

3 Compressor introduction and features

3.1 Identification and Intended Use

The **SRMTec SP1** series piston compressors are reciprocating oil lubricated compressors specifically designed to operate with carbon dioxide, R744 (CO2) gas as refrigerants and to be installed in refrigeration system.

Any whatsoever claim for damages resulting from misuse is excluded. The designer and the operator of the machine where compressor is installed are solely responsible for any damage resulting from misuse.

THE COMPRESSOR USAGE FOR SCOPES DIFFERENT AND NOT INCLUDED IN THE INDICATED EXCLUDES THE MANUFACTURER FROM ANY RESPONSIBILITY FOR THE RISKS THAT SHOULD BE CAUSED AND FOR ANY DAMAGES TO THE MACHINE, PEOPLE OR THINGS.

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The identification of the compressor model is possible by the following scheme:

	SP1-	H	2	005	-S
SP1- = Subcritical Semi-hermetic Piston compressor					
H = motor version H: Full size motor L: Small size motor					
2 = n° of cylinders					
005 = Nominal power [Hp] x 10					
-S = Lubrication type S = Splasher lubrication F = Forced lubrication (with oil pump)					

3.2 Nameplate

All the data necessary to identify the compressor, in addition to the main electrical and mechanical data, are printed on a metal plate attached in the casing of the compressor. Here below is shown the label applied to compressors with electric motors Y/Δ.

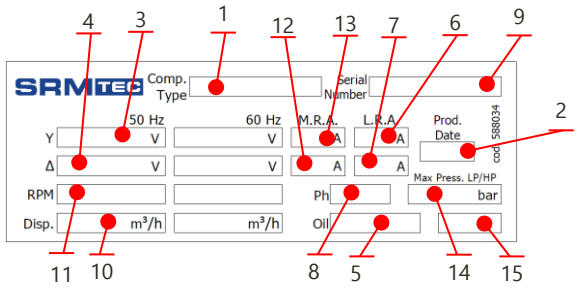


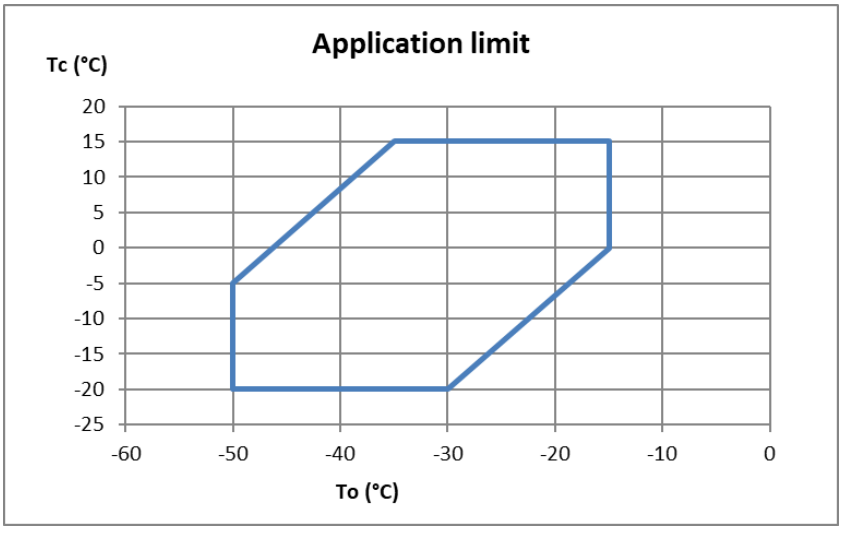
Fig. 2 Name plate for compressors with Y/Δ

Field	Information reported	Description
1	Compressor type	Compressor identification name
2	Production date	Production date of the compressor
3	Starting voltage	Supply voltage of the starting configuration: • Y connection in Y/D with Nominal frequency of electric motor 50Hz or 60Hz
4	Running voltage	Supply voltage of the starting configuration: • D connection in Y/D with Nominal frequency of electric motor 50Hz or 60Hz
5	Oil charge	POE - PAG
6	Starting current	Starting current with starting connection: • Y connection in Y/D
7	DOL current	Direct On Line starting current: • D connection
8	Frequency	Nominal frequency of electric motor Hz

9	Serial number of compressor	Code to be used for any communication to SRMTec concerning the specific compressor
10	Displacement	Refrigerant moved by compressor at full load (Nominal frequency of electric motor 50Hz or 60Hz)
11	RPM	Compressor speed (at 50Hz, 60Hz)
12	F.L.A.	Maximum current drawn by the compressor
13	F.L.A. (2)	Maximum current drawn by the compressor if connected in starting mode
14	Maximum working pressure	Maximum working pressure on Low pressure side (LP) / High pressure side (HP)
15	IP	IP grade protection

3.3 Application range

The normal admissible operating conditions for the SP1 series compressors, with changes in evaporation and condensing temperature, are defined by a polygon. The entire field of operation of the compressor is divided into different areas, featuring special precautions that must be adopted so as to ensure correct operation. For details, check the catalogue and the "SRMTec" selection software.



WARNING:
The compressor must not be operated outside of application limit

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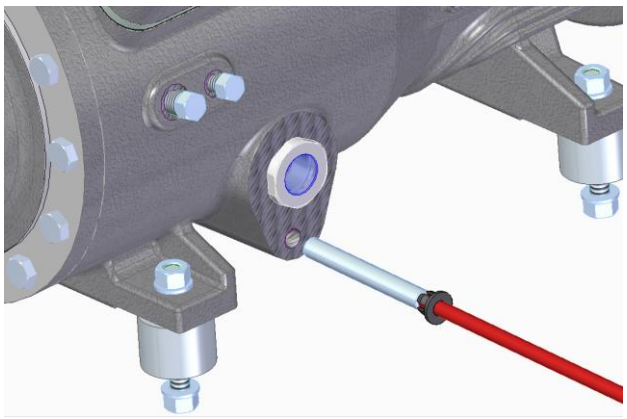
3.4 Crankcase heater

The crankcase heater shall avoid refrigerant resolving within oil when the compressor is stopped. The crankcase heater of these compressors is PTC type, with auto-regulation of power consumption. The power absorption decreases while the temperature increases obtaining in such way an energy saving, proportional to the size of compressor.
The crankcase heater is assembled in a proper seat, machined on the bottom of the compressor casing (in the same side of the oil sight glass) and closed with a plastic cap.



3.5 Lubricant of the compressor

The lubricant shall meet the following requirements:

- ✓ Ensure bushings lubrication;
- ✓ Viscosity of oil under nominal operating conditions;
- ✓ Miscibility with refrigerant at low temperature.

WARNING:
Only use lubricants which are released by SRMTec; lubricants are highly hygroscopic, prevent contact with (humid) air.

In normal operation, some lubricant will remain in the refrigeration system.
There is usually some lubricant in the piping of the refrigeration system, so that the oil level of the compressor oil sight glass will decrease. Dependent on the pipe length and design approx.. 10% more lubricant should be filled to the refrigeration system if necessary.
If the refrigeration system is equipped with an oil separator, also consider the amount of lubricant to be charged into the oil separator.
After commissioning check the oil level of oil sight glass regularly until stable conditions prevail.
The compressor oil level needs to be measured when the compressor is running stable.

