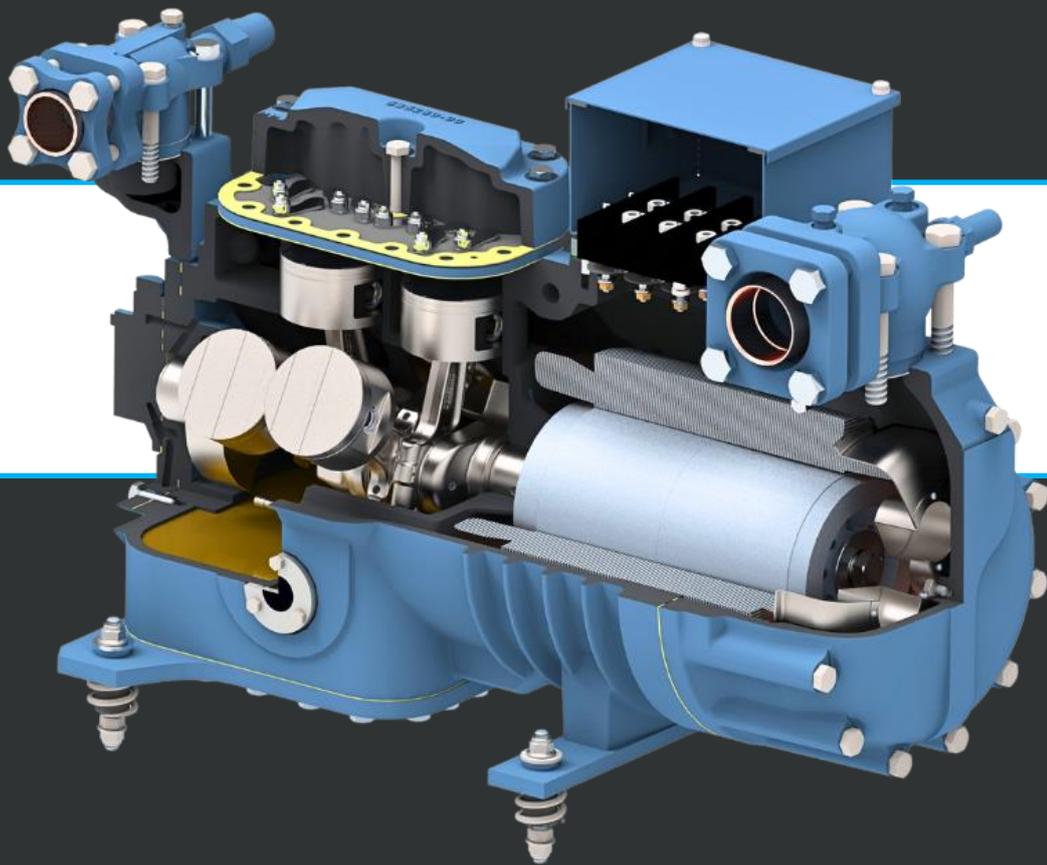




User and Maintenance Manual PP Series



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1 Safety instructions

1.1 Importance of the manual

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

1.3 Symbols 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.

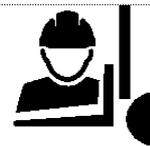


ELECTRICAL OPERATOR: the indicated steps must be performed by a specialized electrical operator that operates in compliance with the safety regulations concerning energized equipment.



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, through 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.



WARNING!:

Compressor to be clearly marked with the logo "ATTENTION FIRE HAZARD"

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 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.



Dichiarazione di incorporazione

Ai sensi dell'allegato II, parte 1, sezione B della Direttiva Macchine 2006/42/CE.

Il fabbricante:
SRM Italy Srl
 E. Majorana 10/12 - 36045
 Lonigo - Vicenza - ITALY

Con la presente dichiara che le seguenti Quasi-Macchine:

Moto-compressori semiermetici a pistone per condizionamento e refrigerazione :

Declaration of Incorporation

As per EC Machines Directive 2006/42/EC, attachment II, part 1, section B.

The manufacturer:
SRM Italy Srl
 E. Majorana 10/12 - 36045
 Lonigo - Vicenza - ITALY

Hereby declare that the following new partly-completed machines:

Semi-hermetic piston compressors for refrigeration and air-conditioning application

Déclaration de l'incorporation

En vertu de l'annexe II, part 1, section B de la Directive Machines 2006/42/CE.

Le fabricant:
SRM Italy
 E. Majorana 10/12 - 36045
 Lonigo - Vicenza - ITALY

Je déclare par la présente que les machines Quasi-Machines suivantes:

Moto-compresseurs semi-hermetiques à piston pour la réfrigération et le conditionnement d'air:

SP2L 003	SP2H 006	SRC-M-300	SP4HF060	SB4L1200
SP2L 004	SP2H 008	SRC-M-340	SP4HF080	SB4L1400
SP2L 005	SP2H 009	SRC-M-340	SP4LF090	SB6L1600
SP2L 006	SP2H 075	SRC-M-120	SP4HF120	SB6L2000
SP2L 075	SP2H 100	SRC-F-185	SP4HF100	SB6L2500
SP2L 100	SP2H 150	SRC-F-222	SP4HF120	SB6L3000
SP2L 130	SP2H 180	SRC-F-250	SP4HF150	
SP2L 150	SP2H 200	SRC-F-295	SP4HF200	
SP2L 200	SP2H 300			
SP2L 300	SP2H 400	ORC-F-188	SP4LN060	
SP2L 320	SP2H 420	ORC-F-226	SP4LN080	
SP2L 400	SP2H 500	ORC-F-264	SP4LN100	
SP2L 500	SP2H 500	ORC-F-300	SP4LN120	
SP2L 700	SP2H 700		SP4HN100	
SP2L 750	SP2H 750	SRC-L-160	SP4HN120	
SP2H 800	SP2H 800	SRC-L-180	SP4HN150	
			SP4HN200	
			SP4L150	
			SP4L180	
			SP4L220	
			SP4L250	
			SP6L270	
			SP6L300	
			SP6L400	
			SP8L500	
			SP8L600	
			SP4H220	
			SP4H250	
			SP4H300	
			SP4H350	
			SP6H370	
			SP6H400	
			SP6H500	
			SP8H600	
			SP8H700	



2 General

2.1 Identification

The RefComp PP series piston compressors are reciprocating oil lubricated compressors specifically designed to operate with hydrocarbon (R290, R1270, R600) gas as refrigerants and to be installed in refrigeration system.

	PP	4	H	N	1500	L	0
PP	= Propane Semi-hermetic Piston compressor						
4	= No. of cylinders						
H	= Motor size version H: Full size motor L: Small size motor						
F/N	= specification of lubrication type (where required) F: Forced lubrication (with oil gear pump) N: Splasher lubrication (without oil gear pump)						
1500	= Nominal power [Hp*100]						
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 ; V = Electrical accessories UL approved 110V AC 50/60Hz						
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);						

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

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.

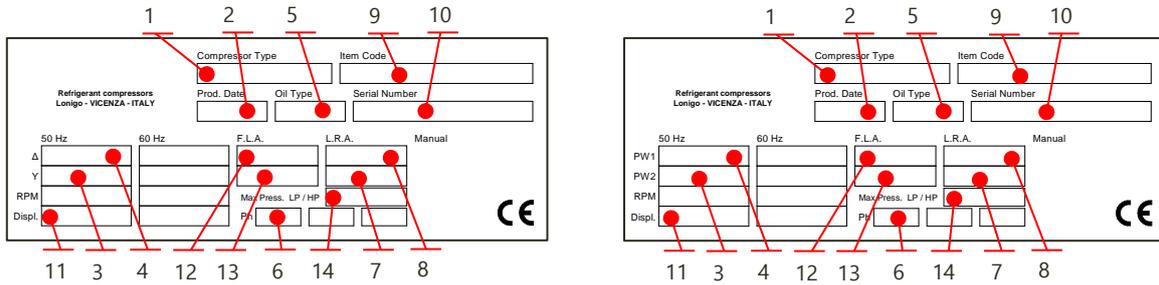


Fig. 1: Name plate for compressors with Y/Δ and PW electric motor

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: <ul style="list-style-type: none"> • First winding in PW • Y connection in Y/Δ
4.	Running voltage	Supply voltage of the starting configuration: <ul style="list-style-type: none"> • 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: <ul style="list-style-type: none"> • 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 RefComp 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)

2.3 Intended Use

The **PP 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 PP series compressors have been developed to be used with R290 and are recommended to use with the high viscosity polyglycol oil to compensate for the high solubility of propane in lubricants. Please note the oil will not be charged in the compressors shipped from the factory.

The use of propane 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
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



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 where the compressor is installed and appropriate precautions must be taken to reduce residual risks (see chapter 2.5)

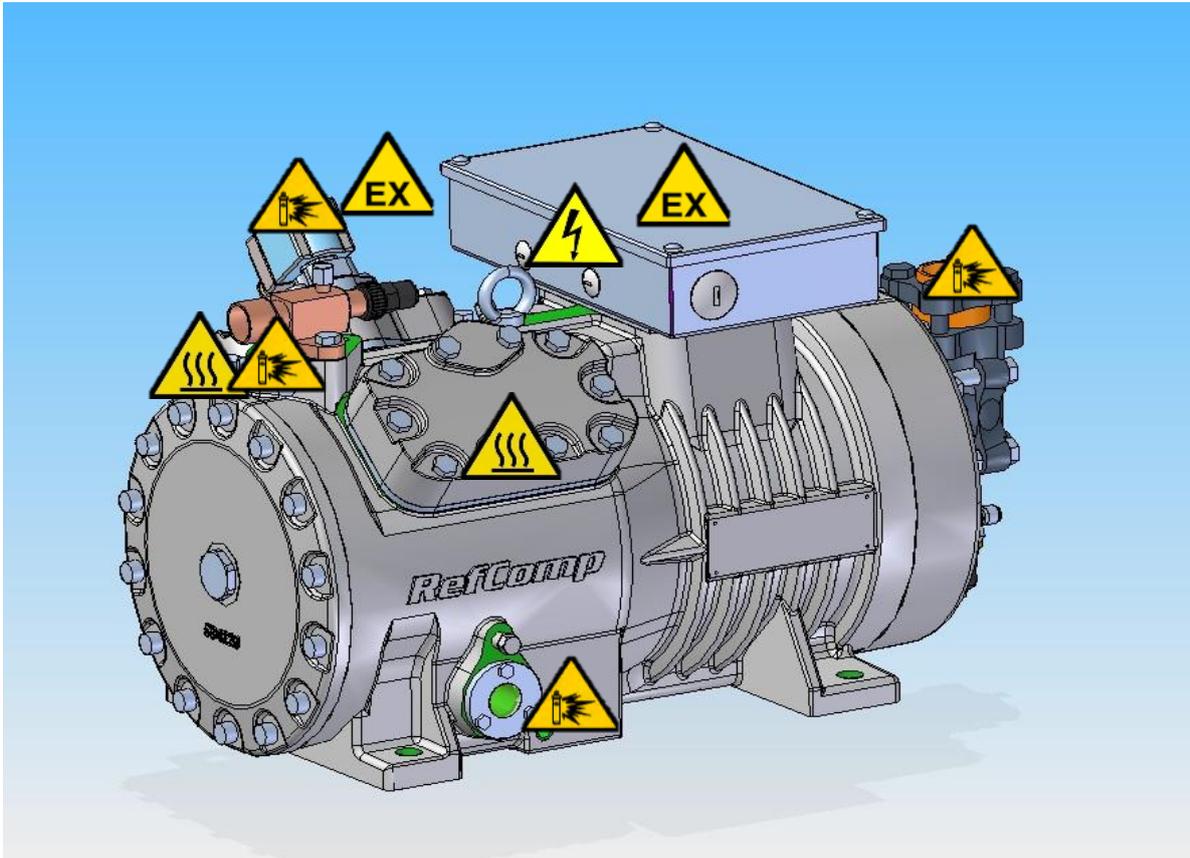


Fig. 2: Dangerous area identification



2.7 Introduction

PP series has 56 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 specifically designed to operate with hydrocarbon (R290, R1270, R600) gas as refrigerants and to be installed in refrigeration system.

Compressors sizes are totally 28, with displacement from 5,4 to 222 m³/h at 50 Hz

Mod. PPxH	PP2H0150	PP2H0200	PP2H0210	PP2H0300	PP2H0310	PP2H0350	PP2H0400	PP4H0500	PP4H0600	PP4H0800	PP4H0900						
No. of cylinder	2				2			4									
Nominal motor power HP	1.5	2	2	3	3	3.5	4	5	6	8	9						
Displacement at 50Hz 60 Hz m ³ /h	5,4 6,5	6,7 8	8,2 9,8	9,8 11,8	11,6 14	13,6 16,3	16,5 19,8	19,3 23,1	23,1 27,7	27,3 32,8	33,1 39,8						
Lubrication	Splasher				Splasher			Splasher									
Capacity control (option)	-				-			-									
Mod. PPxH	PP4HN1000	PP4HF1000	PP4HN1200	PP4HF1200	PP4HN1500	PP4HF1500	PP4HN2000	PP4HF2000	PP4H2200	PP4H2500	PP4H3000	PP4H3500	PP6H3700	PP6H4000	PP6H5000	PP8H6000	PP8H7000
No. of cylinder	4				4				6			8					
Nominal motor power HP	10	12	15	20	22	25	30	35	37	40	50	60	70				
Displacement at 50Hz 60 Hz m ³ /h	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	Forced or Splasher				Pump				Pump			Pump					
Capacity control (option)	50-100%				50-100%				66-100% 33-66-100%			50-75-100%					

Table 1

Mod. PPxL		PP2L0100	PP2L0150	PP2L0160	PP2L0200	PP2L0210	PP2L0250	PP2L0300	PP4L0300	PP4L0400	PP4L0500	PP4L0600						
No. of cylinder		2				2			4									
Nominal motor power	HP	1	1.5	1.5	2	2	2.5	3	3	4	5	6						
Displacement at 50Hz 60 Hz	m ³ /h	5,4 6,5	6,7 8	8,2 9,8	9,8 11,8	11,6 14	13,6 16,3	16,5 19,8	19,3 23,1	23,1 27,7	27,3 32,8	33,1 39,8						
Lubrication		Splasher				Splasher			Splasher									
Capacity control (option)		-				-			-									
Mod. PPxL		PP4LN0600	PP4LF0600	PP4LN0800	PP4LF0800	PP4LN1000	PP4LF1000	PP4LN1200	PP4LF1200	PP4L1500	PP4L1800	PP4L2200	PP4L2500	PP6L2700	PP6L3000	PP6L4000	PP8L5000	PP8L6000
No. of cylinder		4				4				6				8				
Nominal motor power	HP	6	8	10	12	15	18	22	25	27	30	40	50	60				
Displacement at 50Hz 60 Hz	m ³ /h	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		Forced or Splasher				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 m³/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.

PP 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 cylinders)

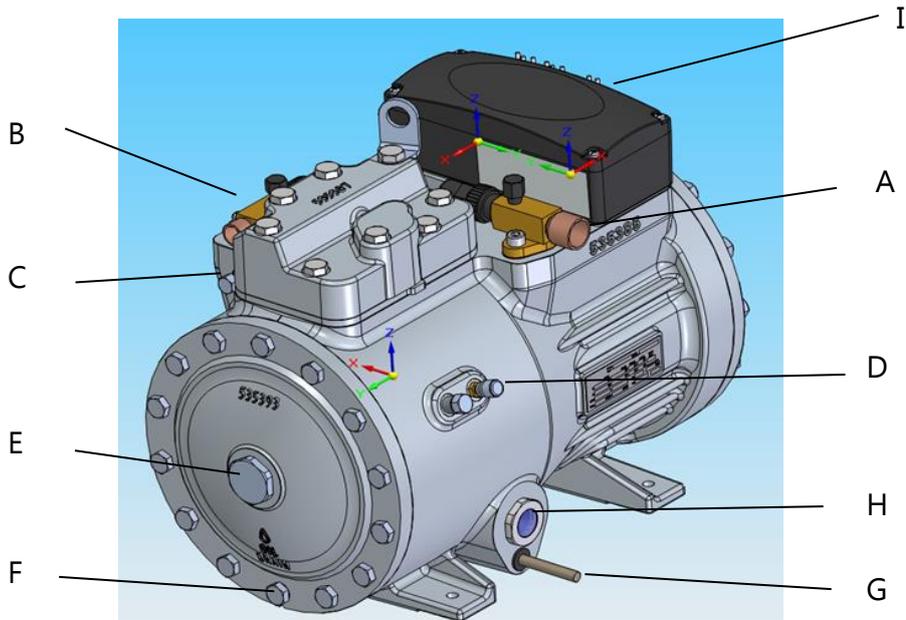


Fig. 3: Model PP2-L/Hxx (splasher lubrication)

- | | | |
|-------------------------------------|----------------------------|--------------------------|
| A) Suction shut-off valve | D) Low pressure connection | G) Crankcase heater |
| B) Discharge shut-off valve | E) Optical oil sensor cap | H) Oil level sight glass |
| C) Discharge temperature connection | F) Oil discharge | I) Electrical box |

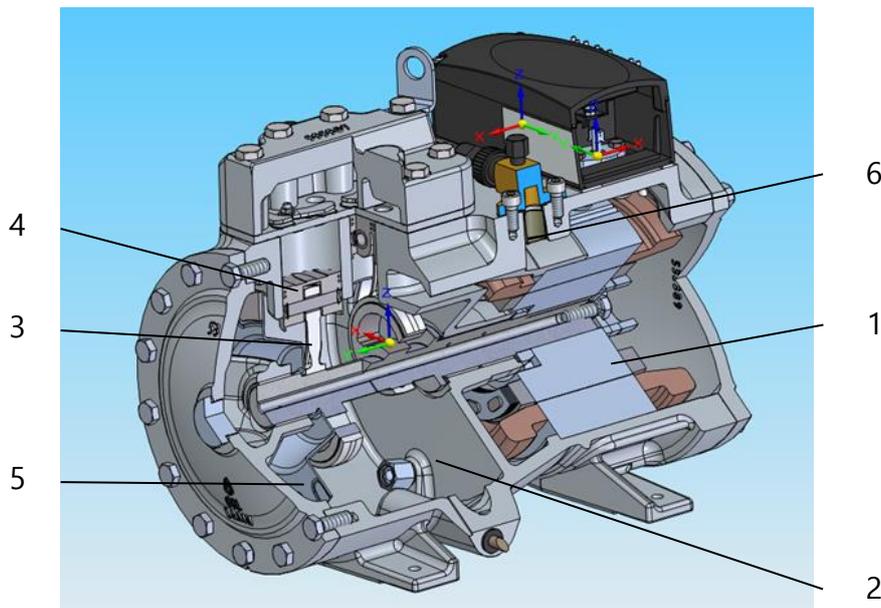


Fig. 4: Cross section of PP2-L/Hxx (splasher lubrication)

- | | |
|---------------------|-------------------------|
| 1) Electrical motor | 4) Piston |
| 2) Shaft | 5) Oil centrifugal disk |
| 3) Connecting rod | 6) Suction filter |



2.7.2 Compressors with splasher lubrication (4 cylinders)

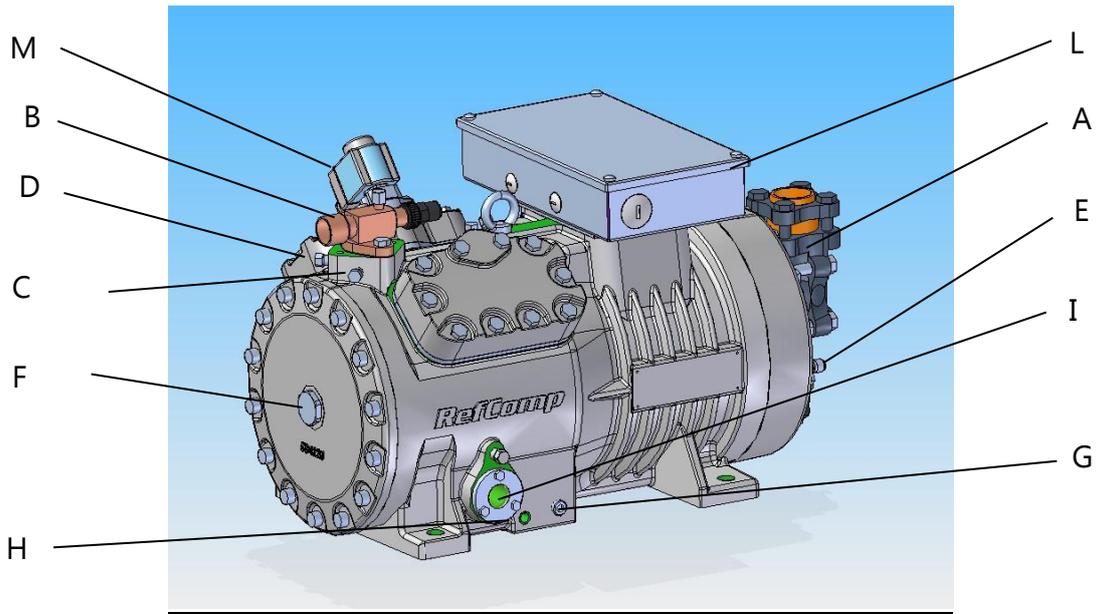


Fig. 5: Model PP4-L/HNxx (splasher lubrication)

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

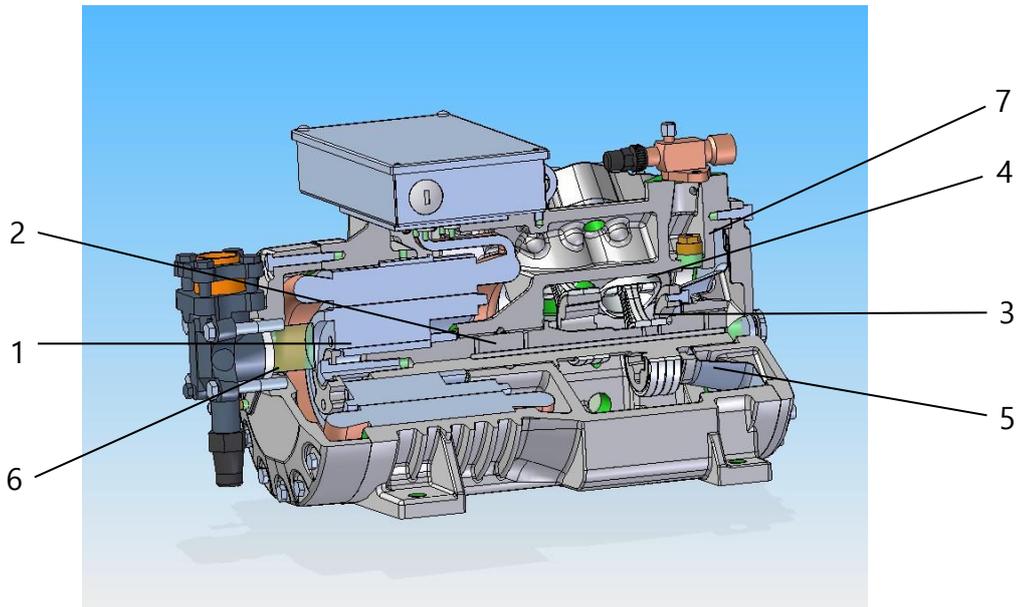


Fig. 6: Cross section of PP4-L/HNxx (splasher lubrication)

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



2.7.3 Compressors with forced lubrication (4 cylinders)

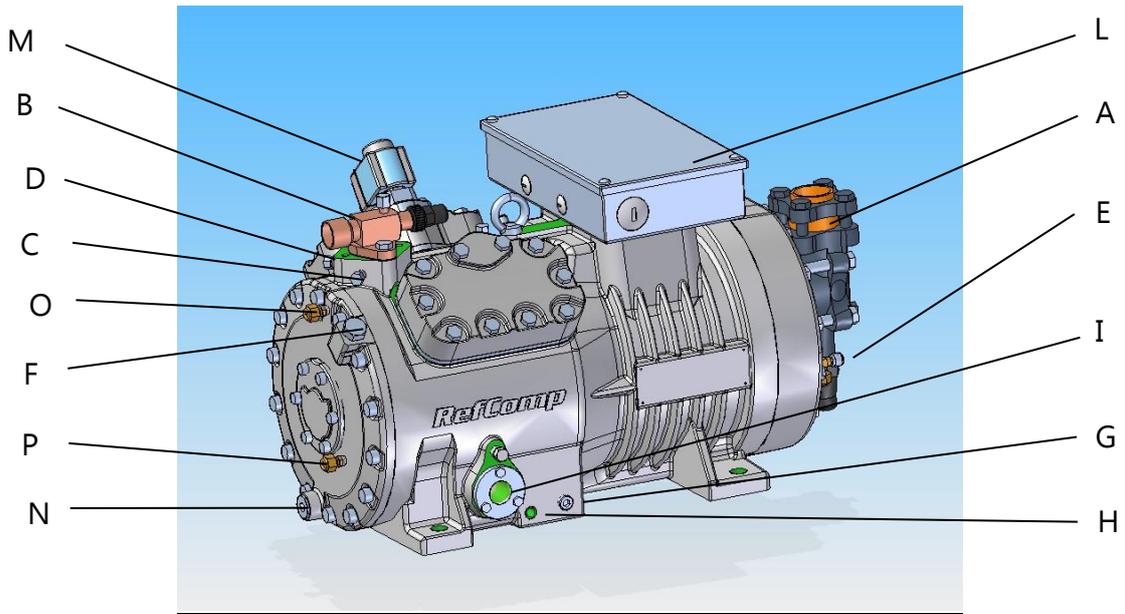


Fig. 7: Model PP4-L/HFxx (forced lubrication)

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

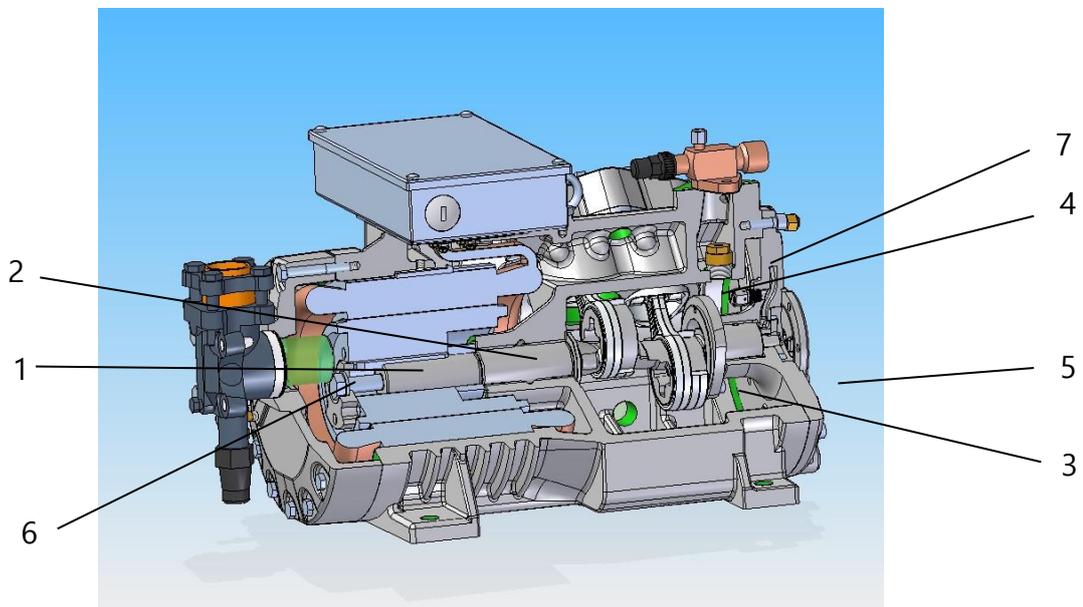


Fig. 8: Cross section of PP4-L/HFxx (forced lubrication with oil pump)

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



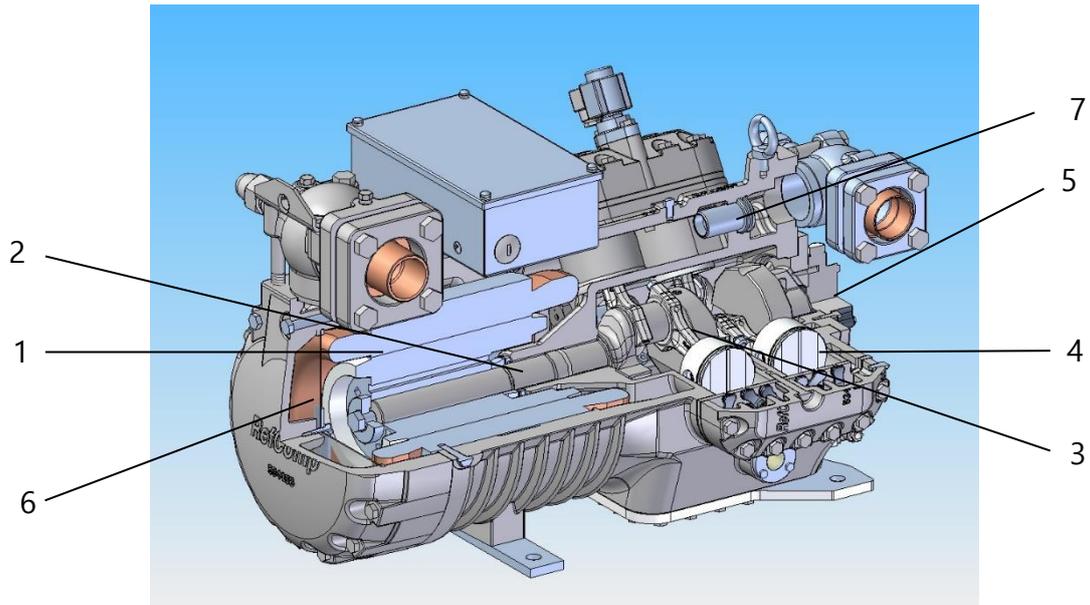


Fig. 9: Cross section of PP8-L/Hxx (forced lubrication with oil pump)

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



3 Lubrication

3.1 Lubrication systems

The oil has the following functions:

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

The PP 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. 10: Compressor model PP4-L/HNxx with splasher lubrication Fig. 10.

