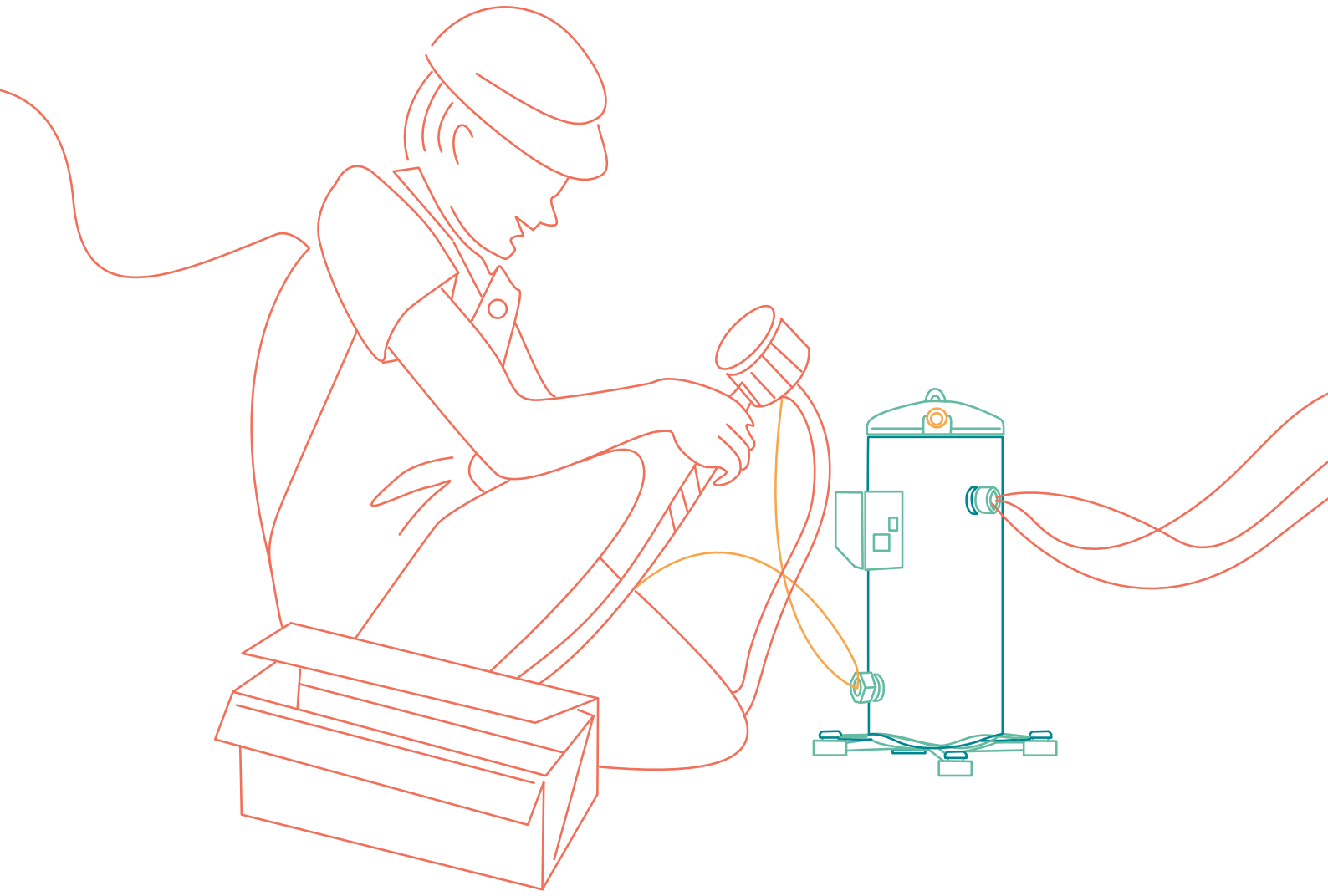
SCROLL INSTALLATION INSTRUCTIONS

FOR EMBRACO SCROLL REFRIGERATION COMPRESSORS



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SCOPE OF THE COMPRESSOR INSTALLATION INSTRUCTIONS

These installation instructions applies to Embraco scroll compressors for refrigeration applications. The Country of Origin is indicated on the compressor label.

It is addressed to professional, commercial refrigeration system manufacturers/installers and maintenance technicians and intends to provide instructions/recommendations on the proper use of Embraco scroll compressors regarding reliability, performance and safety aspects.

The information of this these installation instructions is limited to the Embraco scroll refrigeration compressors and to their installation/operation/service. It is not to be considered comprehensive or as a set of information for training for technicians that need to be qualified by appropriated training nor to replace the instruction manual of the final equipments provided by the manufacturers.

All the operation on systems, their production, installation use, repairing and disposal must be carried out according to all the applicable International and National regulations and standards.

DISCLAIMER

*All product specifications and data are subject to change without notice; thus customer should always verify its latest updates on Embraco website (**www.embraco.com**), catalogues before relying on them.*

The information provided herein is correct to the best of Embraco's knowledge of typical requirements that are often requested to Embraco's products, It is the customer's responsibility, relying solely on its own testing and engineering work, to validate that a particular product with the properties described in Embraco's product specification is suitable for use in a particular application, Embraco makes no representation concerning the suitability of its products for incorporation into or use with customer's applications.

Parameters provided in datasheets and / or specifications may vary in different applications and performance over time. Therefore Embraco's statements related to all operating parameters, including typical parameters, cannot be intended to replace the customer's validation for each application by the customer's technical experts. Product specifications do not expand or otherwise modify Embraco's terms and conditions of purchase, including but not limited to the warranty expressed therein.

Embraco rejects any liability for damages and injures caused by its products and/or the applications they are embedded into being installed or repaired by untrained personnel and/or in discordance with these safety instructions.

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ACRONYMS USED IN THE TEXT

ATEL: Acute-toxicity Exposure Limit

AHRI: Air-Conditioning, Heating and Refrigeration Institute (formerly)

CSR (CSCR): Capacitive Start & Run (Capacitor Start - Capacitor Run)

DTC: Discharge Temperature Control Valve

EN: European Standards

GFCI: Ground Fault Circuit Interrupter

GWP: Global Warming Potential

HFC: HydroFluoroCarbon

HFO: HydroFluoroOlefin

ID: Internal Diameter

IP: International Protection (ratings)

IPRV: Internal Pressure Relief Valve

ISO: International Organization of Standardization

ISPM: Regulation of Wood packaging Material in International Trade

LBP: Low Back Pressure

LCL: Less Then Container Load

LFL: Lower Flammability Limit

LRA: Locked Rotor Amps

LVD: Low Voltage Directive

MBP: Medium Back Pressure

MCC: Maximum Continuous Current

MD: Machine Directive

MOC: Maximum Operating Current

MSDSs: Material Safety Data Sheets

OD: Outside Diameter

ODL: Oxygen Deprivation Limit

ODP: Ozone Depletion

OFDN: Oxygen-Free-Dry-Nitrogen

OLP: Overload Protector

PED: Pressure Equipment Directive

POE: Polyolester

RCD: Residual Current Device

REACH: Regulation on Registration, Evaluation, Authorization and Restriction of Chemicals

RLA: Rated Load Amperage

RoHS: Restriction of Hazardous Substances Directive

SH: Superheating

TXV: Thermostatic Expansion Valve

3Ø: Three-phase

Terms and Definitions

For the refrigeration system terms used in these Scroll installation instructions, refer to EN 378-1 or similar standards.

1. SAFETY

1.1 SAFETY NOTICE

Embraco compressors are designed, manufactured and inspected according to the latest European applicable standards, with particular care on the user's safety.

Embraco compressors are designed as refrigerant pumping elements on refrigeration machines. Only if they are used for this purpose and installed according to the instructions of these installation instructions and the applicable regulations and standards can be put in service, as indicated on the Embraco Manufacturers Declaration of Incorporation according the 2006/42/EC Machinery Directive.

These instructions should be retained throughout the lifetime of the compressor. You are strongly advised to follow these safety instructions, and also the local related rules should be obeyed.

Technicians are strongly advised to follow the entire applicable International and National laws and regulation as well as the instructions of these installation instructions.

1.2 SAFETY ADVICE

WARNING: Indicates Instructions that may result in personal injury or death and property damage if not carefully followed.

CAUTION: indicates instructions that may results in property damage and possible personal injury if not carefully followed.

IMPORTANT: indicates instruction to avoid damages/malfunction of the compressors.

1.3 SAFETY INSTRUCTIONS

Safety statements

- Refrigerant compressors must be used only for their intended use.
- Only qualified/certified and authorized refrigeration technicians are permitted to perform installation and maintenance of compressors.
- Electrical connections must be made by qualified electrical technicians.
- All valid standards for installing, servicing, and maintaining of electrical and refrigeration equipment must be observed.
- Usage of personal safety equipment is recommended (goggles, gloves, clothing, boots and hard hats)

Electrical shock hazard

- Turn off power before servicing.
- Discharge all capacitors.
- Use compressor with grounded system only.
- Molded electrical plug must be used when required.
- Refer to original equipment wiring diagrams.
- Electrical connections must be made by qualified electrical personnel.
- Use only components approved by manufacturer.
- Failure to follow these warnings could result in serious personal injury.

Pressurized system hazard

- System contains refrigerant and oil under pressure.
- Remove refrigerant from both the high and low pressure side before removing compressor.
- Use appropriate back up wrenches on Rotolock fittings when servicing.
- Never install a system and leave it unattended when it has no charge, a holding charge, or with the service valves closed without electrically locking out the system.
- Use only approved refrigerants and refrigeration oils.
- Failure to follow these warnings could result in serious personal injury.