After 300 hours of stable operation check the properties of the oil:

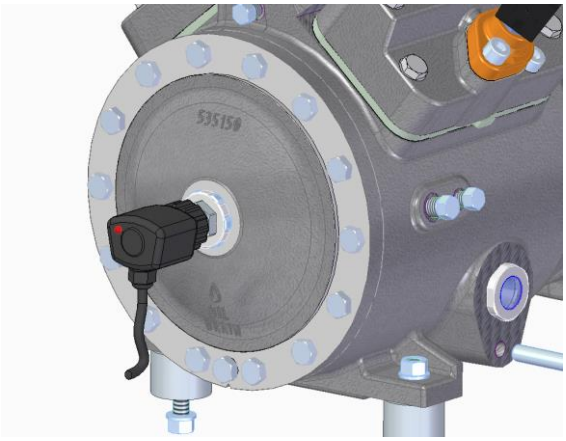
- ✓ Colour
- ✓ Odour
- ✓ Kinematic viscosity
- ✓ Humidity
- ✓ PH of the system
- ✓ The oil composition.

If the oil colour has changed, consider a change of oil.

Oil temperature:
During normal operation, the oil temperature should not exceed 80℃. The temperature difference between the oil temperature and the condensing temperature should be about 40K, and the discharge temperature should not exceed 140℃.

3.6 Electronic oil level switch

The electronic oil level switch is used to monitor the oil level in the compressor to ensure that the working parts of the compressor can be fully lubricated. It is suitable for compressor models with splash lubrication and can be installed directly on flange.



3.7 Oil sight glass

The compressor is filled with lubricant in the standard delivery configuration. Check the compressor oil level by the oil sight glass beside the crankcase oil groove.
Ensure the normal oil level during normal compressor operation, generally between the minimum oil level of the compressor (about 1/3) and the maximum oil level of the compressor (about 2/3).

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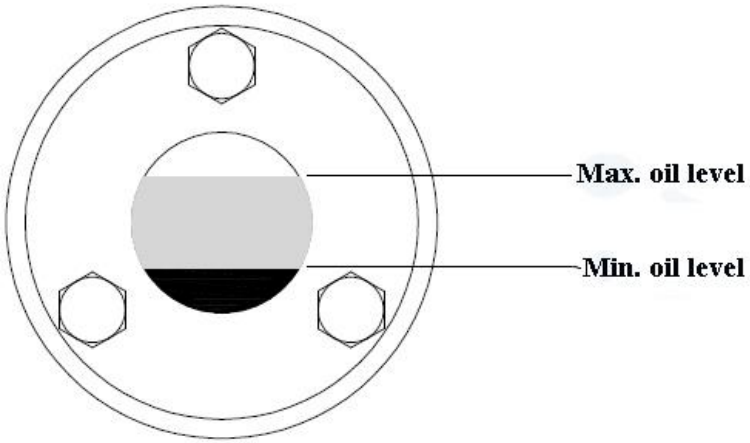
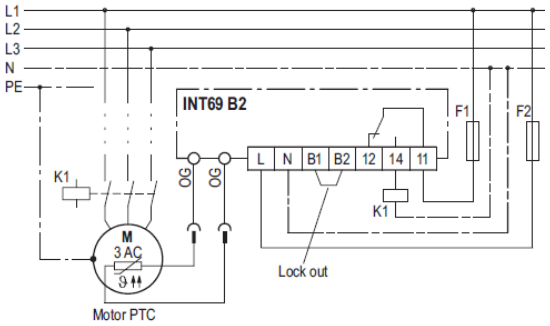


Figure 1 - Oil level

3.8 Motor protection module (INT69B2)

The whole SP1 series use INT69B2 module to protect the compressor motor. The module also can be connected with oil temperature sensor and discharge temperature sensor, in series with motor ptc, to protect the oil circuit and discharge temperature.



3.9 Motor

SP1 series motors are three-phase 4 poles asynchronous motors (50Hz, 1450 rpm or 60Hz, 1750 rpm).
Models from SP1-H2005-S to SP1-H4121-S, are provided with Y/D motors:
230V / 3 / 50Hz motor in delta connection and 400V / 3 / 50Hz motor in star connection.

Bigger models use a part-winding start motor, which reduces the starting current.
The part-winding motor starts up by powering one motor coil first, followed by the remaining coils with a short delay.
Check "Electrical connection" for the electrical scheme.

3.10 Motor thermistor

To protect the motor, six PTC thermistors are woven into the compressor motor windings: three of them are placed on the suction side of the compressor with a switch-off temperature is 100 ° C; the other three are placed on the discharge side of the compressor with a switch-off temperature of 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 INT69B2. The resistance value of the resistance chain can be measured according to the resistance terminals T1 and T2 in the electrical box

4 Installation and commissioning

The following conditions must be met for the installation site:

- The ambient temperature must not be below -15 ° C or above 50 ° C.
- The installation site must not show excessive temperature and humidity fluctuations, which can lead to condensation of moisture in the terminal box.
- At the installation site, the electrical attachments may only be exposed to conditions that correspond to and are covered by the specified IP protection class.

WARNING:
The compressor is protected by nitrogen (0.5-1bar above atmospheric pressure) to prevent air from entering the compressor.

WARNING:
Release the nitrogen from the compressor, and then connected the compressor to the refrigeration circuit to ensure no air enters the suction and discharge shut-off valves. The contact time between the inside of the compressor (such as lubricant) and air should not exceed 30 minutes.

4.1 Vibration damper

The compressor must be installed horizontally and with the vibration dampers (elastomer dampers) supplied as standard. These are installed between the compressor feet and the frame profiles.
For rigid connection, please consult with SRM Tec.

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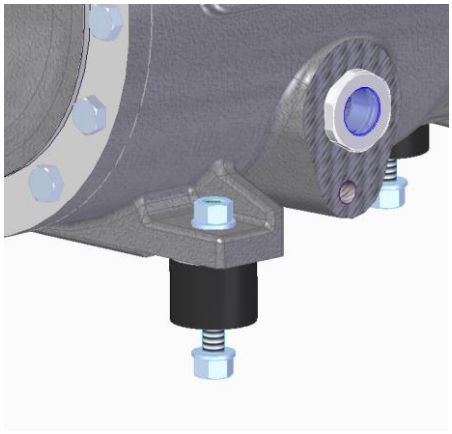

4.2 Pipes connection

Suction and discharge sides don't require flexible pipes.
Suction and discharge pipes should not transmit stresses to compressors.
Use only pipes and components thoroughly clean and free of humidity, without waste, scrap, rust and phosphate coating.

4.3 Electrical connection

Operate the electrical connection according to the wiring diagrams in the terminal box. Please select the specification of motor contactor, cable and fuse according to the Full Load Amps (FLA). Please check the nameplate for the specific value of FLA. The voltage and frequency of the power supply must be in accordance with the rated voltage on the nameplate. Terminal T1-T2 on the wiring board and terminal 1-2 on the motor protector INT 69, shall not be connected to the power supply.

