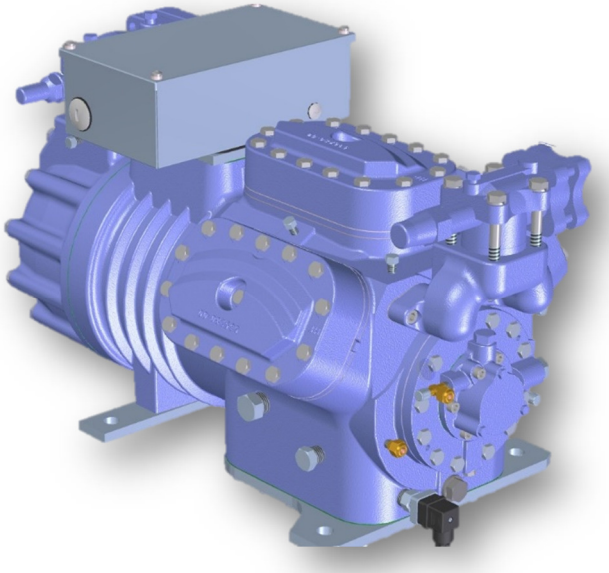
SRM TEC
COOL TECHNOLOGY

User and Maintenance Manual
RP1 Series



MUM004 rev. 00
EN (translation from IT)

Summary

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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 compressor.

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 compressor 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 compressor, 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 compressor.

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

The manual is considered an integral part of the system.

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 has 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.

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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.

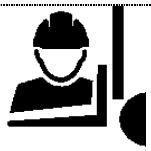
The warnings are accompanied by signal words that identify the severity of the danger.
ADVICE!: indicates a potentially hazardous situation which, if neglected, may cause minor or moderate injury.
WARNING!: indicates a potentially hazardous situation which, if left untreated, can cause death or serious 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.

1.4 Safety signals

On the compressor 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 compressor 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 compressor 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 compressor under rotation. In case of failure to follow safety instructions, there is a risk of serious injury.
	**DANGER – EXPLOSIVE AREA:** indicates hazardous situations due to possibility of flammable or explosive area. In case of failure to follow safety instructions, there is a risk of serious injury and death. **The area has to be protected from effective source of ignition.**

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. When performing maintenance work indoors, switch on the room ventilation.
5. Close the valves of the compressor.
6. Use a 2 stage vacuum pump with gas ballast (1.5mbar standing vacuum) for gas recovery.

1.6 Responsibilities of the operator

The operator of the machine where the compressors is installed 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 compressor and of the machine.
- The user commits to comply with the applicable safety standards and regulations as well as with the guidelines given by this technical information.
- Designers, installers and service personnel must have a certified qualification for dealing with flammable refrigerants.
- The user must provide the operating personnel with all the necessary information on the applicable safety regulations.
- 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 behavioural requirements necessary for the operation of the compressor at the place of use;
- establish clear responsibilities for installation, operation, maintenance and cleaning of the compressor;
- check regularly, for all duration of use of the compressor, 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 compressor:

- Use the compressor only if it is in perfect technical condition. Promptly repair faults that can compromise security.
- It is not permitted to make changes to the compressor 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 compressor against restarting (disconnect the controls).
- Do not by-pass the safety devices or put them out of order.
- All operations on the compressor and/or on electrical equipment must be carried out by specialized personnel.
- Repairs and maintenance operations must be carried out only when the compressor is off. Make sure that it is impossible an accidental restarting of the machine!
- When performing operations on the compressor, the compressor must not be under pressure. Close the compressor or system valves and recover the gas into the compressor and pipings. Observe the indication of the pressure gauge!
- 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

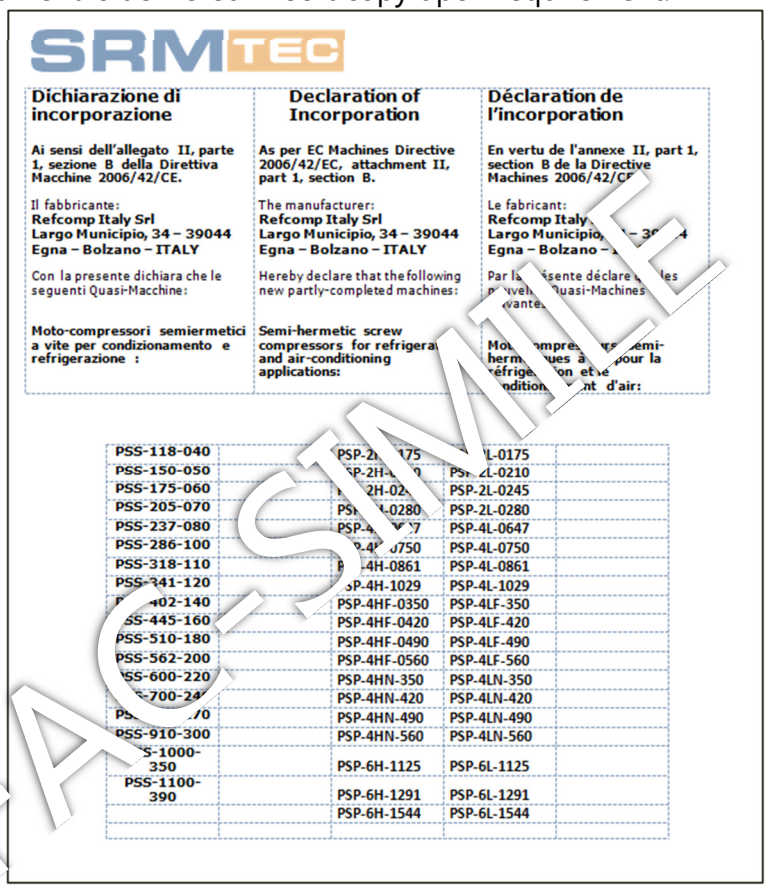
The content, texts, drawings, pictures and any other representation are protected by copyright and trade mark rights. Any violation is punishable.
It is forbidden the reproduction, even partial and by any means, and the use and/or disclosure of the content without prior written declaration by the manufacturer.

1.9 CE Declaration of Incorporation

The following is an example of the conformity declaration and the information contained in it.

As the compressor are dedicated to be installed in a refrigeration system, the CE assessment and certificate have to be produced by the designer and manufacturer of the system.

The original document is delivered in soft copy upon requirement.



SRMTEC

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: Refcomp Italy Srl Largo Municipio, 34 – 39044 Egna – Bolzano – ITALY	The manufacturer: Refcomp Italy Srl Largo Municipio, 34 – 39044 Egna – Bolzano – ITALY	Le fabricant: Refcomp Italy Largo Municipio, Egna – Bolzano –
Con la presente dichiara che le seguenti Quasi-Macchine:	Hereby declare that the following new partly-completed machines:	Par la ésente déclare les uasi-Machines vante:
Moto-compressori semiermetici a vite per condizionamento e refrigerazione :	Semi-hermetic screw compressors for refrigera and air-conditioning applications:	Mo ompre rs émi-herm ues à our la éfrige on et e ndition nt d'air:

PSS-118-040		PSP-2 175	L-0175	
PSS-150-050		SP-2H- 0	PS 2L-0210	
PSS-175-060		2H-02	PSP-2L-0245	
PSS-205-070		PS -0280	PSP-2L-0280	
PSS-237-080		PSP-4 7	PSP-4L-0647	
PSS-286-100		4 0750	PSP-4L-0750	
PSS-318-110		4H-0861	PSP-4L-0861	
PSS-341-120		SP-4H-1029	PSP-4L-1029	
402-140		PSP-4HF-0350	PSP-4LF-350	
SS-445-160		PSP-4HF-0420	PSP-4LF-420	
PSS-510-180		PSP-4HF-0490	PSP-4LF-490	
PSS-562-200		PSP-4HF-0560	PSP-4LF-560	
SS-600-220		PSP-4HN-350	PSP-4LN-350	
S-700-24		PSP-4HN-420	PSP-4LN-420	
PS 70		PSP-4HN-490	PSP-4LN-490	
PSS-910-300		PSP-4HN-560	PSP-4LN-560	
S-1000-350		PSP-6H-1125	PSP-6L-1125	
PSS-1100-390		PSP-6H-1291	PSP-6L-1291	
		PSP-6H-1544	PSP-6L-1544	

FAC-SIMILE

2 General

2.1 Identification

The SRMTec RP1 series piston compressors are reciprocating oil lubricated compressors specifically designed to operate with most common HFC (R404A, R507A, R134a, R407C), HFO (R1234ze, R1234yf, R1233ze) and mixtures (R448A, R449A, R513a) gas as refrigerants and to be installed in refrigeration system.

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

RP1-	H	2	08-	S	L	0

RP1-	= Semi-hermetic **R**efrigerant **P**iston compressor
H	= Motor size version H: Full size motor L: Small size motor
2	= No. of cylinders
09	= Nominal power [Hp]
F/S	= specification of lubrication type (where required) F: Forced lubrication (with oil gear pump) S: Splasher lubrication (without oil gear pump)
L	= Accessories voltage L = Electrical accessories 220V AC 50/60Hz; M = Electrical accessories 110V AC 50/60Hz; Y = Electrical accessories 24V AC 50/60Hz; U = Electrical accessories UL approved 220V AC 50/60Hz (only for S series); V = Electrical accessories UL approved 110V AC 50/60Hz (only for S series
0	= Partial load control (0/1/2) 0 = without steps capacity control; 1 = 1 steps capacity control (100-50% step) made with 1 solenoid valve (where available); 2 = 2 steps capacity control (100-66-33% step) made with 2 solenoid valve (where available);

Two different models are available for each size of compressor: the first one with "full size" motor, dedicated to high evaporating temperature applications (marked by letter "H" in model designation) and the second one with "small size" motor, dedicated to middle and low evaporating temperature applications (marked by letter "L" in model designation).
In such way the possibility to choose the proper compressor for the required working conditions and/or application envelope (air conditioning or refrigeration) is granted to the user.

2.2 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 are shown the labels applied to compressors with electric motors PW e Y/Δ.

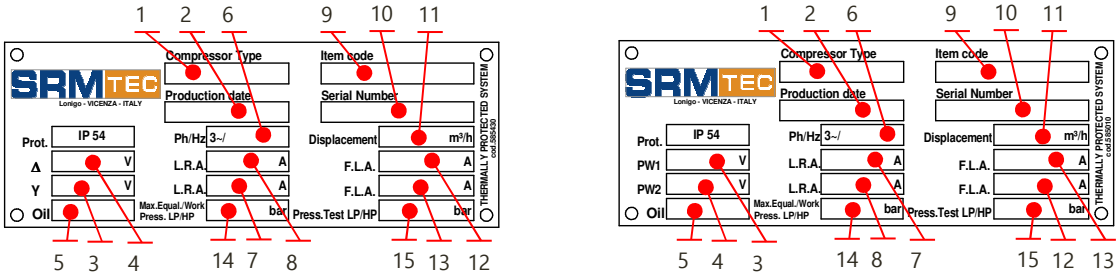


Fig. 1Name plate for compressors with Y/Δ and PW electric motor

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: • First winding in PW • Y connection in Y/Δ
4.	Running voltage	Supply voltage of the starting configuration: • Full winding in PW • Δ connection in Y/Δ
5.	Oil charge	M: mineral oil, E: ester oil
6.	Frequency	Nominal frequency of electric motor Hz
7.	Starting current	Starting current with starting connection: • First winding in PW • Y connection in Y/Δ
8.	DOL current	Locked rotor starting current or Direct On Line starting current
9.	Item code	Code of the compressor that identify the compressor configuration
10.	Serial number of compressor	Code to be used for any communication to SRMTec concerning the specific compressor
11.	Displacement	Refrigerant moved by compressor at full load
12.	Full load ampere (F.L.A.)	Maximum current drawn by the compressor
13.	Full load ampere (F.L.A.) 2	Maximum current drawn by the compressor if connected in starting
14.	Maximum working pressure	Maximum working pressure on Low pressure side (LP) / High pressure side (HP)
15.	Test Pressure	Maximum test pressure in test bench, low pressure side (LP) and High pressure side (LP)

2.3 Intended Use

The **RP1 semi-hermetic piston compressors** have been designed and manufactured exclusively for the installation into a complete system and for the compression of clean refrigerants.
The RP1 series compressors have been developed to be used with most common synthetic refrigerants and are recommended to use with the high viscosity POE oil to compensate for the high solubility of refrigerants in lubricants.
The use of A2L flammability class refrigerants with semi-hermetic compressors in so-called "closed plants" is subjected to the safety regulations on flammable substances according to ATEX 2014/34/EU regulation.

THE ELECTRICAL SYSTEM IS DESIGNED FOR USE IN EXPLOSIVE AND FLAMMABLE AMBIENT WITH CATEGORY II AND ZONE IDENTIFICATION 2 (RARE AND SHORT TERM DANGER), BUT WITH PROPER INSTRUCTIONS TO BE FOLLOWED.
VENTING SYSTEM ACCORDING TO EN 50014 MUST BE PROVIDED TO PREVENT FORMATION OF EXPLOSIVE MIXTURE IN CASE OF A LEAK (MUST BE SWITCHED ON IN CASE OF INDOOR MAINTENANCE WORK)

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.

NEVER APPLY THE COMPRESSOR IN ZONE 1 OR 0 AREAS OR APPLICATIONS OR AMBIENT CATEGORY "I".

2.4 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 1012-1	"Compressors and vacuum pumps. Safety requirements. compressors".
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

2.5 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 in Tab. 3**.**

Residual risk n° 1	**DANGER OF BEING EXPOSED TO FLAMMABLE AND EXPLOSIVE GASSES (only for A2L class refrigerants)**
Frequency of exposure	Low and accidental. There may be exposure if the required ventilation system is not working properly.
Extent of the damage	Serious lesions (non reversible) and even death.
Solutions adopted	Respect of the correct procedure for maintenance operation. Safety signal.

Tab. 3 Residual risk n° 1

Residual risk n° 2	**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. 4 Residual risk n° 2

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2.6 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 2.5)

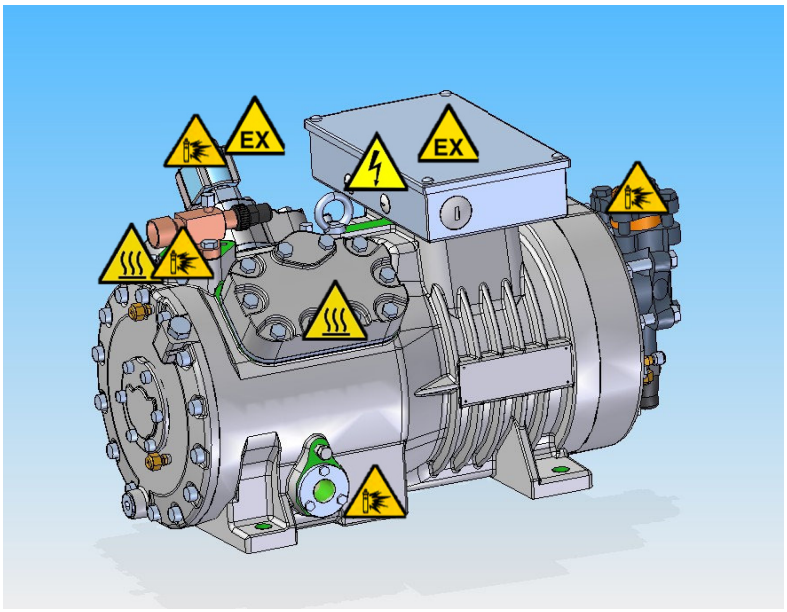

Fig. 2 Dangerous area identification

2.7 Introduction

RP1 series has 34 models of semi-hermetic reciprocating compressors with 2, 4, 6 or 8 cylinders (see Table 1 and Table 2), driven by a 4-poles three-phase electrical motor (1450 rpm at 50Hz) directly coupled to driving shaft designed to operate with common (R22, R407C, R404A, R507, R134a, R449a R448a) gas as refrigerants and to be installed in refrigeration system.

Compressors sizes are totally 17, with displacement from 17,5 to 222 m^3/h at 50 Hz.

Mod. RP1-		H205	H206	H208	H209	H410-S/F	H412-S/F	H415-S/F	H420-S/F	H422	H425	H430	H435	H637	H640	H650	8H60	8H70
No. of cylinder		2				4				4				6			8	
Nominal motor power	HP	5	6	8	9	10	12	15	20	22	25	30	35	37	40	50	60	70
Displacement at 50Hz 60 Hz	m^3/h	17,5 21	21 25,7	24,5 29,4	28 33,6	35 42	42 50,4	49 58,8	56 67,2	64,7 77,6	75 90	86,1 103,3	102,9 123,5	112,5 135	129,1 154,9	154,4 186,3	186 224	222 268
Lubrication		Splasher				Forced or Splasher				Pump				Pump			Pump	
Capacity control (option)		-				50-100%				50-100%				66-100% 33-66-100%			50-75-100%	

Table 1

Mod. RP1-		L203	L204	L205	L206	L406-S/F	L408-S/F	L410-S/F	L412-S/F	L415	L418	L422	L425	L627	L630	L640	L850	L860
No. of cylinder		2				4				4				6			8	
Nominal motor power	HP	3	4	5	6	6	8	10	12	15	18	22	25	27	30	40	50	60
Displacement at 50Hz 60 Hz	m^3/h	17,5 21	21 25,7	24,5 29,4	28 33,6	35 42	42 50,4	49 58,8	56 67,2	64,7 77,6	75 90	86,1 103,3	102,9 123,5	112,5 135	129,1 154,9	154,4 186,3	186 224	222 268
Lubrication		Splasher				Forced or Splacer				Pump				Pump			Pump	
Capacity control (option)		-				50-100%				50-100%				66-100% 33-66-100%			50-75-100%	

Table 2

The 4-cylinder models with displacement from 35 to 56 m^3/h, both "full size" (H) or "small size" (L) version, are available in other two different configurations: with forced lubrication (marked by letter "F" in model designation) or with splasher lubrication (marked by letter "N" in model designation). See Chapter 3 for deeper information concerning the lubrication and refer to following pictures for indication of the main components.

RP1 series compressors can be equipped (option) with a cooling capacity regulation device, as indicated in table above. See chapter 4 for deeper information concerning the capacity regulation.

2.7.1 *Compressors with splasher lubrication (2-4 cylinders)*

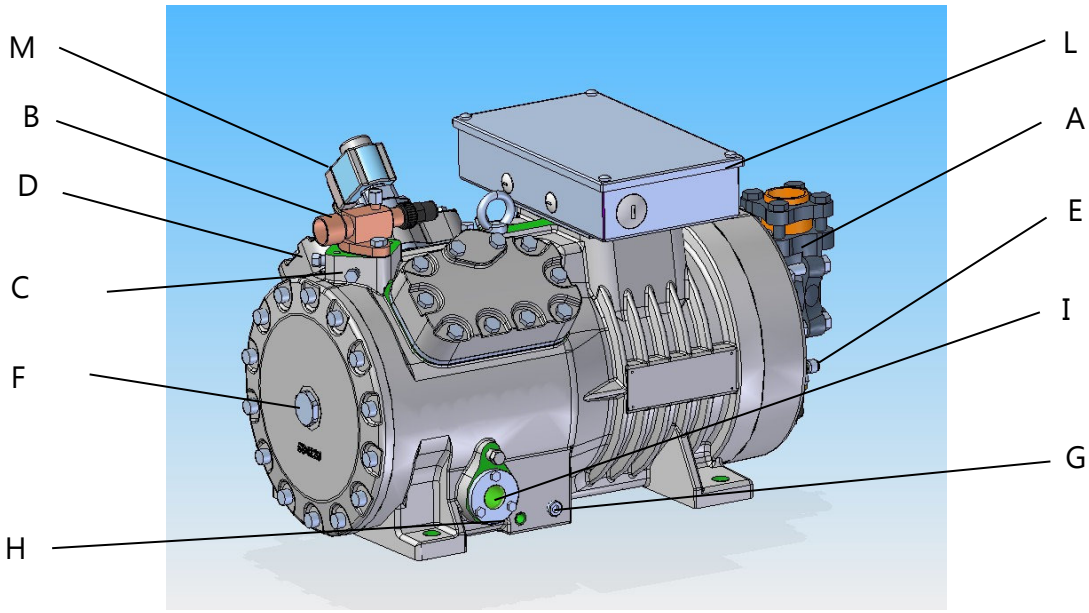

Fig. 3: Model RP1-L/H4xx-S (splasher lubrication)

A) Suction shut-off valve
B) Discharge shut-off valve
C) Discharge temperature connection
D) High-pressure connection
E) Low pressure connection
F) Optical oil sensor cap
G) Oil discharge
H) Crankase heater
I) Oil level sight glass
L) Electrical box
M) Coil for capacity regulation

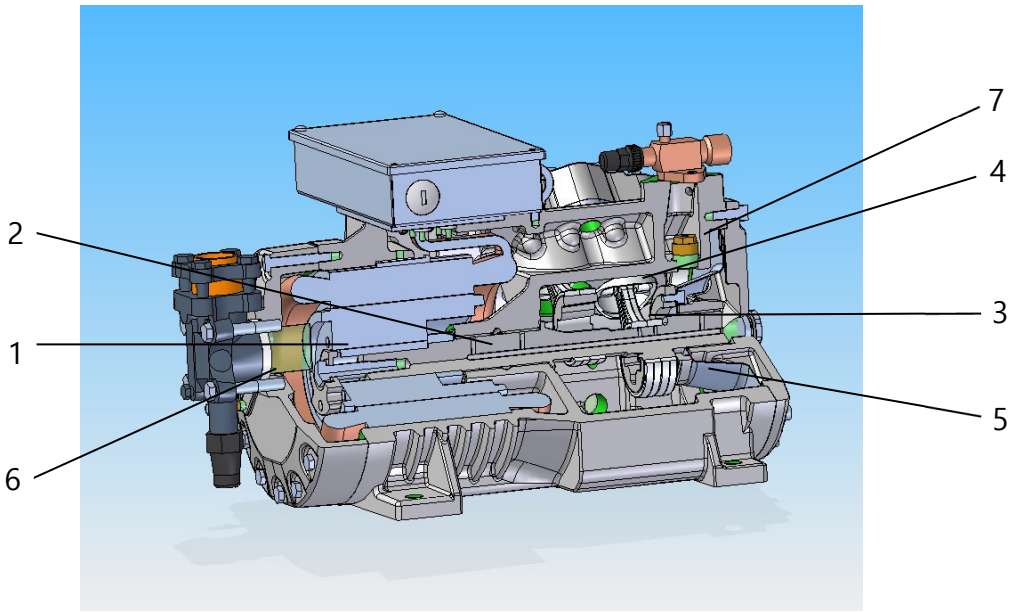

Fig. 4: *Cross section of* RP1-L/H4xx-S *(splasher lubrication)*

1) Electrical motor
2) Shaft
3) Connecting rod
4) Piston
5) Oil centrifugal disk
6) Suction filter
7) Safety valve

2.7.2 Compressors with forced lubrication (4 cylinders)

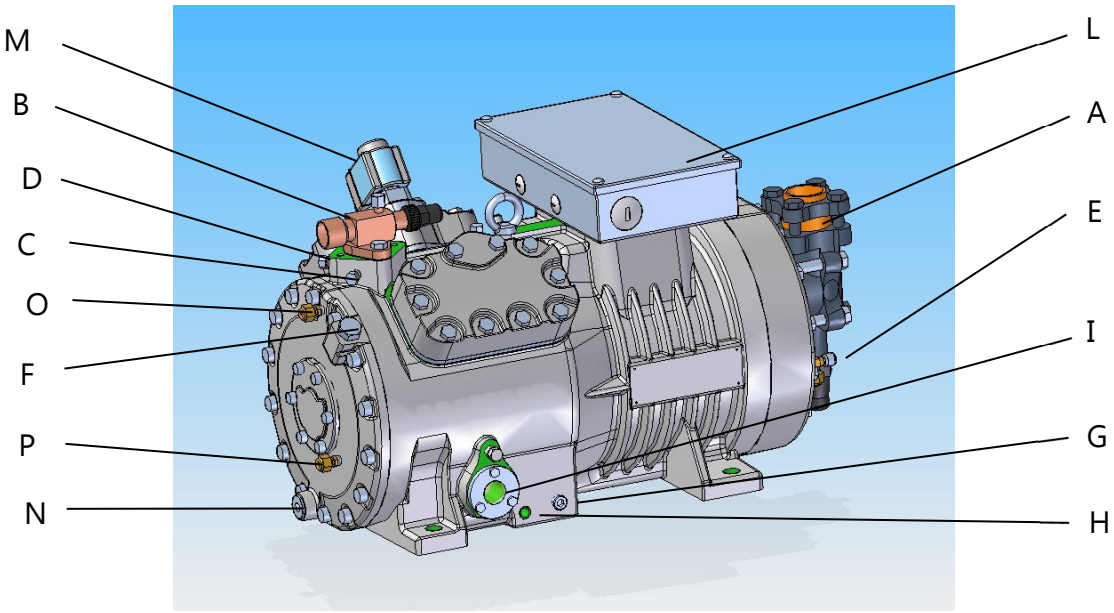

Fig. 5 Model RP1-L/H4xx-F (forced lubrication)

A) Suction shut-off valve
B) Discharge shut-off valve
C) Discharge temperature connection
D) High-pressure connection
E) Low pressure connection
F) Electronic pressure connection
G) Oil discharge
H) Crankase heater
I) Oil level sight glass
L) Electrical box
M) Coil for capacity regulation
N) Oil filter cap
O) Oil low pressure connection
P) Oil high pressure connection

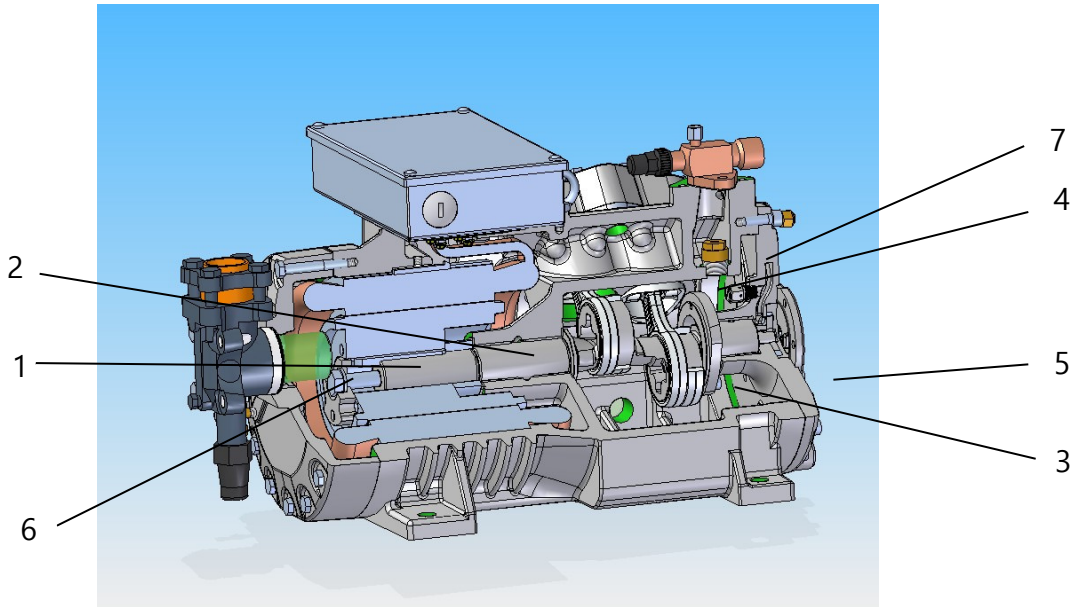

Fig. 6: Cross section of RP1-L/H4xx-F (forced lubrication with oil pump)

1) Electrical motor
2) Shaft
3) Connecting rod
4) Piston
5) Oil pump
6) Suction filter
7) Safety valve

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2.7.3 Compressors with pump lubrication (4-6-8 cylinders)

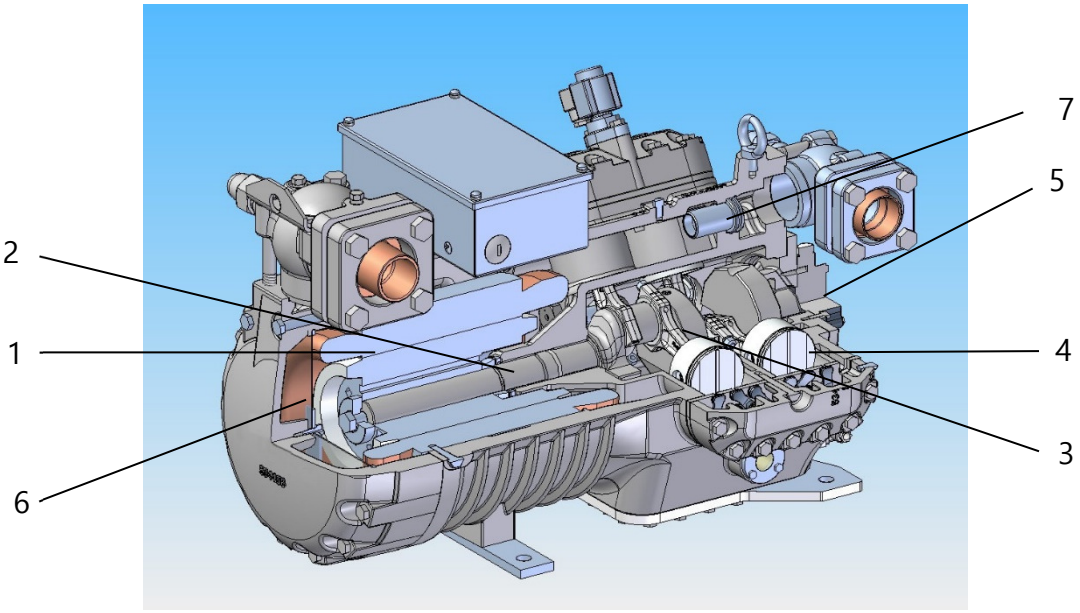


Fig. 7: Cross section of RP1-L/H8xx (forced lubrication with oil pump)

1) Electrical motor
2) Shaft
3) Connecting rod
4) Piston
5) Oil pump
6) Suction filter
7) Safety valve

3 Lubrication

3.1 Lubrication systems

The oil has the following functions:

- ✓ couplings lubrication;
- ✓ cooling;
- ✓ vibrations damping;
- ✓ cleaning;
- ✓ sealing between the compression chambers.

The RP1 compressors are fitted with different lubrication systems as indicated in Table 1 and Table 2:

- Splasher: the lubricant is moved through a disk and circulation of oil through centrifugal effect.
- Forced: an oil pump is integrated into the compressor.
- Pump: an interchangeable oil pump is mounted on the compressor.

3.2 Splasher lubrication

The oil circulation from the oil sump to the different points that have to be lubricated is due only to the centrifugal effect in the oil distribution channels inside the shaft.
The relative low pressure generated in such way is extremely stable and reliable: the geometry of the bushings and of their holes allow, in any case, the formation of an oil film and the consequent hydrodynamic support effect of the relative moving surfaces.
A cross section of a compressor model with splasher lubrication is shown in the Fig. 8.

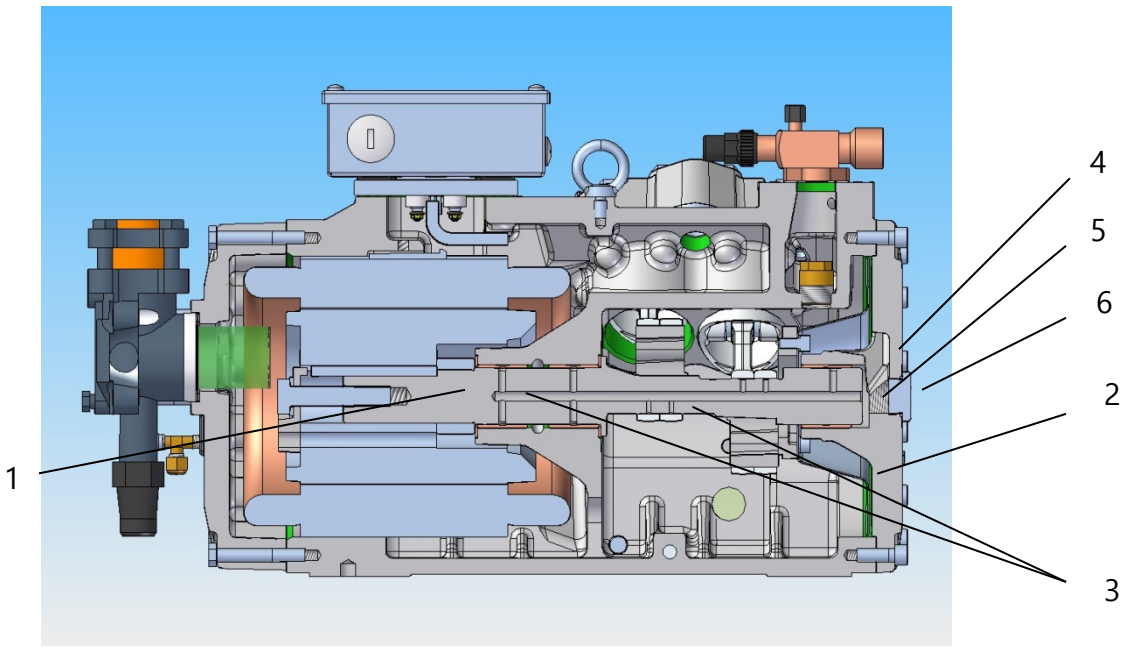


Fig. 8 Compressor model RP1-L/H4xx-S with splasher lubrication

1) Shaft
2) Centrifugal disk
3) Oil distribution channels
4) Oil sump
5) Oil inlet to the main channel
6) Oil sensor connection

The oil is moved from the carter to the oil sump, machined inside the cover casing, by a centrifugal disk, properly shaped. Different channels are realized inside the crankshaft to obtain the right lubrication: the central one (coaxial with the shaft) is directly connected to the oil sump, while the other ones (perpendicular to the shaft) grant the lubrication of the sleeve bearings between casing and shaft in suction and discharge side and of the coupling surfaces between crankshaft and connecting rod.

The splasher lubrication is characterized by:

- ✓ greater simplicity and construction reliability thanks to fewer moving parts;
- ✓ greater stability and security of lubrication, even in the early stages of starting the compressor;
- ✓ oil drag reduction, thanks to the oil flow rate towards the lubrication points closely related to the actual demand
- ✓ reduce foaming problems, thanks to an effective removal of oil dissolved in oil

The working principle is the same also for 2-cylinder models

3.3 Forced ond Pump lubrication

The oil circulation is realized through an oil gear, driven directly by the motor shaft. The oil is sucked by the oil gear from the carter, flowing through the filter. Using proper channels machined inside the shaft, the oil at high pressure exiting from the oil gear, is sent to the bushings of couplings between casing and shaft and to the coupling surfaces between shaft and connecting rod. The geometry of the bushings and their holes are specifically designed to optimize the formation of an oil film and the consequent hydrodynamic support effect of the relative moving surfaces.

3.3.1 Forced lubrication

The oil gear pump is machined directly into the cover casing.

This solution is compact and reliable and grants the proper oil circulation in any working conditions.

A cross section of a compressor model with forced lubrication is shown in the Fig. 9.

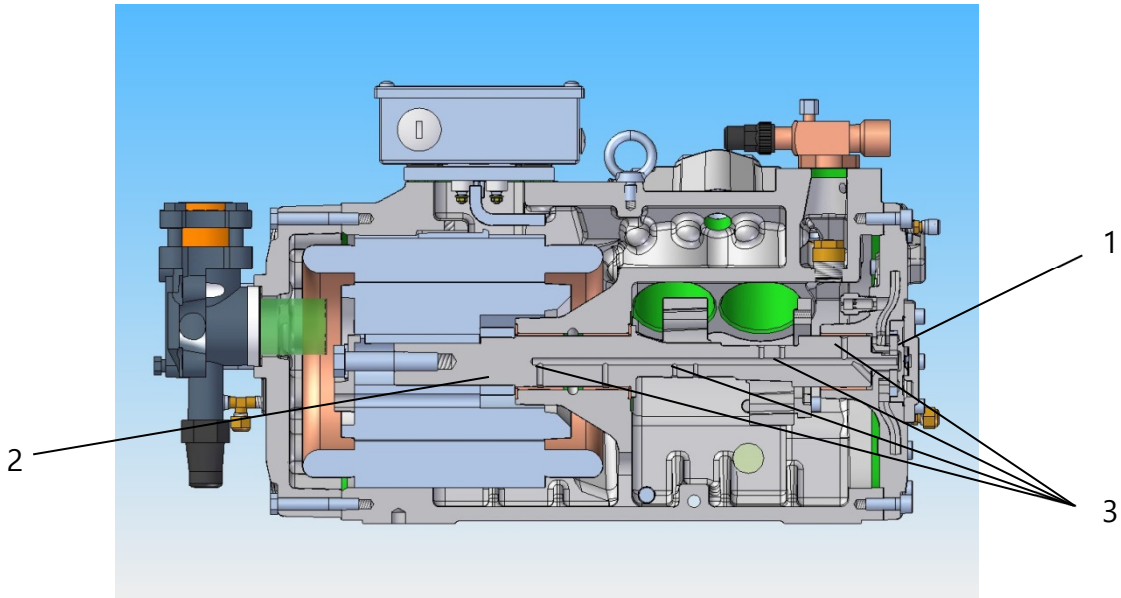


Fig. 9 *Compressor model* RP1-L/H4xx-F *with forced lubrication*

1) Oil pump
2) Shaft
3) Oil distribution channels

The gear pump is driven directly by the shaft of the motor: the slot, properly shaped, at one end of the shaft is coupled with the key of the gear pump shaft. The gear pump can work correctly with the both sense of shaft rotation, because of a special device which exchanges the inlet and outlet port according to the direction of rotation.

