PALLADIO
BY REFPOWER

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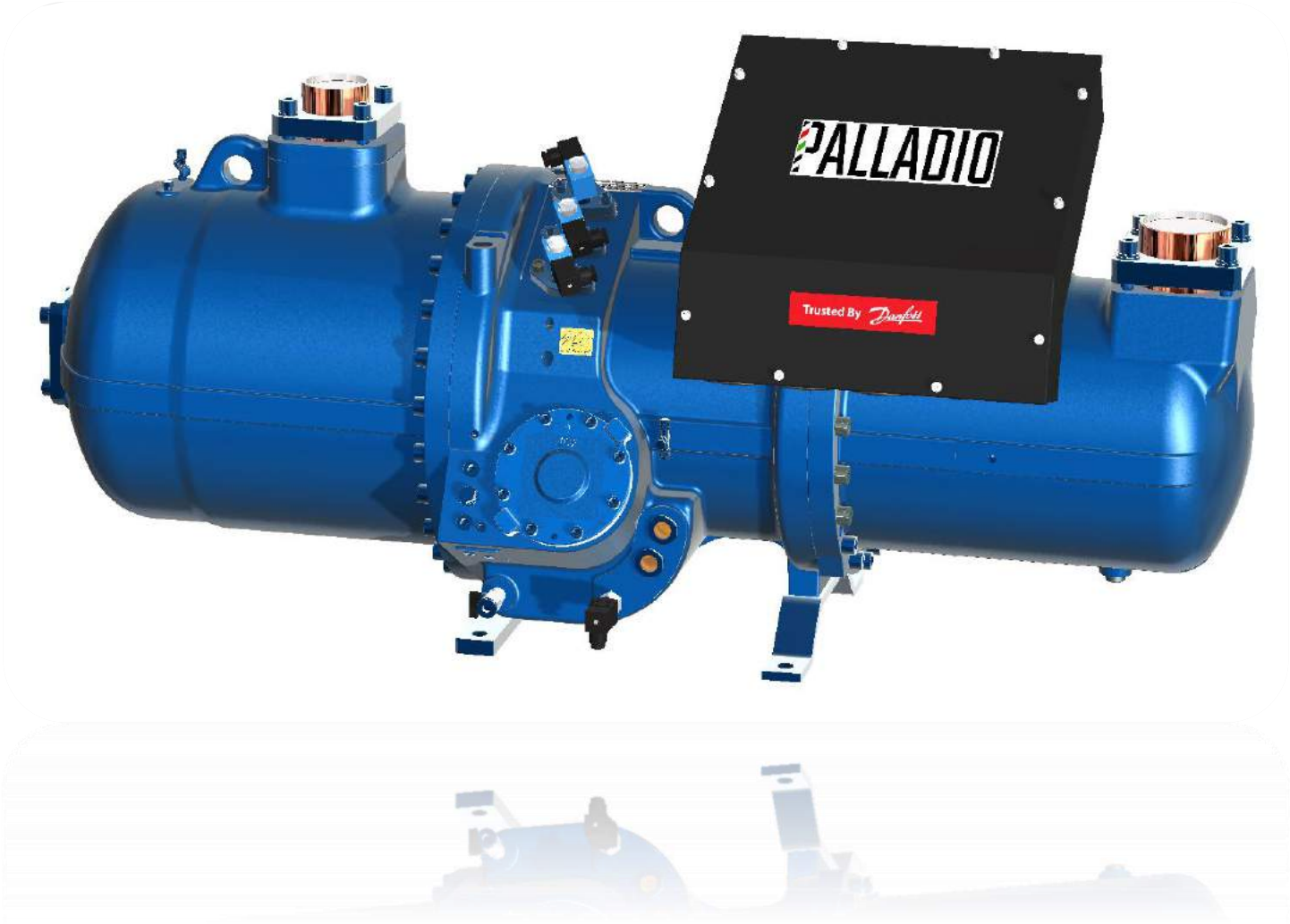
Palladio Compressors – K2 Series

Use and Maintenance Manual



ENGLISH
Rev. 01

Palladio Compressors – K2 Series

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Palladio Compressors - K2 Series

1. General Information and Safety

1.1 INTRODUCTION

The present manual deals with PALLADIO screw compressors K2 series. The K2 series is composed of semi-hermetic twin-screw compressors for refrigeration systems. Compressors are provided with a 2 pole asycronous electrical motor, a compression system composed by a male and a female rotor (where male rotor is directly coupled to electrical motor) and an oil separator.
The K2 series compressors are designed and built in order to be incoporated in a refrigeration plant complying with European Directive 2006/42/EC.

1.2 LEGEND SIMBOLOGY

The present manual uses the following symbols.

Correct application or proper practice to be performed to avoid malfunction or damage of the compressor.

	**Note**

Safety recommendation to avoid major damage to the compressor or the personnel involved in installation and maintenance.

	**Important note**

1.3 SAFETY

The compressor is a partly completed machine; compressor is built in compliance with laws and international standards in force, EN 12693. All informations supplied by the actual manual and by specific technical Information shall be carefully abided by.

1.3.1 Installation area and personnel

The installation plant of the compressor shall be built compliyng:

- main safety standards (EN 378-2);
- European directive in force;
- National regulations specific of the country of installation.

Personnel operating on compressors of the K2 series shall be properly trained on European regulations, National regulations and all instructions provided by the manufacturer of compressor.

1.3.2 Safety devices

The compressor is equipped with internal safety valves to prevent high pressure to exceed maximum admitted pressure written on the nameplate of the compressor. These devices are not subjected to the final user check. During special maintenance activities, these devices shall be controlled.
All safety and control devices of the compressor do not replace the safety devices required by the regulations for cooling circuits or heat pumps where the compressor is installed.

1.4 NAMEPLATE

The compressor nameplate contains foolowing listed data.

1. manufacturer and production site
2. compressor type
3. item code
4. production date
5. serial number
6. power supply voltage
7. oil type
8. start-up type
9. maximum running currents
10. displacement (at 50 Hz and at 60 Hz)

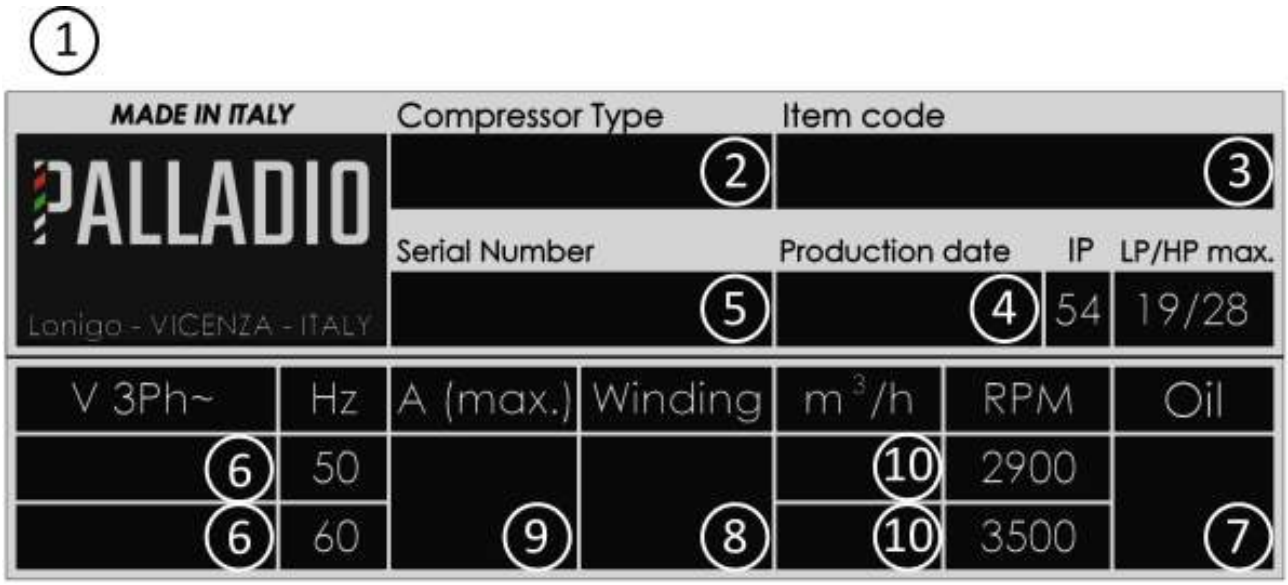

Figure 1A: nameplate

1.5 COMPRESSION PROCESS

The compression process is carried out, as shown in the following figure, in three steps:

1. Suction phase: the screws open a volume between teeth and trap the refrigerant at low pressure in the compression chamber.
2. Compression phase: the screws gradually reduce the volume of trapped refrigerant between teeth and increase the pressure of the refrigerant.
3. Discharge phase: the screws definitely reduce the volume and push the refrigerant out of the compression chamber; the refrigerant gets the maximum plant pressure which depends on the working condition of the plant.

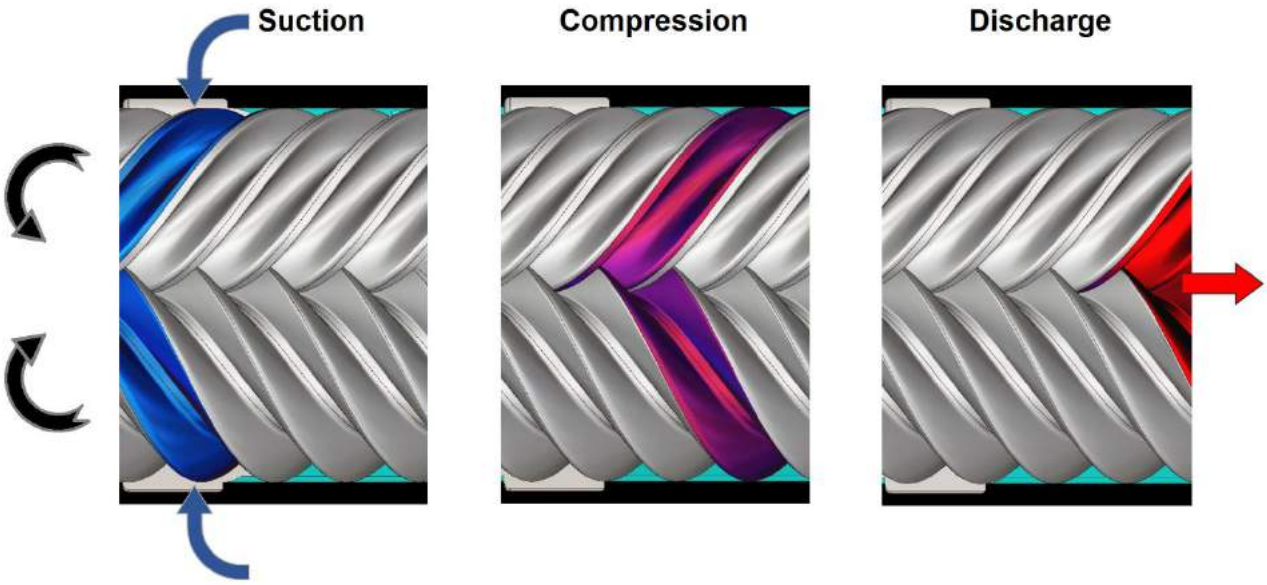

Figure 1B: compression process

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2. Packaging, Opening and Handling

2.1 STORAGE

The compressor is supplied with the necessary oil charge for operation. In order to prevent inlet of wet air or dust and the acidification of lubricant, the compressor is provided with a charge of dry nitrogen at a pressure equal to 1,5bar*a* (22psi*a*).

Note

The compressor should be stored in a storage room at ambient temperature to avoid an increasing of internal nitrogem pressure.

Discharge of nitrogen should be done from discharge shut-off valve: open slowly the shut-off valve and let nitrogen come out. It is reccomended not to leave ambient air in the compressor for more than 30 minutes.

2.2 PACKAGE OPENING

The compressor package is composed as follows:

- a pallet of adequate dimensions on which the compressor is fitted by screws through the holes of fixing feet;
- a wood box of adequate dimensions that covers the compressor; the box is fixed on pallet by staple points.

To unpackage the box it is necessary to break the staple points and lift the box up vertically to avoid hurting the compressor surface. Then, unscrew the screws fitted on fixing feet. After these operations, the compressor may be lifted up from pallet.

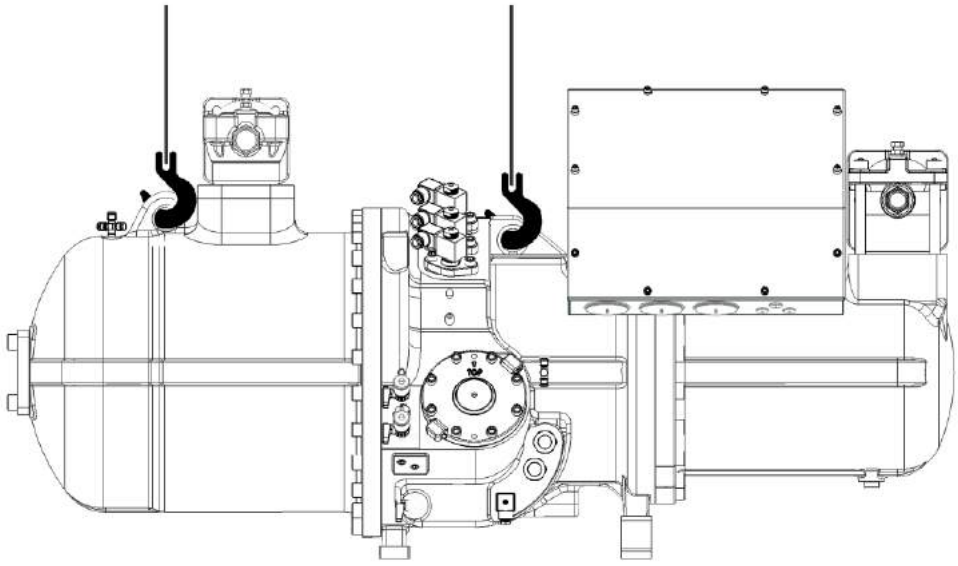
Important note

During the activities of compressor unpackaging, the worker should use personal protective equipments such as gloves and glasses to prevent any injuries caused by wood slivers and staple points.

2.3 HANDLING

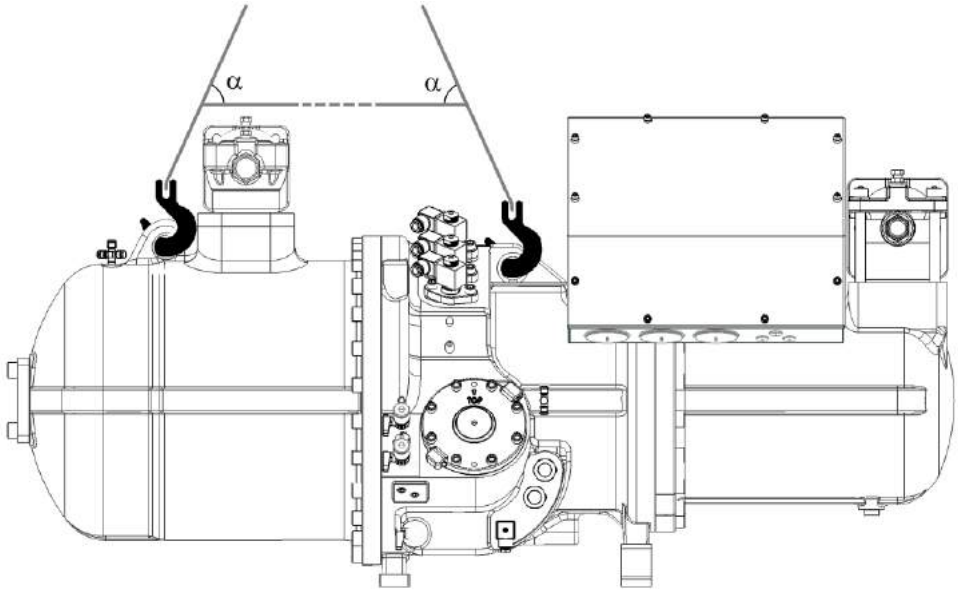
The handling of the compressor fitted on the pallet should be carried out by a lift truck: check the capacity of lift truck which must be adapted to lift the weight of the compressor.

The handling of the compressor should be carried out by lines, belts or chains whose capacity must to be adequate the to compressor weight. Fit snap-hooks, shackle hooks or hooks provided by safety lock in loops of cast iron on bodies of the compressor. It is possible to use a rocker arm to move the compressor in horizontal direction and to keep belts for lifting in vertical direction.



Picture 2A: handling of the compressor by belts hanging on a rocker arm.

If it is not possible to use a rocker arm, apply belts or chains which must be long enough to let lifting in horizontal direction: in this case check the capacity of belts and the chains which must be adequate to the compressor weight multiplied by the factor of increasing due to the inclination of belts



Picture 2B: The compressor handling by oblique belts

The below table gives an indication of the multiplicative coefficient of the compressor weight as a function of the inclination of the lifting belts or chains.

ANGLE α	COEFFICIENT	ANGLE α	COEFFICIENT
90°	1	45°	1.414
85°	1.004	40°	1.556
80°	1.015	35°	1.743
75°	1.035	30°	2
70°	1.064	25°	2.366
65°	1.103	20°	2.924
60°	1.155	15°	3.864
55°	1.221	10°	5.759
50°	1.305	5°	11.474

Note

Only qualified personnel shall carry out the handling of the compressor by lift truck or by haul system and belts.

Important note

During the compressor handling, personnel should keep an adequate clearance from the compressor to avoid risks due to accidental fall of the compressor.