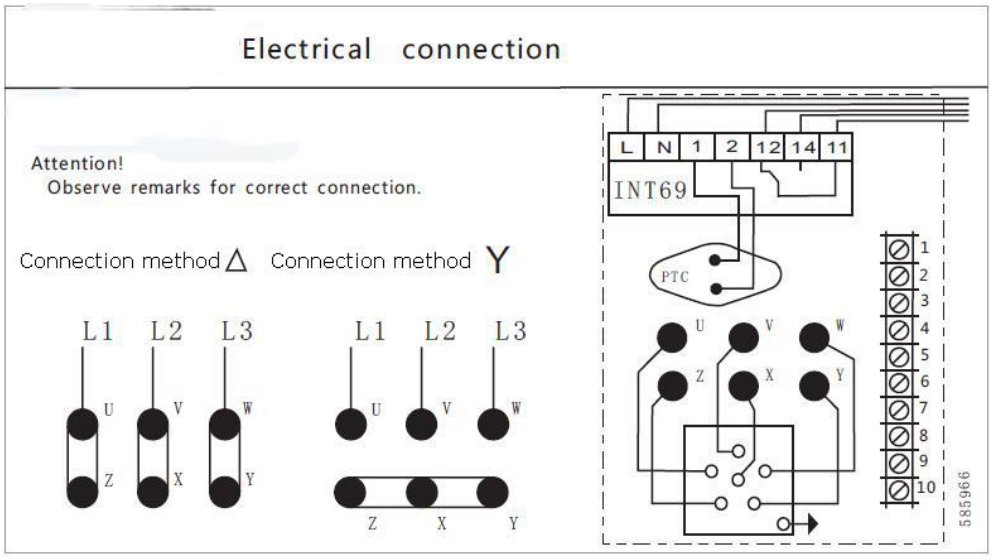

Figure 2 - Y/D connection

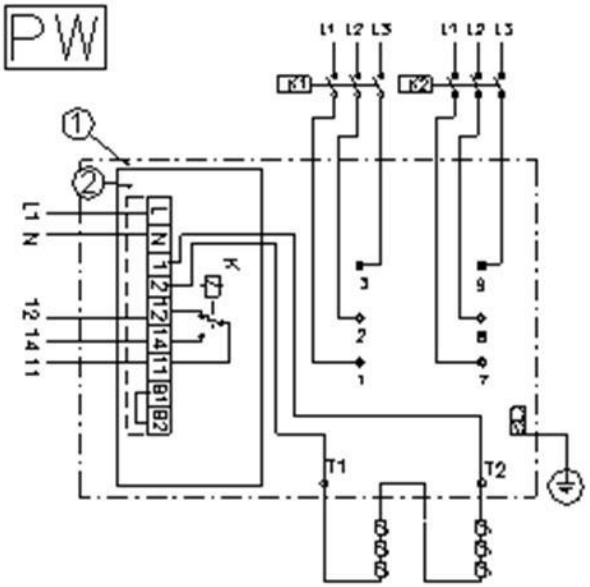

Figure 3 - PW connection

4.4 Pressure Switch

The compressor must be equipped with high and low pressure switches to control the operating range within the applicable limits.

4.5 Pressure limit

The allowable design pressures are as follow:

	Design pressure
High / Low pressure	60bar

To prevent motor overload, the working pressure must be controlled within the application range. If necessary, M.O.P (maximum operating pressure) expansion valve or pressure regulator is recommended.
Motor overload may occur on occasions of high demand such as re-starting after defrost, overloading of cold storage with products to be pulled down.
Compressors are supplied with a pressure relief valve installed on suction side.

WARNING:
Pressure relief valve installed on compressor is not considered as SAFETY VALVE. Safety valves must be installed on plant and designed according the standards and laws of the installation site.

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4.6 Temperature limit

Discharge temperature:

- Max.:140℃;
- Min.: Above condensation saturation temperature 30K.

Suction temperature:

- evaporating temperature + superheat. Please check "Application Range" for the evaporating temperature range, and the superheat range is 8 ~ 30K.

4.7 Running time

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

ATTENTION!
A number of starts higher than the one suggested may damage the electrical motor and affect the theoretical compressor working life.

4.8 Leakage detection/ vacuuming

A leak test must be carried out for the refrigerant circuit in accordance with the applicable guidelines of the installation.
The compressor must not exposed to dry air.
When vacuuming the entire refrigeration system, ensure that the compressor and the system are connected.
During the vacuuming, the oil heater is energized. Required a vacuum of at least 1.5 mbar (using a vacuum pump with a shut-off valve); repeat this operation several times if necessary.

WARNING:
Prohibit starting the compressor under vacuum condition.

The compressor has passed the relevant pressure tests, so the user does not need to do the relevant pressure tests. If the user needs to test by himself, please not exceed the design pressure value on the nameplate.

WARNING:
The test pressure must not be higher than the permissible operating pressure of the unit and its pressure vessel.

4.9 Lubricant charge

The operating procedures for filling oil are as follows:

- ✓ 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;
- ✓ Connect the oil separator to the corresponding oil return inlet of the compressor;
- ✓ Control the amount of refrigerated oil in the range of the horizontal position shown in Figure 3;
- ✓ Close or tighten the freezing oil connection plug.

WARNING:
All compressors have been oil injected unless specifically requested. The nameplate of the compressor indicates the type of oil. Please consult with SRMTec if other lubricants are acceptable (SRMTEc company will not be responsible for the warranty if the refrigerant authorized by SRMTec company is not applied). If a separate delivery of lubricant is required, the lubricant must be charged into the compressor after the compressor has been vacuumed.

4.10 Refrigerant charge

Charge the liquid refrigerant into the condenser or directly into the refrigerant receiver. Complete the refrigerant charging during compressor operation. The discharge temperature must be at least 30K higher than the condensing temperature to avoid liquid backflow, and control the injection speed to avoid liquid hammer.
Insufficient refrigerant charge will result in low suction pressure or excessive degree of superheat. Please use the selection software SRMTec to calculate the correct discharge temperature value for reference.

WARNING:
Charging liquid refrigerant through low pressure port of compressor is not permitted.

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4.11 Start-up procedure

The compressor start-up procedures are as follow:

- ✓ Refer to the wiring diagrams for electrical connections;
- ✓ Perform the following preliminary inspections:
    - Check 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;
    - Check if the protection device of oil pressure (compulsory lubrication type compressor) is normal or equipped;
    - Confirm that there is no leakage in the system.

- ✓ The crankcase heater must be turned on 24 hours before the compressor is turned on, and the oil temperature must be at least 15 degrees above the ambient temperature;
- ✓ Ensure that there is a minimum refrigerant amount in the condenser;
- ✓ Open the suction and discharge shut-off valves and starts the compressor;
- ✓ Ensure the discharge temperature is at least 30K higher than the condensing temperature (Refer to SRMTec selection software);
- ✓ Check that the pressure switch is working properly;
- ✓ Check the working parameters, such as evaporating pressure, condensing pressure, suction and discharge temperature etc. (Refer to SRMTec selection software).

WARNING:
Before starting the compressor ensure that suction and discharge stop valves are fully open.

WARNING:
Compressor surface temperature may exceed 100°C or fall below 0°C during starting.

WARNING:
Liquid hammer and oil hammer must be avoided during compressor operation.