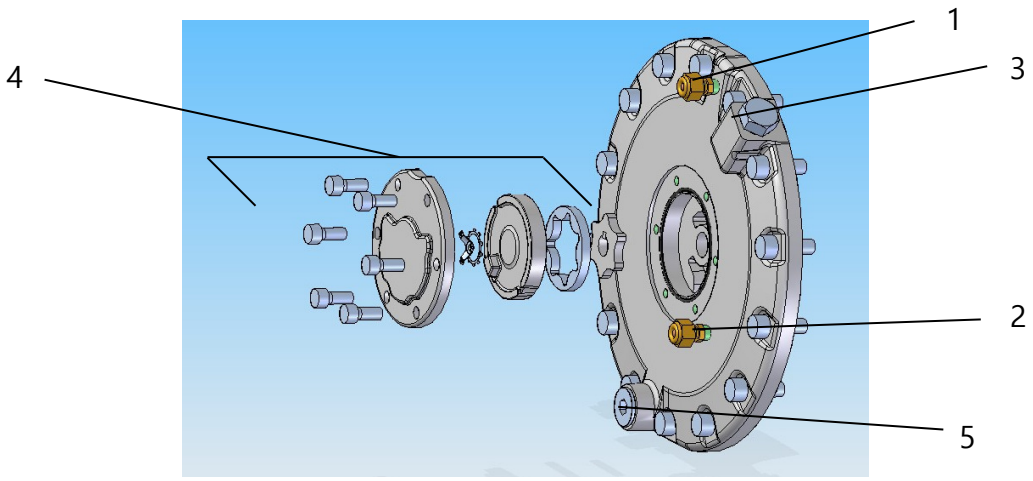


Fig. 10 Gear pump for compressors RP1-L/H4xx-F with forced lubrication

1. Oil high pressure connection (discharge pressure of pump) ¼" SAE-FLARE
2. Oil low pressure connection (pressure inside the carter) ¼" SAE-FLARE
3. Connection for electronic oil differential pressure switch
4. Gear pump with relative cap
5. Casing cap

The gear pump is assembled on the casing cap, which has also the function to fit in slot the bushing and the fifth wheel of the shaft.
The connections for electronic differential pressure device (option) are machined over the casing cap (ref. 3 in Fig. 10).
An optional mechanical differential pressure device (option) could be connected to the high and low pressure connections (ref. 1, 2 in Fig. 10), machined over the casing cap.
The gear pump has also a safety valve (ref. 2 in Fig. 11), which allows the oil by-pass to the carter when the delivery pressure exceeds the set value (open at 4,1 bar; rearmament 2,8 bar).

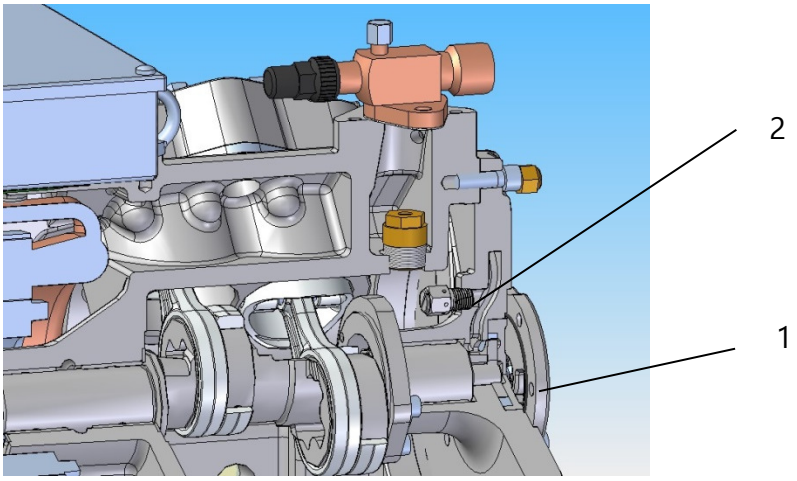


Fig. 11 Compressor model RP1-L/H4xx-F: gear pump and safety valve

1. Gear pump
2. Oil safety valve

3.3.2 Pump lubrication

The oil gear pump (ref. 1 in Fig. 12) is a separate part assembled onto the discharge sleeve bearing cover casing.
This solution is reliable and grants the possibility to replace and maintain the oil pump separately from the compressor body, granting a long life lasting of the compressor.
A cross section of a compressor model with pump lubrication is shown in the Fig. 12.

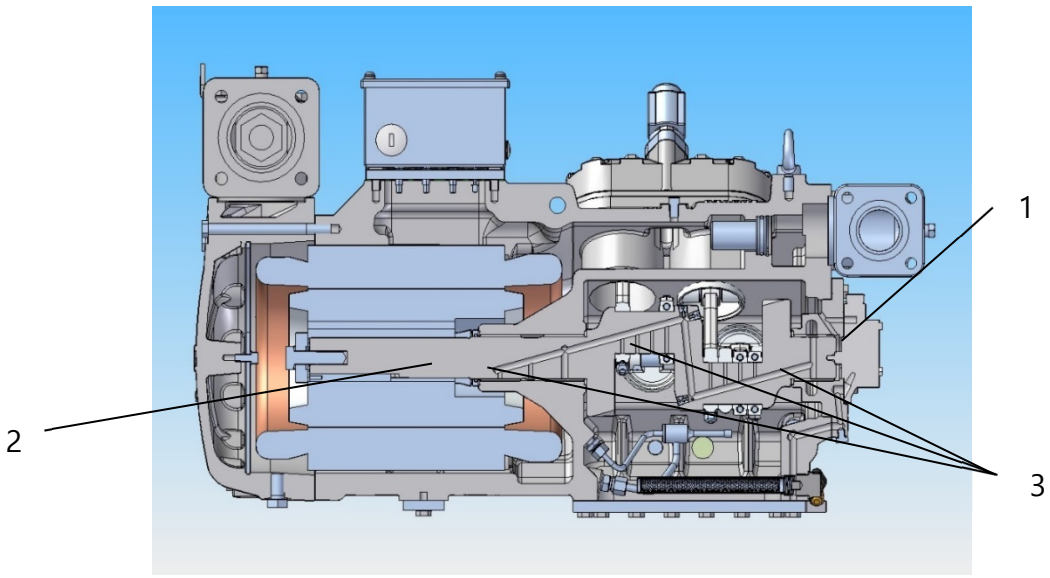


Fig. 12 *Compressor model* RP1-L/H4xx RP1-L/H6xx RP1-L/H8xx *with pump lubrication*

1. Oil pump
2. Shaft
3. Oil distribution channels

The gear pump is driven directly by the shaft of the motor: the slot, properly shaped, at one end of the shaft is coupled with the key of the gear pump shaft. The gear pump can work correctly with the both sense of shaft rotation, because of a special device which exchanges the inlet and outlet port according to the direction of rotation.

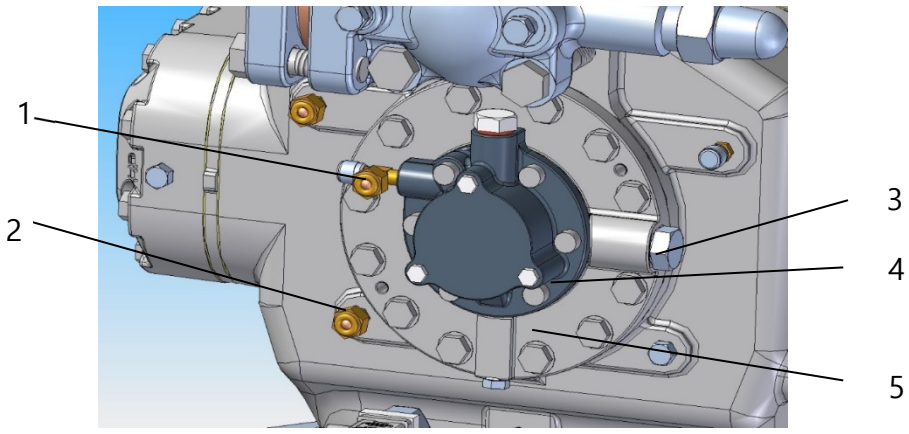


Fig. 13 *Gear pump for compressors* RP1-L/H4xx RP1-L/H6xx RP1-L/H8xx

1. Oil high pressure connection (delivery pressure) ¼" SAE-FLARE
2. Oil low pressure connection (carter pressure) ¼" SAE-FLARE
3. Electronic differential pressure device connection
4. Gear pump
5. Pump support

The gear pump has also a safety valve (ref. 23 in Fig. 14), which allows the oil by-pass to the carter when the delivery pressure exceeds the set value (open at 4,1 bar; rearmament 2,8 bar).

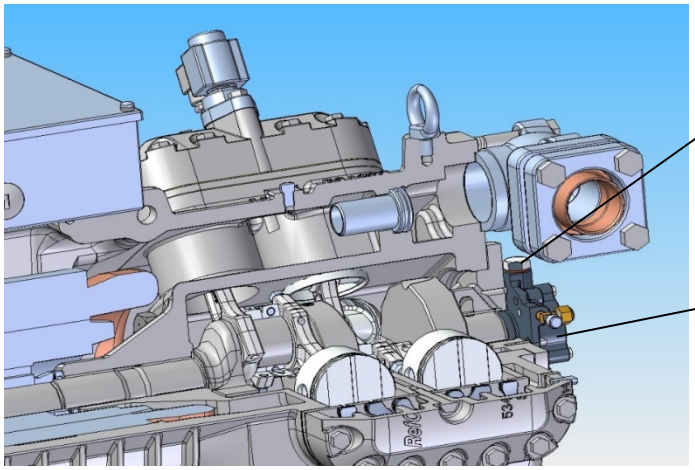


Fig. 14 Detail of gear pump and safety valve of RP1-L/H4xx RP1-L/H6xx RP1-L/H8xx

1. Gear pump
2. Safety valve

3.3.3 Oil pressure (only for compressors with forced or pump lubrication)

The suction pressure of the oil pump is always equal to the carter pressure, because they are directly connected; the delivery oil pressure is the sum of the carter pressure and the pressure generated by the gear pump.
The oil differential pressure, which is the useful pressure to the oil circulation, has to be calculated subtracting from the delivery pressure the carter pressure:

P_{oil} = Delivery pressure – Carter pressure.

The measurement of the differential pressure P_{oil} has to be done between (1) and (2) connections shown in Fig. 10 or Fig. 12.
The differential oil pressure value P_{oil} depends on the size of compressor, on the oil temperature and viscosity and also on the amount of refrigerant dissolved in it. A correct value for this pressure should be between 2,8 and 4,1 bar (lower values are normally due to high oil temperature)
The more critical time for lubrication is obviously the start-up of compressor (see Fig. 15), because of the oil has not reached the right working pressure and the lubrication of moving components depends on the combination of several factors:

- ✓ previous lubrication reached before the last stop;
- ✓ temperature and pressure of compressor during the stand still period;
- ✓ duration of the stop;

The differential oil pressure hardly reaches right working values with cold oil and or high refrigerant dilution in oil inside the carter. In such situations a control of the oil circulation through an oil differential pressure device is absolutely necessary (see paragraph 0).
The refrigerant dilution in the oil inside the carter could be dangerous during the start-up phase because the decrease of suction pressure, and consequently the oil pressure inside

the carter, causes the refrigerant evaporation and foaming. In order to reduce the amount of refrigerant dilution in the oil is necessary to use a crankcase heater (see paragraph 3.4) and eventually a start unloading system (see chapter 4.2)

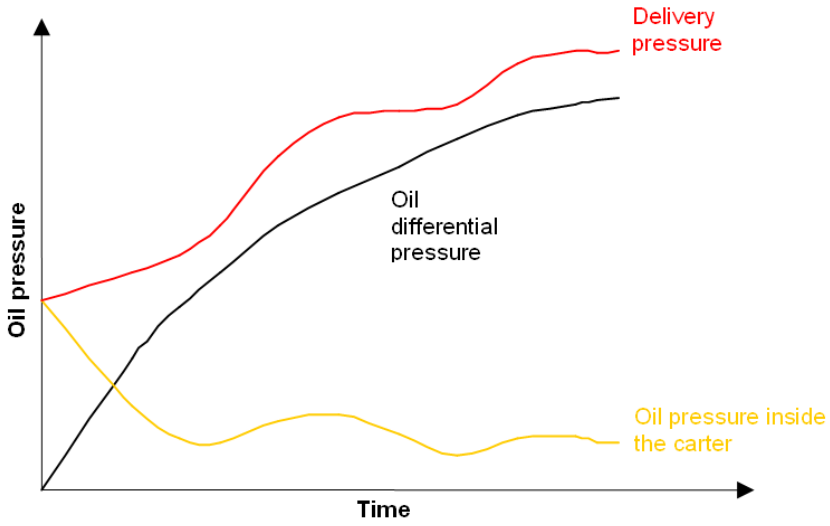


Fig. 15 *Oil pressure vs time during start-up phase*

Furthermore, 4-cylinder models RP1-L/H4 and all 6 and 8-cylinder models are provided with a check valve between suction line and carter, so that during the start-up of compressor, these valves close preventing the sudden equalization of the suction and carter pressures. In this way the trend of oil pressure inside the carter versus the time is similar to that shown in the Fig. 16.

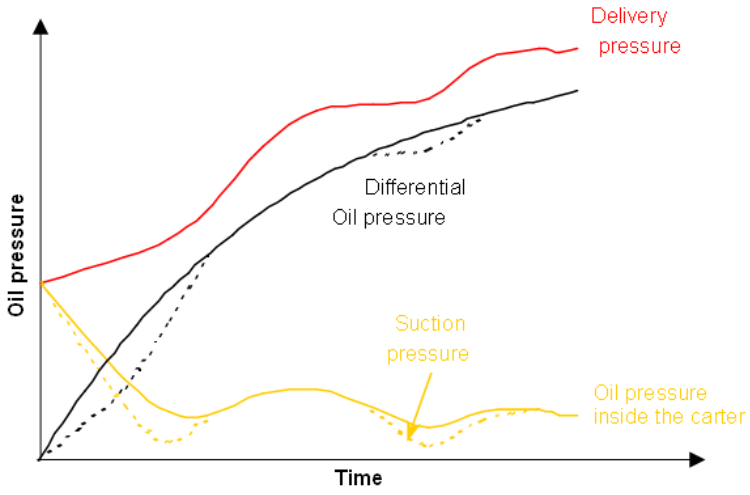


Fig. 16 Oil pressure vs time of compressor with check valve between suction line and carter

The suction pressure and the pressure inside the carter should be equal only during the standstill period of compressor and during its continuous running. This is particularly true for 4-cylinder RP1-L/H4 and all 6 and 8-cylinder models provided with check valves between suction line and carter. Therefore, the value of oil pressure inside the carter, and not the suction one, has to be considered to calculate the oil differential pressure.

3.3.4 *Oil filter (only for compressors with forced or pump lubrication)*

The standard extent of delivery of compressors with forced lubrication includes the oil filter, that is placed in the discharge side of compressor on the bottom of the oil carter so that it could be easily handled from outside. In the same picture it could be also seen the inner way for oil between suction line and carter, from which the gear pump can suck the oil, after passing through the filter.

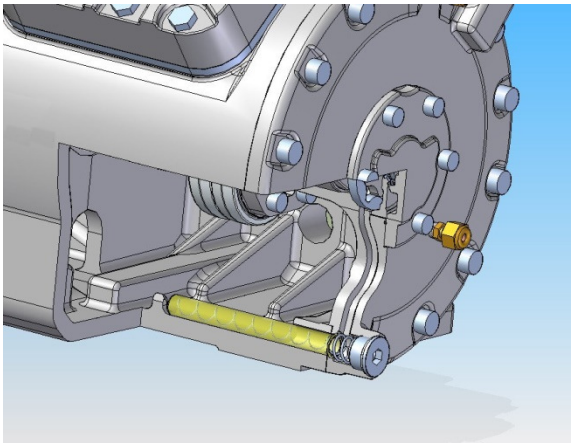


Fig. 17 *Oil filter in models RP1-L/H4xx-F*

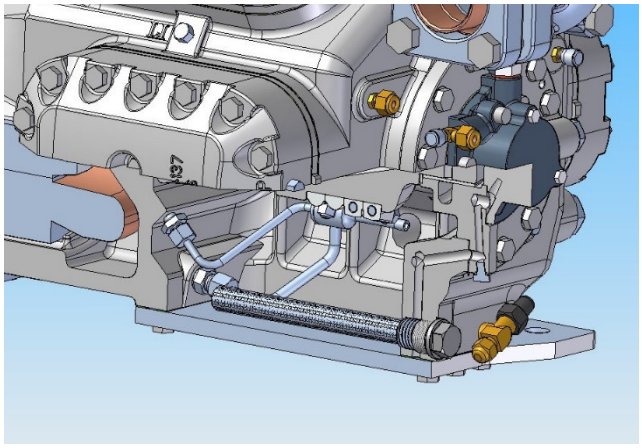


Fig. 18 *Oil filter in models RP1L/H4xx and 6 and 8-cylinder*

The filter for models *RP1-L/H4xx-F* (Fig. 19) is made with rolled sheet of stainless steel with an inner spring with the aim of reinforcing the filter itself and avoiding possible implosions of the wire mesh when it is occluded.

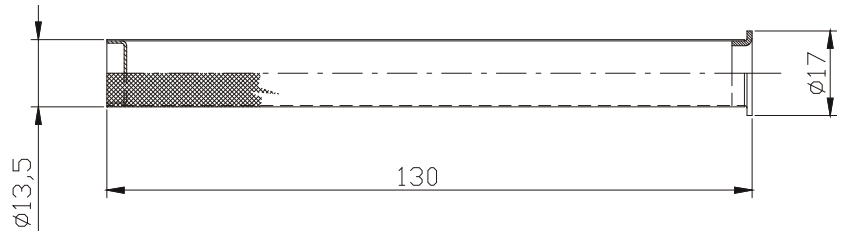


Fig. 19 *Oil filter in models RP1-L/H4xx-F*

The filter (cod. 518530) for models *RP1L/H4xx* and of all 6 and 8-cylinder models is made with a sheet of stainless steel of 100 µm. For these compressors the filter stiffening is realized by a coaxial drilled steel cylinder, through whose holes flows the oil.

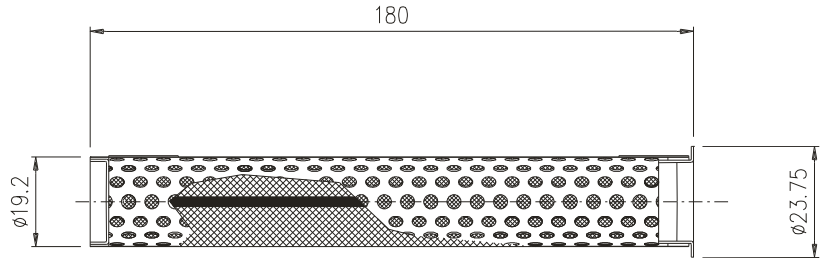


Fig. 20 Oil filter of 4-cylinder models *RP1L/H4xx* and 6 and 8-cylinder models

In the both cases the filter cap has a magnetic pin to retain any impurities that may pass through the mesh. If the oil was particularly dirty, with high concentration of dirt, the filter

will occlude, preventing the gear pump to maintain the necessary pressure for the proper working of compressor.

Warning!
The oil filter could become quickly clogged during the first start of the compressor if the refrigerant circuit has not been carefully cleaned

In case of filter replacement is necessary to discharge the compressor recovering the oil from the carter. When reassembling the new oil filter is strictly recommended to tighten the cap with proper torque. Contact SRMTec for further details.

3.4 Oil heater

Warning!
The application of the oil heater is permitted only in Zone 2 areas.
Danger of spark formation due to unintended switching operation or overheating of the crankcase oil heater during oil change.
Due to the high oil solubility by the refrigerants, an oil sump heater is strongly suggested.
Switch on the oil heater during standstill operations.

The crankcase heater (option) has the purpose to avoid an excessive dilution of the refrigerant in the oil during the stand still of compressor and has to work when the compressor is not operating.

- *Compressor model RP1-L/H2, RP1-L/H4xx-F and RP1-L/H4xx-S*

  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.

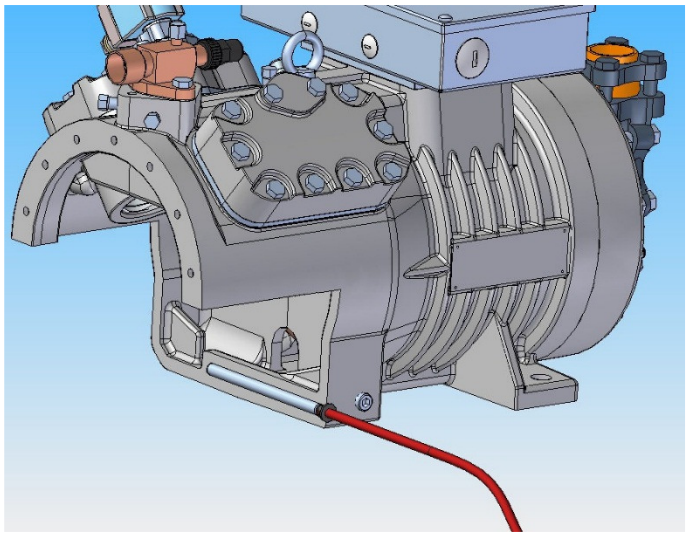


Fig. 21 Crankcase heater (PTC type) for compressors RP1-L/H4xx-F and RP1-L/H4xx-S

- *Compressor model RP1L/H4xx and all 6 and 8 cylinder models*

  The crankcase heaters of these compressors are of constant resistance type. The crankcase heater is assembled in a proper seat inserted in the oil carter, in the oil pump side of the compressor, closed with a metallic cap when shipped from factory (see Fig. 22).

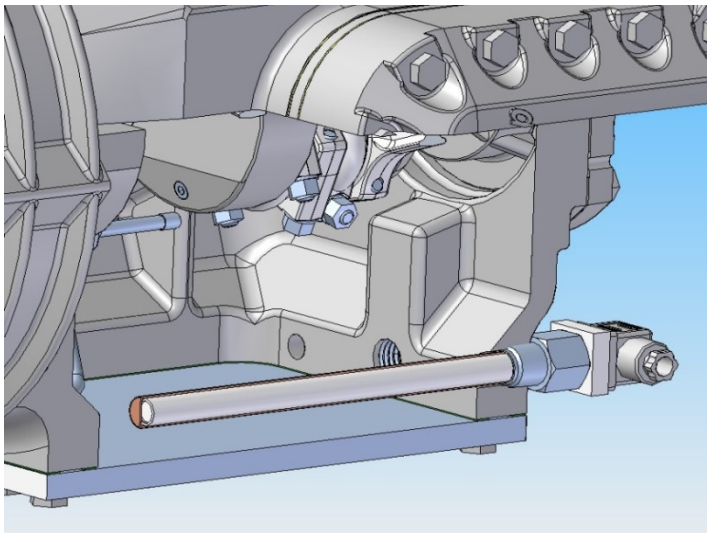


Fig. 22 Crankcase heater in compressor model *RP1L/H4xx* and in 6 and 8-cylinder models

All the crankcase heaters can be assembled and replaced without removing the oil charge from the compressors and recovering the oil of the carter. For deeper information concerning the crankcase heater position see chapter 3.4.
The main technical information of the different crankcase heaters is shown in Table 3.
The main dimensions are shown in Table 4.

Compressor model	Crankcase heater kit p/n	Nominal power (W)	Power supply (V-Hz)	Enclosure class	Seat	Size (Table 4)
RP1-H205÷09 RP1-L203÷06	303951	max. 120W[1]	230-50/60[2]	IP54	Hole	1
	303952	max. 120W[1]	110-50/60	IP54		
RP1-H410÷20-S/F RP1-H406÷12-S/F	303890	max. 220W[1]	230-50/60[2]	IP54	Hole	1
	303891	max. 220W[1]	110-50/60	IP54		
RP1-H425÷35 RP1-L415÷25 RP1-L/H6xx	303894	150	230-50/60[2]	IP65	Sleeve	2
	303895	150	110-50/60	IP65		
	303896	150	24-50/60	IP65		
RP1-L/H8xx	303778	200	230-50/60[2]	IP65	Sleeve	3
	303779	200	110-50/60	IP65		
	303780	200	24-50/60	IP65		

Table 3 *Electrical data of the different crankcase heaters*

[1] Crankcase heater of PTC type
[2] Standard voltage

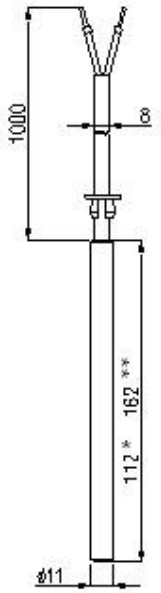
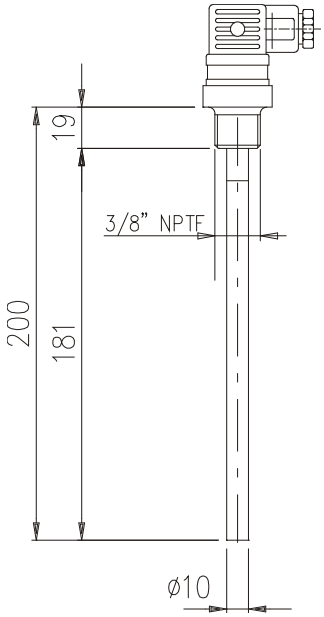
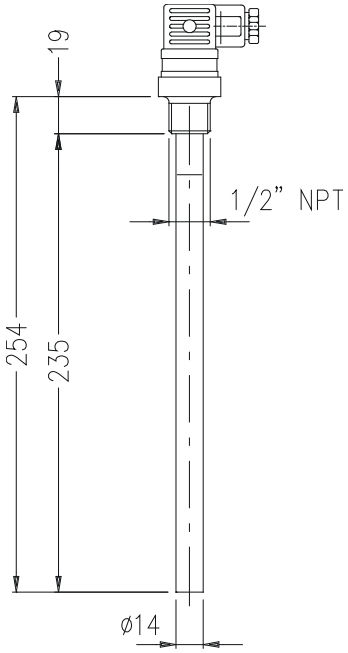
Size		
1	2	3
		

Table 4 *Dimensions of the different type of crankcase heater*

The oil heater must be used when the compressor is off, and in the following situations:

- ✓ when the compressor is installed outdoors;
- ✓ extended standstill periods;
- ✓ high refrigerant charge;
- ✓ risk of the refrigerant condensing inside the compressor. During standstill the compressor crankcase must have the highest temperature in the entire refrigerant circuit.

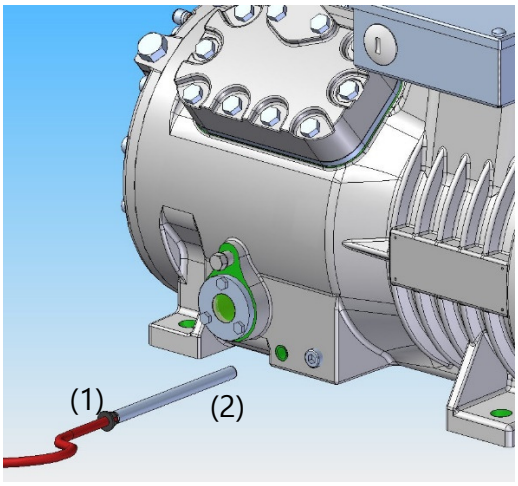
The crankcase heater should be not used in the following situations:

- ✓ systems with low refrigerant charge (less than 1,5-2 the amount of oil charge):
- ✓ Systems with short stand still periods, during which the oil cannot cool down (automatic rotation of compressors).

Warning!
Before starting up for the working season, the heater must be on for at least 24 hours before starting the compressor.

3.4.1 Oil heater assembly procedure

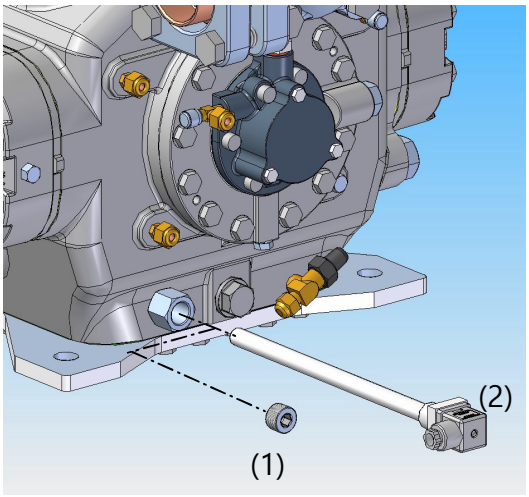
- Hole seat type



Assembling:
a) Insert the heater (2);
b) Insert the plastic sealing (1).

Disassembling / Replacement:
- Remove the plastic sealing plug (1);
- Extract the heater (2).

- Sleeve seat type



Assembling:
a) Remove the cap (1);
b) Screw the heater (2).

Disassembling / Replacement:
a) Remove the heater (2)

If it is necessary to disassemble the sleeve, follow the following instructions:
- ✓ Disconnect power supply;
- ✓ Close the suction and discharge shut-off valves;
- ✓ Discharge the refrigerant and recover the oil.

Warning!

Protect the connectors from moisture.
Connect the ground clamp to the proper terminal

3.5 Oil level

The oil, if requested, is always supplied in separate cans inside the packaging, to prevent contamination of the plant with any external part or air content. The standard oil charge is indicated in the table of technical data reported in chapter 7.2.

Warning!

The compressor is delivered with a nitrogen charge of about 1 bar to prevent contamination of external air.

It is responsibility if the customer to extract the nitrogen charge of the compressor, produce a deep vacuum and charge the oil amount required.

The oil level has to be controlled during the continuous running of compressor or few seconds before the stop: Fig. 23 shows the minimum (¼ of the glass) and maximum level (3/4 of the glass). In any case the oil has always to be seen through the glass.

Thanks to this glass it's possible to control if there's an excessive dilution of refrigerant in the oil because of the continuous foaming (this could happen in particular in the compressors with additional cooling through liquid injection; see chapter 12 "Additional cooling")

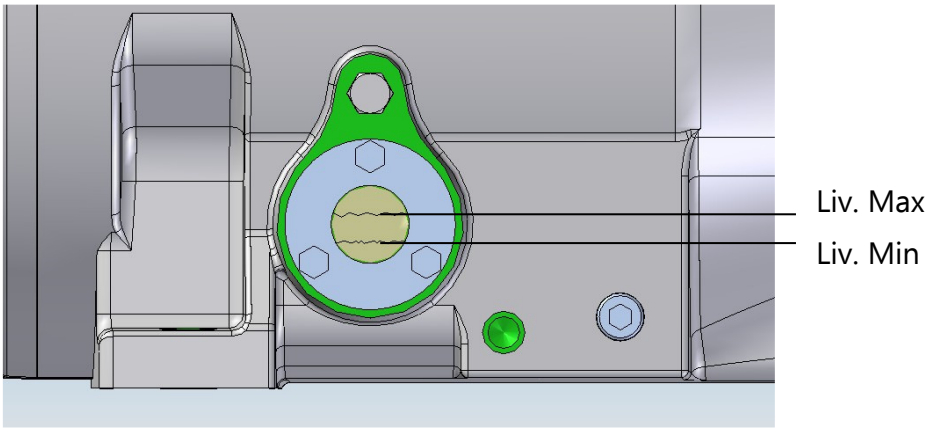


Fig. 23 *Oil monitoring through sight glass*

Warning!

- ✓ According to the type of installation and the operating conditions of the compressor (whether the oil cooling circuit is used or not, see chapter 12 'Additional cooling'), some extra oil may be needed.
- ✓ The oil level in the sight glass should be checked when the compressor is on.

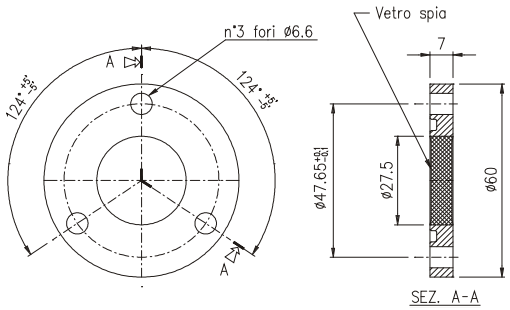


Fig. 24 Oil sight glass

3.6 Lubrication monitoring

3.6.1 Oil differential pressure control

It is necessary to monitor the oil differential pressure for the compressors with forced lubrication in order to control the lubrication. Both mechanical and electronic differential pressure switch are available for SRMTec reciprocating compressors.

3.6.1.1 Mechanical differential pressure switch MP54

This pressure switch stops the compressor when the oil differential pressure (P_{oil}) is too low. However the pressure switch doesn't consider the pressure value during the start-up of compressor, in the first 90 seconds from the start (Fig. 25). If the value of oil differential pressure is higher than 0,65 bar (to add to 0,2 bar of the differential contact) after this delay the compressor is kept running, otherwise is switched-off.
It's necessary a manual reset to restart the compressor: therefore is requested a skilled operator to check and eventually solve the cause of the missing start and, under his control, verify that the compressor can start correctly with the right oil differential pressure.

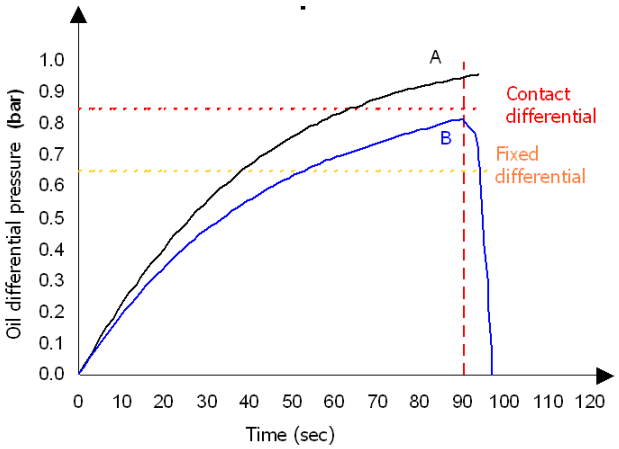


Fig. 25

The pressure switch takes under control the value of differential pressure also during continuous running (Fig. 26): indeed, if during running the oil pressure decreases under 0,65bar for more than 90 seconds, the compressors is switched-off. The compressor is kept running if, before this time, the value of pressure overcomes 0,65bar (to add to 0,2bar of contact differential).

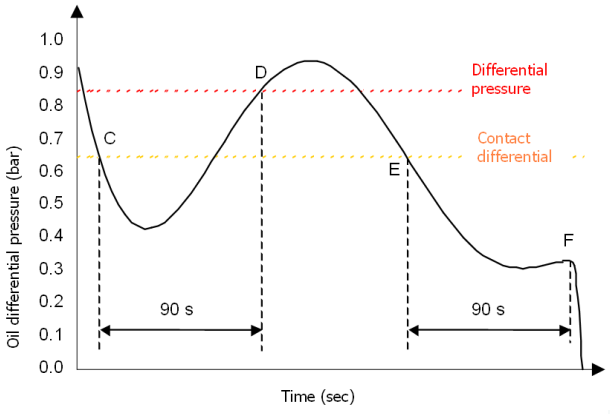


Fig. 26

The mechanical pressure switch MP54 can be ordered together with the compressor:

- for RP1-H422÷435, L415÷425, H6xx, L6xx, H8xx and L8xx models is provided already assembled on the compressor;
- for RP1-H410÷420-F and L406÷412-F models is provided as a kit (ref. Fig. 27, Fig. 28) to be assembled during the installation of the compressor in the plant, because it protrudes from the compressor dimensions and could be damaged during transportation.

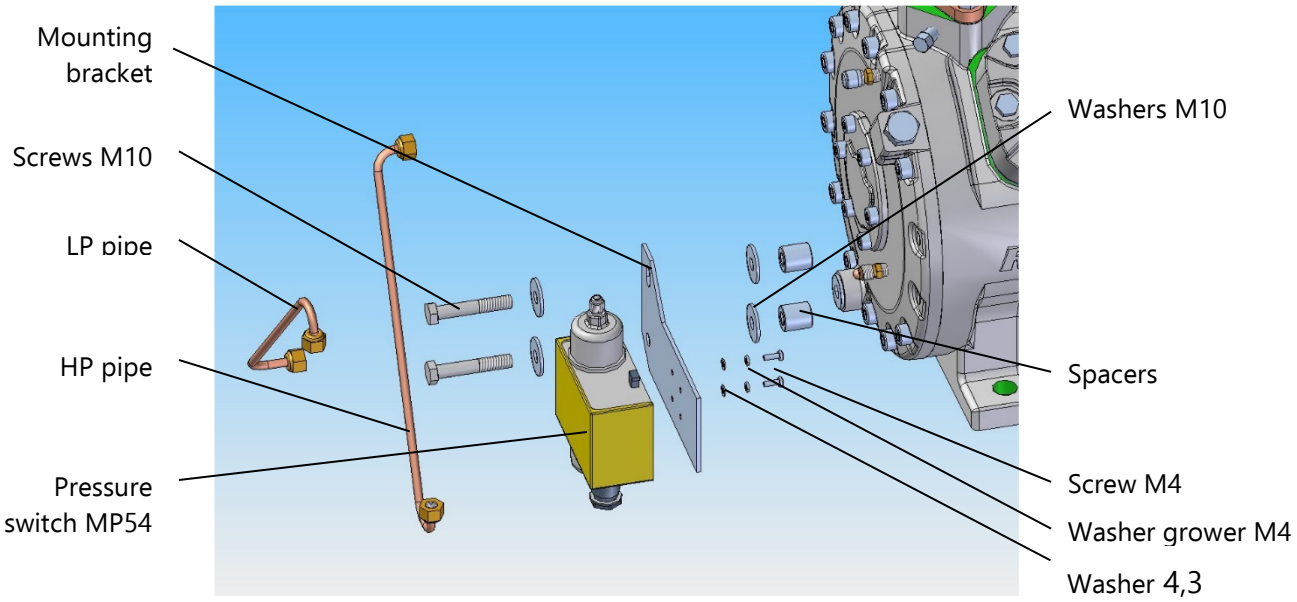


Fig. 27 Components of pressure switch kit (p/n 303860) for RP1-H410÷420-F, L406÷412-F

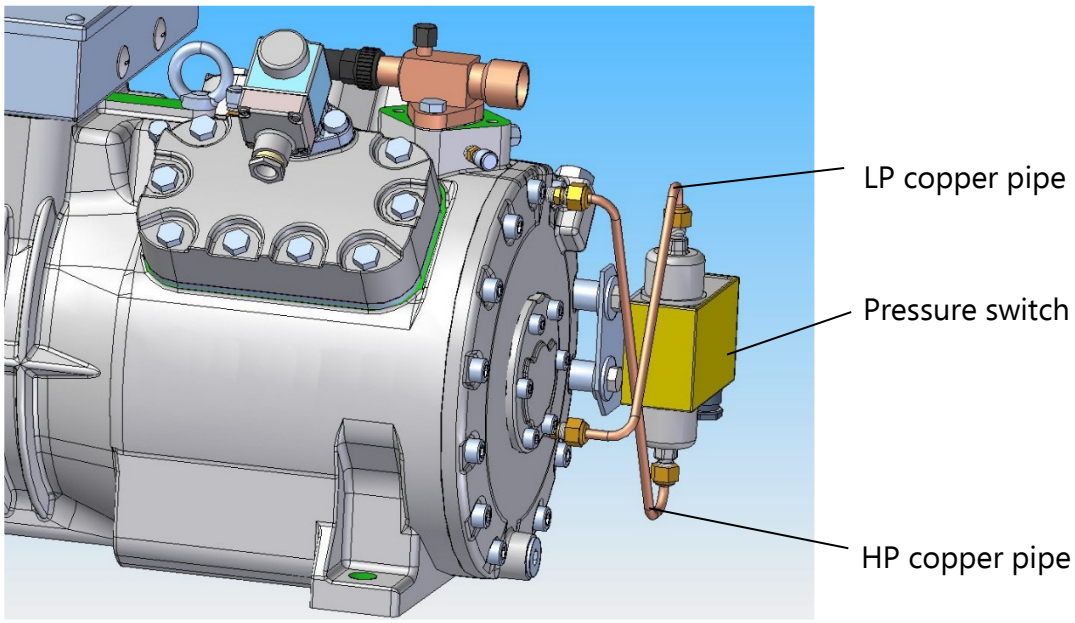


Fig. 28 Assembling scheme of MP54 for SP4HF / SP4LF

Fig. 30 and Fig. 29 show the assembling scheme of pressure switch MP54 kit for 8-cylinder models

This scheme is also valid for 4-cylinder models RP1-H422÷435, L415÷425 and all 6-cylinder models. Unlike the 8-cylinder models is not necessary to use the spacers between the mounting bracket of pressure switch and the compressor casing.