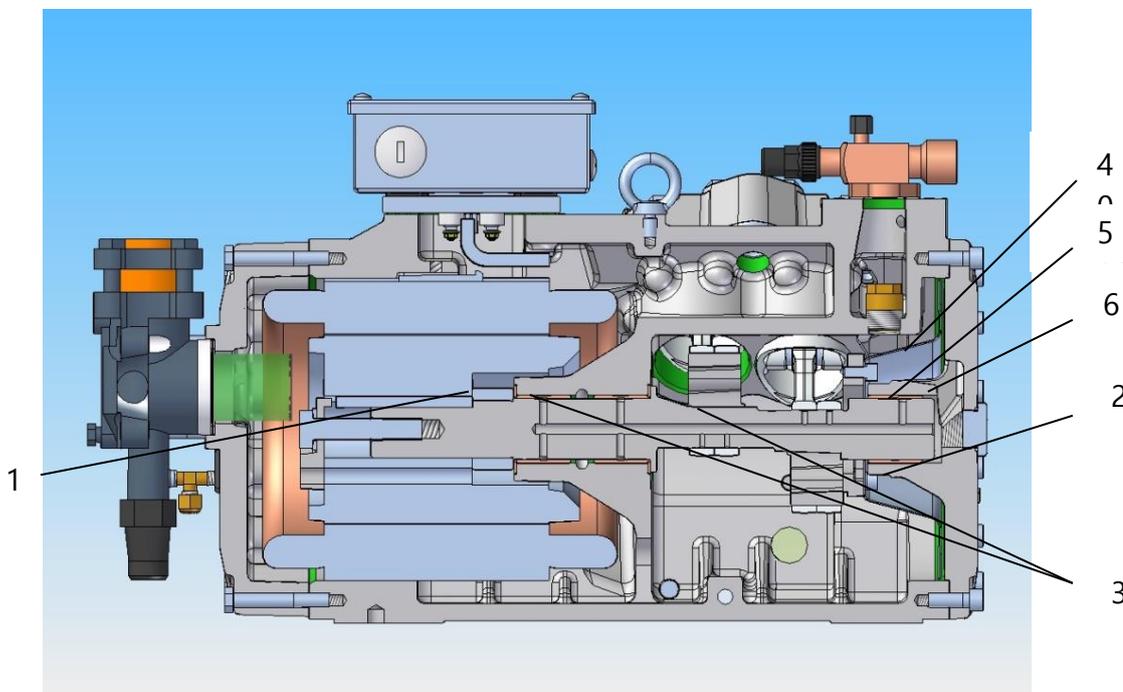


Fig. 10: Compressor model PP4-L/HNxx with splasher lubrication

- | | |
|------------------------------|--------------------------------|
| 1) Shaft | 4) Oil sump |
| 2) Centrifugal disk | 5) Oil inlet to the main canne |
| 3) Oil distribution channels | 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 and 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. 11 .

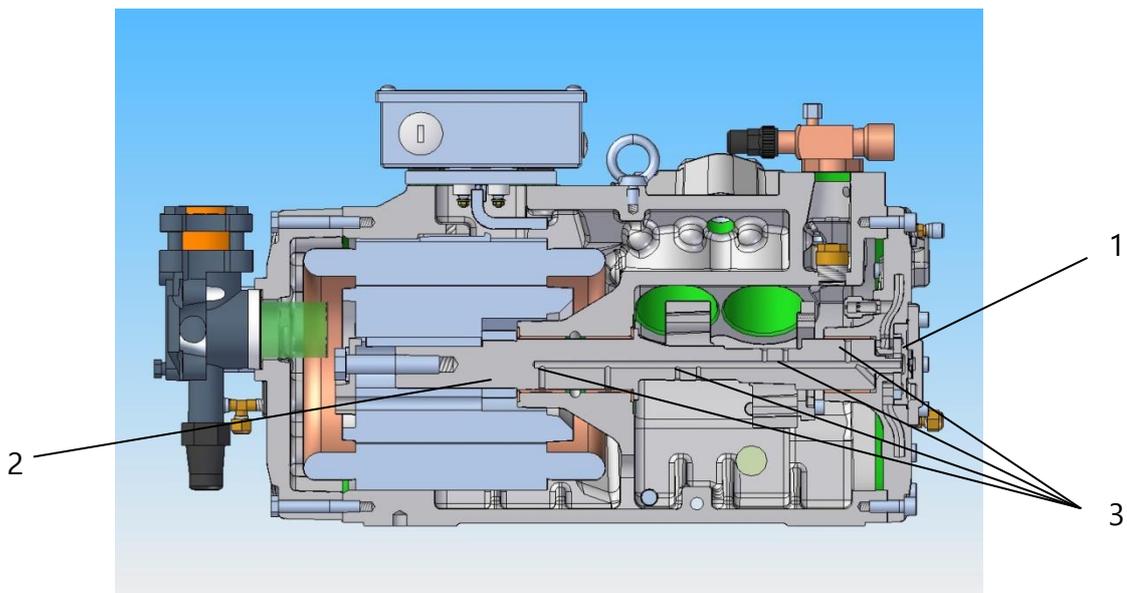


Fig. 11: *Compressor model PP4-L/HFxx with forced lubrication*

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



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.

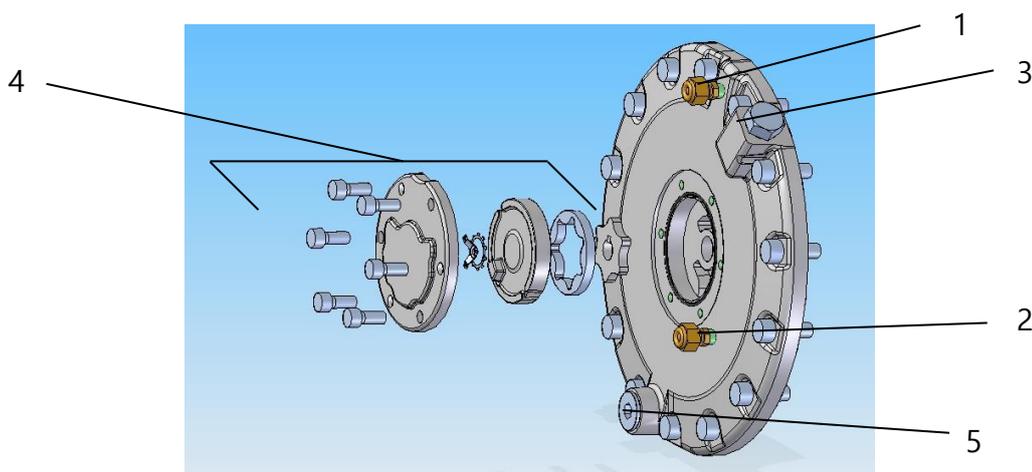


Fig. 12: Gear pump for compressors PP4-L/HFxx with forced lubrication

1. Oil high pressure connection (discharge pressure of pump) 1/4" SAE-FLARE
2. Oil low pressure connection (pressure inside the carter) 1/4" 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. 12).

An optional mechanical differential pressure device (option) could be connected to the high- and low-pressure connections (ref. 1, 2 in **Errore. L'origine riferimento non è stata trovata.**), machined over the casing cap.

The gear pump has also a safety valve (ref. 2 in Fig. 13), 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).

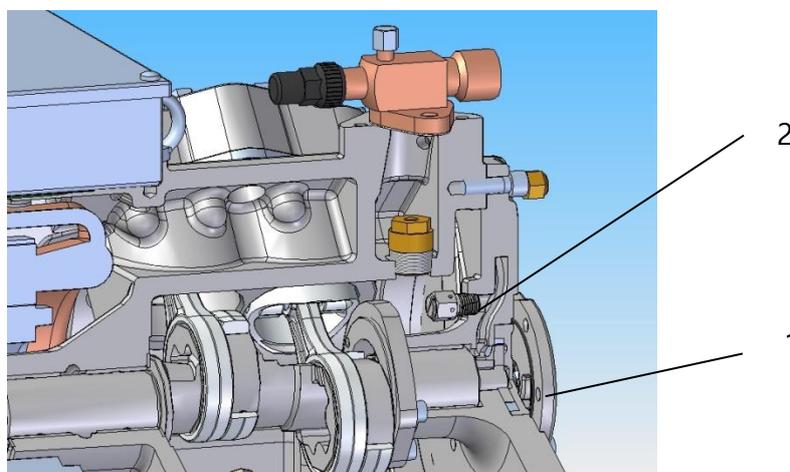


Fig. 13: Compressor model PP4-L/Hxx: gear pump and safety valve

1. Gear pump
2. Oil safety valve

3.3.2 Pump lubrication

The oil gear pump (rif. 1 in Fig. 14) 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. 14.

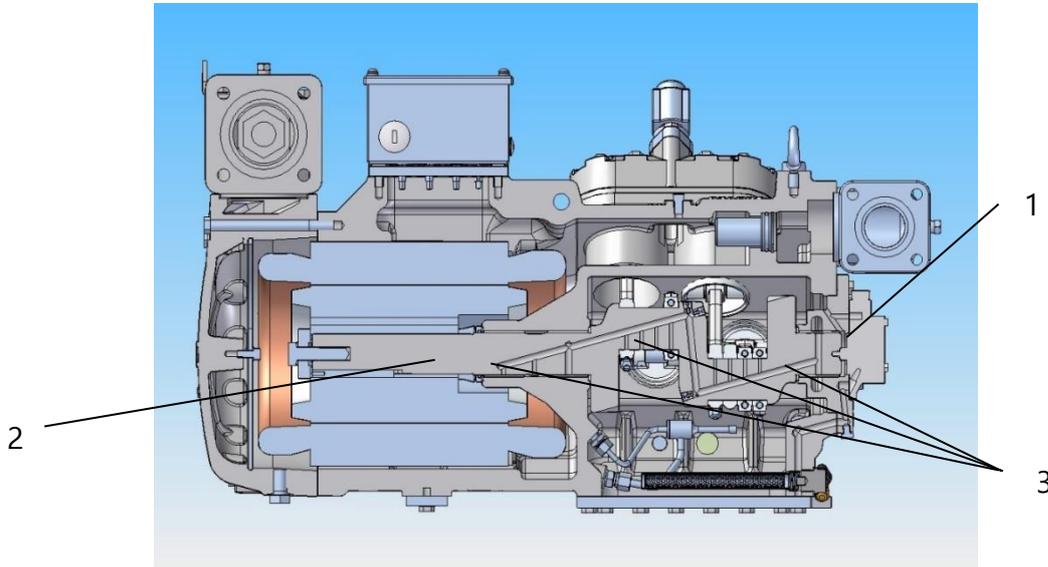


Fig. 14: Compressor model PP4-L/Hxx PP6-L/Hxx PP8-L/Hxx with pump lubrication

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.

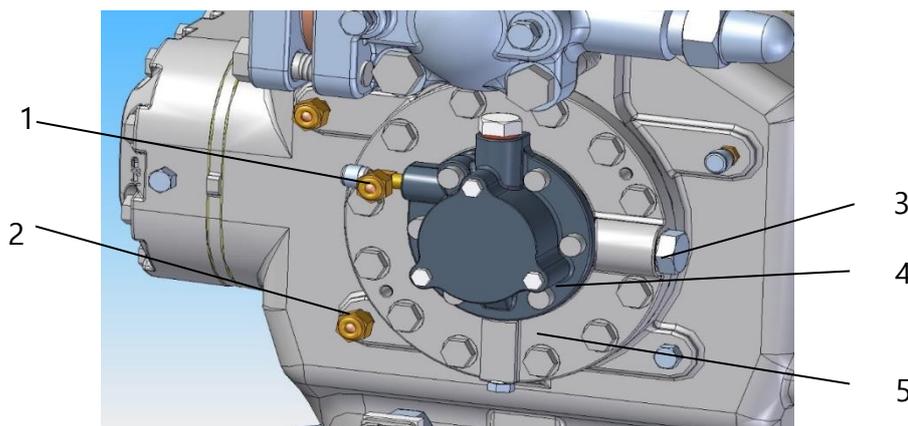


Fig. 15: Gear pump for compressors PP4-L/Hxx PP6-L/Hxx PP8-L/Hxx

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. 2 in Fig. 15), 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).

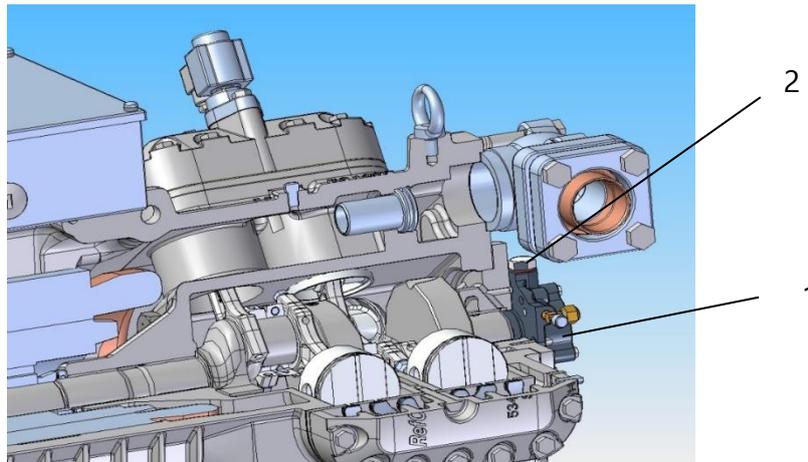


Fig. 16: Detail of gear pump and safety valve of PP4-L/Hxx PP6-L/Hxx PP8-L/Hxx

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:

$$P_{oil} = \text{Delivery pressure} - \text{Carter pressure.}$$

The measurement of the differential pressure P_{oil} has to be done between (1) and (2) connections shown in Fig. 12 **Errore. L'origine riferimento non è stata trovata.** or Fig. 14. 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. 17 **Errore. L'origine riferimento non è stata trovata.**), 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 3.6).

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)

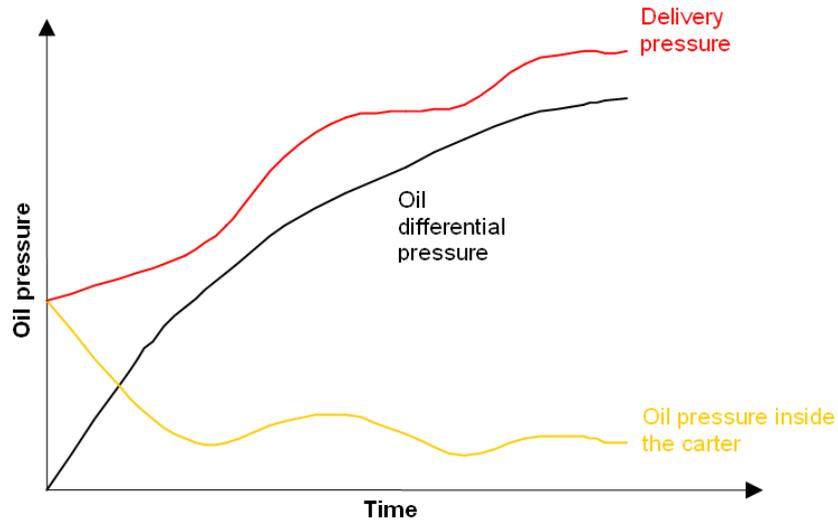


Fig. 17 :Oil pressure vs time during start-up phase

Furthermore, 4-cylinder models PP4-L/H 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. 18 **Errore. L'origine riferimento non è stata trovata..**

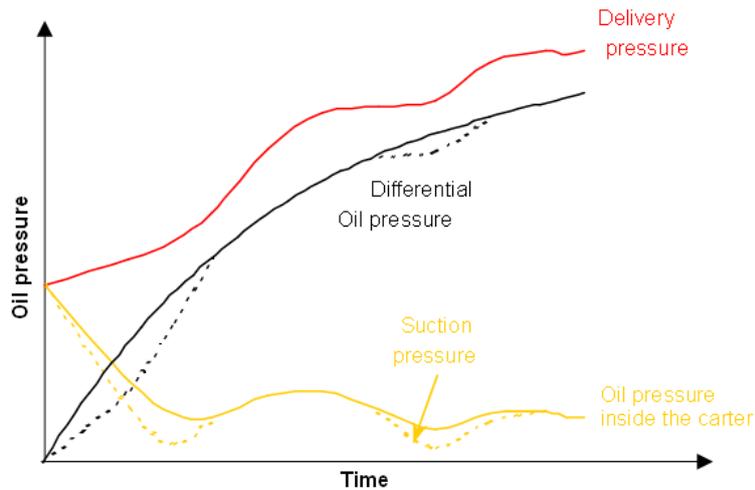


Fig. 18 :Oil pressure vs time of compressor with check valve between suction line and carter

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 PP4-L/H 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.

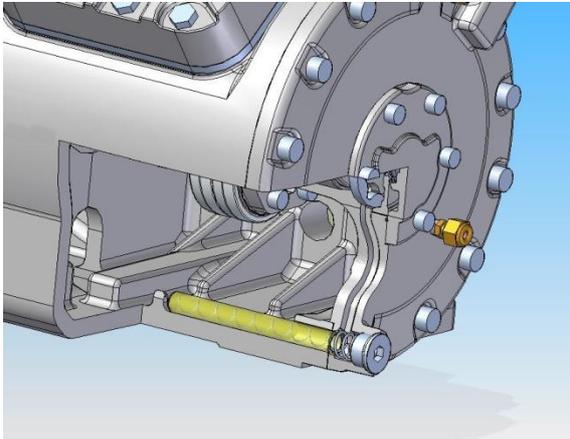


Fig. 19 :Oil filter in models PP4-L/Hxx-F

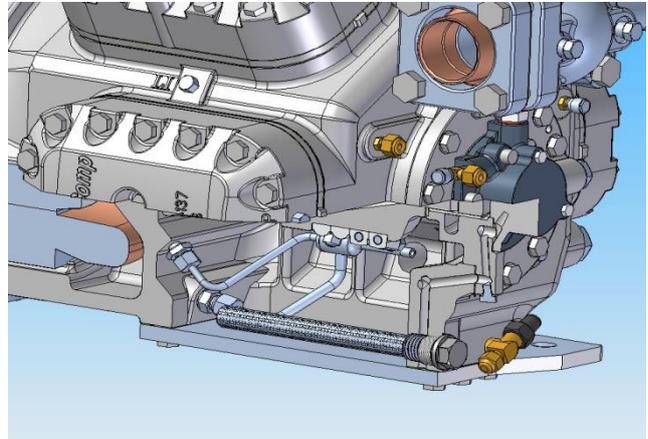


Fig. 20 Oil filter in models PP4L/Hxx and 6 and 8-cylinder

The filter for models *PP4-L/Hxx-F* (Fig. 21) 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.

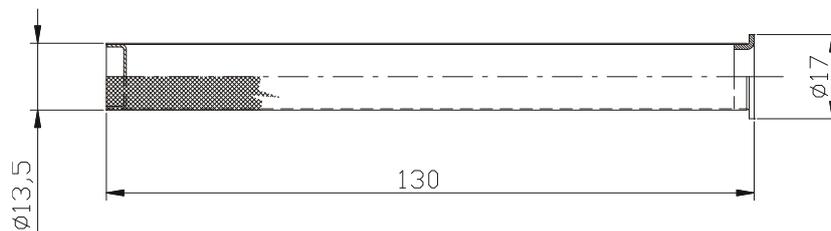


Fig. 21: Oil filter in models PP1-L/H4xx-F

The filter for models *PP4L/Hxx* 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.

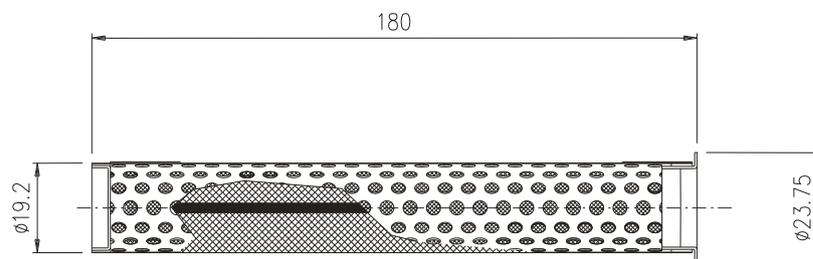


Fig. 22: Oil filter of 4-cylinder models PP4L/Hxx and 6 and 8-cylinder models

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 RefComp 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.

**Caution!**

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

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 PP2-L/Hxx, PP4-L/HFxx and PP4-L/HNxx*

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.

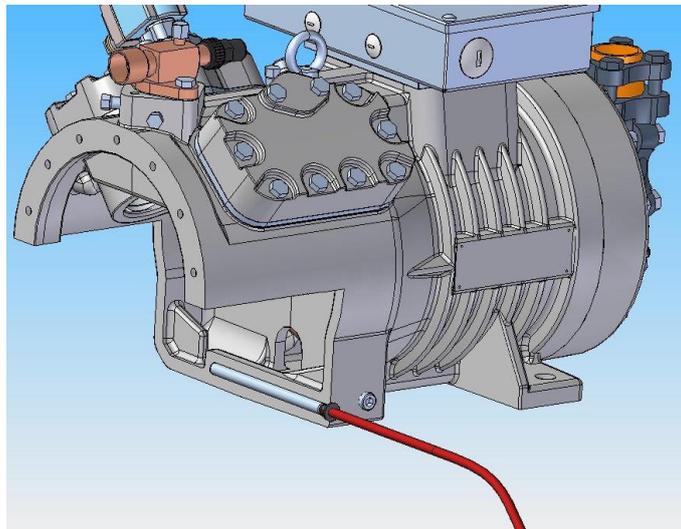


Fig. 23: Crankcase heater (PTC type) for compressors PP4-L/HFxx and PP4-L/HNxx

- *Compressor model PP4L/Hxx 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. 24 **Errore. L'origine riferimento non è stata trovata.**).



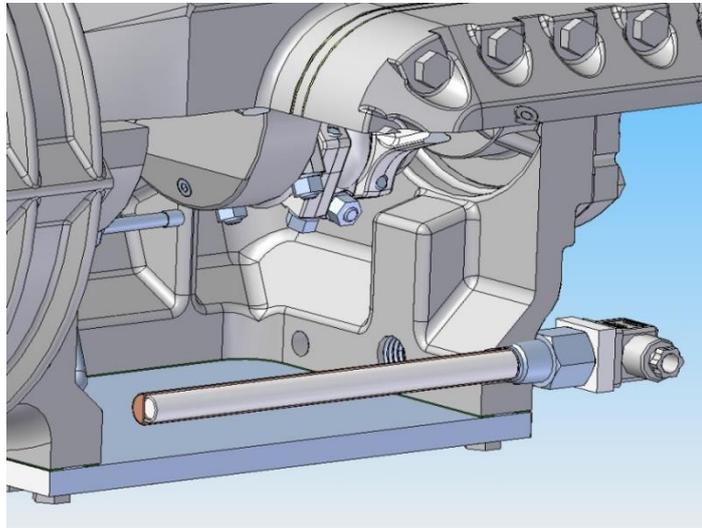


Fig. 24: Crankcase heater in compressor model *PP4L/Hxx* and in 6 and 8-cylinder models

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 dimensions are shown in Table 3.



For others information of crankcase heaters kit codes, ask to RefComp Commercial Department.

Size		
1	2	3

Table 3 *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.

Caution!

Never use pump down operation in hydrocarbon systems. Risk of contamination with Oxygen of the plant.



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

Switch on the oil heater during standstill operations.

The exceptions must, however, always be assessed carefully

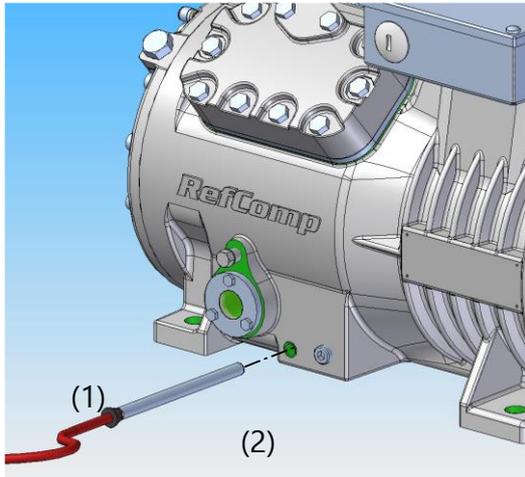


The compressor can be switched-on when the oil temperature is 30 K higher than room temperature or than any other components of the whole circuit. During the inspections in the plants is suggested to verify always if the crankcase heater is switched on.



3.4.1 Oil heater assembly procedure

- Hole seat type



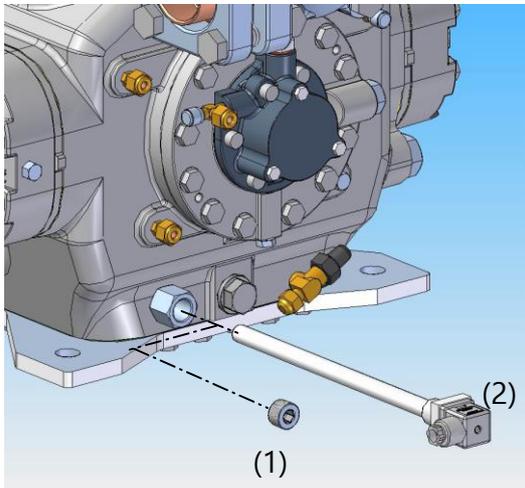
Assembling:

- 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. 25 shows the minimum (1/4 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")

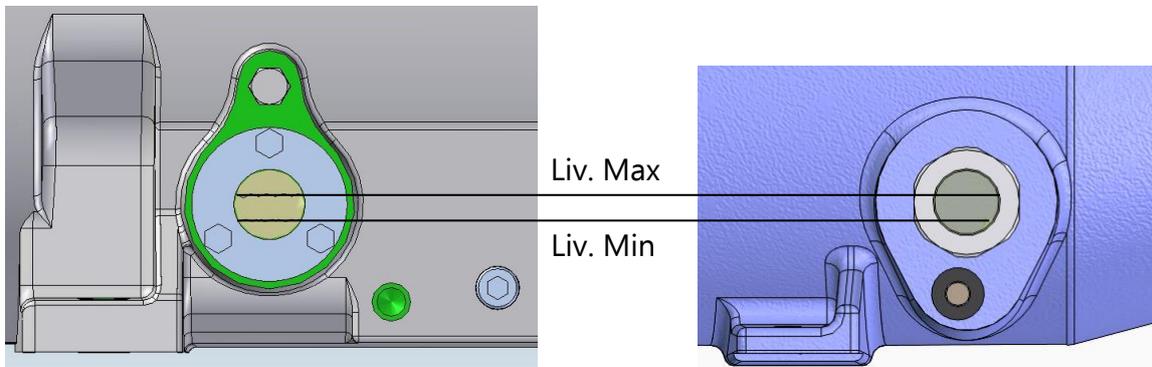


Fig. 25: Oil monitoring through sight glass

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.

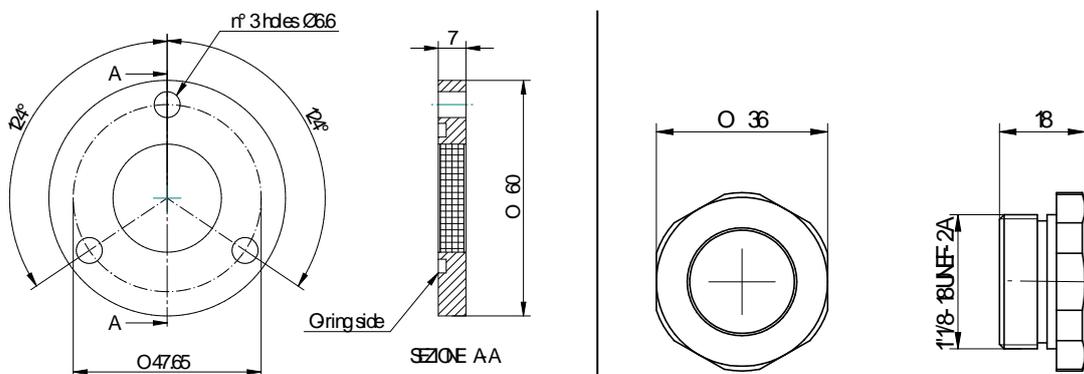


Fig. 26: Types of oil sight glass

3.6 Lubrication monitoring

3.6.1 Electronic differential pressure switch

Warning!



This electrical part can be used in potentially explosive areas of zone 1 and zone 2. A corresponding zone barrier (see manufacturer test certificate) needs to be installed for the superordinate control or regulating unit.

It's possible to order, as alternative to mechanical pressure switch, the electric one Ex, and it could be added at any time after the compressor installation.

The pressure switch is divided into two main parts (see picture 2- Fig. 27 **Errore. L'origine riferimento non è stata trovata.**):

- 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);
- Control circuit, with ring nut, threaded cap $\varnothing 29$, 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.

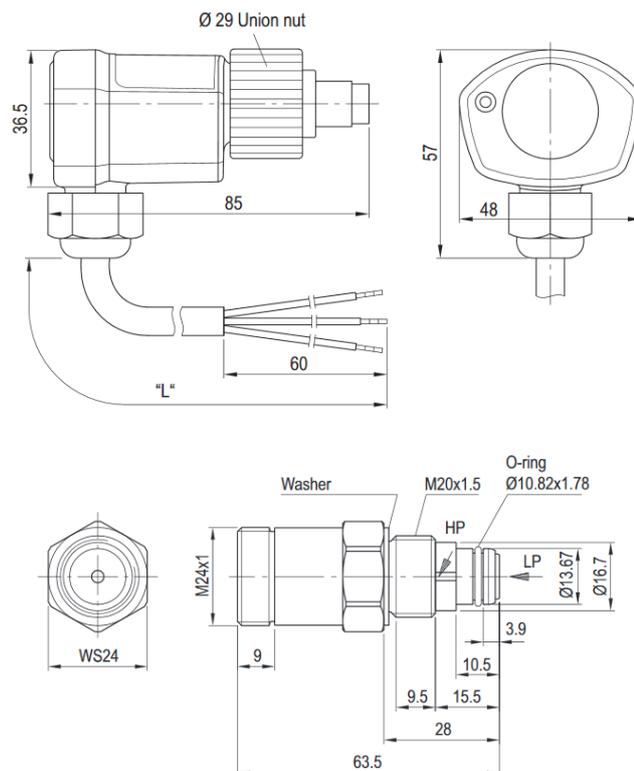


Fig. 27: Components and dimensions

The pressure probe a) is mounted directly on the gear pump support or housing cover on the proper threaded holes (rif. 3 **Errore. L'origine riferimento non è stata trovata.**, rif 3 **Errore. L'origine riferimento non è stata trovata.**, 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 RefComp factory before the delivery of compressor, allows the installation or substitution of control circuit without discharging the compressor.