4.12 Trouble-shooting

Problem	Possible causes	Actions
The compressor doesn't start	a) Interface switch open b) Burned fuses c) Over- temperature relais open d) Faulty contactor e) Expansion valve doesn't open f) Failure electric motor g) Terminals loose h) Safety intervention i) The thermostat is set at High temperature	a) Close the switch b) Check the electrical circuit and verify the absence of a short circuit or ground currents. Check for possible motor overload. Replace fuse after determining the cause of failure. See Item 12 c) Repair or replace d) Repair or replace e) Check continuity / insulation between terminals, check for burned insulation f) Check all electrical connections. Tighten the contacts g) Determine and eliminate causes of action securities, before restarting the motor h) If necessary, lower the thermostat temperature, remaining at 15K above the ambient temperature.
Excessive compressor noise	a) Brackets of pipes inadeguate b) Inadequate clearance c) Liquid inside the compressor casing d) Rotor electric motor is not fixed e) Sound insulation / vibration inappropriate	a) Replace, remove or add pipe fixing points b) Perform maintenance, replacing all the parts do not matching c) Control sizing and setting of expansion valve d) Control block key and bolt e) Check anchor condition,
Excessive Discharge pressure	a) Discharge valve partially closed b) Excess of refrigerant charge c) Failure capacitor d) Presence of non-condensable gases in refrigerant circuit e) Capacitor undersized or malfunctioning	a) Open the valve b) Drain excess refrigerant c) Removing dirt in batteries or in the nozzles of the capacitor d) Eliminate non-condensable fluids e) Set condensing fluid flow or revise sizing
Insufficient Discharge pressure	a) Faulty condensing temperature regulation b) Intake valve partially closed c) Refrigerant amount not enough d) The compressor does not increase the load e) Condenser oversized f) Worn seal rings or Discharge valve	a) Check operation of electronically control of condenser b) Open the valve c) Check for leaks. Charge refrigerant d) CR / SU Leads working. e) Review the design parameters f) Special maintenance compressor

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Problem	Possible causes	Actions
Excessive suction pressure	a) Excessive eat load b) Excess of flow lamination c) The compressor does not increase the load d) Inadequate size of compressor e) Insufficient size of evaporator	a) Decrease load or increase system potential b) Check valve bulb. Adjust superheat. Check expansion valve sizing. c) Check CR / SU d) Review the design parameters e) Review design parameters
Insufficient suction pressure	a) Lack of refrigerant b) Evaporator dirty or iced c) Clogged filter dryer in liquid line d) Suction line filter or compressor intake filter clogged e) Faulty expansion valve f) Condensing temperature too low g) Pump or evaporator fan not working	a) Check for leaks. Charge refrigerant b) Clean or defrost c) Replace the cartridge d) Clean filter e) Check and reset valve to proper superheat. Repair or replace if necessary f) Check condensing temperature control devices g) Check and restart
The compressor doesn't work at part load	a) Faulty CR Lead b) Stem of CR Lead blocked	a) Replace b) Replace
The compressor doesn't increase the load	a) Faulty CR Lead	a) Replace
Increasing and decreasing capacity steps too short	a) Oversized expansion valve causes an excessive suction pressure	a) Control the sizing of expansion valve
The oil pressure gauge gives a low pressure	a) No lubricant b) Too much condensation in the compressor casing c) Pressure drops along the pipes to the oil pressure probe d) Pipes to the oil probe clogged e) Gasket of oil pump installed incorrectly f) Oil pressure gauge defective g) Faulty delivery valve of pump h) Device for reverse rotation oil pump is stuck in the wrong place. i) Faulty oil pressure switch. j) Damaged oil pump k) Damaged pump shaft key l) Damaged bearings m) Faulty components of CR Lead	a) See paragraph 3.7 b) Supply crankcase Heater. Set the expansion valve in order to achieve greater superheating. Check solenoid valve of liquid line c) Check and tighten attack of filter d) Clean e) Check the pump seal. All holes of the gasket must match the holes in service pump and pump support. f) Repair or replace. Keep valve closed except during gauge reading g) Repair or replace. h) Reverse two phase of power supply. i) Repair or replace. j) Replace k) Replace damaged parts l) Compressor Maintenance m) Replace damaged parts

Problem	Possible causes	Actions
Oil leakage of compressor	a) Oil trapped in the refrigeration pipes or in the evaporator b) Oil leaks from components of CR Lead c) Low speed in the suction pipes d) Excessive leakage from oil scraper rings in the pistons	a) Check speed of refrigerant b) Replace damaged components of CR Lead c) Check sizing of suction pipes d) Maintenance of the compressor
Over current relais open	a) Excessive condensing temperature b) Fuse open on one phase, resulting in single-phase operation c) Low voltage at full load d) Contacts of the power cables loose e) Faulty relay f) Overload Relays sized incorrectly g) High temperature of the overcurrent relay. h) Damaged power wires or on the ground i) Lack of phase resulting in imbalance of tension and in a single-phase operation j) Failure to complete insertion of the winding in the electric motor (if PW) or Δ winding k) Faulty or on the ground wirings l) Compressor seized	a) See remedies to discharge temperature. b) Find the cause of the opening relay, repair and replace fuse c) Check line voltage and verify which phase has excessive voltage drop d) Check and tighten all terminals e) Repair or replace f) Refer to nameplate data relay for proper sizing g) Ventilate the electrical box in which is located the relay. h) Repair or rewire i) Check voltage power line. Do not restart until the error was not corrected. j) Repair or replace the contactor or timer device k) Repair or rewind motor l) Special maintenance
Compressor starts and stops too close	a) Temperatures of differential thermostat too close b) Losses from the solenoid valve c) Too High refrigerant charge d) Lack of refrigerant e) Malfunction of the control valve of working fluids in condenser and evaporator.	a) Check the temperatures of the evaporator. Adjust the temperature differential, However, avoiding the formation of ice. b) Replace the solenoid valve c) Remove excess d) Check that there are no leaks. Repair and add refrigerant. e) Check the temperature setting of the control valve. Clean, repair or replace if necessary.

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5 Maintenance

5.1 Information for maintenance

The steps for the electric motor, in addition to measures of isolation and current already mentioned, are:

- Control of the state and the temperature of electrical cables from the contactor to the motor terminal;
- Check the tightness of the electrical cables to terminals.

5.2 Lubricant-refrigerant system

If the working conditions of the system are correct and the lubricant-refrigerant system is free of contaminants, the lubrication circuit and the motor insulation will be maintained in good condition, the compressor will operate for long without problems.
Good working conditions of the system are determined by:

- a proper suction superheating;
- working temperature within the application range;
- proper charge of refrigerant;
- smooth operation of the compressor (without short cycles of work, proper oil return, starts not close). In practice, it must be avoided anything that may cause flooding or incorrect flow of refrigerant, or a lack of oil to the compressor.

The contaminants or undesirable components in the circuit, are for the most part:

- air,
- water,
- iron oxide (red or black Fe_2O_3 Fe_2O_4)
- copper oxides (red Cu_2O, CuO or black)
- solid particles, metal dust or dirt.

Substances whose presence is less frequent, but not less dangerous, are:

- antifreeze
- welding materials,
- chlorinated solvents,
- colours to verify losses,
- nitrogen or other gases that cannot switch to a liquid state.

The dangerous effects of contaminants are sludges, corrosion, coppering and icing with the following damage of compressor

5.3 Sludges

5.3.1 Main causes

The sludge are solid materials derived from the splitting of the molecule from oil. The process of formation of sludge begins with the High temperatures and the presence of air which cause acids. These acids cause a process of decomposition of the refrigerant which accelerates the formation of sludge. When acids are formed, they react with the metal elements of the components forming insoluble metal salts in both the refrigerant and oil.