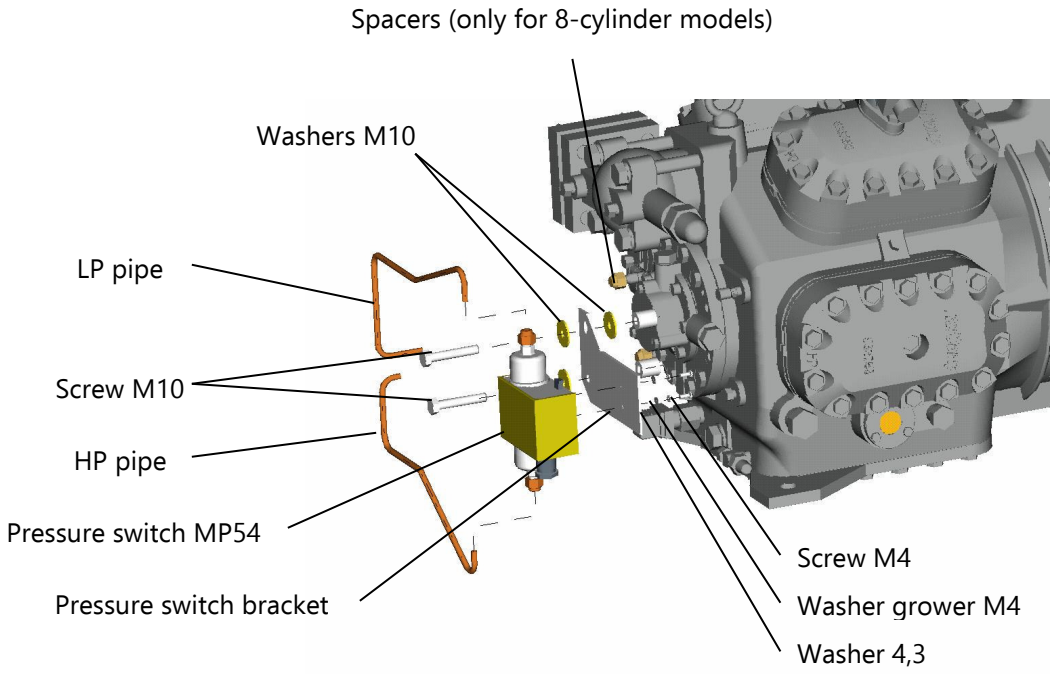


Fig. 29 Components of MP54 pressure switch kit 303191 for 6-8 cylinder models

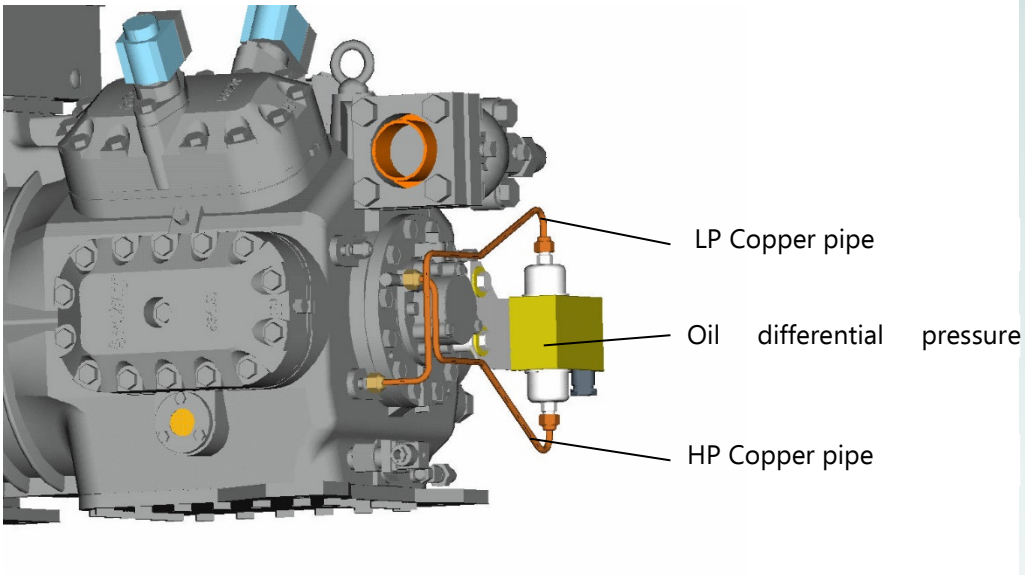


Fig. 30 Assembling scheme of pressure switch MP54 for 8-cylinder models

Compressor model	Crankcase heater kit p/n
RP1-H410÷20-F RP1-L406÷12-F	303860
RP1-H425÷35 RP1-L415÷25 RP1-L/H6xx	303191
RP1-L/H8xx	303781

Tab. 5 Pressure switch kits

DESCRIPTION	p/n	Q.ty in kit		
		303860	303191	303781
Pressure switch MP54 (60B1009)	760508	1	1	1
Pressure switch bracket	513540	1		1
	519044		1	
Spacer MP54	519600	2		2
LP copper pipe	540738	1		
	540682		1	
	540736			1
HP copper pipe	540739	1		
	540683		1	
	540737			1
M4x12 screw	610630	2	2	2
Washer grower M4	614463	2	2	2
Washer D=4.3	614464	2	2	
M10 x 35 screw	612150		2	
M10 x 60 screw	614586	2		2
Washer D=10.5	611100	4	2	4

Tab. 6 Pressure switch kit components

The pressure switch MP54 can be ordered in any time after the sale of compressor as a kit. The pressure switch has to be assembled before making the vacuum in the circuit and the refrigerant charge.

Warning !

Several starts and stops due to low differential pressure could damage the compressor: before each start is necessary to identify the reason for arrest and remove the cause

Control voltage	AC 115-230V 50/60Hz or DC 24V
Time for relay action	90 seconds
Differential pressure	0,65 bar
Contact differential	0,2 bar
Contacts load (M-S exit from thermal relé)	2 A, 250 V AC / 0,2 A, 24 V DC
Protection degree	IP 20

Table 5 Technical features of differential pressure switch MP54

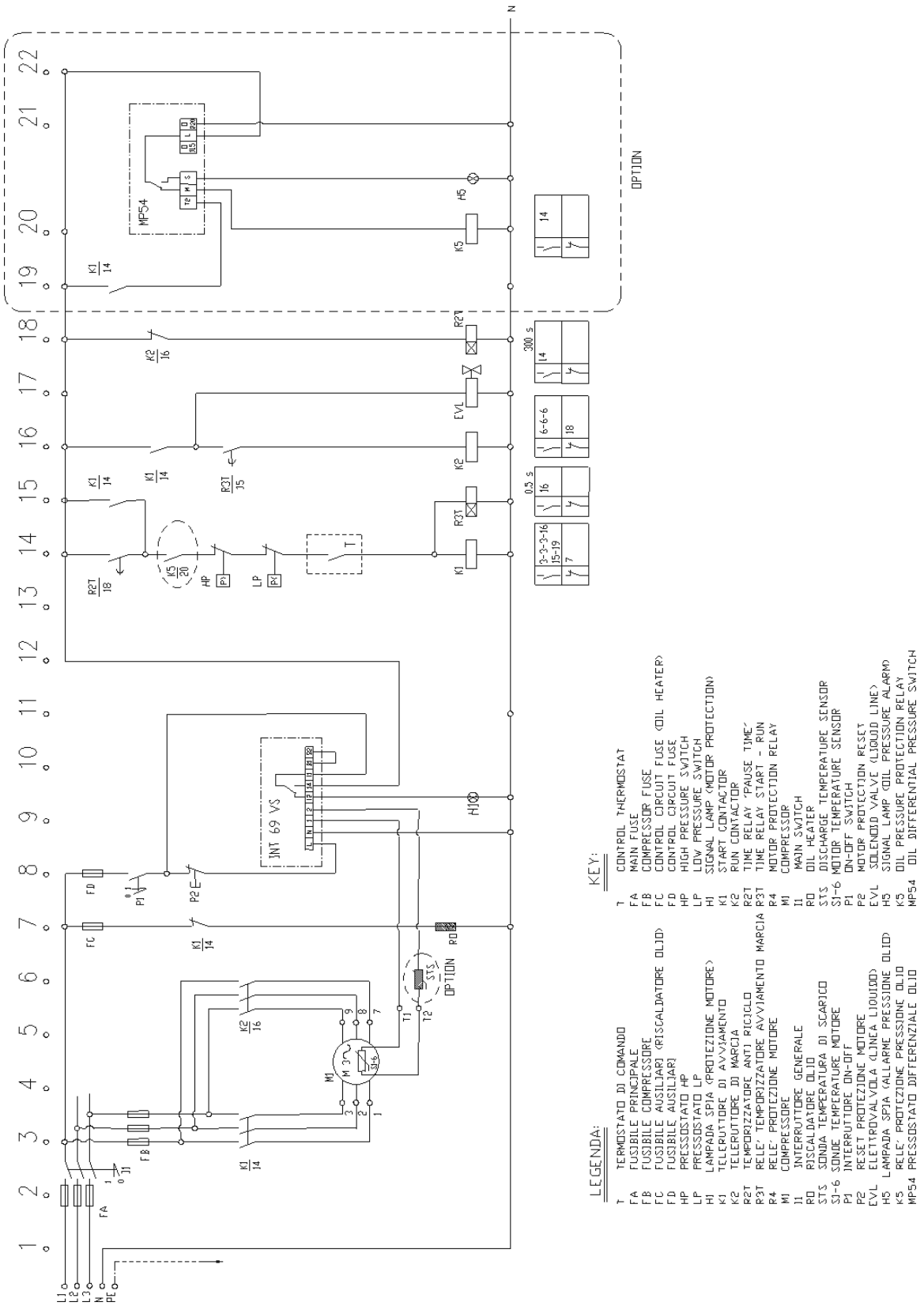


Fig. 31 Electrical scheme of pressure switch MP54

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3.6.2 *Electronic differential pressure switch*

Warning!
This electrical part cannot be used in potentially explosive areas of zone 1 and zone 2.

It's possible to order, as alternative to mechanical pressure switch, the electric one (SRMTec code 303782), and it could be added at any time after the compressor installation.
The pressure switch is divided into two main parts (see picture
Fig. 32):

a) Pressure sensing probe with threaded connection M20x1.5 and copper gasket (already assembled in the compressor if the pressure switch is requested together with the compressor);
b) Control circuit, with ring nut, threaded cap ∅29, connection cables.

This part, when supplied together with the compressor, is not assembled but positioned inside the electrical box, in order to prevent damage during transportation.

The sensor is of passive type and has to be connected to a PLC or to a protection module INT69 if connected to the safety chain.

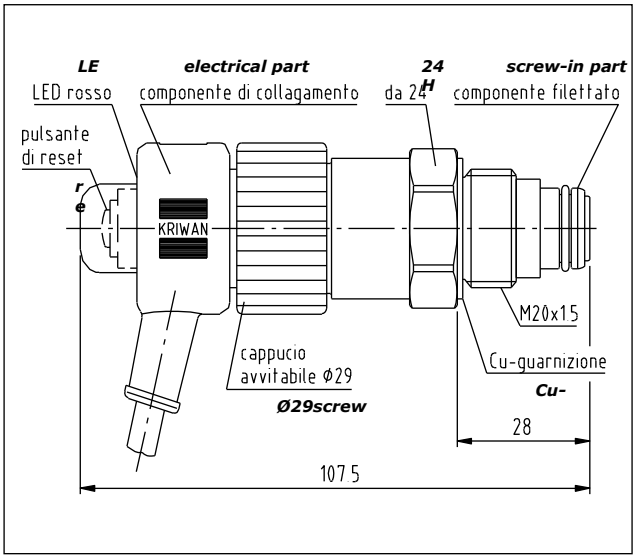

Fig. 32 *Electronic pressure switch Components and dimensions*

The pressure probe is mounted directly on the gear pump support or housing cover on the proper threaded holes (rif. 3 Fig. 10, 3 Fig. 13, see "Installation" section): proper inner oil holes connect the probe with gear pump suction and deliver. The electronic pressure switch, in contrast with the mechanical one, doesn't require any mounting brackets nor capillary pipes and offers a greater simplicity and quick installation. Furthermore, the preassembling of this pressure probe, in SRMTec factory before the delivery of compressor, allows the installation or substitution of control circuit without discharging the compressor.

Material	Brass
Voltage supply	230V a.c. ± 10%, 10VA
Frequency	50 / 60 Hz
Working temperature	-30....60 °C
Protection degree	IP 54
Delay	90 sec
Differential pressure	0,65 bar ± 0,15 bar
Opening power	250 V a.c., max. 2,5 A, 720 VA ind.
Approved	U.L.
Release	Mechanical / manual
Connection cable	4 x AWG18 (0,75 mm2) L = 1 m Conductor with coloured codes
Weight	200g

Table 6 *Technical features of electronic pressure switch*

Concerning the operation, referring to Fig. 34 Electrical scheme for electronic pressure switch (MCE006), consider the following: at the starting of electrical motor, the make (lockup) of the auxiliary electrical contact of K1 contactor (brown and black wires) activates the pressure switch.

The red LED lights immediately on the back of the control circuit indicating the absence of the oil differential pressure. The output contact of the switch is closed (red and orange wires), and activates the circuit delay. If the differential oil pressure was below the value set for a period of time higher than the set delay (90 s), the output contact opens and the compressor is stopped.

If the oil differential pressure reaches or exceeds the value set by the delay time set, the red LED will turn off and the output contact remains closed (keeping the compressor running) and the delay time is reset. In the case of intervention of the oil pressure switch, reset button allows the reactivation after a period of at least 90 s by the intervention itself.

The operator, before resetting the compressor, must always check the possible reasons that impede to establish the proper oil differential pressure and remove possible cause.

Periods of not enough differential oil pressure, intermittent and less than the time delay set, are discovered by an internal microprocessor which , integrating the durations of these periods, led to the shutdown of the compressor at a given cumulative time.

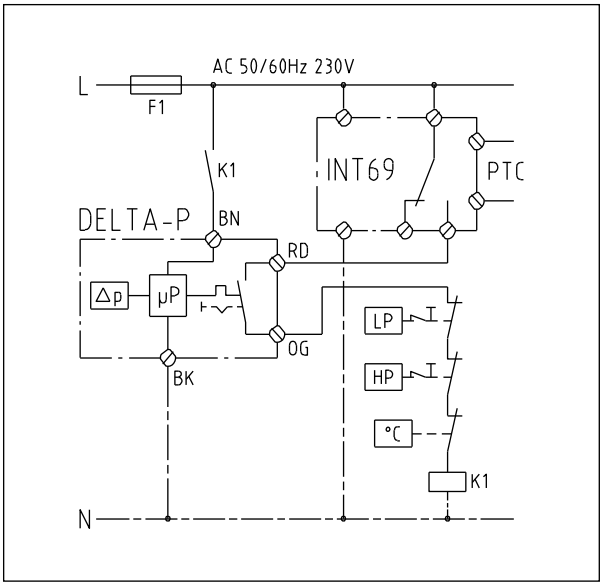

Fig. 33 Connecting electrical scheme Delta-P

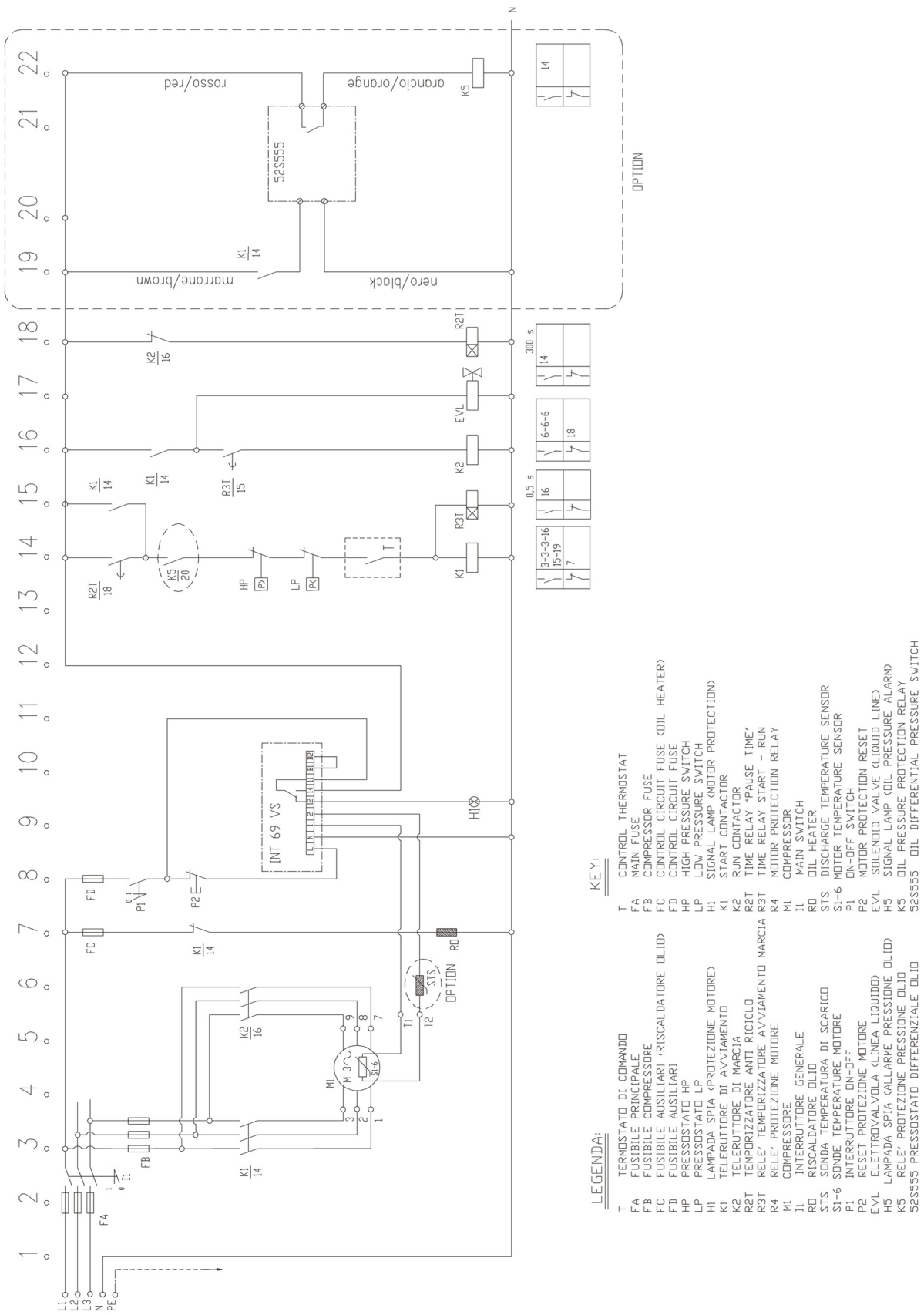

Fig. 34 Electrical scheme for electronic pressure switch (MCE006)

In case of installation or replacement on compressors with sensor not factory installed, refer to Fig. 35:

- ✓ identify the connection for the pressure switch (see Chapter 8.1 "Dimensional drawings");
- ✓ ensure that the compressor is not under pressure and then remove the cap and aluminium washer from the seating support of the gear pump;
- ✓ screw the threaded probe in the seating support, with the relative copper washer using a tightening torque of 100 Nm;
- ✓ assembly the part of the control circuit upon that of pressure probe and tighten the lock nut;
- ✓ connect to the control system (see Fig. 33).

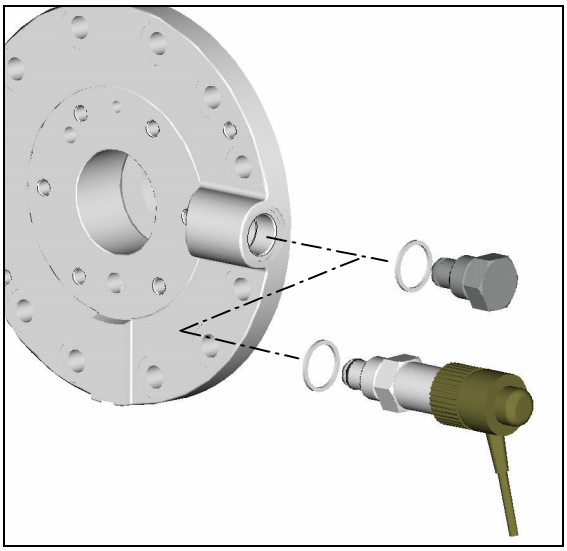

Fig. 35 *Assembly of the electronic pressure switch*

If the oil sensor is factory installed:

- ✓ assembly the part of the control circuit upon that of pressure probe and tighten the lock nut;
- ✓ connect to the control system (see Fig. 33).

3.7 Oil recovery

Four-cylinder models RP1-L/H4xx and all 6 and 8-cylinder models have a depressor (see Fig. 36) that facilitates the oil return towards oil carter in suction side.
The gear pump has a displacement bigger that that require from the lubrication circuit. During continuous running, the circuit absorbs the necessary amount of oil while the remaining one comes back from the support bushing of the shaft (on motor side) to the carter flowing through the depressor.
Fig. 37 shows the working principle of Venturi tube which allows the functioning of the depressor: the principal flow (blue arrow) passing through the smaller tube realizes a decrease of pressure useful to recover the oil from the motor casing to the carter.

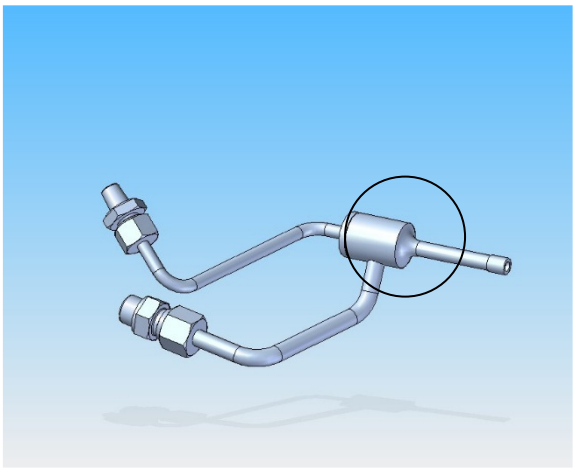

Fig. 36 *Depressor for oil recover*

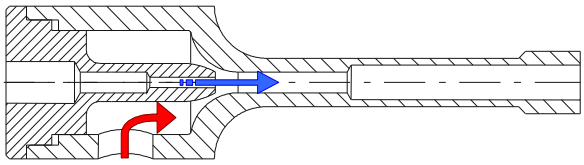

Fig. 37 *Venturi effect used in the compressor*

3.8 Anti-foaming valves

As shown in paragraph "Oil pressure", 4-cylinder models RP1-L/H4 and all 6 and 8-cylinder models are equipped with a check valve between suction line and oil carter (see Fig. 38). These valves are closed during transient states, preventing the equalization of the suction pressure and carter pressure and the consequent foaming.

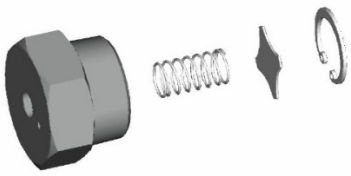

Fig. 38 Exploded of check valve

3.9 Lubricants

The lubricant oils have been chosen considering the following needs:

- ✓ Adequate bearings lubrication;
- ✓ Viscosity according to the working envelope of compressor;
- ✓ Miscibility with refrigerant at low temperatures;

Warning!

Do not use lubricants different from that suggested. Oil lubricants approved by SRMTec are highly hygroscopic and don't have to come in contact with air humidity.

Here below are shown the lubricants approved by SRMTec for RP1 compressors series.

3.9.1 Lubricant for R22

Supplier	Type	Chemical comp.	Density at 15°C [g/ml]	Viscosity at 40°C [cSt]	Flash point [°C]	Pour point [°C]	Flock point [°C]
SHELL	SD 22-12	Mineal and AB mixtture	0.878	38	185	-45	none

Table 7: properties of oil for refrigerant R22

3.9.2 Lubricant for HFC (R407C, R134a, R404A, R507a, R448a, R449A, R407F, R1233ze)

Supplier	Type	Chemical comp.	Density at 15°C [g/ml]	Viscosity at 40°C [cSt]	Flash point [°C]	Pour point [°C]	Flock point [°C]
ICI	Emkarate RL32H*	POE	0.975 (min.) 0.981 (max.)	30 (min.) 34 (max.)	200	-35	none
ICI	Emkarate RL68H**	POE	0.977 (min.) 0.983 (max.)	63 (min.) 73 (max.)	170	-20	none

Table 8: properties of oil for HFC refrigerants

*: for condensing temperatures < 55°C

**: for condensing temperatures > 55°C

3.10 Oil charge

During the operation a certain amount of oil is mixed with the refrigerant and is dragged into the system. The refrigerant charge can be particularly high with very long circuits. Consequently, the quantity of oil remaining in the compressor can be below the initial level and, in general, poor. In these cases, it will be necessary to add oil in quantities that may reach the 10% charge.

If the system is equipped with oil separator, it must be filled prior to the commissioning of the plant to compensate the fraction of oil that accumulates in the same and does not return to the compressor.

It is therefore essential, in the early periods of operation, periodically check the oil level in the crankcase. As mentioned in paragraph "Oil level", the test must be performed with the compressor is running. In the quoted paragraph also sets out the criteria for evaluation. When the compressor stops, the level may vary because of the amount of refrigerant which is mixed in the oil itself.

Once the oil control and its level have been established, after the first 300 hours of operation of the compressor, it is recommended to take a sample of oil, to judge the colour, smell and subject it to chemical analysis to determine the initial physical-chemical state circuit.

What should be checked:

- viscosity;
- moisture content;
- the initial acidity of the system;
- components present and their quantity.

For the limits, see the technical specifications provided by the supplier firms.

Table 9 shows some technical characteristics of oils used.

Once verified the chemical and physical stability of the system, control may become an annual or longer check. If values seem to be critical, replace the oil, filter driers in the liquid (several times if necessary), taking care to also replace the oil of the receiver, because the acid is concentrated usually in oil.

	SHELL SD 22-12	EMKARATE RL 32H	EMKARATE RL 68H
Appearance	Clear liquid, free from suspended material	Clear liquid, free from suspended material	Clear liquid, free from suspended material
Color	Colorless	150 Hazen	200 Hazen
Viscosity	38 cSt at 40 °C	30 (min) – 34 (max) cSt at 40 °C	63 (min) – 73 (max) cSt at 40 °C
Humidity	Negligible	50 ppm max.	50 ppm max.
Acidity	< 0,04 mg KOH/g	0,04 mg KOH/g	0,04 mg KOH/g

Table 9

3.11 Oil temperature

The maximum temperature of the oil during operation must not exceed 80°C. The difference between the discharge and the lubricant temperatures is around 40K, so the discharge temperature must not exceed 120°C.

4 Capacity control

In many applications it is required to regulate the cooling capacity of compressor in order to better fit to real need. This avoids frequent starts and stops the compressor, which can damage the same from both electrical and mechanical point of view and also improves the energy efficiency of the system.
SRMTec RP1 compressors series can be provided with a built-in capacity control device that can be requested together in the order of compressor or as a kit to be installed in any time after the sale of compressor.
The control system is based on special heads: the refrigerant flowing towards the inner the cylinders is interrupted through the servo-control of a shutter inside the heads. In this way the cooling capacity decreases proportionally to the numbers of the quiescent cylinders.

4.1 Capacity control head (CR)

Fig. 39 shows the working scheme of the capacity control head, that in this contest will be identified as "CR" head.
The CR head is equipped with a solenoid valve (1) that change the operation of the head according to its status:

a) De-energized = LOAD
   When the coil of this solenoid valve (1) is not excited, the stem (2) closes the connection between delivery (8) and shutter chamber (3). The spring (5) keeps up the shutter (6) from its seat and allows to refrigerant to flow into the inlet of cylinders (7).
b) Energized = UNLOAD
   At part load the solenoid valve (1) is excited. The stem (2) rises and opens the connection between discharge side (8) and shutter chamber (3). The pressure acting upon the upper surface of the shutter (6) allows overtaking the spring reaction (5): the shutter is forced to move downward, interrupting the flow of refrigerant entering through the suction port (7). The hole machined inside the head (9) grants the connection between discharge side (8) and shutter chamber (3). In the shutter the hole (4) connects the chamber (3) with the low pressure side (7). When the solenoid valve is de-energized, the refrigerant which is eventually inside the chamber (3) is discharged in suction side (7), allowing the spring (5) to lift the shutter (6) and establish the normal functioning of the head.

SPS compressor series could be equipped with variable steps of capacity control, according to the number of cylinders, as shown on Table 10.

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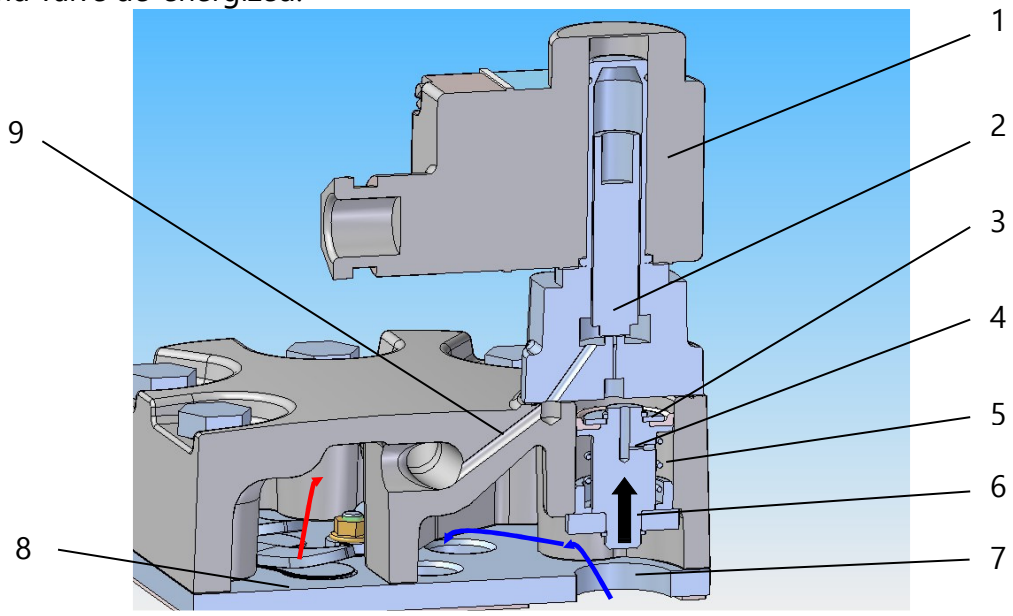
a) Solenoid valve de-energized:



b) Solenoid valve energized:

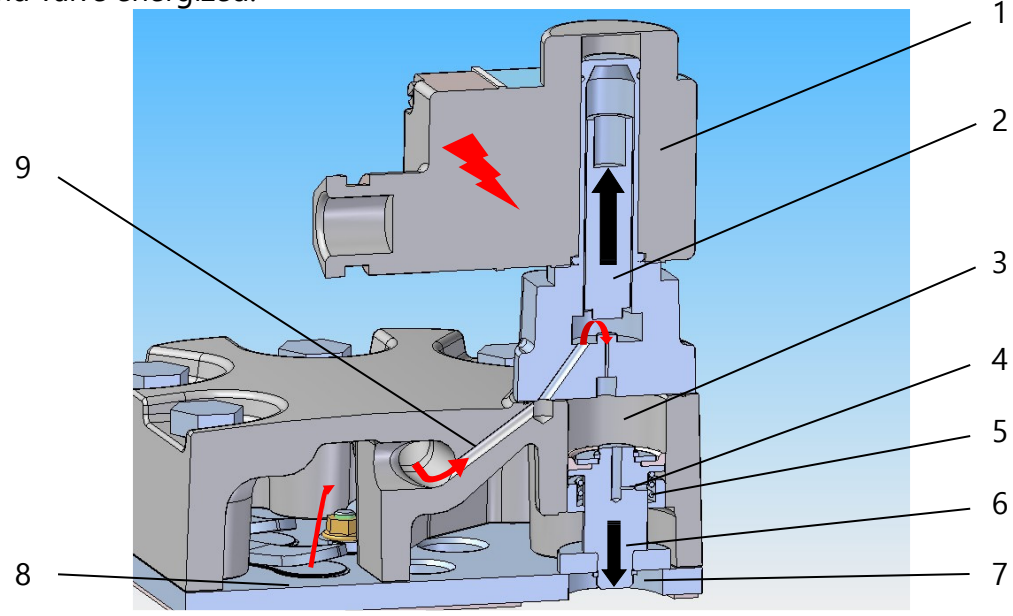


Fig. 39 *Working principle of CR head*

1) Coil of solenoid valve
2) Stem of solenoid valve
3) Shutter chamber
4) Discharge channel from shutter chamber
5) Shutter spring
6) Shutter
7) Suction
8) Discharge
9) Connecting hole between discharge and shutter chamber

No. of cylinders	No. of CR heads	Capacity regulation
4 cylinders	1	50%
6 cylinders	1	66%
	2	33-66%
8 cylinders	1	75%
	2	50-75%

Table 10 *Capacity control steps*

The absorbed power doesn't decrease proportionally with the reduction of cooling capacity: the reduction factor depends on the evaporating temperature and on the capacity step as shown in Fig. 40 and in Table 11.

For instance: 6-cylinder model with one CR head at part load has 4 cylinders working with 66% of cooling capacity and 70% of absorbed power.