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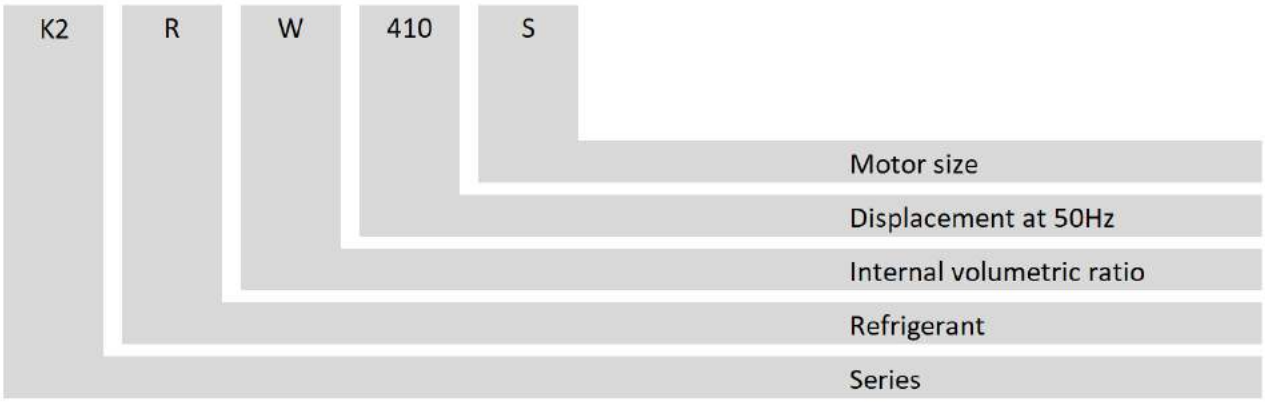
3. Models and technical data

3.1 MODELS

The product code meaning of K2 series models is explained as follows:



3.2 TECHNICAL DATA

MODELS	DISPL. 50HZ	MOTOR NOM. POWER		WEIGHT	MOTOR Y / Δ LRA		FLA	DIMENSIONS	SUCTION CONNECTION	DISCHARGE CONNECTION	OIL CHARGE
					Y	Δ		L x H x W			
	m³/h	Hp	kW	kg	A	A	A	mm	mm	mm	kg
K2__410S	410	110	85	794	278	835	194				
K2__480S	480	140	105	798	362	1094	226	1564 x 774 x 683	104,8	80	18
K2__560S	560	140	105	806	362	1094	226				
K2__640S	640	160	120	1002	375	1157	268				
K2__720S	720	180	135	1012	455	1334	300	1748 x 830 x 702	104,8	80	22
K2__810S	810	210	157	1020	545	1646	319				

MODELS	DISPL. 50HZ	MOTOR NOM. POWER		WEIGHT	MOTOR Y / Δ LRA		FLA	DIMENSIONS	SUCTION CONNECTION	DISCHARGE CONNECTION	OIL CHARGE
					Y	Δ		L x H x W			
	m³/h	Hp	kW	Kg	A	A	A	mm	mm	mm	kg
K2__410F	410	150	115	796	415	1245	240				
K2__480F	480	200	150	808	530	1590	326	1594 x 774 x 683	104,8	80	18
K2__560F	560	220	164	826	545	1646	352				
K2__640F	640	240	179	1020	595	1802	386				
K2__720F	720	240	179	1020	595	1802	386	1748 x 830 x 702	104,8	80	22
K2__810F	810	240	179	1020	595	1802	386				

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4. Envelope

4.1 APPLIED REFRIGERANTS

The following refrigerants can be applied to K2 series compressors:
R134a, R1234yf; R1234ze; R407C; R513A.

SINGLE-COMPONENT REFRIGERANTS		
REFRIGERANTS NUMBER	**PREFIX OF COMPOSITION DESIGNATION**	**SAFETY GROUP**
R134a	HFC	A1
R1234yf	HFO	A2L
R1234ze	HFO	A2L

BLENDS		
REFRIGERANTS NUMBER	**NOMINAL COMPOSITION IN MASS FRACTION %**	**SAFETY GROUP**
R407c	R-32/125/134a (23,0/25,0/52,0)	A1/A1
R513A	R-1234yf/134a (56,0/44,0)	A2L/A1

Table 4A e 4B: composition and safety group of applied refrigerants

The paragraph 4.3 shows the envelopes for each refrigerant of K2 series compressors. In case of economiser circuit, refer to RefPower Srl in order to know the proper envelope.
In case of additional refrigerants belonging to safety group A1 and A2L, refer to RefPower Srl in order to know the proper envelope.

4.2 USE SAFETY GROUP A2L REFRIGERANTS

The safety refrigerant class is defined according to the standards ISO 817:2014 and ASHRAE 34.

Importante note
The compressor and all the standard sensors and equipments are not designed for operations in areas with a risk of explosion and they must be installed in areas which are not classified according to the Directives 1999/92/EC and 2014/34/EU and according to the Annex I of EN 378-2.

Note
The use of A2L safety class refrigerants must comply with European Directives, regulations and laws which are in force in the country of installation of the cooling system.
Safety signs shall be provided where necessary.

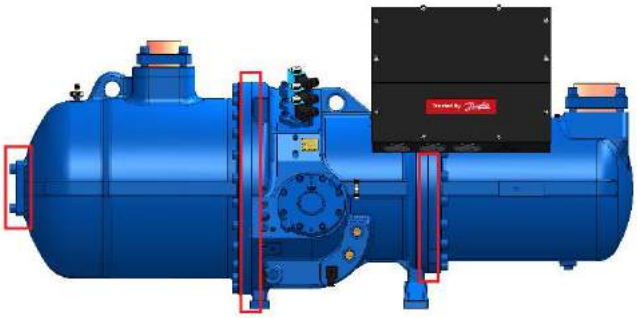
The cooling plant where the compressor is installed shall be in compliance with the standards for cooling plants, i. e. EN 378-2; the area where the compressor and the equipments are installed shall not be classified as hazardous area:
For example, the compressor can be installed in:

1. Outdoor areas whose installation and ventilation conditions ensure that the spaces around compressor are not classified even in case of potential damages of the compressor or of the connected plant.
2. Indoor areas or technical compartment whose forced ventilation can avoid a hazardous or explosive atmosphere.
3. Indoor areas or technical compartment equipped by gas sniffer devices in order to measure hazardous concentration of gas and activate the forced ventilation or disactivate the compressor or any other source of ignition.

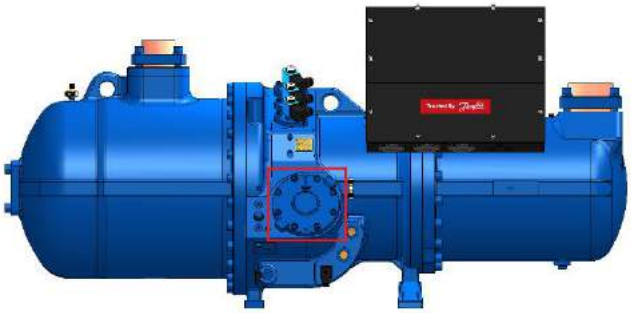
4.2.1 Refrigerant leakage control points

The main points on the compressor in order to control potential refrigerant leakage, which are not to be considered within the scope of EN ISO 14903, are listed below:

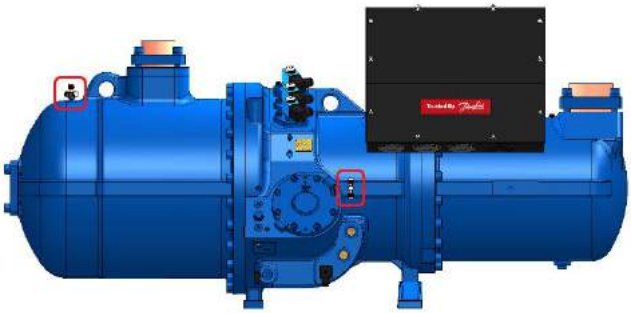
- flanges



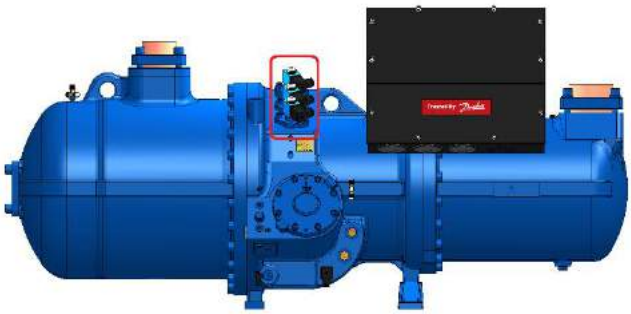
- oil filter seat



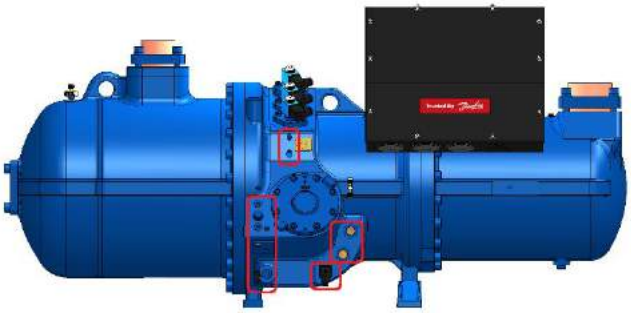
- SAE connections for pressure meters



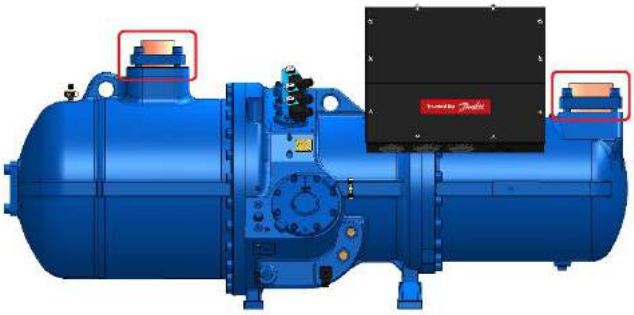
- solenoid valves for partial load



- connections for oil circuit and /or threads for closure of oil circuit



- suction and discharge main connections

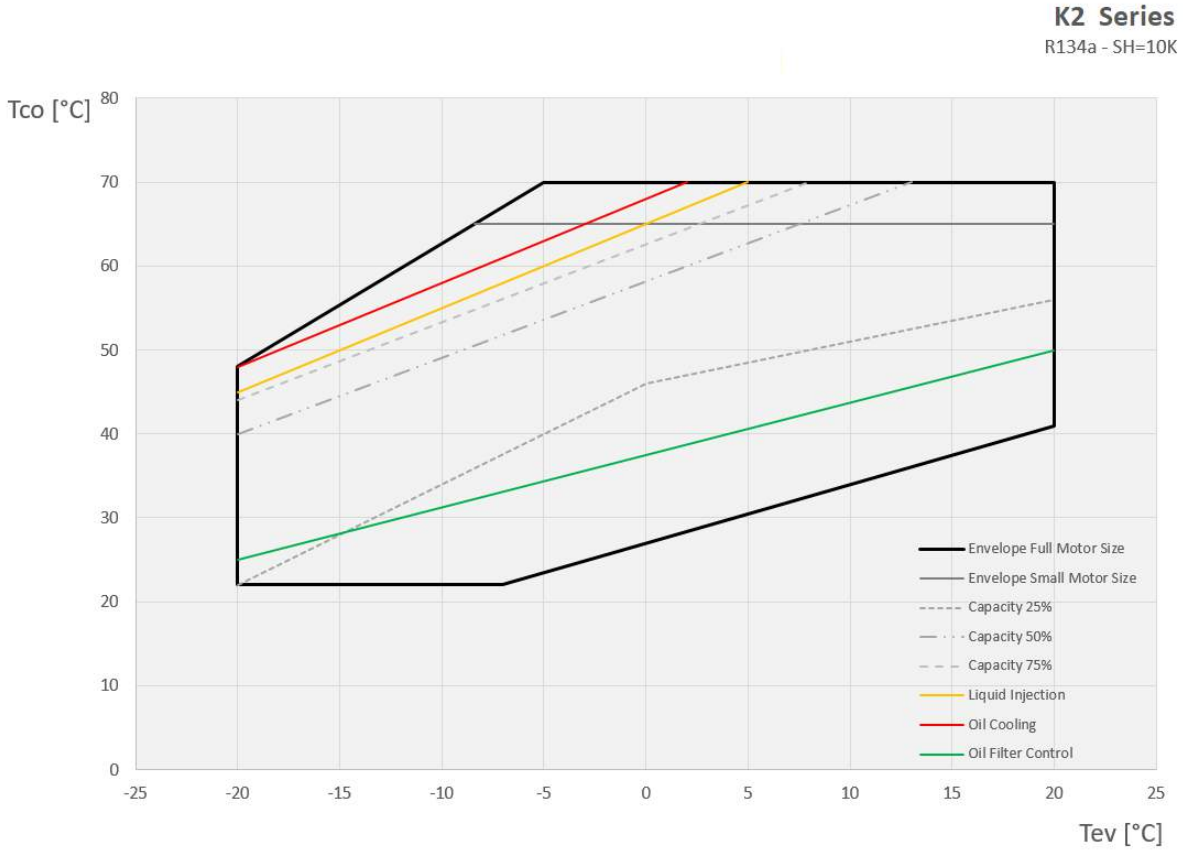


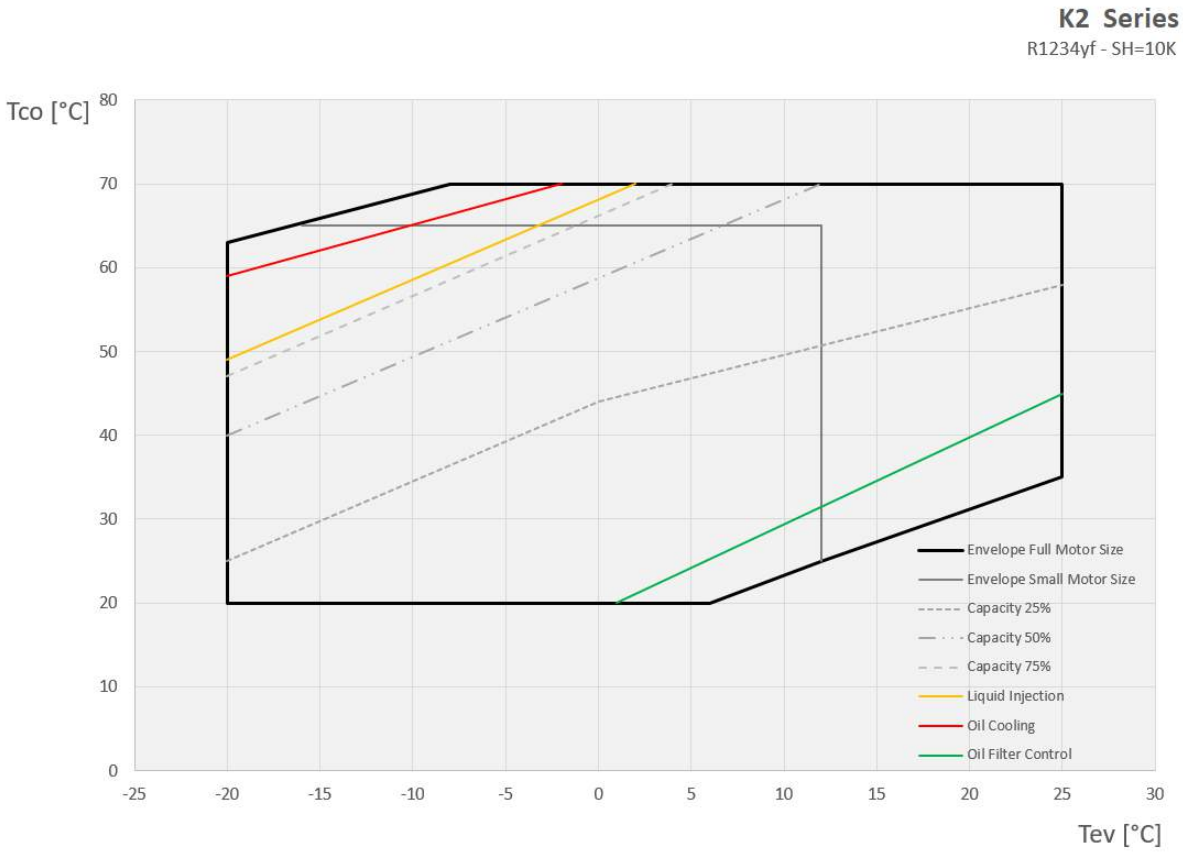
4.2.2 Activities following refrigerant leakage or refrigerant combustion

- Refrigerant gases, exhausted gases and condensates of burning are harmful for health. Ensure an adequate ventilation on the zone of the leakage or combustion in order to decrease concentration of gases, exhaust gases and facilitate evaporation of condensates.
- Make sure that compressor is off and open the electrical box to eliminate locked gas and to facilitate evaporation of potential condensates.
- Check the operating state of electrical equipment on compressor (electrical valves, sensors, ect.)

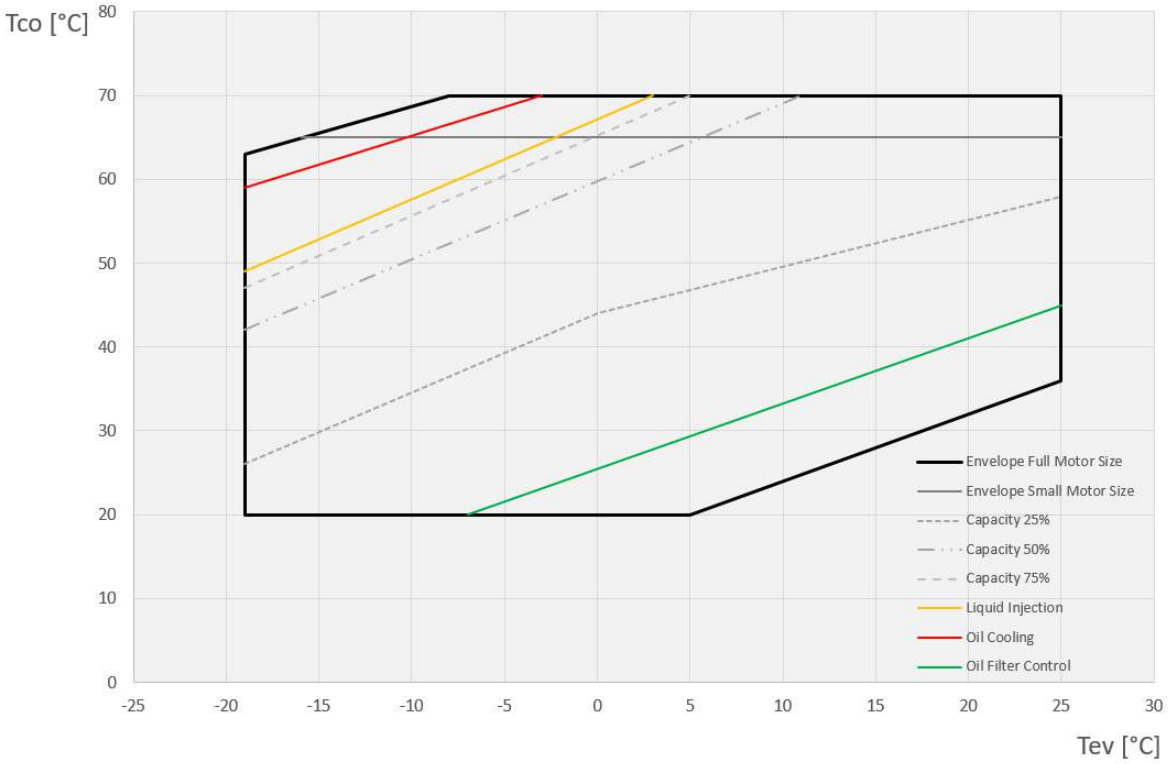
	**Important note** Use adequate personal protective equipment as gloves, glasses and masks to carry out maintenance activities following gas leakage or gas combustion.