Mineral acids form salt crystals, which tend to adhere to the surfaces modifying them. Mineral acids are more corrosive in the presence of moisture.

5.3.2 Low to avoid sludge

The sludge is avoided by keeping the plant clean and dry, avoiding introducing air, using only the oil recommended by SRMTec, which are High-quality oils.

5.4 Corrosion

5.4.1 Main causes

- Very High operating temperatures can cause corrosion also in a relatively clean plant. However, in the presence of contaminants, even moderately elevated temperatures can cause more severe corrosion than in the case of High temperatures and lack of contaminants. The air with high moisture causes the formation of rust. If in the system there are also acids, the red iron oxide (Fe_2O_3) forming, causes the generation of iron salts and of other water.
- The presence of welded materials can still lead to the formation of metal salts
- The methyl alcohol (used as antifreeze) may react with aluminium, causing corrosion
- The adoption of inappropriate methods of soldering leads to the introduction in the system of contaminants such pickling agent, welded materials or, under the influence of heat, the formation of oxides of copper and iron on the metal surfaces inside.

5.4.2 How to avoid corrosion

Keep the system in a satisfactory state of cleanliness, which means that it is necessary to prevent the introduction of any contaminant.

Use only refrigerants of qualified suppliers. The refrigerant must be supplied in original container, filled by the manufacturer and use only the lubricants recommended by SRMTec. Avoid having discharge temperatures higher than those provided by the process. Contact SRMTec in case of uncertainty or doubt.

5.5 Coppering

5.5.1 Main causes

The coppering is due to the high temperature and to contaminations such us water, air or other which dissolve the copper in the oil.

Subsequently, the dissolved copper precipitates in the oil on the very Lot metal parts. The coppering happens often in the shafts and near the valves, where the temperature is very high.

5.5.2 How to avoid coppering

- Avoid High operation temperatures which can cause a partial decomposition of the oil and refrigerant and promote the formation of acids that corrode copper. The maximum recommended reachable temperature is 120 ° C. In some cases it can be tolerated occasional spikes in temperature 30°C higher. In all cases, the lower the service temperature, the better the results.
- Use only the recommended lubricants and also make sure that its viscosity corresponds to that request.

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- Avoid contamination with welded, chlorinated solvents and other contaminants capable of causing, directly or indirectly, the formation of copper salts.
- In realizing the pipes, it's recommended to use clean copper pipes and to prevent the oxidation of the metal during welding or brazing.

5.6 Icing

5.6.1 Main causes

When the moisture in refrigerant exceeds the maximum allowable value, causes the formation of ice crystals that block the expansion valve or the suction filter avoiding the circulation of the refrigerant.

If the valve is blocked, it will cause a strong fluctuation of evaporating pressure due to the continuous forming and melting of ice.

If the suction filter is blocked, it will cause an High pressure difference in the filter that could blow the filter with the risk of burning the motor.

5.6.2 How to avoid icing

Avoid the presence of water in the system following exactly installation and charging rules. Use only refrigerants of qualified suppliers. The refrigerant must be supplied in original container, filled out by the manufacturer and use only those lubricants recommended by SRMTec. Avoid using lubricants in containers already open. Install dehydrator filters in liquid line.

5.7 Relief for maintenance

It's suggested to create an operation register used to record the data of the compressor: date, time, step of capacity (anyway it is preferable to report the data at full), suction pressure, suction gas temperature, Discharge pressure, Discharge temperature, oil pressure, oil temperature, voltage, current (6 values, all the power cables of the motor), oil level, oil acidity, electrical insulation (with stand still compressor, of course).

Concerning the frequency and the kind of control, see the table below:

Action	Weekly frequency	Monthly frequency	Two-monthly frequency	Annual frequency
Reading and recording the level of refrigerant pressure	X			
Reading and recording the level of oil pressure and calculate the net oil pressure (1)	X			
Reading and recording voltage power line to the electric motor	X			
Reading and recording the current of the power line to the electric motor	X			
Check compressor oil level	X			
Check the refrigerant charge through the light oil	X			
Check for proper heating of the gas inlet (the inlet gas temperature control)		X		
Check the setting of all safety devices		X		
Check all contactors and all electrical contacts		X		

Check moisture indicator of the refrigerant		X		
Check operation of the solenoid valve		X		
Check condition of the oil in the compressor			X	
Check condition of the oil in the compressor			X	
Check the status of the capacitor (battery or heat exchanger)				X

Comparing the data of operation, in particular the discharge temperature, it can be understood if the changes can detect hidden faults or future failures.
In addition to this data should be recorded the outside state, with regard to cleaning and colour, of some parts of the compressor and of the plant, for example if some parts are oily or dirty but are just not very greasy.
By the time it's possible to judge the changes, for example if some parts are heated, the colour could be changed.

5.8 Rules for a good oil management

- Buy lubricant in smaller containers and only in relation to the immediate needs.
- Make sure the type and viscosity of lubricant is suitable for the application.
- Do not transfer the oil from one container to another, if it comes into contact with air, the oil absorbs moisture. The air is the main contaminant.
- Normally supplied in sealed containers, should never be exposed to air for longer than is absolutely necessary to pour from the container into the crankcase of the compressor.
- It would have no smell. However, it is good practice to compare it with the smell of the new oil.
- If it has a pungent odour, almost unbearable, is not good. The colour is not a requirement to be judged in an absolute way, however it is good practice to compare it with the colour of the new oil. If it's blue, green, brown or black, is to change, after doing an oil change it is necessary to check carefully what will be the development of quality of new oil (control, viscosity, acidity, moisture content and extraneous).The tests to trust are those made in chemical laboratories qualified.
- Monitor the oil level in the early days of operation to make sure that the oil returns regularly and, if necessary, add oil to restore the proper level.

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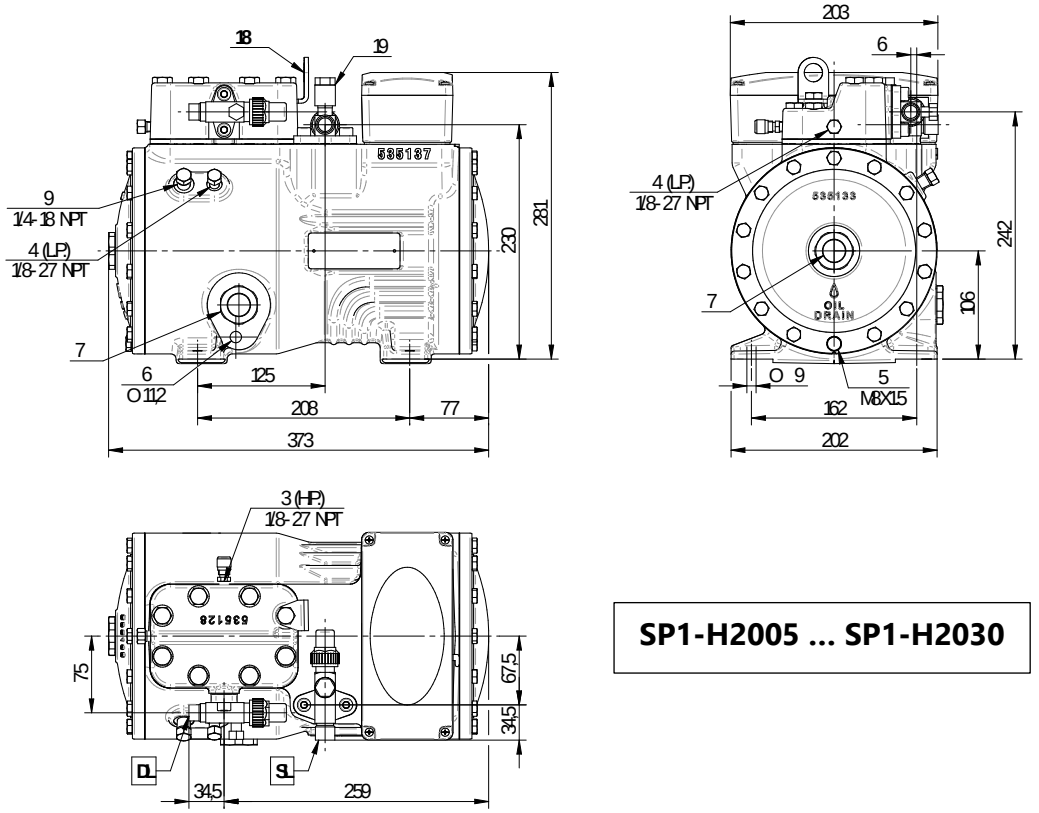
6 Technical data and dimensions