Burn hazard

- Do not touch the compressor until it has cooled down.
- Ensure that materials and wiring do not touch high temperature areas of the compressor.
- Use caution when brazing system components.
- Failure to follow these warnings could result in serious personal injury or property damage.

For the compressor connection to the electrical supply line and for maintenance/ repairing operations, refer also to Appendix 1 - Recommendations - safety instruction for compressor installation.

2. PRODUCT INTRODUCTION

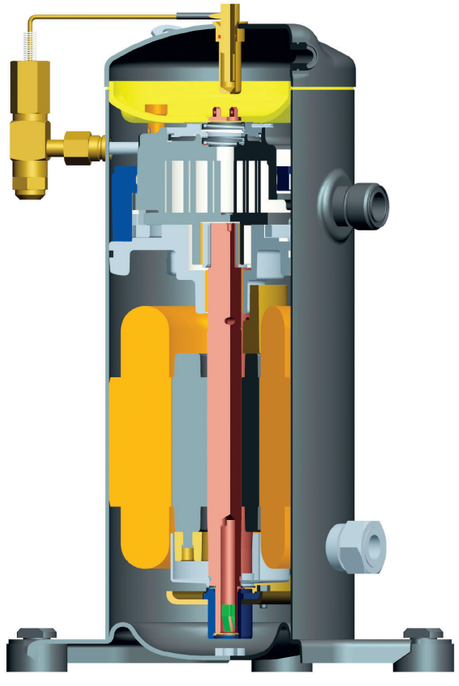
Embraco offers a full range of hermetic reciprocating compressors for refrigeration from fractional horse power (hp) up to 1.5hp with a long experience in developing innovative solutions for commercial and professional refrigeration.

With the new range of scroll compressors for refrigeration Embraco complete the product range for commercial and professional applications with a range of scroll compressors from 2hp up to 13hp working with R404A, R452A, R449A, R448A and R134a, R513A (MBP only).

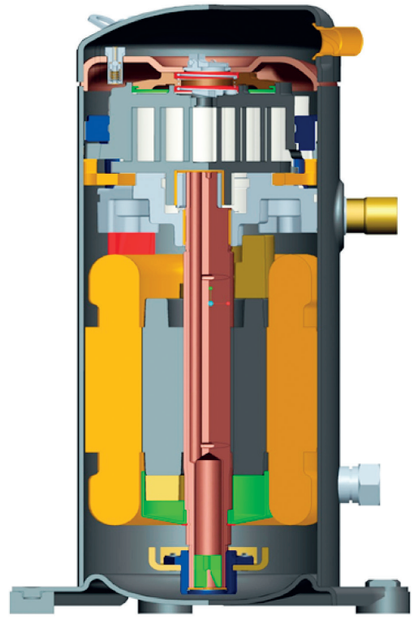
By visualizing the whole cycle of a scroll mechanism, we can notice that 3 phases: suction, compression and discharge are simultaneously made in a continuous movement.
It represents numbers of advantages:

- Less parts in movement versus other compressor technologies; the compression system is composed by only the mobile and the fix scroll.
- There is no dead space, the volumetric efficiency is close to 1.
- The absence of re-expansion loss makes that there is no reduction of the isentropic efficiency.
- The perfect suction system symmetry by two points diametrically opposed and discharge by the center of spirals assure a functioning with much lower pulsations and noise.

*Figure **2.0 Product sections***

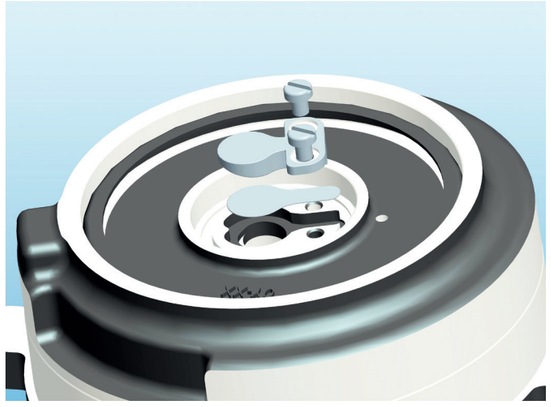


LBP section



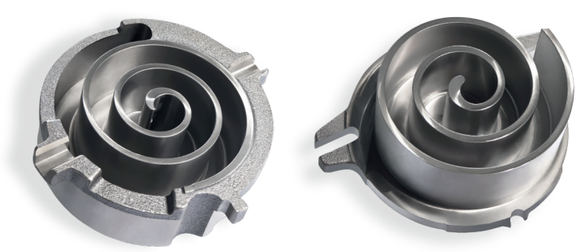
MBP section

*Figure **2.0.1. Discharge valve***



- Dynamic valve specially designed for MBP/LBP working conditions - allows high compression ratio reducing compression.
- Instant shutdown.
- More efficient for pump down control.

*Figure **2.0.2 Involutes***



- Unique design with dual compliance – radial and axial.
- Effective control of discharge temperature to improve compressor reliability.
- Specially designed for Mid/Low temperatures compression ratio.
- Height-thickness ratio to assure strength of involutes.
- High isentropic efficiency design.

2.0.3 Motor

- Designed for higher motor efficiency in different condition.
- Designed to ensure uniform three phase motor winding temperature.
- Build-in overload protector.

2.1 COMPRESSOR TEST CONDITION

Table 2.1 Test condition

TEST CONDITIONS (RATING POINT)	APPLICATION	EVAPORATING TEMPERATURE °C	CONDENSING TEMPERATURE °C	RETURN GAS TEMPERATURE °C	SUB-COOLING	AMBIENT TEMPERATURE °C
EN 12900	LBP	-35	40	20	NO SUB-COOLING	35
	MBP	-10	45			
ARI 540 (2015)	LBP	-31.6	40.6	4.4	NO SUB-COOLING	35
ARI 540 (2004)	HBP	-6.7	54.4	48.9	NO SUB-COOLING	35

2.2 COMPRESSOR COOLING TYPES

Scroll compressors are designed as static, not requiring forced ventilation cooling. Its cooling is secured by refrigerant. Ambient temperature has very little impact on compressor performance.

3. COMPRESSOR APPLICABLE STANDARDS AND REGULATIONS

Compressors comply with the latest European standards and regulations and are marked with CE mark.

- Low Voltage Directive 2014/35/EU.
- Machinery Directive 2006/42/EC.
- Pressure Equipment Directive (PED) 2014/68/UE.
- RoHS II Directive 2011/65/EU.
- REACH Regulation (EC) 1907/2006.

4. EMBRACO RELEVANT DOCUMENTS

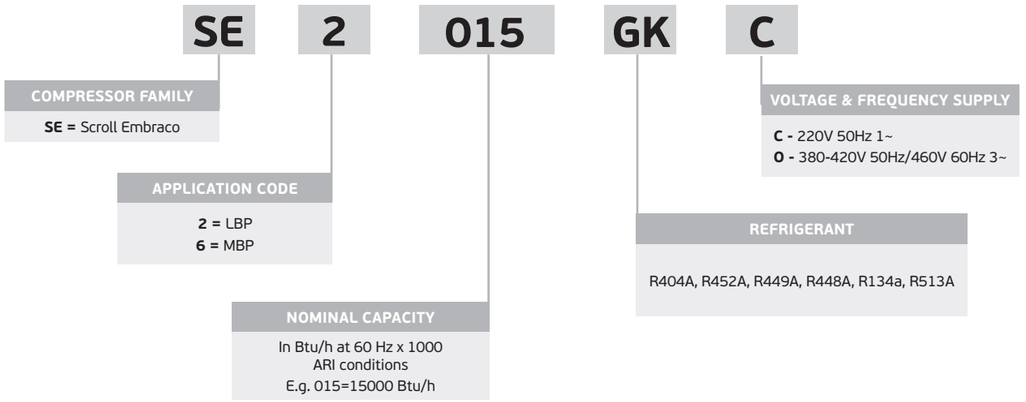
- **Embraco Product Selector** on **www.embraco.com**
- Scroll Installation instructions.

Check available documents on **www.embraco.com** or contact Embraco Technical support team.

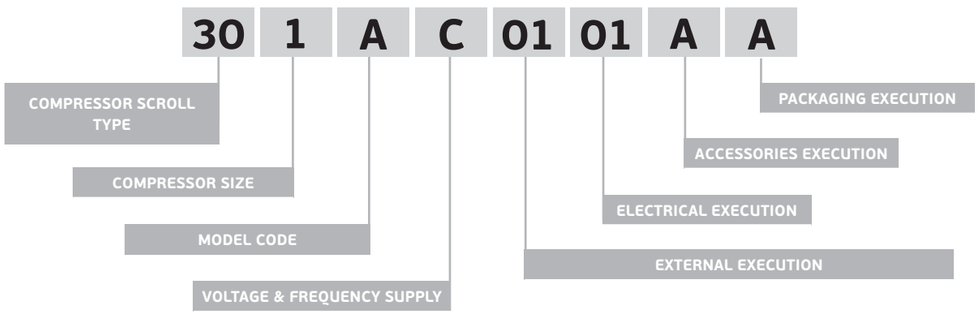
5. COMPRESSOR NOMENCLATURE

Information printed on compressor label: model, voltage and frequency supply, bill of material.