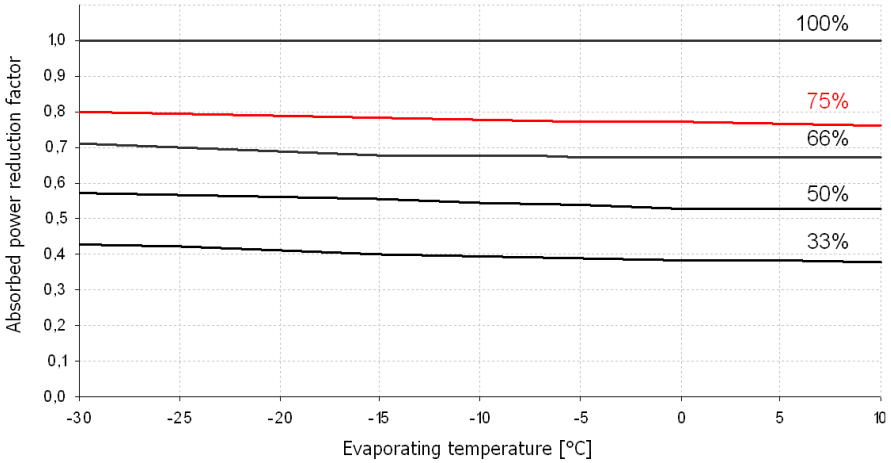


Fig. 40 *Absorbed power reduction factor*

No. of cylinders	No. of CR heads	Capacity regulation	Abdorbed power reduction factor
4 cylinders	0	100%	1
	1	50%	0.53
6 cylinders	0	100%	1
	1	66%	0.70
	2	33-66%	0.40
8 cylinders	0	100%	1
	1	75%	0.77
	2	50-75%	0.52

Table 11 *Absorbed power reduction factor*

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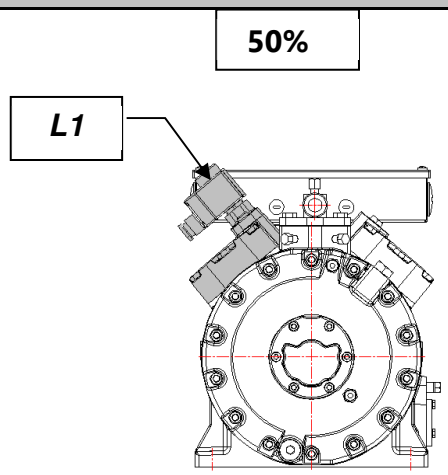
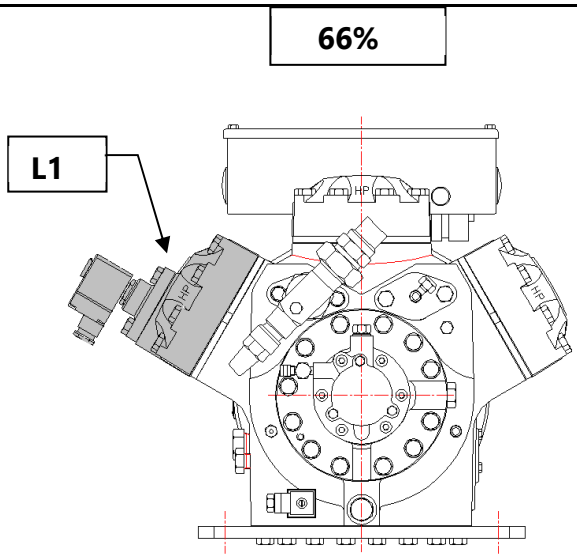
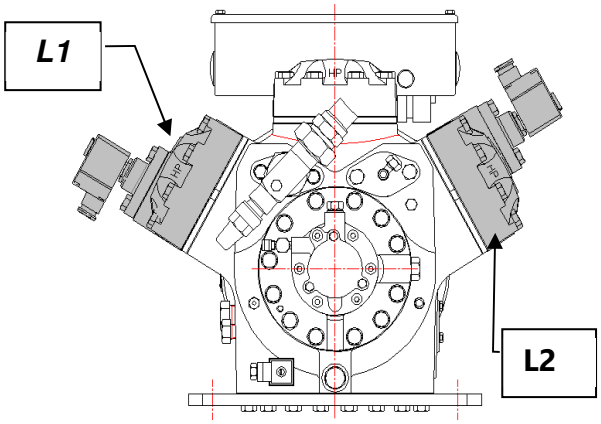
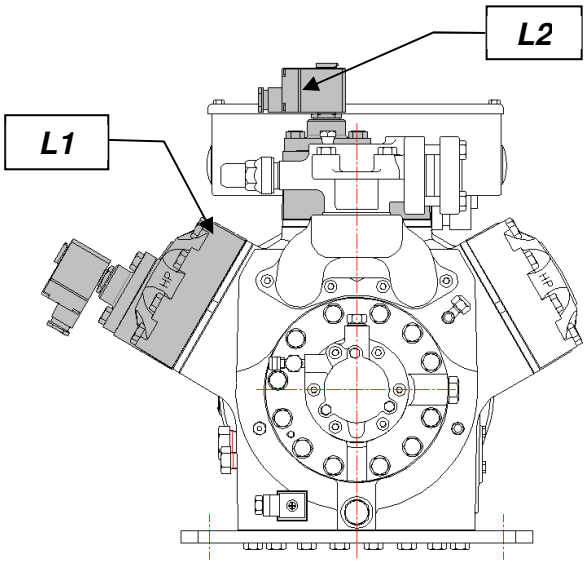
No. of cylinders	No. of CR heads	Capacity regulation	CR Head position
4 cylinders	1	50%	
6 cylinders	1	66%	

No. of cylinders	No. of CR heads	Capacity regulation	CR Head position
	2	33-66%	66-33%  66-33%  Only for RP1-L640/H650

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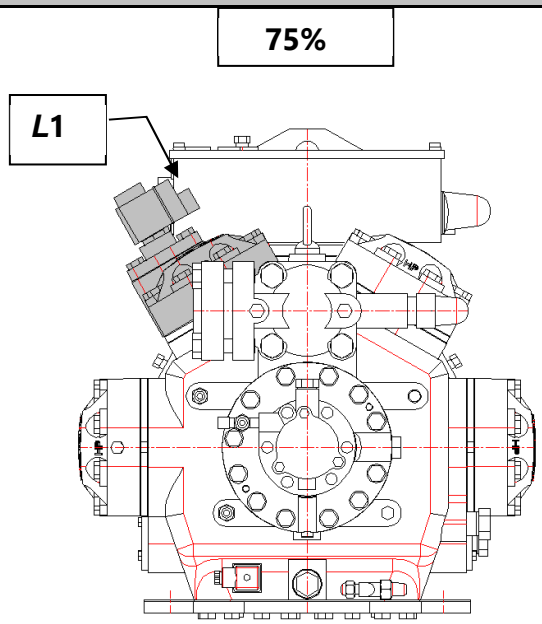
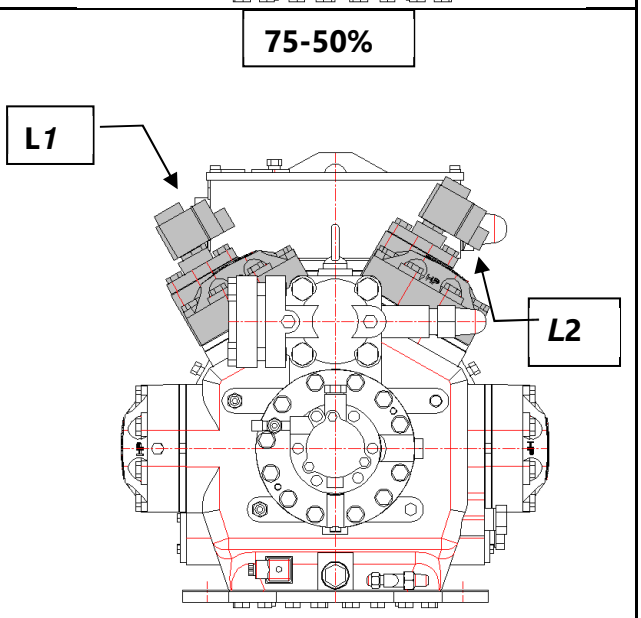
No. of cylinders	No. of CR heads	Capacity regulation	CR Head position
8 cylinders	1	75%	
	2	50-75%	

4.1.1 Application envelope at part load

At part load, because of the smaller amount of refrigerant flowing inside the compressor, the motor is less cooled and the whole compressor has a lower efficiency causing the discharge temperature increase.

It very important to carefully consider the application envelope at part loads, as shown in chapter 11 "Application range"

4.1.2 Additional cooling of compressor at part load

The different models can be equipped with an additional cooling devices: for further information consider chapter 12 "Additional cooling".

4.1.3 Warnings in plant design with compressors working at part loads

It's necessary to design the pipes with dimensions that could maintain a minimum speed of the refrigerant, in the conditions of minimum load. of:

- at least 4 m/s in the horizontal sections;
- at least 7 m / s in the vertical sections,

in order to ensure a correct return oil.

Oil separators have to be used in large plants with long pipes in order to reduce the amount of oil trapped in the circuit. Also the expansion valve has to consider the both working conditions: full load and part loads. Moreover also it could be useful to use an evaporator with different inner circuits, each with its own expansion valve.

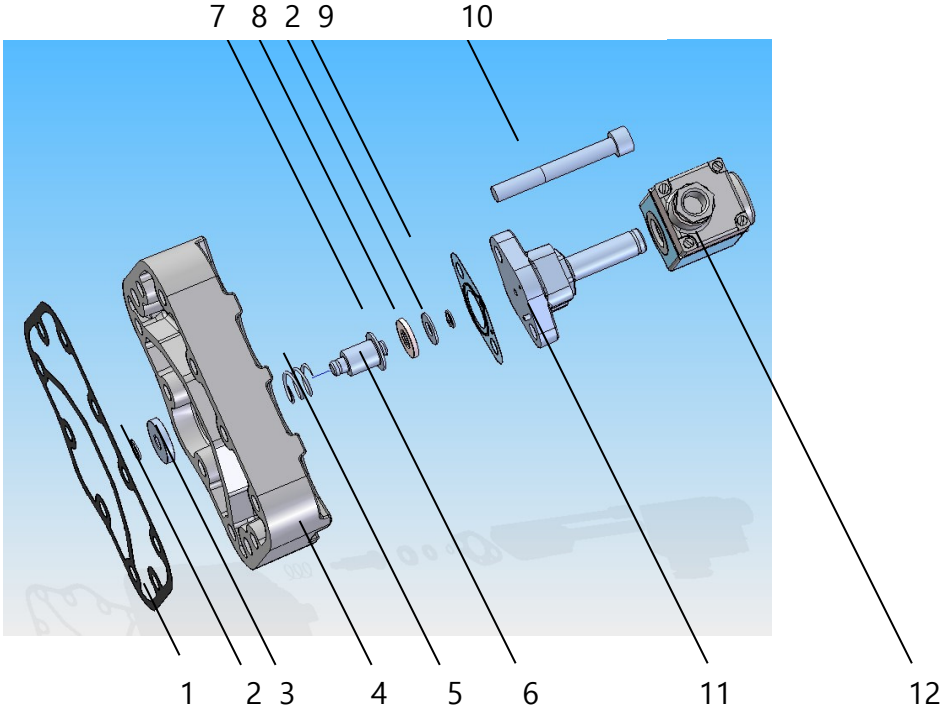
4.1.4 Activation of capacity control

The activation of the CR heads is usually delegated to controllers of temperature, pressure and humidity, whose differential must be carefully selected to avoid overlap with the stop of the compressor, avoiding at the same time too short reduced cycle times.

4.1.5 Part load kit

The kit part no. for capacity control is related to the type of compressor and to the supply voltage of the solenoid.

Fig. 41 shows capacity regulation kit components



Ref.	Description	Ref.	Description
1	Head upper gasket	7	Shutter sealing ring
2	Seeger A9 type	8	Shutter retainer disc
3	Disc intake closing	9	Solenoid valve gasket
4	CR head	10	M10 screw
5	Spring shutter unloader	11	Solenoid valve + cylindric pin ϕ=3
6	Shutter	12	Coil

Fig. 41 *Capacity control kit*

Mod. RP1-		L/H2	L/H4xx-S L/H4xx-F	L/H4	L/H6	L/H8
No. of cylinder		2	4	4	6	8
CR partial load head kit	230V	-	303810	303135		
	110V	-	303811	303136		
	24V	-	303812	303137		
Coil part. No.	230V	-	303852	303228		
	110V	-	303853	303227		
	24V	-	303854	303226		

Table 12 CR partial load kit

4.2 Start unloading

When starting the compressor it is essential to limit the starting current of the electric motor, as usually dictated by the electrical power distributor, to prevent excessive overload on the network.

Electric motors are therefore available in the standard version part-winding (PW) or, on request, star/delta (Y/Δ) version. For further information see chapter 7.1 "electrical data".

During the starting phase, the electric motor winding PW or Y/Δ provides a reduced torque so it may be necessary to reduce the load torque through the Starting Unloading System (SU = Starting Unloading).

The system consists of a refrigerant bypass between the high and low pressure, achieved by a particular head and it is driven, during start-up, by a suitable solenoid valve installed on the head itself.

The symbol SU is stamped on the top of the head.

4.2.1 SU head

Fig. 42 shows the working principle.

The coil of solenoid valve (1) is de-energized at full load. The shutter (2) closes the connection (10) between the suction (7) and the shutter chamber (3).

The mutual action of spring (5) and of refrigerant high pressure leads the shutter (6) to close the by-pass, avoiding the direct connection between suction and discharge through the inner channel.

At the starting of compressor the solenoid valve (1) is energized. The stem (2), rising, opens the channel (9) between the suction (7) and shutter chamber (3). High pressure flows from the upper part of the shutter towards the suction side of the head.

The pressure on the lower surface of the shutter (6) allows to win the conflicting action of the spring (5); the shutter is then lifted from its seat, thereby connecting suction and discharge side. The connection between suction (7) and shutter chamber (3) is grant through the channel (9), realized in the inner of head. In the same way the connection between discharge (8) and suction (7) is grant from channel (9). The shutter has in its inner a channel (4) which connects chamber (3) and suction side (7). When the valve is not energized, the channel (4) allows the equalization of the pressures acting on the lower and upper surfaces of the shutter.

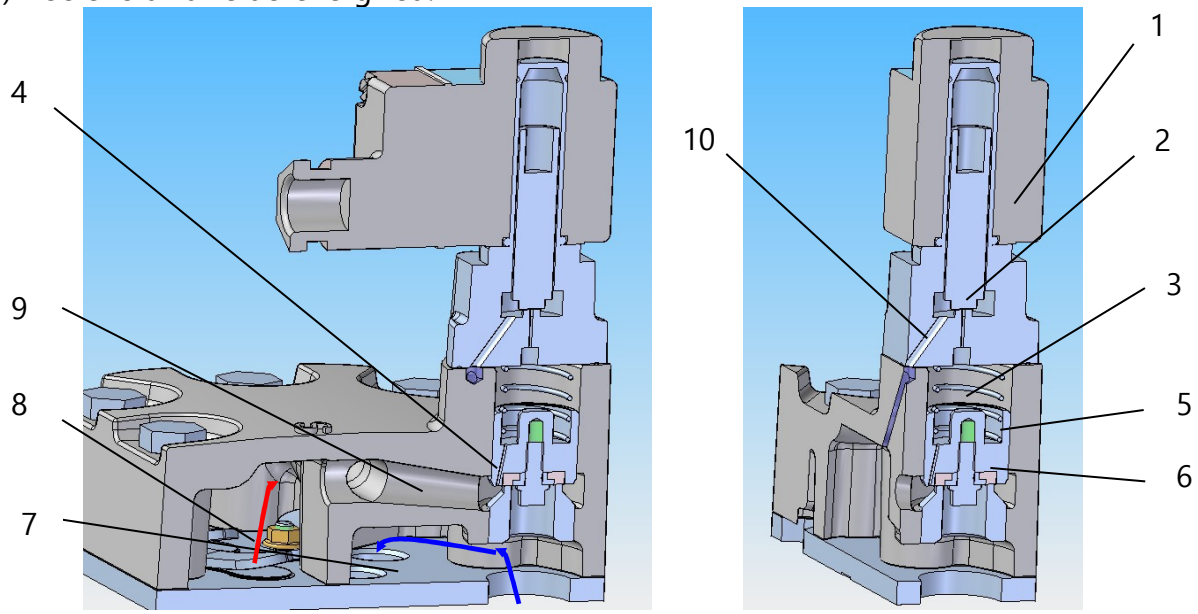
Warning!

Refrigerant temperature has a sudden increase during start-up phase

It is necessary to provide:

- Reduced acting time (1 second for P-W and 1-2 seconds for Start-Delta)
- an exhaust temperature sensor connected to the security module of the electric motor. This sensor is already installed when the starting load is required from factory and is included in start unloading kit when the device is request as after sale option.
- It's necessary to install a check valve in the discharge side of compressor in order to avoid the flow back of refrigerant from high pressure side of the plant towards the compressor.

a) Solenoid valve de-energized:



b) Solenoid valve energized:

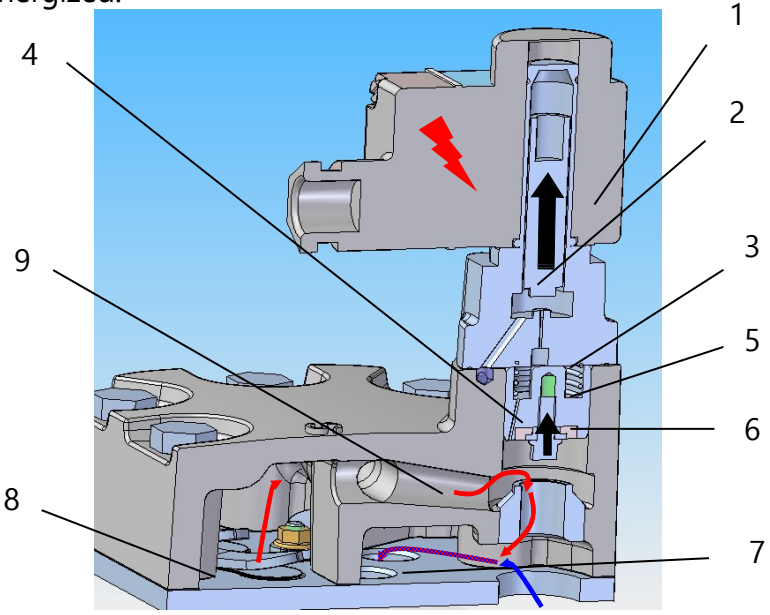


Fig. 42 *Working principle of start unloader*

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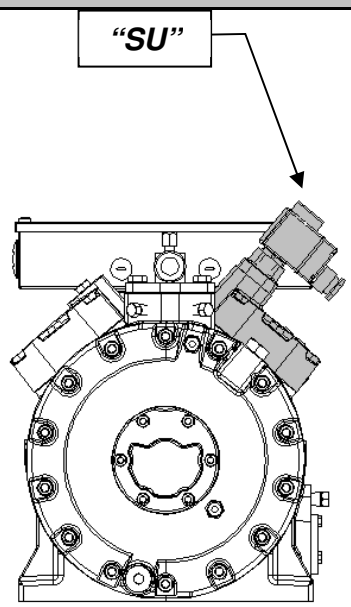
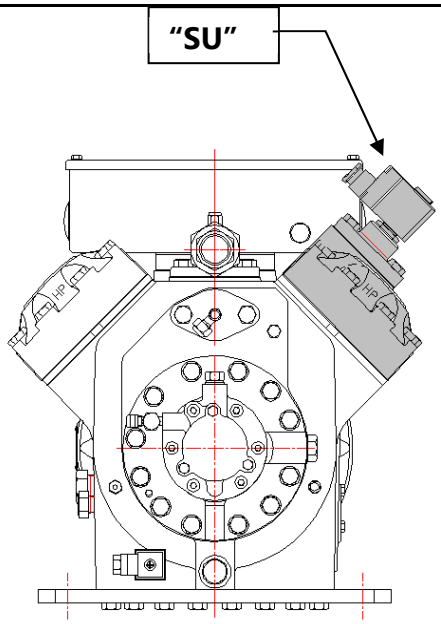
1) Coil of solenoid valve
2) Stem of solenoid valve
3) Shutter chamber
4) Discharge channel from shutter chamber
5) Shutter spring
6) Shutter
7) Suction side
8) Discharge side
9) Connecting hole between discharge and shutter chamber
10) Discharge pressure connection

4.3 Position of SU heads

The table below shows the position of SU heads

No. of cylinders	SU Head position
4 cylinders RP1-L/H4xx-S RP1-L/H4xx-F	
4 cylinders RP1-L/H4	

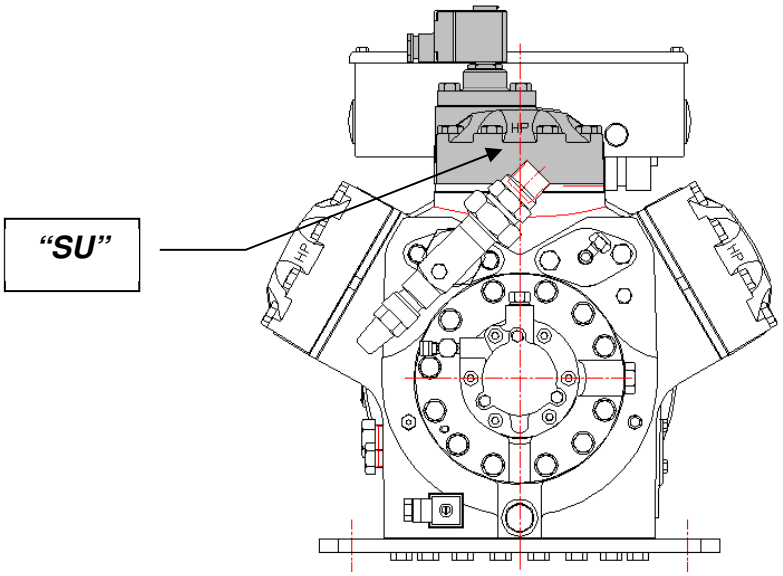
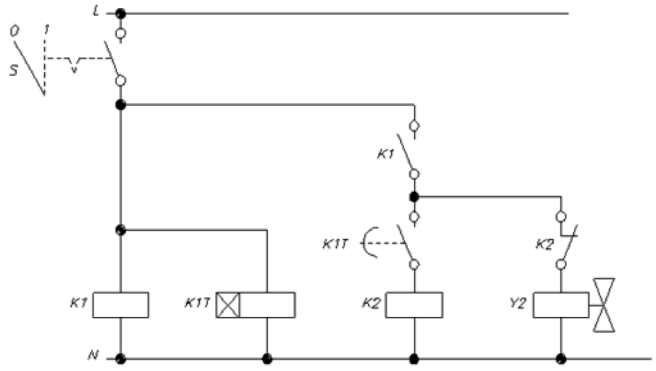
No. of cylinders	SU Head position
6 cylinders	

Table 13 SU head positions

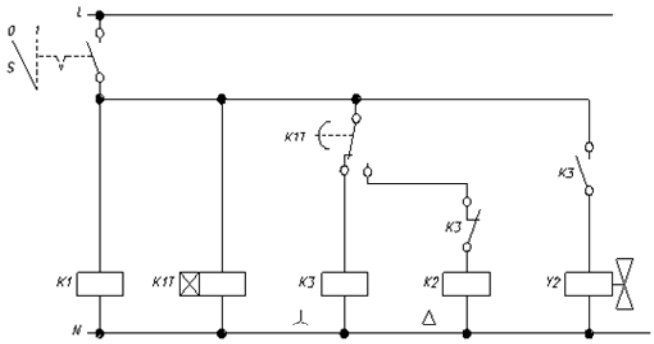
4.3.1 Activation of SU head

The pictures below show the connection of the start unloading solenoid valve Y2 according to the starting mode.



K1	First contactor PW
K2	Second contactor PW
K1T	Relè
Y2	Start unloading solenoid valve
S	Starting contact

Fig. 43 *Part-winding connection*



K1	Main contactor
K2	Working contactor
K3	Starting contactor
K1T	Relè
Y2	Starting unloading solenoid valve
S	Starting contact

Fig. 44 *Star-Delta connection*

4.3.2 SU head kit

The kit part no. for start unloading is related to the type of compressor and to the supply voltage of the solenoid.

Picture 3-9 shows start unloading kit components

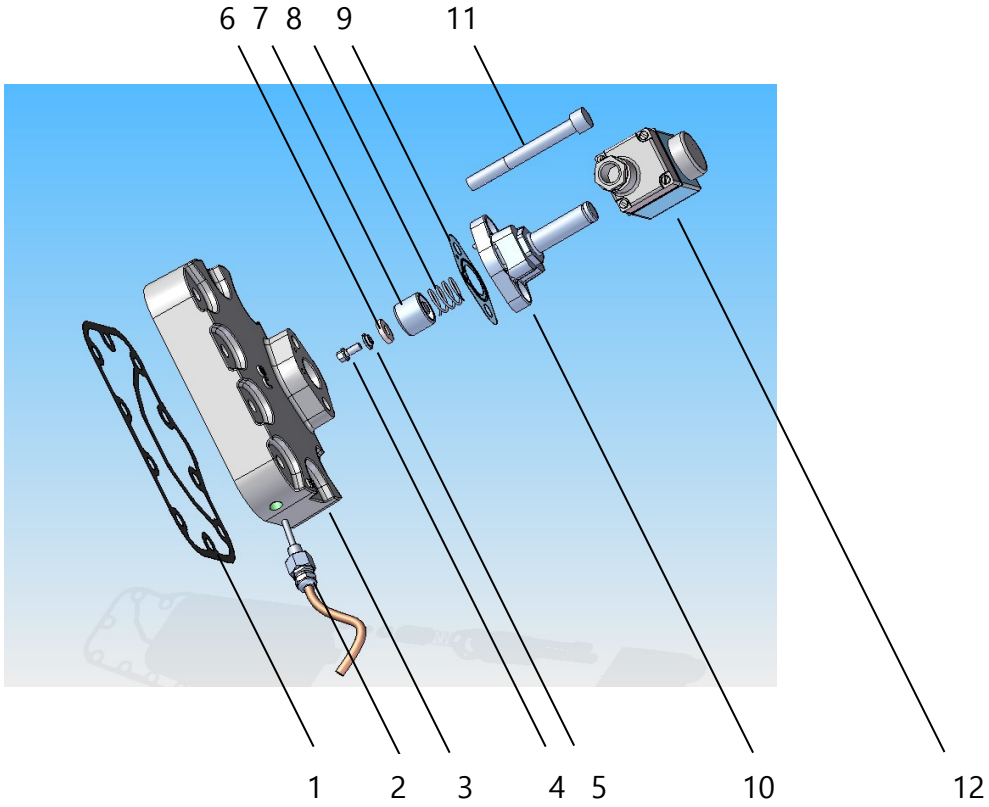


Fig. 45 *Start unloading kit*

Mod. RP1-		2H-				4HF- 4HN-				4H-				6H-			8H-	
		0175-05	0210-06	0245-08	0280-09	0350-10	0420-12	0490-15	0560-20	0647-22	0750-25	0861-30	1029-35	1125-37	1291-40	1544-50	1860-60	2220-70
No. of cylinder		2				4				4				6			8	
SU Start unloader kit	230V 110V 24V	- - -				303813 303814 303815				303138 303139 303140							-	
Coil part. No.	230V 110V 24V	- - -				303855 303856 303857				303225 303224 303223							-	

Table 14 SU partial load kit

4.4 Variable speed control

RECOMMENDATIONS:

Usage of frequency converter to control the load of the compressor and of the system is strongly recommended.

Usage of frequency converter in combination of compressor internal load control is discouraged.

Warning!

The installation of the inverter is permitted only in Safe Zone areas.

Danger of spark formation due to switching operation.

Use shielded cables between frequency converter and compressor motor

Caution!

Due to the high oil solubility by the refrigerants, an oil sump heater is absolutely required.

The usage of a frequency converter permits the speed control with conventional asynchronous motors, reaching the highest efficiency control method for compressors.

In the variable-frequency control mode, the operating frequency of the motor can be adjusted automatically to greatly reduce the reactive loss of the motor.

All the SRMTec compressor are designed to operate in the frequency range 25Hz-60Hz, and the motor have to be connected according to the Fig. 46.

When using frequency converter for capacity control, several basic factor has to be taken into account:

- positive displacemente compressors have a practically contant torque requirement over the entire speed range;
- to grant the constant torque operation of the compressor, the voltage and frequency must be changed proportionally;
- the speed of the asycronous motor is affected by the slippering of the motor.

This mean that, as conventional inverters cannot supply motor overating voltages higher than supply voltage, when the motor is driven at frequency higher than the nominal speed (>50Hz) it will be supplied with "under voltage" conditions. The selection of a special winding motor voltage (380V-3-60Hz) could avoid this situation but the sizing of the inverter is affected by the larger current drawn.

For details on motor size and electrical data please refer to Table 20; for special motor voltage please check the data on SRMTec selection software or contact SRMTec.

When the driving frequency instead is much lower than the nominal, the refrigerant flow could be not sufficient to cool down the motor.

It is so necessary to check in the SRMTec selection software the application envelope limitations according to the rotating frequency.

Caution!

Due to the high oil solubility the acceleration and deceleration ramps have to be reduced in order to prevent foaming in oil separator.

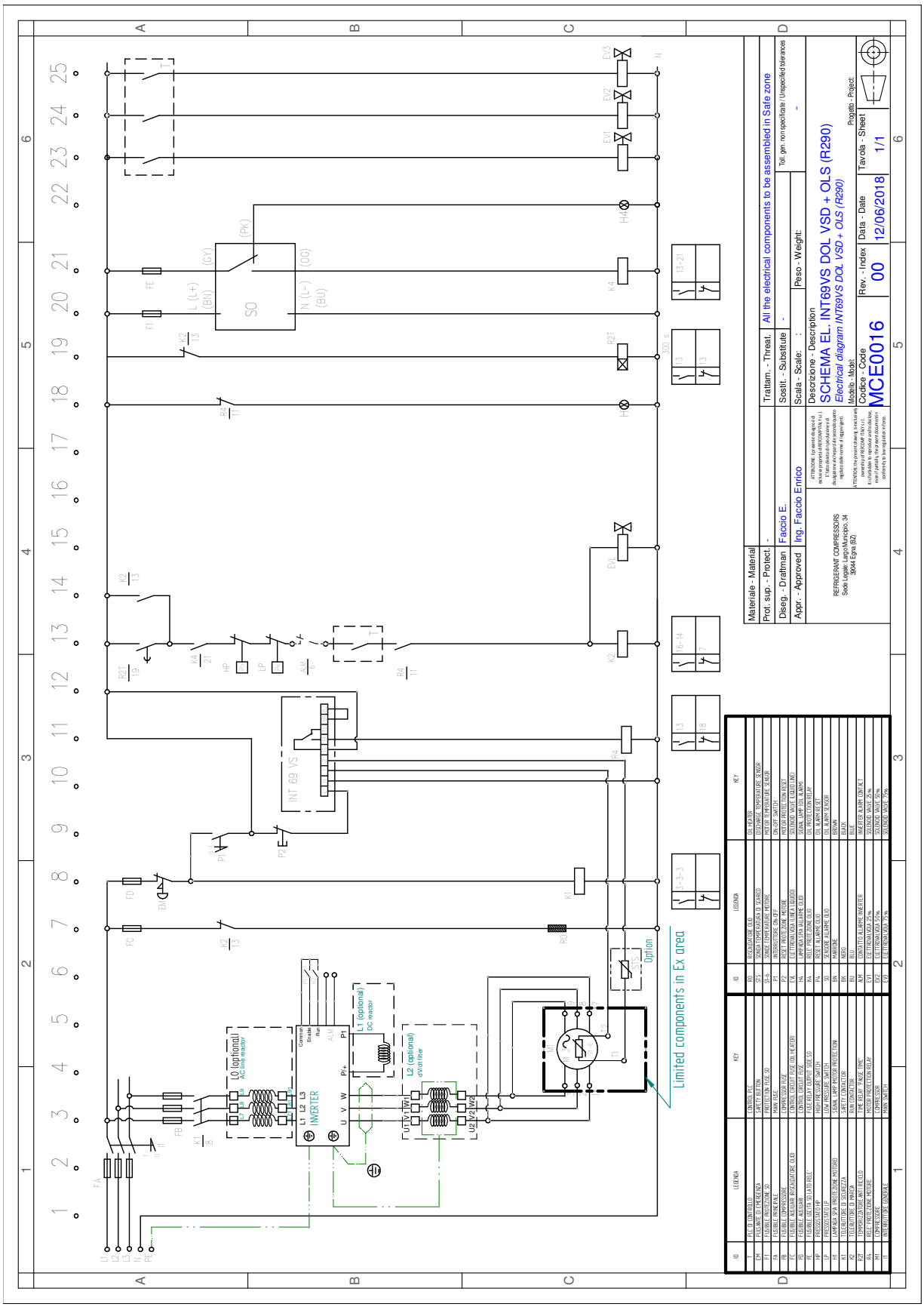


Fig. 46 Electrical connection for Variable frequency drive

The motor speed control has to be regulated between minimum and maximum speed with smooth and reduced variation of load. Refer to the picture below for a reference of time and speed variation.

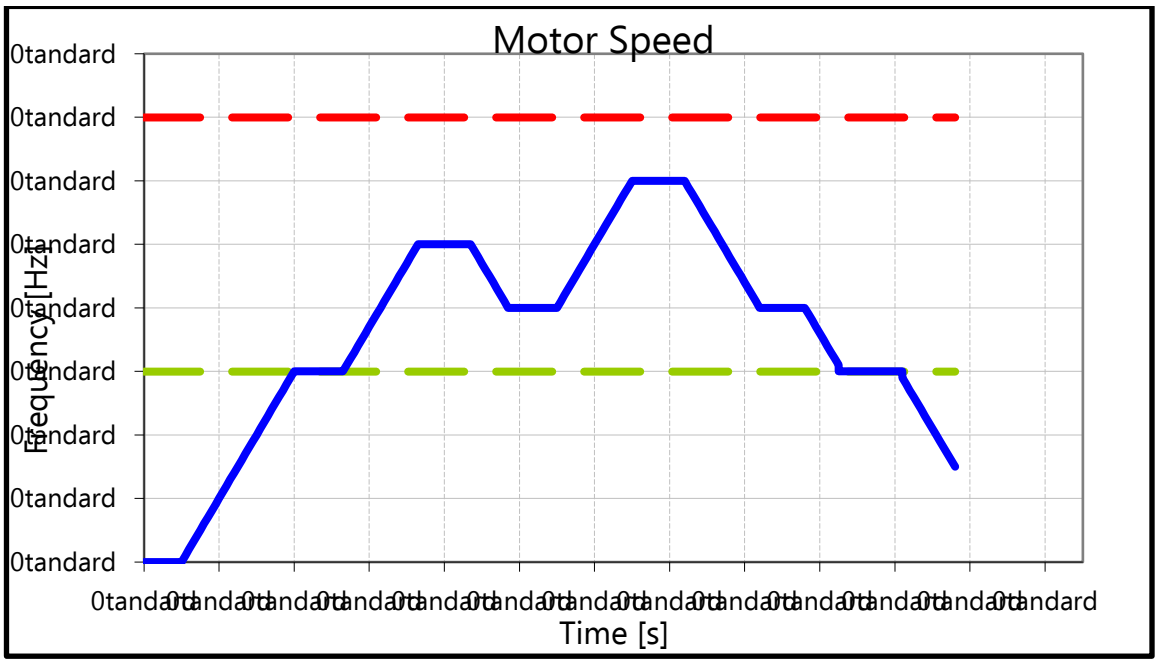


Fig. 47 Speed vs Time variation example

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5 Components

5.1 Suction filter

2 and 4-cylinder models RP1-L/H4xx-S and RP1-L/H4xx-F are equipped with suction filter which can be inspected and cleaned only dismounting suction shut-off valve. Fig. 48 shows the position of suction filter in 4-cylinder models.

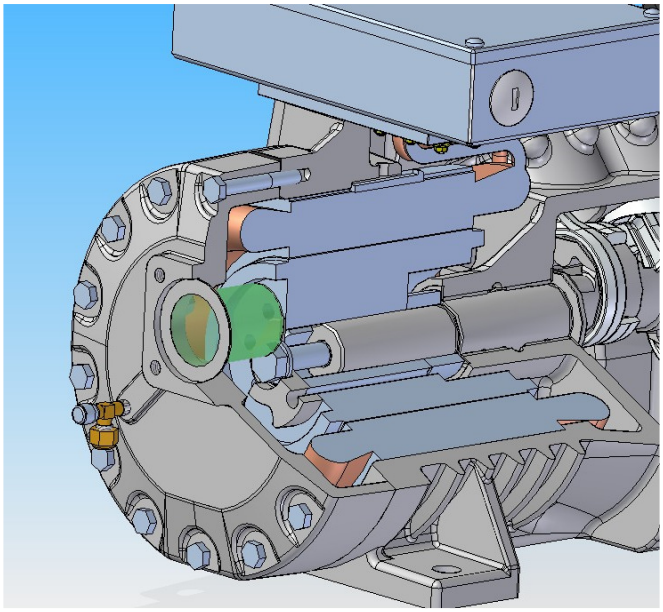


Fig. 48 *Position of suction filter for 4-cylinder models*

For RP1-L/H4, RP1-L/H6 and RP1-L/H8 models is necessary to disassemble the suction cover to check the filter: it is fixed in its seat through a SEEGER ring and it's fixed to the cover with a screw, as shown in Fig. 49.

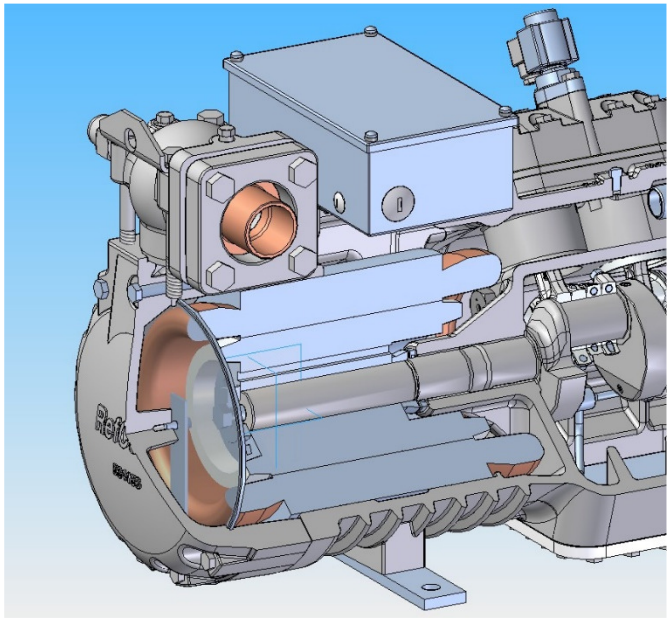


Fig. 49 *Position of suction filter in 6 and 8-cylinder models*

5.2 Shut-off valves

The tables below show the type of shut-off valves mounted on the compressors, with reference to the types indicated in Table 17:

Mod. RP1-	H205	H206	H208	H209	H410-S/F	H412-S/F	H415-S/F	H420-S/F	H422	H425	H430	H435	H637	H640	H650	8H60	8H70
No. of cylinder	2				4				4				6			8	
Nominal motor power HP	5	6	8	9	10	12	15	20	22	25	30	35	37	40	50	60	70
Suction side valve type	1				1		2		2				2		2	2	
Discharge side valve type	1				1		1		1				1		2	2	

Table 15

Mod. RP1-	L203	L204	L205	L206	L406-S/F	L408-S/F	L410-S/F	L412-S/F	L415	L418	L422	L425	L627	L630	L640	L850	L860
No. of cylinder	2				4				4				6			8	
Nominal motor power HP	3	4	5	6	6	8	10	12	15	18	22	25	27	30	40	50	60
Sucton side valve type	1	1	2	2	2	2	2	1	1	2	2	2	2	2	1	1	2
Discharge side valve type	1	1	1	1	1	2	2	1	1	1	1	1	2	2	1	1	1

Table 16

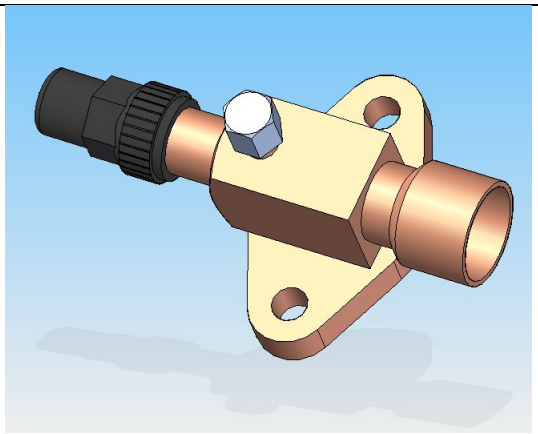
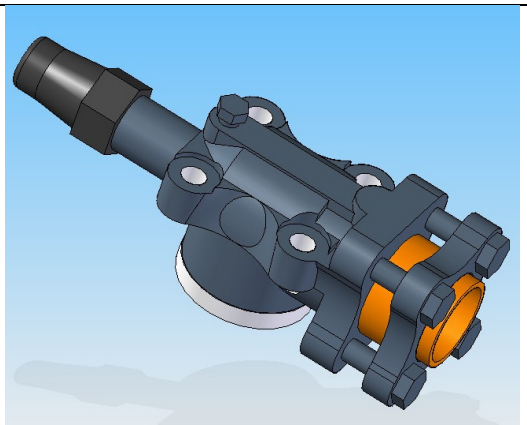
Valve types	
1	**2**
	

Table 17 Valve types

5.3 Shaft and connecting rods

SP Series are equipped with a balanced shaft using proper weights. For 2 and 4-cylinder models RP1-L/H2 and RP1-L/H4xx-S and RP1-L/H4xx-F the balancing weight is fixed to the shaft during the assembling phase with screws (see Fig. 51), while for 4-cylinder models RP1-L/H4 and all 6 and 8-cylinder models, this weights are realized directly in the shaft cast iron (see Fig. 53).