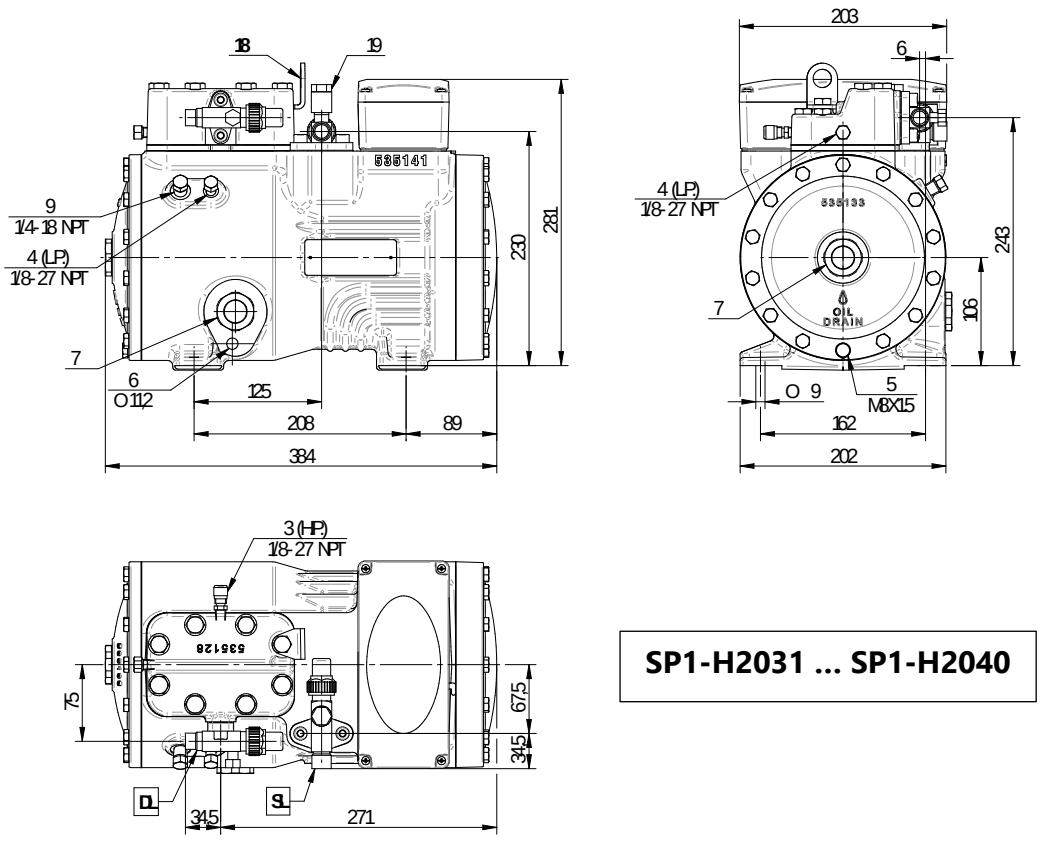
6.1 Technical data

model	Displacement	Nr. Cylinder.	suction valve	discharge valve	motor conn.	max working current F.L.A.	max power consump.	Starting current L.R.A.	Weight	Oil charge
	50Hz		inch	inch	volt	A	kW	A	Kg	Lt.
SP1-H2005-S	1,5	2	5/8	1/2	Δ / Y Δ: 220-240V - 3 - 50Hz, 265-290V - 3 - 60HZ Y: 380-420V - 3 - 50Hz, 440-480V - 3 - 60HZ	4,2 / 2,4	1,1	16,4 / 9,4	47	1,0
SP1-H2007-S	1,8	2	5/8	1/2		4,8 / 2,8	1,2	16,4 / 9,4	47	1,0
SP1-H2008-S	2,3	2	5/8	1/2		6,0 / 3,4	1,5	26,4 / 15,2	48	1,0
SP1-H2010-S	2,8	2	5/8	1/2		6,8 / 3,9	1,9	26,4 / 15,2	48	1,0
SP1-H2020-S	3,6	2	5/8	1/2		8,5 / 4,9	2,5	43,5 / 25,0	50	1,0
SP1-H2030-S	4,5	2	5/8	1/2		9,9 / 5,7	3,1	43,5 / 25,0	50	1,0
SP1-H2031-S	5,5	2	5/8	1/2		13,3 / 7,6	4,0	66,6 / 38,2	52	1,0
SP1-H2040-S	6,7	2	5/8	1/2		16,1 / 9,3	4,8	66,6 / 38,2	52	1,0
SP1-H2041-S	7,8	2	7/8	5/8		17,5 / 10,1	5,5	79,2 / 45,8	78	1,2
SP1-H2050-S	9,2	2	7/8	5/8		20,1 / 11,5	6,4	96,1 / 55,5	80	1,2
SP1-H2060-S	11,2	2	7/8	5/8		24,7 / 14,2	7,8	123,7 / 71,5	84	1,2
SP1-H4070-S	13,0	4	1 1/8	5/8		29,6 / 17,0	8,8	161,7 / 93,5	97	1,8
SP1-H4090-S	15,6	4	1 1/8	5/8		33,7 / 19,4	10,7	203,8 / 117,8	98	1,8
SP1-H4100-S	18,4	4	1 1/8	7/8		39,3 / 22,6	12,7	235,2 / 136	103	1,8
SP1-H4120-S	22,3	4	1 1/8	7/8		47,6 / 27,4	15,5	235,2 / 136	103	1,8
SP1-H4150-S	28,7	4	1 1/8	7/8	PW (Y/YY) 380-420V - 3 - 50Hz 440-480V - 3 - 60Hz	33,3	19,5	121 / 198	158	2,4
SP1-H4200-S	34,7	4	1 3/8	1 1/8		40,4	23,7	162 / 265	162	2,4
SP1-H4250-S	41,3	4	1 3/8	1 1/8		49,4	28,4	185 / 303	172	2,4
SP1-H4300-S	48,5	4	1 3/8	1 1/8		57,4	33,6	215 / 352	175	2,4