4.3 ENVELOPE

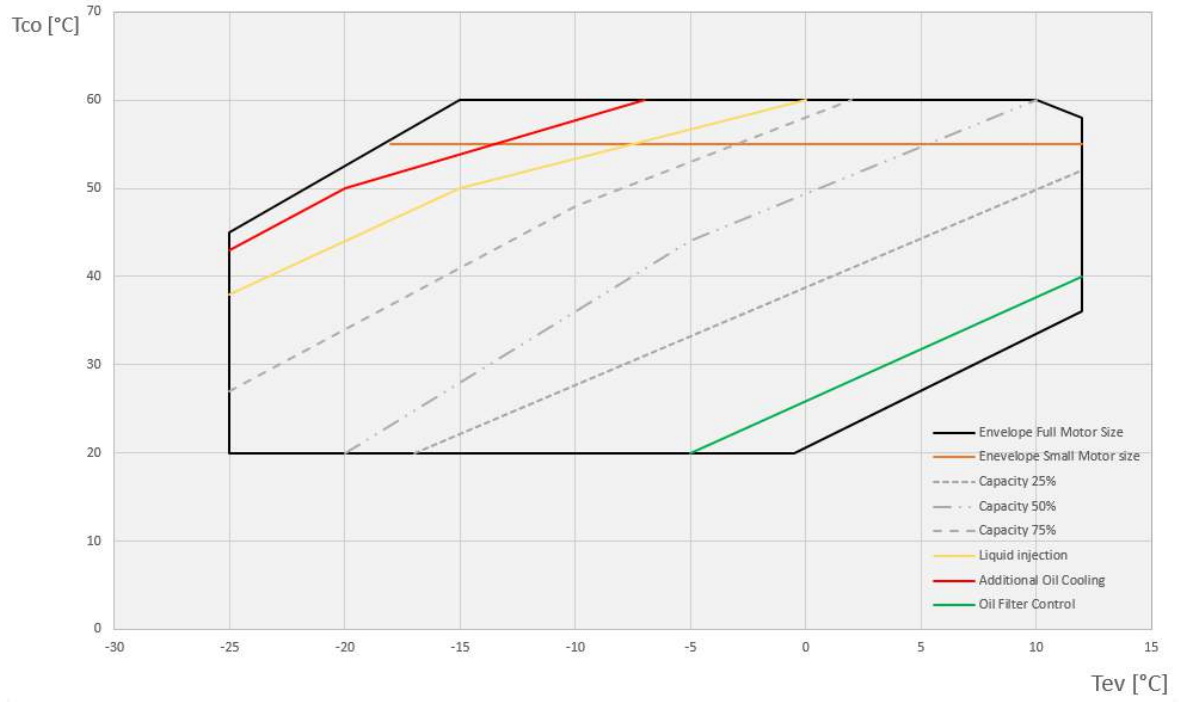

K2 Series
R134a - SH=10K
Tco [°C]
80
70
60
50
40
30
20
10
0
-25
-20
-15
-10
-5
0
5
10
15
20
25
Tev [°C]
Envelope Full Motor Size
Envelope Small Motor Size
Capacity 25%
Capacity 50%
Capacity 75%
Liquid Injection
Oil Cooling
Oil Filter Control


K2 Series
R1234yf - SH=10K
Tco [°C]
80
70
60
50
40
30
20
10
0
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
Tev [°C]
Envelope Full Motor Size
Envelope Small Motor Size
Capacity 25%
Capacity 50%
Capacity 75%
Liquid Injection
Oil Cooling
Oil Filter Control

K2 Series
R1234ze - SH=10K

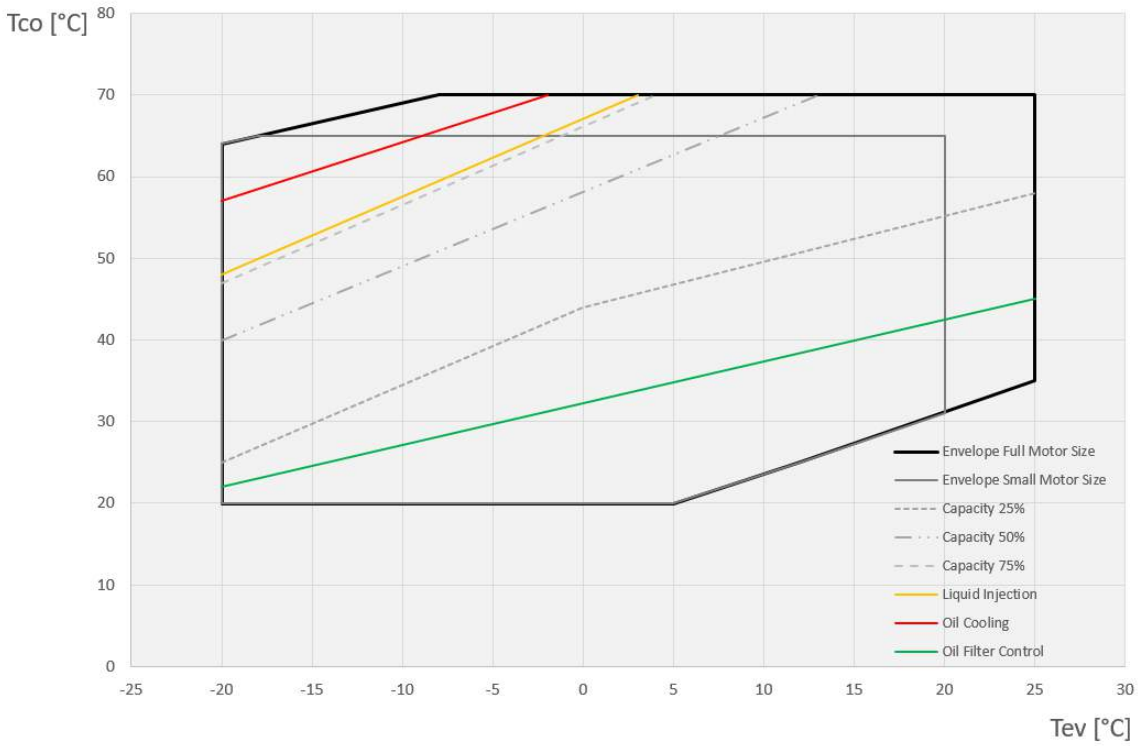


K2 Series
R407c - SH=10K



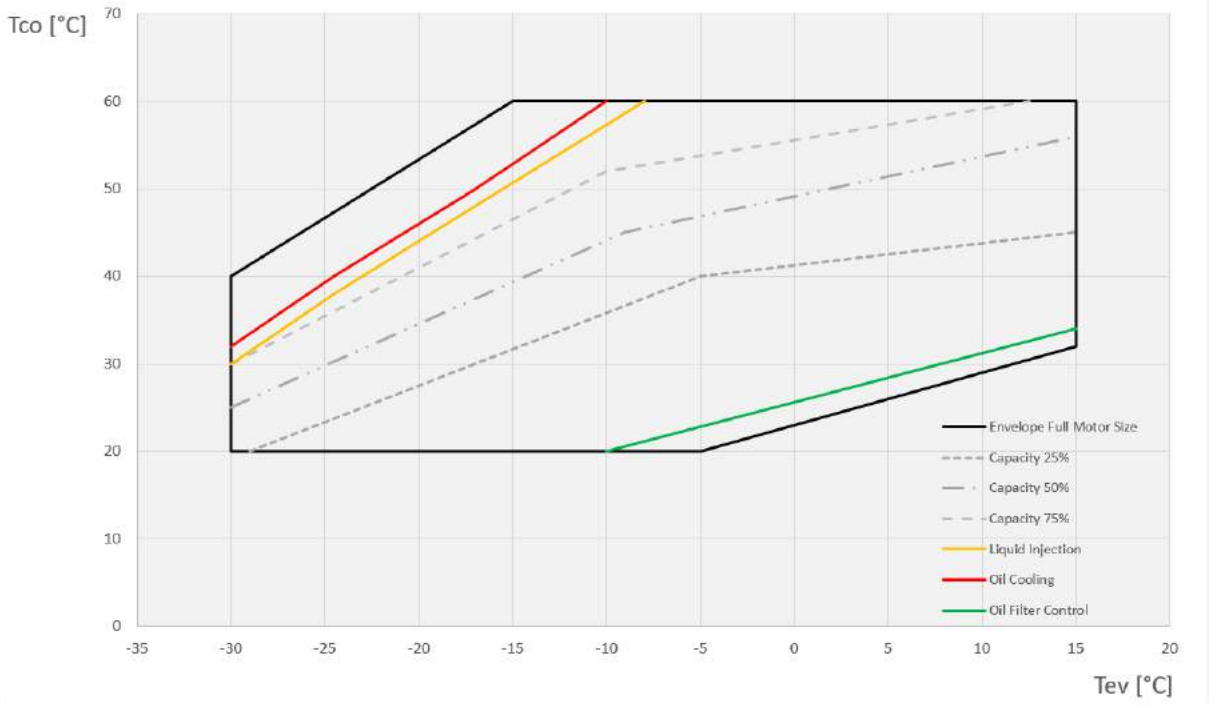
K2 Series

R513A - SH=10K



KSFW - KSFH Series

R290, propane - SH=10K



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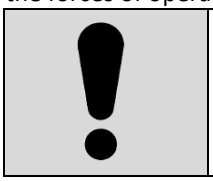
5. Installation and Star Up

5.1 INSTALLATION

5.1.1 Installation area

The installation of the compressor should comply with the following recommendations:

- The K2 series compressors should be installed in horizontal position.
- The supports on which the compressor is placed should be designed in order to hold up the weight of the compressor and the forces of operation.

	**Note** Do not install compressor on inadequate supports to avoid risks of structural failure.

- Before installation it is necessary to provide adequate space around the compressor to allow routine maintenance.
- The K2 series compressors are not designed to be installed in explosive, chemically aggressive or radioactive atmosphere.

	**Important note** The installation in explosive, chemically aggressive or radioactive enviroment should be approved by Palladio Compressors Srl.

5.1.2 Fixing to the frame

- Fixing of the compressor should be carried out by screwed connections through the specified holes.

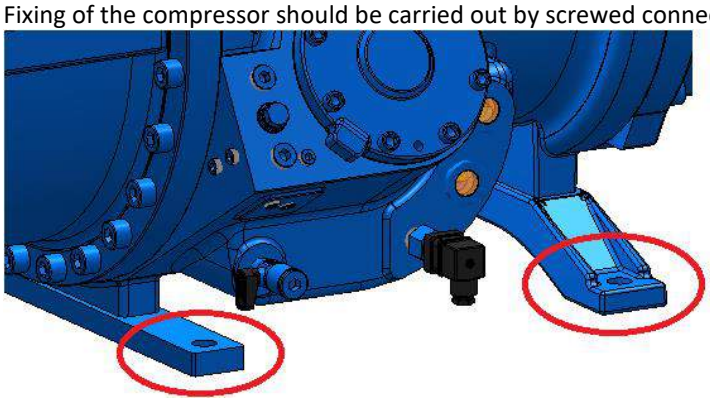


Figure 5A: holes to fix the compressor to the structure of the plant

- In order to avoid the transmission of vibrations due to the operation, it may be necessary to place the compressor on vibration dampers. The vibration dampers are supplied as standard. The vibration dampers kit is composed as follows.

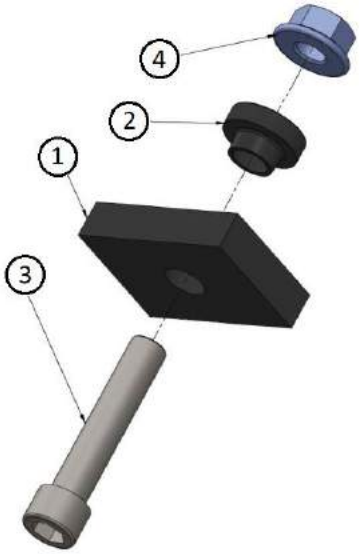


Figure 5B: dampers kit

REFERENCE	DESCRIPTION	Q.TY
1	RUBBER PAD 50 x 70 x 15 x Ø16	1
2	DAMPER CLINCH JOINT Ø14 x 30 x 16	1
3	SCREW 12.9 TCEI M14 x 70 UNI 5931	1
4	NUT KLOCK FLANG. M14 DIN 6927 CL.8 ZN	1

- In order to perform the right assembling operation of the kit, the damper clinch joint (reference 2) shall be compressed 0,5 mm than original dimension.

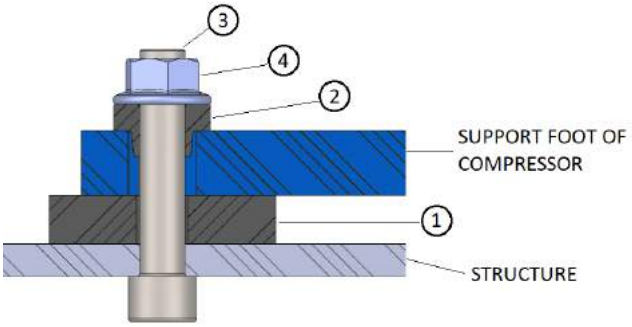


Figure 5C: assembling vibration dampers kit

5.1.3 Suction tube connection and discharge tube connection

Important note

The supplied compressors are charged with nitrogen up to 1,5bar*a* (21,7psi*a*). Pay attention to outlet of nitrogen: it is mandatory to open the discharge shut-off valve and wait for the complete outlet of nitrogen from the compressor.

- The K2 series compressors are provided with pipe connections whose inside diameter is suitable for the commercial copper tubes.
- Pay attention during the activities of cutting the tubes to avoid introduction of dusters or swarfs in the tubes; do an adequate cleaning after the activities of cutting.
- Before brazing the tubes to the connections, ensure that the tubes are clean, devoid of drosses and dry.
- After brazing, wait for the complete cooling down of the brazed components to tighten them to the compressor.

Important note

Brazing operations may cause thermal expansion of mechanical components. The tighting of warm components to the compressor may be compromised by successive thermal reduction. Moreover thermal reduction may compromise seal of the gaskets also.

- Before the tightening of the brazed components to the compressor, check the gaskets and remove all the thin protection discs.

5.2 CHECKS BEFORE THE START-UP

Before of the compressor start-up, it is necessary to execute the following activities:

- Check that the oil level is between the two oil sight-glasses.
- Place the oil heating cartridge.
- Pay attention that the oil temperature in the compressor is at least 15K higher respect to the outside room temperature; at this purpose turn on the heating cartridge at least 8 hours in advance.
- Make sure of the right functioning of the security devices installed on the compressor such as the pressure switches and thermostats.
- Check that both suction and discharge shut-off valves can open when necessary.

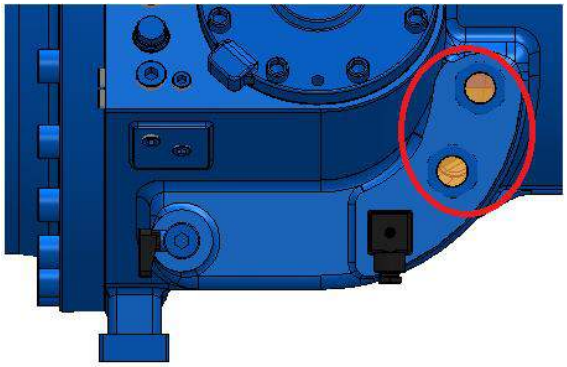


Figure 5D: Oil sight glasses for oil level control

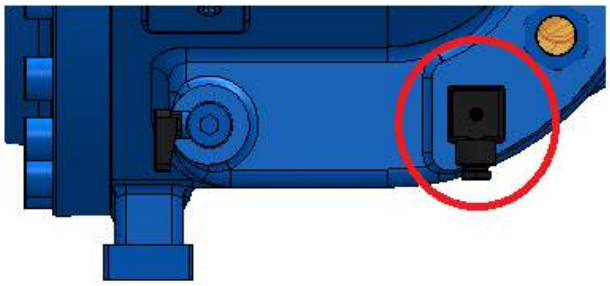


Figure 5E: Heater for oil heating

5.3 START-UP

5.3.1 Direction of rotation

In case of the first start-up, it is mandatory to check the rotation direction of the electric motor.
If the rotation is correct, you could see the following points at the same time:

- the suction pressure drops slightly;
- the discharge pressure increases slightly.

If the rotation is inverse and incorrect, you could see the following points:

- the suction pressure increases;
- the discharge pressure drops slightly.

Note

If it is difficult to observe the change of pressure, it will be possible to execute a start-up with the suction shut-off valve closed (or the valve upstream of the evaporator closed).

The suction pressure drops very quickly in case of the correct direction of rotation, or increases very quickly in case of the wrong direction of rotation.

Important notice

In case of wrong direction of rotation, it is necessary to switch the 2 electrical cables to the terminals of the power panel.

- This operation must be performed by specialized personnel.
- It is necessary to remove the power supply from the electrical panel before executing this operation.

5.3.2 Oil level

In case of first start-up it is suggested to check the oil level:

- The level must be visible between the 2 oil sight-glasses (see Figure 5D);
- During the first start-up a foam formation is possible but when the proper working conditions are reached, the foam must be reabsorbed.

Note

If the foam of oil persists even after the first start-up, it will necessary to check the refrigerant charge contained in the plant.

5.3.3 Discharge temperature:

Once the working conditions are reached, it is suggested to check the compressor discharge temperature.

Note
In case of the very low compressor discharge temperature, it is possible that an excessive charge of refrigerant was charged inside the plant (for this reason it is important to observe the presence of foam through the oil sight-glasses caused by the refrigerant at liquid state dissolved in oil). In case of high discharge temperature, it is suggested to verify the suction temperature and the suction superheating.

Important notice
The discharge pipe, the discharge shut-off valve and the oil separator may reach very high temperatures; affix the appropriate pictograms and instructions on the high temperature parts.

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6. Lubrication

6.1 LUBRICATION FUNCTION

The lubrication and the oil circuit control ensure the following functions:

- mechanical sealing between screws and compression chamber;
- lubrication of bearings;
- control of partial load of compressor;
- cooling.

	**Note** It is proper to carry out periodical maintenance by checking the oil circuit and the oil circuit components in order to ensure the function of the circuit. Refer to chapter 11.

6.2 LUBRICANT LEVEL

The lubricant level shall be visible through the sight glasses placed at right side of the oil filter.