5.1 COMPRESSOR MODEL CODE



5.2 COMPRESSOR BILL OF MATERIAL CODE



5.2.1 COMPRESSOR SIZE

1 – MBP models for 2-6hp
2 – MBP models for 7-13hp
3 – LBP models for 2-6hp
4 – LBP models for 7-13hp

5.2.2 VOLTAGE AND FREQUENCY SUPPLY

*Table **5.2.2***

VOLTAGE CODE	RATED VOLTAGE & FREQUENCY
C	220V 50HZ 1~
O	380-420V 50HZ / 460V 60HZ 3~

5.2.3 EXTERNAL EXECUTION

*Table **5.2.3***

EXTERNAL EXECUTION	COMPRESSOR SIZE	APPLICATION	CONFIGURATION TYPE
01	2-6 hp	MBP	Brazing connection; discharge tube ID Ø12.92mm ±5; suction tube ID Ø22.4mm ±5; oil sight glass.
02	2-6 hp	LBP	Brazing connection; discharge tube ID Ø12.92mm ±5; suction tube ID Ø22.4mm ±5; Liquid Injection with DTC valve; oil sight glass.
03	7-13 hp	LBP	Brazing connection; discharge tube ID Ø22.47mm; suction tube ID Ø28.83mm; Liquid Injection with DTC valve; oil sight glass.
04	7-13 hp	MBP	Brazing connection; discharge tube ID Ø22.47mm; suction tube ID Ø28.83mm; oil sight glass.
11	2-6 hp	MBP	Rotolock connection; threaded discharge connection 3/4"-16 UNF 2A, ID Ø9mm; threaded suction connection 1 1/4"-12 UNF 2A, ID Ø19.2mm; oil sight glass.
12	2-6 hp	LBP	Rotolock connection; threaded discharge connection 3/4"-16 UNF 2A, ID Ø9mm; threaded suction connection 1 1/4"-12 UNF 2A, ID Ø19.2mm; Liquid injection with DTC valve; oil sight glass.
13	7-13 hp	LBP	Rotolock connection; threaded discharge connection 1 1/4"-12 UNF 2A, ID Ø19.2mm; threaded suction connection 1 3/4"-12 UNF 2A, ID Ø26.4mm. Liquid Injection with DTC valve; oil sight glass.
14	7-13 hp	MBP	Rotolock connection; threaded discharge connection 1 1/4"-12 UNF 2A. ID Ø19.2mm; threaded suction connection 1 3/4"-12 UNF 2A, ID Ø26.4mm; oil sight glass.

5.2.4 ELECTRICAL EXECUTION

*Table **5.2.4***

EXECUTION	MOTOR TYPE	CONFIGURATION TYPE
01	3 PHASE	Internal overload protector, terminal cover with gasket and wiring diagram, grounding screw.
04	1 PHASE CSR	CSR box with start and run capacitor, Internal overload protector, terminal cover with gasket and wiring diagram, grounding screw.

5.2.5 ACCESSORIES EXECUTION

*Table **5.2.5***

EXECUTION	CONFIGURATION TYPE
A	Grommets, sleeves, tube plug, DTC valve included for LBP

5.2.6 PACKAGING EXECUTION

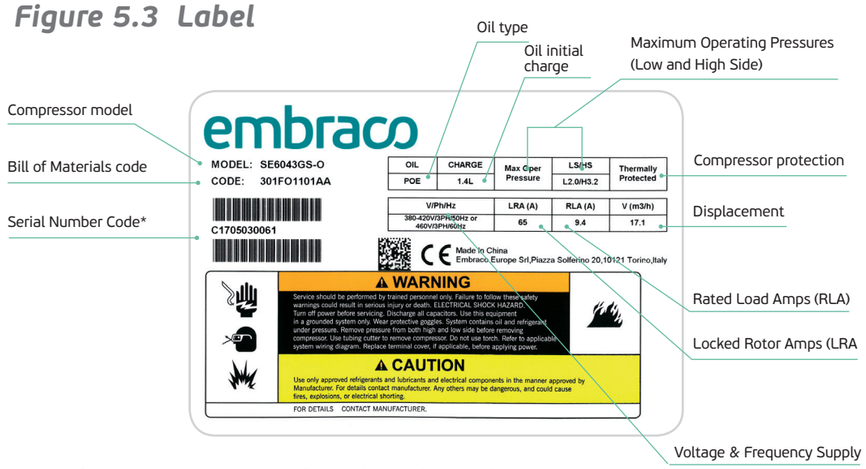
*Table **5.2.6***

EXECUTION	PCS PER PALLET
A	9
B	12 (for compressors 7-13 hp)
C	16 (for compressors 2-6 hp)

***Note:** See* Chapter **15** *for detailed information about packaging.*

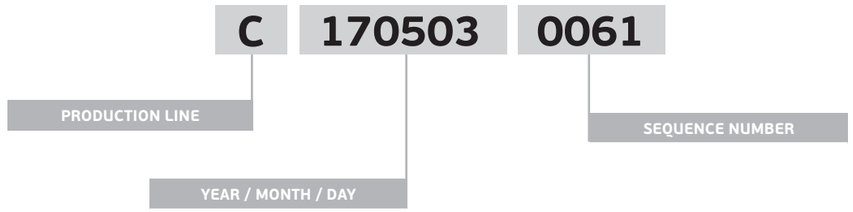
5.3 COMPRESSOR LABEL

Figure 5.3 Label



* Manufacturing Date is part of Serial Number Code.

5.3.1 SERIAL NUMBER CODE



6. PRODUCT DESCRIPTION

6.1 APPLICATION DESCRIPTION

Each compressor model is intended for specific refrigerant and application. Their use in different application and/or with different refrigerant may result in significant impact to motor-compressor performance, life expectancy or even may result in personal injury and damages.

LBP (Low Back Pressure) scroll compressors are designed to correspondent to the latest scroll technology of refrigeration for low temperature application; including special scroll set design, dynamic discharge valve and injection system. These special designs result in a compressor that is suitable for the most demanding refrigeration applications with efficiencies comparable to the semi-hermetic piston compressors.

LBP models are optimized for low temperature applications with discharge temperature management, working down to -40°C of evaporating temperature; for instance commercial and professional refrigeration application, frozen food cabinets, frozen food display cases, cold rooms, frozen products, environmental test chambers.

MBP (Medium Back Pressure) scroll compressors are designed to correspondent to the latest scroll technology of refrigeration for medium temperature applications.

MBP models are optimized for medium temperature applications, able to run down to -30°C of evaporating temperature without injection solution; for instance commercial and professional cabinets, fresh products cabinets, ice machines, milk coolers and cold room.

6.2 APPROVED REFRIGERANTS

Usage of different refrigerants can generate abnormal working conditions, excessive pressure in the refrigeration system, damages of the compressor and explosions.

All operations related to the use of refrigerants shall be performed only by trained and qualified technicians and in accordance with applicable International and National standards, laws and regulations related to this subject.

Users must have available and understand the applicable HFCs Material Safety Data Sheets (MSDSs).

When selecting the refrigerant, it is important to measure different aspects the environment would require: legislations, standards, cost, availability, and surely the applications. Thanks to its specific technology, the scroll allows the compressor to run as multi refrigerant product, Embraco has therefore qualified the range with the following refrigerants:

Table ***6.2 Approved refrigerants***

APPLICATION	REFRIGERANTS					
	R404A	R452A	R449A	R448A	R134a	R513A
LBP	✓	✓	✓	✓	X	X
MBP	✓	✓	✓	✓	✓	✓

R404A is an HFC refrigerant without any ozone depletion (ODP=0) and suitable for medium temperature and low temperature applications, it is near an azeotropic mixture and the glide effect is negligible. It has to be charged in liquid phase.

R452A is a HFC/HFO blend, it contains R125/R32/R1234yf, but belong to A1 safety class (GWP: 2140; ODP: 0), originally developed for transport application, it can also be used in commercial refrigeration in both medium and low temperature applications with similar performances than R404A. It can therefore be used in new installations as well as retrofit of existing installations.

R449A is a HFC/HFO blend, it contains R125/R32/R134a/R1234yf, low GWP (1397), no ozone depletion (ODP=0) and belong to A1 safety class. It can be used for medium and low applications.

The impact of its glide (6,1K) and higher discharge temperature has to be taken consideration for retrofit; an audit of the heat exchangers, expansion devices has to be done before final decision.

R448A is a non flammable HFC/HFO blend. It contains R125/R32/R134a/R1234yf/R1234ze, low GWP (1387), no ozone depletion (ODP=0) and belong to A1 safety class. It can be used for medium and low applications. The impact of its glide (6,3K) and higher discharge temperature has to be taken consideration for retrofit; an audit of the heat exchangers, expansion devices has to be done before final decision.

R134a is a pure refrigerant with zero glide and low GWP (1430), it is only qualified for medium temperature application.

R513A is a HFO refrigerant, it contains R1234yf/R134a, low GWP (631), no ozone depletion (ODP=0) with zero glide and belong to A1 safety class. It is qualified for medium temperature application, suitable for new installations as well as retrofit of existing installations.