Material	Brass
Voltage supply	-
Frequency	-
Working temperature	-30...90 °C
Protection degree	IP 54
Delay	-
Differential pressure	0,65 bar ± 0,15 bar
Opening power	30V 50/60Hz, max. 30mA
Approved	UL
Release	Automatic
Connection cable	3 x AWG18 (0,75 mm ²) L = 3 m Conductor with coloured codes
Weight	250g

Table 4 *Technical features of electronic pressure switch*

Concerning the operation, referring to picture 2-35, consider the following:

Before the starting of the compressor, without the oil pressure, the contact brown and red are connected.

The PLC has to be programmed in order to stop the compressor if, within a time delay of 90s after starting, the signal of the differential oil pressure signal has not closed.



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.

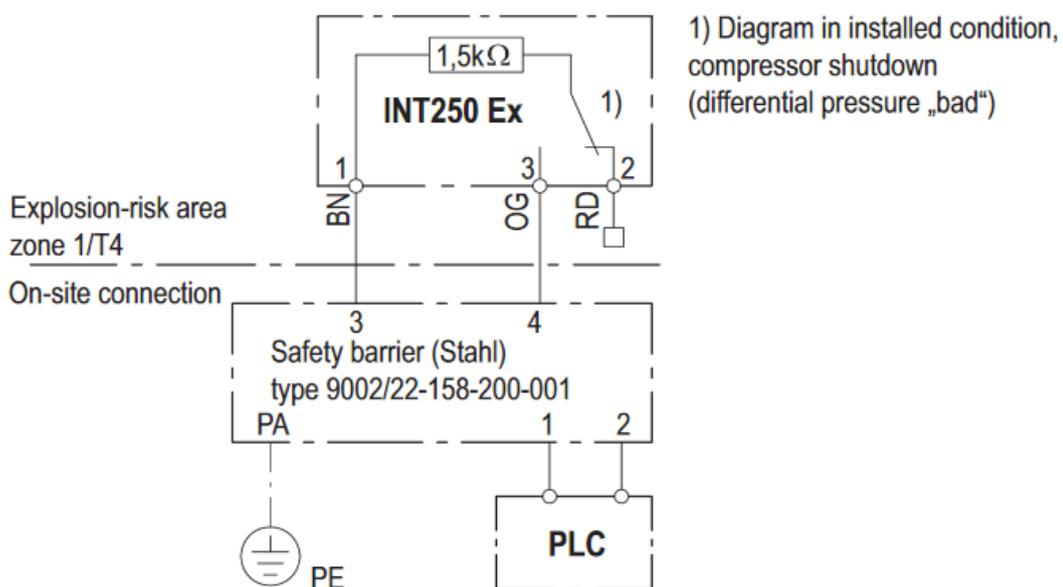


Fig. 28 Connecting electrical scheme INT250Ex



In case of installation or replacement on compressors with sensor not factory installed, refer to Fig. 29

- ✓ 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. 28).

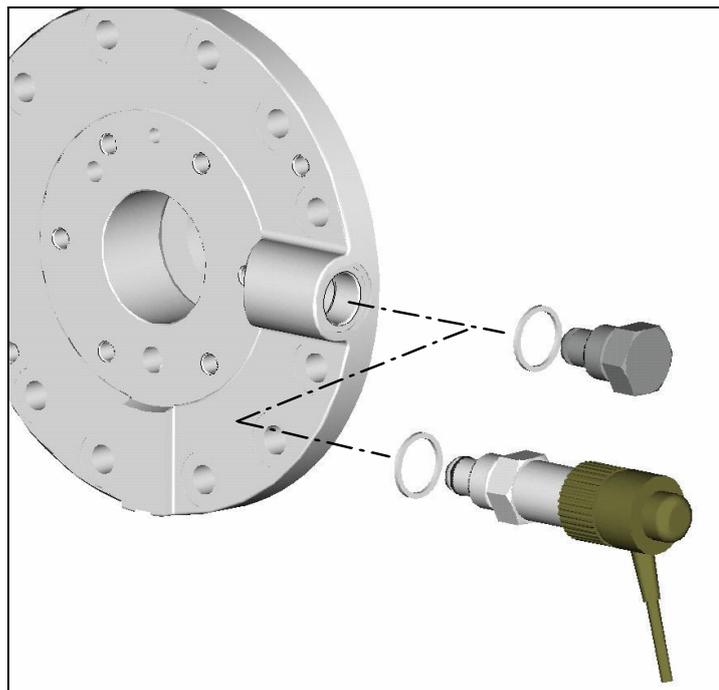


Fig. 29 *Assembly of the electronic pressure switch*

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. 28).



3.7 Oil recovery

Four-cylinder models PP4-L/Hxx and all 6 and 8-cylinder models have a depressor (see Fig. 31 **Errore. L'origine riferimento non è stata trovata.**) 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. 30 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.

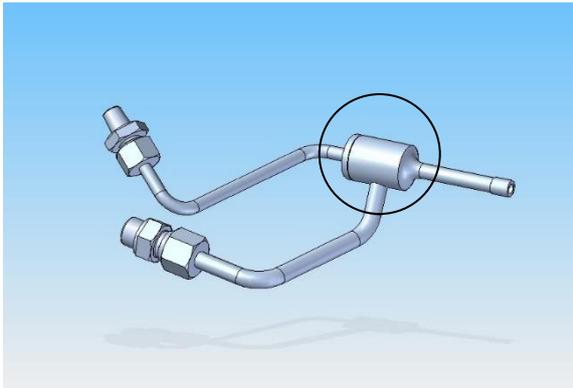


Fig. 31 Depressor for oil recover

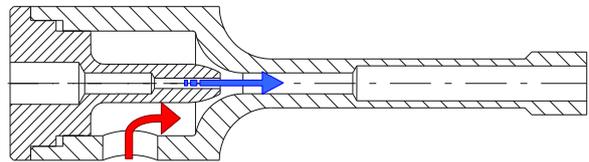


Fig. 32 Venturi effect used in the compressor

3.8 Anti-foaming valves

As shown in paragraph "Oil pressure", 4-cylinder models PP4-L/H and all 6 and 8-cylinder models are equipped with a check valve between suction line and oil carter (see Fig. 33). These valves are closed during transient states, preventing the equalization of the suction pressure and carter pressure and the consequent foaming.

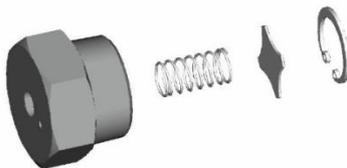


Fig. 33 Exploded of check valve

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 RefComp are highly hygroscopic and don't have to come in contact with air humidity.

Here below are shown the lubricants approved by RefComp for PP compressors series.



3.9.1 Lubricant for R290

Supplier	Type	Chemical comp.	Density at 15°C [g/ml]	Viscosity at 40°C [cSt]	Flash point [°C]	Pour point [°C]	Flock point [°C]
CPI	CP-1516-68	PAG	0.989	61.5	218	-48	none
MOBIL	SHC 226E	PAO	0.83	69.0	266	-50	None

Table 5: properties of oil for refrigerant R290;

3.9.2 Lubricant for R600a

Supplier	Type	Chemical comp.	Density at 15°C [g/ml]	Viscosity at 40°C [cSt]	Flash point [°C]	Pour point [°C]	Flock point [°C]
CPI	CP-1507-68	Glycol	1.13	61.5	218	-48	none

Table 6: properties of oil for refrigerant R600a;

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 5: properties of oil for refrigerant R290; Table 5 and Table 6 show some technical characteristics of oils used.

Once verified the chemical and physical stability of the system, control may become an annual or longer.

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

Caution!

The usage of the compressor capacity control is strongly discouraged because of:



- Risk of air trap in the capacity control chamber during vacuum operations;
- The compressor load control, especially in STEP version, could induce quick changes in suction pressure and condensing pressures. There is the risk of boundary friction due to strong de-gassing of the refrigerant from the oil and unstable gas superheat.
- Risk of strong foaming in the oil separator.

The usage of a Variable frequency drive, to be installed in remote panel, is strongly recommended

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.

RefComp PP 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. 34 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).

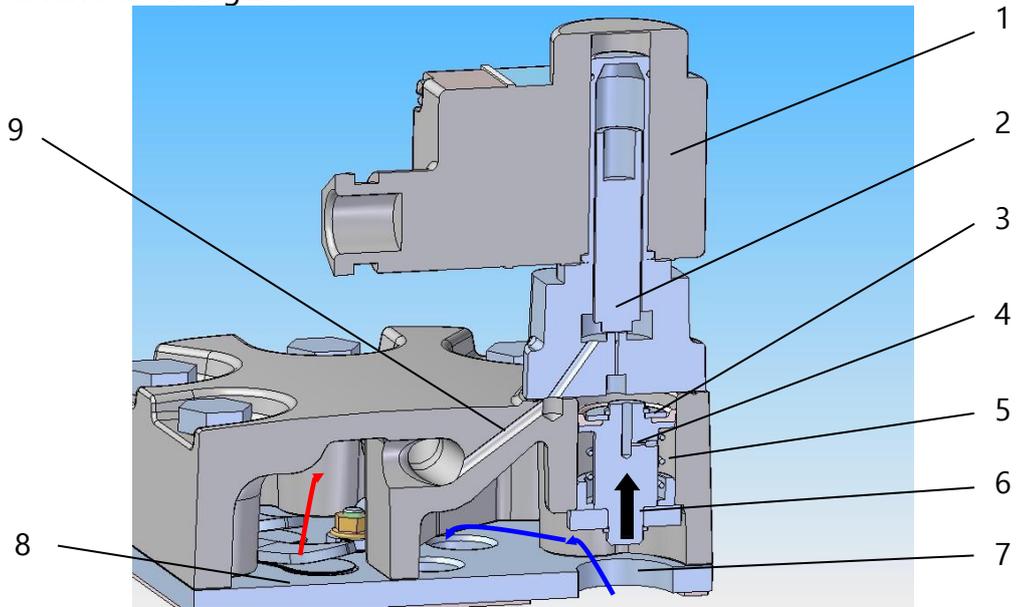
b) Energized = UNLOAD

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.

PP compressor series could be equipped with variable steps of capacity control, according to the number of cylinders, as shown on Table 7.



a) Solenoid valve de-energized:



b) Solenoid valve energized:

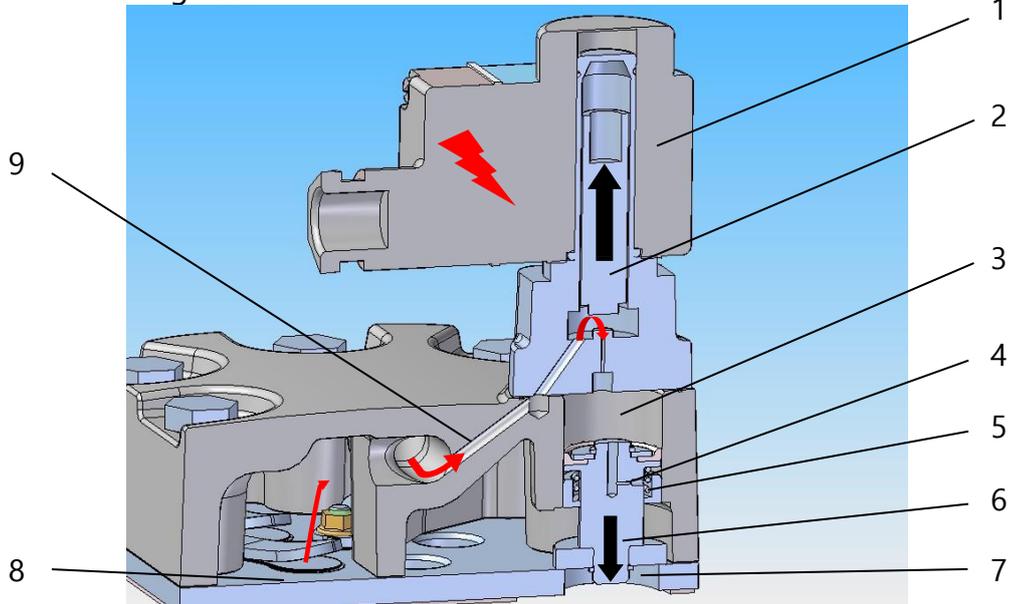


Fig. 34 Working principle of CR head

- | | | |
|---|---------------------------|--|
| 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 7 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. 35 and in Table 8.

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.

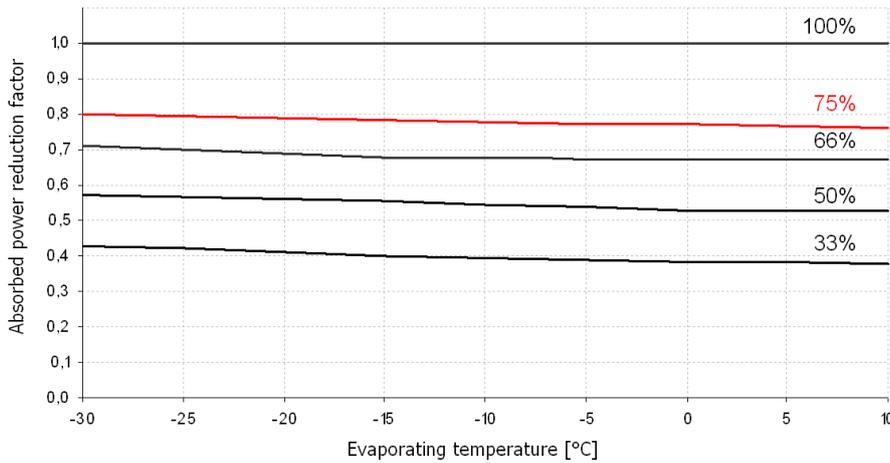
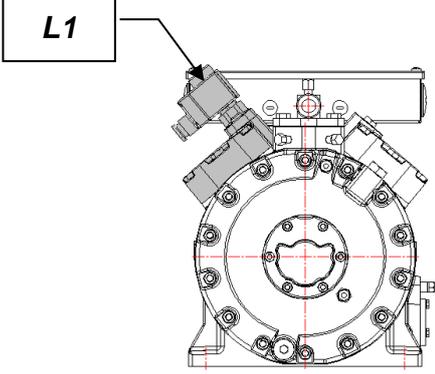
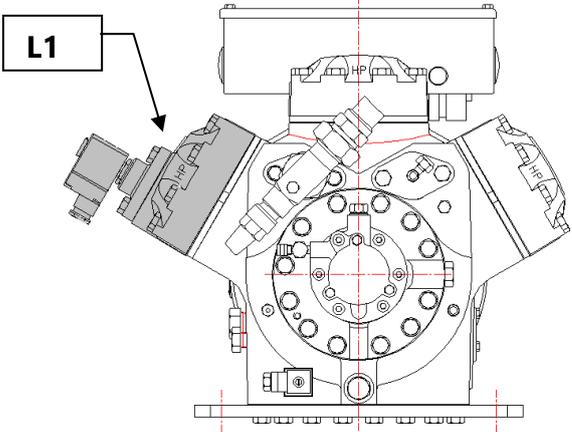


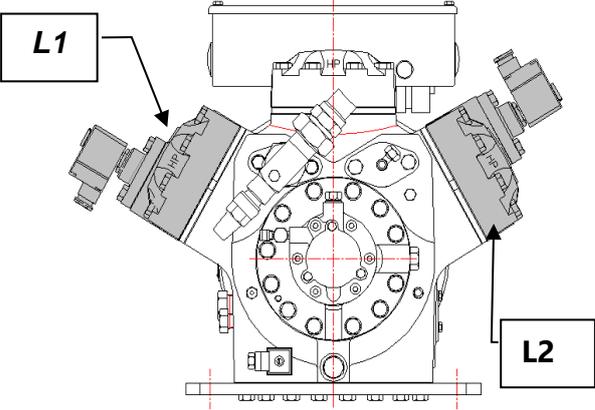
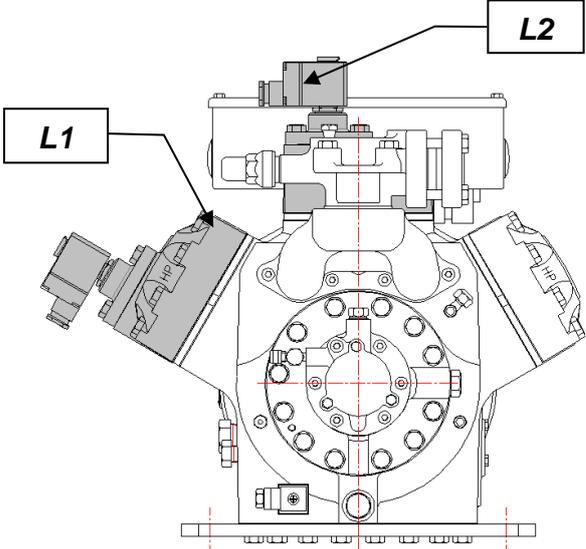
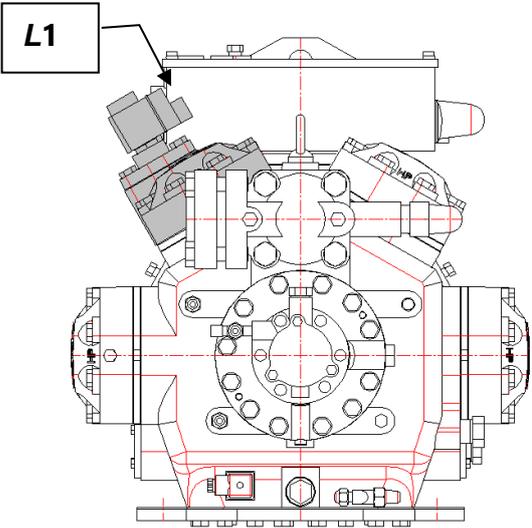
Fig. 35 Absorbed power reduction factor

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 8 Absorbed power reduction factor



No. of cylinders	No. of CR heads	Capacity regulation	CR Head position
4 cylinders	1	50%	<p style="text-align: center;">50%</p> 
6 cylinders	1	66%	<p style="text-align: center;">66%</p> 

No. of cylinders	No. of CR heads	Capacity regulation	CR Head position
	2	33-66%	<p style="text-align: center;">66-33%</p>  <p style="text-align: center;">66-33%</p>  <p style="text-align: center;">Only for PP1-L640/H650</p>
8 cylinders	1	75%	<p style="text-align: center;">75%</p> 



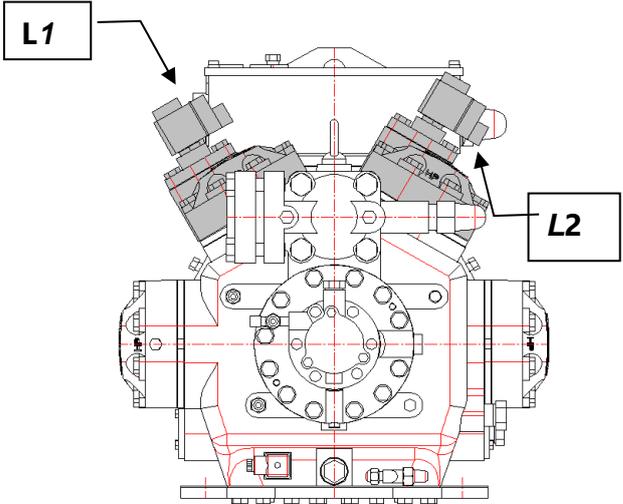
No. of cylinders	No. of CR heads	Capacity regulation	CR Head position
	2	50-75%	<div style="text-align: center;">75-50%</div> 

Table 9 CR head positions

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 device: 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.

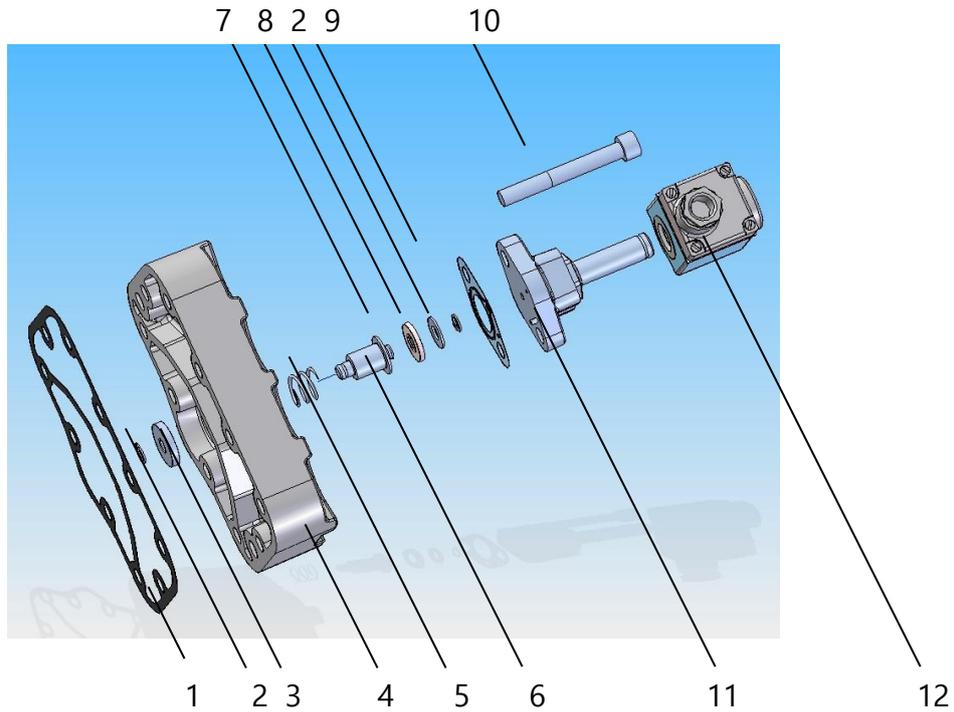
4.1.4 Activation of capacity control

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. 36 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. 36 Capacity control kit



For others information of Part load kit codes, ask to RefComp Commercial Department.



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. 37 shows the working principle.1)2)3)4)5)6)7)8)9)10)

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!

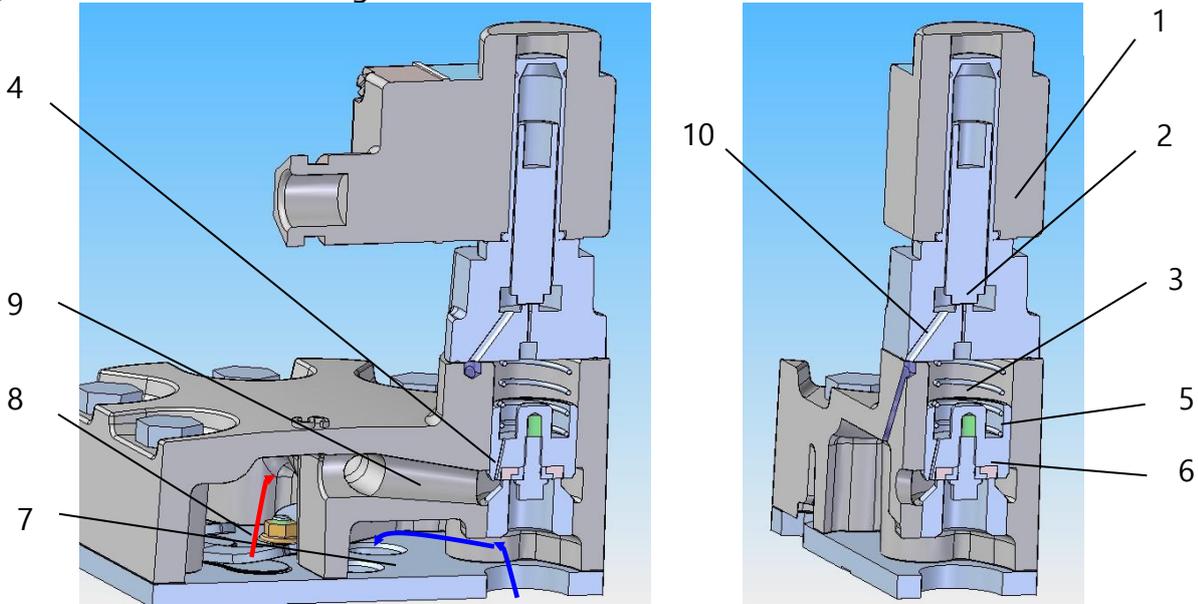
Refrigerant temperature has a sudden increase during start-up phase

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:

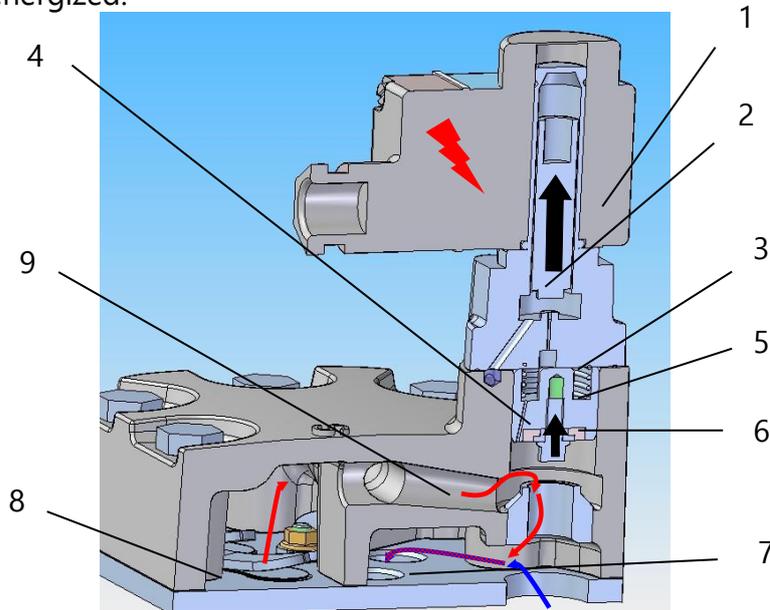


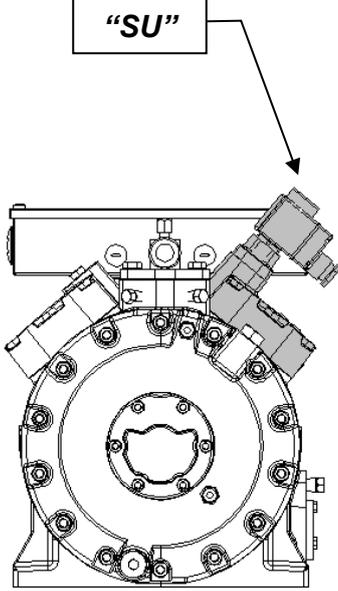
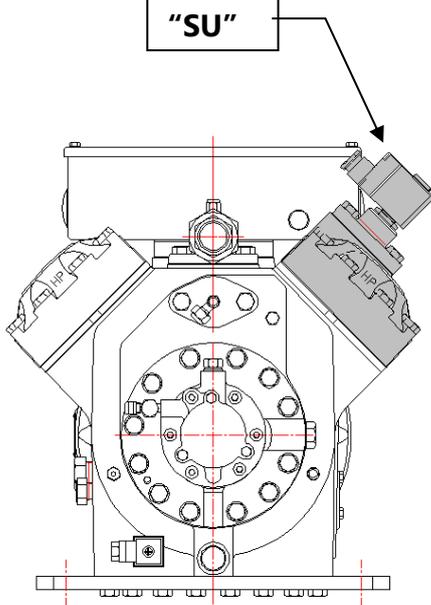
Fig. 37 Working principle of start unloader

- | | | |
|---|---------------------------|--|
| 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 connection | pressure | |



4.3 Position of SU heads

The table below shows the position of SU heads

No. of cylinders	SU Head position
4 cylinders PP4-L/HNxx PP4-L/HFxx	
4 cylinders PP4-L/Hxx	

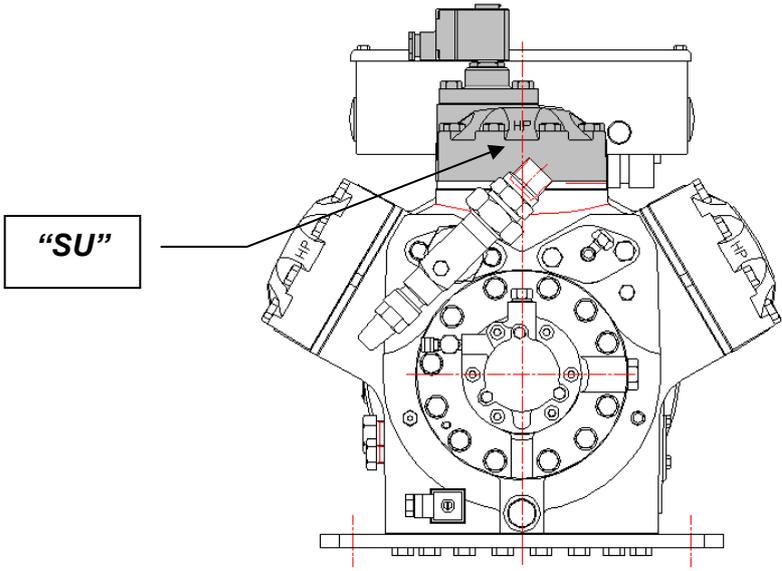
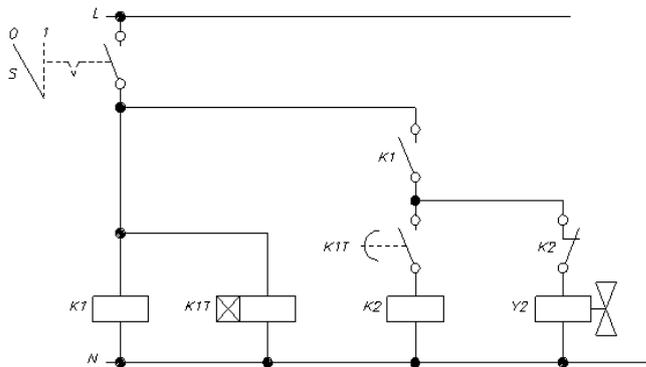
No. of cylinders	SU Head position
6 cylinders	

Table 10 SU head positions

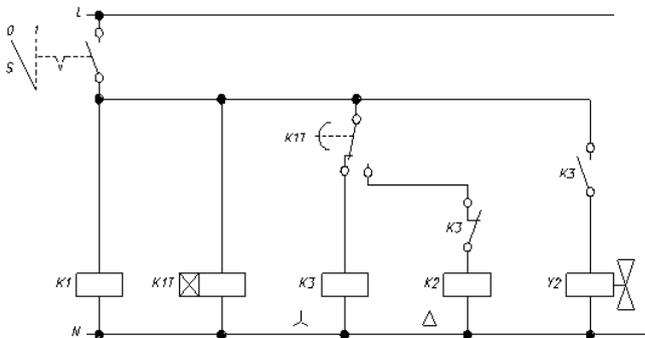
4.3.1 Activation of SU head

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. 38 Part-winding connection



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

Fig. 39 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

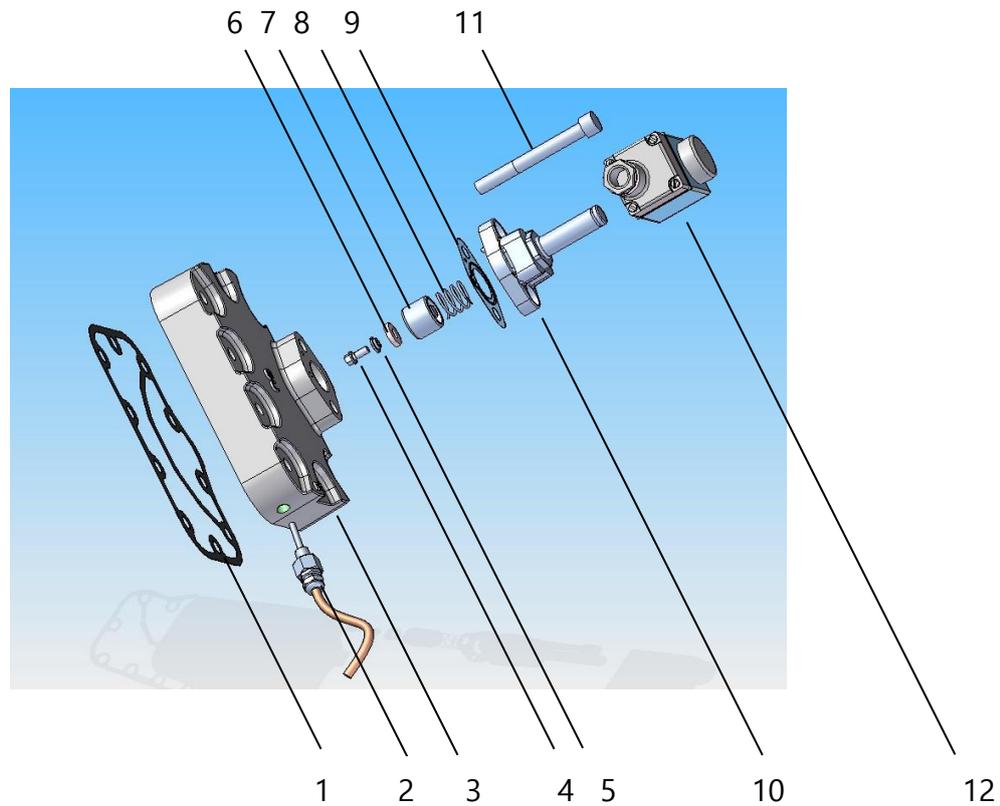


Fig. 40 Start unloading kit



For others information of Start unloading kit codes, ask to RefComp Commercial Department.