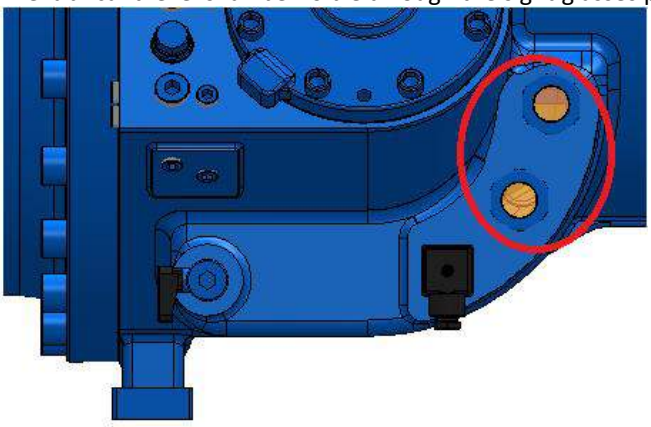


Figure 6A: oil sight glass to check level

The oil foam can appear on the oil surface during transient working or during the start-up of the compressor. Make sure that the oil foam is not present during stable working conditions.

6.3 STANDARD SUPPLY

The standard supply is composed by 2 grub screws and by an hexagonal head screw. The grub screws and the hexagonal head screw are assembled on the compressor.
Morerover, 2 brass nipples (SAE and NPT thread ½') and a long cylindrical head screw are supplied as standard for the lubricating circuit interception. The nipples and the long cylindrical head screw are not assembled on the compressor as standard.

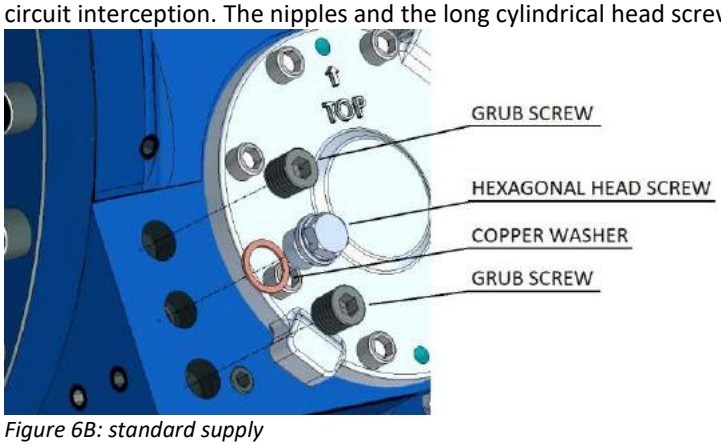


Figure 6B: standard supply

The arrangement for the interception of the lubricant circuit shall be planned at the purchase order.

6.4 OPTIONAL SUPPLY

6.4.1 Arrangement for the additional oil cooling or for the oil flow switch

The arrangement for the additional oil cooling or for the oil flow rate switch is composed by the nipples and the long cylindric head screw. The thread of connections is SAE type, measure 5/8".

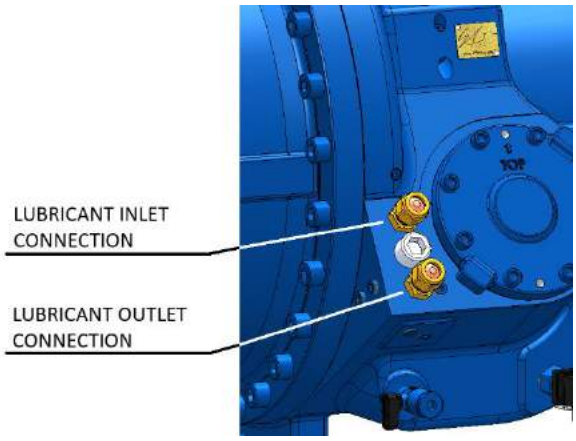
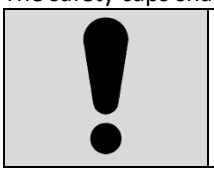


Figure 6C: optional arrangement

The safety caps shall be removed and kept in order to install the additional oil cooling or the oil flow switch.

	**Note** The start-up of compressor shall be carried out after the right installation of the additional oil cooling or the oil flow rate switch and after the opening of shut-off valves only.

6.4.2 Oil level monitor device

The standard supply of the K2 series compressors does not include oil level monitor device. The oil level monitor kit is composed by:

1. aluminium gasket
2. mechanical adaptor sight
3. electronical device

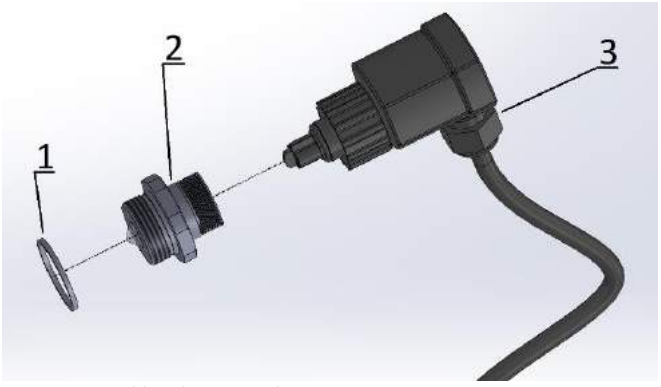


Figure 6D: Oil level monitor kit

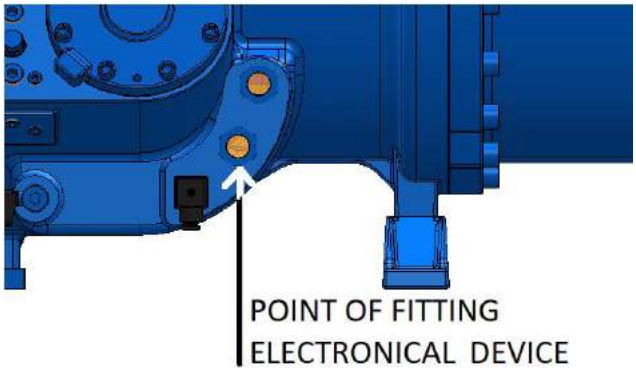


Figure 6E: Point of fitting for oil level device

In case of supply of the optical device for the oil level control, the aluminium washer (1) and the sight glass for mechanical adaptation (2) are assembled instead of the standard sight glass; the electronical device (3) is supplied in electrical box and it shall be assembled on sight glass (2). The kit shall be required at the purchase order of the compressor.

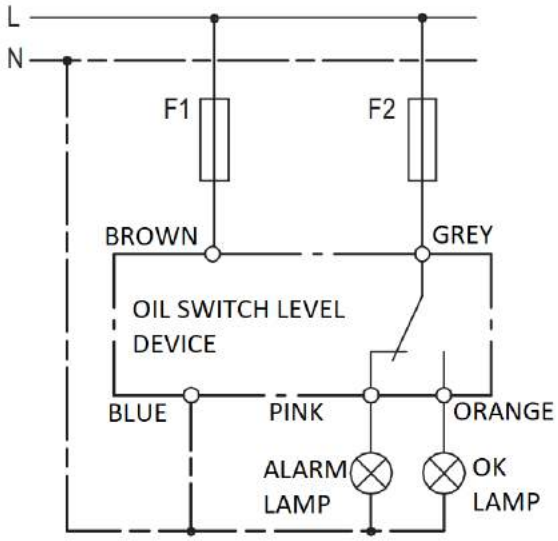


Figure 6F: wiring of oil level monitor kit

	Note In case of supply of the kit after the first compressor start-up, the assembly of the oil level monitor kit shall be carried out by qualified personnel.

	Important note Before the assembly of the kit, it is mandatory: • disable the compressor • wait for the complete cooling down of the compressor • evacuate the refrigerant from the compressor • recover the lubricant using proper shut-off valve • avoid the contact between the recovered lubricant and the ambient air during the assembly of the oil level monitor kit

6.4.3 Kit oil flow switch

The kit oil flow switch kit may be assembled only if the compressor is equipped with the arrangement (par. 6.4.1).

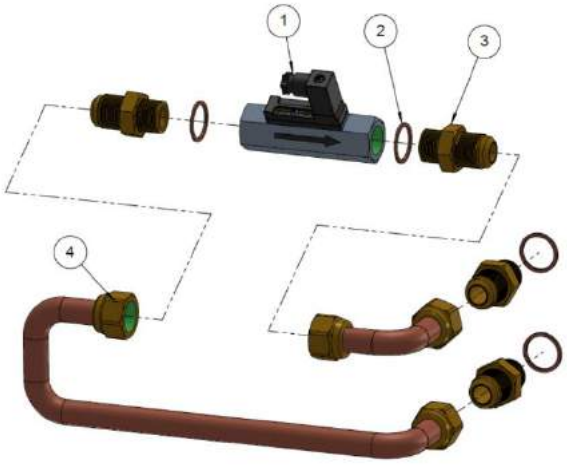


Figure 6G: example images for installation of oil switch kit

Figure 6H: indication of direction of lubricant on the oil switch

The oil flow switch kit is composed by the components listed in the following table

REFERENCE	DESCRIPTION	Q.TY
1	OIL FLOW SWITCH 10 LITER	1
2	COPPER WASHER Øi22XØ26X1.5	4
3	CONNECTION 5/8"SAE-1/2"GAS	4
4	NUT 5/8 SAE PIPE Ø16	4

Tabel 6A: Oil flow switch kit

Assembly of the oil flow switch kit

- The oil flow switch can be assembled both in vertical or in horizontal position.
- Pay attention to the direction of assembling of the oil flow switch; the direction of the arrow printed on the oil flow switch shall comply with the direction of the oil flow.
- The kit does not include the supply of shaped tubes.
- Pay attention to the electrical data printed on the oil switch: make sure not to exceed to the maximum allowed voltage.
- The oil flow switch is equipped with 2 normally open contacts; the power supply is not necessary.

Note
The assembling of the oil flow switch shall be carried out by qualified personnel.

Note
- The oil flow switch kit is devoid of pipes.
- The external diameter of pipes shall be equal to 16mm.

Important note
In case of assembling the oil flow switch on the compressor after the first start-up, make sure to:
- completely evacuate the refrigerant from the compressor;
- wait for the complete compressor cooling.

6.5 LUBRICANT FLOW RATE

The lubricant flow rate in the internal circuit of the compressor depends upon difference of pressure from discharge to suction and upon dimensions of the circuit.
The lubricant flow rate can be calculated using the following formula:

$$V_{oil} \propto k_{oil} \cdot (p_{dis} - p_{suc})$$

V_{oil}: oil flow rate [l/min]
K_{oil}: specific coefficient of each compressor
p_{dis}: discharge pressure of the compressor [bar]
p_{suc}: suction pressure of the compressor [bar]

The refrigeration plant shall allow compressor to work inside the proper envelope as soon as possible so that the oil circuit performs its functions.

Note
The compressor and the bearings can stand short working spans in low conditions without the proper lubrication. Long working spans without the proper lubrication can damage the compressor and compromise the working life.

In case of installation of the flow switch flow rate (par. 6.4.1), it is recommended a normally open flow switch to get a closed contact during the normal working condition.

It is possible to apply a delay to signal of flow switch as follows:

- 120 s at start-up;
- 60 s during normal working conditions.

Note
The selection of the oil flow rate switch shall consider the maximum lubricant flow rate calculated by the previous formula.

Important note
Piping dimensions shall be adequate to ensure mechanical safety and to avoid the block of oil flow rate. During the installation of a flow switch, a flow rate or a flow rate meter, make sure that there is absence of pressure in the compressor and pay attention to the temperature of components and lubricant.

6.6 OIL COOLING

During heavy working conditions, an additional oil cooling system may be necessary. Refer to chapter 9 to install cooling system.
If it is necessary to apply an external heat exchanger, it will be appropriate to refer to the flow rate calculated with the previous formula for a correct dimensioning of the pipe-size diameters and of the heat exchanger itself.

6.7 OIL HEATING

The oil heating is mandatory in the following cases:

- long periods during which the refrigeration plant is stopped;
- low temperature of the compressor during short blocking periods of the refrigeration plant;
- in case of excessive refrigerant charge diluted in the oil charge.

The oil heating is possible thanks to an heating resistance placed below the oil filter. It is suggested to energize the electrical resistance at least 24 h before the compressor start-up.

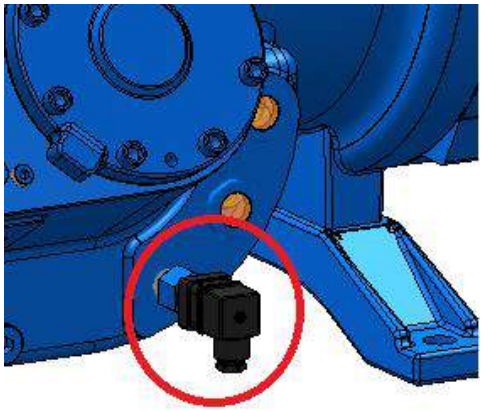


Figure 6I: heating electrical resistance

Important note
Pay attention to the electrical features of the heating resistance; the proper supply voltage is printed on the edge of the resistance.

In case of assembly of the electrical resistance to the compressor, apply the proper torque and use an appropriate spanner on the metallic edge of the resistance.
The electrical connector is DIN 43650 type: do not turn electrical cable upwards to avoid water to penetrate in connector through the cable.

6.8 OIL FILTER

The oil filter makes sure the lubricating circuit cleanliness and the right oil flow rate in the compressor. The excessive obstruction of the filter reduces the oil flow rate in the compressor. The obstruction of the filter can be estimated by checking the oil pressure downstream of filter. Refer to the following data to estimate the obstruction of the oil filter.

WORKING CONDITION			OPTIMAL OIL FILTER CONDITION		
Pressure difference discharge-suction [ΔHP-LP]	bar	<6	Pressure difference discharge-oil [ΔHP-OP]	bar	<1,5
Pressure difference discharge-suction [ΔHP-LP]	bar	>6	Pressure difference discharge-oil [ΔHP-OP]	bar	<3

Note
The pressure differences shall be measured at the compressor full load.

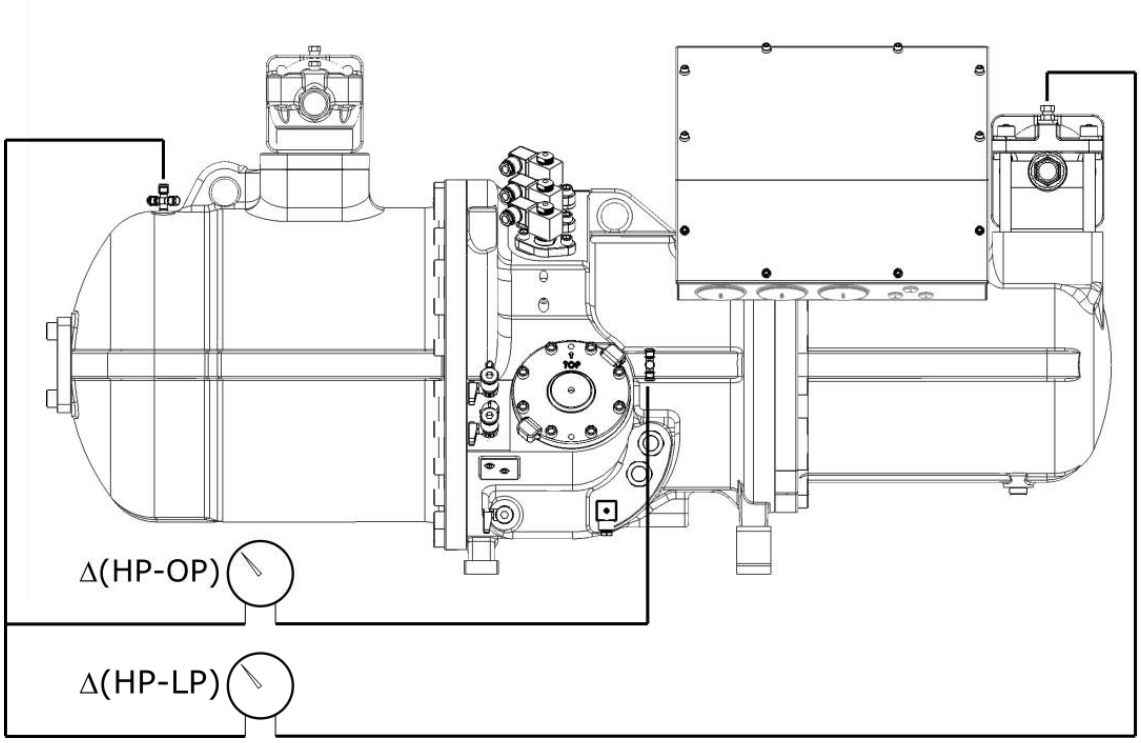


Figure 6L: pressure measurement points for high pressure (HP), oil circuit (OP) and low pressure (LP)

Palladio Compressors - K2 Series

7. Capacity Control

7.1 OPERATION

K2 series compressors allow a control of the partial cooling capacity by powering 3 solenoid valves which modify the oil circuit. The oil circuit allows the filling and the emptying of an hydraulic cylinder which moves a slider whose function is to modulate the volume of the compression room and the suction capacity of the screws.
The solenoid valves are placed near the electrical box, above the oil filter.

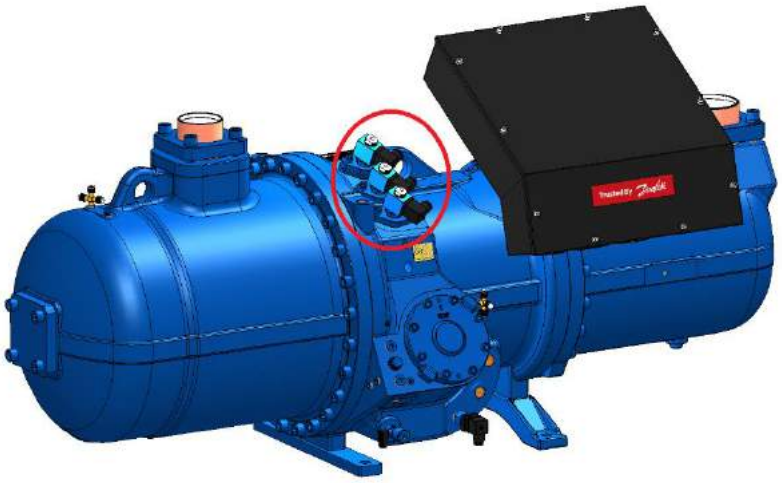


Figure 7A: position of the solenoid valves in K2 compressors

Note

Pay attention to the electrical features of the solenoid valves in order to avoid any damages to the solenoids.

Ensure that the electrical power supply cables of the solenoid valves are installed in such a way as to prevent condensation from entering the DIN 43650 connectors.