6.2.1 REFRIGERANTS GENERAL INFORMATION

Table ***6.2.1***

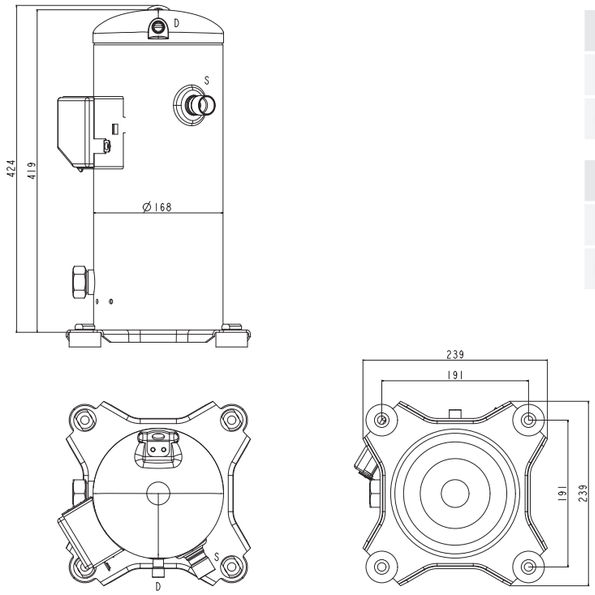
ACCORDING TO EN378	R404A	R452A	R449A	R448A	R134a	R513A
CHEMICAL NAME	Mixture R125/R143a/ R134a	Mixture R32/R125/ R1234yf	Mixture R32/R125/ R1234yf/ R134a	Mixture R32/R125/ R1234yf/R134a/ R1234ze (E)	1,1,1,2-tetrafluoro-ethane	Mixture R134a/R1234yf
MOLECULAR FORMULA	Weight % (44/52/4)	Weight % (11/59/30)	Weight % (24.3/24.7/ 25.3/25.7)	Weight % (26/26/20/21/7)	CH2FCF3	Weight % (44/56)
SAFETY CLASS (1)	A1	A1	A1	A1	A1	A1
PED FLUID GROUP	2	2	2	2	2	2
PRACTICAL LIMIT [kg/m³] (2)	0.52	0.423	0.357	0.388	0.25	0.319
ATEL/ODL [kg/m³]	0.52	0.423	0.357	0.388	0.21	0.319
LFL [kg/m³]	NF (*)	NF (*)	NF (*)	NF (*)	NF (*)	NF (*)
VAPOUR DENSITY 25°C, 101.3 KPA [kg/m³]	3.99	4.30	3.62	3.58	4.17	4.256
MOLECULAR MASS [g/mol]	97.6	103.51	87.21	86.28	102	108.4
NORMAL BOILING POINT [°C]	– 46.5 to – 45.7	-47 to -43.2	-46 to -39.9	-45.9 to -39.8	-26	-29.05
ODP	0	0	0	0	0	0
GWP [100 yr ITH]	3922	2140	1397	1387	1430	631.4
AUTOIGNITION TEMPERATURE [°C]	728	ND	ND	ND	743	ND
CRITICAL TEMPERATURE [°C]	72.12	74.9	81.5	83.7	101.06	96.5
CRITICAL PRESSURE [kPa abs]	3734.9	4001.7	4447	4660	4059.3	3766
TEMPERATURE GLIDE AT 1 BAR ABS PRESSURE [K]	0.75	0.38	0.61	0.63	0	0.1

Note: *HFC refrigerants (R404A, R452A, R449A, R448A, R134a and R513A) are classified in Safety Class A1 - lower toxicity, no flame propagation, (according to ISO817).*

Refrigerant glide - Single component refrigerants evaporates and condense at constant temperature, bubble point temperature and dew point temperature are the same. Some refrigerants mixtures, classified as zeotropic refrigerants, have a measurable temperature change during evaporation or condensing process. This temperature change is described as „glide“. The „glide“ depends on the mixture substances and their compositions. As a consequence of „glide“, different temperatures are measured at inlet and outlet of heat exchangers. For correct performance evaluation of zeotropic refrigerants with the glide more than 1K, the average evaporator temperature and average condenser temperature shall be considered.

6.3 EXTERNAL DIMENSIONS

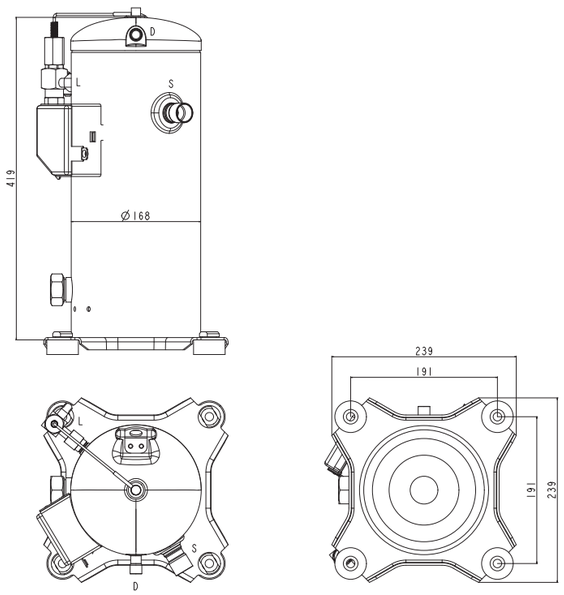
MBP_2-6 HP



BRAZING	I.D. mm	MATERIAL
S - SUCTION	22.35-22.45	COPPER PLATED STEEL
D - DISCHARGE	12.87-12.97	COPPER PLATED STEEL

ROTOLOCK	I.D. inches	MATERIAL
S - SUCTION	1 1/4"12UNF2A	STEEL
D - DISCHARGE	3/4"16UNF2A	STEEL

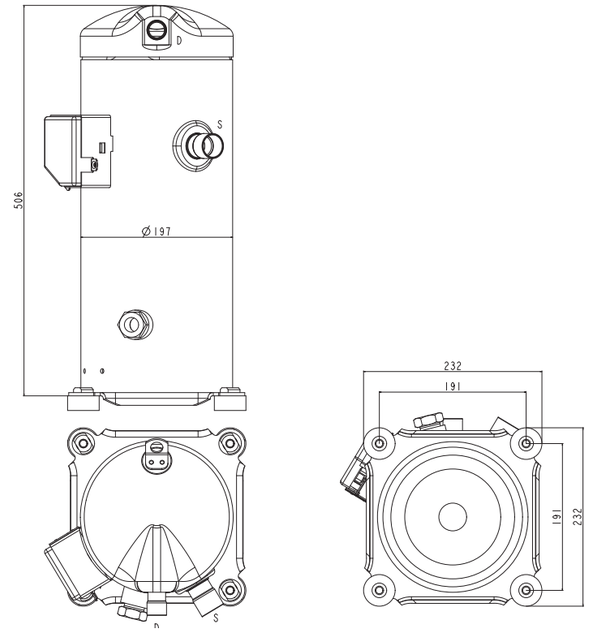
LBP_2-6 HP



BRAZING	I.D. mm	MATERIAL
S - SUCTION	22.35-22.45	COPPER PLATED STEEL
D - DISCHARGE	12.87-12.97	COPPER PLATED STEEL
L - LIQUID INJ.	3/8"	COPPER PLATED STEEL

ROTOLOCK	I.D. inches	MATERIAL
S - SUCTION	1 1/4" 12UNF 2A	STEEL
D - DISCHARGE	3/4" 16UNF 2A	STEEL
L - LIQUID INJ.	3/8"	STEEL

MBP_7-13 HP

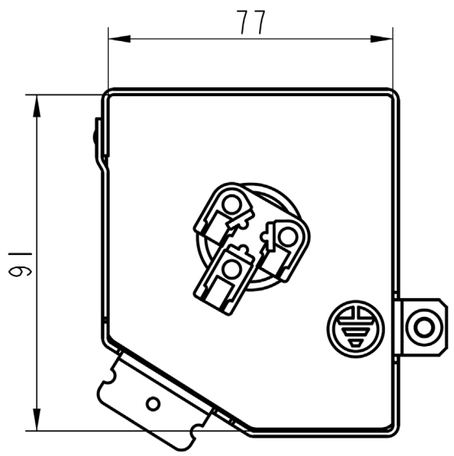


BRAZING	I.D. mm	MATERIAL
S - SUCTION	28.83	COPPER PLATED STEEL
D - DISCHARGE	22.47	COPPER PLATED STEEL

ROTOLOCK	I.D. inches	MATERIAL
S - SUCTION	1 3/4" 12UN	STEEL
D - DISCHARGE	1 1/4" 12UNF 2A	STEEL

6.4 HERMETIC TERMINAL DIMENSIONS

Figure 6.4 Hermetic terminal



6.5 SIGHT GLASS

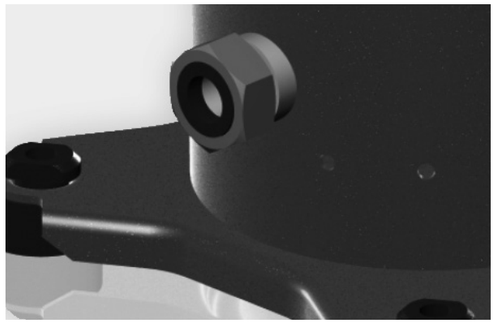


Figure 6.5 Sight glass

Compressors are equipped and delivered with threaded oil sight glass of size 1 ¼" 12UNF.

It can be used for visual check of oil, its quantity, composition or used for parallel multi compressor connections. Recommended size of wrench for sight glass nut is 36mm applying torque 55÷60Nm.