5 Components

5.1 Suction filter

2 and 4-cylinder models PP2-L/Hxxxx, PP4-L/HNxxxx and PP4-L/HFxxxx are equipped with suction filter which can be inspected and cleaned only dismantling suction shut-off valve. Fig. 41 shows the position of suction filter in 4-cylinder models.

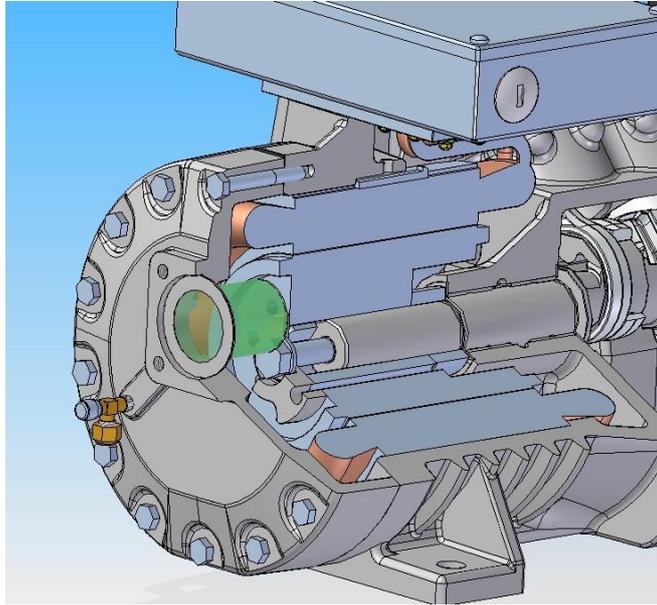


Fig. 41 Position of suction filter for 4-cylinder models

For PP4-L/H, PP6-L/H and PP8-L/H 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. 42.

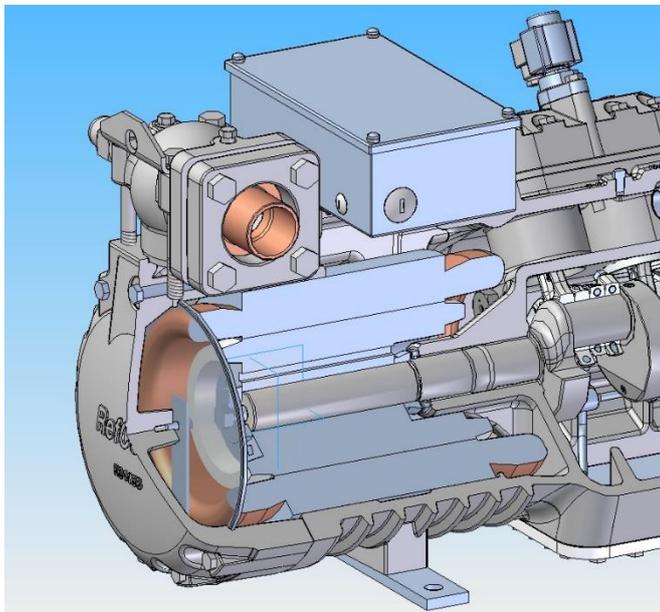


Fig. 42 Position of suction filter in 6 and 8-cylinder models



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 13:

Mod. PPxH	PP2H0150	PP2H0200	PP2H0210	PP2H0300	PP2H0310	PP2H0350	PP2H0400	PP4H0500	PP4H0600	PP4H0800	PP4H0900
No. of cylinder	2				2			4			
Nominal motor power HP	1.5	2	2	3	3	3.5	4	5	6	8	9
Suction side valve type	1				1			1			
Discharge side valve type	1				1			1			

Mod. PPxH	PP4HN1000	PP4HF1000	PP4HN1200	PP4HF1200	PP4HN1500	PP4HF1500	PP4HN2000	PP4HF2000	PP4H2200	PP4H2500	PP4H3000	PP4H3500	PP6H3700	PP6H4000	PP6H5000	PP8H6000	PP8H7000
No. of cylinder	4				4				6				8				
Nominal motor power HP	10	12	15	20	22	25	30	35	37	40	50	60	70				
Suction side valve type	1		2		2				2		2		2				
Discharge side valve type	1		1		1				1		2		2				

Table 11

Mod. PPxL	PP2L0100	PP2L0150	PP2L0160	PP2L0200	PP2L0210	PP2L0250	PP2L0300	PP4L0300	PP4L0400	PP4L0500	PP4L0600
No. of cylinder	2				2			4			
Nominal motor power HP	1	1.5	1.5	2	2	2.5	3	3	4	5	6
Suction side valve type	1				1			1			
Discharge side valve type	1				1			1			

Mod. PPxL	PP4LN0600	PP4LF0600	PP4LN080	PP4LF0800	PP4LN100	PP4LF1000	PP4LN120	PP4LF1200	PP4L1500	PP4L1800	PP4L2200	PP4L2500	PP6L2700	PP6L3000	PP6L4000	PP8L5000	PP8L6000
No. of cylinder	4				4				6				8				
Nominal motor power HP	6	8	10	12	15	18	22	25	27	30	40	50	60				
Suction side valve type	2	2	2	1	1	2	2	2	2	2	1	1	1	2	2	1	2
Discharge side valve type	1	2	2	1	1	1	1	1	1	2	2	1	1	1	1	1	1

Table 12

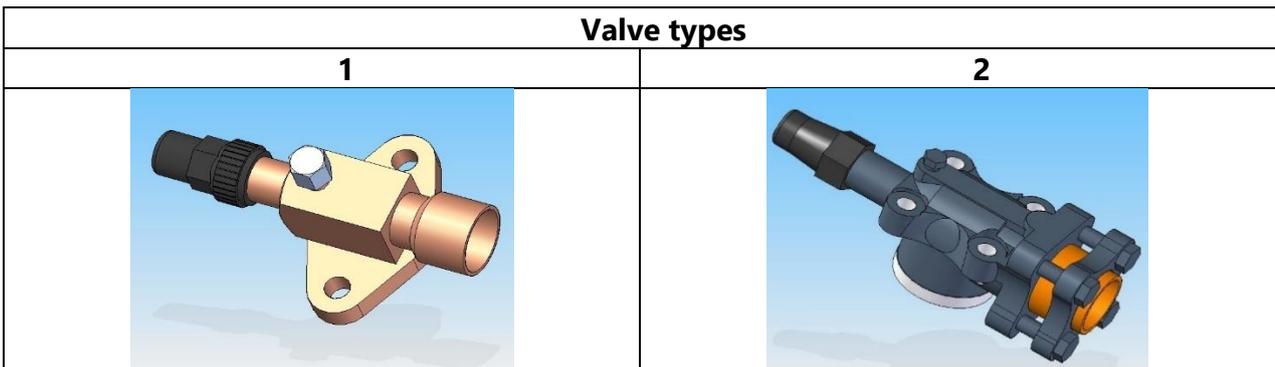


Table 13 Valve types

5.3 Shaft and connecting rods

PP Series are equipped with a balanced shaft using proper weights. For 2 and 4-cylinder models PP2-L/H and PP4-L/HN4xxxx and PP4-L/HFxxxx the balancing weight is fixed to the shaft during the assembling phase with screws (see Fig. 44), while for 4-cylinder models PP4-L/H and all 6 and 8-cylinder models, this weights are realized directly in the shaft cast iron (see Fig. 46).

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

5.3.1 Compressor models PP2-L/Hxxxx, PP4-L/HNxxxx, PP4-L/HFxxxx

The connecting rod for these compressors is realized in a single component (see Fig. 43), so the assembling is realized by moving the dial along the shaft until it reaches the correct position at the working cylinder.

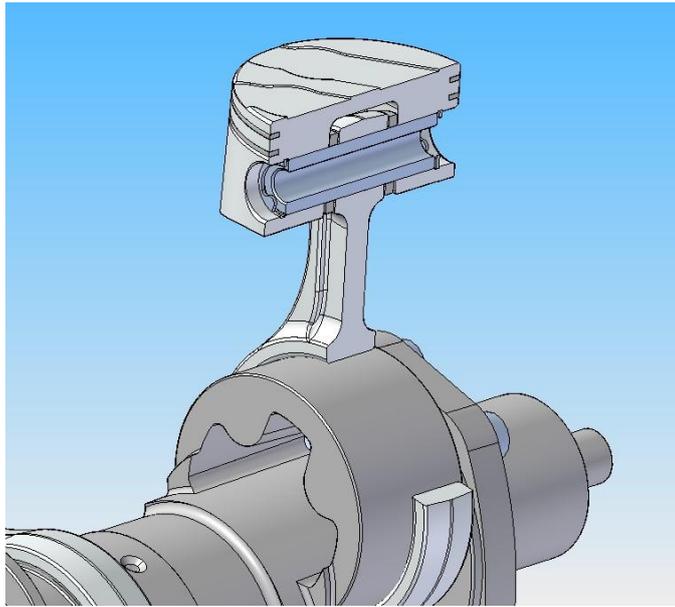


Fig. 43 Connecting rod for compressor models PP2-L/Hxxxx, PP4-L/Hxxxx, PP4-L/HNxxxx

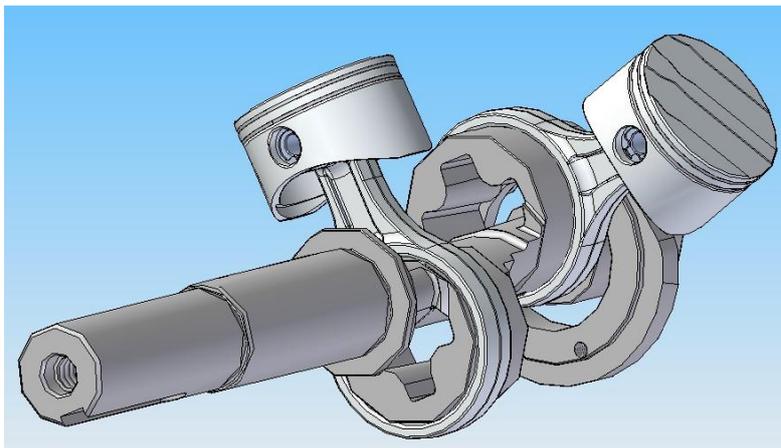


Fig. 44 Motor shaft and connecting rod for PP2-L/Hxxxx, PP4-L/Hxxxx, PP4-L/HNxxxx



5.3.2 Compressors model PP4-L/H 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. 45.

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.

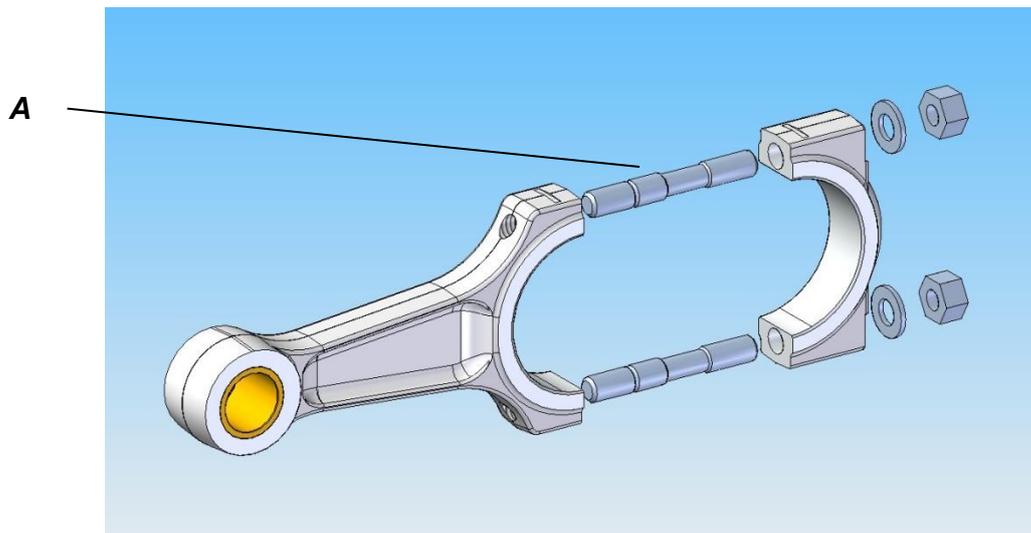


Fig. 45 Connecting rod components for compressors PP4-L/H and all 6 and 8-cylinder-models

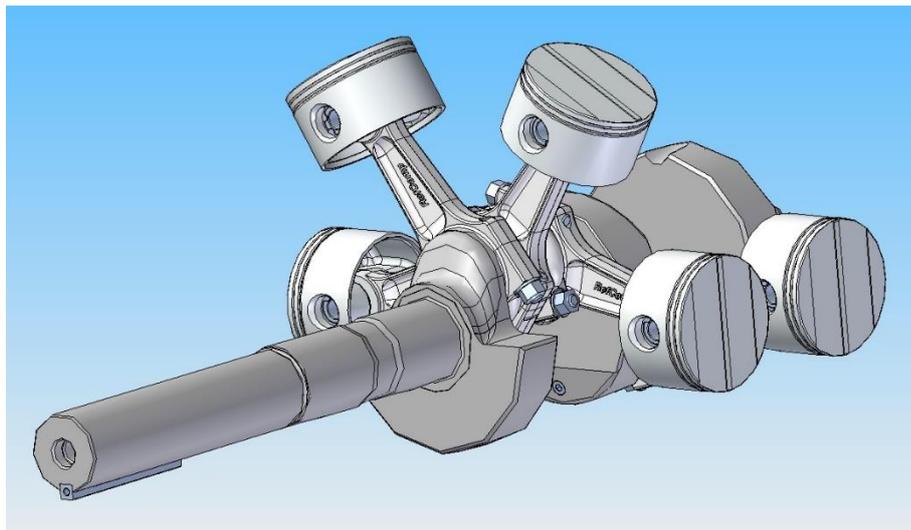


Fig. 46 Motor shaft and connecting rod for PP4-L/H and all 6 and 8-cylinder-models



5.4 Pistons

The pistons are mounted with sealing/scrapper rings as showed in the picture below.

It's necessary to assemble the scraper rings (rif. 4 in Fig. 47) in the correct direction, with the writing "TOP" up.

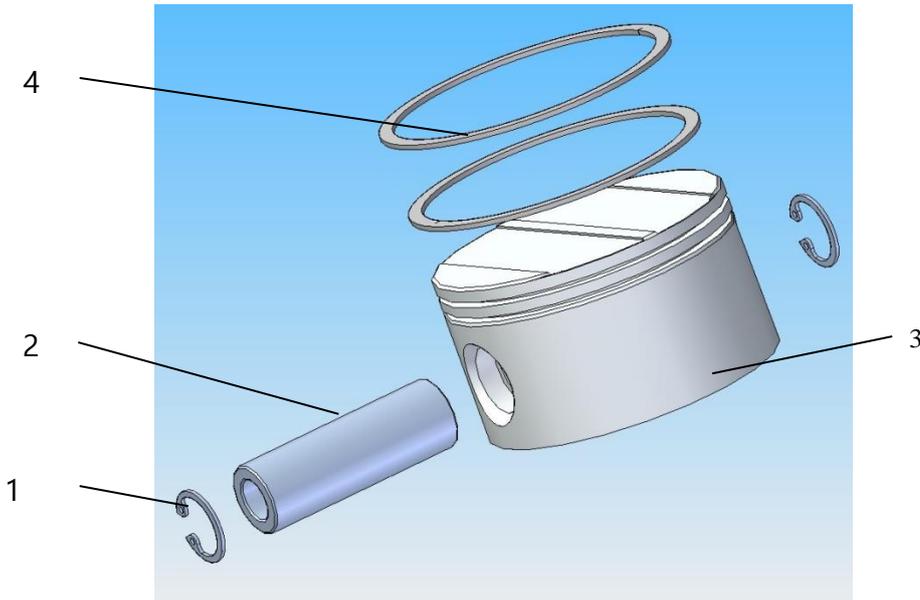


Fig. 47 Piston

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 13 show the valve plate type related to compressor models.

In the pictures of Table 13 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 RefComp.
- The plate valves and valves do not need maintenance



Valve plate types	
PP2-L/Hxxxx PP4-L/HNxxxx PP4-L/HFxxxx	PP4-L/Hxxxx PP6-L/Hxxxx PP8-L/Hxxxx
<p>Lower side</p>	<p>Lower side</p>
<p>Upper side</p>	<p>Upper side</p>

Table 14: 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).

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. 48, while on the pump support is single and assembled as shown in Fig. 49.

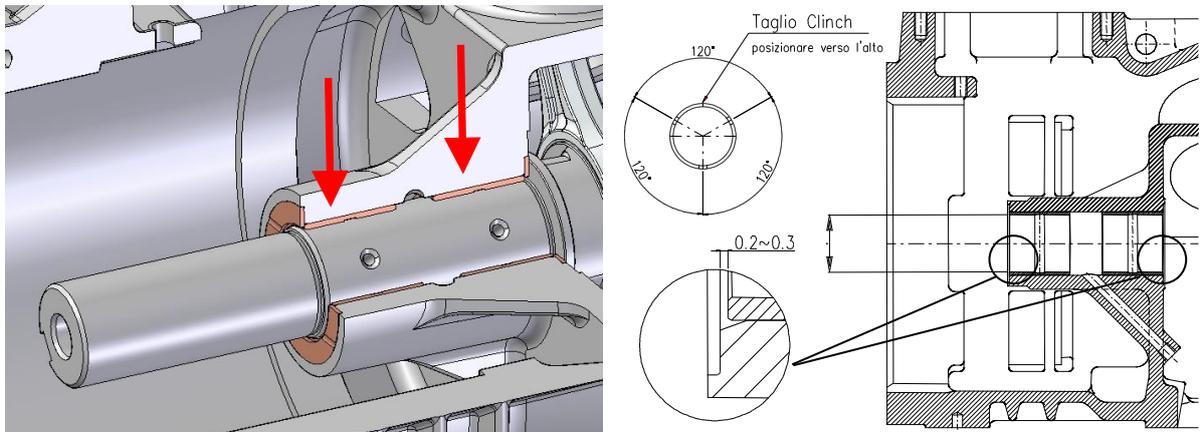


Fig. 48 Bushing assembly on motor side

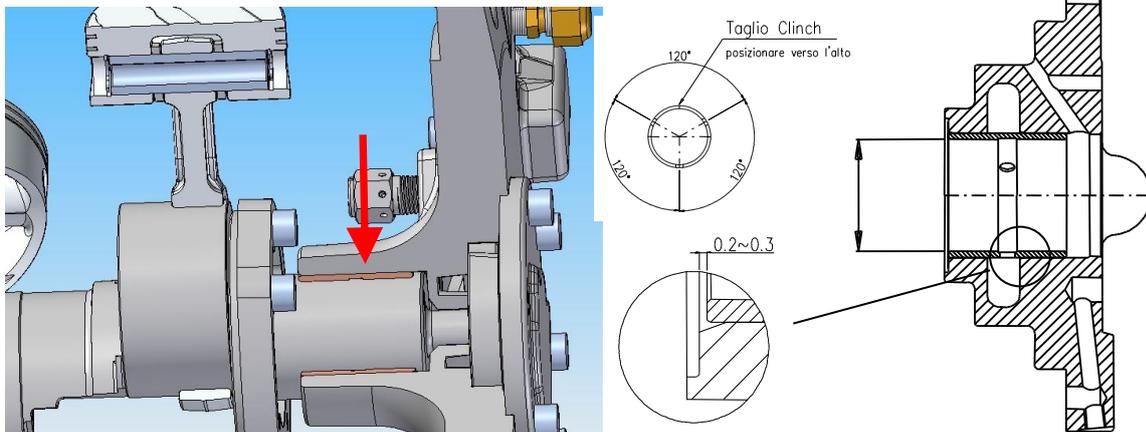


Fig. 49 Bushing assembly on pump support side

To assemble the sleeve bearings, respect the following instructions:

- cutting "Clinch" should be placed at the top;
- respect a placement dimension of $0.2 \div 0.3$ mm;
- assembled inner diameter should be $\Phi = 45.04 (+0/+0.04)$ 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 RefComp or Authorized Service Center.



5.7 Thrust 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 thrust bearings have to be fixed with special tools (see Fig. 50) which allow mounting these on the compressor casing and preventing their rotation.

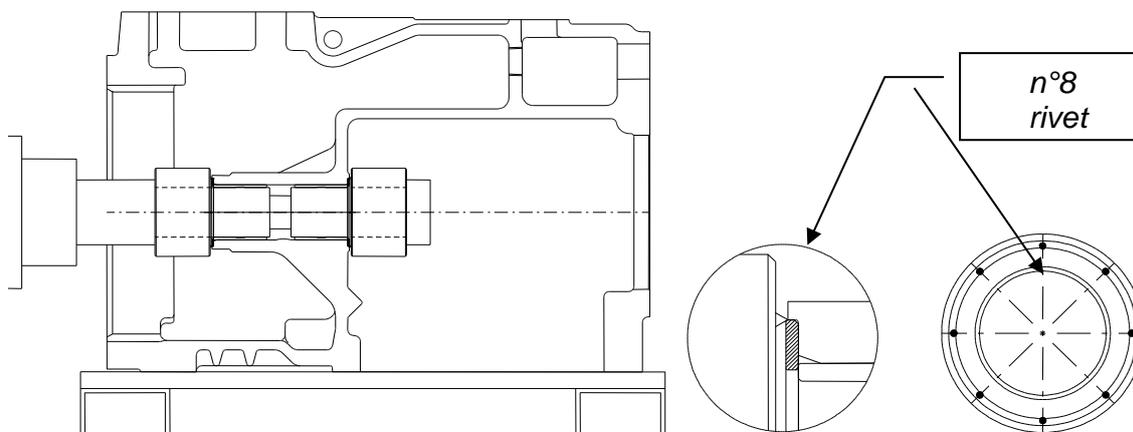


Fig. 50 Thrust bearing washer assembly

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 16 in 7.1: Electrical specifications.

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

The PP2-L/H 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 - $\Delta\Delta$).

As regards the mains connections, there is no difference between the two PW motor configurations. Fig. 51 and Fig. 52 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. 51:



- ✓ 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 - $\Delta\Delta$ configuration there is continuity between each pair of terminals and there is not reciprocal insulation between any of them.



PART-WINDING CONFIGURATION

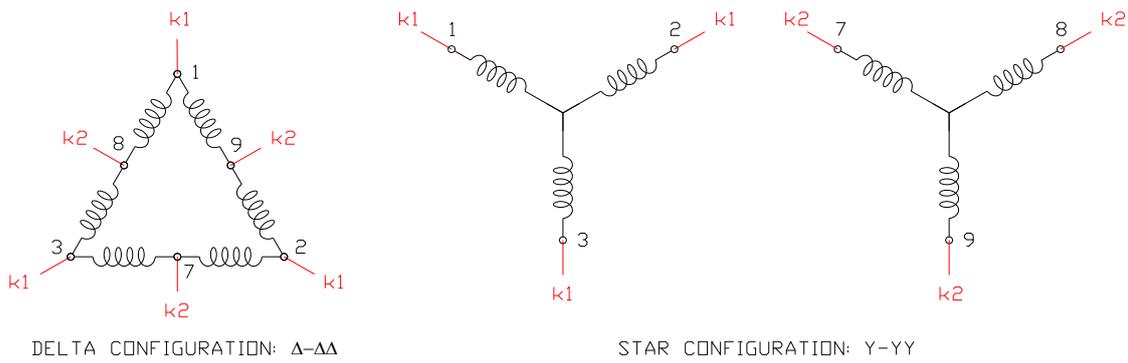


Fig. 51: internal winding connections for the motors with part-winding configuration

• STAR-DELTA CONFIGURATION

Important note:



With reference to Fig. 52, 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.

STAR-DELTA CONFIGURATION

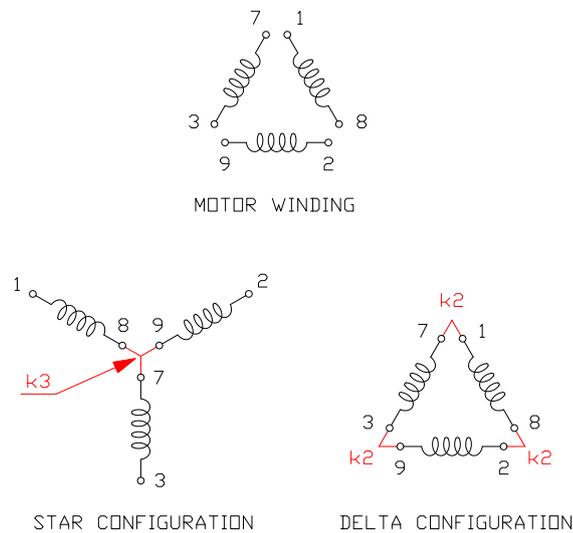


Fig. 52: internal winding connections for the motors with star-delta configuration

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 Chapter4: Capacity Control). See also chapter **Errore. L'origine riferimento non è stata trovata.** "Operating Instructions".



Fig. 53 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. 53.
- ✓ 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. 53 again.