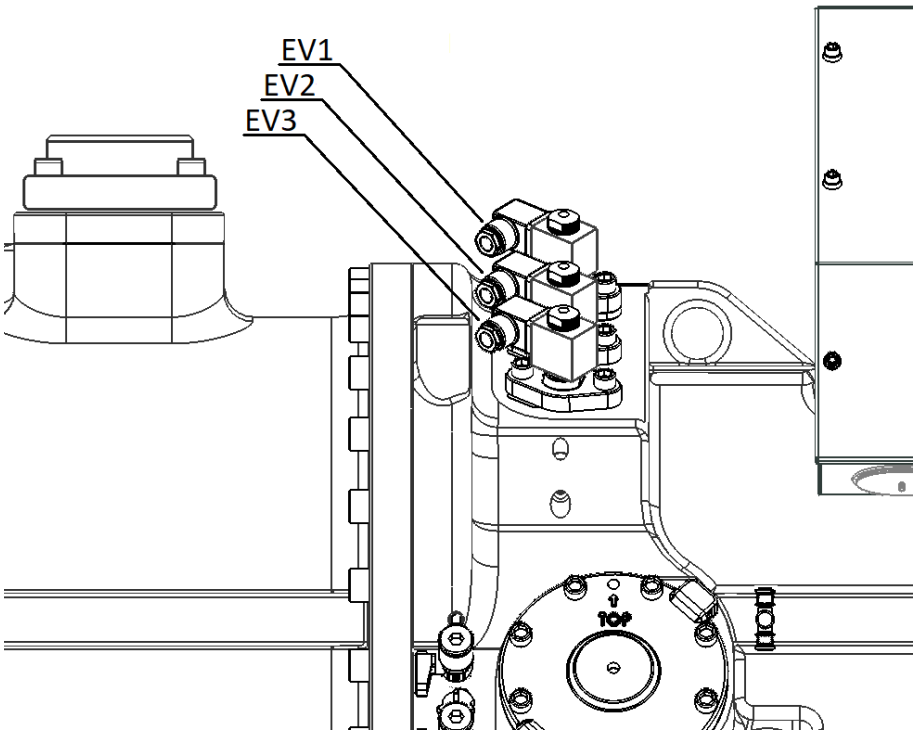


Figure 7B: numeration of the solenoid valves

7.2 STEP CAPACITY CONTROL

K2 series compressors allow a control of the partial cooling capacity by steps. Steps correspond to 25%, 50% and 75% of full load. The following table shows the control logic of the cooling capacity.

LEVEL COOLING CAPACITY	ELECTROVALVE EV1	ELECTROVALVE EV2	ELECTROVALVE EV3
25%	OFF	OFF	ON
50%	OFF	ON	OFF
75%	ON	OFF	OFF
100%	OFF	OFF	OFF

Note

25% step capacity may be used in start-up phase and in stop phase only. It is appropriate that the compressor works at 25% step capacity for 30s maximum.

7.3 STEPLESS CAPACITY CONTROL

K2 series compressors allow a control of the partial cooling capacity in stepless modality. This way of modulation allows to decide among 2 fixed steps of minimum capacity: 25% or 50% of full load capacity; the modulation of capacity from 50% to full load capacity can be continuous; in step-less capacity control modality the solenoid valves feeding time depends on the achievement of the cooling capacity required by refrigeration plant.

LEVEL COOLING CAPACITY	ELECTROVALVE EV1	ELECTROVALVE EV2	ELECTROVALVE EV3
25%	OFF	OFF	ON
50%	ON	ON	OFF
Capacity Increasing	ON/OFF	OFF	OFF
Capacity Decreasing	OFF	ON/OFF	OFF
Stationary Capacity	OFF	OFF	OFF

Legenda

ON — *Continuous powering of the electrical valve*

OFF — *Continuous switching off of the electrical valve*

ON/OFF — *Discontinuous powering of the electrical valve; time of powering solenoid valves depends on the achievement of the required step of capacity; time of powering cannot be lower than 5s.*

7.4 CHANGE OF CAPACITY CONTROL

K2 series compressors allow the change of control capacity configuration from stepless to fixed steps modality and vice versa.

Important note

Before modifying the configuration of the capacity control ensure:

- Absence of pressure in the compressor;
- Switching off of the solenoid valves.

The use of different plates located between the compressor and the solenoid valve EV1 allows 2 different capacity control modalities: step or step-less.
The following picture shows the 2 different plates, the correct orientation of the plates and the assembly sequence of the components.

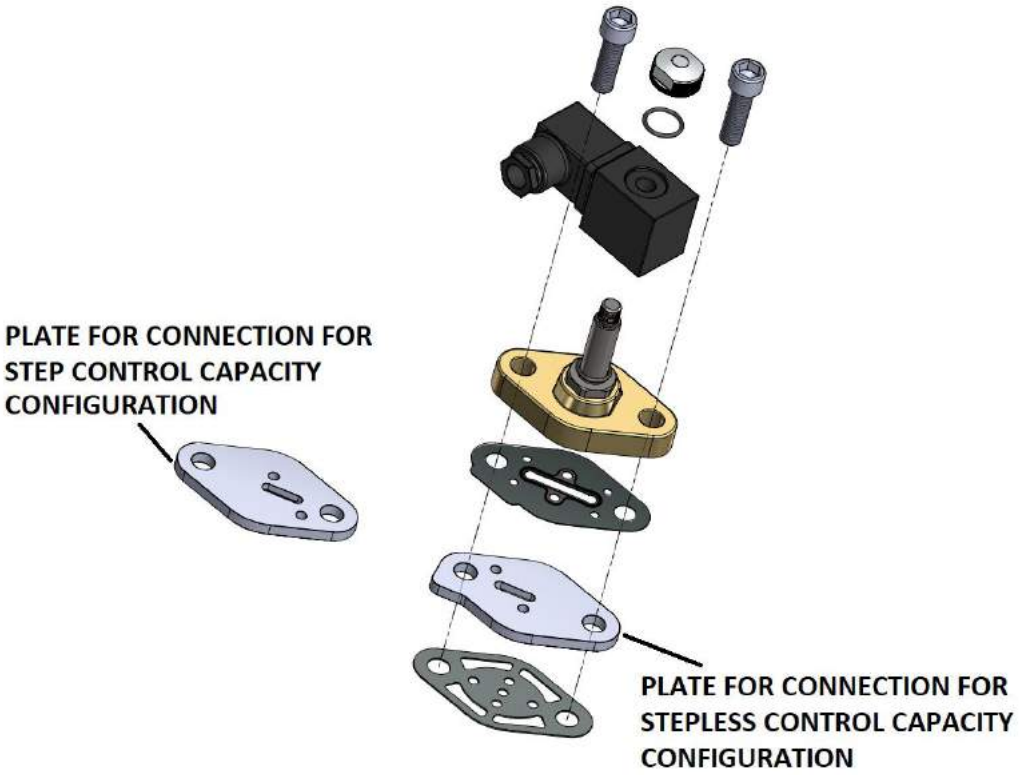


Figure 7C: plates, orientation, sequence of components for step and step-less capacity control

Note

Use appropriate equipment to tighten the coupling screws of all components.

Palladio Compressors - K2 Series

8. Electrical Devices

8.1 MOTOR

The K2 series compressors are equipped with 2-pole three-phase asynchronous motors (2900 rpm at 50 Hz). The available standard start-up configuration is the star-delta (Y-Δ) version, for both standard size motor and full size motor:

- models K2__410/480/560/640/720/810S: motor type Y/Δ;
- models K2__410/480/560/640/720/810F: motor type Y/Δ.

Depending on the compressor models, it is also available the part-winding (P-W) version as option.

8.1.1 Electrical Plate

The electrical plate is provided with:

- 6 power PIN (numbers 1, 2, 3, 7, 8 and 9);
- 2 PIN for motor PTC resistance (T1 and T2).

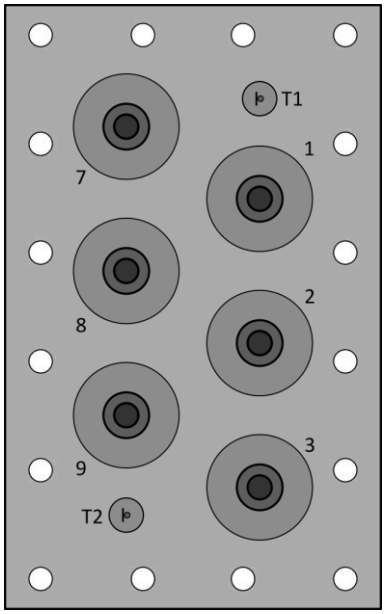


Figure 8A: scheme of electrical plate

8.1.2 Star-Delta configuration and Star-Delta start-up

At the initial instants of the motor start-up in Y-Δ configuration, the starting torque should overcome the resisting torque. In order to decrease the resisting torque and to allow the start-up of the compressor, it is mandatory to apply the minimum step of the compressor regulation capacity.

Important note
Electrical continuity in star-delta motor:
continuity at terminals 1 and 8, 3 and 7, 2 and 9; insulation 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

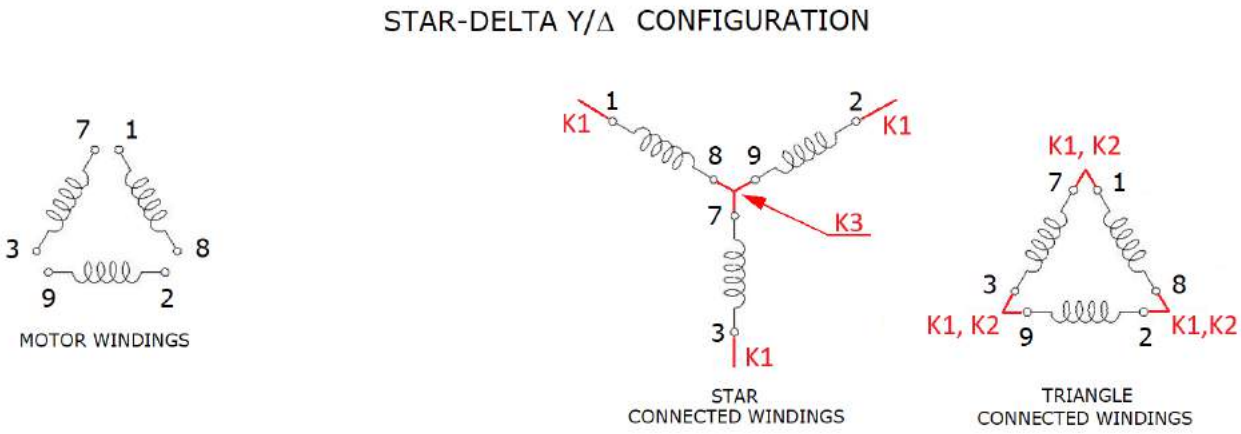


Figure 8B: connections of windings at start-up of motor; KC and KB are contactors

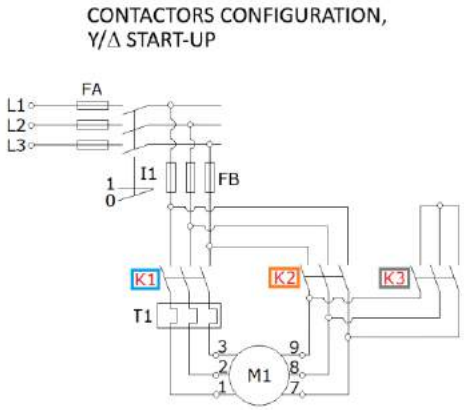
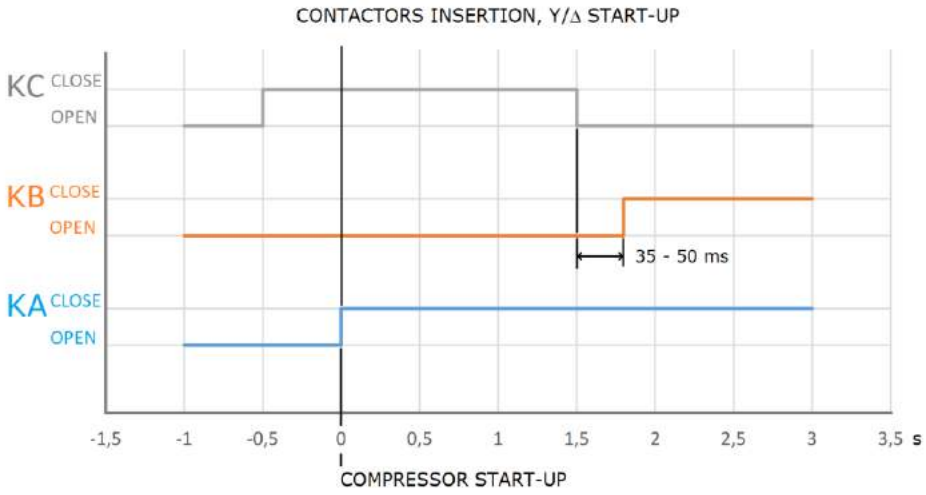


Figure 8C – Contactors configuration
FA: main fuses; FB: compressor fuses;
I1: main switch; M1: electrical motor;
T1, T2: overload relays;



Figures 8D – Time diagram
Time diagram regarding contactors insertion K1, K2 and K3 for star-delta configuration.

The picture 8C shows the connection scheme of the electrical motor to the electrical network three phases in star-delta configuration (Y-Δ); the pictures 8D show the temporal sequence of the insertion times of the contactors.
In case of Y-Δ motors the duration of the start-up in star configuration (insertion of contactors K1 and K3) shall not be over than 1,5 sec (recommended value 0,8 sec); during the change to the delta configuration (insertion of contactors K1 and K2) the insertion of the contactor K2 shall be 35-50 msec later than the cutoff of the contactor K3.

8.1.3 Part-Winding configuration and Part-Winding start-up

At the initial instants of the motor start-up in both in P-W configuration, the starting torque should overcome the resisting torque. In order to decrease the resisting torque and to allow the start-up of the compressor, it is mandatory to apply the minimum step of the compressor regulation capacity.

Important note

In P-W configuration electrical continuity is measured at terminals 1 and 2, 1 and 3, 2 and 3, and at terminals 7 and 8, 7 and 9, 8 and 9; electrical insulation at terminals 1 and 7/8/9, 2 and 7/8/9, 3 and 7/8/9 (see picture 8A).

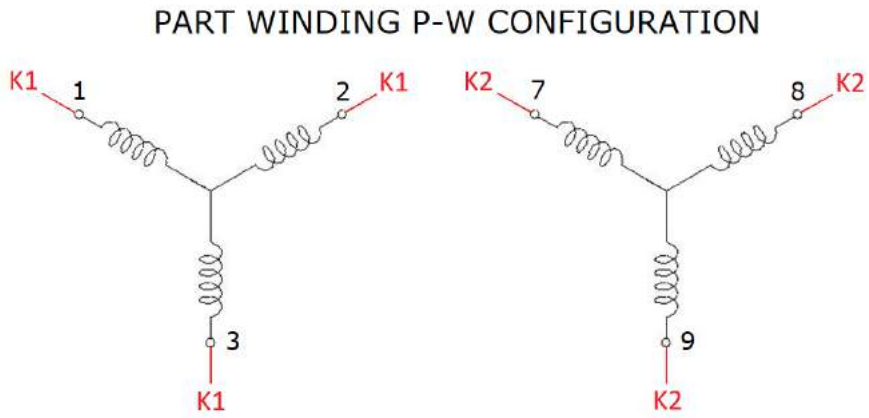


Figure 8E: connections of windings in part-winding configuration; K1 and K2 are contactors

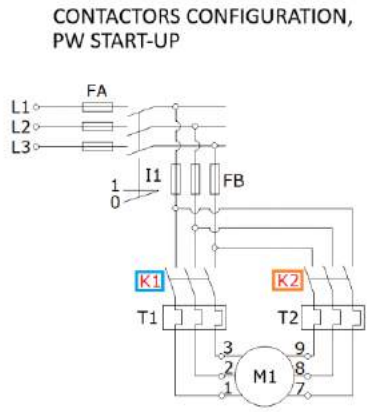
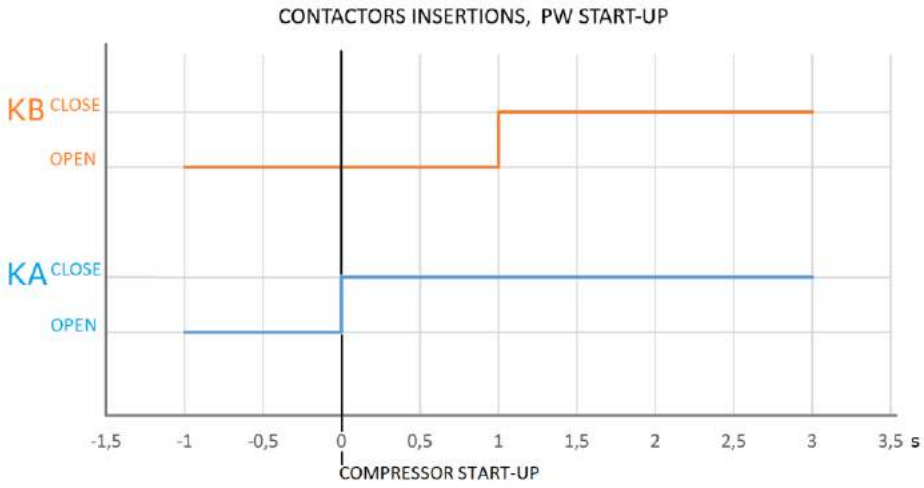


Figure 8F – Contactors configuration
FA: main fuses; FB: compressor fuses;
I1: main switch; M1: electrical motor;
T1, T2: overload relays;



Figures 8G – Time diagram
Time diagram regarding contactors insertion K1 and K2 for part/winding configuration;

The picture 8F shows the connection scheme of the electrical motor to the electrical network three phases in parti-winding configuration (P-W); the picture 8G shows the temporal sequence of the insertion times of the contactors. The star-up of the compressor is in the following modalities.

In case of PW motors the insertion delay of the K2 speed contactors shall not be over than 1 sec (recommended value 0,6 sec).

8.1.4 Dol configuration and Direct start-up

It is possible to start up the compressor in direct mode, by powering a soft starter which shall be by-passed by closing a single contactor which is connected in parallel when the start-up is completed.
In case of direct mode start-up, called DOL start-up also, the compressor shall be equipped with the optional kit for DOL start-up.

Important Note

In the case of the use of a soft starter, pay attention to the selection of proper device and to the proper setting of all parameters of device according to the instructions provided by the manufacturer.