These different solutions entail a different procedure to assembling the connecting rods on the shaft.

5.3.1 Compressor models RP1-L/H2, RP1-L/H4xx-S, RP1-L/H4xx-F

The connecting rod for these compressors is realized in a single component (see Fig. 50), so the assembling is realized by moving the dial along the shaft until it reaches the correct position at the working cylinder.

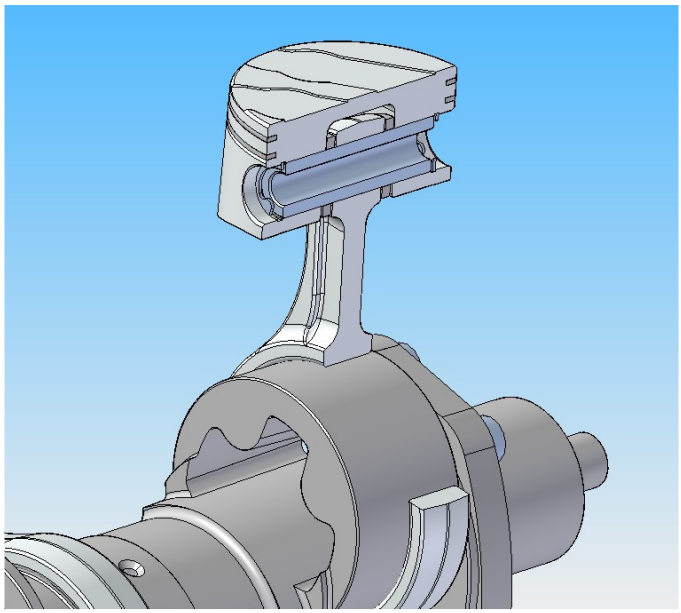


Fig. 50 Connecting rod for compressor models RP1-L/H2, RP1-L/H4xx-S, RP1-L/H4xx-F

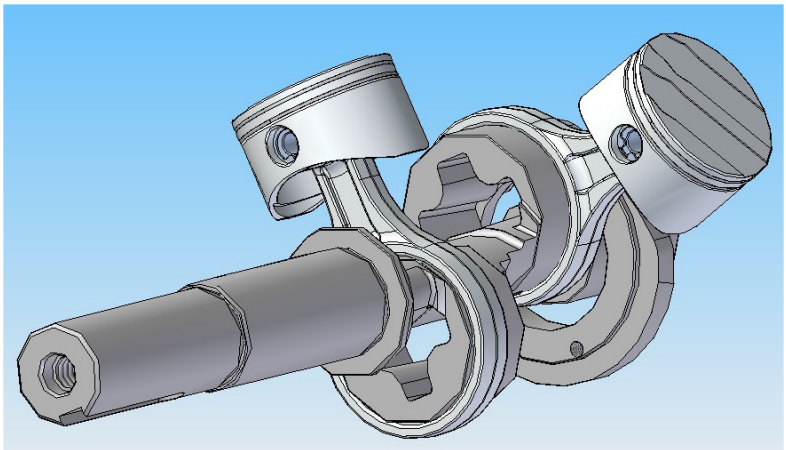


Fig. 51 Motor shaft and connecting rod for RP1-L/H2, RP1-L/H4xx-S, RP1-L/H4xx-F

5.3.2 Compressors model RP1-L/H4 and all 6 and 8-cylinder models

The connecting rod of these models is divided in two main parts, assembled together on the shaft with screws "A" shown in Fig. 52.

The connecting rod is coupled with the piston pivot through a bushing which allows a better lubrication of the system in order to grant a longer life, especially at low temperatures. See chapter "Tightening torque" to know the torque of the screw A.

Warning!

The two parts of the rod have to be assembled always in the same way, for this reason assembling signs are reported onto the parts.

Never mix the two parts of different rods.

Before assembling, the components should be lubricated with the same lubricant used in the compressor.

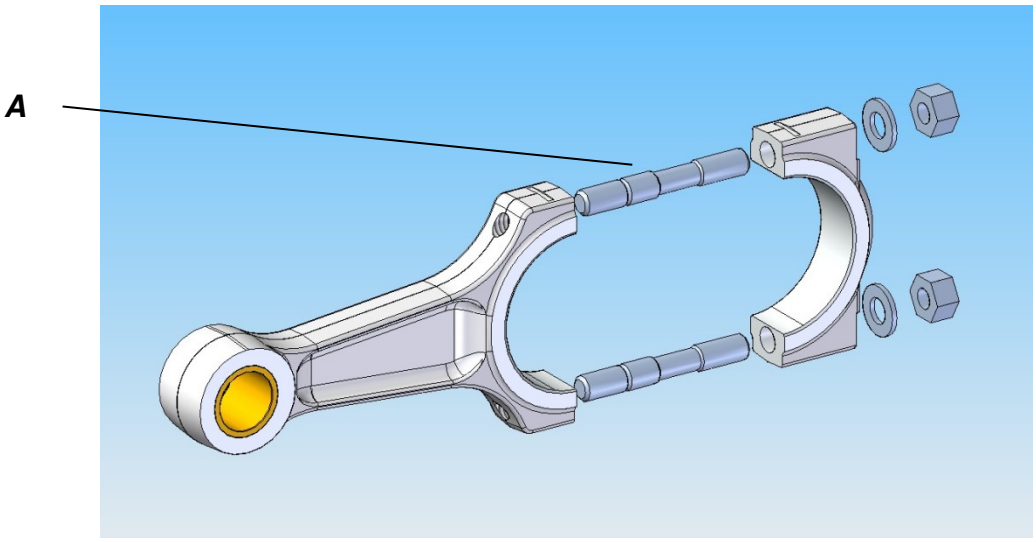


Fig. 52 Connecting rod components for compressors RP1-L/H4 and all 6 and 8-cylinder-models

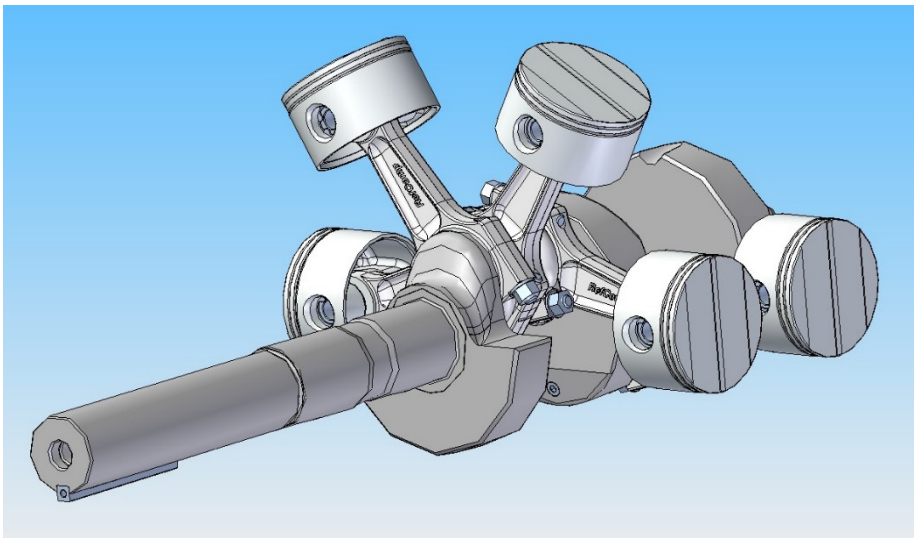


Fig. 53 Motor shaft and connecting rod for RP1-L/H4 and all 6 and 8-cylinder-models

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5.4 Pistons

The pistons are mounted with sealing/scraper rings as showed in the picture below.
It's necessary to assemble the scraper rings (rif. 4 in Fig. 54) in the correct direction, with the writing "TOP" up.

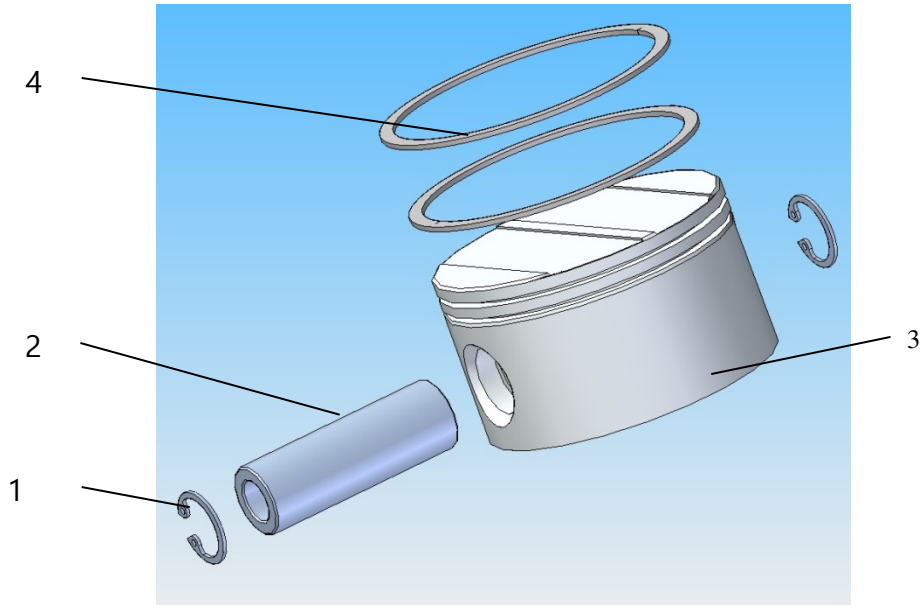


Fig. 54 *Piston*

1)Seeger ring
2)Pivot
3)Piston
4)Scraper ring

5.5 Valve plates

The valve plates differs according to cylinder size and components layout; the Table 17 show the valve plate type related to compressor models.
In the pictures of Table 17 it can be seen also the suction (A) and the discharge (B) holes and the dowel pin.
A gasket is assembled in the lower surface to divide the high and low pressures avoiding by-pass between pistons. Another gasket is assembled in the upper side in order to separate low pressure side (Suction) from high pressure side (Delivery).

To assemble the valve plate, follow the procedure below:

- Install the proper gasket on the compressor casing (the gasket shows part of the profiles of the intake valves)
- Insert the pins in holes indicated as P1 and P2 on the plate.
- Position the face indicated as "lower side" versus the compressor casing putting attention to position the pins P1 and P2 on the corresponding holes already present on the casing of the compressor.
- For the torque of the locking screws of the head please contact SRMTec.
- The plate valves and valves do not need maintenance

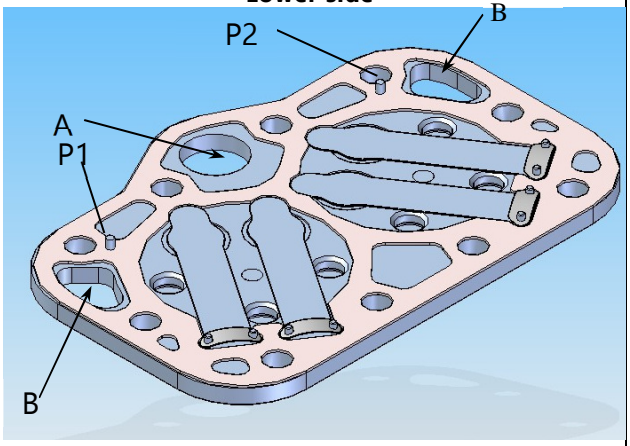
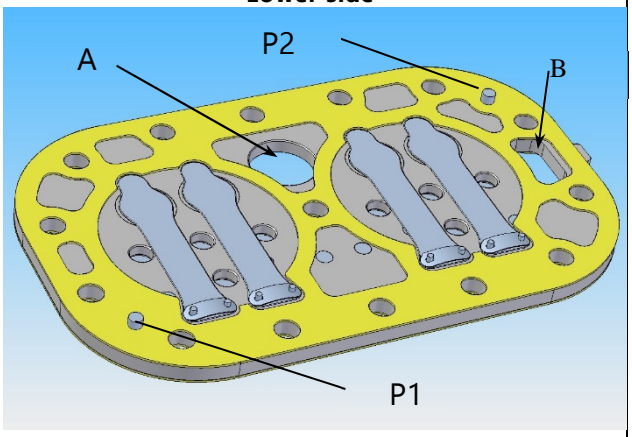
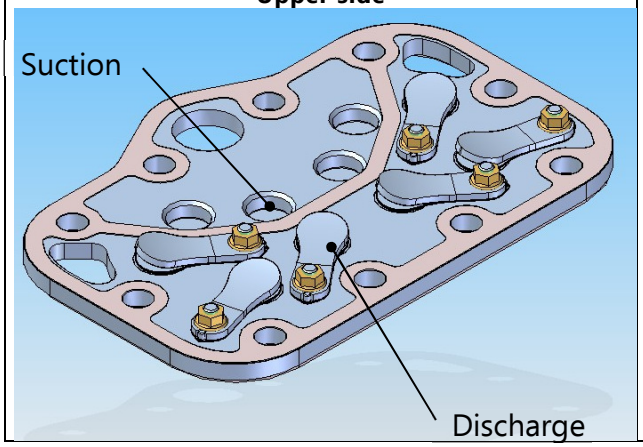
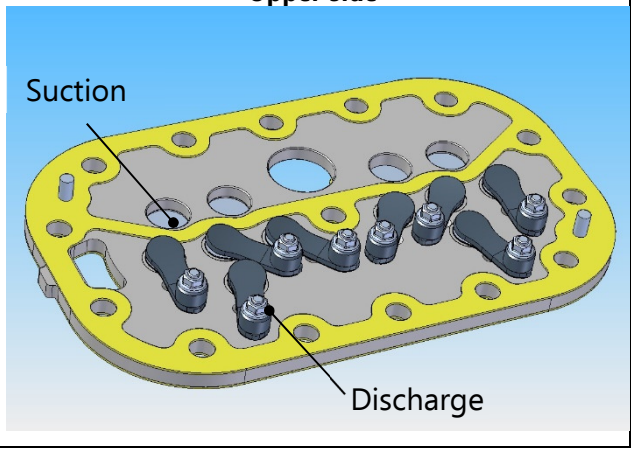
Valve plate types	
RP1-L/H2xx **RP1-L/H4xx-S** **RP1-L/H4xx-F**	**RP1-L/H4xx** **RP1-L/H6xx** **RP1-L/H8xx**
Lower side 	**Lower side** 
Upper side 	**Upper side** 

Table 18: Valve plate types

Warning!

To mount the plate is not necessary to use force; all the pieces must match in a natural way.

Carefully control the cleaning the plate, especially at the surfaces of the valves. If necessary, clean with a clean paper (do not touch these parts with the metal).

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5.6 Sleeve bearings

The crankshaft is supported by lubricated sleeve bearing on two sides: casing and pump support.
The sleeve bearings in the casing case are two and fitted as shown in Fig. 55, while on the pump support is single and assembled as shown in Fig. 56.

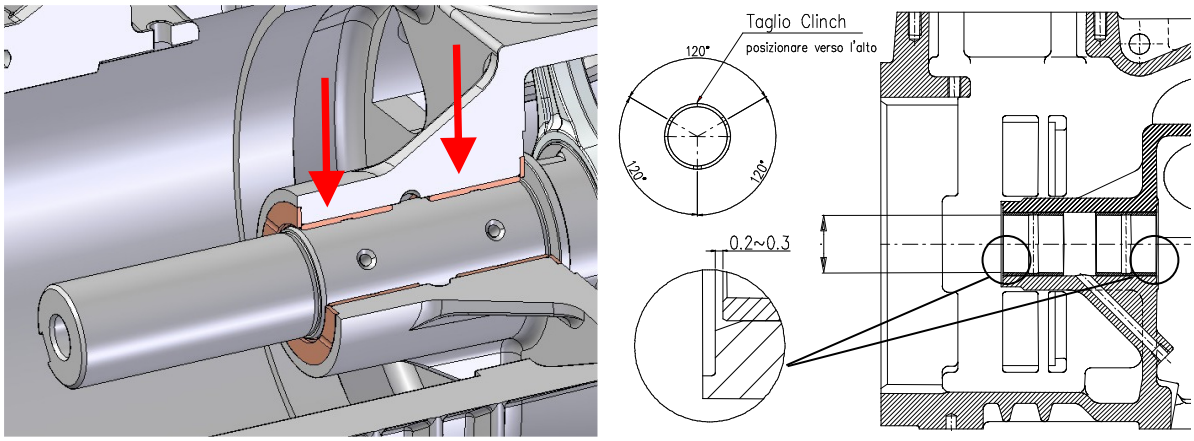

Fig. 55 *Bushing assembly on motor side*

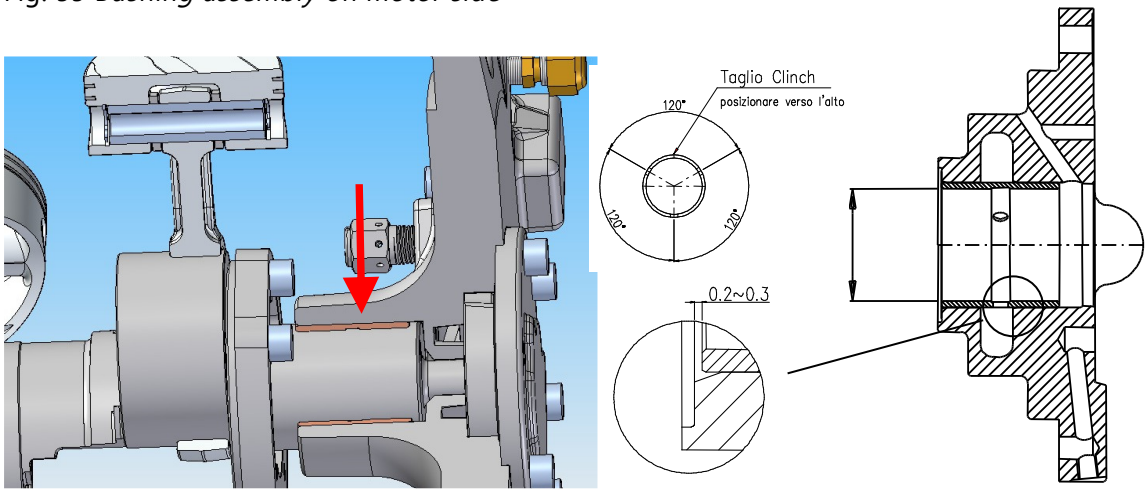

Fig. 56 Bushing assembly on pump support side

To assemble the sleeve bearings respect the following instructions:

- cutting "Clinch" should be placed at the top;
- respect a placement dimension of 0.2÷0.3 mm;
- assembled inner diameter should be Φ = 45.04 (+0/+0.04) mm.

Note: If it is necessary to replace the bushings, the new sleeve bearings can be mounted in the seat only if the maximum diameter is 50.016 mm. If the hole is larger, contact more information to SRM Italy Srl or Authorized Service Center.

5.7 Trust bearing washer

The compressors are equipped with thrust bearing washer; these are assembled in the casing in the motor shaft support and in the gear pump cover.
The trust bearings have to be fixed with special tools (see Fig. 57) which allow mounting these on the compressor casing and preventing their rotation.

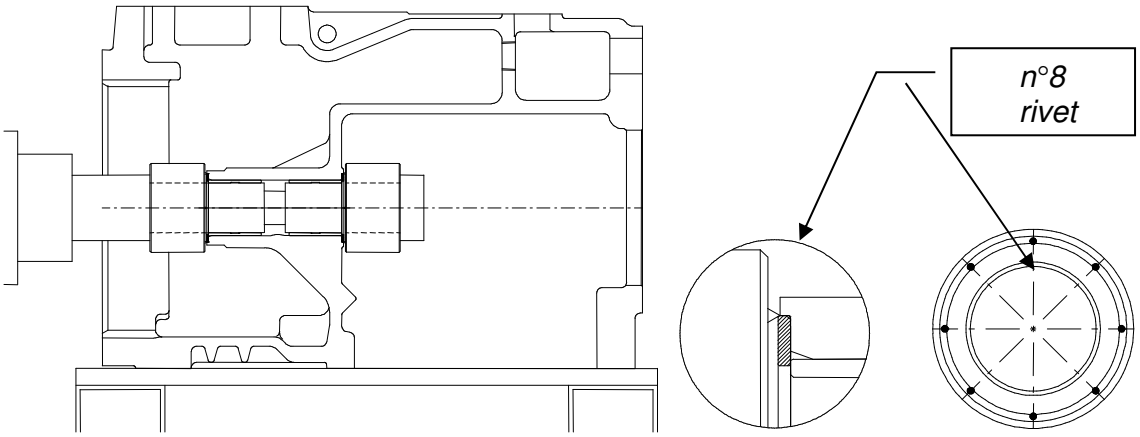

Fig. 57 Trust bearing washer assembly

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6 Electrical motor

The electrical connection of the machine to the network line must be carried out by the customer at its own expense and responsibility, by use of specialized personnel and in accordance with safety standard EN 60204.

It is mandatory to install upstream of the power supply line a suitable isolating device with residual current protection coordinated with the earth system.

Each connection must be performed under the conditions described in par. 1.5

6.1 General

The motor stator is secured to the compressor casing by using different system:

- Interference insertion for 2, 4, 6 cylinders;
- a screw and a key for 8 cylinders models.

Special tools could be required to replace the motor.

The electrical motors are designed and tested in compliance with the European standard EN 700-24035-2-34.

The electric motors are three-phase asynchronous two-pole motors (2900 rpm at 50 Hz). To reduce the peak current, they are available in the part-winding (PW) or star/delta (Y/Δ) version; for the standard supply see Table 20 in 7.1: Electrical specifications.

The electrical motors are three-phase asynchronous 4 poles motors (1450 rpm at 50 Hz).

The RP1-L/H2 series is equipped as standard with a double voltage motor:

- 230 V/3/50 Hz delta-connected;
- 400 V/3/50 Hz star-connected.

All models, starting from 4 cylinder models, are equipped as standard with part-winding (PW) motor, which allows to reduce starting current. It is also available, as option, a star-delta (Y/Δ) motor.

Depending on the compressor model there are two different types of PW motors which differ from each other for the connection of the three phases: star or delta type. In any case at the compressor starting only a part of the windings is powered, while in normal operation all are powered. The PW version can be:

✓ Double star (Y-YY);

✓ Double delta (Δ–ΔΔ).

As regards the mains connections, there is no difference between the two PW motor configurations. Fig. 58 and Fig. 59 below show the internal connections of the phases, depending on the configuration of the electrical motor.

- **PART-WINDING CONFIGURATION**

  Important note:

  The two above-mentioned part-winding types of motors can be distinguished by measuring the electrical resistance between terminals 1-2-3 and 7-8-9.

  With reference to Fig. 58:

  ✓ in the Y-YY configuration there is continuity between terminals 1 and 2, 1 and 3, 2 and 3, 7 and 8, 7 and 9, 8 and 9; while there is insulation between terminals 1 and 7/8/9, 2 and 7/8/9, 3 and 7/8/9.

- ✓ in the Δ-ΔΔ configuration there is continuity between each pair of terminals and there is not reciprocal insulation between any of them.

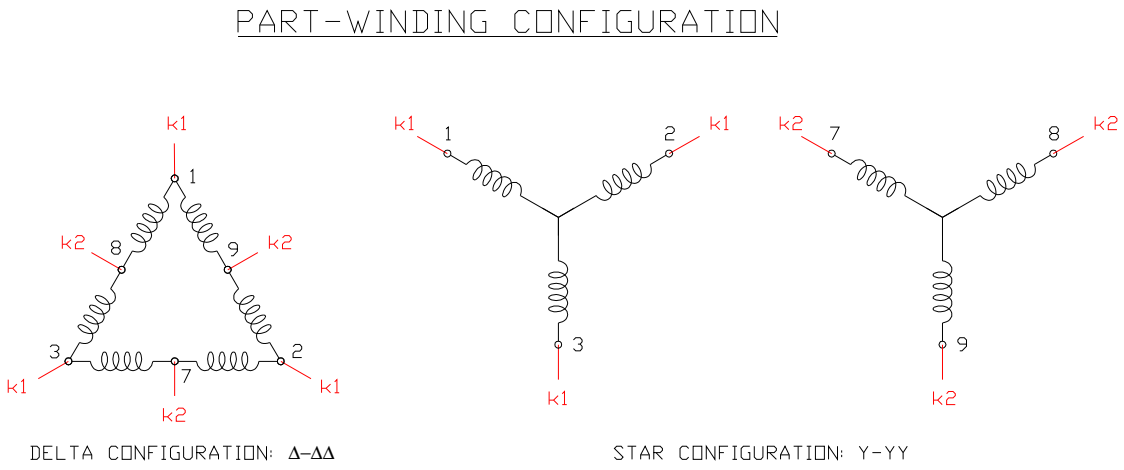


Fig. 58: internal winding connections for the motors with part-winding configuration

- **STAR-DELTA CONFIGURATION**

Important note:
With reference to Fig. 59, measuring the electrical resistance between terminals 1-2-3 and 7-8-9, the star-delta version has the following values: continuity between terminals 1 and 8, 3 and 7, 2 and 9, and insulation between terminals 1 and 2/3/7/9, 2 and 1/3/7/8, 3 and 1/2/8/9, 7 and 1/2/8/9, 8 and 2/3/7/9, 9 and 1/3/7/8.

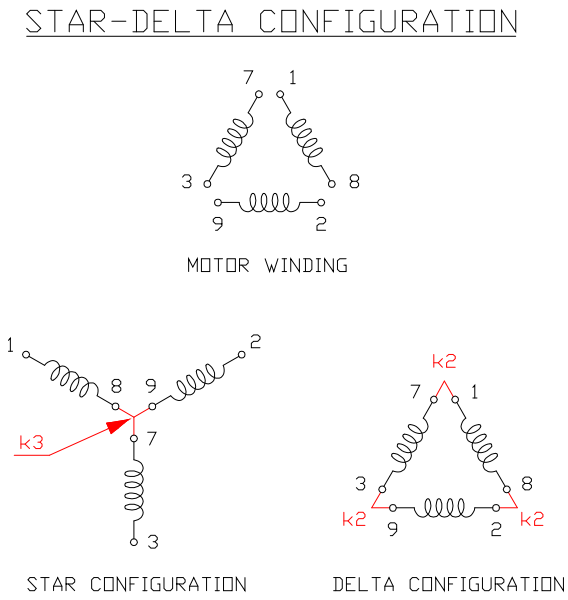


Fig. 59: internal winding connections for the motors with star-delta configuration

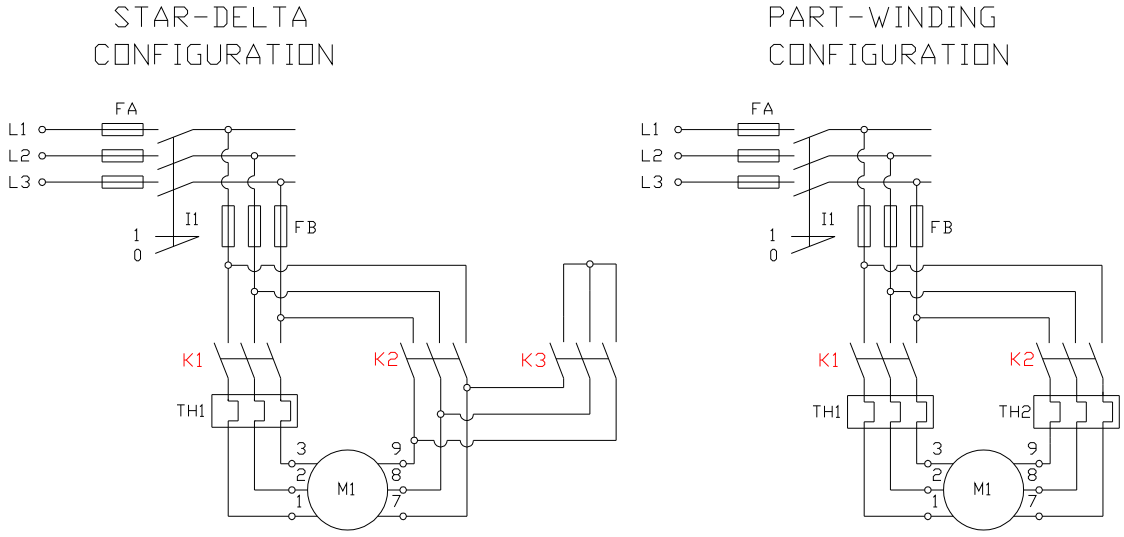
By starting the electrical motor either in part-winding configuration or with the windings in star connection for the electrical motor in star-delta configuration there is a reduction in the starting current LRA and starting torque. To achieve a reduction in the resisting torque and consequently start the motor without overloading it, it should be useful to use a pressure equalization device during the start-up.

Note:

The manufacturer suggests to install SU Heads (see Chapter 0: Capacity Control). See also chapter 0"Operating Instructions".

Fig. 60 shows how to connect the electrical motor to the three-phase line, both for the star-delta configuration and the part-winding one. It also gives the time sequence for the contactors. The compressor therefore starts as follows:

- ✓ In the PW motors, the delay in closing the run contactor K2 from when the starting contactor K1 closes must be 1 second maximum (recommended value 0.6 sec), see Fig. 60.
- ✓ In the star-delta configuration, on the other hand, the starting duration in star configuration (closing of contactors K1-K3) must not exceed 1.5 sec (recommended value 0.8/1 sec); while when switching to delta configuration (closing of contactors K1-K2), contactor K2 must be closed with a delay of 35-50 msec from the instant when contactor K3 is opened, see Fig. 60 again.



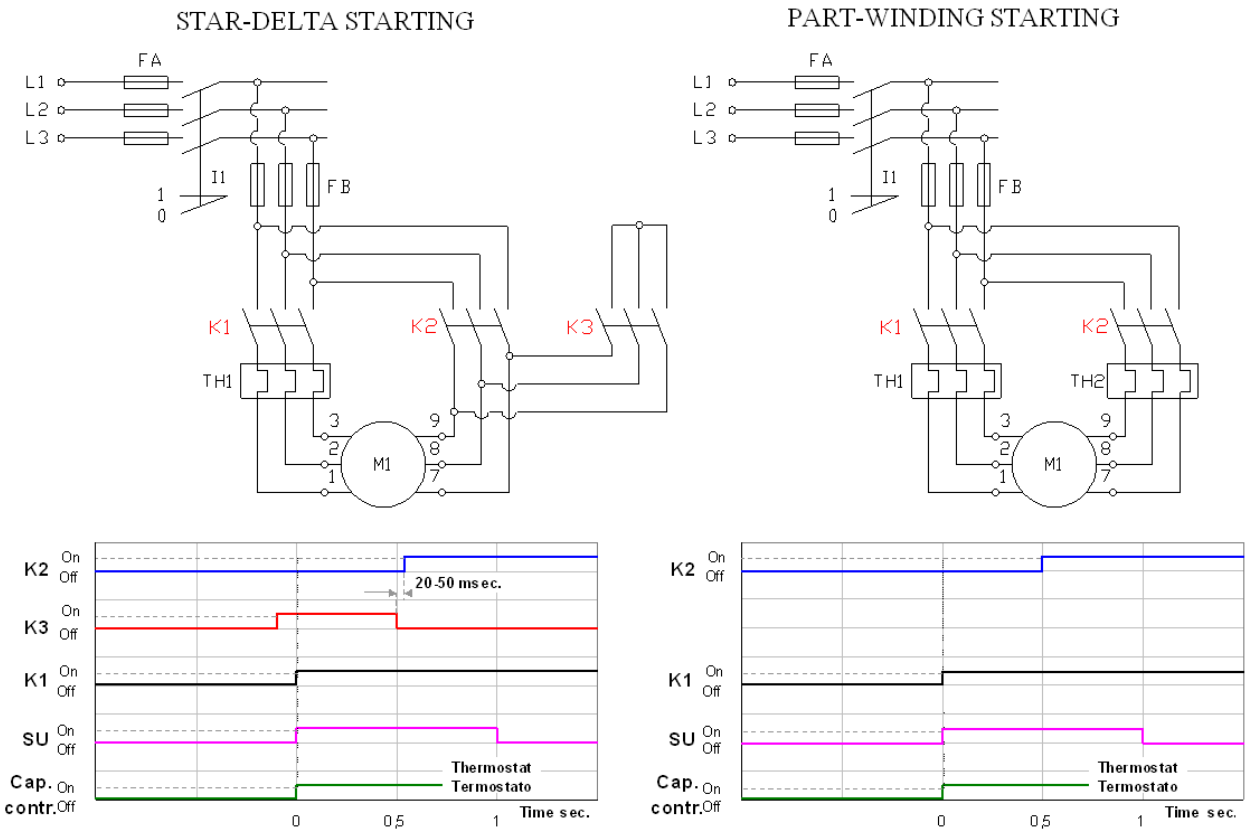


Fig. 60: connection diagrams to the three-phase network and time charts for the activation of contactors K1,K2 and K3 in the two compressor starting modes: star-delta and part-winding;
FA, FB: main fuses and compressor's fuses
I1: main switch; M1: electrical motor; TH1, TH2: overload relay;

6.2 Protection devices

6.2.1 Motor thermistors (standard)

To protect the motor against high temperatures six PTC thermistors connected in series are inserted in the motor windings. Three thermistors are positioned on the intake side of the motor (suction side) and have an activation temperature of 100°C, while the other three are positioned on the opposite side of the motor (discharge side) and have an activation temperature of 120°C.

The resistance of the chain of thermistors when cold (temperature less than 40°C) must be less than 1800 Ohm; but even if just one of the thermistors reaches the critical temperature, the resistance of the chain will increase exponentially, with the consequent activation of the INT 69 B2 electronic module (INT 69 SNY as an option), which cut off the power supply to the motor. The resistance can be measured between terminals T1 and T2 on the terminal block.

Attention !
When measuring the resistance of the thermistors' chain, never apply a voltage higher than 3V.

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6.2.2 INT 69 B2

This electronic protection module is supplied as standard with the compressor and in combination with the thermistors it carries out the function of monitoring the temperature of the electrical motor windings. The thermistors in the motor can be connected in series to a further PTC probe for monitoring the temperature of the oil (set point 120°C; chapter 8.1 shows the position of the temperature sensor in the compressor; see also chapter 12: "*Additional cooling*).
The protection device is electrically connected by the manufacturer as shown in Fig. 61. For the technical specifications of the module, see Table 19.

Activation threshold	4500 Ohm;
Reset threshold	2750 Ohm;
Power supply	230 V ±10%, 50/60 Hz, 3VA;
Switching relay	250 V AC, continuous current max 2.5 A, switch capacity 300 VA
Ambient temperature	-30° C...+70° C
Fuse required	4 A quick blow

Table 19: INT 69 B2 technical specifications

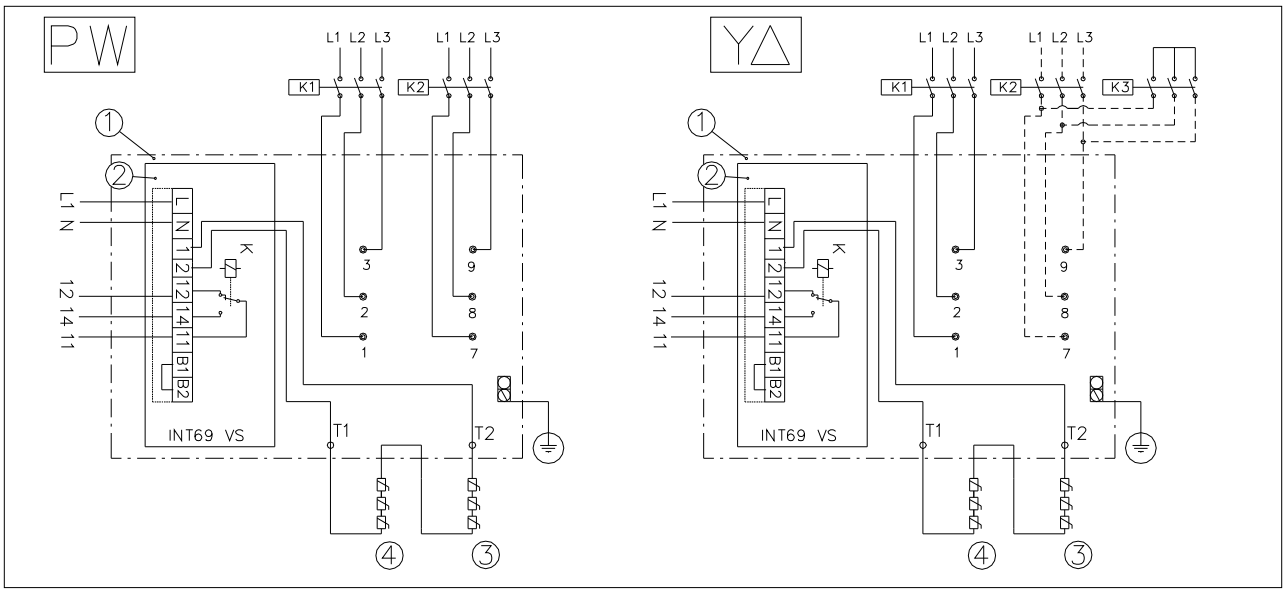

Fig. 61: electrical connections to the INT 69 B2 module (part-winding and star delta);

1: Terminal plate;
2: Motor protection device INT 69 B2;
3, 4: Motor thermistors PTC;
L1, L2, L3: Supply voltage;
PW: K1 Contactor 1st PW (PW 50%);
K2 Cont. 2nd PW (PW 50%);
Y/Δ: K1 and K3 Start contactors (Y);
K1 and K2 Run contactors (Δ);
L1/N: Phase + neutral;
11/14: Control circuit;
1/2 : Connection cables to thermistor (orange);
12: allarm;
B1, B2: Link for automatic reset;
K: Relay (supplied fitted);

To protect the electronic module, it is recommended to install a 4A fast-blow fuse to prevent the contacts from melting in the event of short-circuits.
The correct operation of the module must be checked when testing the installation and after any fault occurred in the auxiliary circuit. For this purpose, remove one of the connection wires from terminals T1 and T2 on the terminal block (not powered). When supplying power to the auxiliary control circuit, the power runs between terminals 12 and N, signaling an alarm.
In the event where the thermal protector on the electric motor is activated, this must be reset by specialist personnel. The device can only be reset after the causes of activation have been identified and removed.

Attention!
Following an alarm and after the motor has cooled down, an internal lockout prevents the compressor from starting again.