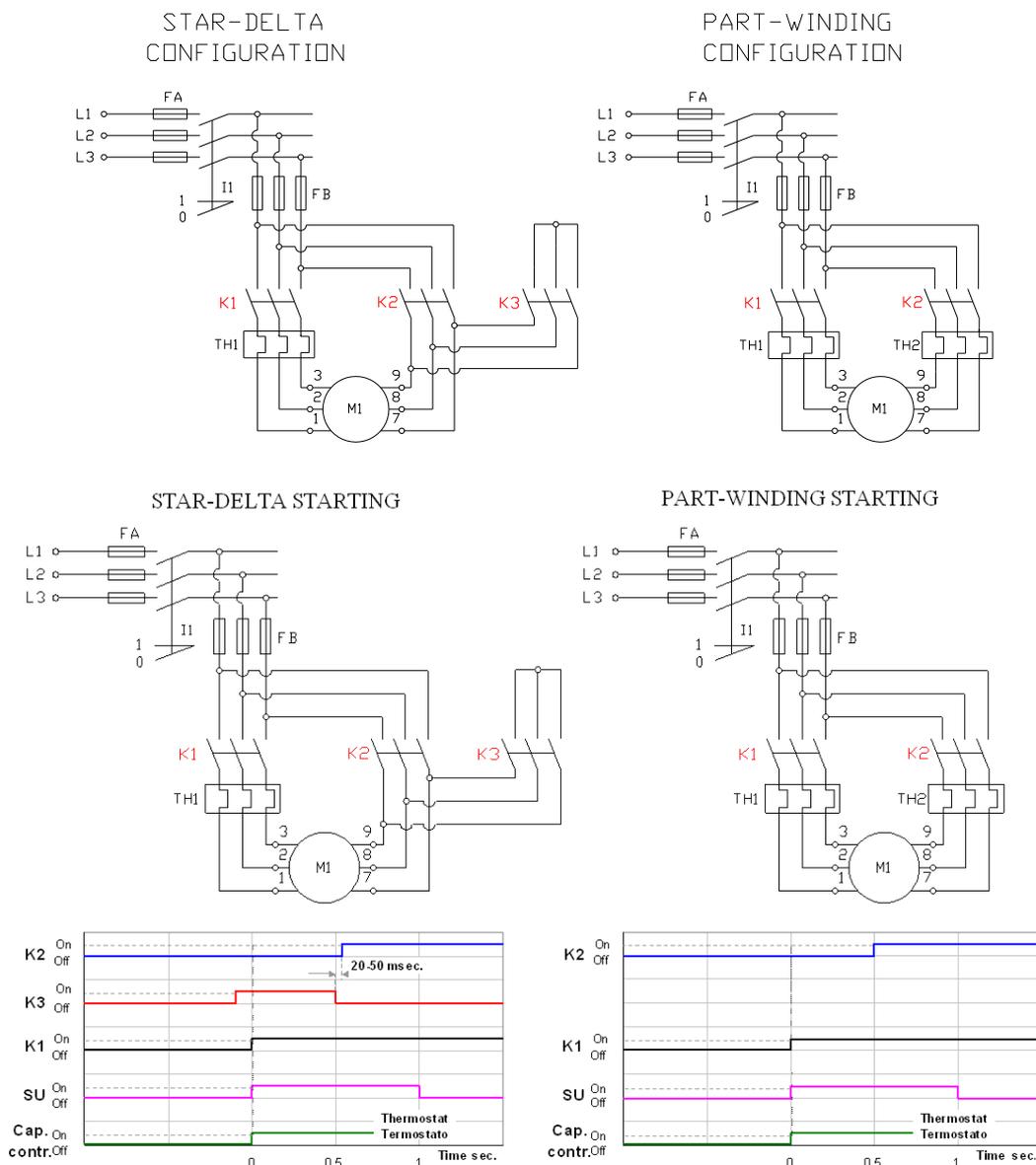


Fig. 53: connection diagrams to the three-phase network and time charts for the activation of contactors K1, K2 and K3 in the two compressor starting modes: star-delta and part-winding; FA, FB: main fuses and compressor's fuses
I1: main switch; M1: electrical motor; TH1, TH2: overload relay;



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.

6.2.2 INT 69 B2



Warning!

THE PROTECTION MODULE MUST NOT BE INSTALLED FOR ANY REASON INSIDE THE ELECTRICAL BOX!



The sparks produced by the internal relay could provoke and ignition.

Is mandatory to install the protection module in an Electrical box installed in a Safe Zone.

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. 54. For the technical specifications of the module, see Table 15.

Activation threshold	4500 Ohm;
Reset threshold	2750 Ohm;
Power supply	230 V \pm 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 15: INT 69 B2 technical specifications



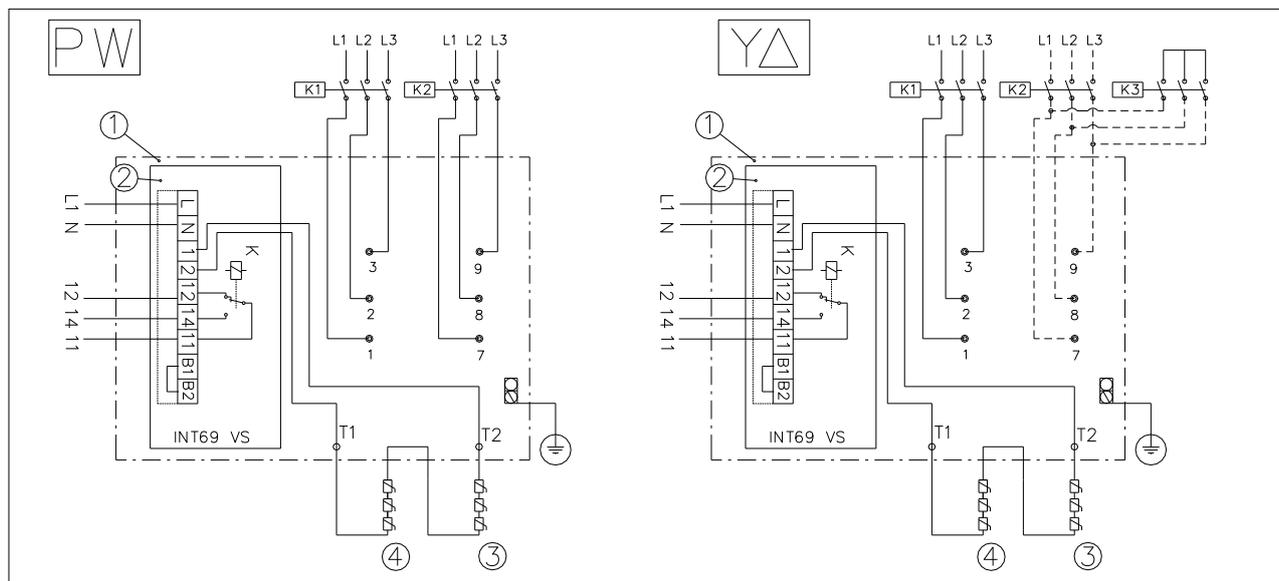


Fig. 54: electrical connections to the INT 69 B2 module (part-winding and star delta);

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



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 k Ω . The reset of the device is possible with a resistance value of less than 2.4 k Ω . 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, RefComp 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 an "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:

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

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

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

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

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

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

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

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. 56: 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.

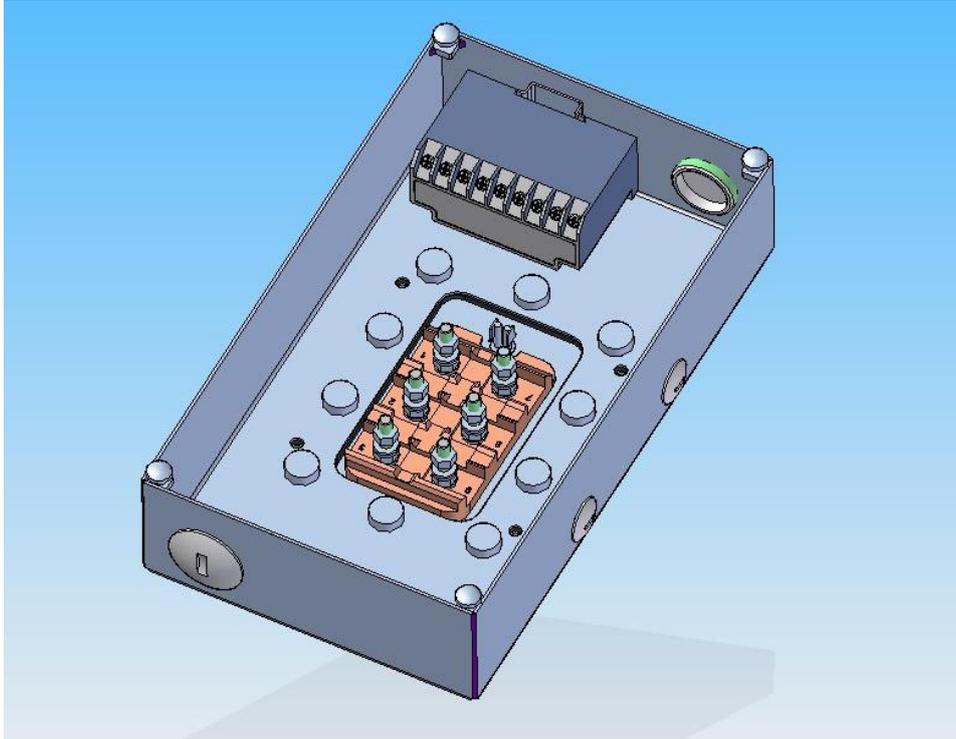


Fig. 55 *Electrical board and terminal plate*

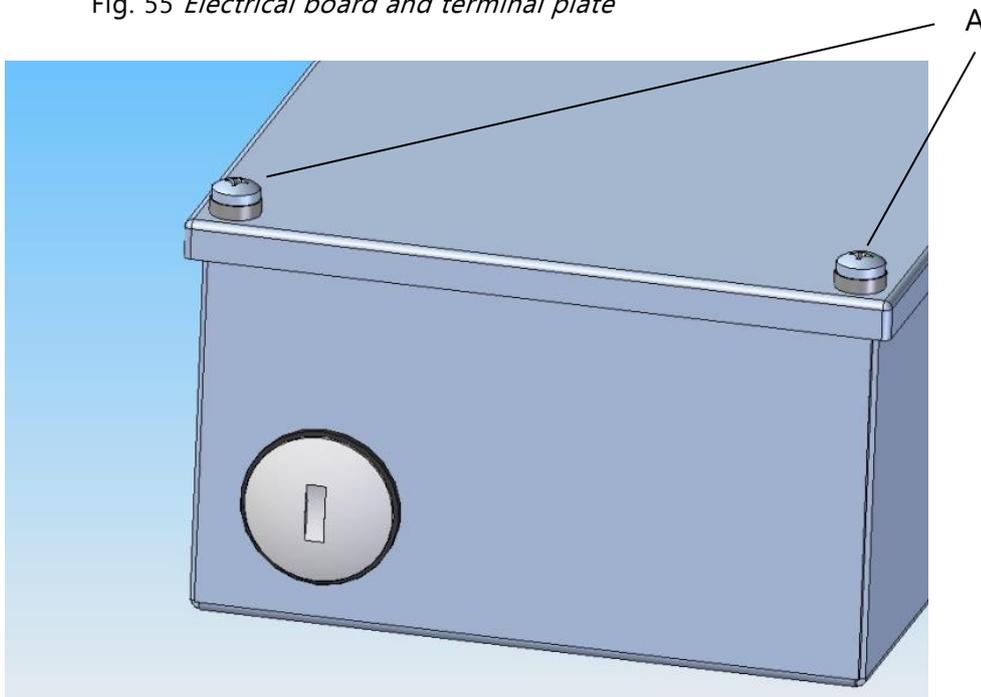


Fig. 56 *Electrical box: teflon washer*



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 boards as shown in Picture 5 6. The bonds for the direct starting are provided with the compressor, as a separate kit.

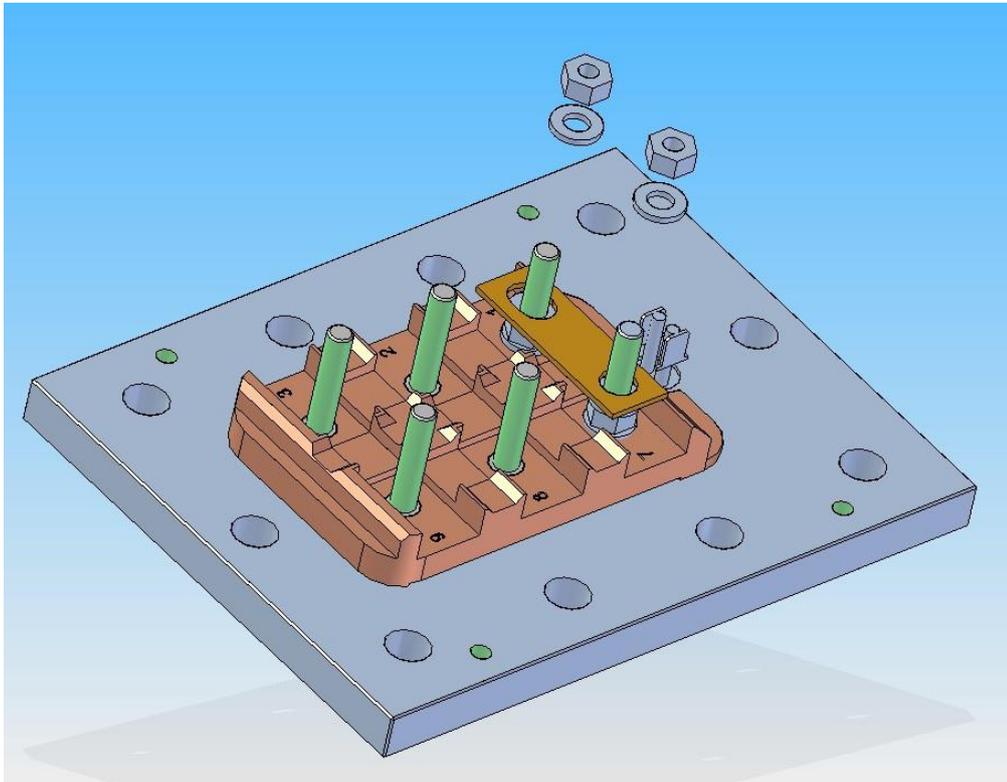


Fig. 57 Bonds on terminal board for DOL starting

6.9 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 hydrocarbon 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 RefComp compressor are designed to operate in the frequency range 25Hz-60Hz, and the motor have to be connected according to the Fig. 58.

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

- positive displacement compressors have a practically constant 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 asynchronous motor is affected by the slipping of the motor.

This means that, as conventional inverters cannot supply motor operating 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 16;

Standard Delivery –
Fornitura standard

for special motor voltage please check the data on RefComp selection software or contact RefComp.

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 RefComp 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.



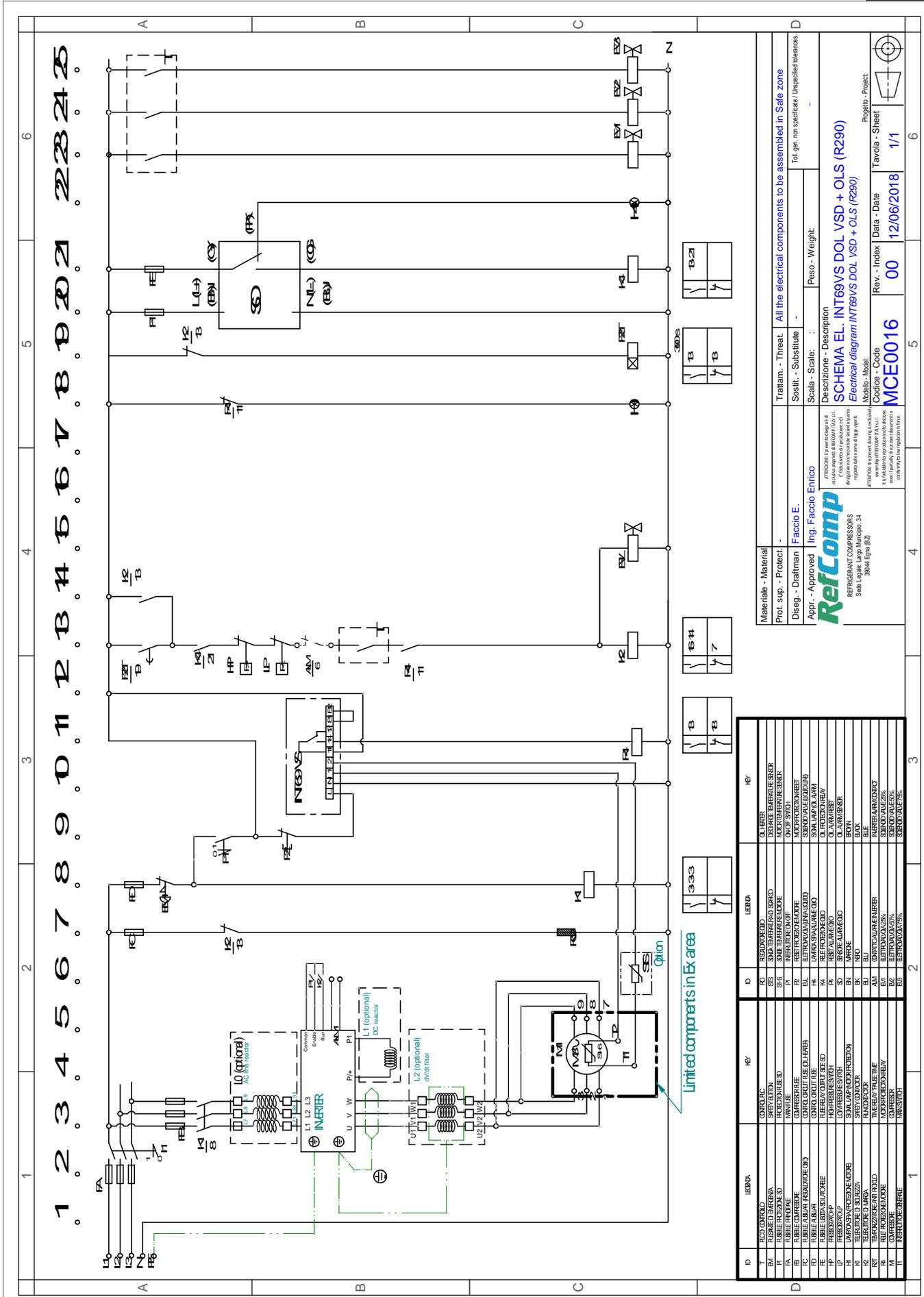


Fig. 58 Electrical connection for Variable frequency drive



Materiale - Material		Trattam. - Treat.		Sostit. - Substitute		Descrizione - Description	
Prot. sup. - Protect.		All the electrical components to be assembled in Safe zone		-		SCHEMA EL. INT69VS DOL VSD + OLS (R290)	
Diseg. - Draftman		Ing. Faccio E.		-		Electrical diagram INT69VS DOL VSD + OLS (R290)	
Appr. - Approved		-		-		Modello - Model:	
MCE0016		00		12/06/2018		1/1	
Rev. - Index		Date - Date		Tavola - Sheet		-	

ID	LIBENA	REV	ID	LIBENA	REV
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88	CONDENSATORE	0	88	CONDENSATORE	0
89	CONDENSATORE	0	89	CONDENSATORE	0
90	CONDENSATORE	0	90	CONDENSATORE	0
91	CONDENSATORE	0	91	CONDENSATORE	0
92	CONDENSATORE	0	92	CONDENSATORE	0
93	CONDENSATORE	0	93	CONDENSATORE	0
94	CONDENSATORE	0	94	CONDENSATORE	0
95	CONDENSATORE	0	95	CONDENSATORE	0
96	CONDENSATORE	0	96	CONDENSATORE	0
97	CONDENSATORE	0	97	CONDENSATORE	0
98	CONDENSATORE	0	98	CONDENSATORE	0
99	CONDENSATORE	0	99	CONDENSATORE	0
100	CONDENSATORE	0	100	CONDENSATORE	0

Limited components in Ex area

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.

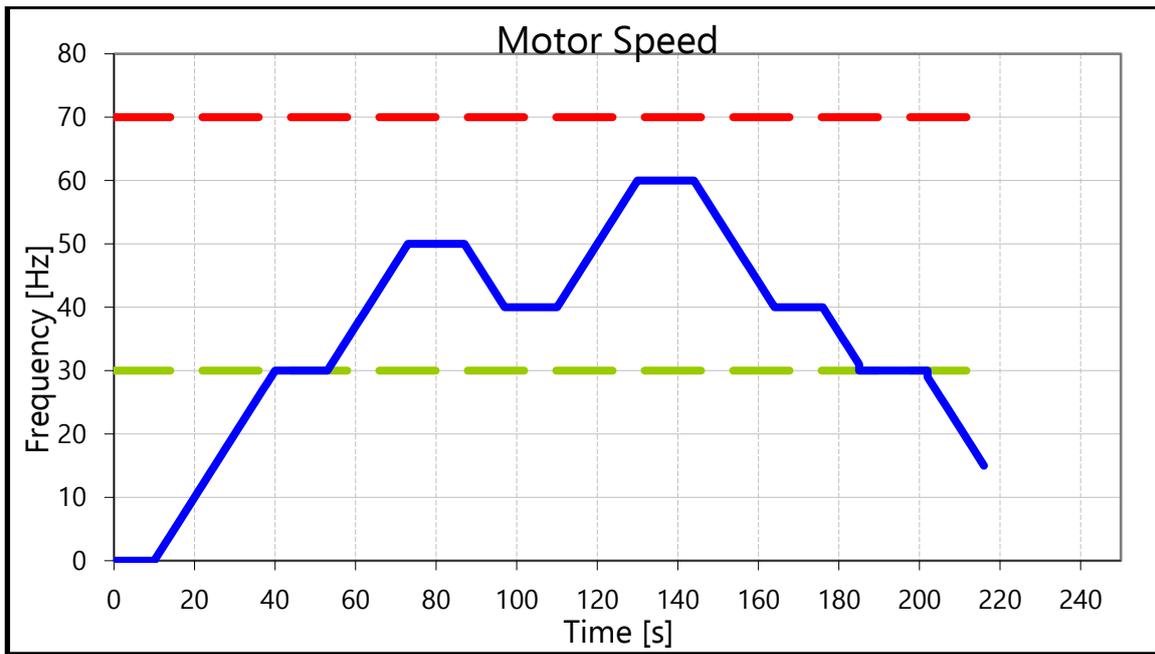


Fig. 59 Speed vs Time variation example

7 Data

7.1 Electrical data

Mod. PPxH			PP2H0150	PP2H0200	PP2H0210	PP2H0300	PP2H0310	PP2H0350	PP2H0400	PP4H0500	PP4H0600	PP4H0800	PP4H0900								
Nominal motor power	HP/kW*		1.5/1.1	2/1.5	2/1.5	3/2.2	3/2.2	3.5/2.6	4/3	5/3,7	6/4,4	8/5,9	9/6,6								
Nominal Voltage (V)	V	230V Δ – 400V Y																			
PW	Starting current (A)	LRA Y																			
		LRA YY																			
	Max running current (A)	FLA																			
Y/Δ	Starting current (A)	LRA Y	17	20	20	22	36	36	46	54	60	85	85								
		LRA Δ	29	34	34	39	62	62	79	54	60	85	85								
	Max running current (A)	FLA	4	5	5	6	6	8	9	12	14	16	20								
Crankcase heater			90W PTC						120W PTC												
			230V-50/60Hz																		
Mod. SPxH			PP4HN1000	PP4HF1000	PP4HN1200	PP4HF1200	PP4HN1500	PP4HF1500	PP4HN2000	PP4HF2000	PP4H2200	PP4H2500	PP4H3000	PP4H3500	PP6H3700	PP6H4000	PP6H5000	PP8H6000	PP8H7000		
Nominal motor power	HP/kW*		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	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																			
		LRA Δ																			
	Max running current (A)	FLA																			
Crankcase heater			220W				150W					200W									
			230V-50/60Hz				230V-50/60Hz					230V-50/60Hz									
	Standard Delivery – Fornitura standard																				

Table 16: electrical data of H version;



Mod. PPxL		PP2L0100	PP2L0150	PP2L0160	PP2L0200	PP2L0210	PP2L0250	PP2L0300	PP4L0300	PP4L0400	PP4L0500	PP4L0600			
Nominal motor power	HP/kW*	1/0,7	1.5/1.1	1.5/1.1	2/1.5	2/1.5	2,5/1.8	3/2.2	3/2,2	4/3	5/3,7	6/4,4			
Nominal Voltage (V)	V	230V Δ – 400V Y													
PW	Starting current (A)	LRA Y													
		LRA YY													
	Max running current (A)	FLA													
Y / Δ	Starting current (A)	LRA Y	12	17	17	20	28	28	36	35	49	54	60		
		LRA Δ	20	29	29	34	48	48	62	35	49	54	60		
	Max running current (A)	FLA	3	4	5	6	6	8	9	9	10	12	14		
Crankcase heater		90W PTC						120W PTC							
		230V-50/60Hz													
Mod. PPxL		PP4LN0600 PP4LF0600	PP4LN0800 PP4LF0800	PP4LN1000 PP4LF1000	PP4LN1200 PP4LF1200	PP4L1500	PP4L1800	PP4L2200	PP4L2500	PP6L2700	PP6L3000	PP6L4000	PP8L5000	PP8L6000	
Nominal motor power	HP/kW*	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	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													
		LRA Δ													
	Max running current (A)	FLA													
Crankcase heater		220W 230V-50/60Hz				150W 230V-50/60Hz				200W 230V-50/60Hz					
		Standard Delivery – Fornitura standard													

Table 17: electrical data of L version;

7.2 Technical data

Mod. SPx-H		PP2H0150	PP2H0200	PP2H0210	PP2H0300	PP2H0310	PP2H0350	PP2H0400	PP4H0500	PP4H0600	PP4H0800	PP4H0900		
Nominal motor power	HP/ kW*	1.5/1.1	2/1.5	2/1.5	3/2.2	3/2.2	3.5/2.6	4/3	5/3,7	6/4,4	8/5,9	9/6,6		
Displacement at 50/60Hz	m ³ / h	5,4	6,7	8,2	9,8	11,6	13,7	16,5	17,5/21	21/25,7	24,5/29, 4	28/33,6		
No. of cylinders	-	2	2	2	2	2	2	2	4	4	4	4		
Weight	Kg	48	50	52	52	78	78	78	86	87	87	91		
Oil charge	L	1	1	1	1	1.2	1.2	1.2	1,8	1,8	1,8	2,6		
Suction line internal Ø	mm (in.)	16 (5/8")	16 (5/8")	16 (5/8")	16 (5/8")	22 (7/8")	22 (7/8")	22 (7/8")	16 (5/8")	16 (5/8")	22 (7/8")	22 (7/8")		
Discharge line internal Ø	mm/ in.	12 1/2")	12 1/2")	12 1/2")	12 1/2")	16 (5/8")	16 (5/8")	16 (5/8")	28 (1"1/8)	28 (1"1/8)	28 (1"1/8)	28 (1"1/8)		
Capacity control steps		-	-	-	-	-	-	-	-	-	-	-		
Mod. PPx-H		PP4HN1000 PP4HF1000	PP4HN1200 PP4HF1200	PP4HN1500 PP4HF1500	PP4HN2000 PP4HF2000	PP4H2200	PP4H2500	PP4H3000	PP4H3500	PP6H3700	PP6H4000	PP6H5000	PP8H6000	PP8H7000
Nominal motor power	HP/ kW*	10/7,5	12/8,9	15-nov	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	35/42	42/50,4	49/58,8	56/67,2	64,7/77, 6	75,9	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	-	4	4	4	4	4	4	4	4	6	6	6	8	8
Weight	Kg	143	146	152	156	193	206	209	238	241	246	250	345	360
Oil charge	L	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.)	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)	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 18: technical data of H version;

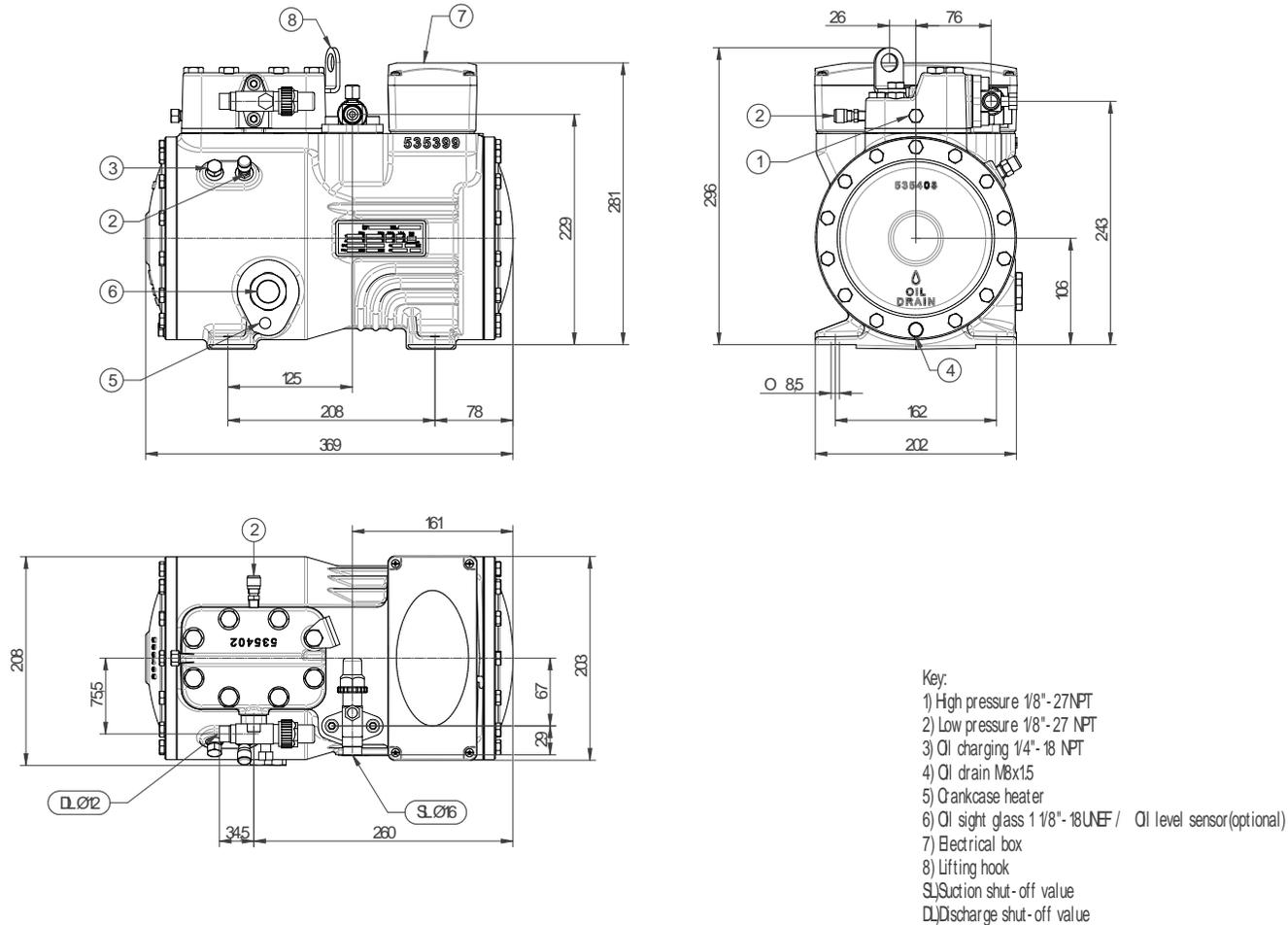


Mod.PPx-L		PP2L0100	PP2L0150	PP2L0160	PP2L0200	PP2L0210	PP2L0250	PP2L0300	PP4L0300	PP4L0400	PP4L0500	PP4L0600			
Nominal motor power	HP/kW*	1/0,7	1.5/1.1	1.5/1.1	2/1.5	2/1.5	2,5/1.8	3/2.2	3/2	4/3	5/3,7	6/4,4			
Displacement at 50/60Hz	m ³ /h	5,4	6,7	8,2	9,8	11,6	13,7	16,5	17,5/21	21/25,7	24,5/29,4	28/33,6			
No. of cylinders	-	2	2	2	2	2	2	2	4	4	4	4			
Weight	Kg	47	48	50	52	78	78	78	84	85	85	86			
Oil charge	L	1	1	1	1	1.2	1.2	1.2	1,8	1,8	1,8	2,6			
Suction line internal Ø	mm (in.)	16 (5/8")	16 (5/8")	16 (5/8")	16 (5/8")	22 (7/8")	22 (7/8")	22 (7/8")	16 (5/8")	16 (5/8")	22 (7/8")	22 (7/8")			
Discharge line internal Ø	mm/in.	12 1/2")	12 1/2")	12 1/2")	12 1/2")	16 (5/8")	16 (5/8")	16 (5/8")	28 (1"1/8)	28 (1"1/8)	28 (1"1/8)	28 (1"1/8)			
Capacity control steps		-	-	-	-	-	-	-	-	-	-	-			
Mod. PPx-L		PP4LN0600 PP4LF0600	PP4LN080 PP4LF0800	PP4LN100 PP4LF1000	PP4LN120 PP4LF1200	PP4L1500	PP4L1800	PP4L2200	PP4L2500	PP6L2700	PP6L3000	PP6L4000	PP8L5000	PP8L6000	
Nominal motor power	HP/kW*	6/4,5	8/5,9	10/7,5	12/8,9	15-nov	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	35/42	42/50,4	49/58,8	56/67,2	64,7/77,6	75,9	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	-	4	4	4	4	4	4	4	4	6	6	6	8	8	
Weight	Kg	134	139	144	146	182	186	195	220	230	236	247	340	345	
Oil charge	L	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.)	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)	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 19: technical data of L version;