6.6 FREE INTERNAL VOLUME

*Table **6.6a Compressor free internal volume for 3 phase motor***

COMPRESSOR SIZE	FREE INTERNAL VOLUME (L)	
	LOW SIDE	HIGH SIDE
2 HP	4.1	1
2.5 - 3 HP	3.8	1
3.5 - 5 HP	3.6	1
6 HP	3.2	1
7 HP	7.3	0.9
8 - 9 HP	6.5	0.9
10 - 13 HP	6.3	0.9

*Table **6.6b Compressor free internal volume for 1 phase motor***

COMPRESSOR SIZE	FREE INTERNAL VOLUME (L)	
	LOW SIDE	HIGH SIDE
2 - 3 HP	3.6	1
3.5 - 4 HP	3.2	1

7. TECHNICAL SPECIFICATIONS

*Table **7.1** MBP - 3PH – 380V 50HZ*

PRODUCTS		R404A			R449A			R452A			R134A		
EMBRACO MODEL	HP	Cooling Capacity (W)	Power Input (W)	COP (W/W)	Cooling Capacity (W)	Power Input (W)	COP (W/W)	Cooling Capacity (W)	Power Input (W)	COP (W/W)	Cooling Capacity (W)	Power Input (W)	COP (W/W)
SE6015GS-O	2	3689	1864	1.98	3565	1735	2.05	3560	1862	1.91	2081	1093	1.9
SE6018GS-O	2.5	4405	2105	2.09	4256	1960	2.17	4250	2103	2.02	2484	1236	2.01
SE6021GS-O	3	5016	2335	2.15	4847	2173	2.23	4840	2332	2.08	2829	1369	2.07
SE6026GS-O	3.5	6322	2951	2.14	6108	2747	2.22	6100	2948	2.07	3566	1731	2.06
SE6030GS-O	4	7172	3235	2.22	6930	3011	2.3	6920	3231	2.14	4045	1897	2.13
SE6036GS-O	5	8809	3895	2.26	8512	3625	2.35	8500	3890	2.19	4969	2284	2.18
SE6043GS-O	6	10467	4628	2.26	10114	4308	2.35	10100	4623	2.18	5904	2714	2.18
SE6053GS-O	7	12685	5609	2.26	12257	5221	2.35	12240	5602	2.18	7155	3289	2.18
SE6056GS-O	8	13362	5908	2.26	12911	5499	2.35	12893	5901	2.18	7536	3465	2.17
SE6067GS-O	9	16418	7259	2.26	15864	6757	2.35	15842	7251	2.18	9260	4257	2.18
SE6078GS-O	10	18505	8182	2.26	17881	7616	2.35	17856	8173	2.18	10437	4798	2.18
SE6085GS-O	12	20246	8863	2.28	19563	8250	2.37	19536	8853	2.21	11419	5198	2.2
SE6089GS-O	13	21291	9320	2.28	20573	8676	2.37	20544	9310	2.21	12009	5466	2.2

*Table **7.2** MBP - 1PH – 220V 50HZ*

PRODUCTS		R404A			R449A			R452A			R134A		
EMBRACO MODEL	HP	Cooling Capacity (W)	Power Input (W)	COP (W/W)	Cooling Capacity (W)	Power Input (W)	COP (W/W)	Cooling Capacity (W)	Power Input (W)	COP (W/W)	Cooling Capacity (W)	Power Input (W)	COP (W/W)
SE6015GK-C	2	3689	1897	1.94	3565	1766	2.02	3560	1895	1.88	2081	1112	1.87
SE6018GK-C	2.5	4405	2213	1.99	4256	2060	2.07	4250	2211	1.92	2484	1298	1.91
SE6021GK-C	3	5016	2464	2.04	4847	2294	2.11	4840	2461	1.97	2829	1445	1.96
SE6026GK-C	3.5	6322	3010	2.1	6108	2802	2.18	6100	3007	2.03	3566	1765	2.02
SE6030GK-C	4	7172	3300	2.17	6930	3072	2.26	6920	3296	2.1	4045	1935	2.09

Testing conditions: EN12900 Te -10°C; Tc 45°C; Rg 20°C; No subcooling; Ta 35°C

*Table **7.3 LBP** 3PH – 380V 50HZ*

PRODUCTS		R404A			R449A			R452A		
EMBRACO MODEL	HP	Cooling Capacity (W)	Power Input (W)	COP (W/W)	Cooling Capacity (W)	Power Input (W)	COP (W/W)	Cooling Capacity (W)	Power Input (W)	COP (W/W)
SE2006GS-O	2	1261	1168	1.08	1171	1067	1.1	1241	1131	1.1
SE2008GS-O	2.5	1610	1480	1.09	1495	1352	1.11	1585	1434	1.11
SE2010GS-O	3	1891	1722	1.1	1756	1572	1.12	1862	1668	1.12
SE2012GS-O	3.5	2453	2233	1.1	2277	2040	1.12	2414	2163	1.11
SE2014GS-O	4	2861	2376	1.2	2656	2170	1.22	2817	2302	1.22
SE2017GS-O	5	3395	2729	1.24	3152	2492	1.26	3342	2643	1.26
SE2020GS-O	6	3977	3172	1.25	3692	2897	1.27	3915	3072	1.27

*Table **7.4 LBP** 1PH – 220V 50HZ*

products		R404A			R449A			R452A		
EMBRACO MODEL	HP	Cooling Capacity (W)	Power Input (W)	COP (W/W)	Cooling Capacity (W)	Power Input (W)	COP (W/W)	Cooling Capacity (W)	Power Input (W)	COP (W/W)
SE2006GK-C	2	1261	1178	1,07	1171	1076	1,09	1241	1141	1,09
SE2008GK-C	2,5	1610	1510	1,07	1495	1379	1,08	1585	1463	1,08
SE2010GK-C	3	1891	1762	1,07	1756	1609	1,09	1862	1707	1,09
SE2012GK-C	3,5	2453	2281	1,08	2277	2083	1,09	2414	2209	1,09
SE2014GK-C	4	2861	2427	1,18	2656	2216	1,2	2817	2351	1,2

Testing conditions: EN12900 Te -35°C; Tc 40°C; Rg 20°C; No subcooling; Ta 35°C

8. OPERATING CONDITIONS

8.1 AMBIENT TEMPERATURE

The ambient temperature surrounding the system strongly influences the compressor working conditions. The system must be designed and tested in order to ensure that the compressor works (at normal and abnormal expected conditions in the field) within its admitted limits (see Chapter **8.4** - Operating envelopes) at the max ambient temperature where the system will be installed.

A functional and efficient refrigeration system is the combination of various components, properly selected and assembled in order to reach the pursued safety level and performance of the finished product and respecting the admitted limits of each component.

The compressor is one of the system components: the information of these installation instructions relates only to the Embraco compressors with their standard electrical components and accessories.

8.2 COMPRESSOR SELECTION

The hermetic scroll compressors are very specialized machines, designed:

a) to work with a specific refrigerant

b) for a specific type of application (LBP or MBP)

c) for electrical supply at 50 or 60 HZ with a certain supply voltage

d) to deliver a certain cooling capacity

e) to operate in certain admitted working range

f) to be properly installed

Correct function of defined compressor and related electrical accessories is possible only if requirements mentioned in points a)...f) are assured. Working out of the defined limits may result in malfunction of the compressor caused damages to properties and injuries to persons.

The compressor cooling capacities at various evaporating temperatures, with condensing temperatures as parameter are indicated in the Technical datasheets in the **Embraco Product Selector** on **www.embraco.com**

For each compressor use only the refrigerant indicated in *Table* ***6.2*** Approved refrigerants. Usage of different refrigerant can generate abnormal working conditions, excessive pressure in the refrigeration system, damages of the compressor and explosions.

8.3 SUPPLY VOLTAGES AND FREQUENCIES

The compressor must be selected according to the voltage and frequency conditions where the installation will operate in the field.

Verify that the voltage fluctuations are within the admitted limits of the selected compressor (see *Table* ***10.1***). Voltage must be measured at the compressor electrical pins at the start and running at the max load.
As it is not allowed to run the compressors without the terminal cover properly fixed on the terminal fence, this measurement must be taken outside the cover, as close as possible to compressors pins.

Deviations of the supply voltage from the approved limits may impact the overload protector actuation and damage the compressor and other parts.

For the compressor connection to the electrical supply line and for maintenance/repairing operation, refer also to Appendix 1 – Recommendations – safety instruction for compressors installation.

The correct sizing of the electric supply cables is important to guarantee low voltage drops at compressor start and during running under high load.

8.4 OPERATING ENVELOPES

The The Operating Envelops represented in this section, are valid for all models of scroll compressors for correspondent application and refrigerant used.

Compressors are developed and approved as multirefrigerant solutions; means that the same compressors model or Bill of Material can use different refrigerant based on customer need.

List of approved refrigerants is indicated in *Table* ***6.2*** – Approved refrigerants and/or Chapter **7** – Technical specification.