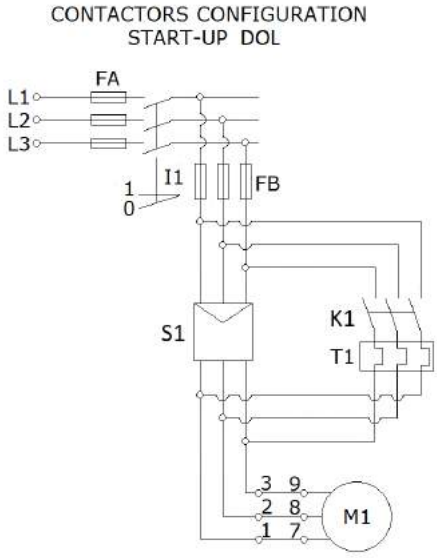


Figure 8H – Example soft starter - contactor configuration
FA: main fuses; FB: compressor fuses; I1: main switch; M1: electrical motor; T1: overload relays; S1: soft starter; K1: contactor of exchange

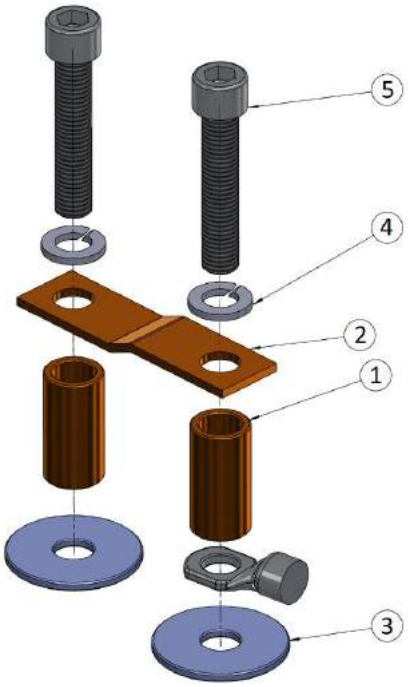


Figure 8I – Kit Direct start-up

REFERENCE	DESCRIPTION	Q.TY
1	Spacer direct starting L=39mm	2
2	Direct starting plate	1
3	Galvanized plane washer	2
4	Spring Lock washer M12 UNI1751A galvanized	2
5	Screw 12.9 TCEI M 12x60 UNI5931 Zn	2

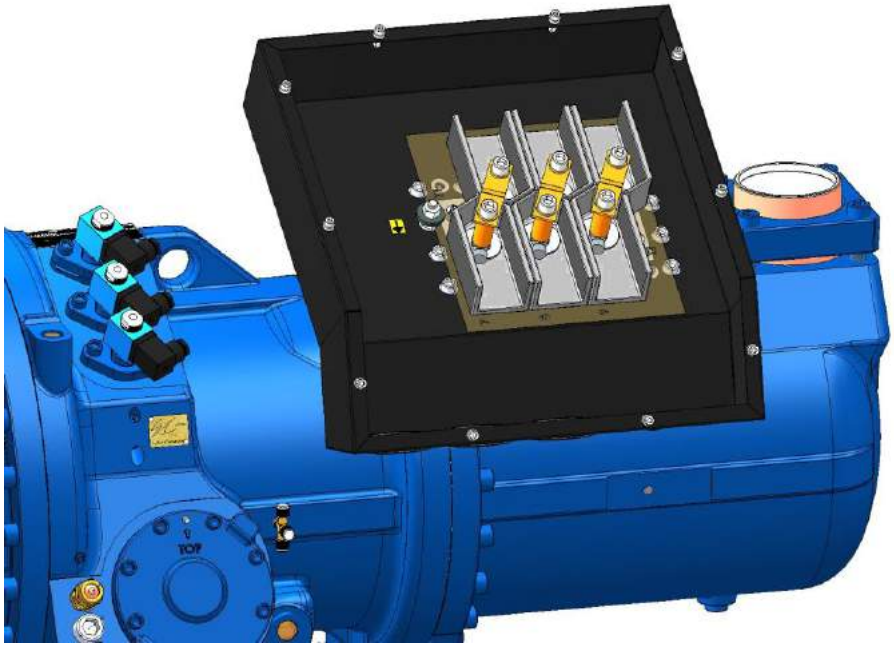


Figure 8L – Assembly of kit DOL start up

8.2 PROTECTION DEVICES

8.2.1 Motor thermal switch

To protect the motor from the high working temperature, the motor is provided with 6 thermal switches, connected in series, placed in the windings. 3 thermal switches are placed in the suction side of the motor and their set point temperature is equal to 100°C, whereas 3 thermal switches are placed in discharge side of the motor and their set point temperature is equal to 120°C.

The electrical resistance of series of thermal switch at ambient temperature (temperature lower than 40°C) shall be lower than 1800Ω. If a single thermal switch reaches the set point tempeature, the electrical resistance increases exponentially. The electrical resistance can be measured at terminal T1 and T2 on the compressor electrical plate.

	**Important note** To measure the resistance of the thermal switches series do not apply a voltage higher than 3Vdc.

8.2.2 Protection device INT69 E1

Figure 8M –INT69 E1

Functions and main features.

The electronic protective device INT69 E1 is supplied as standard in case of compressor supplied by electrical grid; it performs the following functions:

- Monitoring PTC thermistors of electrical motor windings;
  - An additional PTC probe can be connected in series to the windings thermal switches to control the oil temperature.

	Note Pay attention to the characteristics of each probe which is connected in series: check the compatibility of the probe with the intervention threshold and with the reactivation threshold of the RefPower protective device INT69 E1.

- Monitoring phases sequence;
- Monitoring phases loss;
- INT69 E1 is not suitable for use with frequency converters and soft-starter

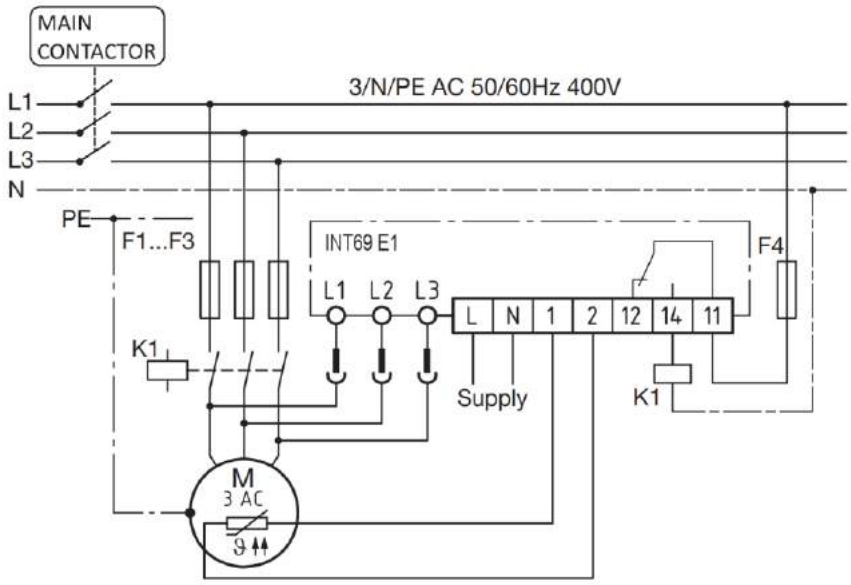
The main features of the protection module INT69 E1 are described in the following table.

FEATURE	VALUE
Supply voltage	AC/DC 50/60Hz 115/230V -15% / +10%, 3VA.
Ambient temperature	-30° C...+70° C
Switching capacity	Max. 240V AC, continuous current max 2,5 A C300 Min AC/DC >24V, >20mA
Amb. Temp. resistance, $R_{25,total}$	<1800 Ω
Intervention threshold, R_{trip}	11400 Ω ±20%
Reactivation threshold, R_{reset}	2950 Ω ±20%
Phase monitoring	3AC 50-60Hz 200-632V ±10%
Reset of lock-out	Power off >5s
Required fuse	Fast blow 4 A

Table 8A – INT69 E1 device characteristics

Connections.

The device is connected to the electrical plate at the assembling stage of the compressor. The terminals of the INT69 E1 device shall be connected to the compressor as shown in the following pictures.



CLAMP	FUNCTION
L - N	Phase / neutral power supply
L1 - L2 - L3	Phases power supply compressor (pay attention to the codes printed on the cables)
1 – 2	Connectors on terminal plate (T1 and T2) for motor thermal switch
11 - 14	Relay

Figure 8N – example connection.

To protect the INT69 E1 device, the installation of a 4A rapid fuse is recommended. The proper functioning of the device shall be checked during the chiller testing, after every failure of the chiller and after every failure of the auxiliary circuit.

Important note
In case of device intervention, the reactivation shall be carried out by qualified personnel only. The reactivation shall be carried out after having identified the causes of the previous intervention.

Important note
1. Pay attention to the motor rotation at the first start-up. A reverse rotation longer than 30 s may cause severe damages to the compressor.
2. Connect the terminals of the phase sequence monitor to the cables of the first contactor.
3. Do not apply power supply to terminals T1 and T2 on the terminal plate.

Important note
The protection device is not suitable for ATEX area.

8.2.3 Protection device INT69 E2

Figure 8O –INT69 E2

Functions and main features.

The electronic protective device INT69 E2 is supplied as standard in case of compressor driven by converters and soft-starter; it performs the following functions:

- Monitoring PTC thermistors of electrical motor windings;
  - An additional PTC probe can be connected in series to the windings thermal switches to control the oil temperature.

	Note Pay attention to the characteristics of each probe which is connected in series: check the compatibility of the probe with the intervention threshold and with the reactivation threshold of the RefPower protective device INT69 E2.

- Monitoring phases sequence;
- Monitoring phases loss;

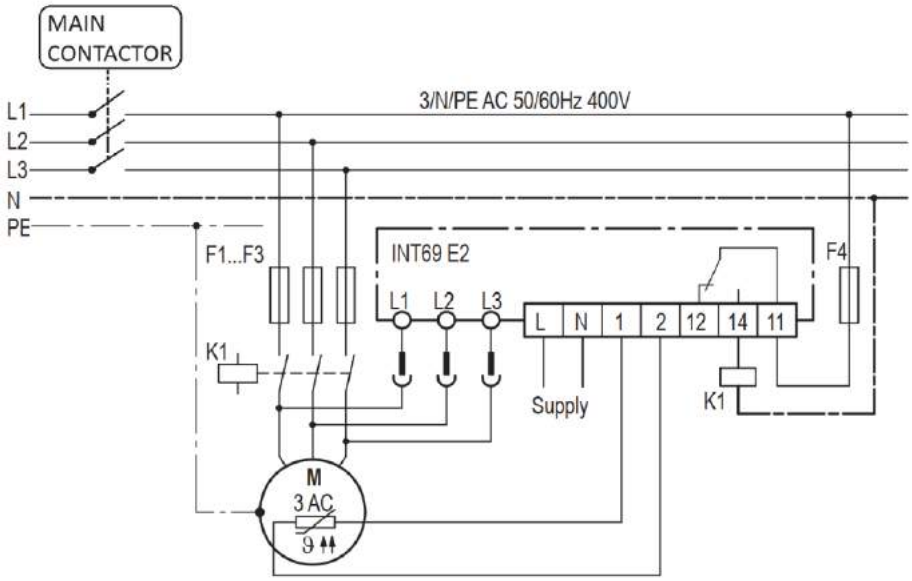
The main features of the protection module INT69 E2 are described in the following table.

FEATURE	VALUE
Supply voltage	AC/DC 50/60Hz 115/230V -15% / +10%, 2VA.
Ambient temperature	-30° C...+70° C
Switching capacity	Max. 240V AC, continuous current max 2,5 A C300 Min AC/DC 100 mV min. 0,5mA
Amb. Temp. resistance, $R_{25,total}$	<1800 Ω
Intervention threshold, R_{trip}	11400 Ω ±20%
Reactivation threshold, R_{reset}	2950 Ω ±20%
Phase monitoring	3AC 20-100Hz 80-575V ±10%
Reset of lock-out	Power off >5s
Required fuse	Fast blow 4 A

Table 8B – INT69 E2 device characteristics

Connections.

The device is connected to the electrical plate at the assembling stage of the compressor. The terminals of the INT69 E2 device shall be connected to the compressor as shown in the following pictures.



CLAMP	FUNCTION
L - N	Phase / neutral power supply
L1 - L2 - L3	Phases power supply compressor (pay attention to the codes printed on the cables)
1 – 2	Connectors on terminal plate (T1 and T2) for motor thermal switch
11 - 14	Relay

Figure 8P – example connection.

To protect the INT69 E2, the installation of a 4A rapid fuse is recommended. The proper functioning of the device shall be checked during the chiller testing, after every failure of the chiller and after every failure of the auxiliary circuit.

Important note
In case of device intervention, the reactivation shall be carried out by qualified personnel only. The reactivation shall be carried out after having identified the causes of the previous intervention.

Important note
1. Pay attention to the motor rotation at the first start-up. A reverse rotation longer than 30 s may cause severe damages to the compressor.
2. Connect the terminals of the phase sequence monitor to the cables of the first contactor.
3. Do not apply power supply to terminals T1 and T2 on the terminal plate.

Important note
The protection device is not suitable for ATEX area.

8.2.4 Use of A2L or A3 refrigerant

After a refrigerant leakage from the plant, from the compressor or from the area near to the installation of the compressor, carry out the following activities:

- Make sure that the compressor is off and open the electrical box to eliminate gas locks and to facilitate the evaporation of the potential condesates.
- Check the operating state of the electrical equipment on the compressor (electrical valves, sensors, ect.)

8.3 POWER SUPPLY

The features of the power supply network for the compressors are the following:

- Electrical power supply for standard motor version (Part-Winding, PW, and Star-Delta, Y-Δ): 400Vac - 3 phases - 50Hz / 460Vac - 3 phases - 60Hz (other types of power supply are available on request)
- Admitted voltage range: ± 10 % of the nominal voltage
- Admitted voltage imbalance L1 - L2 - L3: ± 2 %
- Maximum voltage loss at the motor start-up: 10 % of the nominal voltage
- Admitted frequency range: ± 2 % of the nominal frequency
- Admitted current imbalance: 5% or 12 % calculated as follows.

  I_1, I_2 and I_3 are the currents of the first contactor whereas I_7, I_8 e I_9 are the currents of the second contactor.

  Calculation of the 3 phase currents:

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

  Calculation of the imbalance $SB_3^{\%}$ of 3 currents I_R - I_S - I_T:

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

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

  The admitted imbalance for 3 currents is:

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

  Calculation of the imbalance $SB_6^{\%}$ of 6 currents I_1, I_2, I_3, I_7, I_8 e I_9:

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

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

  The admitted imbalance for 6 currents is:

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

8.4 DESIGN OF ELECTRICAL COMPONENTS

The design of the electrical components such as cables, fuses, etc. shall be carried out considering the maximum current (FLA) absorbed by the electric motor during a regular operation.
Moreover, in order to be on safe side, the contactors shall be designed for at least 65% of the maximum phase current (FLA) in case of Part Winding configuration motor. Whereas in case of Star/Delta configuration motor, the contactors shall be designed for at least 75% of the maximum phase current (FLA).

8.5 ELECTRICAL DATA

MODEL	STAR-DELTA START-UP		
	Start-up current		Maximum operating current
	LRA Y A	LRA Δ A	FLA A
K2__410S	278	835	194
K2__480S	362	1094	226
K2__560S	362	1094	226
K2__640S	375	1157	268
K2__720S	450	1334	300
K2__810S	545	1646	319

Table 8B – motor data for the small size version; standard supply

MODEL	STAR-DELTA START-UP		
	Start-up current		Maximum operating current
	LRA Y A	LRA Δ A	FLA A
K2__410F	415	1245	240
K2__480F	530	1590	326
K2__560F	545	1646	352
K2__640F	595	1802	386
K2__720F	595	1802	386
K2__810F	595	1802	386

Table 8C – motor data for the full size version; standard supply

as:

- LRA is the start-up current (Locked Rotor Ampere);
- FLA is the maximum current absorbed by the motor during regular working conditions (full load ampere).

Palladio Compressors - K2 Series

9. Additional cooling

9.1 ADMITTED DISCHARGE TEMPERATURE OF THE COMPRESSOR

The main factors determining discharge temperature are:

- absorbed electrical power which depends on:
  - working conditions (evaporating and condensing pressure);
  - operating compression ratio of the compressor;
  - cooling capacity;
- superheating of the refrigerant at suction;
- properties of refrigerant and lubricant.

The excessive discharge temperature may cause:

- carbonization and permanent alteration of the oil with reduction of its useful life;
- reduction of kinematic viscosity, consequent loss of lubrication capacity and decrease in the volumetric efficiency of the compressor.

The excessive cooling of oil may cause:

- high pressure drop in oleodynamic circuit;
- excessive dilution of the oil by the refrigerant, which has the following consequences:
  - the alteration of the lubricant flow inside the compressor and reduction of lubricating properties;
  - by-pass of suction refrigerant fluid (through the oil hydraulic circuit) and reduction of the cooling effect.

Maximum admitted discharge temperature is equal to 110°C, but when the compressor is stopped, the minimum admitted temperature of oil is equal to 40°C to let the start up of the compressor (chapter 6: “Lubrication”).

9.2 CALCULATION ADDITIONAL COOLING CAPACITY

The additional cooling capacity shall be properly calculated in order to keep the discarge temperture equal or lower than 110 °C. Use suitable calculation methods and softwares.

Note

In order to calculate the additional cooling capacity, it is recommended applying the most critical working conditions of the plant (minimum evaporation temperature, maximum condensing temperature, maximum superheating).

Therefore, depending on the value of the required additional cooling capacity, two different methods are distinguished to limit the discharge temperature:

- cooling by injection of refrigerant liquid mass flow-rate in rotors;
- cooling by an external circuit using a heat exchanger (type air/oil or water/oil or refrigerant/oil).

9.3 LIQUID INJECTION

This method is the injection of refrigerant fluid on rotors (saturated liquid) at intermediate pressure. The liquid refrigerant shall be tapped downstream the condenser of refrigeration plant.

Note

If the additional required cooling capacity overcomes 10% of cooling capacity of the compressor, the liquid injection requires an excessive mass flow-rate that may cause:

1. diluition of oil;
2. decreasing of lubricating properties of oil;
3. excessive increasing of absorbed power supply;
4. a decrease of the compressor cooling capacity.