1. Reset the INT 69 B2 module by briefly disconnecting the power supply through the main switch or by pressing a specific button that can be installed for this purpose in the power supply line.
2. Never apply power to the module terminals 1-2, B1-B2, nor to terminals T1 and T2 of the terminal plate.

The protection device 69 INT VS installed on the compressor, cut off the power supply to electric motor with a total resistance of the thermocouples in the motor windings higher than 5.12 kΩ. The reset of the device is possible with a resistance value of less than 2.4 kΩ. A phase monitor must be installed to check the correct direction of the electrical motor rotation. The reset must occur only after it has been identified and eliminated the cause of protection. To change the default setting from manual to automatic reset, simply remove the bond between B1 and B2 (shown in the diagram of Figure 5 4). However, as indicated above, SRMTec recommends to make the automatic reset, because any operation of this protection means a malfunction of the system.

The delay for the restart of the compressor in case of intervention of temperature security probes of the motor is 30 minutes. This time is related to the cooling needs of the electric motor, otherwise the next start, in case the compressor has locked rotor, results in an excessive increase in temperature with the risk of burning.
The protection is installed in the terminal box driving through a "omega" but can also be installed in the central control panel and, therefore, at a remote location: in this case the cables connecting the probes should be twisted in order to not to be affected by noise and generate false alarms.
The cables connecting the probes to the terminals T1 and T2 of the motor terminal box must be twisted together, and possibly should be placed under power lines to prevent any disturbances.

6.3 Power supply

- Motor power supply for standard version (part-winding and star-delta):

  400 V - 3 phases - 50 Hz / 460 V - 3 phases - 60 Hz (other power supply on request);
- Permissible voltage range: ± 10 % of rated voltage;
- Permissible voltage unbalance between L1 - L2 - L3: ± 2 %;
- Maximum voltage drop during the starting phase: 10 % of rated voltage;
- Permissible frequency range: ± 2 % of rated frequency;
- Permissible current unbalance: 5 /12 % calculated as follows:

  Currents on the first contactor: I_1 - I_2 - I_3
  Currents on the second contactor: I_7 - I_8 - I_9
  Currents of each supply phase

$$I_R = I_1 + I_7$$
$$I_S = I_2 + I_8$$
$$I_T = I_3 + I_9$$

  Unbalance of the three R - S - T currents:

$$I_M = \frac{I_R + I_S + I_T}{3}$$
$$SB_3^{\%} = \frac{MAX\left|\left(I_R, I_S, I_T\right) - I_M\right|}{I_M} \cdot 100$$
$$SB_3^{\%} < 5\%$$

  Unbalance of the six 1 - 2 - 3 - 7 - 8 - 9 currents:

$$I_M = \frac{I_1 + I_2 + I_3 + I_7 + I_8 + I_9}{6}$$
$$SB_6^{\%} = \frac{MAX\left|\left(I_1, I_2, I_3, I_7, I_8, I_9\right) - I_M\right|}{I_M} \cdot 100$$
$$SB_6^{\%} < 12\%$$

6.4 Selection of electrical components

The various electrical components: cables, fuses etc. must be sized considering the maximum current that can be absorbed by the electrical motor during normal operation, i.e. the FLA.
Specifically, erring on the side of safety, in Part-Winding configuration the contacts on the motor contactors must be sized for a current equal to at least 65% of the maximum operating current (FLA). On the other hand, for the star-delta configuration the contacts must be sized for a current equal to at least 75% of the FLA.

6.5 Electrical supply for auxiliaries

The power supply of auxiliary electrical components (solenoids, crankcase heater etc..) is, as standard, 230V 50/60Hz.
As option the power supply of the auxiliaries could be:

- 110V 50/60Hz
- 24V AC 50/60Hz

It's not necessary that all auxiliaries have the same power supply.

6.6 Size of the motor

The electrical motor is available in two different sizes:

- Full size motor: "H"
- Small size motor: "L"

High condensing and low evaporating temperatures require a full size motor: see chapter 11 *"Application range"*

To verify the sizes of the suggested motor, please refer also to the used refrigerant.

6.7 Electrical box

The protection degree of electrical box is IP54. This protection is achieved if all the gaskets, seals and connections are properly installed after the installation of electric cables. In particular pay attention to the screws "A" in Fig. 63: these screws must be fitted with the Teflon washer with which they are provided, if the washer were omitted, the degree of protection is not guaranteed.

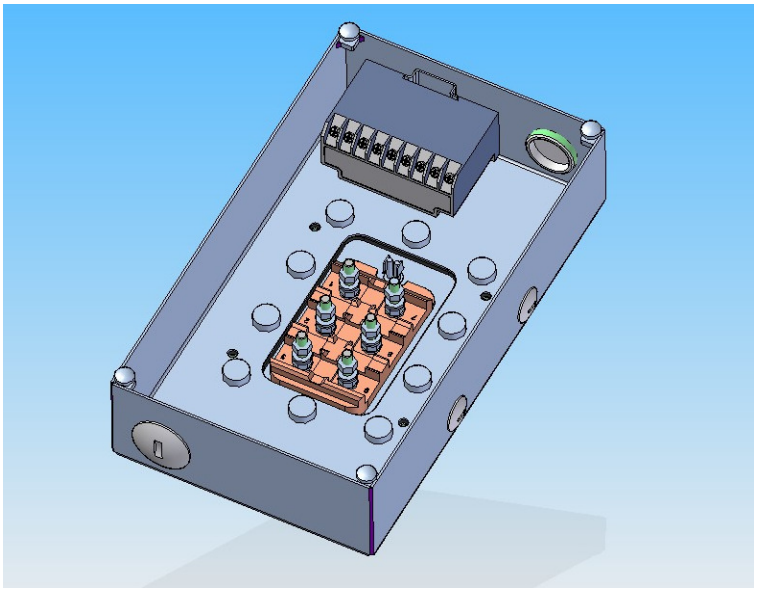

Fig. 62 *Electrical board and terminal plate*

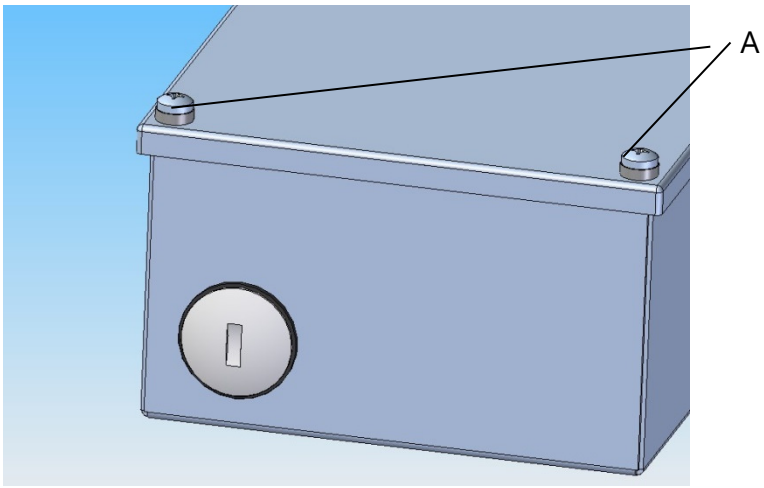

Fig. 63 Electrical box: teflon washer

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6.8 Terminal board

The terminal board inside the electrical box has 6 terminals connected with electrical motor. These 6 terminals are insulated with glass inserts from the metallic parts and, in the upper part, the glass is coated with rubber insulation and prevents any condensation which, touching the same terminal, could cause a short circuit. During the maintenance operations must make sure that the rubber that has not been damaged. During routine maintenance is necessary to verify the tightness of the cables.

The direction of rotation is not important, so the power supply connection hasn't a right direction. It's enough to verify that:

- the first phase is connected to terminals 1-7
- the second phase is connected to terminals 2-8
- the third phase is connected to terminals 3-9

The electric motor, if necessary, can also be used with direct starting (DOL). To do so can be used bonds between pin 1-7, 2-8 and 3-9 of the terminal boars as shown in Picture 5 6. The bonds for the direct starting are provided with the compressor, as a separate kit (code 303167).

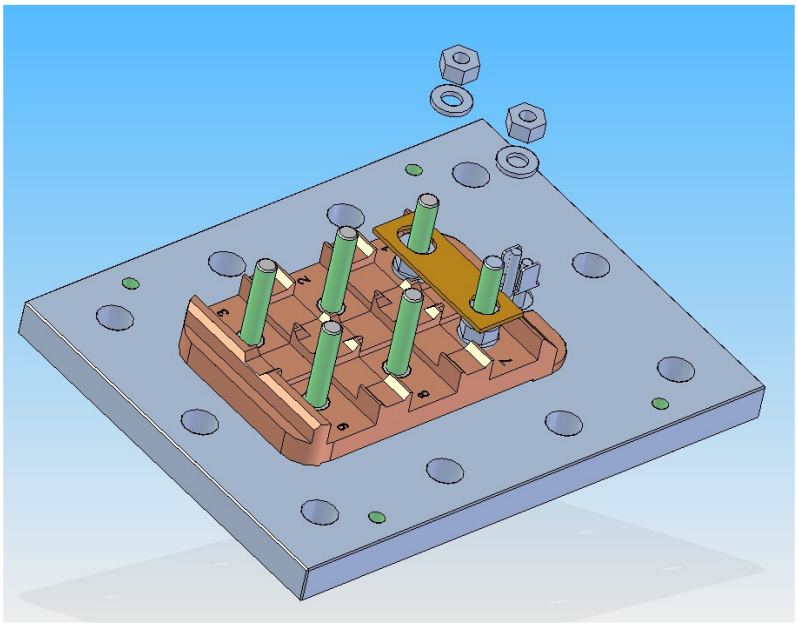


Fig. 64 Bonds on terminal board for DOL starting

7 Data

7.1 Electrical data

Mod. RP1-			H205	H206	H208	H209	H410-S/F	H412-S/F	H415-S/F	H420-S/F	H422	H425	H430	H435	H637	H640	H650	8H60	8H70
Nominal motor power		HP/kW*	5/3,7	6/4,4	8/5,9	9/6,6	10/7,5	12/8,9	15/11	20/15	22/16,4	25/18,5	30/22	35/26,1	37/27,6	40/30	50/37	60/45	70/52
Nominal Voltage (V)		V	230V Δ – 400V Y				400/3/50Hz - 460/3/60Hz												
PW	Starting current (A)	LRA Y					71	75	86	106	102	123	150	178	178	201	233	271	329
		LRA YY					110	125	144	108	170	201	243	290	290	330	394	361	439
	Max running current (A)	FLA					24	27	33	40	37	43	52	56	60	75	93	115	140
Y / Δ	Starting current (A)	LRA Y	54	60	85	85													
		LRA Δ	54	60	85	85													
	Max running current (A)	FLA	12	14	16	20													
Crankcase heater			120W PTC 230V-50/60Hz				220W 230V-50/60Hz				150W 230V-50/60Hz							200W 230V-50/60Hz	

Standard Delivery - Fornitura standard

Table 20: electrical data of H version;

Mod. RP1-			L203	L204	L205	L206	L406-S/F	L408-S/F	L410-S/F	L412-S/F	L415	L418	L422	L425	L627	L630	L640	L850	L860
Nominal motor power		Hp/kW*	3/2	4/3	5/3,7	6/4,4	6/4,5	8/5,9	10/7,5	12/8,9	15/11	18/13,3	22/16,4	25/18,5	27/20,2	30/22	40/30	50/37	60/45
Nominal Voltage (V)		V	230V Δ – 400V Y				400/3/50Hz - 460/3/60Hz												
PW	Starting current (A)	LRA Y					43	54	71	75	88	102	102	123	123	150	201	233	271
		LRA YY					70	86	110	125	146	170	170	201	201	243	330	394	361
	Max running current (A)	FLA					16	19	24	27	29	33	39	43	48	54	75	97	115
Y / Δ	Starting current (A)	LRA Y	35	49	54	60													
		LRA Δ	35	49	54	60													
	Max running current (A)	FLA	9	10	12	14													
Crankcase heater			120W PTC 230V-50/60Hz				220W 230V-50/60Hz				150W 230V-50/60Hz							200W 230V-50/60Hz	

Standard Delivery - Fornitura standard

Table 21: electrical data of L version;

7.2 Technical data

Mod. RP1-		H205	H206	H208	H209	H410-S/F	H412-S/F	H415-S/F	H420-S/F	H422	H425	H430	H435	H637	H640	H650	8H60	8H70
Nominal motor power	HP/kW*	5/3,7	6/4,4	8/5,9	9/6,6	10/7,5	12/8,9	15/11	20/15	22/16,4	25/18,5	30/22	35/26,1	37/27,6	40/30	50/37	60/45	70/52
Displacement at 50/60Hz	m^3/h	17,5/21	21/25,7	24,5/29,4	28/33,6	35/42	42/50,4	49/58,8	56/67,2	64,7/77,6	75,90	86,1/ 103,3	102,9/ 123,5	112,5/ 135	129,1/ 154,9	154,4/ 186,3	186/224	222/268
No. of cylinders	-	2	2	2	2	4	4	4	4	4	4	4	4	6	6	6	8	8
Weight	Kg	86	87	87	91	143	146	152	156	193	206	209	238	241	246	250	345	360
Oil charge	L	1,8	1,8	1,8	2,6	2,6	2,6	2,6	3,7	3,7	3,7	3,7	4,2	4,2	4,2	4,2	5	5
Suction line internal Ø	mm (in.)	16 (5/8")	16 (5/8")	22 (7/8")	22 (7/8")	22 (7/8")	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)	35 (1"3/8)	42 (1"5/8)	54 (2"1/8)	54 (2"1/8)
Discharge line internal Ø	mm/in.	28 (1"1/8)	28 (1"1/8)	28 (1"1/8)	28 (1"1/8)	28 (1"1/8)	35 (1"3/8)	42 (1"5/8)	42 (1"5/8)	42 (1"5/8)	54 (2"1/8)	54 (2"1/8)	54 (2"1/8)	54 (2"1/8)	54 (2"1/8)	54 (2"1/8)	67 (2"5/8)	67 (2"5/8)
Capacity control steps		-	-	-	-	100, 50%	100, 50%	100, 50%	100, 50%	100, 50%	100, 50%	100, 50%	100, 50%	100, 66, 33%	100, 66, 33%	100, 66, 33%	100, 75, 50%	100, 75, 50%

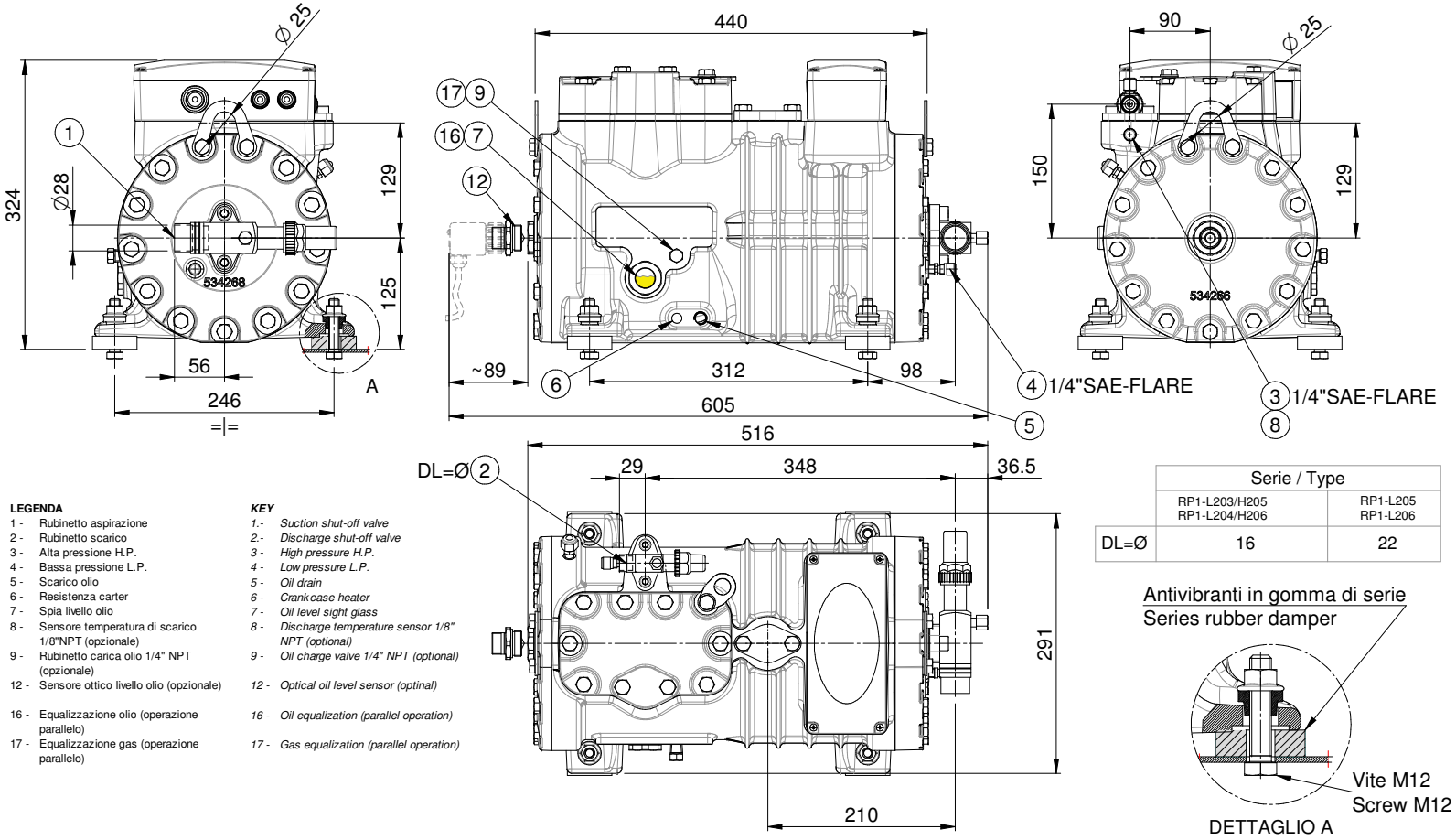
Table 22: technical data of H version;

Mod. RP1-		L203	L204	L205	L206	L406-S/F	L408-S/F	L410-S/F	L412-S/F	L415	L418	L422	L425	L627	L630	L640	L850	L860
Nominal motor power	HP/kW*	3/2	4/3	5/3,7	6/4,4	6/4,5	8/5,9	10/7,5	12/8,9	15/11	18/13,3	22/16,4	25/18,5	27/20,2	30/22	40/30	50/37	60/45
Displacement at 50/60Hz	m^3/h	17,5/21	21/25,7	24,5/29,4	28/33,6	35/42	42/50,4	49/58,8	56/67,2	64,7/77,6	75,90	86,1/ 103,3	102,9/ 123,5	112,5/ 135	129,1/ 154,9	154,4/ 186,3	186/224	222/268
No. of cylinders	-	2	2	2	2	4	4	4	4	4	4	4	4	6	6	6	8	8
Weight	Kg	84	85	85	86	134	139	144	146	182	186	195	220	230	236	247	340	345
Oil charge	L	1,8	1,8	1,8	2,6	2,6	2,6	2,6	3,7	3,7	3,7	3,7	4,2	4,2	4,2	4,2	5	5
Suction line internal Ø	mm (in.)	16 (5/8")	16 (5/8")	22 (7/8")	22 (7/8")	22 (7/8")	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)	35 (1"3/8)	42 (1"5/8)	54 (2"1/8)	54 (2"1/8)
Discharge line internal Ø	mm/in.	28 (1"1/8)	28 (1"1/8)	28 (1"1/8)	28 (1"1/8)	28 (1"1/8)	35 (1"3/8)	42 (1"5/8)	42 (1"5/8)	42 (1"5/8)	54 (2"1/8)	54 (2"1/8)	54 (2"1/8)	54 (2"1/8)	54 (2"1/8)	54 (2"1/8)	67 (2"5/8)	67 (2"5/8)
Capacity control steps		-	-	-	-	100, 50%	100, 50%	100, 50%	100, 50%	100, 50%	100, 50%	100, 50%	100, 50%	100, 66, 33%	100, 66, 33%	100, 66, 33%	100, 75, 50%	100, 75, 50%

Table 23: technical data of L version;

8 Dimensional drawings and packaging

8.1 Dimensional drawings



LEGENDA

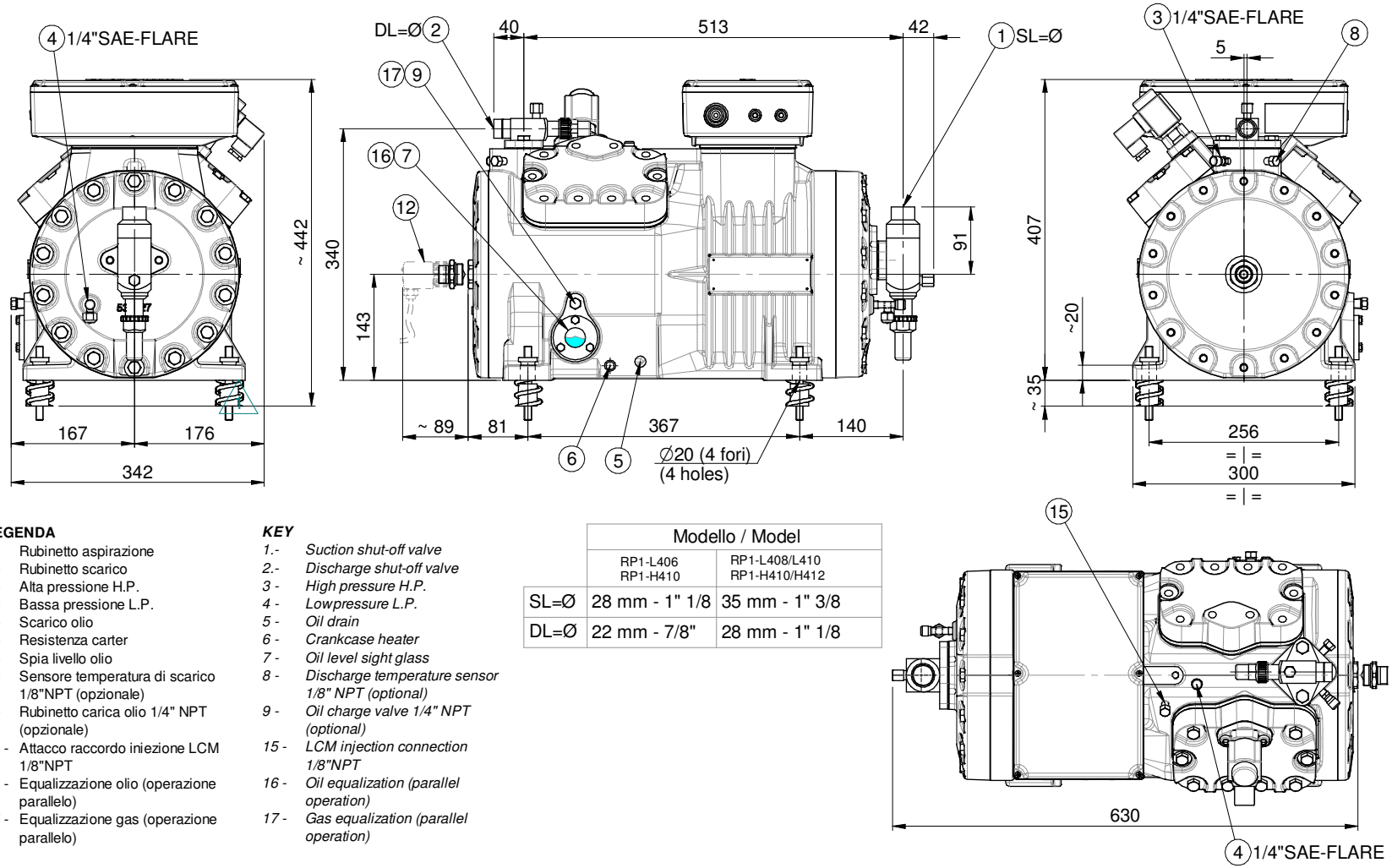
1 -	Rubinetto aspirazione
2 -	Rubinetto scarico
3 -	Alta pressione H.P.
4 -	Bassa pressione L.P.
5 -	Scarico olio
6 -	Resistenza carter
7 -	Spia livello olio
8 -	Sensore temperatura di scarico 1/8"NPT (opzionale)
9 -	Rubinetto carica olio 1/4" NPT (opzionale)
12 -	Sensore ottico livello olio (opzionale)
16 -	Equalizzazione olio (operazione parallelo)
17 -	Equalizzazione gas (operazione parallelo)

KEY

1.-	*Suction shut-off valve*
2.-	*Discharge shut-off valve*
3 -	*High pressure H.P.*
4 -	*Low pressure L.P.*
5 -	*Oil drain*
6 -	*Crankcase heater*
7 -	*Oil level sight glass*
8 -	*Discharge temperature sensor 1/8" NPT (optional)*
9 -	*Oil charge valve 1/4" NPT (optional)*
12 -	*Optical oil level sensor (optinal)*
16 -	*Oil equalization (parallel operation)*
17 -	*Gas equalization (parallel operation)*

	Serie / Type	
	RP1-L203/H205 RP1-L204/H206	RP1-L205 RP1-L206
DL=Ø	16	22

Fig. 65 Dimensions of models RP1-L203/204 RP1-H205/206



LEGENDA

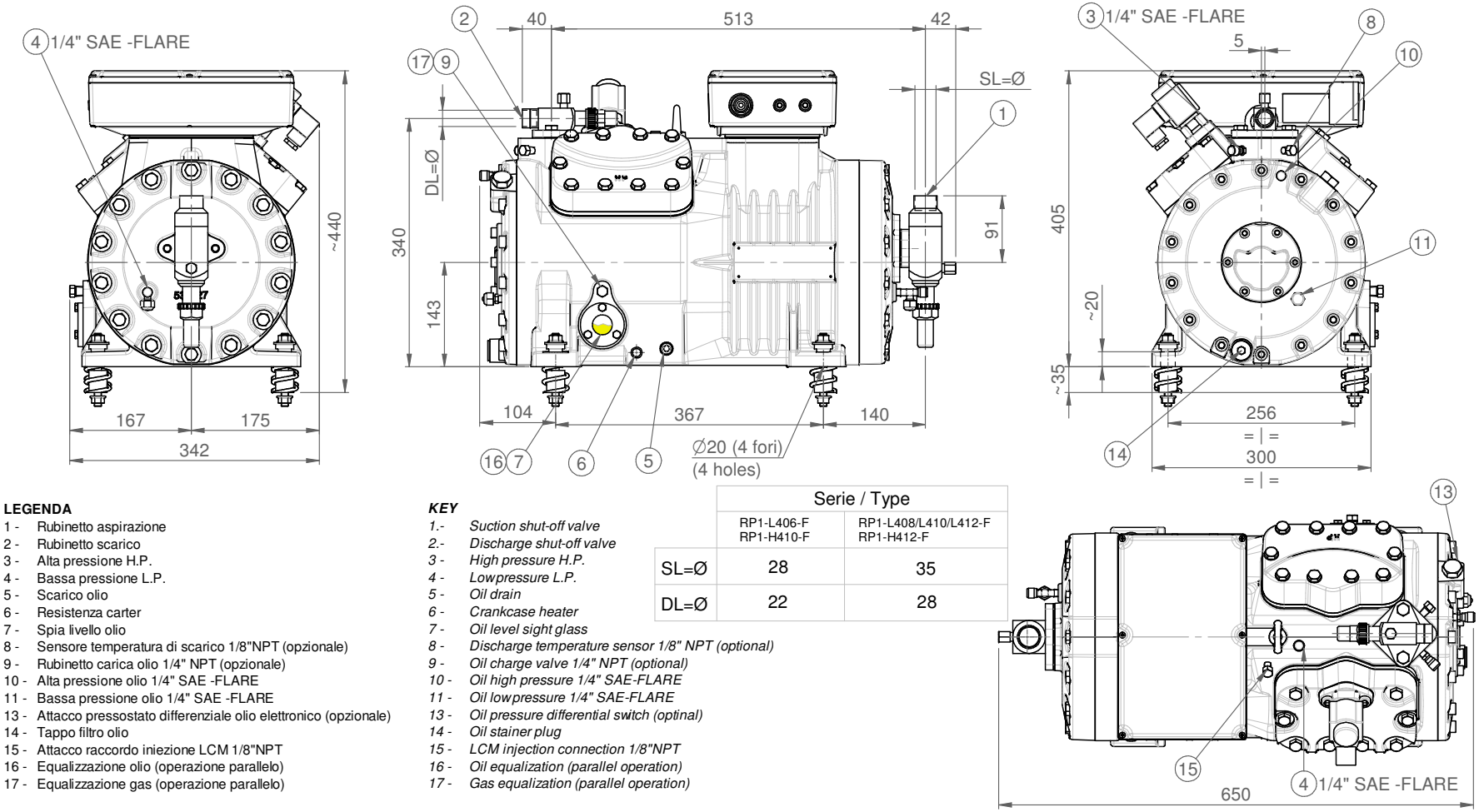
1 - Rubinetto aspirazione
2 - Rubinetto scarico
3 - Alta pressione H.P.
4 - Bassa pressione L.P.
5 - Scarico olio
6 - Resistenza carter
7 - Spia livello olio
8 - Sensore temperatura di scarico 1/8"NPT (opzionale)
9 - Rubinetto carica olio 1/4" NPT (opzionale)
15 - Attacco raccordo iniezione LCM 1/8"NPT
16 - Equalizzazione olio (operazione parallelo)
17 - Equalizzazione gas (operazione parallelo)

KEY

1.- Suction shut-off valve
2.- Discharge shut-off valve
3 - High pressure H.P.
4 - Lowpressure L.P.
5 - Oil drain
6 - Crankcase heater
7 - Oil level sight glass
8 - Discharge temperature sensor 1/8" NPT (optional)
9 - Oil charge valve 1/4" NPT (optional)
15 - LCM injection connection 1/8"NPT
16 - Oil equalization (parallel operation)
17 - Gas equalization (parallel operation)

	Modello / Model	
	RP1-L406 RP1-H410	RP1-L408/L410 RP1-H410/H412
SL=Ø	28 mm - 1" 1/8	35 mm - 1" 3/8
DL=Ø	22 mm - 7/8"	28 mm - 1" 1/8

Fig. 66 Dimensions of models RP1-L406/408-S, RP1-H410/412-S



LEGENDA

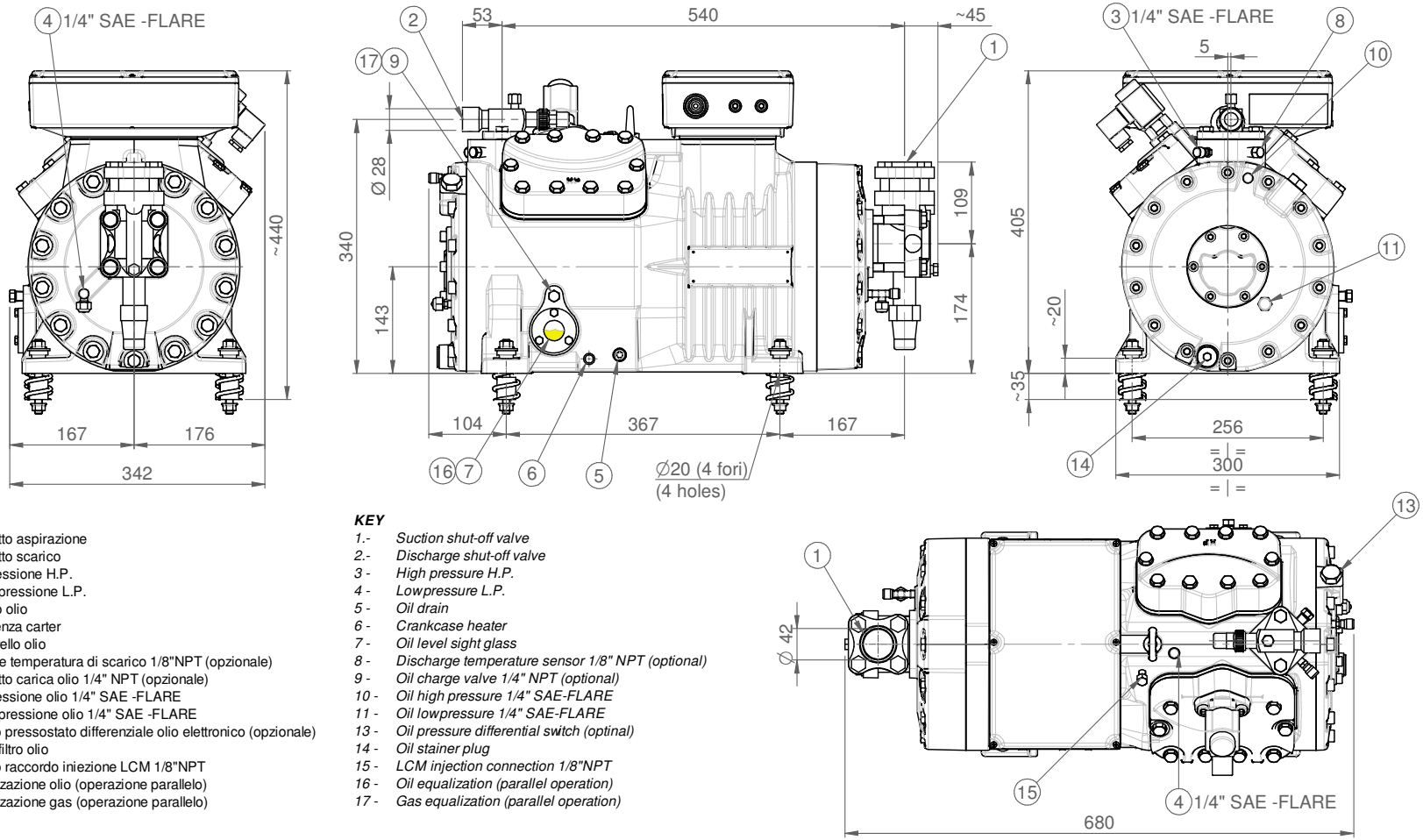
1 - Rubinetto aspirazione
2 - Rubinetto scarico
3 - Alta pressione H.P.
4 - Bassa pressione L.P.
5 - Scarico olio
6 - Resistenza carter
7 - Spia livello olio
8 - Sensore temperatura di scarico 1/8"NPT (opzionale)
9 - Rubinetto carica olio 1/4" NPT (opzionale)
10 - Alta pressione olio 1/4" SAE -FLARE
11 - Bassa pressione olio 1/4" SAE -FLARE
13 - Attacco pressostato differenziale olio elettronico (opzionale)
14 - Tappo filtro olio
15 - Attacco raccordo iniezione LCM 1/8"NPT
16 - Equalizzazione olio (operazione parallelo)
17 - Equalizzazione gas (operazione parallelo)

KEY

1.- Suction shut-off valve
2.- Discharge shut-off valve
3 - High pressure H.P.
4 - Lowpressure L.P.
5 - Oil drain
6 - Crankcase heater
7 - Oil level sight glass
8 - Discharge temperature sensor 1/8" NPT (optional)
9 - Oil charge valve 1/4" NPT (optional)
10 - Oil high pressure 1/4" SAE-FLARE
11 - Oil lowpressure 1/4" SAE-FLARE
13 - Oil pressure differential switch (optinal)
14 - Oil stainer plug
15 - LCM injection connection 1/8"NPT
16 - Oil equalization (parallel operation)
17 - Gas equalization (parallel operation)

	Serie / Type	
	RP1-L406-F RP1-H410-F	RP1-L408/L410/L412-F RP1-H412-F
SL=Ø	28	35
DL=Ø	22	28

Fig. 67 Dimensions of models RP1-L406/408-F, RP1-H410/412-F



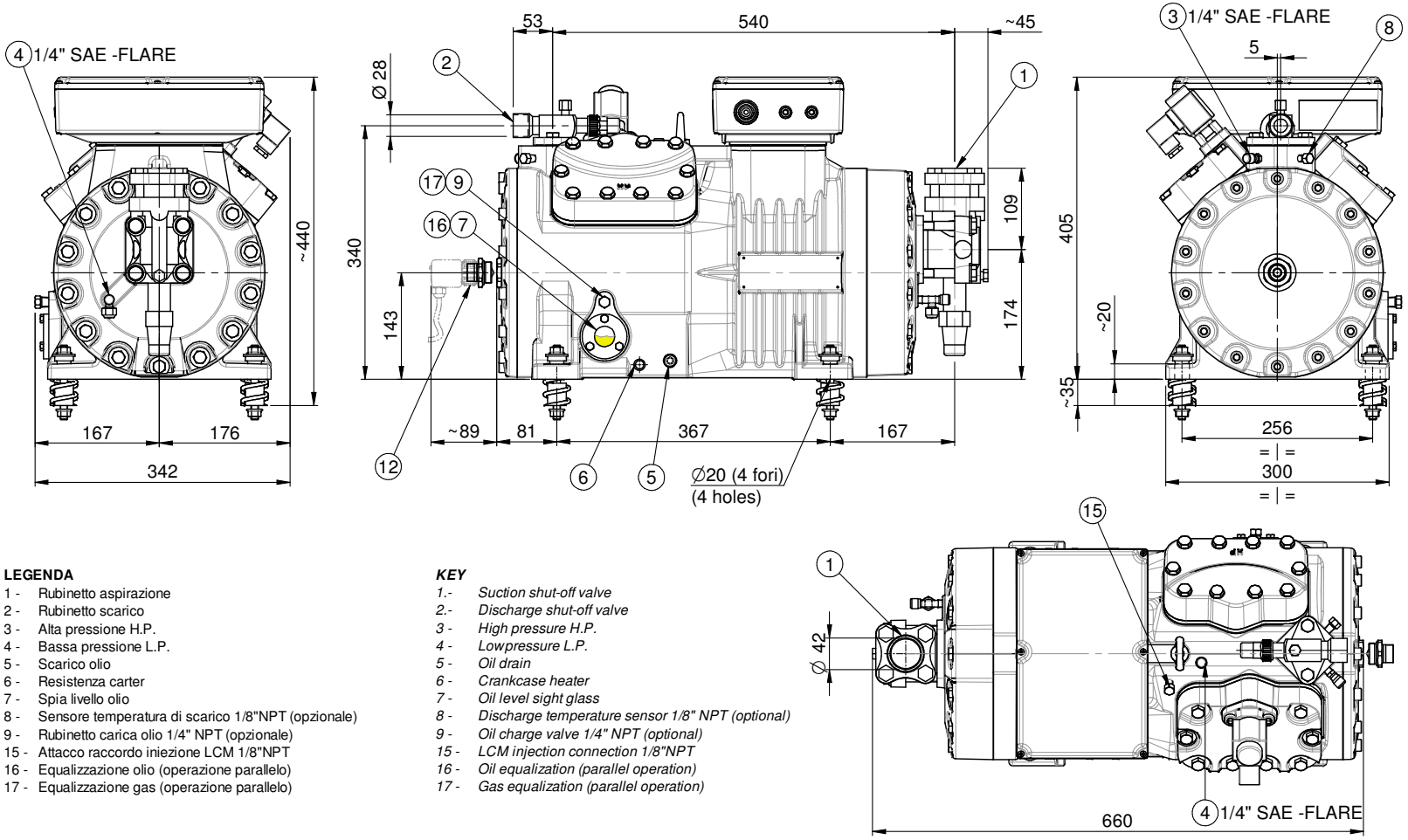
LEGENDA

1 - Rubinetto aspirazione
2 - Rubinetto scarico
3 - Alta pressione H.P.
4 - Bassa pressione L.P.
5 - Scarico olio
6 - Resistenza carter
7 - Spia livello olio
8 - Sensore temperatura di scarico 1/8"NPT (opzionale)
9 - Rubinetto carica olio 1/4" NPT (opzionale)
10 - Alta pressione olio 1/4" SAE -FLARE
11 - Bassa pressione olio 1/4" SAE -FLARE
13 - Attacco pressostato differenziale olio elettronico (opzionale)
14 - Tappo filtro olio
15 - Attacco raccordo iniezione LCM 1/8"NPT
16 - Equalizzazione olio (operazione parallelo)
17 - Equalizzazione gas (operazione parallelo)