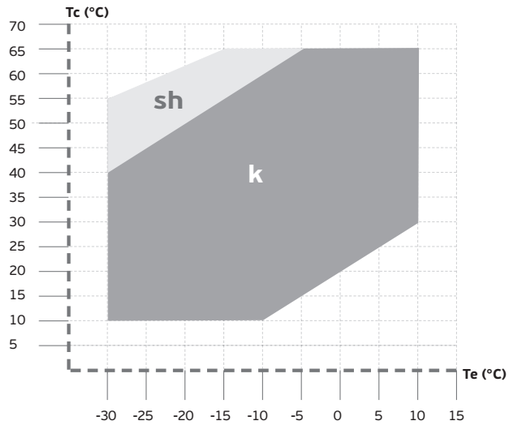
Scroll compressors are designed and approved:

MBP - up to 65°C of Condensing temperature for refrigerants R404A, R449A, R448A, R452A; and up to 75°C with refrigerant R134a, R513A

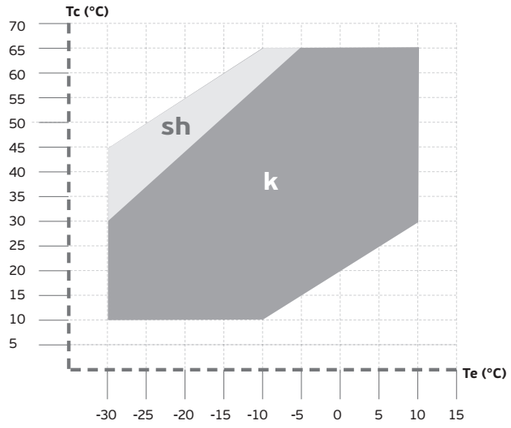
LBP - up to 65°C of Condensing temperature for refrigerants R404A, R449A, R448, R452A

Figure ***8.4*** **OPERATING ENVELOPES**

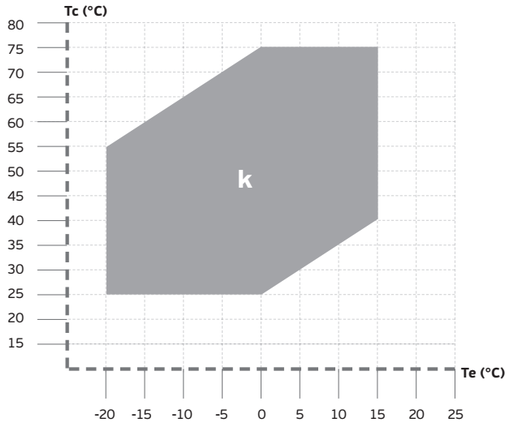
MBP - R404A/R452A



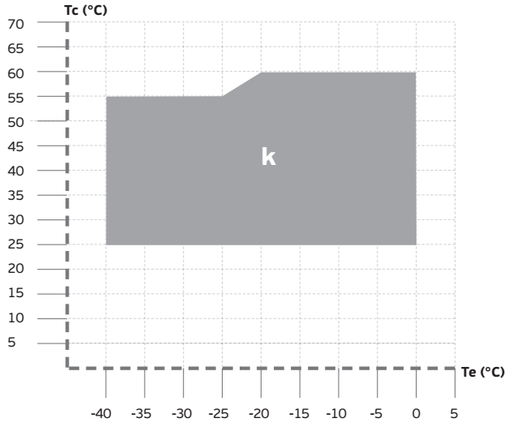
MBP - R449A /R448A



MBP - R134a/R513A



LBP R404A/R452A/R449A/R448A



Legend

Tc: Condensing Temperature °C

Te: Evaporating Temperature °C

k: Operating condition. Ambient 35°C, return gas temperature 20°C

sh: Superheating area; 11.1k

8.5 LOW AMBIENT OPERATION

Even if the compressor can work in low ambient conditions, the system may require specific design or recommendations to ensure compressor working conditions to remain inside the application envelop.

In the low ambient temperature, normally, the cooling load will be lower. To avoid the liquid flood back .

during the operation, the expansion device should be designed to maintain the minimum and stable superheat. Short cycle of start/stop should be avoided, see Chapter **8.10** – Compressor On/off cycling.

The system should be verified by testing.

To prevent the flood start, a crankcase heater is required to avoid the compressor being the coldes point of the installation. It has to be put in operation at minimum 12 hours before the first time start up. Despite the radial compliance of our scroll compressors, the usage of a suction accumulator can be required, according to the refrigerant charge of the system and refrigerant charge limits of the compressor see Chapter **8.8** – Accumulator.

HP control pressure management like fan speed controller or regulating pressure switch for the condenser fan is required to ensure the discharge pressure will never be lower than the minimum saturated condensing temperature of the compressor envelop. And also maintain the enough pressure difference between the discharge and suction pressure, to guarantee the right operation of the expansion device.

If the refrigerant is charged on the site, the adequate refrigerant quantity should be monitored by the scale before start the compressor.

In case of ultra low ambient temperature; both the suction and discharge pressure inside the system will be very low after a long time off period. When the compressor start up, because there is no enough pressure difference between both sides of the expansion device, there will be no enough refrigerant to pass the expansion device, the suction line pressure will be lower and the low pressure switch will cut off the compressor running. In this case, because the pressure of the high side is also very low, it is impossible for the suction pressure to arrive at the reset point of the low pressure switch, the compressor can't start again. Some methods should be considered to maintain the pressure inside of the receiver during the long time off period. Never short the circuit of the low pressure switch.

8.6 REFRIGERANT CHARGE

Avoid the liquid or gaseous refrigerants from vessel to come in contact with human body. Skin, eyes may be permanently damaged; use personal safety equipment (gloves, goggles).

Refrigerant charge amount depends from the internal volume of the system, its design and working conditions, from the type of refrigerants and safety limits.

For each system, the optimal refrigerant charge should be determined by appropriate lab tests in order to optimize the working conditions and energy consumption.

It is recommended to charge the system using the weighted charge method, using high side of the system.

Do not exceed the recommended charge limits or implement safety device (i.e. suction accumulator). Never charge liquid to the low side at the start of the charging procedure, refer to Chapter **11.6 -** Charging process.

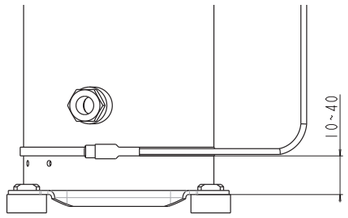
Table ***8.6*** **MAXIMUM RECOMMENDED REFRIGERANT CHARGE FOR ALL APPROVED REFRIGERANTS**

COMPRESSOR SIZE	MAXIMUM CHARGE (KG)
2 HP	2.8
2.5-3 HP	3.5
3.5-5 HP	4.5
6 HP	5.5
7 HP	6.5
8-9 HP	8
10-13 HP	10.5

SE scroll compressors are tolerant to liquid refrigerant, despite it, Embraco recommends avoiding this running condition. If the refrigerant charge is higher than the limits listed in the upper table, it is recommended to use additional protections in the system to ensure proper running conditions (piping design, suction accumulators, crankcase heaters, pump down).

8.7 CRANKCASE HEATER

Figure 8.7 Crankcase heater dimension



Crankcase heater is used to prevent refrigerant migration into the compressor shell during compressor off. It is suggested to be installed on all compressors for refrigeration application. It should be active at minimum 12 hours before the first compressor start and be active when compressor is off. This will prevent oil dilution and bearing stress on initial start up.

The crankcase heater must be mounted below the oil sight glass approximately 10-40 mm from the compressor bottom.

Table ***8.7 Recommended crankcase heaters***

MODEL	ALTERNATIVE 1			ALTERNATIVE 2			COMPRESSOR DIAMETER (mm)
	VOLTAGE (V)	NOMINAL POWER (W)	LENGTH (mm)	VOLTAGE (V)	NOMINAL POWER (W)	LENGTH (mm)	
SE6015-SE6043	220	70	490	230	70	480	168
SE6053-SE6089	220	90	590	230	70	570	197
SE2006-SE2020	220	70	490	230	70	480	168

The compressor is safe to start without crankcase heater when the refrigerant charge quantity is less than recommended charge limit (see Table in Chapter **8.6**). but nevertheless Embraco recommends usage of the crankcase heater.

8.8 ACCUMULATORS

Due to the inherent ability of scroll to handle liquid refrigerant in flooded start and defrost cycle operation conditions, accumulators may not be required. An accumulator is suggested on single compressor 2-6 hp systems when the charge limitations exceed 4.5kg, and on the single compressor 7-12 hp systems when charge limitations exceed 8kg. On systems with defrost schemes or transient operations that allow prolonged uncontrolled liquid return to the compressor, an accumulator is required unless a suction header of sufficient volume to prevent liquid migration to the compressor is used.

Excessive liquid flood back or repeated flooded starts will dilute the oil in the compressor causing inadequate lubrication and bearing wear. Proper system design will minimize liquid flood back, thereby ensuring maximum compressor life.

In order to assure that liquid refrigerant does not return to the compressor during the running cycle, attention must be given to maintaining proper superheat at the compressor suction inlet. Recommended is 5-8K superheat, measured on the suction line 150mm from the suction port, to prevent liquid refrigerant flood back.

Another method to determine if liquid refrigerant is returning to the compressor is to accurately measure the temperature difference between the compressor bottom shell and the suction line. During continuous operation we recommend that this difference be a minimum of 25°C. To measure oil temperature through the compressor shell, place a thermocouple on the bottom center (not the side of the suction) of the compressor shell and insulate from the ambient.

During rapid system changes, such as defrost or ice harvest cycles, this temperature difference may drop rapidly for a short period of time. When the crankcase temperature difference falls below the recommended 25°C; duration should not exceed a maximum (continuous) time period of two minutes and should not go lower than a 12°C difference.

8.9 PUMP DOWN RECOMMENDATIONS

Refrigeration scroll compressors use a low-leak discharge valve to prevent high pressure backflow into the low side. Typically, this check valve prevents system pressures from equalizing and pump down can be achieved. If short cycling cannot be avoided, using a 3-minute time delay will limit the cycling of the compressor to an acceptable level.

For the single phase MBP compressors, there is a small balance port on the discharge check valve to balance the high and low side inside of the compressor when the compressor is stoped, if pump down is applied, an external check valve on the discharge line is suggested.