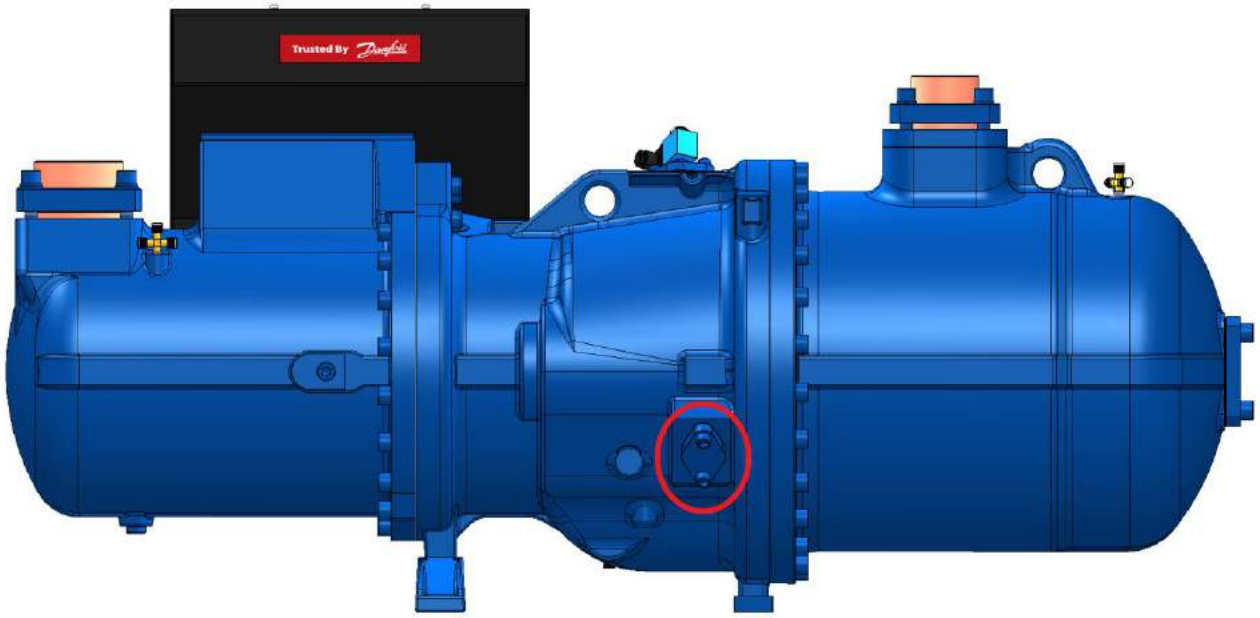


Figure 9A: place of nozzle for injection of refrigerant fluid (saturated liquid)

The liquid injection requires the installation of a component for the expansion; the component can be:

- expansion thermostatic valve;
- calibrated nozzle;
- capillary tube.

Important note

In order to select the right thermostatic expansion valve, contact the supplier of the valves.

The sensing probe or the thermal switch of the cooling system shall be placed on the discharge tube at 10 - 20 cm from the discharge shut-off valve; it shall be insulated in order not to be influenced by the external ambient temperature. Ensure the adequate mechanical thermal contact of sensor to the discharge tube.
Make sure to get liquid refrigerant at saturated or subcooling conditions.

Note

- Ensure the absence of dangerous vibrations on the injection tube.
- The injection tube shall be provided with a shut-off valve to close the injection circuit during the stop of the plant or the stop of the injection circuit.
- The injection tube shall be provided with a mechanical filter.
- The injection tube shall be provided with a siphon at least 25 cm upwards before entering the compressor.

The sensing probe or the thermal switch shall start the liquid injection when the discharge temperature overcomes 110°C, whereas it stops the liquid injection when the discharge temperature descreases under 100 – 105°C.
The compressor shall be equipped with injection connection; this optional accessory is available on request.

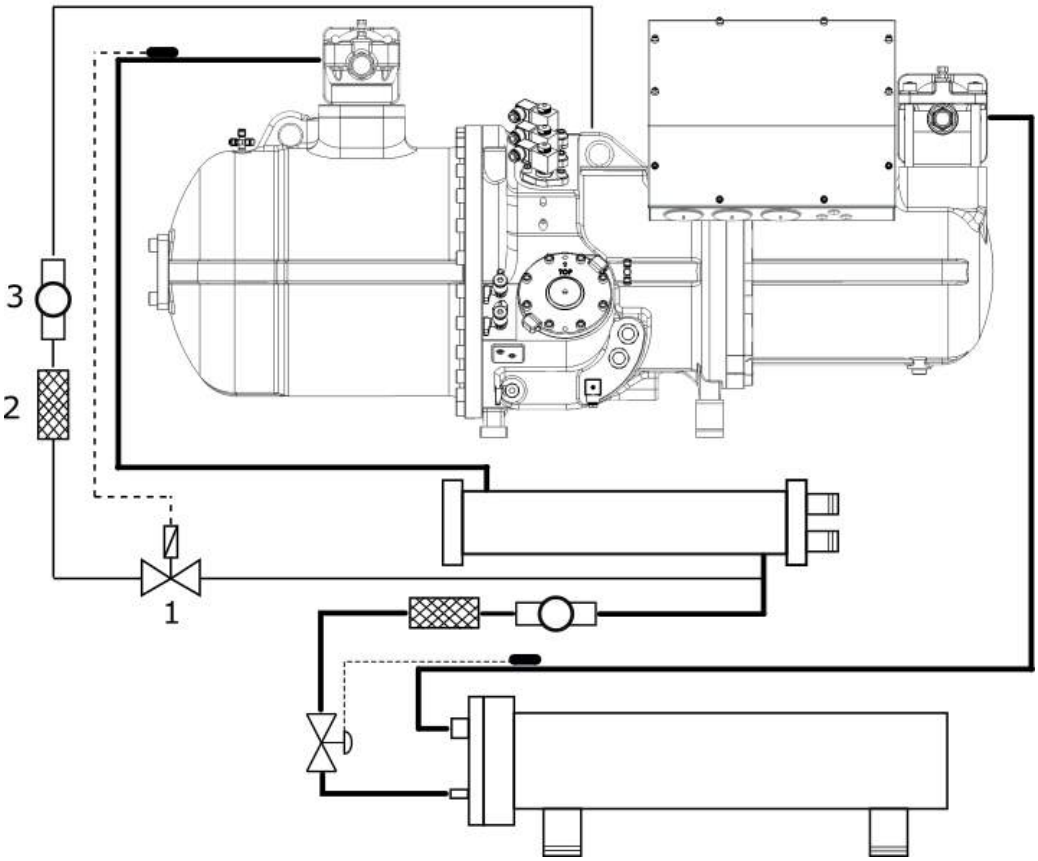


Figure 9B: example of circuit provided by liquid injection; 1) valve to open circuit; 2) filter; 3) sigth glass.

9.4 OIL COOLING WITH HEAT EXCHANGER

9.4.1 Arrangement

The additional oil cooling is possible only if the compressor is provided with the proper arrangement (par 6.4.1)

Note

The standard delivery of the K2 series compressors is not equipped with connections for the additional oil cooling circuit (par 6.3).

9.4.2 Commissioning of the oil cooling

This method to decrease discharge temperature of the compressor is the oil cooling by an external circuit. Refer to chapter 4 of the present manual about the application limits of this cooling method.
In order to connect the compressor to the external circuit, it is necessary to use the 2 brass connections placed at the oil filter side:

- lower brass connection for the outlet flow from the compressor;
- higher brass connection for the inlet flow to the compressor.

The thread of connections is SAE type, measure 5/8", male.

Note

Refer to the formula about oil flow rate described in chapter 6 "Lubrication" to properly size additional heat exchanger.

For proper sizing of the heat exchanger apply appropriate calculation methods or consult the heat exchanger supplier.

Note

Increase the oil charge with an amount of oil equal to the internal volume of the external oil cooling circuit.

Important note

Check pressure drop if the external oil cooling circuit is lower than 0,5 bar during functioning to allow a right oil mass flow-rate at the lubrication of the compressor.

Place the cooling heat exchanger near the compressor and use the lowest possible quantity of elbows for the tubelines of the external circuit.

9.4.3 Cooling by air

The cooling plant composed by an air heat exchanger equipped with fans shall be activated by the probe placed on the discharge tube of the compressor whose set point is 110°C; the control can be at ON-OFF method or at variable speed.

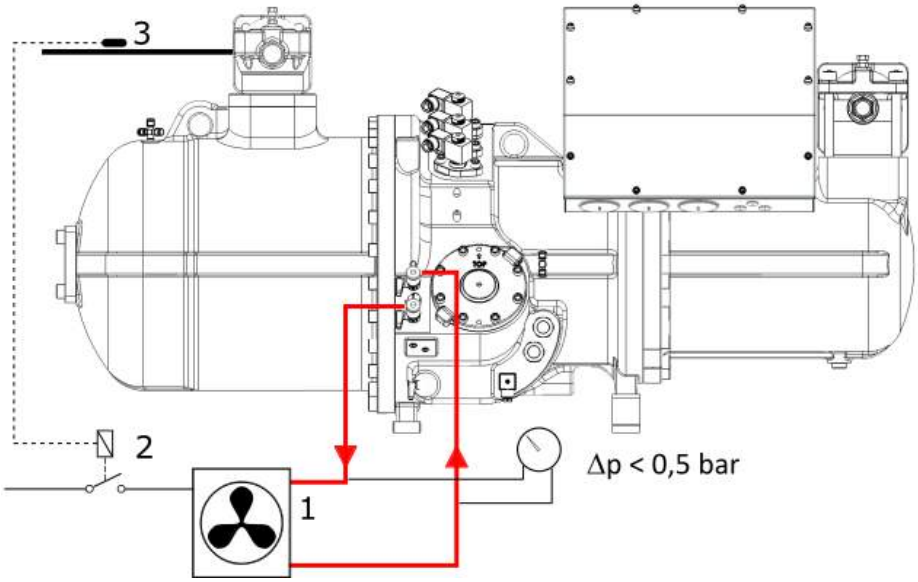


Figure 9C: cooling example; air heat exchanger (1) on-off start up (2) thermal switch on discharge tube (3) of the compressor

9.4.4 Cooling by water

The water/oil heat exchanger can use the condenser water or cooled water. The water supply can be modulated by a 3-way valve provided with a probe placed on the discharge tube of the compressor (set-point at 110°C).

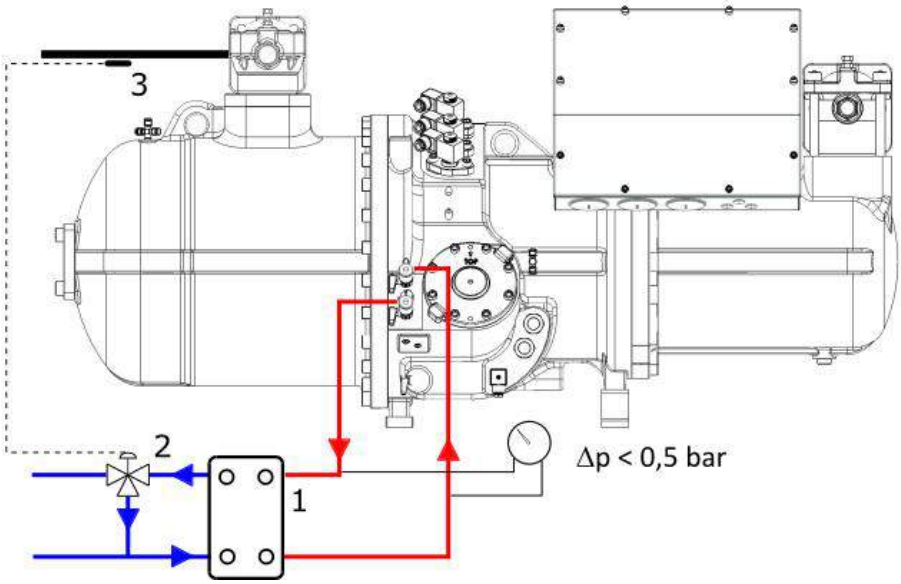


Figure 9D: cooling example 1) water heat exchanger; 2) modulating 3-way valve; 3) thermal switch on discharge tube of the compressor

9.4.5. Cooling by refrigerant

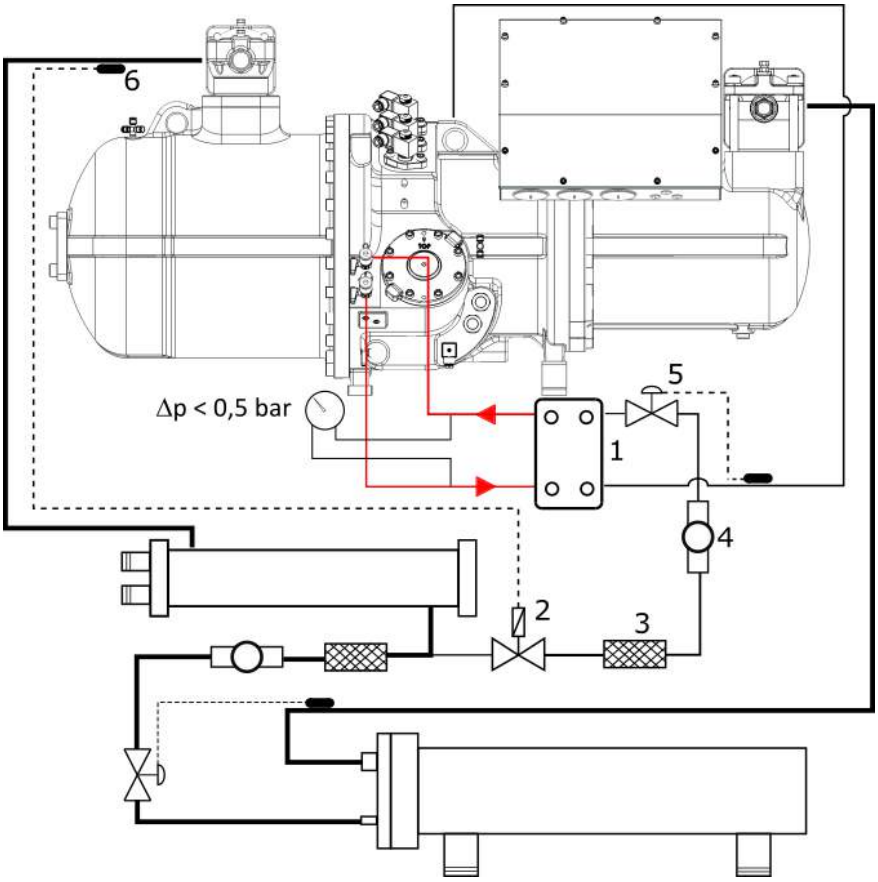


Figure 9E: example oil cooling by refrigerant; 1) a refrigerant/oil heat exchanger; 2) a valve to open circuit; 6) switch placed on discharge tube of the compressor; 3) a dryer filter on liquid tube; 4) a sight glass; 5) an expansion valve to ensure the correct superheating to the refrigerant returning to the the compressor.

The lubricant can be cooled by refrigerant tapped from the main liquid tube placed downstream the condenser. Circuit shall be opened by a check valve controlled by the compressor discharge temperature in order to avoid a by-pass from the main circuit.
A thermostatic expansion valve can regulate the right refrigerant mass flow-rate to the compressor.

	**Important note** The selected heat exchanger shall be able to withstand the high difference of temperature between 2 fluids.

Palladio Compressors - K2 Series

10. Economiser

10.1 PURPOSE AND PRINCIPLE OF ECONOMISER CIRCUIT OPERATION

The purpose of the economiser circuit is:

- To increase the liquid subcooling at the expansion valve inlet.
- To increase the evaporator cooling capacity.

10.1.1 Description of circuit

- From downstream of the condenser the liquid is tapped.
- The drawn out liquid expands through an expansion valve.
- The expanded fluid exchanges heat from the main liquid fluid in a countercurrent heat exchanger.
- The superheated refrigerant is sucked by the compressor through a shut-off valve in the compression chamber at intermediate pression between suction pressure and discharge pressure.

10.2 INSTALLATION

Pay attention to the following recommendations in order to install the economiser circuit:

1. Design the economiser heat exchanger based on thermal cooling capacity which is a purpose of the economiser circuit.
2. Diameters of the economiser circuit tubes should be selected on the basis of the flow-rate of the liquid fluid and expanded fluid.
3. Connect the superheated refrigerant pipe to the compressor with a siphon elbow from above to avoid oil or liquid return directly to the compression chamber.
4. Install at upstream of the economiser circuit a valve to avoid by-pass or leakage during the stop of the economiser.
5. Install at upstream of the economiser circuit a dryer filter to protect the expansion valve and the heat exchanger.

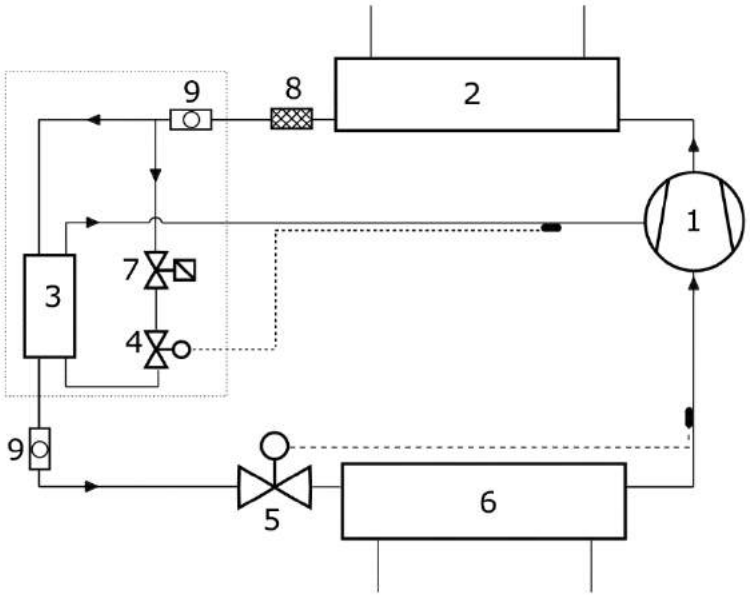


Figure 10A: semplified scheme of economiser circuit

1. *The compressor*
2. *Condenser*
3. *Countercurrent heat exchanger economiser circuit*
4. *Thermostatic expansion valve of economiser circuit*
5. *Main thermostatic expansion valve*
6. *Evaporator*
7. *Shut-off valve economiser circuit*
8. *Dryer filter*
9. *Sight glass*

Note

The economiser circuit shall be built by qualified personnel. Pay attention to the brazing activities not to damage the gaskets of the compressor shut-off valve for the economiser circuit.