KEY

1.- Suction shut-off valve
2.- Discharge shut-off valve
3 - High pressure H.P.
4 - Lowpressure L.P.
5 - Oil drain
6 - Crankcase heater
7 - Oil level sight glass
8 - Discharge temperature sensor 1/8" NPT (optional)
9 - Oil charge valve 1/4" NPT (optional)
10 - Oil high pressure 1/4" SAE-FLARE
11 - Oil lowpressure 1/4" SAE-FLARE
13 - Oil pressure differential switch (optinal)
14 - Oil stainer plug
15 - LCM injection connection 1/8"NPT
16 - Oil equalization (parallel operation)
17 - Gas equalization (parallel operation)

Fig. 68 Dimensions of models RP1-L410/412-F, RP1-H415/420-F



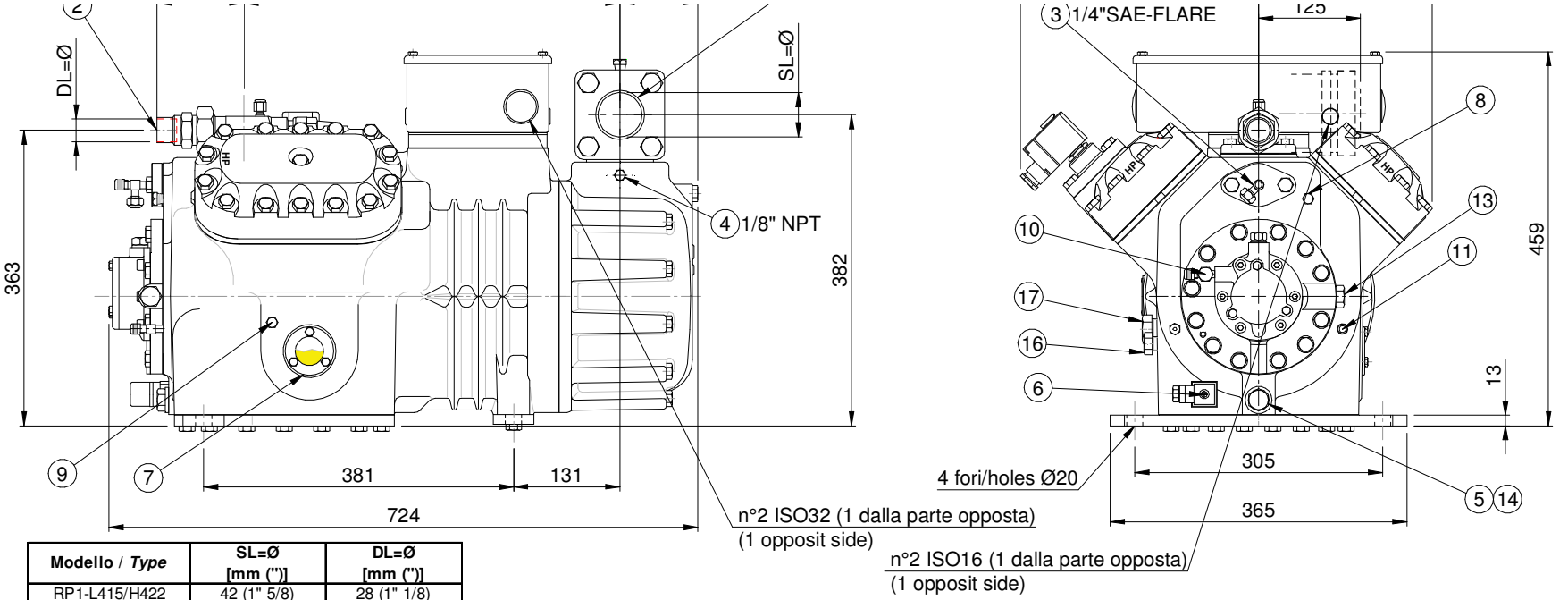
LEGENDA

1 - Rubinetto aspirazione
2 - Rubinetto scarico
3 - Alta pressione H.P.
4 - Bassa pressione L.P.
5 - Scarico olio
6 - Resistenza carter
7 - Spia livello olio
8 - Sensore temperatura di scarico 1/8"NPT (opzionale)
9 - Rubinetto carica olio 1/4" NPT (opzionale)
15 - Attacco raccordo iniezione LCM 1/8"NPT
16 - Equalizzazione olio (operazione parallelo)
17 - Equalizzazione gas (operazione parallelo)

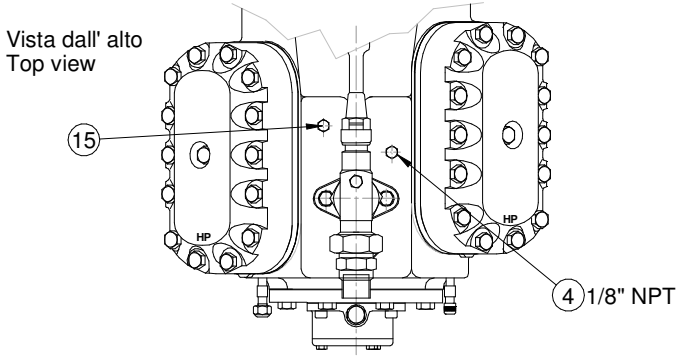
KEY

1.- Suction shut-off valve
2.- Discharge shut-off valve
3 - High pressure H.P.
4 - Lowpressure L.P.
5 - Oil drain
6 - Crankcase heater
7 - Oil level sight glass
8 - Discharge temperature sensor 1/8" NPT (optional)
9 - Oil charge valve 1/4" NPT (optional)
15 - LCM injection connection 1/8"NPT
16 - Oil equalization (parallel operation)
17 - Gas equalization (parallel operation)

Fig. 69 Dimensions of models RP1-L410/412-S, RP1-H415/420-S



Modello / *Type*	SL=Ø [mm (")]	DL=Ø [mm (")]
RP1-L415/H422	42 (1" 5/8)	28 (1" 1/8)
RP1-L418/H425	42 (1" 5/8)	28 (1" 1/8)
RP1-L422/H430	54 (2" 1/8)	28 (1" 1/8)
RP1-L425/H435	54 (2" 1/8)	35 (1" 3/8)



LEGENDA

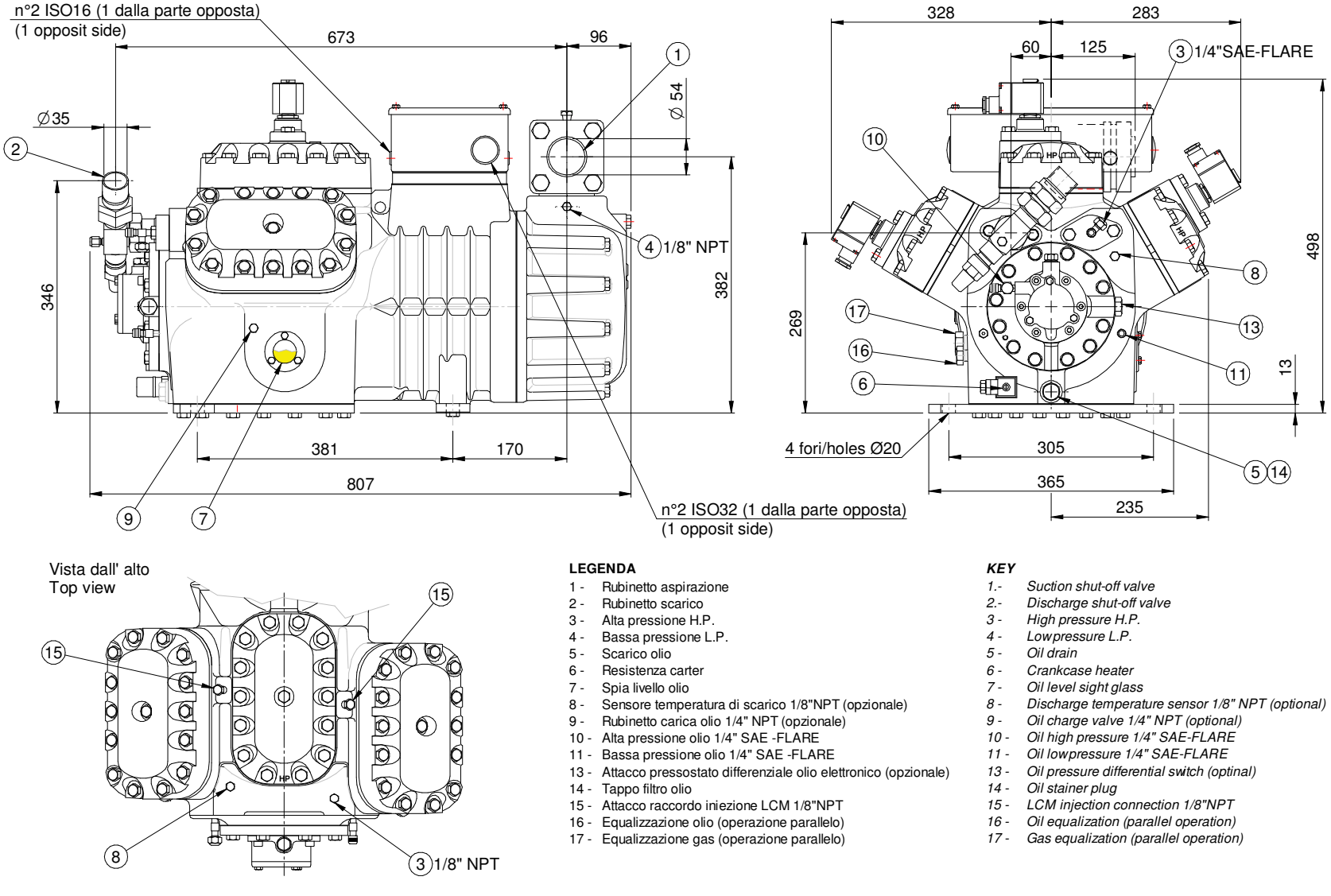
1 - Rubinetto aspirazione
2 - Rubinetto scarico
3 - Alta pressione H.P.
4 - Bassa pressione L.P.
5 - Scarico olio
6 - Resistenza carter
7 - Spia livello olio
8 - Sensore temperatura di scarico 1/8"NPT (opzionale)
9 - Rubinetto carica olio 1/4" NPT (opzionale)
10 - Alta pressione olio 1/4" SAE -FLARE
11 - Bassa pressione olio 1/4" SAE -FLARE
13 - Attacco pressostato differenziale olio elettronico (opzionale)
14 - Tappo filtro olio
15 - Attacco raccordo iniezione LCM 1/8"NPT
16 - Equalizzazione olio (operazione parallelo)
17 - Equalizzazione gas (operazione parallelo)

KEY

1.- Suction shut-off valve
2.- Discharge shut-off valve
3 - High pressure H.P.
4 - Lowpressure L.P.
5 - Oil drain
6 - Crankcase heater
7 - Oil level sight glass
8 - Discharge temperature sensor 1/8" NPT (optional)
9 - Oil charge valve 1/4" NPT (optional)
10 - Oil high pressure 1/4" SAE-FLARE
11 - Oil lowpressure 1/4" SAE-FLARE
13 - Oil pressure differential switch (optinal)
14 - Oil stainer plug
15 - LCM injection connection 1/8"NPT
16 - Oil equalization (parallel operation)
17 - Gas equalization (parallel operation)

1:2.5

Fig. 70 Dimensions of models RP1-L415/418/422/425, RP1-H422/425/430/435



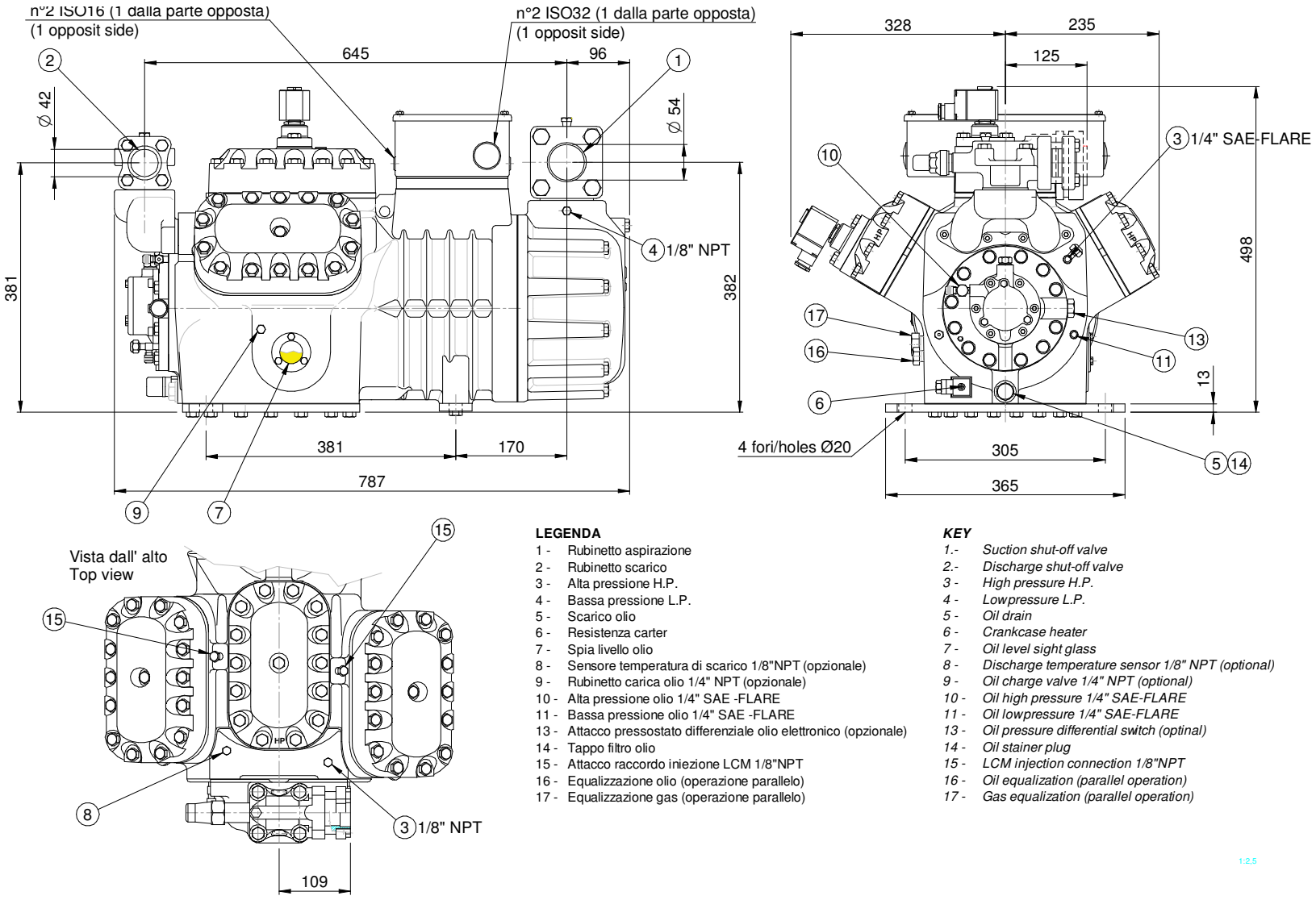
LEGENDA

1 - Rubinetto aspirazione
2 - Rubinetto scarico
3 - Alta pressione H.P.
4 - Bassa pressione L.P.
5 - Scarico olio
6 - Resistenza carter
7 - Spia livello olio
8 - Sensore temperatura di scarico 1/8"NPT (opzionale)
9 - Rubinetto carica olio 1/4" NPT (opzionale)
10 - Alta pressione olio 1/4" SAE -FLARE
11 - Bassa pressione olio 1/4" SAE -FLARE
13 - Attacco pressostato differenziale olio elettronico (opzionale)
14 - Tappo filtro olio
15 - Attacco raccordo iniezione LCM 1/8"NPT
16 - Equalizzazione olio (operazione parallelo)
17 - Equalizzazione gas (operazione parallelo)

KEY

1.- Suction shut-off valve
2.- Discharge shut-off valve
3 - High pressure H.P.
4 - Lowpressure L.P.
5 - Oil drain
6 - Crankcase heater
7 - Oil level sight glass
8 - Discharge temperature sensor 1/8" NPT (optional)
9 - Oil charge valve 1/4" NPT (optional)
10 - Oil high pressure 1/4" SAE-FLARE
11 - Oil lowpressure 1/4" SAE-FLARE
13 - Oil pressure differential switch (optinal)
14 - Oil stainer plug
15 - LCM injection connection 1/8"NPT
16 - Oil equalization (parallel operation)
17 - Gas equalization (parallel operation)

Fig. 71 Dimensions of models RP1-L627, RP1-H637



LEGENDA

1 - Rubinetto aspirazione
2 - Rubinetto scarico
3 - Alta pressione H.P.
4 - Bassa pressione L.P.
5 - Scarico olio
6 - Resistenza carter
7 - Spia livello olio
8 - Sensore temperatura di scarico 1/8"NPT (opzionale)
9 - Rubinetto carica olio 1/4" NPT (opzionale)
10 - Alta pressione olio 1/4" SAE -FLARE
11 - Bassa pressione olio 1/4" SAE -FLARE
13 - Attacco pressostato differenziale olio elettronico (opzionale)
14 - Tappo filtro olio
15 - Attacco raccordo iniezione LCM 1/8"NPT
16 - Equalizzazione olio (operazione parallelo)
17 - Equalizzazione gas (operazione parallelo)

KEY

1.- Suction shut-off valve
2.- Discharge shut-off valve
3 - High pressure H.P.
4 - Lowpressure L.P.
5 - Oil drain
6 - Crankcase heater
7 - Oil level sight glass
8 - Discharge temperature sensor 1/8" NPT (optional)
9 - Oil charge valve 1/4" NPT (optional)
10 - Oil high pressure 1/4" SAE-FLARE
11 - Oil lowpressure 1/4" SAE-FLARE
13 - Oil pressure differential switch (optinal)
14 - Oil stainer plug
15 - LCM injection connection 1/8"NPT
16 - Oil equalization (parallel operation)
17 - Gas equalization (parallel operation)

Fig. 72 Dimensions of models RP1-L630/640, RP1-H640/650

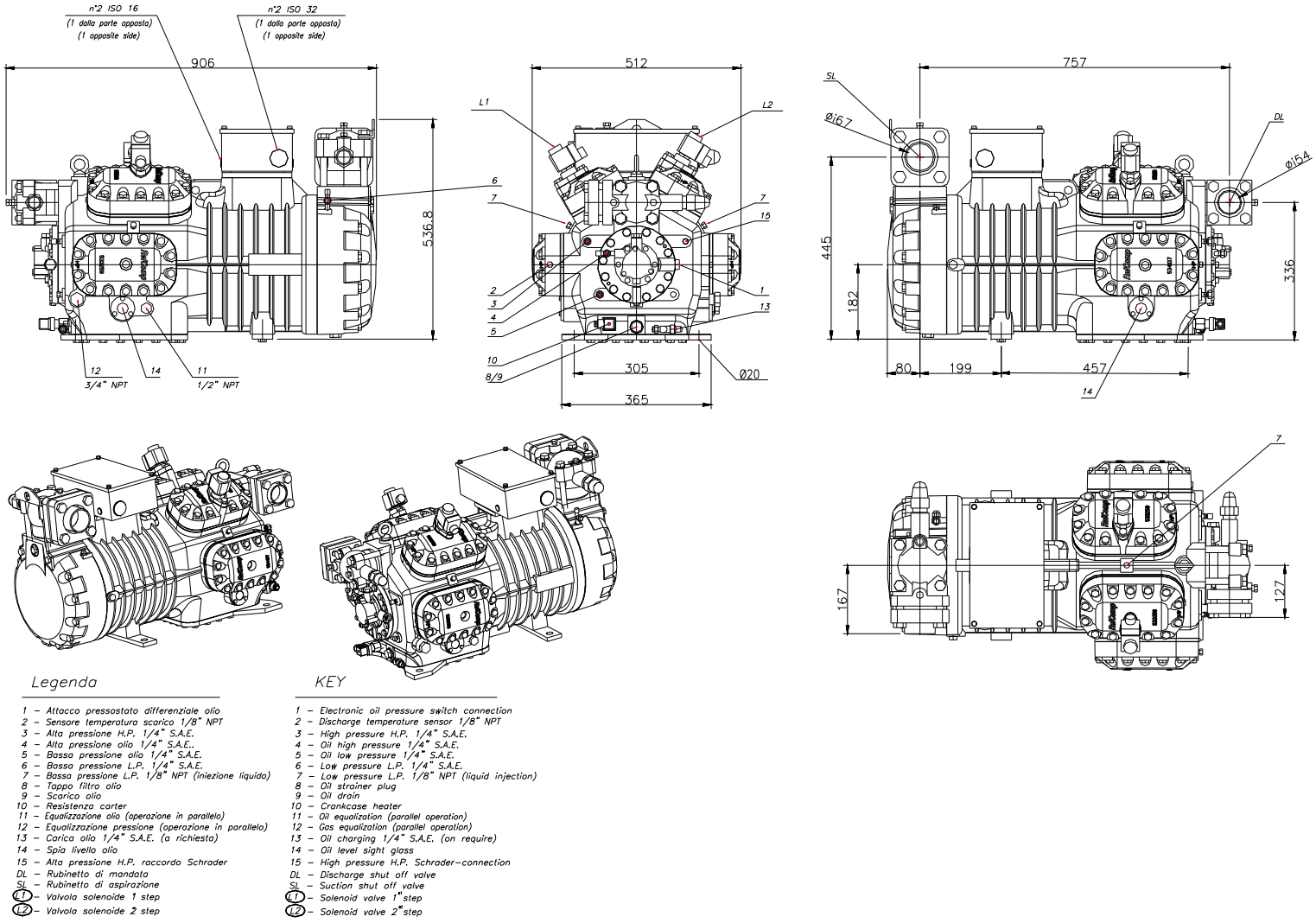


Fig. 73 Dimensions of models RP1-L850/860, RP1-H60/870

8.2 Packaging

Compressors models RP1-L/H4xx-S/F and RP1-L/H2xx are packed individually using wooden pallets with corrugated cardboard for packaging, as shown in Fig. 74.
For the compressor models and RP1-L/H4xx, RP1-L/H6xx and RP1-L/H8xx, as shown in Fig. 75, is realized reinforced perimeter structure and its wooden sky coverage to increase strength and stiffness of packing.
The compressor is fixed to the pallet with 4 bolts (Fig. 76).
The type of corrugated cardboard is suitable for transport by sea, with a thickness of 9.4 mm and structure (combination wave) AA. The cartoon is guaranteed by the absence of separation of layers after 24 hours in water.

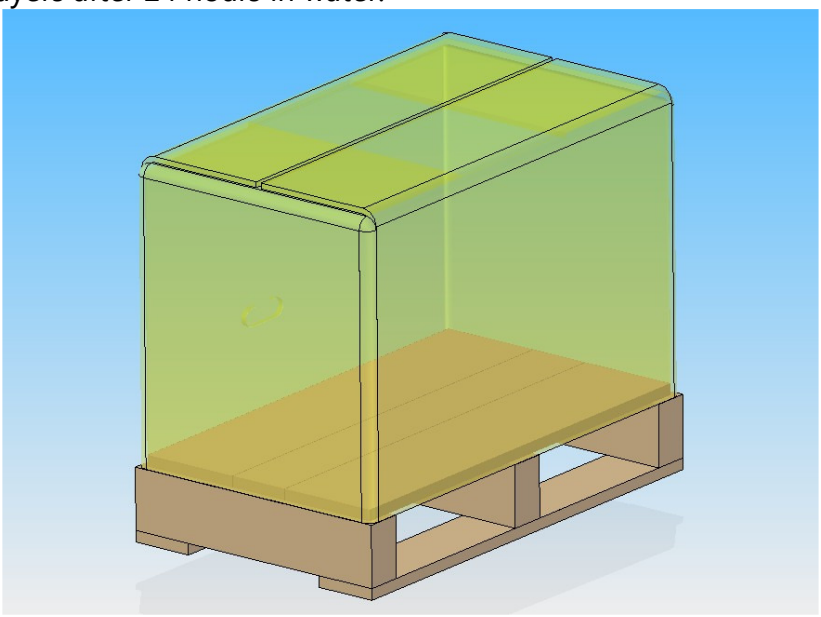


Fig. 74 Packing with carton box

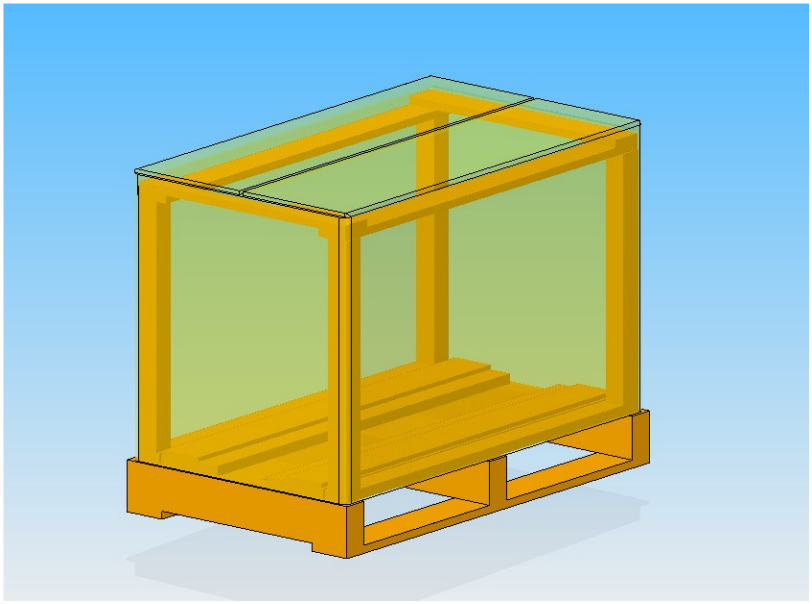


Fig. 75 Packing with reinforced structure

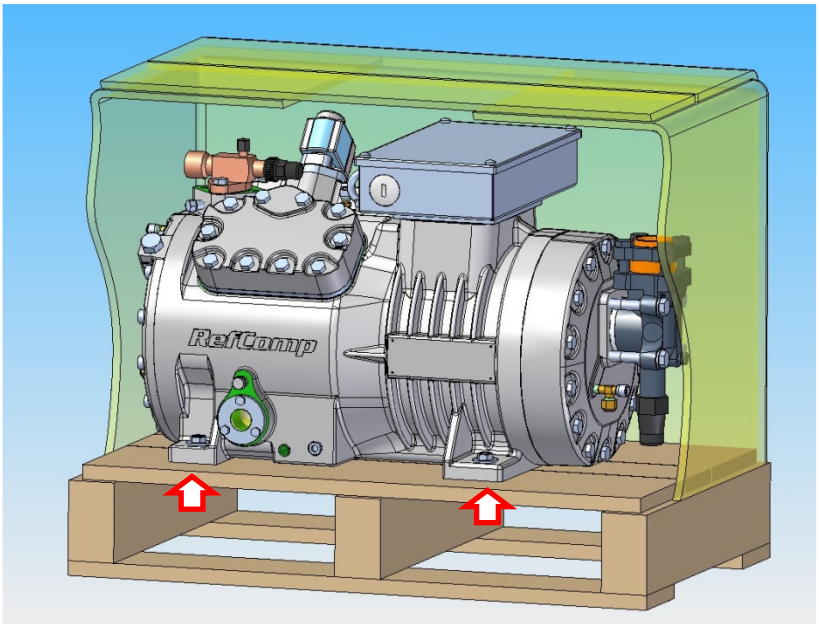


Fig. 76 Compressor fixed to the pallet through screws

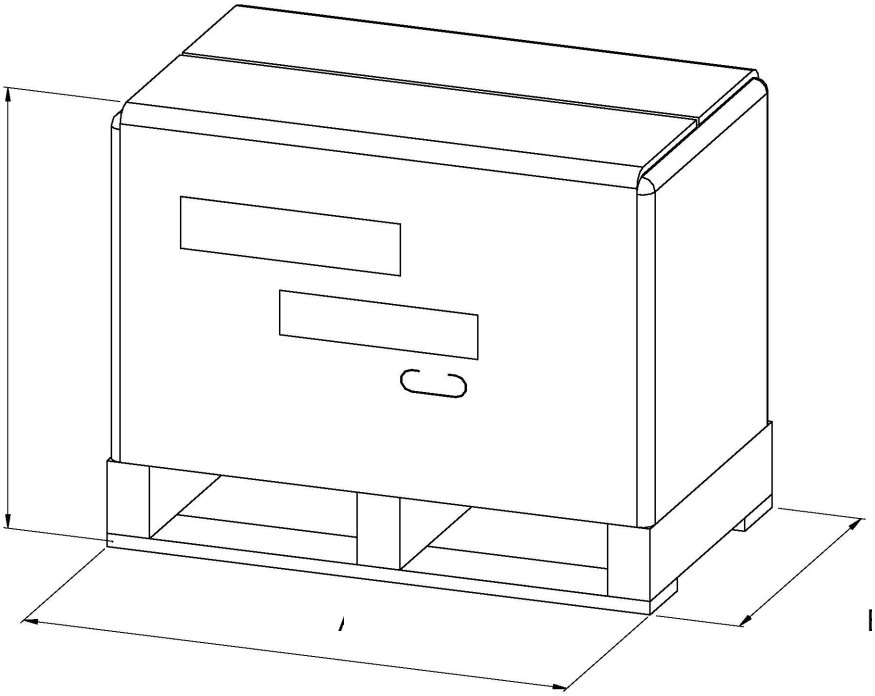


Fig. 77 Dimensions for packing of SP Series

Model	A [mm]	B [mm]	C [mm]
RP1-L/H2xx	516	291	325
RP1-L/H4xx-S/F	740	440	600
RP1-L/H4xx, RP1-L/H6xx	870	670	730
RP1-L/H8xx	1030	615	765

Table 24 Packages dimensions

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Warning!

Compressors have to be moved or lifted with a forklift truck with special equipment carried out by trained personnel. The shipping weights of the various compressors (compressors should be considered in the standard configuration) are listed in the Table 22. For deeper information see Chapter 0 "*Extent of delivery*").

9 Transport, Handling and Storage

9.1 Receiving and unpacking

Upon receipt of the compressor, after removing the upper part of the package, make sure that no damages occurred during transport. If you notice damage due to transport, please provide to make a written complaint, possibly accompanied with photos of the damaged parts, to your insurance company and send copies to the Manufacturer and transporter. For the entire period that the compressor is not used, before unpacking it, store in a dry place at a temperature between + 5 ° C and + 45 ° C and in position to avoid contact with atmospheric agents.

For the entire period that the compressor is not used, after being unpacked, before first start-up or for long period unused, you need to change the oil and check the operation.

If the compressor is not used for long periods, you need to change the oil and check the operation.

Please dispose of the packaging according to the different types of material in full compliance with the legislation in force in the country of use.

9.2 Transport & Handling

It should be distinguished two types of transport: the packaging of the compressor and of the compressor installed on the refrigeration unit mounted with spring vibration damper.

9.2.1 Carriage of packaged compressor

In the case of transportation of the compressor in the package, it should take care that the transport doesn't cause impacts and vibrations on the compressor to avoid the breakaway of the compressor itself from the pallet. A transport carried out on unpaved roads could cause the damage botL of the packing and of the compressors.

The transport of the packed compressor must be operated by qualified personnel using a forklift truck.

ATTENTION: before making any transport operations, make sure that the lift capacity is suitable for the load to be lifted.

Place the forks exclusively in the pallet bottom. After positioning the forks at the points indicated, lift slowly without sudden movements.

With the usage of a forklift, bring the compressor as close as possible to the place to install, than carefully remove the protective packing, paying attention not to damage it, and follow the instructions below:

• Remove the carton.
• Remove the screws that fix compressor to the wooden pallet.

Please dispose of the packaging according to the different types of material in full compliance with current legislation in the country of utilization.

It is mandatory to install the compressor in a ventilated area with proper ventilation to keep the room temperature between +2°C to +40°C, with humidity level between 5 to 95%.
It is mandatory to contact the manufacturer or authorized dealer in the event of an inadequate exhaust of hot air from the place of installation of the compressor.
It is mandatory that the air introduced into the compressor installation site is clean and free of dust, fumes and flammable vapors.

9.2.2 Carriage of compressor mounted on the system

In order to minimize the vibrations and the stresses transmitted to the support frame and to the pipes of the refrigeration circuits, especially when starting/stopping the compressor should be mounted on vibration dampers.
If these needs don't occur, the units can be connected directly to the frame rigidly and without the interposition of washers.
In the case of transportation of the compressor already installed on the refrigeration unit and mounted on spring vibration dampers, excessive vibrations due to transport could cause the rupture of the cooling pipes resulting in leakage of refrigerant. To avoid such damage is possible to lock the compressor as described below.
Fig. 78 shows in detail the different shape to be taken by the spring dampers in normal operation and during transport of the compressor.
During the transport of the compressor already installed on the chiller, you must tighten the self-locking nut (1) until the base of the compressor (3) is in contact with the element of spring guide (2), preventing any possible movement of the compressor.
After installing the refrigeration unit, self-locking nut must be loosened up just to have an adequate clearance between the nut and the dampers (3).

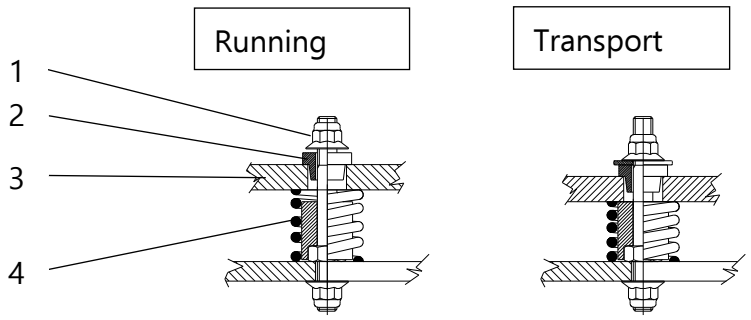
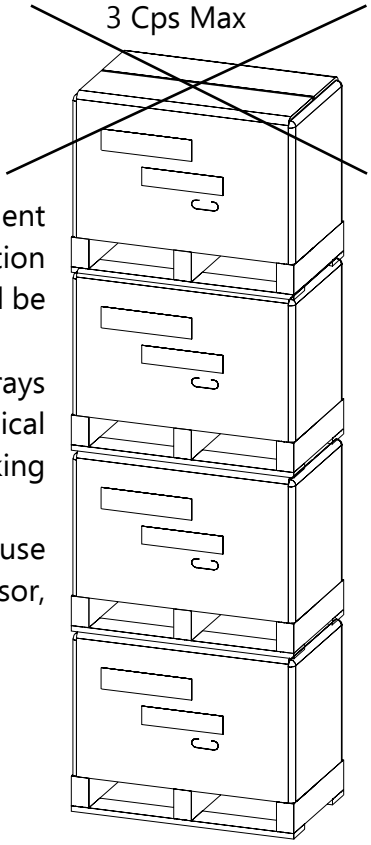


Fig. 78 Shape of spring dampers during transport and running

1) Self locking nut
2) Damping wasLer
3) Compressor base
4) Spring guide

9.3 Storage

If it is necessary to storage the compressor for some time, it's necessary to be very careful at storage height: exceeding the maximum value recommended can lead to accidents (see. Fig. 79)



The temperature and humidity of storage environment should not subjected to large variations and the duration of storage should not exceed one year; the package also should be stored in the shade.

- ✓ High variations in temperature and humidity and direct rays of the sun age board causing the degradation of mechanical properties which is particularly dangerous if there is stacking of multiple compressors.
- ✓ The strong cyclical variations in temperature could cause damage on mechanical and plastic parts of the compressor, with a risk of seizing to the next start up

Fig. 79 Maximum storage height allowed

9.4 Handling and lifting

The transport of the packed compressor must be operated by qualified personnel using a forklift truck.

ATTENTION: before making any transport operations, make sure that the lift capacity is suitable for the load to be lifted.

Due to their weight the compressor must be handled with appropriate equipment and for safety reasons must be lifted using the appropriate lugs as shown in Fig. 80.