6.2 Overall dimension drawings



SP1-H2005 ... SP1-H2030



SP1-H2031 ... SP1-H2040

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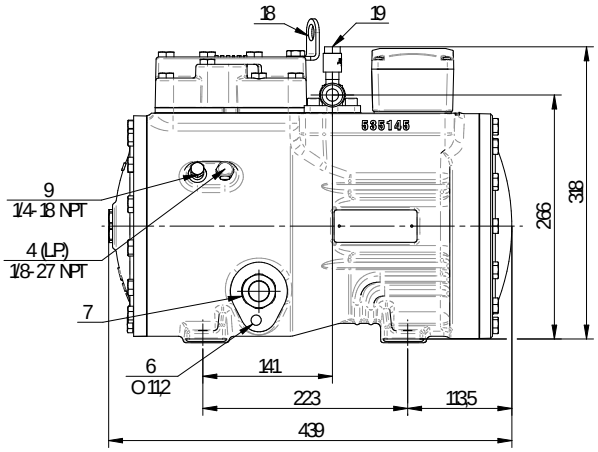
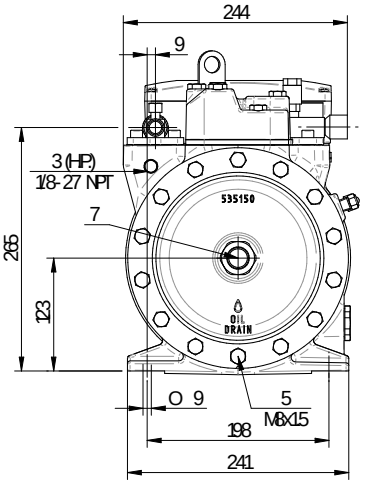
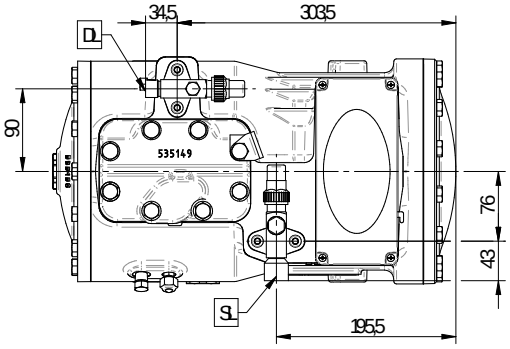
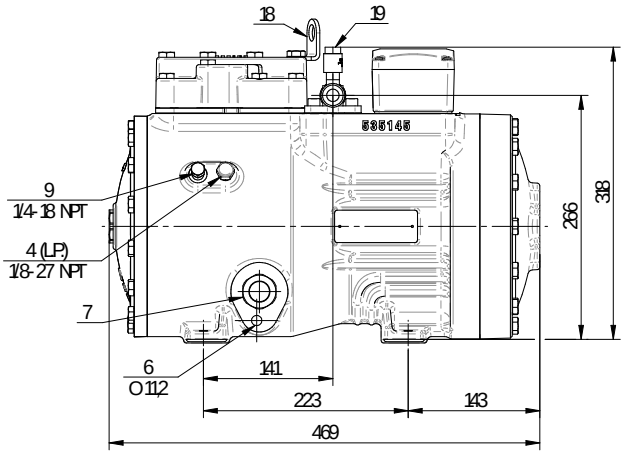
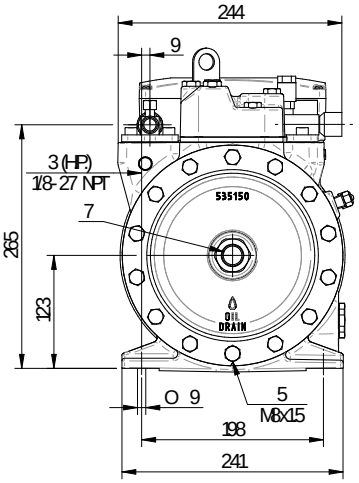