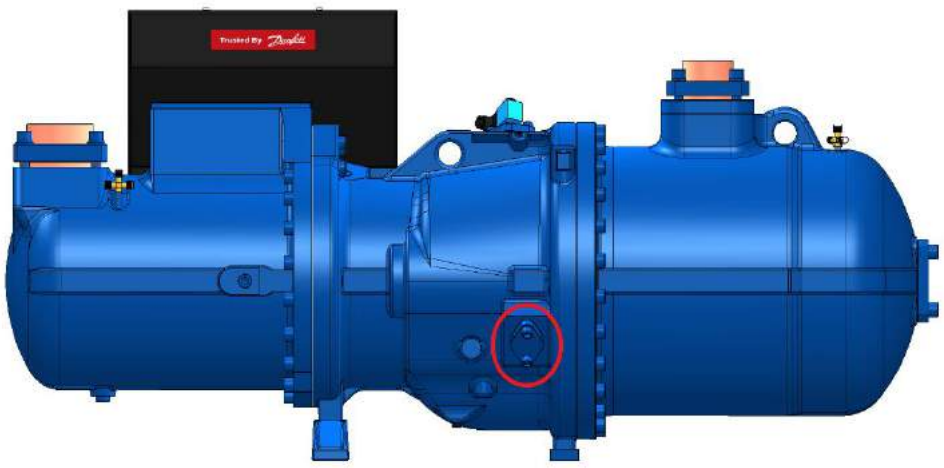


Figure 10B: place of nozzle for economizer inlet to compressor

10.3 OPERATION LIMITS

The additional flow-rate sucked by the compressor requires the increasing of the absorbed electrical power by the compressor at the same evaporating and condensing temperature. Application limits of the compressor are reduced compared to the application of the same compressor without economizer circuit. The maximum permissible condensation temperature is therefore lower than the standard one.

	Note If necessary contact the supplier to define the envelope of the economiser circuit if not attached to the compressor documents.

Palladio Compressors - K2 Series

11. Regular Maintenance

11.1 LUBRICATION

11.1.1 Lubricant

After the installation and the first start-up it is not necessary lubricant replacement.

	**Note** Check periodically the oil acidity in order to avoid damages to the motor and to the compressor; if it is necessary, clean the circuit by placing an acid retention filter in the suction pipe.

The lubricant may be collected through the low shut-off valve (chapter 6: “Lubrication”). Moreover, the lubricant can be charged in the compressor through the same shut-off valve by the vacuum in compressor.

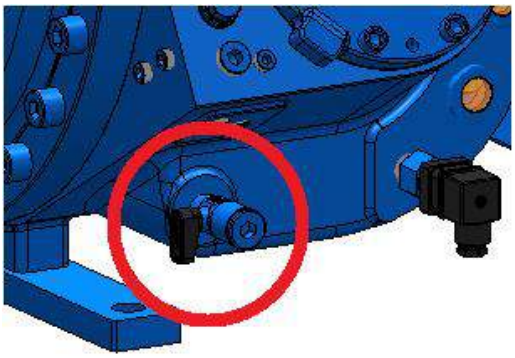


Figura 11A: shut-off valve for lubricant outlet and inlet

	**Important note** The shut-off for lubricant inlet and outlet is placed in the zone of the compressor at high temperature and at high pressure. Do not open the shut-off valve during the compressor activity.

11.1.2 Oil filter

The oil circuit pressure (OP) shall be checked periodically. If it is necessary to replace the oil filter, perform the extraction of the support as follows:

1. Unscrew the screws of oil filter support flange;
2. Screw 2 M10 screws in the proper holes.

	**Important note** Make sure that there is no pressure in the compressor before extracting the oil filter support. The oil filter support shall not be removed during the compressor activity.

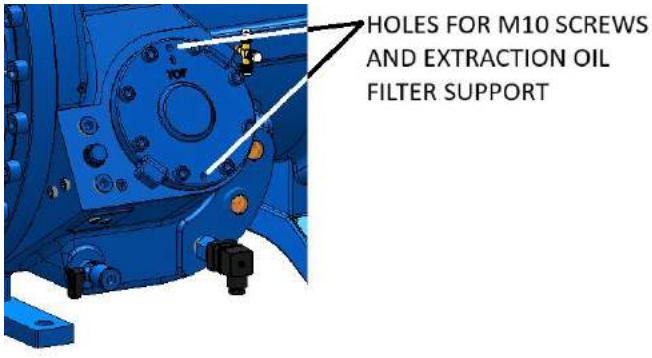


Figure 11B: holes for the extraction of the oil filter support

11.2 BEARINGS

The bearings are designed to 40000 working hours in condition of a regular lubrication, cleaned oil filter, expected oil pressure (chapter 6: "Lubrication") and expected envelope (chapter 4: "Envelope"). Any alteration of the working conditions and the excessive variability of the load may reduce the effective life time of the bearings.

Note

The substitution of the bearings can be carried out by qualified personnel in an equipped factory only.

11.3 DIRECTION OF ROTATION ROTORS

At the stop of the compressor, the reverse rotation of the rotors can occur to equalize the pressure at the compressor inlet and outlet. If the period of reverse rotation is over than 3 seconds, check the valve under the shut-off valve: in this case, if it is damaged, it should be substituted.

Note

In any case, the period of a reverse rotation should not be over than 5 s to avoid any serious damages of the rotors, bearings and other components of the compressor and false warnings of the protection module.

11.4 PERIODIC MAINTENANCE TABLE

The following table summarizes the controls and the periodic activities of the regular maintenance:

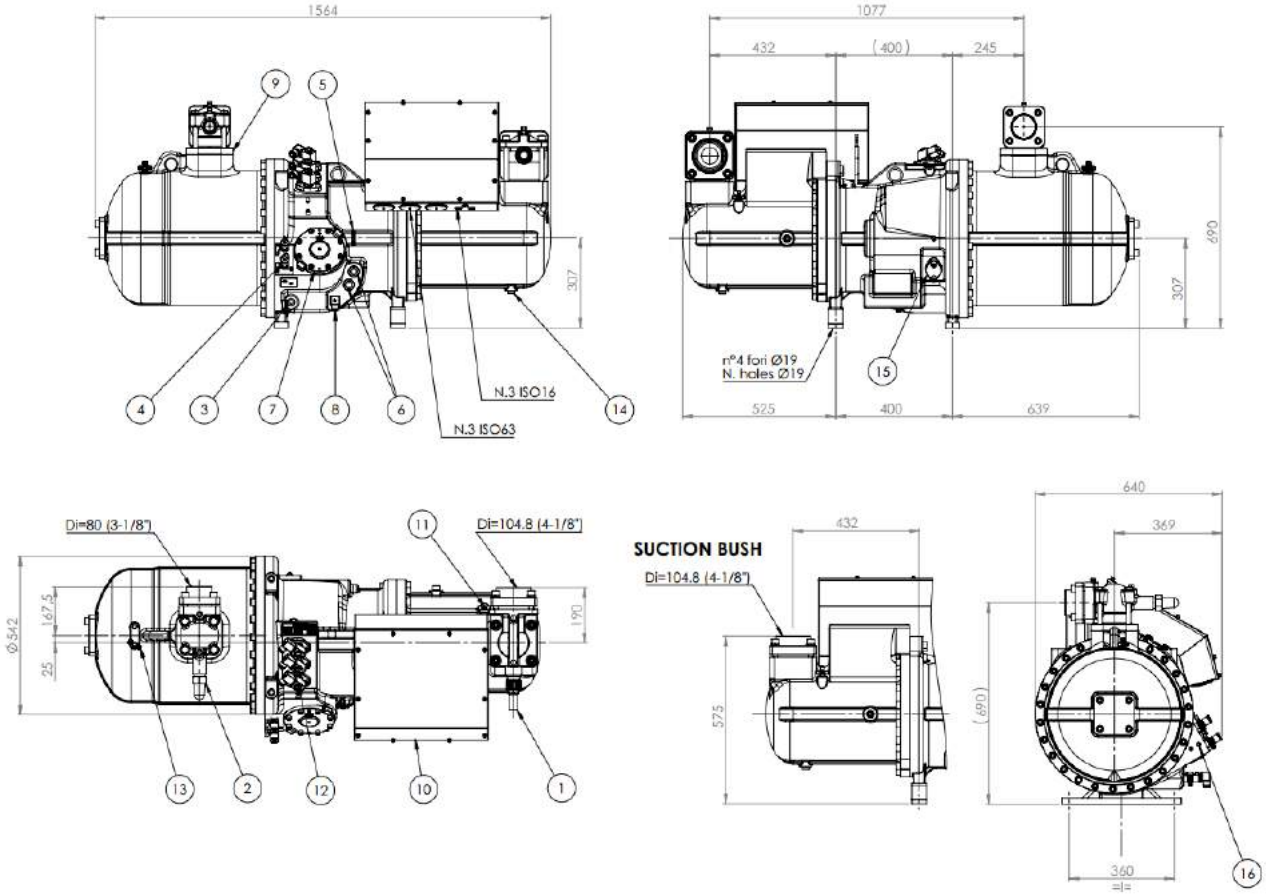
- S: substitution
- C: control

COMPONENTS	**ACTIVITY**					
	Period (h)					
	50-100	1000	10000	20000	30000	40000
Oil filter	C/S					S
Oil	C	C	C	C	C	S
Suction filter		C	C		C	C
Solenoid valves		C	C	C	C	C
Bearings						S
Check valve		C	C	C	C	C
Motor protection device		C	C	C	C	C
Power voltage	C	C	C	C	C	C
Motor contactor		C	C	C	C	C

Palladio Compressors - K2 Series

12. Weights And Overall Dimensions

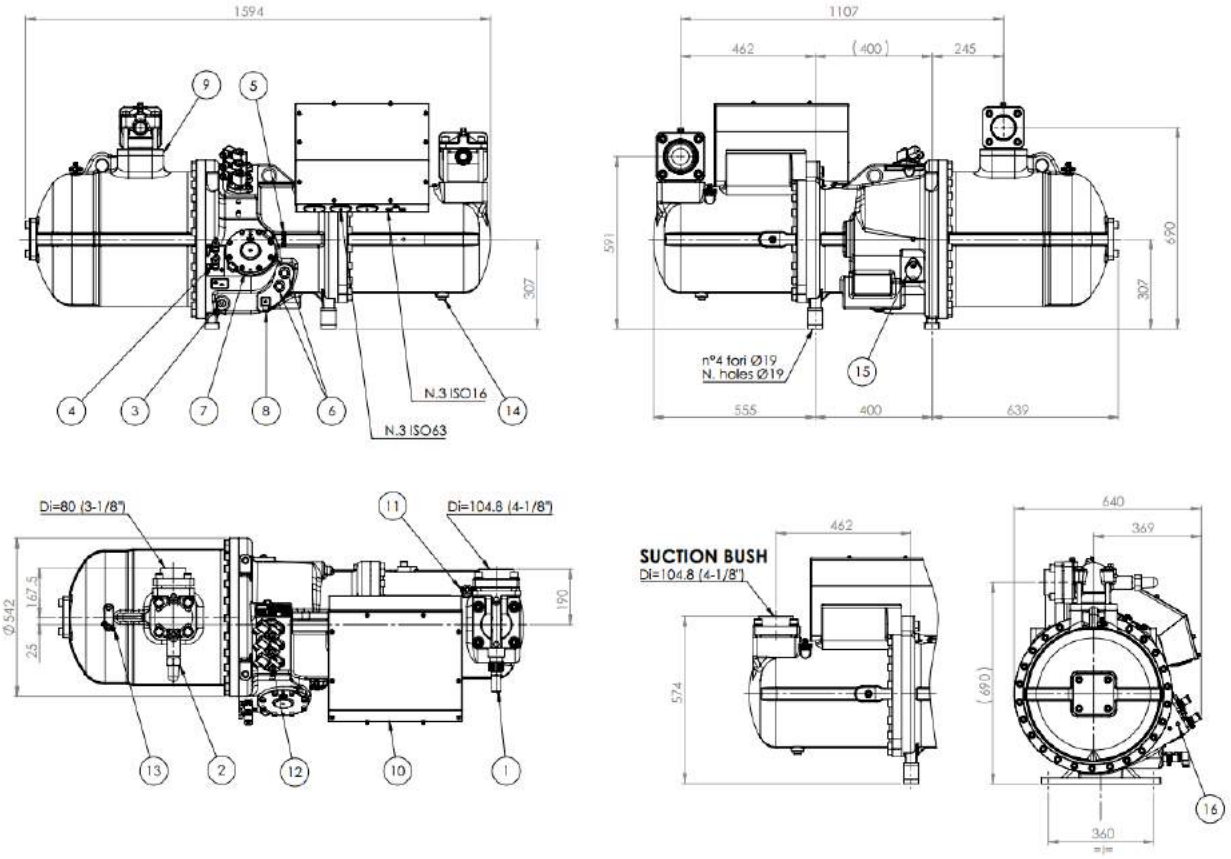
12.1 OVERALL K2__410-480-560 S



KEY	
1)	Suction line
2)	Discharge line
3)	Oil charge/drain valve 1/2" NPT
4)	Oil cooling connections SAE Flare m5/8"
5)	Oil pressure connections SAE Flare m1/4"
6)	Oil sight glass
7)	Oil filter
8)	Crankase heater
9)	Check valve
10)	Electrical box
11)	Low pressure SAE Flare m1/4"
12)	Capacity control solenoid valves
13)	High pressure SAE Flare 1/4"
14)	Oil drain motor side
15)	Liquid injection/Eco connection (optional)
16)	Oil temperature sensor (1/8" NPT)

Figure 12A – overall dimensions compressors K2_410/560S

12.2 OVERALL K2__410-480-560 F



KEY	
1)	Suction line
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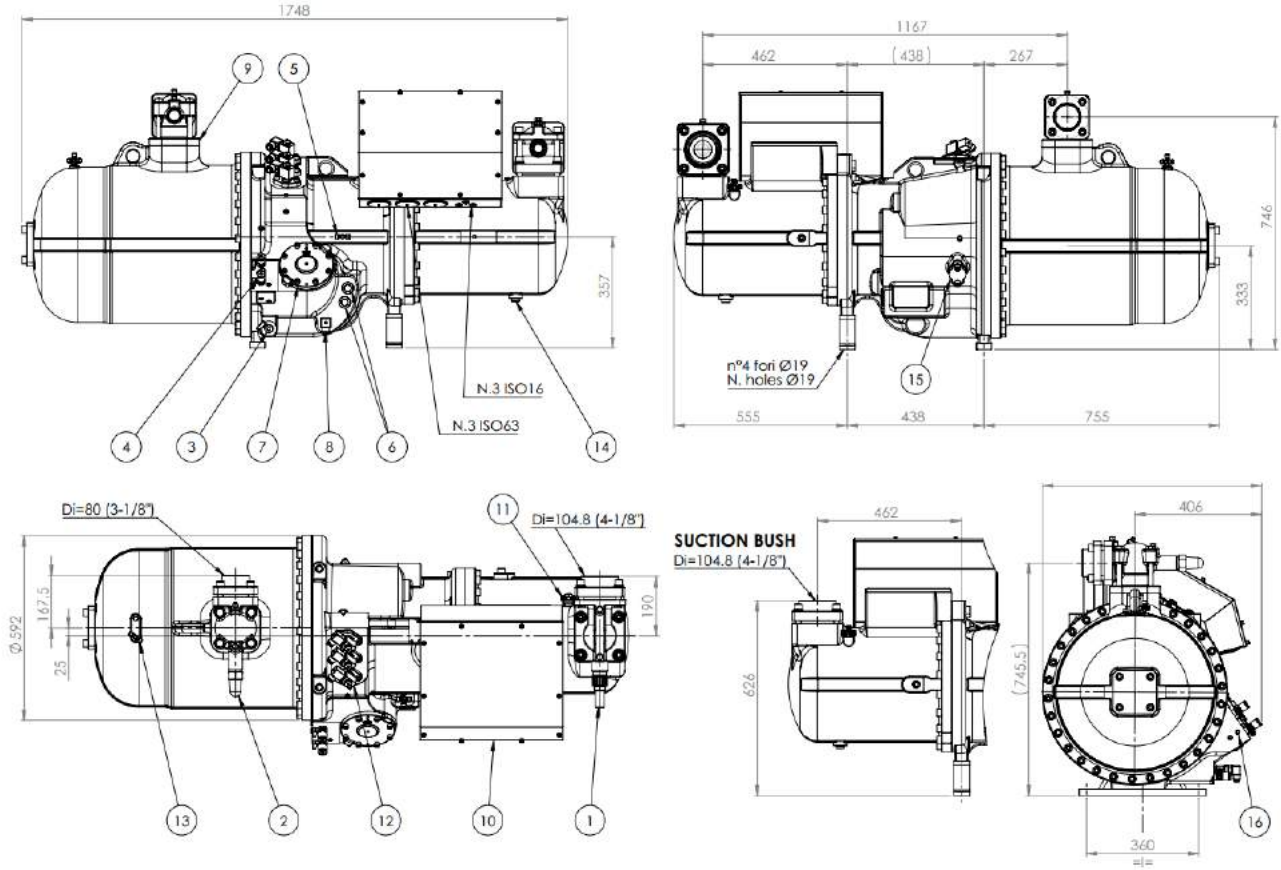
5)	Oil pressure connections SAE Flare m 1/4"
6)	Oil sight glass
7)	Oil filter
8)	Crankase heater
9)	Check valve
10)	Electrical box
11)	Low pressure SAE Flare m1/4"
12)	Capacity control solenoid valves
13)	High pressure SAE Flare m1/4"
14)	Oil drain motor side
15)	Liquid injection/Eco connection (optional)
16)	Oil temperature sensor (1/8" NPT)

Figure 12B – overall dimensions compressors K2_410/560F

12.3 OVERALL K2__640-720-810



KEY	
1	Suction line
2	Discharge line
3	Oil charge/drain valve 1/2" NPT
4	Oil cooling connections SAE Flare m 5/8"
5	Oil pressure connections SAE Flare m 1/4"
6	Oil sight glass
7	Oil filter
8	Crankase heater
9	Check valve
10	Electrical box
11	Low pressure SAE Flare m 1/4"
12	Capacity control solenoid valves
13	High pressure SAE Flare m 1/4"
14	Oil drain motor side
15	Liquid injection/Eco connection (optional)
16	Discharge temperature sensor (1/8" NPT)

Figure 12C – overall dimensions compressors K2_640/810

12.4 WEIGHTS AND PACKAGINGS

MODELS	COMPRESSOR WEIGHT	PACKAGING WEIGHT	TOTAL WEIGHT	PACKAGING DIMENSIONS		
	kg	kg	kg	W [mm]	H [mm]	L [mm]
K2_410S	794	85	879	830	1063	1860
K2_480S	798	85	883	830	1063	1860
K2_560S	806	85	891	830	1063	1860
K2_640S	1002	85	1087	830	1063	1860
K2_720S	1012	85	1097	830	1063	1860
K2_810S	1020	85	1105	830	1063	1860
K2_410F	796	85	881	830	1063	1860
K2_480F	808	85	893	830	1063	1860
K2_560F	826	85	911	830	1063	1860
K2_640F	1020	85	1105	830	1063	1860
K2_720F	1020	85	1105	830	1063	1860
K2_810F	1020	85	1105	830	1063	1860