8 Dimensional drawings and packaging

8.1 Dimensional drawings



PP2L0100-PP2H-0150; PP2L0150-PP2H-0200;
PP2L0160-PP2H-0210; PP2L0200-PP2H-0300;

Fig. 60 Dimensions of models from PP2L0100 to PP2H300

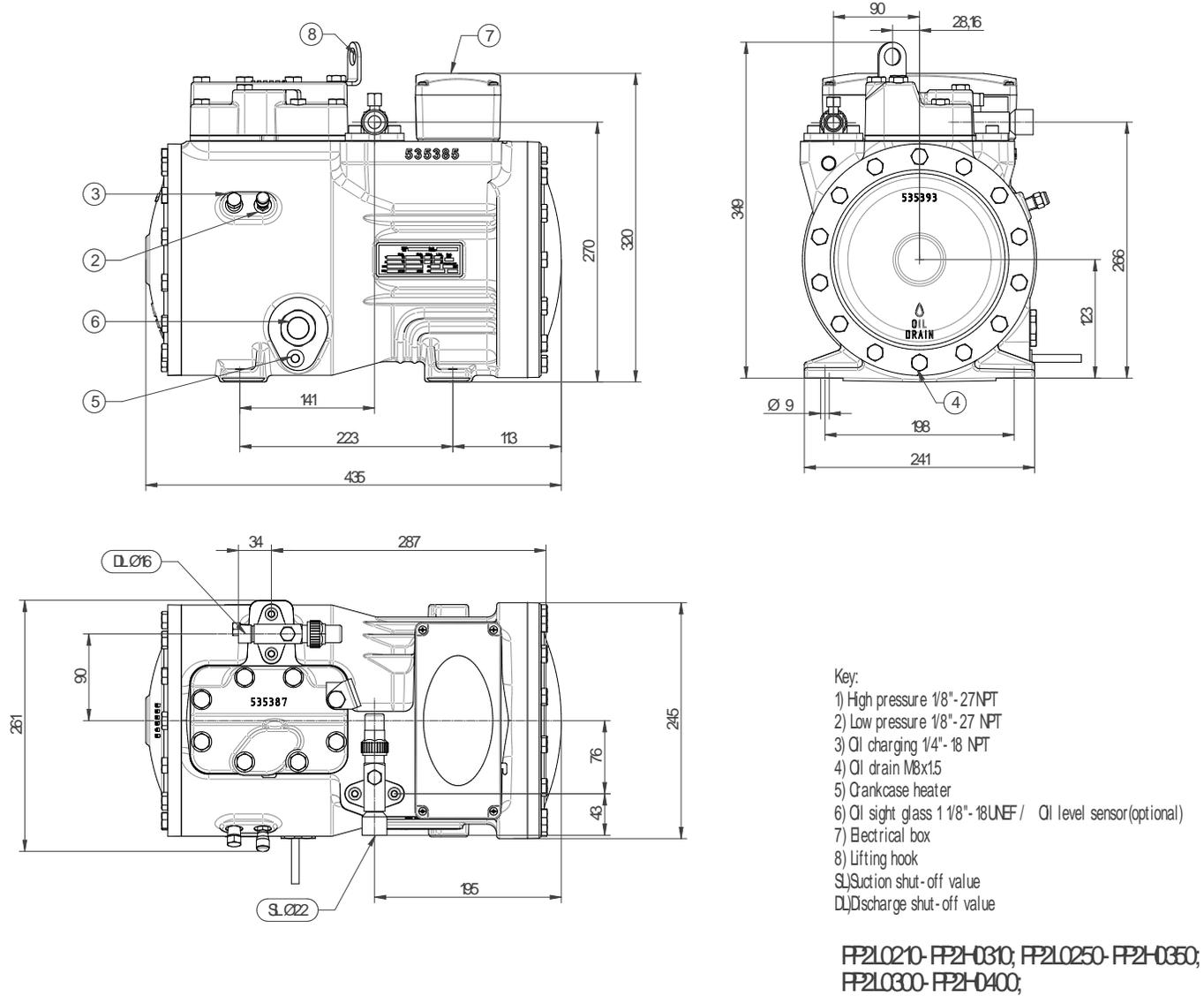
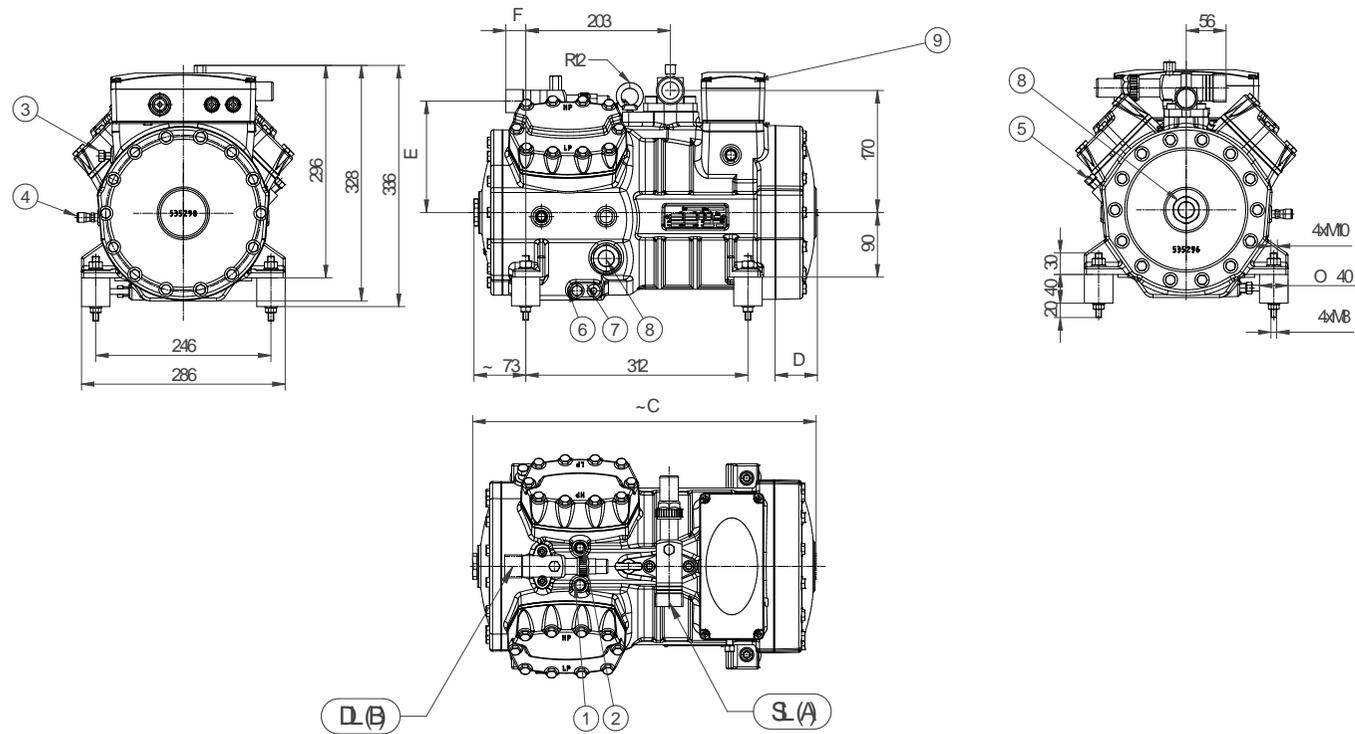


Fig. 61 Dimensions of models from PP2L0210 to PP2H0400



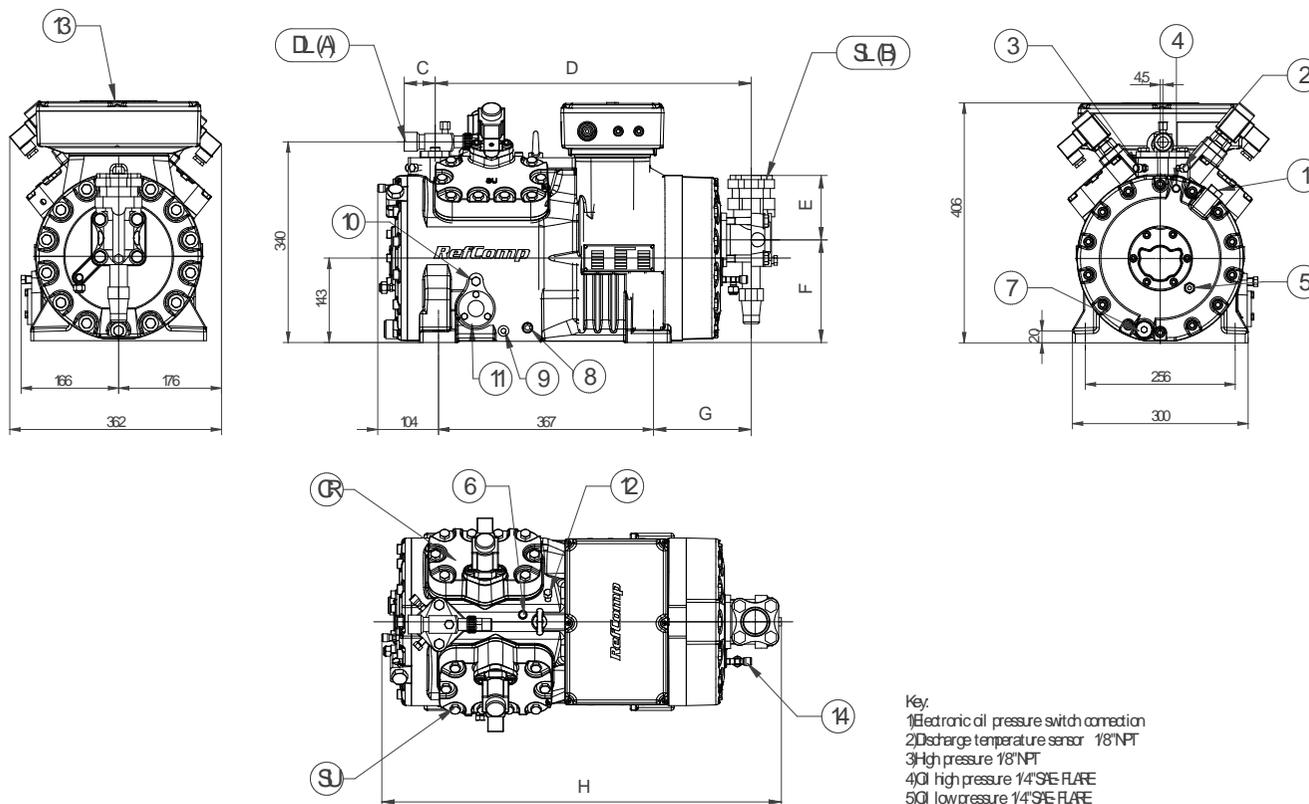
- Key:
- 1) High pressure 1/8"NPT
 - Discharge temperature sensor 1/8"NPT(optional)
 - 2) High pressure 1/4"SAE-FLARE
 - 3) Low pressure 1/8"NPT
 - 4) Low pressure 1/4"SAE-FLARE
 - 5) Oil charging 1/4"NPT
 - 6) Oil drain 1/4"NPT
 - 7) Crankcase heater
 - 8) Oil sight glass 1 1/8" - 18UNF
 - Oil level sensor(optional)
 - 9) Electrical box
 - S.) Suction shut-off valve
 - D.) Discharge shut-off valve

PP4L0300- PP4H-0500; PP4L0400- PP4H-0600;
 PP4L0500- PP4H-0700; PP4L0600- PP4H-0900;

Item	Units	Parameter								Note
Type	/	PP4L0300	PP4H0400	PP4L0400	PP4H0600	PP4L0500	PP4H0700	PP4L0600	PP4H0900	
Dimensions	mm	452.5x310x336	452.5x310x336	452.5x310x336	452.5x310x336	452.5x310x336	482x310x336	482x310x336	482x310x336	
size A	mm/inh	28.85/ 1 1/8"	28.85/ 1 1/8"	28.85/ 1 1/8"	28.85/ 1 1/8"	28.85/ 1 1/8"	28.85/ 1 1/8"	35.5/ 1 3/8"	35.5/ 1 3/8"	
size B	mm/inh	19.35/ 3/4"	19.35/ 3/4"	22.45/ 7/8"	22.45/ 7/8"	22.45/ 7/8"	22.45/ 7/8"	28.85/ 1 1/8"	28.85/ 1 1/8"	
size C	mm	452.5	452.5	452.5	452.5	452.5	482	482	482	
size D	mm	29	29	29	29	29	58.5	58.5	58.5	
size E	mm	149	149	149	149	149	149	155	155	
size F	mm	10.5	10.5	17	17	17	17	28	28	

Fig. 62 Dimensions of models from PP4L0300 to PP4H0900



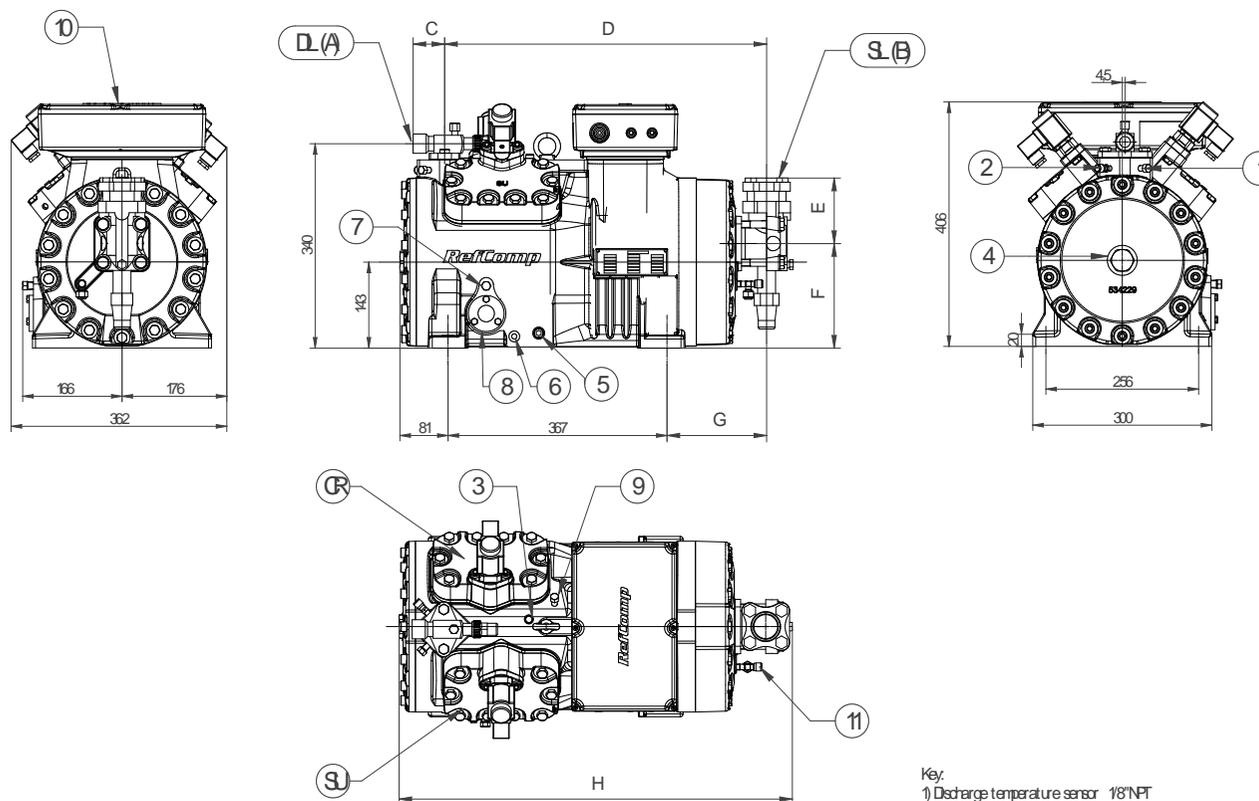


- Key:
- 1) Electronic di pressure switch connection
 - 2) Discharge temperature sensor 1/8"NPT
 - 3) High pressure 1/8"NPT
 - 4) High pressure 1/4"S/E FLARE
 - 5) Low pressure 1/4"S/E FLARE
 - 6) Low pressure 1/8"NPT
 - 7) Oil strainer plug M2x15
 - 8) Oil drain 3/8"NPT
 - 9) Oil case heater
 - 10) Oil charging 1/4"NPT
 - 11) Oil sight glass
 - 12) Oil injection connection 1/8"NPT
 - 13) Electrical box
 - 14) Low pressure 1/4"S/E FLARE
 - D) Discharge shut-off valve
 - S) Suction shut-off valve
 - OR) Capacity regulator
 - SU) Start unloader

Type	ØA	ØB	C	D	E	F	G	H
PP4LF0600	22-7/8"	28-1/8"	40	512	72	162	139	651
PP4LF0800	28-1/8"	35-1/8"	53	512	72	162	139	651
PP4LF1000	28-1/8"	35-1/8"	53	512	72	162	139	651
PP4LF1200	28-1/8"	35-1/8"	53	512	72	162	139	651
PP4HF1000	22-7/8"	28-1/8"	40	512	72	162	139	651
PP4HF1200	28-1/8"	35-1/8"	53	512	72	162	139	651
PP4HF1600	28-1/8"	42-15/8"	53	540	109	174	167	682
PP4HF2000	28-1/8"	42-15/8"	53	540	109	174	167	682

PP4LF0600- PP4HF1000; PP4LF0800- PP4HF1200;
 PP4HF1000- PP4HF1600; PP4LF1200- PP4HF2000;

Fig. 63 Dimensions of models from PP4LF0600 to PP4HF2000



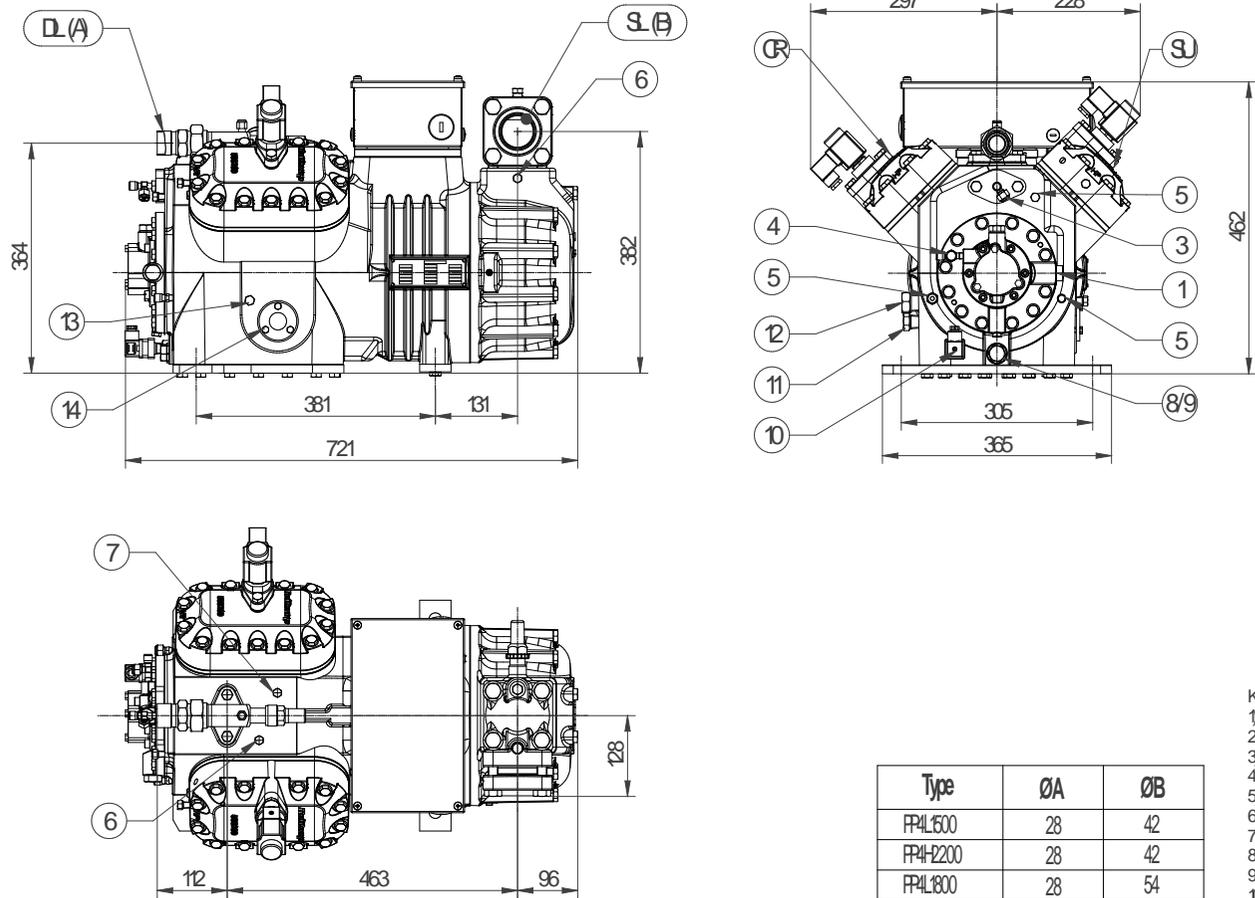
- Key:
- 1) Discharge temperature sensor 1/8"NPT
 - 2) High pressure 1/4" SAE FLARE
 - 3) Low pressure 1/8"NPT
 - 4) Plug 1/18 - 18 UNF/ Optional : Oil level sensor
 - 5) Oil drain 3/8"NPT
 - 6) Crankcase heater
 - 7) Oil charging 1/4"NPT
 - 8) Oil sight glass
 - 9) LO/Injection connection 1/8"NPT
 - 10) Electrical Box
 - 11) Low Pressure 1/4" SAE FLARE
 - D) Discharge shut-off valve
 - S) Suction shut-off valve
 - C) Capacity regulator
 - SJ) Start unloader

Type	ØA	ØB	C	D	E	F	G	H
FP4LN0600	22-7/8"	28-1/8"	40	512	72	162	139	628
FP4LN0800	28-1/8"	35-13/8"	53	512	72	162	139	628
FP4LN1000	28-1/8"	35-13/8"	53	512	72	162	139	628
FP4LN200	28-1/8"	35-13/8"	53	512	72	162	139	628
FP4HN000	22-7/8"	28-1/8"	40	512	72	162	139	628
FP4HN200	28-1/8"	35-13/8"	53	512	72	162	139	628
FP4HN600	28-1/8"	42-15/8"	53	540	109	174	167	669
FP4HN2000	28-1/8"	42-15/8"	53	540	109	174	167	669

FP4LN0600- FP4HN000; FP4LN0800- FP4HN200;
 FP4HN000- FP4HN600; FP4LN200- FP4HN2000;

Fig. 64 Dimensions of models from PP4LN0600 to PP4HN2000



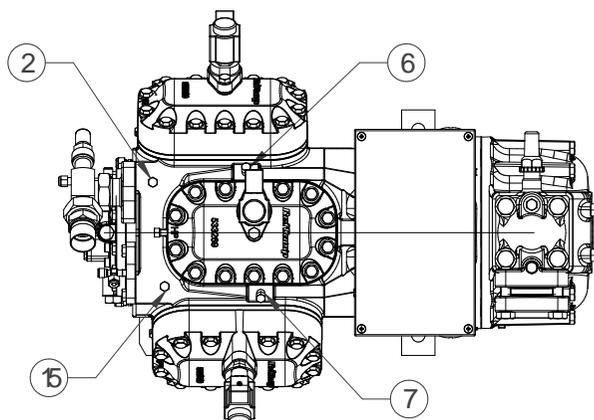
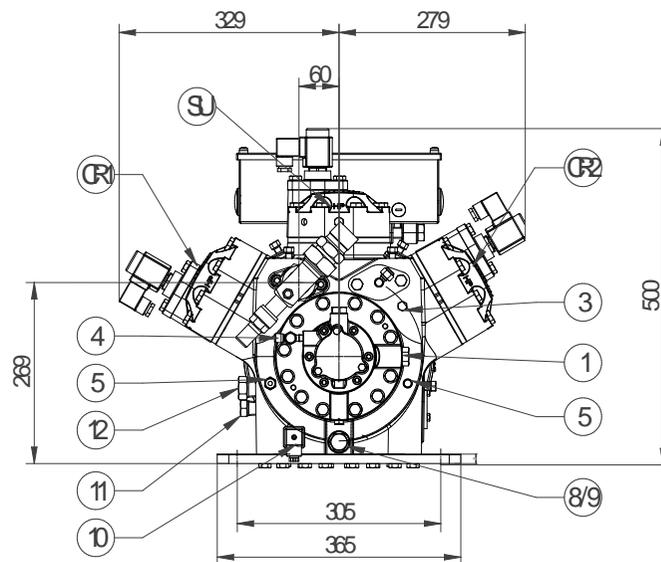
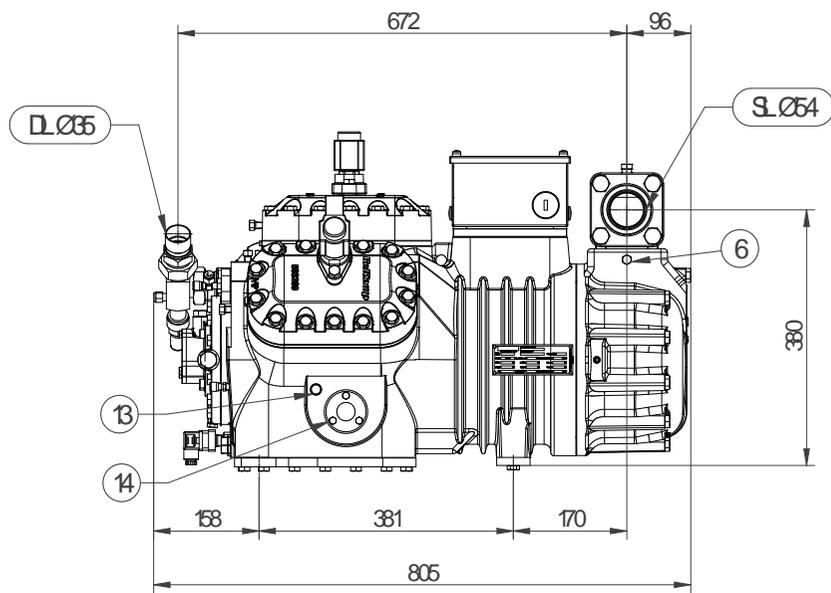


- Key:
- 1) Electronic oil pressure switch connection
 - 2) Discharge temperature sensor 1/8"NPT
 - 3) High pressure 1/4"S/E FLARE
 - 4) Oil high pressure 1/4"S/E FLARE
 - 5) Oil low pressure 1/4"S/E FLARE
 - 6) Low pressure 1/8"NPT
 - 7) Low pressure 1/8"NPT (liquid injection)
 - 8) Oil strainer plug
 - 9) Oil drain 3/8"NPT
 - 10) Crankcase heater
 - 11) Oil equalization (parallel operation) 1/2"NPT
 - 12) Gas equalization (parallel operation) 3/4"NPT
 - 13) Oil charging 1/4"NPT
 - 14) Oil sight glass
 - D) Discharge shut-off valve
 - S) Suction shut-off valve
 - GR) Capacity regulator
 - SJ) Start unloader