8.10 COMPRESSOR CYCLING

System normal cycling is 6-12 cycles per hour (depending on application); with sufficient continuous run time to ensure the proper return of the oil to the compressor and enough motor cooling.

The suggested minimum continuous running time is 3 minutes. To avoid frequent start/stop, the minimum interval between the stop and next start is 3 minutes.

It is recommended to use delay timer to limit compressor cycling.

Compressor pumps oil in the system (small weight percentage of the pumped refrigerant) during running. At compressor starting oil may be pumped in higher amount; after each start the compressor has to run for an enough long time (depending on system design) to assure the oil returns to the compressor. Contact **Embraco Technical support team** if more info is needed.

Significant increase of cycling may impact oil circulation and overheat the motor. It results in early damage of the compressor motor and in single phase application to demage of its components - relay, start and run capacitor.

8.11 SHELL TEMPERATURE

System component failure may cause the top shell and discharge line to briefly reach temperatures above 150°C. Materials (e.g. wires), which could be damaged by these temperatures, should not come in contact with the shell.

The plastics used on the installation bases where the compressor is installed must be self-extinguishing.

8.12 MAXIMUM DISCHARGE GAS PRESSURES AND TEMPERATURES

Systems shall be designed for Maximum operating pressures according to applicable standards (EN 378 or similar applicable standards) that must not be exceeded.

In any case, for Embraco compressors the maximum pressure peak, during "Pull-Down", the maximum pressures under continuous running and the maximum discharge gas temperature under continuous running, shall be kept below the values indicated in follow Table:

*Table **8.12 12 Discharge gas maximum pressures/temperature***

REFRIGERANT	APPLICATION	PULL-DOWN MAXIMUM PEAK			MAXIMUM DISCHARGE GAS TEMPERATURE CONDITIONS (°C)
		MPA (rel)	BAR (rel)	AT CONDENSING TEMPERATURE (°C)	
R404A	LBP	2.77	27.7	60	125
R452A		2.72	27.2	60	125
R449A		2.60	26.0	60	125
R448A					
R404A	MBP	3.10	31.0	65	125
R452A		3.06	30.6	65	125
R449A		2.92	29.2	65	125
R448A					
R134A		2.26	22.6	75	125
R513A		2.22	22.2	75	125

Do not use the compressor for pressurizing the system to check the pressostat limits.

The high pressure and low pressure cut-out eventually used should have a manual reset feature for the highest level of system protection.

Ensure that the discharge gas temperature is always higher than the saturation temperature (including during compressor start after long stop and defrost).

8.13 DISCHARGE LINE THERMOSTAT

8.13.1 DISCHARGE LINE THERMOSTAT FOR LBP

A discharge line thermostat can be required in the compressor control circuit. The thermostat has a cut out setting that will insure discharge line temperatures below the 125°C maximum limit. It should be installed approximately 160 mm from the discharge tube outlet. If a service valve is installed at the discharge tube, the thermostat should be located 130 mm from the valve braze. For proper operation in extremely low outdoor ambient conditions, it is recommended to insulate the thermostat to protect it against a direct air stream.

8.13.2 DISCHARGE LINE THERMOSTAT FOR MBP

Operation above, or on the left side of the operation envelope can cause high compression ratio or excessive internal compressor temperatures. This will result in overheating of the involutes, causing excessive wear resulting in premature compressor failure. If the system design can't guarantee to operate inside the operation envelope, then the discharge line thermostat is required in the compressor control circuit. The suggested highest cut out setting for the discharge line thermostat is 125°C; it should be installed approximately 170 mm from the discharge tube outlet, or approximately 130 mm from the valve outlet port.

8.14 PRESSURE CONTROLS

Both High and Low pressure switches are required on the compressor. The suggested cut out settings are indicated in below Table:

*Table **8.14 Pressure controls settings***

		R404A		R449A		R448A		R452A		R134A		R513A	
Application Type	Control Type	Mpa (rel)	Bar (rel)	Mpa (rel)	Bar (rel)	Mpa (rel)	Bar (rel)	Mpa (rel)	Bar (rel)	Mpa (rel)	Bar (rel)	Mpa (rel)	Bar (rel)
MBP	**Low**	0.20	2.0	0.16	1.6			0.18	1.8	0.13	1.32		
	High	3.24	32.4	2.39	23.9			3.13	31.3	2.39	23.9		
LBP	**Low**	0.13	1.3	0.10	1.01			0.12	1.2	--	--		
	High	2.90	29.0	2.73	27.3			2.82	28.2	--	--		

8.15 INTERNAL PRESSURE RELIEF VALVE (IPR VALVE)

Scroll refrigeration compressors with 3 phase motor have internal pressure relief valves (IPR valve), which open at a discharge to suction differential pressure of 2.76 – 3.10 Mpa (27.6-31 Bar). This action will trip the motor protector and remove the motor from the line.

Single phase compressor are not equipped with IPR valve as motor is under lower overload ability and properly protected by OLP only.

9. INSTALLATIONS

9.1 SYSTEM COMPONENTS COMPATIBILITY

All refrigeration system components shall be compatible with all approved refrigerants: R404A, R452A, R449A, R448A, R134a, R513A and the oil charged in the compressor. Substances containing chlorine, mineral oils, paraffin and silicone are not allowed.

All equipment used in the refrigerator manufacturing process that require lubrication and may come into contact with the refrigeration system components, must use exclusively polyolester oil as a lubricant (suggested viscosity 32 cSt @ 40°C).

Particular attention must be given to the internal cleanliness of the system, see Chapter **11.1** – System cleanliness, avoid entering into the system of any solid residues (dust, brazing flux, metal particles, etc.), humidity and free of debris or any particles including copper residues.

9.2 PAINTING

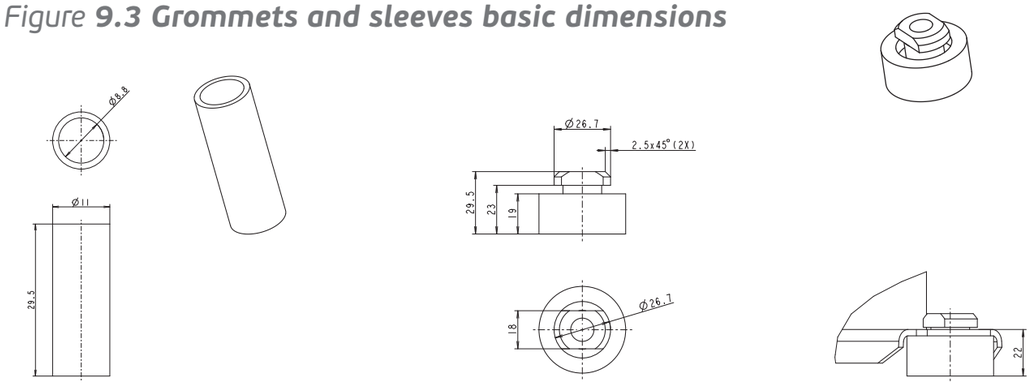
The compressor paint resists corrosion for the exposure of 5% natural salt spray of 600 hours.

9.3 GROMMETS AND SLEEVES

Embraco supplies mounting grommets that further reduce the transmission of vibration and reaction to the fixing points and tube of the system. Base plate of the installation must have sufficient mass and stiffness to further reduce transmission of residual vibrations.

Components of this external suspension system are supplied partly by Embraco (rubber grommets and sleeves) while the remaining components for their blocking - screws, washers and nuts, have to be sourced by the customer. It is recommended to use screw M10 with tightening torque 12-14Nm.

*Figure **9.3 Grommets and sleeves basic dimensions***



It is very important that these components are assembled correctly in order to guarantee the proper clearance (approximately 1.5mm) between the rubber grommet and flat washer, fixed between nut and sleeve.

For condensing units with scroll compressors it is recommended to use rubber grommets which are delivered together with compressors.

9.4 MOUNTING FOR RACK SYSTEMS

The usage of standard grommets is not recommended for most refrigeration scroll rack installations. These grommets allow for excessive movement that will result in tube breakage, unless the entire system is properly designed.

For rack applications, it is recommended to use special grommets made of steel. Grommets should be formulated from a hardened material specifically designed for refrigeration applications. Hardened material limits compressor motions, which minimize potential problems of excessive tubing stress. Adequate insulation is provided to prevent vibration from being transmitted to the mounting structure. This mounting arrangement is recommended for multiple compressor rack installations. For more information, contact **Embraco** Technical Support team.

9.5 SCREENS

Screens with a mesh size finer than 30 x 30 (0.6mm openings) should not be used anywhere in the system with scroll compressors.