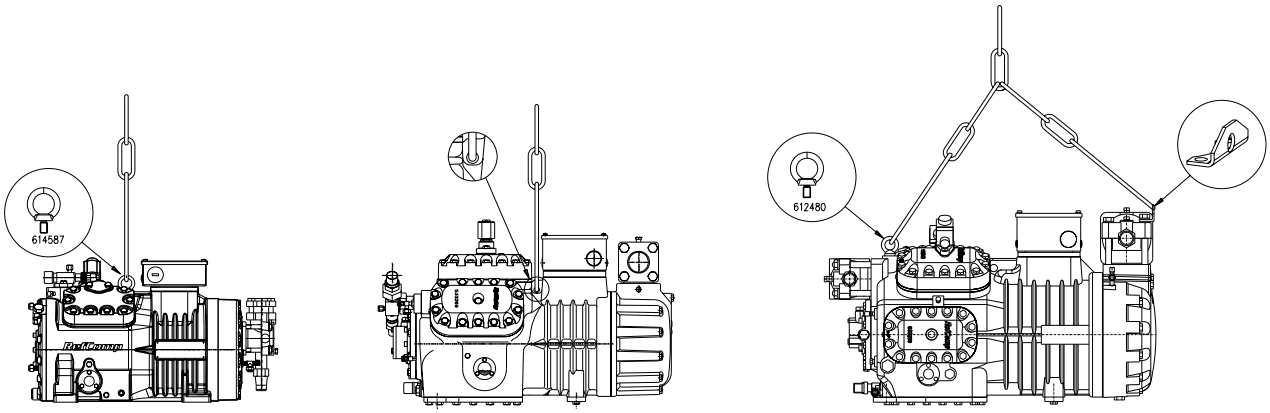
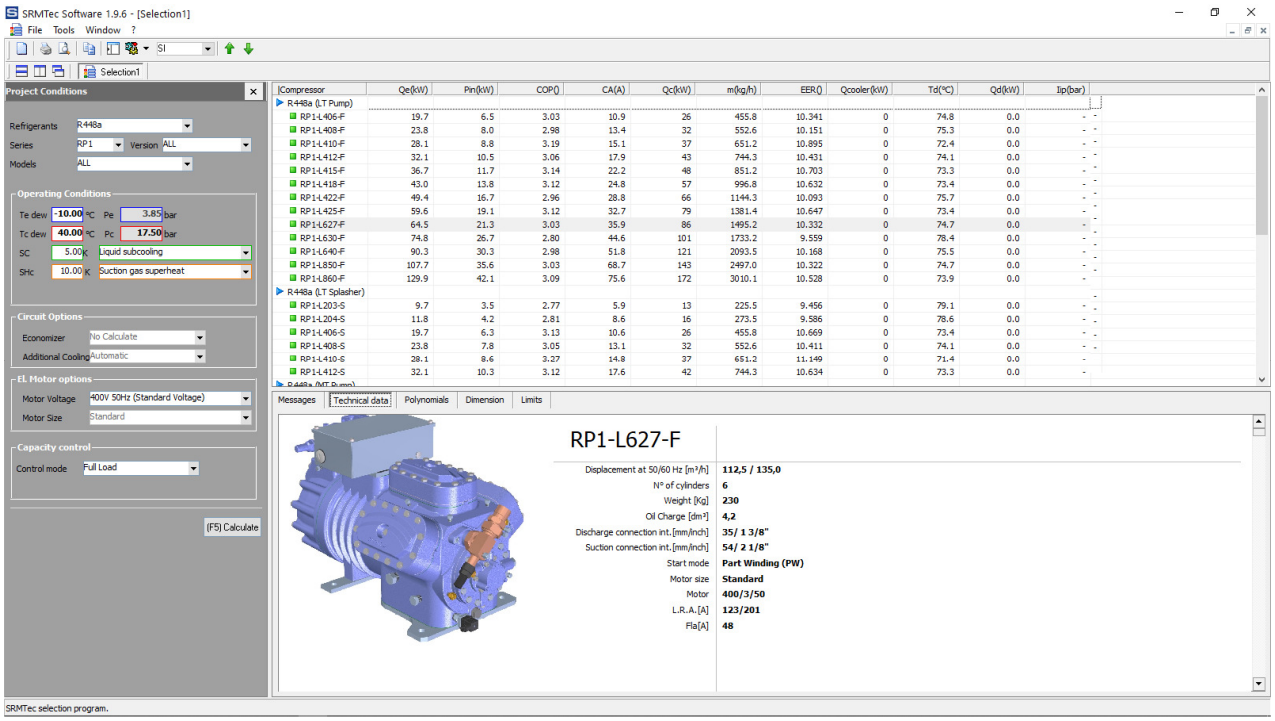


Fig. 80 Lifting instructions

10 Performance data for the RP1 series compressors

In order to have performance data for conditions different than those as given above, use SRMTec selection program (contact SRMTec to have the updated software version):



Performance data are obtained through measurements made at the suction and discharge connection. See chapter 8:"*Dimensional drawing and packaging*" for connections position on each models.

According to the chapter 11: "*Application range*", the following tables highlight the working conditions which require the monitoring of the additional cooling (see chapter 12);

The performances are optimized for the following working conditions:

- Gas suction overheating: SH=10K;
- Liquid sub-cooling: SC=5K;
- Three-phase electrical net frequency: f=50Hz;
- Nominal voltage: V=400V;
- Working conditions without ECOnomiser circuit.

Key:

Te: Evaporating temperature [° C];
Tc: Condensing temperature [° C];
Qe: Refrigerant power [kW];
Pta: Absorbed power [kW];

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11 Application range

11.1 General

The normal admissible operating conditions for the RP1 series compressors, with changes in evaporation and condensing temperature, are defined by a polygon, as highlighted in Fig. 81.

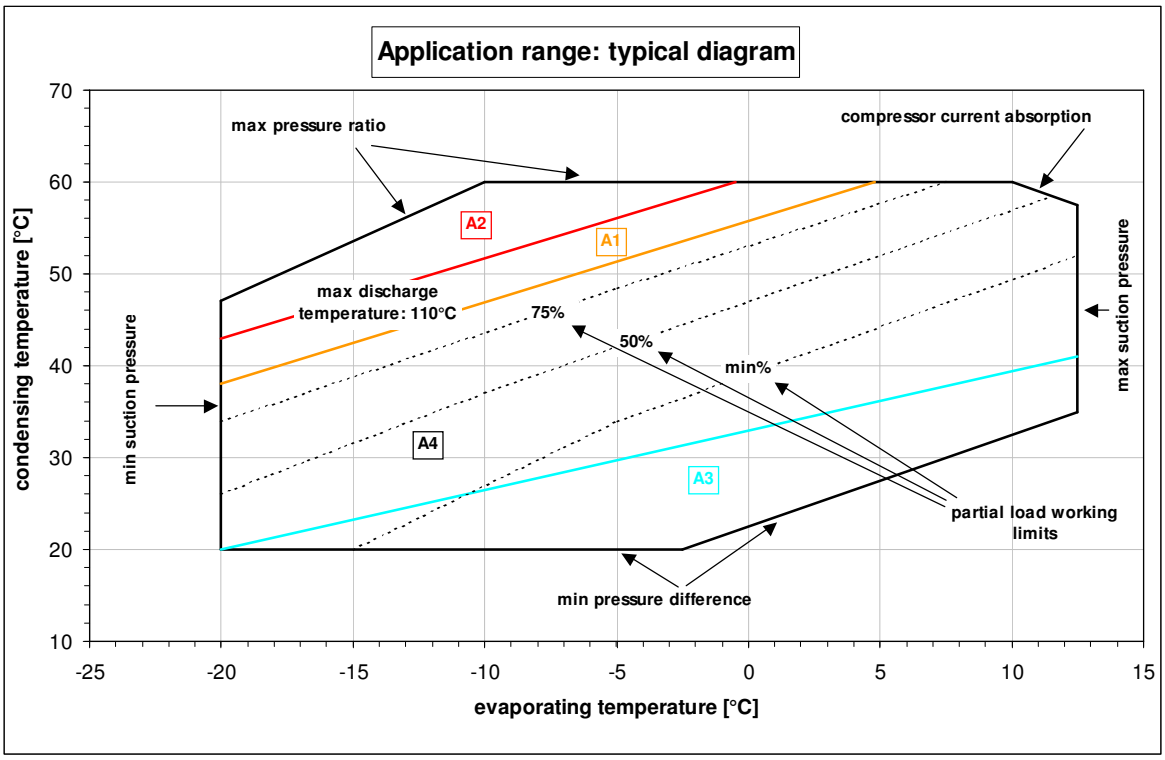

Fig. 81 typical application range

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; specifically:

- Area A1: area in which the correct operation of the compressor requires additional cooling by the injection of liquid (refrigerant) or cooling of the oil in an external circuit (air-oil, water-oil and refrigerant-oil heat exchangers), see chapter 12: "*Additional cooling*";
- Area A2: area in which additional cooling must be provided only by cooling the oil. Use air-oil or water-oil exchangers (the injection of liquid into the compressor is not allowed), see chapter SA-11: "*Additional cooling*";
- Area A3: not considered;
- Area A4: area of standard compressor operation;

In addition to the above given areas, the diagram gives also, as dotted lines, the working limits on partial loads. For each partial load, these lines limit the maximum possible condensation temperature in relation to the evaporation temperature.

For the operating limits with different refrigerant fluids that can be used with the RP1 compressors refer to the official selection software indications.

12 Additional cooling

12.1 Allowable Discharge temperature

The discharge temperature value is due to the following factors:

- ✓ absorbed power and possible part load operation which causes a decrease in cooling of electrical motor;
- ✓ working pressure ratio of compressor;
- ✓ superheat of liquid in suction side;
- ✓ refrigerant characteristics such us thermal capacity;
- ✓ characteristics of lubricant mixed together with refrigerant.

Too high discharge temperature value causes:

- ✓ possible carbonization and deterioration of lubricant with a reduction of its useful life;
- ✓ reduction of kinematic viscosity with consequent loss of lubrication capacity of compressor;
- ✓ Most oil entrainment in the refrigerant, depending on the pressure, as the temperature increases the vapor pressure (volatility) of the same;

Too high lubricant dilution causes:

- ✓ High pressure drops in oil circuit;
- ✓ an excessive dilution of the oil by the refrigerant;
- ✓ alteration of the lubricant flow within the compressor;
- ✓ reduced lubricating properties;
- ✓ refrigerant bypass towards suction side (through the oil circuit) which has undergone the process of compression, then it will not give any refrigerant effect.

The maximum allowable discharge temperature is 125°C while, when the compressor is off, the minimum lubricant temperature to allow start-up is 30 °C
Here below are shown how to calculate the additional cooling power in case it is required and the possible ways to realize it.

12.2 Evaluation of additional cooling power

The additional cooling power required (P_{oc}) can be calculated by multiplying the evaporator mass flow rate (m) and the difference between Discharge enthalpy without additional cooling (L) and the enthalpy corresponding to Discharge pressure and at 125°C ($L_{125°C}$), as shown in the equation 11.1 (enthalpy values are read in the refrigerant pressure-enthalpy diagram):

$$P_{oc} = m \cdot (h - h_{125°C}) \qquad \text{[kW]} \qquad \text{(Eq. 12.2.1)}$$

In calculating the cooling power required it is recommended to consider the most severe working conditions (minimum evaporating temperature, maximum condensing pressure, maximum superheat). As alternative this calculation is made automatically by SRMTec selection software.

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Therefore, depending on the value of the additional cooling capacity required it can be distinguished two methods to limit the compressor discharge temperature:

1. compressor heads cooling with natural or forced ventilation;
2. through the injection of liquid refrigerant.

The second method is more effective than the first, and in some cases both are required. The following pages show the both said methods.

12.3 Fan for additional cooling

It's a fan assembled on the top of compressor as shown in the picture below:

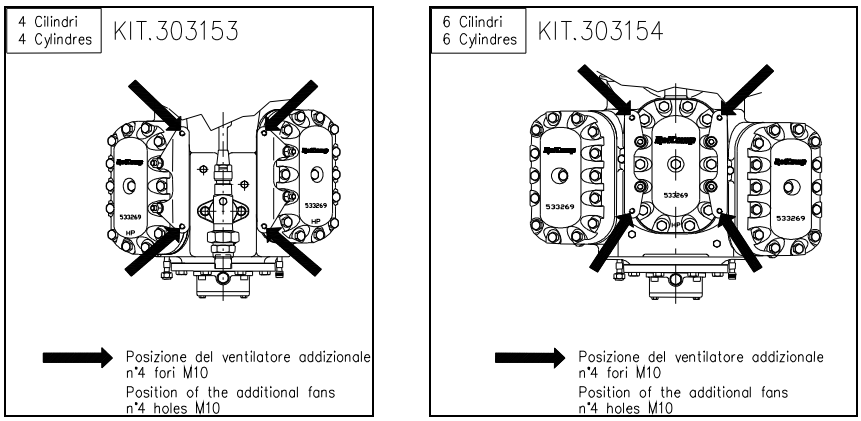


Fig. 82 F*an fixing points*

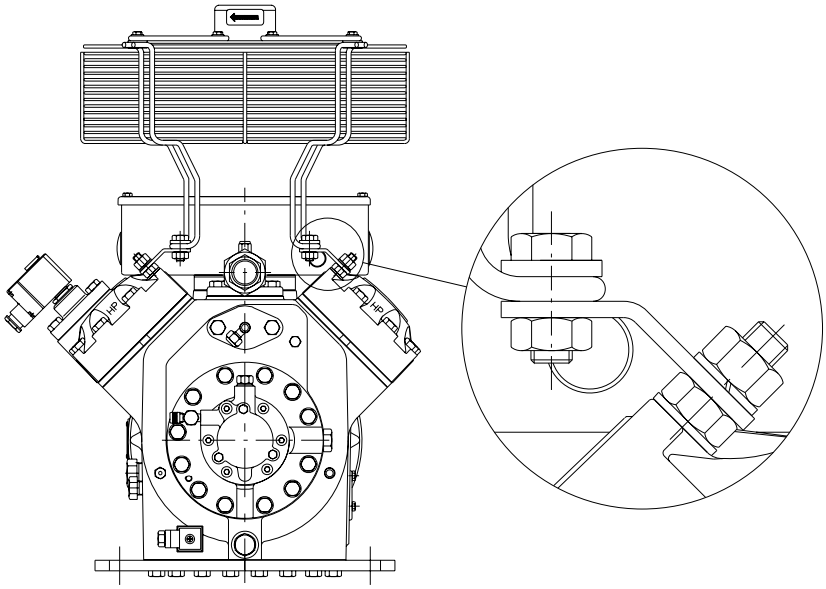


Fig. 83 Front view of compressor with fan assembled

Alternatively, the compressor can also be cooled by the air flow from the air cooled condenser, if its speed exceeds 3 m/s. Of course, the compressor must be in full flow of air. Table 25 shows the code for the cooling kit designed for the SP series and specifications of the fans assembled.

Compressor	Fan kit	Supply voltage Volt - ph - Hz	Absorbed current A	Absorbed power *W*	Air flow *m^3/L*
RP1-L4xx-S/F	303153	230/440-3-50/60Hz	0,50 (50Hz) 0,29 (60Hz)	120 (50Hz) 180 (60Hz)	2200 (50Hz) 2650 (60Hz)
RP1-L4					
RP1-L6	303154				
RP1-L8					

Table 25 *Technical and electrical characteristics of the fan*

If the supply voltages of the compressor and fan are the same, the fan is connected directly to the terminals of the compressor motor and always works with the compressor, otherwise it should be connected to another power line.

13 Operative instruction

13.1 Compressor requirements

SRMTec Compressors can only work with refrigerants allowed by SRMTec and cannot, in any case, work with air or other gases. In particular, if they work with air, there is risk of spontaneous explosion, because of the mixture of air and oil which, if the compression ratio reaches values close to 1:15 (pressure evaporation / condensation pressure, relative), triggers a mechanism of self-ignition and explosion. This effect is called "EFFECT DIESEL" and it's probably is higher as closer is the discharge shut-off valve.
Never start the compressor, if the suction and discharge shut-off valves are not fully opened and the terminal box cover correctly fitted and fixed.
While the compressor is running, do not operate with the suction and discharge valves, do not remove the terminal box cover
To seal the pressure of the refrigerant circuits use only nitrogen or carbon dioxide, and never use oxygen or acetylene.
The compressor can never be put into operation if it is not connected to the circuit.
During operation, the compressor surface can reach temperatures greater than 100 ° C and below 0 ° C.

WARNING !
The staff is required to wear appropriate personal protective equipment (safety footwear, overalls, gloves, goggles and mask).

WARNING !
Work on electrical equipment should be performed in the absence of tension, only by a qualified electrician.

WARNING !
All maintenance operations must be performed with standstill compressor without power supply, after opening of the switch cabinet or detachment of the plug from the factory.

WARNING !
The maintenance, inspection and regulation should be performed only by qualified personnel with appropriate personal protective equipment (safety footwear, overalls, gloves, glasses and mask), tools and auxiliary equipment suitable (if necessary).

WARNING !
If the maintenance is on the Mechanical parts of the machine the power switch has to be opened (par. 1.5).

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

WARNING !
If operations of circuit breakers (motor circuit breakers, circuit breakers or differential) occur repeatedly (2 or more times in a row), it is essential to be warned and/or 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 restoration indiscriminate, in most cases does not solve the problem.

WARNING !
It is prohibited to clean electrical equipment using compressed air: danger of damage to electrical components.

WARNING !
The cleaning and troubleshooting must be done with stand still compressor and with the electricity supply disconnected

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 op tripped breaker must be with stand still compressor and with the electricity supply disconnected (by removal of the plug from the power plant general).

WARNING !
If operations of circuit breakers (breaker, switch or differential) occur repeatedly (2 or more times) it is essential to be warned and / or call a service engineer.

13.2 Installation

The compressor must be installed horizontally. To prevent the compressor from transmitting vibrations to the structure it should be used the damping kits.
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
If used under extreme conditions, such as low ambient temperatures or aggressive atmosphere, take appropriate measures after contacting SRMTec.

13.2.1 Compressors RP1-L/H4xx-F/S, RP1-L/H4 and RP1-L/H6

The compressor models RP1-L/H4xx-F/S, RP1-L/H4 and RP1-L/H6 are provided, standards, with spring shock absorbers. The dampers are supplied loose in the packaging, in a special nylon bag.
The RP1-L/H2xx models are supplied with rubber dampers.

To facilitate the identification and proper installation, the different dampers are indicated by a particular colour (related to the stiffness of the spring).
Table 26 shows the codes, the relative colours in the two side of installation of the different dampers.

Compressor models	Side A hardness / colour	Kit*	Side B hardness / colour	Kit*
RP1-L/H2xx		303804		303804
RP1-L/H4xx-F/S	Green	303131	Grey	303130
RP1-L/H4				
RP1-L/H6	Green	303131	Blue	303132
RP1-L/H8		303804		303804

* EacL kit includes 2 dampers

Table 26 *Spring dampers kit for SP compressors*

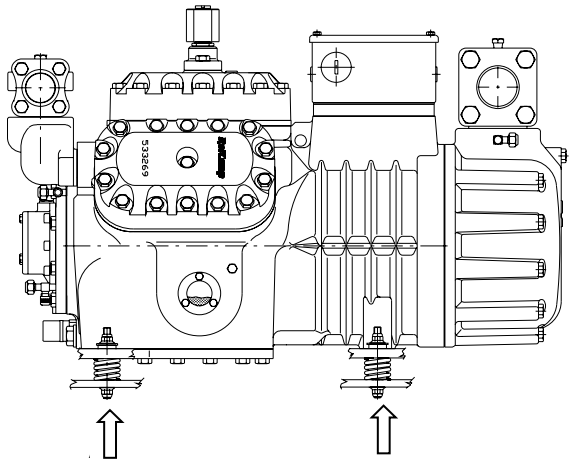
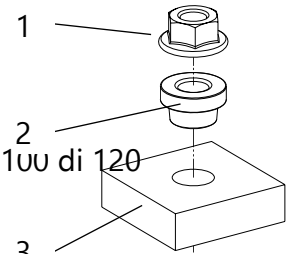


Fig. 84 Spring dampers positions on compressors models RP1-L/H4 e RP1-L/H6

13.2.2 Compressors RP1-L/H8

Compressors RP1-L/H8 are provided, standard, with rubber dampers (code 303 804 Kit).
The dampers are supplied loose in the packaging, in a special nylon bag.

Fig. 85 shows an exploded of rubber damper and the related assembly. During the transport of the compressor already installed on the chiller (with rubber dampers) should not be taken special care.



1) Self locking nut
2) Damping washer
3) Rubber dampers
4) Screw

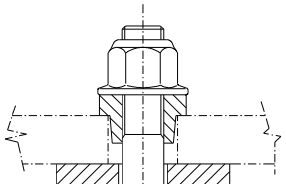


Fig. 85 *Rubber damper for* RP1-L/H8 *compressors*

Even for the 8-cylinder compressor is available, option, spring dampers kit, no. 303803. The kit consists of 4 identical damping elements.

Fig. 86 shows an exploded view of the spring shock absorbers and their installation on the compressor model RP1-L/H8.

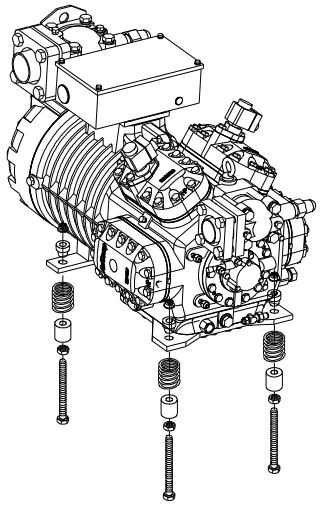


Fig. 86 Rubber dampers assembling on RP1-L/H8 compressors

Fig. 87 shows the recommended position of spring dampers during transportation of the compressor, already installed on the drive. Again, the tightness of the nut allows to lock the compressor to the element of spring guide, avoiding any possible displacement of the compressor.

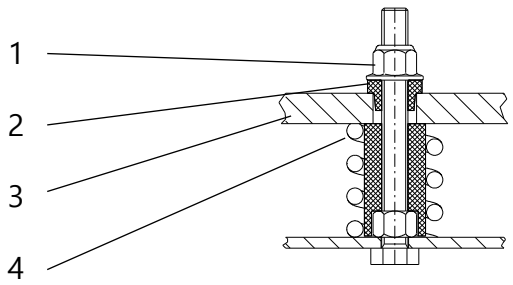


Fig. 87 Spring dampers positions (option) during transport for RP1-L/H8 models

1) Self locking nut
2) Damping wasLer
3) Compressor base
4) Spring guide

13.3 System requirements

13.3.1 Suction superheat

Because of the lubricant solubility with refrigerants, the design, operation mode and control of the compressor and the system are subject to particular requirements.

Low or insufficient superheat in operation and insufficient heating or the oil sump during shut-off periods lead to a substantial reduction of the oil viscosity in the compressor.

This results in reduced performance, heavy wear on drive gear parts, increased oil carryover and foaming into the oil separator.

Secure the compressor against wet operations and guarantee a sufficiently high suction gas temperature.

ATTENTION!
THE DISCHARGE GAS TEMPERATURE MUST BE AT LEAST 20K ABOVE THE CONDENSING TEMPERATURE!

Preferred use of heat exchanger between liquid line and suction gas line in order to rise the suction superheat at approx. 20K at system design conditions.

13.3.2 Pressure specifications

The maximum allowable pressures for hydraulic and running tests are:

	Hydraulic test	Working pressure
High pressure	27,5 bar	25 bar
Low pressure	21 bar	See note ([3])

The working pressures, in order to avoid a motor overload, have to be inside the compressor working envelope (see Chapter 11 *"Application range"*).

Never operate the compressor at a higher pressure than the maximum operating pressure specified by SRMTec and indicated on its plate. The user must ensure also that the balanced pressure does not exceed the maximum value specified by SRMTec.

The compressors are designed and tested according to the European standards EN 700-24035-2-34.

13.3.3 Balanced pressure when starting

In order to generate a starting torque greater than the resisting one, the balanced system pressure (pressure inside the compressor during standstill periods) must not exceed 13 bar.

13.3.4 Maximum ambient temperature

During operation, the temperature of the environment where the compressor is working must be kept below the maximum value of 50°C.

If the compressor is installed in a soundproofed cabinet, suitable ventilation and temperature monitoring systems must be provided.

13.3.5 Temperatures

Discharge: maximum:120°C;

([3]): See chapter 11 *" Application range"*

	minimum : 30K over the condensing saturation temperature.
Suction:	maximum: see envelope;
	minimum : 8K for R-22, R-407C, R-134a, R-404A and R-507.

13.3.6 Number of start-ups

The compressor can be started a maximum of 6 times per hour (1 start every 10 minutes).

Start-up numbers:	maximum 6 / Lour.
Minimum time between two following start-up :	10 minutes
Miminum stop:	3 minutes

ATTENTION!
A NUMBER OF STARTS HIGHER THAN THE ONE SUGGESTED MAY DAMAGE THE ELECTRICAL MOTOR AND AFFECT THE THEORETICAL COMPRESSOR WORKING LIFE.

13.3.7 Pump-down

If the evaporator and/or the suction pipe of the compressor may become warmer during the stops, it is recommended to take a pump-down cycle.

ATTENTION!
LIMIT THE PUMP DOWN PRESSURE TO 1.5BAR A.
RISK OF OXYGEN SUCTION INTO THE SYSTEM CAN LEAD TO SYSTEM COBTAMINATION.
RISK OF EXPLOSION

13.3.8 Heat pump

WARNING!
Backflow cycle or defrost systems with Lot gas require appropriate measures to protect the compressor from:

- ✓ Liquid return;
- ✓ Increased oil carryover lowering the level of the same within the compressor

To prevent liquid hammers to compressor it is recommended to install a liquid receiver in suction side. It could be also necessary to install a pressure regulating valve after the compressor to limit the pressure decrease during backflow and reverse cycles. It's also possible to shut-off the compressor just before the cycle backflow and start up after the pressure equalization. The compressor should work inside the envelope prescribed by the application limits and by protection devices within 20 seconds from the start.

13.4 Testing

13.4.1 Sealing/ evacuation/ oil charge testing

NOTE:
The compressor are supplied with nitrogen protective charge (0,5-1 bar over the atmospheric pressure) to avoid the entry of air inside compressor.

To introduce the oil inside the compressor follow the instructions below:

a) Test the sealing of the cooling system with dry nitrogen (N_2), if the circuit is tested with dry air, the compressor must be excluded.
b) Empty the whole circuit including the compressor and the sections isolated by shut-off valves, on both the suction and discharge side;
c) Connect the oil container to its intake connection in the compressor (see picture on the compressor model described in section 8.1 *"Dimensional Drawings"*).
d) Introducing a quantity of oil to bring the level within the range shown in Fig. 88.
e) Close and/or screw the oil connection tap.

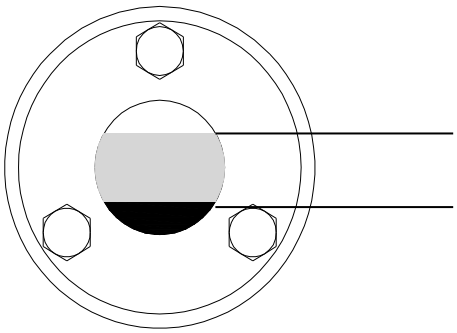


Fig. 88 *Oil level range*

The compressor has already passed the required pressure tests, so it is not necessary that these tests are performed by the customer. If the customer needs to rerun the test he must be careful to never exceed the design pressures indicated on the rating plate of the compressor (see paragraph13.3.2: "Pressure").

WARNING!

- **NEVER EXPOSE THE COMPRESSOR TO PRESSURE HIGHER THAN THE DESIGN VALUES INDICATED ON THE RATING PLATE;**
- **NEVER START THE COMPRESSOR UNDER VACUUM.**

13.5 Refrigerant charge

Charge the liquid refrigerant directly into the receiver and into the condenser, and complete the charge on the suction side during operation.
To avoid liquid backflow when the refrigerant is charged in the liquid phase (verify that the discharge temperature is around 20K above the condensing temperature.
An insufficient charge causes a low suction pressure and a high superheat (observe the chapter 11: "*Application limits*").

To identify the correct discharge temperature, use the SRMTec SRMTEC selection software.

13.6 Starting

STARTING:

- ✓ After discharging the protective nitrogen charge, connect the compressor to the plant, making sure that the shut-off valves are closed. This avoids contact between the humidity of the air and the oil. However if the oil comes into contact with the humidity, it must be for not longer than 30 min;
- ✓ Make all the electrical connections as given in the wiring diagram on chapter 0: "Electrical devices";
- ✓ Perform the following preliminary checks:

- ✓ Correct setting of the start timers;
- ✓ Oil level;
- ✓ Correct safety and protection devices setting and functioning;
- ✓ Correct functioning of the high and low pressure switches;
- ✓ Look for leakage along the piping and system components;
- ✓ Turn on the oil heater at least 24 hours before each first seasonal start-up. The oil inside the separator must have a temperature at least 15K higher than the ambient temperature;
- ✓ Charge the condenser with the minimum refrigerant charge;

START:

- ✓ Fill up the plant with the necessary amount of refrigerant;
- ✓ Re-start the compressor and open slowly the suction shut-off valve;
- ✓ Make sure that the oil level is visible through the sight glass. Presence of foam is normal as long as the working conditions are not stable. The discharge temperature must be about 30K higher than the condensing temperature;
- ✓ Check the correct intervention for the pressure switches;
- ✓ Check the working parameters (data logging is recommended):
    - Evaporating pressure;
    - Condensing temperature;
    - Suction gas temperature;
    - Discharge temperature;
    - Pressure drop through the oil filter;
    - Contingent unbalanced electrical absorbed currents on all the 6 wires connected to the electricity grid.
- ✓ Change the oil filter if dirty (see chapter 3: "*Lubrication*").

13.7 Protection devices intervention and trouble shooting

Problem	Possible causes	Actions
1) 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.
1) 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,
2) 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
4) Insufficie nt Discharge pressure	a) Faulty condensing temperature regulation b) Intake valve partially closed c) Refrigerant amount nor enough d) Suction pressure inadequate e) The compressor does not increase the load f) Condenser oversized g) 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) See paragraph 13.3.2 e) CR / SU Leads working. See paragraph 0. f) Review the design parameters g) Special maintenance compressor

Problem	Possible causes	Actions
5) 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) See item (8) d) Review the design parameters e) Review design parameters
6) 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) Compressor does not choke h) 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) See paragraph 11 h) Check and restart
7) The compressor doesn't work at part load	a) Faulty CR Lead b) Stem of CR Lead blocked	a) Replace b) Replace
8) The compressor doesn't increase the load	a) Faulty CR Lead	a) Replace
9) Increasing and decreasing capacity steps too short	a) Oversized expansion valve causes an excessive suction pressure	a) Control the sizing of expansion valve
10) 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 0 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
11) 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
12) 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, paragraph 12 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
13) Compress or 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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14 Parallel compounding

14.1 Characteristics of the plant

Parallel compounding offers the following advantages:

- increased cooling capacity comparing to single compressor;
- High efficiency in capacity regulation;
- reduced absorbed power with starting in sequence of compressors
- ability to keep operating the unit in case of failure of compressors
- simply and economic circuit

14.2 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.

A pressure difference between the oil carters of 0.01 bar causes a difference in the level of 10 cm. Therefore it's absolutely necessary to equalize to pressures between carters of compressors connected in parallel

There are two main systems to connect in parallel SRMTec reciprocating compressor. SRMTec recommends to use the system of equalizing oil and gas (for a maximum of two compressors of the same size) or the system with oil level regulators (for more than two compressors and when compressors are of different sizes).

14.2.1 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 carters to the same value, thus providing the balance of the amount of oil returning to each compressor.

14.3 Oil level regulating system

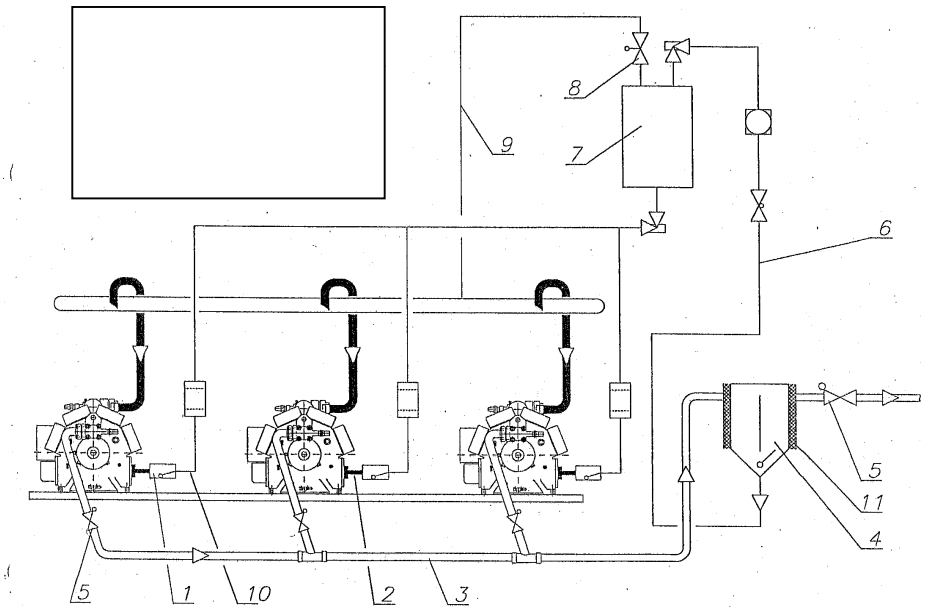

Fig. 89 Parallel compounding with oil level regulators and single oil separator

This system (Fig. 89) is suitable for parallel compounding of two or more compressors even of different sizes and also shown and high reliability. The working principle is the following: oil drawn from the compressors is separated from the refrigerant in an oil separator located after the discharge shut-off valve, 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 level regulator, positioned in place of the oil sight glass which introduces a certain amount of oil each time the preset level is lowered.
Notes:

- It's suggested to use regulators which allow to regulate the level in a certain range (from ½ to ¼ of the oil sight glass)
- It' suggested to use regulators provided with a connection for equalization between regulators: this equalization Has the aim to prevent risk of make a siphon of oil inside the carters during the shut-off procedure or to full the regulators with oil
- The pressure of oil Has to be maintained to a value between suction and Discharge ones to grant a safety return of oil. It's necessary to install a differential pressure regulating valve connected to the suction pipe to reach this aim. The suggested value is P tank = P suction + 1,4 bar, which implies to choose a regulator suitable to work with the relative differential of pressure.

14.4 Suction line

The suction pipes have to be designed so that a standstill compressor cannot be flooded with oil or liquid refrigerant; it's suggested to connect each suction pipe to the suction manifold trough an elbow. The diameter of manifold Has to be chosen so that the gas speed is lower than 4 m/s at full load. In each suction pipes the gas speed Has to be higher than 4 m/s in horizontal section and 7 m/s in vertical ones.

14.4.1 Suction liquid receiver

It's suggested to use a suction liquid receiver for each suction pipes.

14.4.2 Suction filter

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

14.5 Discharge line

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

14.6 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 separator it's necessary to use a check valve to avoid flow back of refrigerant condensed. The minimum section of connecting manifold should have a section at least equal to the section of Discharge shut-off valve. The separator must be insulated to prevent a deterioration of separation efficiency with decreasing temperature and prevent condensation. It also should be warmed during standstill periods.

14.7 Condenser

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

14.8 Evaporator

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

14.9 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

15 Maintenance

15.1 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.

15.2 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

15.3 Sludges

15.3.1 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.

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

15.3.2 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.

15.4 Corrosion

15.4.1 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.

15.4.2 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.

15.5 Coppering

15.5.1 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.

15.5.2 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.
- 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.

15.6 Icing

15.6.1 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.

15.6.2 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 dehidrator filters in liquid line.

15.7 Relief for maintenance

It's suggested to create a 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		

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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.

Note:
Compressors and refrigerant circuits shall be installed, operated and maintained only by qualified and authorized personnel.

15.8 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.

16 Extent of delivery

16.1 Standard delivery

- Star (400 V) or Delta (230 V) for RP1-L/H2 models, Part Winding motor for all other models
- Standard power supply 400V/3/50Hz or 460V/3/60Hz
- Suction shut-off valve (only for RP1-L/H2 and RP1-L/H4xx-S/F)
- Discharge shut-off valve
- Security check valve
- Oil sight glass
- Oil filter (not usable for the models with splasher lubrication)
- Oil charge
- PTC probes welded in the motor windings and security safety device INT69 for RP1-L/H2 models
- INT69B2 for all other models (230V/1/50-60Hz)
- Electrical box with IP54 protection degree
- Security nitrogen charge
- Spring dampers (except for 2 and 8-cylinder models with rubber dampers

Under request are available the following accessories:

- Capacity regulation device (CR Leads)
- Suction shut-off valve or suction flange (except for RP1-L/H2, RP1-L/H4xx-S/F in which it's standard)
- Special voltage motors
- Starting Unloader device SU (not usable for 2 and 8-cylinder models)
- Liquid injection module with its relative accessories (not usable for RP1-L/H2 models)
- Additional fan for heads cooling (not usable for RP1-L/H8 models)
- Spring dampers (not usable for RP1-L/H2 models)
- Discharge temperature probe
- Cranckase heater
- Opto-electronic probe for oil level (usable only for RP1-L/H2 and RP1-L/H4xx-S models with splasher lubrication)
- Oil charge valve
- Connections for parallel compounding
- Special packaging

Electrical accessories, standard or optional, in support of the compressor (security module device, crankcase heater, coils for capacity control) are at 230 V AC 50/60 Hz. Special voltages are available upon request.
The compressors are packaged individually and are fixed on the pallet: the package will contain anti-vibration spring and any accessories required at time of order which cannot be already installed on the compressor for reasons of space

16.2 Accessories already installed on the compressor

- ✓ Suction shut-off valve;
- ✓ SU Leads;
- ✓ Oil charge;
- ✓ CR Leads;
- ✓ Discharge temperature probe;
- ✓ Oil charge valve;

16.3 Accessories supplied as a kit inside the package of compressor

- ✓ Crankcase Heater;
- ✓ Connections for parallel compounding;
- ✓ Liquid injection device (bracket, electrical box and temperature probe(s), coil, pipes)

16.4 Accessories with a different package

- ✓ Additional fan.

Most of the accessories, if not required at time of order, can be ordered and installed on the compressor at any time thereafter. Please refer to the Chapters of this Use and Maintenance Manual for the verification of available codes.

Warning!

All the compressors at the time of delivery, are provided with a protective charge of nitrogen (1-2 bar/15-30 PSI), this pressure must be released before removing any part of the compressor. To remove the protective charge is necessary and sufficient to open the cap on attachment of high pressure. If any of the caps placed on the low pressure are opened, there is no guarantee that the pressure is discharged completely

SRM Italy Srl - via E. Majorana 11/12 – 36045 Lonigo (VI) - Italy - info@srmtec.it

SRM Italy Srl
via E. Majorana 11/12 – 36045 Lonigo (VI) - Italy
tel/fax.: +39 0444 726726
info@srmtec.it
www.srmtec.it