Type	ØA	ØB
FP4L1500	28	42
FP4H2200	28	42
FP4L1800	28	54
FP4H2500	28	42
FP4L2200	28	54
FP4H3000	28	54
FP4L2500	35	54
FP4H3500	35	54

FP4L1500- FP4H2200; FP4L1800- FP4H2500;
 FP4L2200- FP4H3000; FP4L2500- FP4H3500;

Fig. 65 Dimensions of models from PP4L1500 to PP4H3500

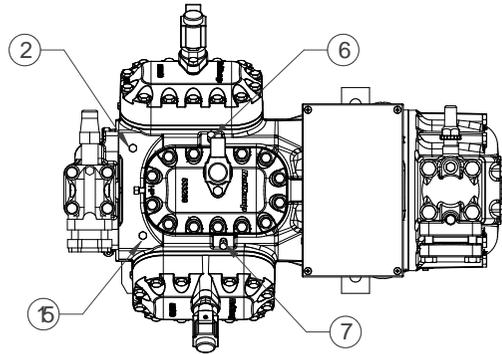
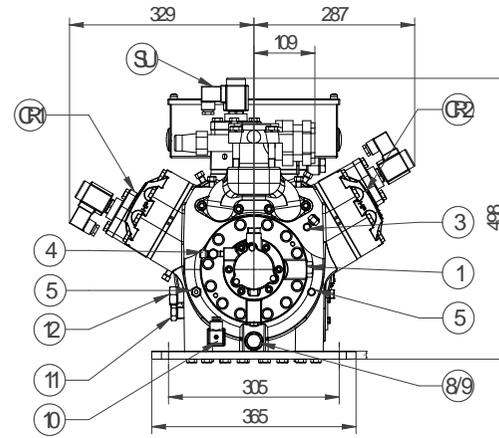
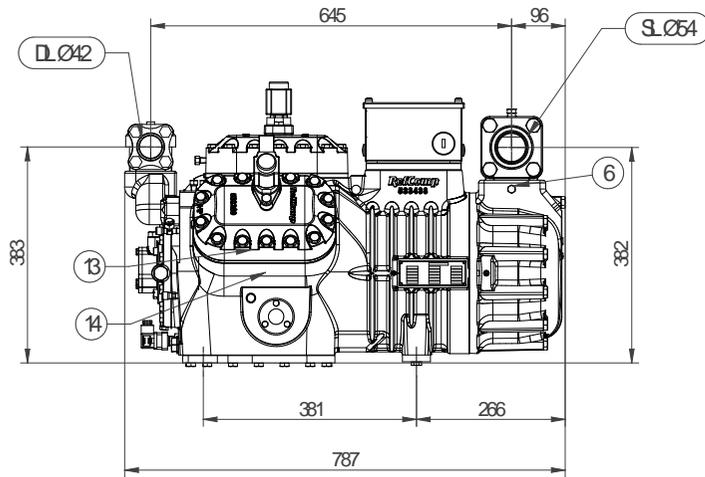


- Key:
- 1) Electronic oil pressure switch connection
 - 2) Discharge temperature sensor 1/8"NPT
 - 3) High pressure 1/4"S/E FLARE
 - 4) Oil high pressure 1/4"S/E FLARE
 - 5) Oil low pressure 1/4"S/E FLARE
 - 6) Low pressure 1/8"NPT
 - 7) Low pressure 1/8"NPT (liquid injection)
 - 8) Oil strainer plug
 - 9) Oil drain 3/8"NPT
 - 10) Crankcase heater
 - 11) Oil equalization (parallel operation) 1/2"NPT
 - 12) Gas equalization (parallel operation) 3/4"NPT
 - 13) Oil charging 1/4"NPT
 - 14) Oil sight glass
 - 15) High pressure 1/4"NPT
 - D) Discharge shut-off valve
 - S) Suction shut-off valve
 - CR) Capacity regulator
 - CR2) Capacity regulator
 - SJ) Start unloader

FF6L2700- FF6-3700; FF6L3000- FF6-4000

Fig. 66 Dimensions of models from PP6L2700 to PP6H3700

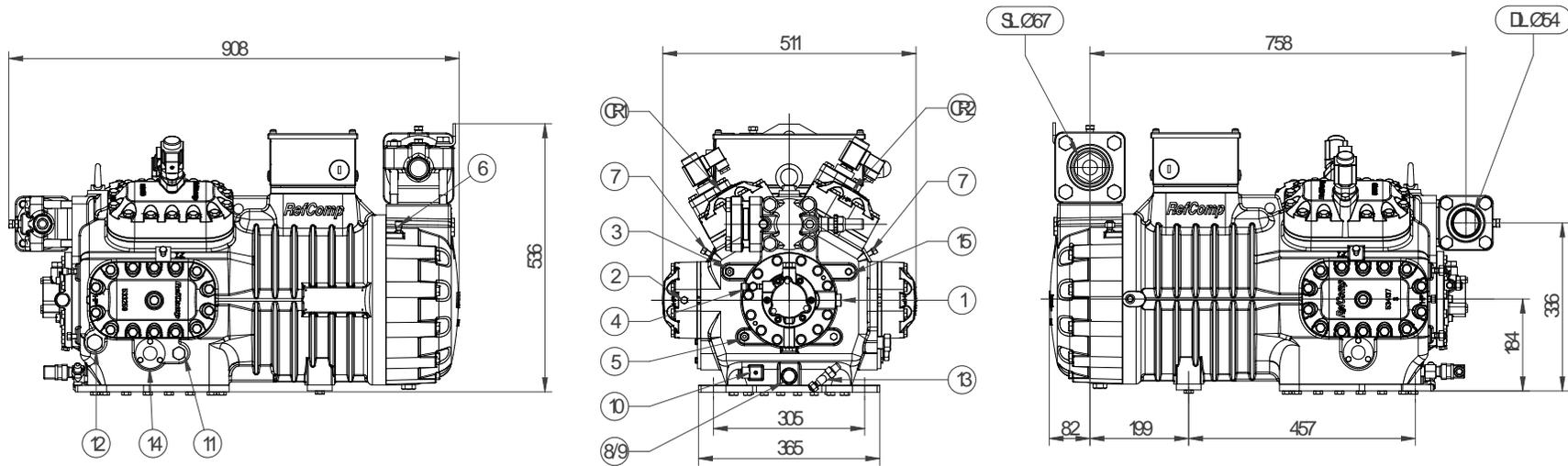




- Key:
- 1) Electronic oil pressure switch connection
 - 2) Discharge temperature sensor 1/8"NPT
 - 3) High pressure 1/4"S/E FLARE
 - 4) Oil high pressure 1/4"S/E FLARE
 - 5) Oil low pressure 1/4"S/E FLARE
 - 6) Low pressure 1/8"NPT
 - 7) Low pressure 1/8"NPT (liquid injection)
 - 8) Oil strainer plug
 - 9) Oil drain 3/8"NPT
 - 10) Crankcase heater
 - 11) Oil equalization (parallel operation) 1/2"NPT
 - 12) Gas equalization (parallel operation) 3/4"NPT
 - 13) Oil charging 1/4"NPT
 - 14) Oil sight glass
 - 15) High pressure 1/4"NPT
 - D) Discharge shut-off valve
 - S) Suction shut-off valve
 - CR) Capacity regulator
 - CR2) Capacity regulator
 - SJ) Start unloader

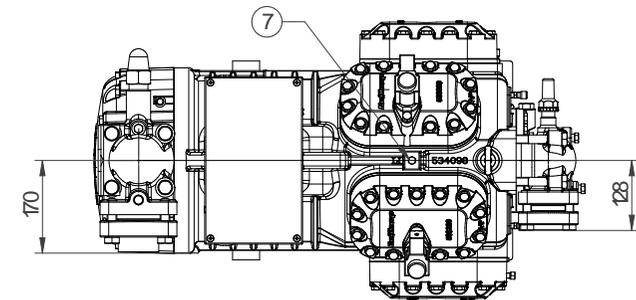
PP4L4000-PP4H5000

Fig. 67 Dimensions of models PP4L4000/PP4H5000



Key:

- 1) Electronic oil pressure switch connection
- 2) Discharge temperature sensor 1/8"NPT
- 3) High pressure 1/4"S/AE FLARE
- 4) Oil high pressure 1/4"S/AE FLARE
- 5) Oil low pressure 1/4"S/AE FLARE
- 6) Low pressure 1/8"NPT
- 7) Low pressure 1/8"NPT (liquid injection)
- 8) Oil strainer plug
- 9) Oil drain 3/8"NPT
- 10) Crankcase heater
- 11) Oil equalization (parallel operation) 1/2"NPT
- 12) Gas equalization (parallel operation) 3/4"NPT
- 13) Oil charging 1/4"NPT
- 14) Oil sight glass
- 15) High pressure 1/4"NPT
- D) Discharge shut-off valve
- S) Suction shut-off valve
- CR1) Capacity regulator
- CR2) Capacity regulator
- SJ) Start unloader



FF8L5000- FF8L6000; FF8L6000- FF8L7000;

Fig. 68 Dimensions of models from PP8L5000 to PP8H7000



8.2 Packaging

Compressors models PP2-L/Hxxxx and PP4-L/HNxxxx, PP4-L/HFxxxx are packed individually using wooden pallets with corrugated cardboard for packaging, as shown in Fig. 69.

For the compressor models and PP4-L/Hxxxx, PP6-L/Hxxxx and PP8-L/Hxxxx, as shown in Fig. 70, 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. 71).

The type of corrugated cardboard is suitable for transport by sea, with a thickness of 9.4 mm and structure (combination wave) AA. The carton is guaranteed by the absence of separation of layers after 24 hours in water.

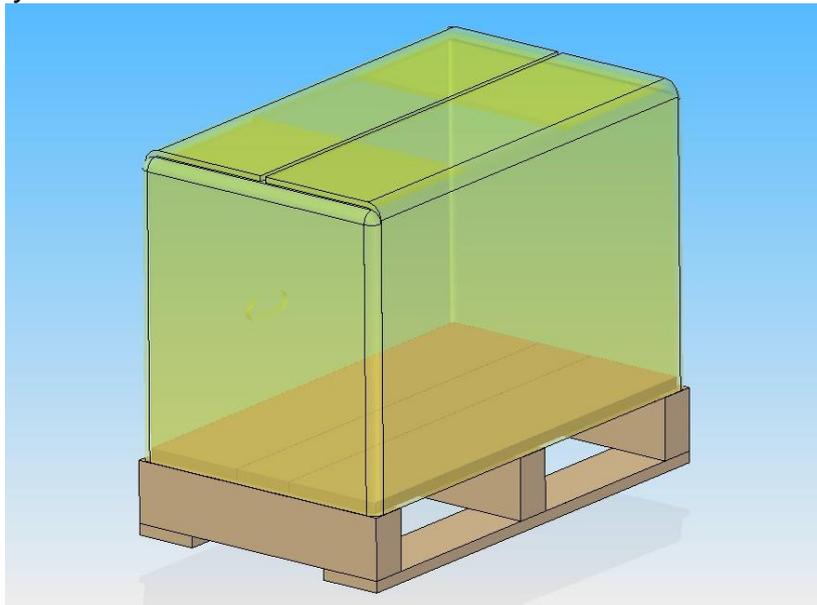


Fig. 69 Packing with carton box

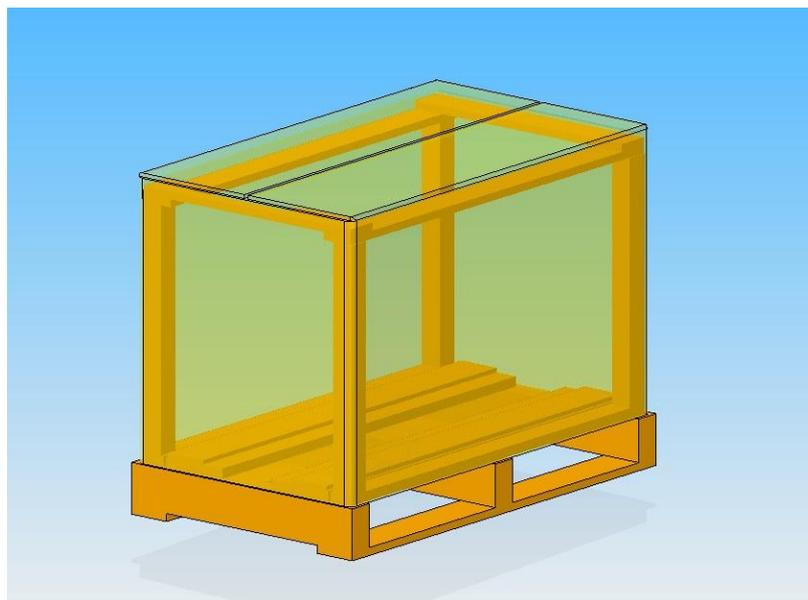


Fig. 70 Packing with reinforced structure



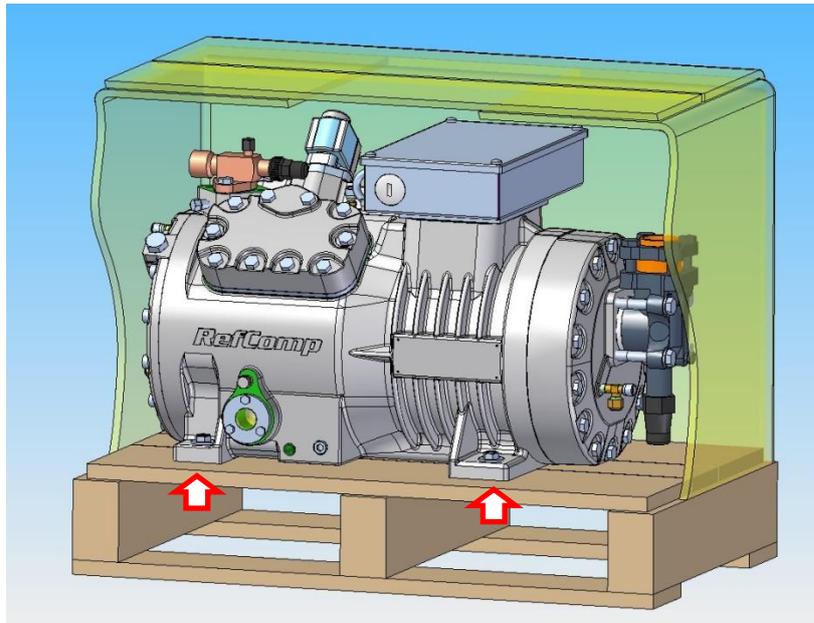


Fig. 71 Compressor fixed to the pallet through screws

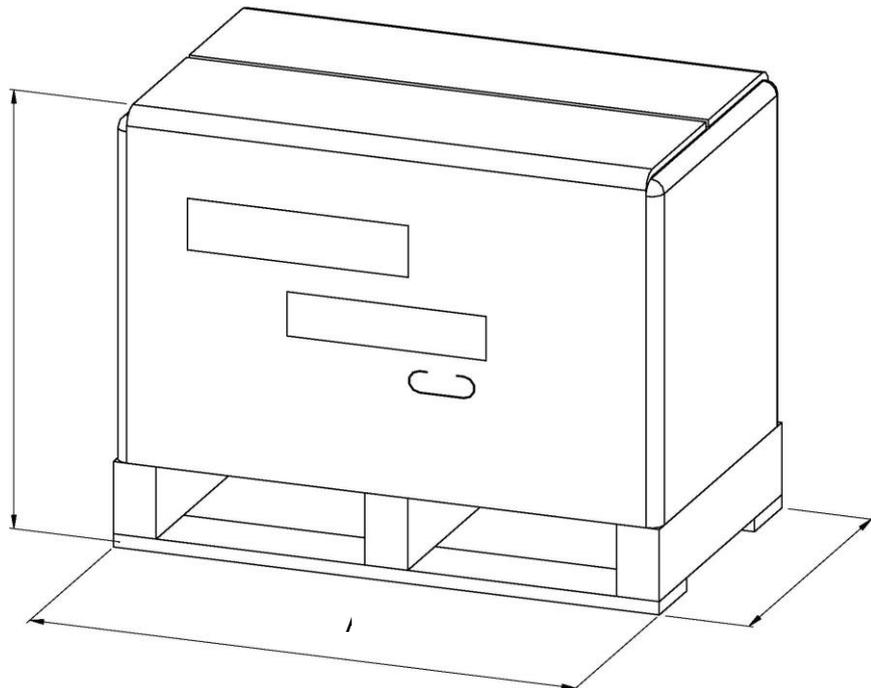


Fig. 72 Dimensions for packing of SP Series

Model	A [mm]	B [mm]	C [mm]
PP2-L/H2xxxx	516	291	325
PP4-L/HNxxxx, PP4-L/HFxxxx	740	440	600
PP4-L/Hxxxx, PP6-L/Hxxxx	870	670	730
PP8-L/Hxxxx	1030	615	765

Table 20 Packages dimensions



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 18. For deeper information see Chapter15 "*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. 73 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).

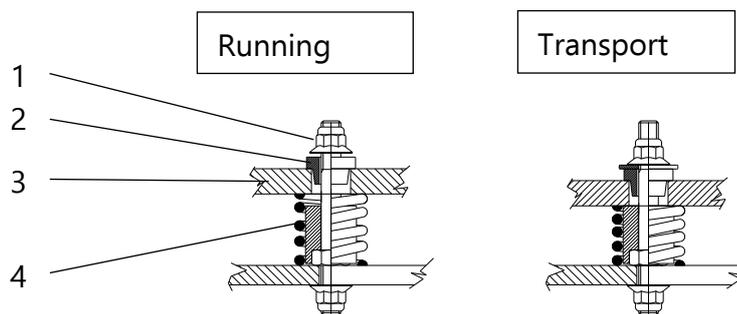


Fig. 73 Shape of spring dampers during transport and running

- | | |
|---------------------|--------------------|
| 1) Self locking nut | 3) Compressor base |
| 2) Damping washer | 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. 74)



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

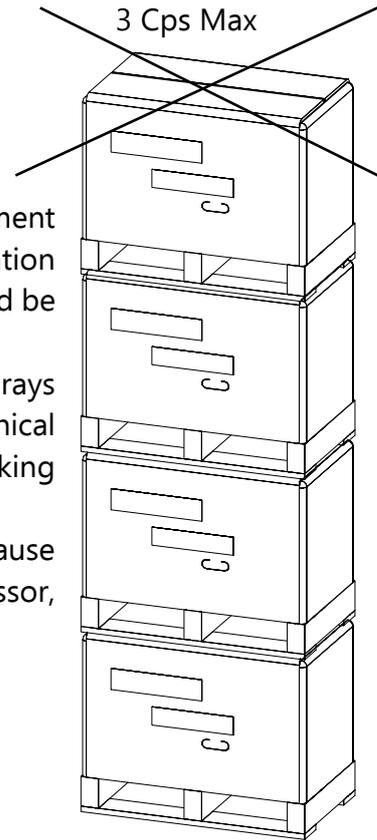


Fig. 74 Maximum storage height allowed

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. 75.

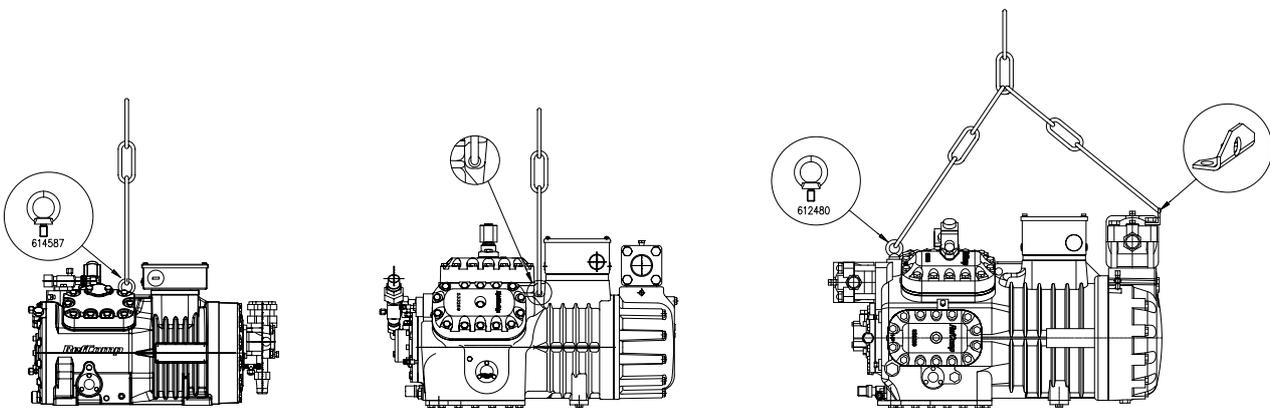


Fig. 75 Lifting instructions



10 Performance data for the PP series compressors



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

Compressor	Qe(kW)	Pin(kW)	COP()	CA(A)	Qc(kW)	m(kg/h)	EER()	Qcooler(k)
PP1-H412-F	32.2	8.0	4.03	14.4	40	384.3	13.733	
PP1-H415-F	37.9	9.2	4.12	17.0	47	457.1	14.056	
PP1-H420-F	43.3	10.5	4.12	19.2	54	516.6	14.070	
PP1-H422-F	49.6	12.4	4.00	22.8	61	582.1	13.648	
PP1-H425-F	58.1	14.4	4.03	26.0	72	693.3	13.766	
PP1-H430-F	66.6	16.5	4.04	29.4	83	797.3	13.772	
PP1-H435-F	80.4	19.7	4.08	35.4	100	960.0	13.925	
PP1-H637-F	86.2	21.7	3.97	38.1	109	1029.3	13.689	
PP1-H640-F	99.9	24.9	4.01	43.9	121	1193.3	13.689	
PP1-H650-F	120.7	30.1	4.01	51.1	150	1443.5	13.682	
PP1-H860-F	144.0	35.5	3.95	61.1	180	1719.3	13.461	
PP1-H870-F	177.7	43.3	4.01	71.1	217	2072.6	13.680	
R290 (MT Splasher)								
PP1-H205-S	13.3	3.91	3.41	6.1	16	158.5	13.347	
PP1-H206-S	16.3	3.98	4.09	7.4	20	194.1	13.565	

PP1-H640-F	
Displacement at 50/60 Hz [m³/h]	129,1 / 154,9
N° of cylinders	6
Weight [Kg]	246
Oil Charge [dm³]	4,2
Discharge connection int. [mm/inch]	35 / 1 3/8"
Suction connection int. [mm/inch]	54 / 2 1/8"
Start mode	Part Winding (PW)
Motor size	Standard
Motor	400/3/50
L.R.A. [A]	201/330

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=20K;
- Liquid sub-cooling: SC=5K;
- Three-phase electrical net frequency: f=50Hz;
- Nominal voltage: V=400V;
- Refrigerant fluid: R290, R600;
- Working conditions without ECONomiser circuit.

Key:

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

11 Application range

11.1 General

The normal admissible operating conditions for the PP series compressors, with changes in evaporation and condensing temperature, are defined by a polygon, as highlighted in Fig. 76.

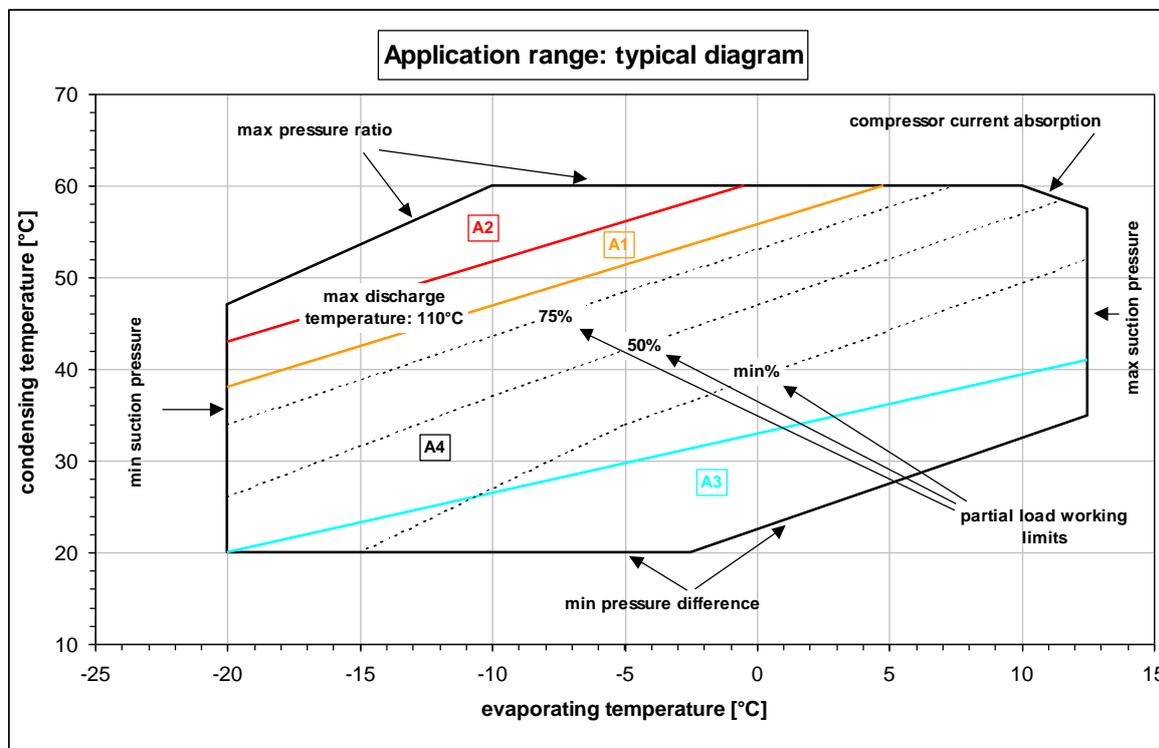


Fig. 76 typical application range

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;

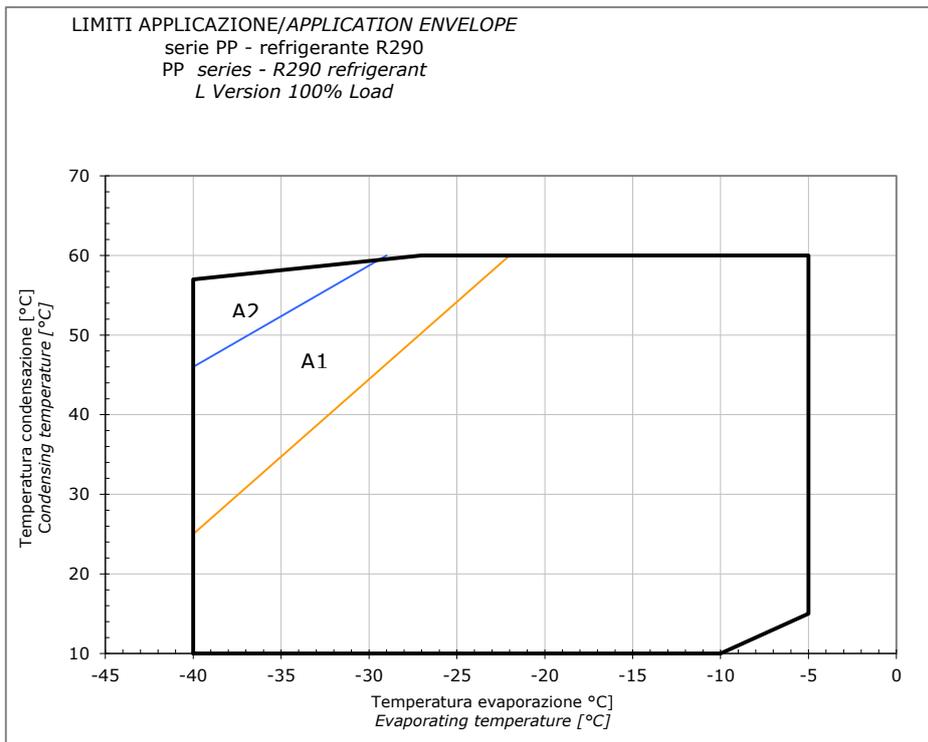
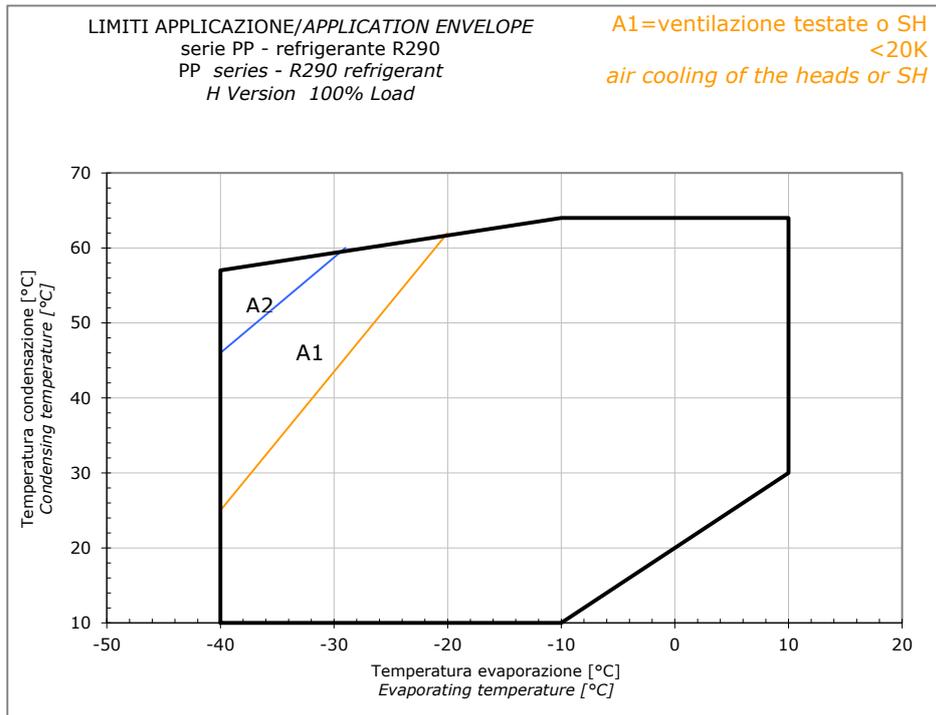
In addition to the above given areas, the diagram gives also, as dotted lines, the working limits on partial loads. For each partial load, these lines limit the maximum possible condensation temperature in relation to the evaporation temperature.