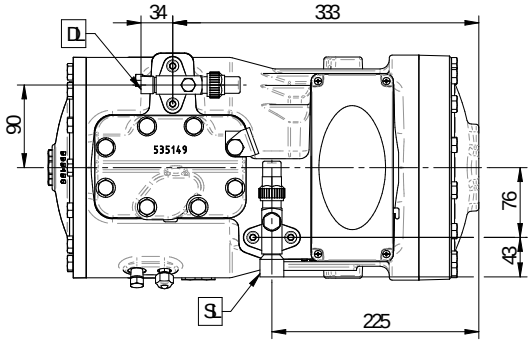




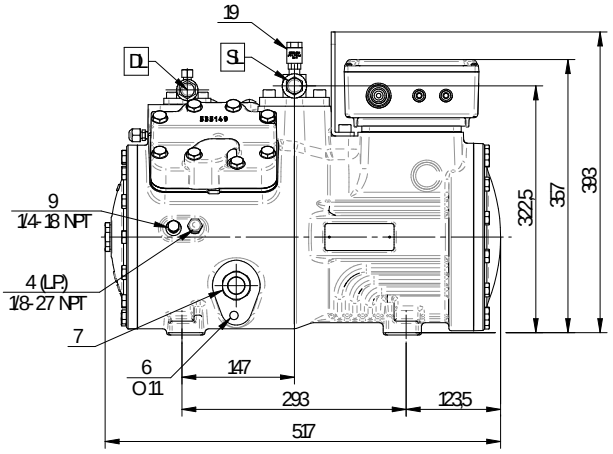
SP1-H2041 ... SP1-H2050

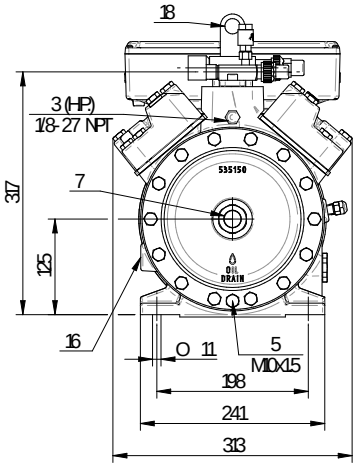


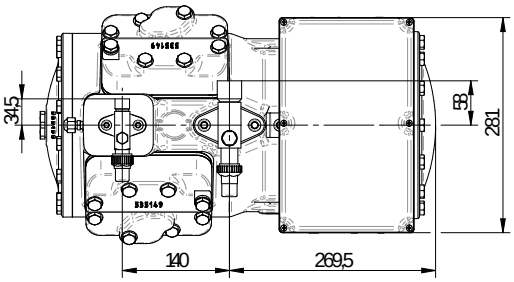




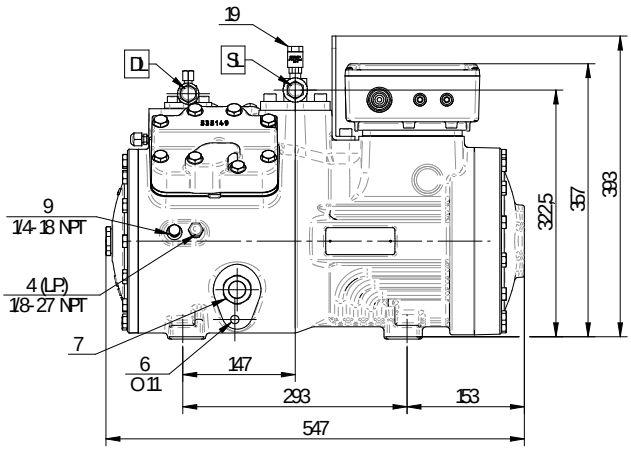
SP1-H2060

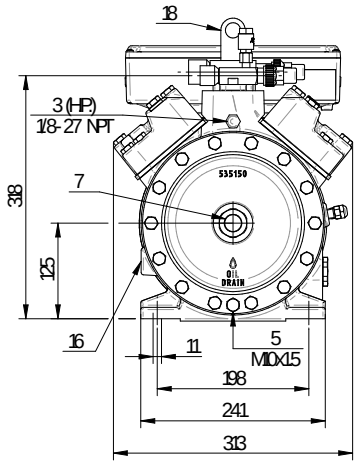


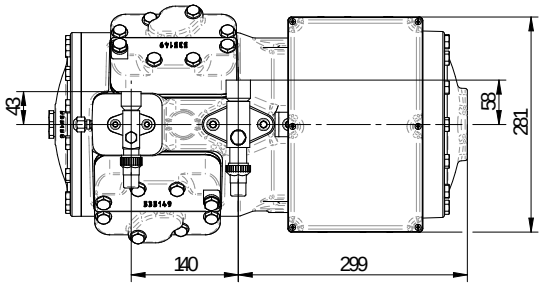




SP1-H4070 ... SP1-H4090







SP1-H4100 ... SP1-H4120

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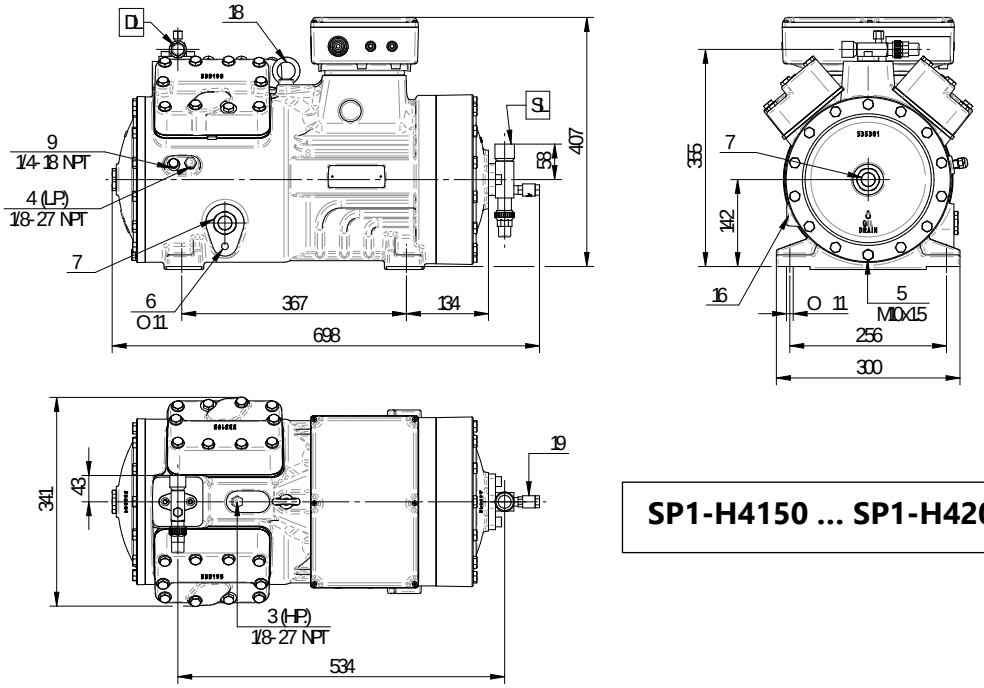
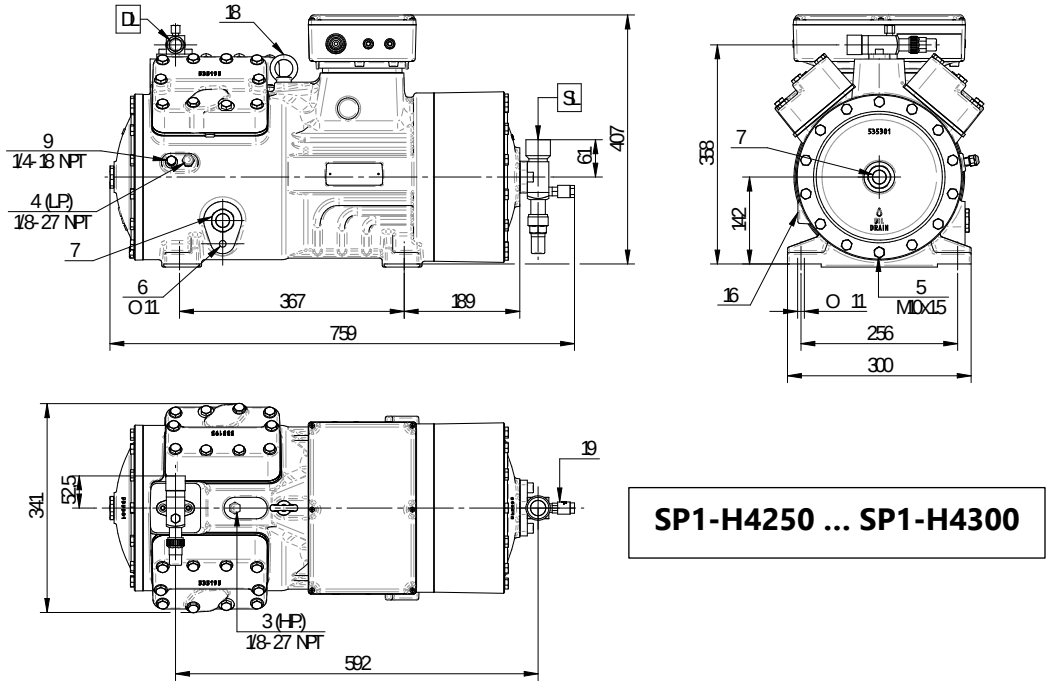


SP1-H4150 ... SP1-H4200



SP1-H4250 ... SP1-H4300

7 Extent of delivery

7.1 Standard delivery

- SP1-H2005-S ÷ SP1-H4120-S star-connection motor (400V / 3 / 50Hz) or delta-connection motor (230V / 3 / 50Hz);
- SP1-H4150 ÷ SP1-H4300-S part-winding start motor (400V / 3 / 50Hz-460V / 3 / 60Hz);
- Crankcase heater;
- Discharge stop valve;
- Suction stop valve;
- Rubber vibration damper;
- Direct-on-line (DOL);
- Pressure relief valve;
- Oil sight glass;
- Oil charge: special POE68 for CO2 application
- PTC thermistor resistor;
- INT69 B2 protection module
- IP54 electrical box;
- Nitrogen protection;

7.2 Optional accessories

- Motor with special voltage;
- Photoelectric oil level switch assembled (only applicable to splash lubrication compressors);
- Special voltage for electronic parts (electronic protection module, crankcase heater).
- Lubricant: in case of booster system where is installed SP1 and TP1 in the same circuit, the lubricant charged on TP1 must be charged also on SP1.

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