The following paragraphs describe the operating limits for the different refrigerant fluids that can be used with the PP compressors. All the operating limits refer to a suction vapor superheat of 20K.

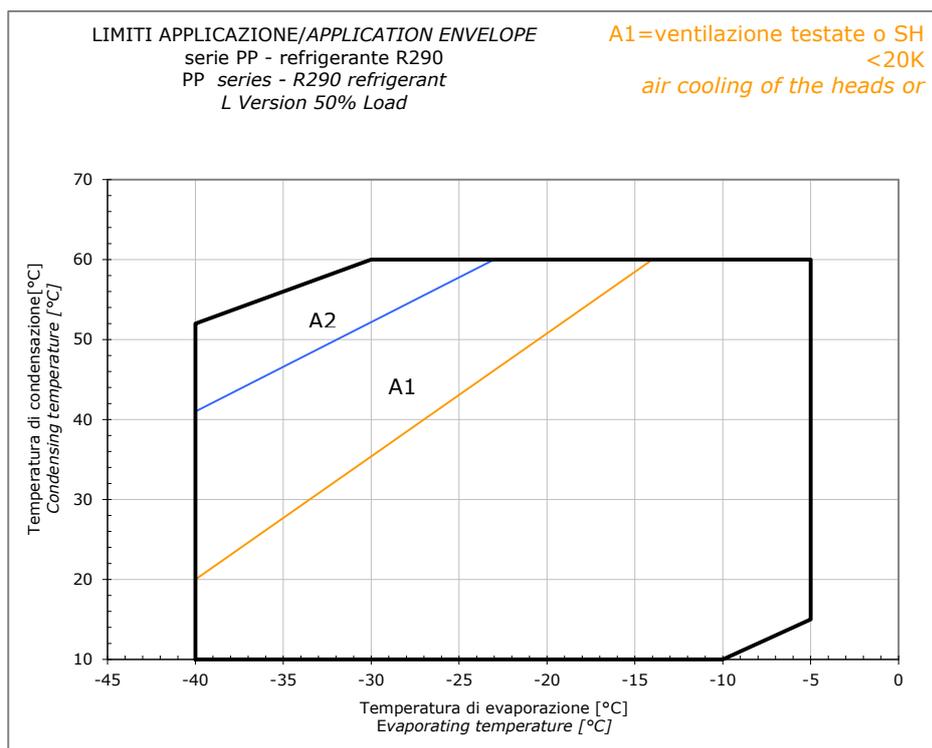
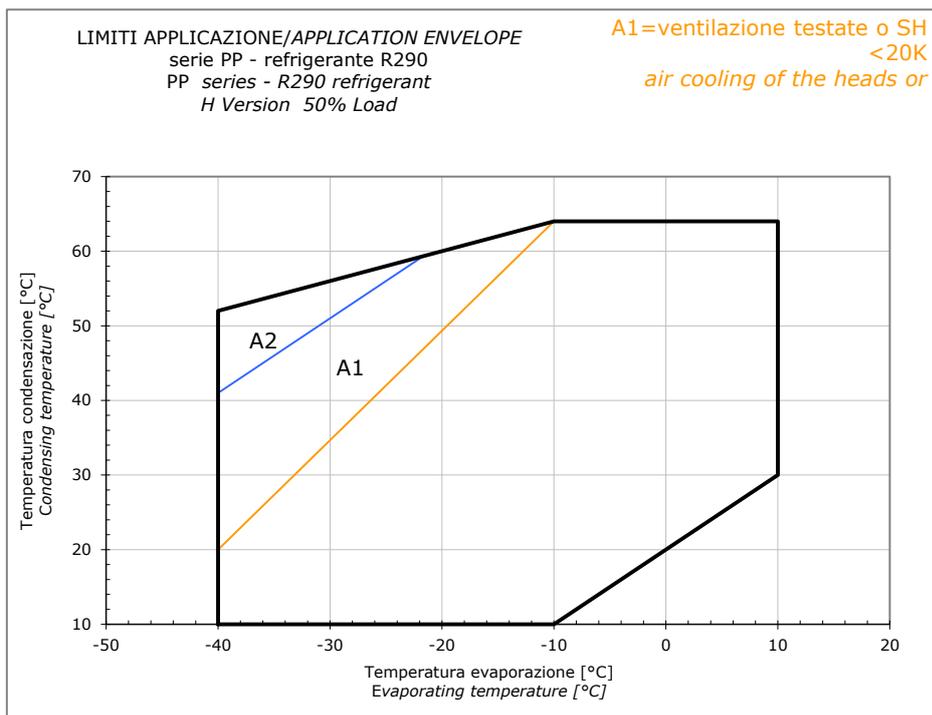


11.2 Application range with the R290 refrigerant

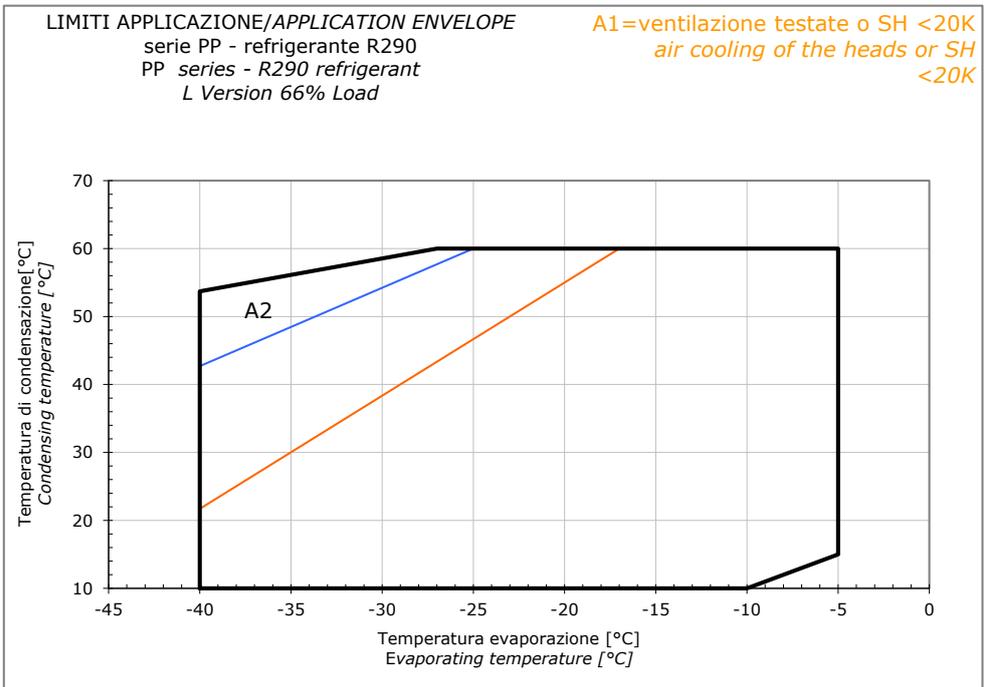
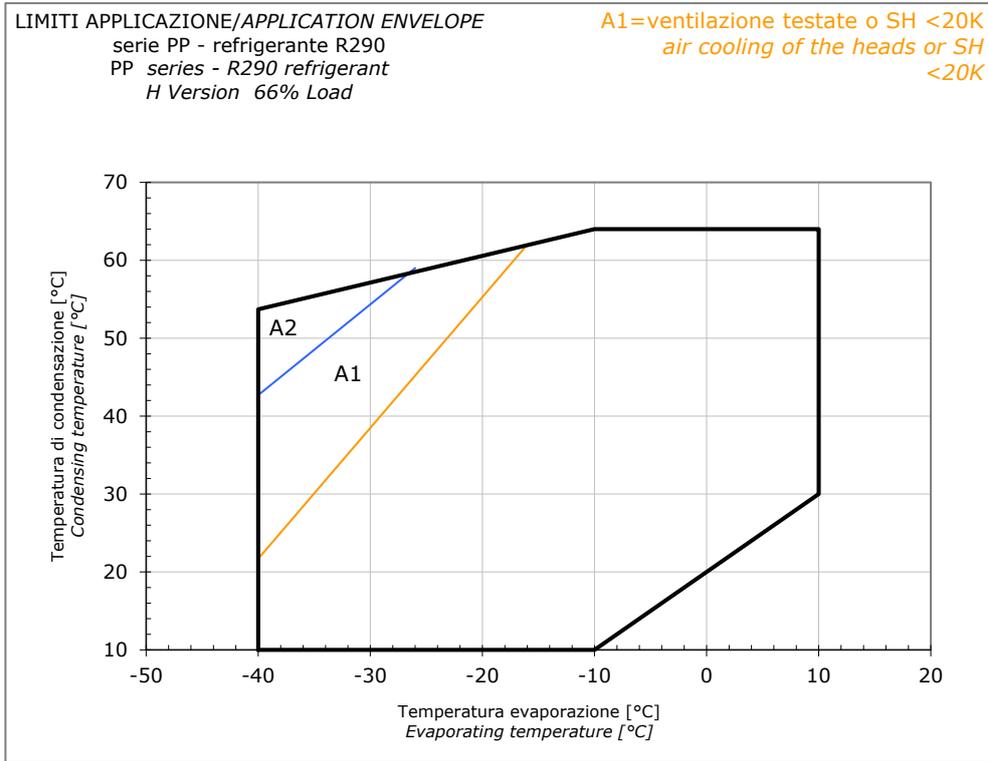
11.2.1 H and L version all the compressors: full load.



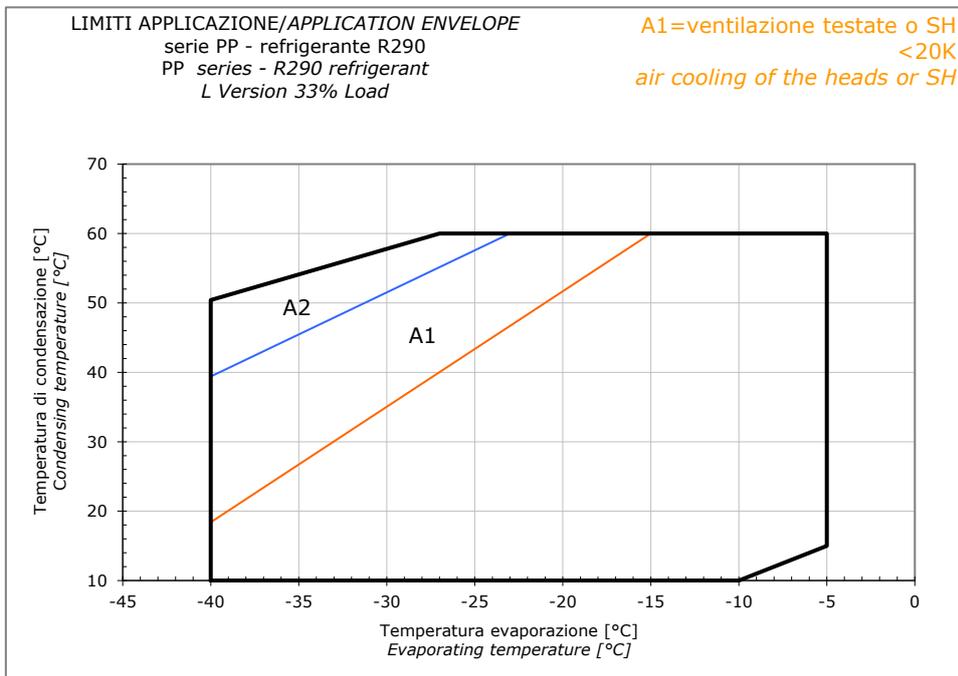
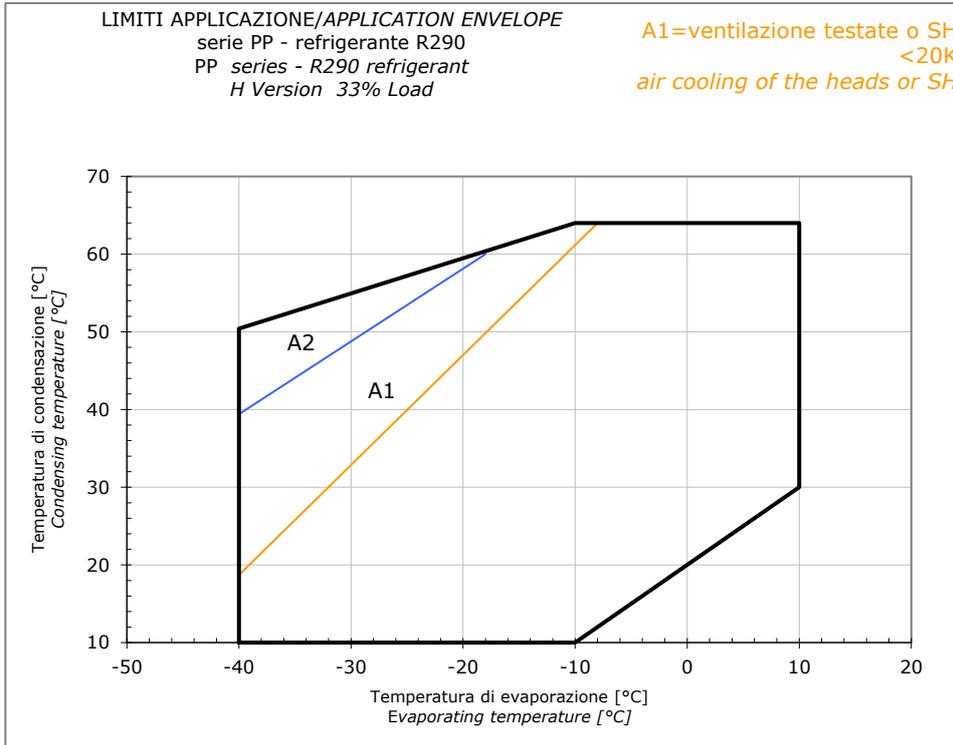
11.2.2 H and L version 4 cylinder compressors, partial load.



11.2.3 H and L version 6 cylinder compressors, partial load, 66%.



11.2.4 H and L version, 6 cylinder compressors, partial load, 33%.



11.3 Application range with the R600 refrigerant

Please contact RefComp.



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 as 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):

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

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 RefComp selection software.

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 Compressor requirements

RefComp Compressors can only work with refrigerants allowed by RefComp 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.

Here below a synthesis of the compressor requirements:

1. Use of the high viscosity oil to compensate for the high solubility of propane in lubricants (Table 5). Use additional oil separator to reduce the oil carry-over in low temperature side of the system.
2. Terminal box / Solenoid valves / Oil heater / oil pressure switch must be **IP 54** or higher (standard accessories already comply with IP 54 requirements, no need for a special version)
3. Motor protection module INT69VS or IT69B2 to be installed in the closed **electrical switchboard** (delivered separately)
4. Use of crankcase heater
5. Compressor to be clearly marked with the logo "ATTENTION FIRE HAZARD"

12.4 Safety requirements

1. 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)
2. Used dryers contain residual quantities of propane and must be purged with nitrogen.
3. Before changing the oil, switch on the oil heater, reduce pressure by evacuation then purge with nitrogen (at atmospheric pressure and ambient temperature there is a small amount of propane diluted in the oil, which could result in a flammable mixture over the oil surface)
4. System to be marked with warning labels "ATTENTION FIRE HAZARD"
5. System designer to be certified for flammable refrigerants



**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 on 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.

12.5 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 RefComp.

12.5.1 Compressors PP4-L/HNxxxx, PP4-L/HFxxxx, PP4-L/Hxxxx and PP6-L/Hxxxx

The compressor models PP4-L/HNxxxx, PP4-L/HFxxxx, PP4-L/Hxxxx and PP6-L/Hxxxx are provided, standards, with spring shock absorbers. The dampers are supplied loose in the packaging, in a special nylon bag.

The PP2-L/Hxxxx 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).

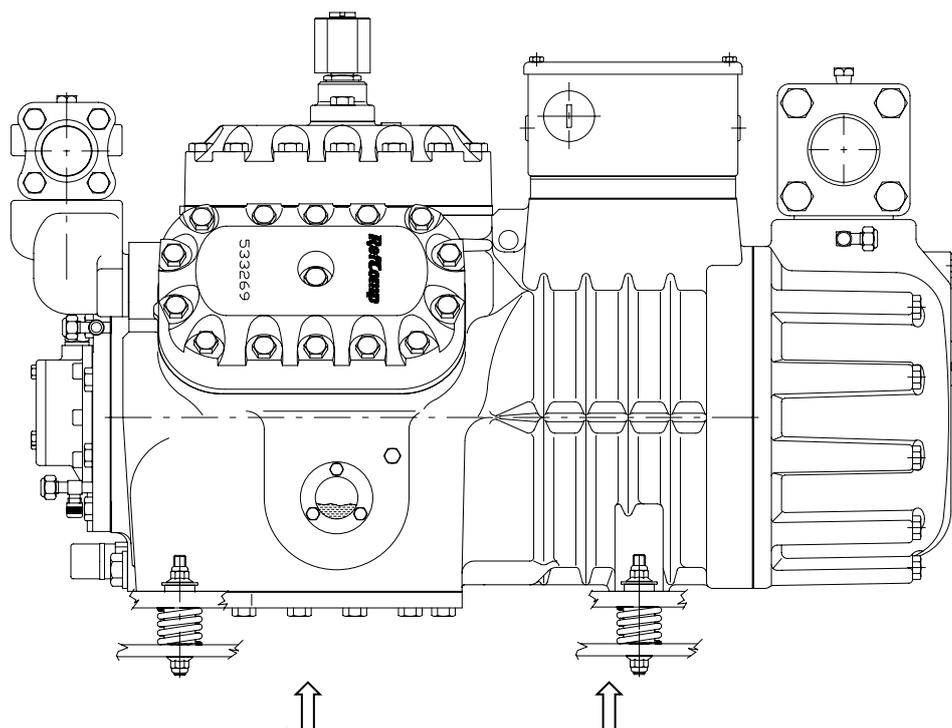


Fig. 77 Spring dampers positions on compressors models PP4-L/H e PP6-L/H



12.5.2 Compressors PP8-L/H

Compressors PP8-L/H are provided, standard, with rubber dampers.

The dampers are supplied loose in the packaging, in a special nylon bag. Fig. 78 shows an exploded view 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.

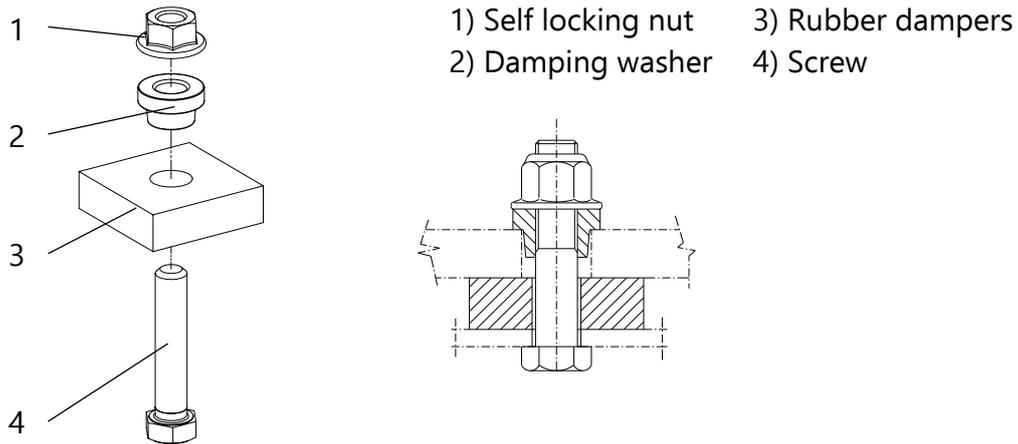


Fig. 78 Rubber damper for PP8-L/H compressors

Even for the 8-cylinder compressor is available, option, spring dampers kit. The kit consists of 4 identical damping elements.

Fig. 79 shows an exploded view of the spring shock absorbers and their installation on the compressor model PP8-L/H.

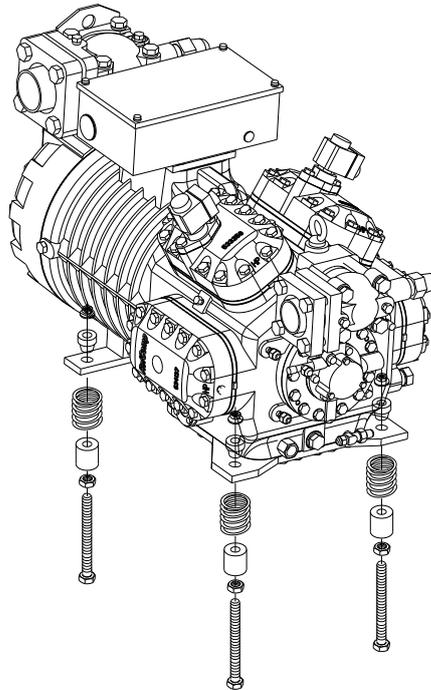


Fig. 79 Rubber dampers assembling on PP8-L/H compressors

Fig. 80 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.

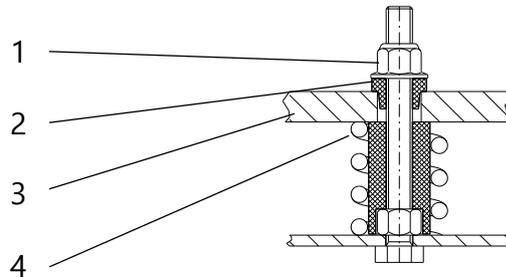


Fig. 80 Spring dampers positions (option) during transport for PP8-L/H models

- | | |
|---------------------|--------------------|
| 1) Self locking nut | 3) Compressor base |
| 2) Damping washer | 4) Spring guide |



For others information of dampers kit codes, ask to RefComp Commercial Department.

12.6 System requirements

1. Minimum refrigerant charge
2. Pump down
3. Suction superheat > 10K (the use of a heat exchanger between suction and liquid line is strongly recommended)
4. Discharge gas temperature at least 20K above condensing temperature
5. Expansion valve specifically designed for R290, with steady control behaviour
7. Suction accumulator
8. Extreme system cleanness (the use of an additional suction filter is recommended for steel pipes or widely branched piping)
9. Use of "2.5" quality propane or higher
10. Use of a generously sized liquid dryer and a moisture indicator (moisture must be < 50 ppm)
11. Size of system components to be properly selected (refrigerant charge typically 50% lower than R22)
12. Use of two type tested pressure switches: at least one must have a special design where reset is only possible with a tool
13. Do not use capillary pipes and non metallic hoses .

12.6.1 Suction superheat

Because of the lubricant solubility with Hydrocarbon 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.

12.6.2 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 ⁽¹⁾

⁽¹⁾: See chapter 11 "Application range"

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 RefComp and indicated on its plate. The user must ensure also that the balanced pressure does not exceed the maximum value specified by RefComp.

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

12.6.3 *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.

12.6.4 *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 when using R290 and +40°C when using R600a.

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

12.6.5 *Temperatures*

Discharge:	maximum: 120°C; minimum : 30K over the condensing saturation temperature.
Suction:	maximum: see envelope; minimum : 15K for R290.

12.6.6 *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 / Hour.
Minimum time between two following start-up :	10 minutes
Minimum 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.

12.6.7 *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**



12.6.8 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.

12.7 Testing

12.7.1 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. 81.
- e) Close and/or screw the oil connection tap.

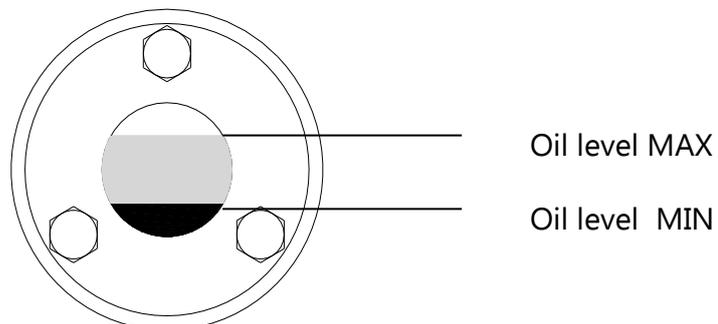


Fig. 81 Oil level range

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 paragraph 12.6.2: "Pressure").



**WARNING!**

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

12.8 Refrigerant charge



The refrigerant charge of hydrocarbons refrigerant is significantly lower than common refrigerants (around 40-60% lower) due to the lower liquid density.

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 RefComp selection software.

12.9 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 6.2: "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*").



Protection devices intervention and trouble shooting

Problem	Possible causes	Actions
1) The compressor doesn't start	<ul style="list-style-type: none"> a) Interface switch open b) Burned fuses c) Over- temperature relays 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 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> a) Brackets of pipes inadequate b) Inadequate clearance c) Liquid inside the compressor casing d) Rotor electric motor is not fixed e) Sound insulation / vibration inappropriate 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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) Insufficient Discharge pressure	<ul style="list-style-type: none"> a) Faulty condensing temperature regulation b) Intake valve partially closed c) Refrigerant amount not enough d) Suction pressure inadequate e) The compressor does not increase the load f) Condenser oversized g) Worn seal rings or Discharge valve 	<ul style="list-style-type: none"> a) Check operation of electronically control of condenser b) Open the valve c) Check for leaks. Charge refrigerant d) See paragraph 12.6.2 e) CR / SU Leads working. See paragraph 4. f) Review the design parameters g) Special maintenance compressor

Problem	Possible causes	Actions
5) Excessive suction pressure	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> a) Faulty CR Lead b) Stem of CR Lead blocked 	<ul style="list-style-type: none"> a) Replace b) Replace
8) The compressor doesn't increase the load	<ul style="list-style-type: none"> a) Faulty CR Lead 	<ul style="list-style-type: none"> a) Replace
9) Increasing and decreasing capacity steps too short	<ul style="list-style-type: none"> a) Oversized expansion valve causes an excessive suction pressure 	<ul style="list-style-type: none"> a) Control the sizing of expansion valve
10) The oil pressure gauge gives a low pressure	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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 relays open	<ul style="list-style-type: none"> 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 	<ul style="list-style-type: none"> 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	<ul style="list-style-type: none"> 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. 	<ul style="list-style-type: none"> 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.



13 Parallel compounding

13.1 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

13.2 Design and installation

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

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 RefComp reciprocating compressor. RefComp 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).

13.2.1 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.

13.3 Oil level regulating system

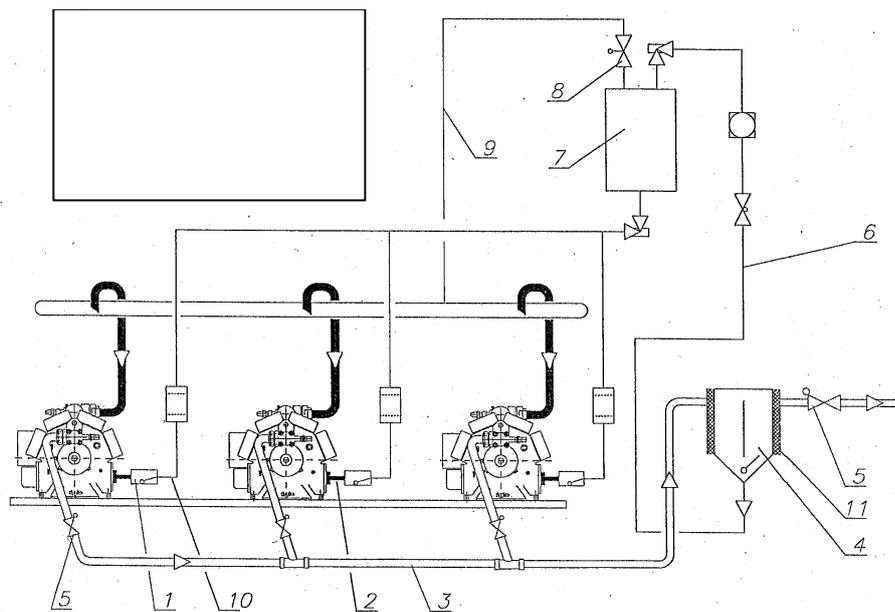


Fig. 82 Parallel compounding with oil level regulators and single oil separator

This system (Fig. 82) 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 $\frac{1}{2}$ to $\frac{1}{4}$ 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 $P_{\text{tank}} = P_{\text{suction}} + 1,4 \text{ bar}$, which implies to choose a regulator suitable to work with the relative differential of pressure.

13.4 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.

13.4.1 Suction liquid receiver

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



13.4.2 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.

13.5 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

13.6 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.

13.7 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.

13.8 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.

13.9 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

14 Maintenance

14.1 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.

14.2 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, copping and icing with the following damage of compressor

14.3 Sludges

14.3.1 Main causes

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



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

14.3.2 *Low to avoid sludge*

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

14.4 Corrosion

14.4.1 *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.

14.4.2 *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 RefComp.

Avoid having discharge temperatures higher than those provided by the process. Contact RefComp in case of uncertainty or doubt.

14.5 Coppering

14.5.1 *Main causes*

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

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

14.5.2 *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.

14.6 Icing

14.6.1 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.

14.6.2 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 RefComp. Avoid using lubricants in containers already open. Install dehydrator filters in liquid line.

14.7 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		
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.

14.8 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.

15 Extent of delivery

15.1 Standard delivery

- Star (400 V) or Delta (230 V) for PP2-L/H models, Part Winding motor for all other models
- Standard power supply 400V/3/50Hz or 460V/3/60Hz
- Suction shut-off valve (only for PP2-L/H and PP4-L/HNxx, PP4-L/HFxx)
- 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 PP1-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 PP2-L/H, PP4-L/HNxx, PP4-L/HFxx 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 PP2-L/H models)
- Additional fan for heads cooling (not usable for PP8-L/H models)
- Spring dampers (not usable for PP2-L/H models)
- Discharge temperature probe
- Crankcase heater
- Opto-electronic probe for oil level (usable only for PP2-L/H and PP4-L/HNxx, 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

15.2 Accessories already installed on the compressor

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

15.3 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)

15.4 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



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