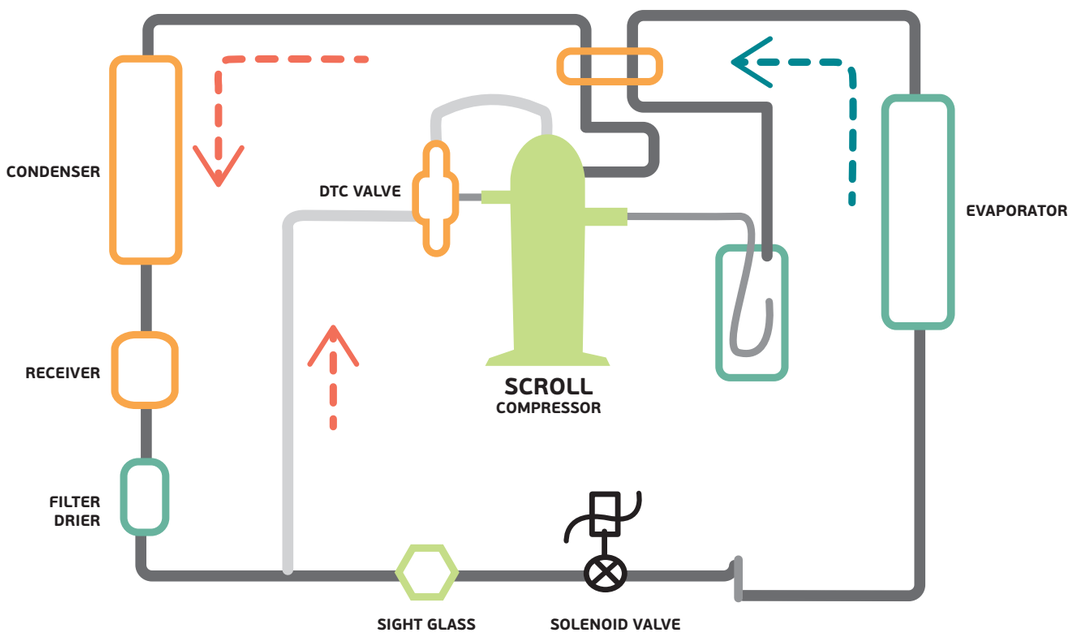
9.6 LIQUID INJECTION

Scroll compressor for LBP application is supplied with an injection port suitable for connection to a liquid refrigerant source. This port is connected to an inner pocket of the scroll mechanism. As pocket is perorated from the suction inlet, there is no loss of replacement capacity results from injection at this point.

Refrigerant injected in this manner must include the system components listed on the following instructions.

Failure to follow these instructions can result in liquid refrigerant completely filling the scroll during an “off” cycle. When power is reapplied in this condition, the hydraulic effect produced can result in pressures high enough to cause permanent damage to the compressor scroll sets. It is a condition of warranty that these components are properly installed.

The advantage of this type of injection system is that it tends to be self regulating i.e., as the pressure differential across the capillary tube increases, the amount of liquid fed to the compressor also increases. Since more cooling is needed at high compression ratio conditions, this “automatic” increase in liquid feed is exactly what is needed. For the liquid injection system to be effective, a minimum of 3K sub-cooled liquid at the capillary inlet is required. However, DO NOT use mechanically cooled sub-cooled liquid. The cap tube will be oversized under this condition and will dilute the oil in the compressor shell.



9.7 SOLENOID VALVE

A solenoid valve with a minimum 3mm orifice must be provided in the injection circuit that opens whenever the compressor is operative or cooling is required during pump down. The solenoid must be closed when the compressor is cycled off.

Note: *Not required if DTC valve is used.*

9.8 CURRENT SENSING RELAY

To prevent the solenoid valve from remaining open during a motor protector trip, current sensing relay must be sensitively designed to act whenever the compressor is off, and closes the solenoid to stop injection.

Note: *These parts are Not required if DTC valve is used.*

The following components are not required, but they are recommended for liquid injection:

- Sight Glass just before the capillary tube inlet is recommended to allow visual inspection for the presence of liquid refrigerant.
- Filter/Drier installed in the injection circuit is recommended to avoid the possibility of capillary tube blockage due to contaminants.

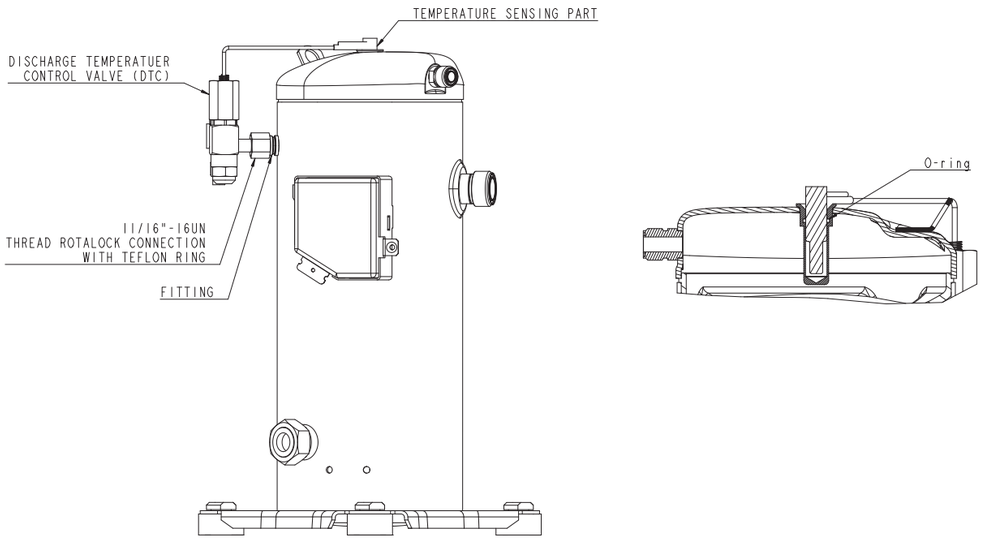
9.9 TEMPERATURE RESPONSIVE EXPANSION VALVE (TXV)

It is possible to use a TXV (temperature responsive expansion valve) valve to realize the liquid injection. When the discharge temperature is higher than the settings, the valve will open. Based on discharge temperature detected by the bulb, valve opening degree is set. Liquid refrigerant will be fed into the injection port; the injection flow will change according to the discharge temperature. The purpose of this valve is to eliminate the need for a capillary tube on the LBP scroll model family.

Suggested valve specifications: Opening Setpoint: 90°C ±3°C

The valve bulb must be installed properly on the thermal top cap to adequately control scroll temperatures. The valve should be tightened on the injection fitting to a torque of 25 - 28 Nm.
A 90° orientation on the valve is recommended, however it will function properly in any orientation. Avoid contact of capillary tube (connecting the valve to the bulb) with compressors during operation. Do not bend the capillary tube within 25mm of the valve.

*Figure **9.9 Assembly of valve bulb***



9.10 SUGGESTED APPLICATION TECHNIQUES

For the most efficient thermal sensing, spread a thin film of thermal grease around the DTC Valve bulb before installing into the top cap well. However for proper functioning of the valve this is not required.

At your discretion, field serviceability can be improved by installing a shut-off valve in the liquid line just before the DTC Valve. The valve requires a solid column of liquid. A liquid line sight glass could be applied to visually insure liquid flow.

9.11 COMPRESSOR OR VALVE SERVICE

1. Replacing a LBP scroll compressor using capillary tube, liquid injection solenoid and current sensing relay: The compressor and DTC Valve eliminate the need for the solenoid and current sensing relay. These devices may be left on if desired, but they are not required.
2. Replacing a LBP compressor using the DTC Valve:
   We recommend replacing both the DTC Valve and the compressor at the same time. If you wish to use the existing DTC Valve, the valve filter should be taken out and cleaned and/or replaced.
3. Replacing a DTC Valve on a LBP compressors:
   Before replacing the DTC Valve, clean and/or change the filter to verify there is an unobstructed column of liquid to the valve.

9.12 CONNECTORS

9.12.1 COMPRESSOR PRESSURIZATION

Compressors are delivered pressurized to a pressure of about 0.3-0.35 bar with dry nitrogen and must be evacuated before implemented in the system.
We suggest removing the rubber plugs from the connectors of the compressor (keep it in upright position) in the following sequence: discharge, suction. The rubber plugs should be removed with care to avoid oil loss.

The compressor tubes are sealed with caps to avoid contamination by external air and humidity entering inside the compressor.

9.12.2 CONNECTORS BRAZING PROCESS

Welders must be trained and qualified technicians and all applicable safety regulations and procedures must be adopted.

Do not allow the flame from the torch to reach the housing during the brazing of the compressor connectors in order to avoid overheating, damages and oil carbonization on the compressor's internal shell wall.

Do not allow the flame from the torch to approach the "hermetic terminal (fusite)" in order to avoid the cracking of the glass insulating material of the pins and subsequent refrigerant, oil leaks and short circuits.

To minimize any entry of contaminants and humidity, the compressor should remain open no more than 3 minutes between the extraction of the tube rubber plugs and the system tubes brazing.

System components should remain sealed as long as possible before their assembly. The brazing of the components to the system should be carried out no later than 15 minutes after their assembling. We suggest removing the rubber plugs from the connectors of the compressor (keep it in upright position) in the following sequence: discharge, suction.

9.12.3 TUBE BRAZING

- Disconnect compressor from electrical wiring.
- The copper plated steel connectors on scroll compressors can be brazed in approximately the same manner as any copper connector.
- Recommended: brazing material with a minimum of 5% silver.
- Use of a dry nitrogen purge to eliminate possibility of carbon buildup on internal connector surfaces is recommended.
- Be sure process connector fitting I.D. and process connector O.D. are clean prior to assembly.
- Remove the discharge plug at first, and then remove the suction plug.
- Apply heat in copper connector. As connector approached brazing temperature, move torch flame to the joint.
- Heat the joint area until braze temperature is attained, moving torch up and down and rotating around connector as necessary to heat connector evenly. Add braze material to the joint while moving torch around circumference.
- After braze material flows around joint, move torch to heat fitting. This will draw the braze material down into the joint. The time spent heating the compressor connector close to the compressor shell should be minimal.
- As with any brazed joint, overheating may be detrimental to the final result.

9.12.4 TUBE DISCONNECTS

Recover refrigerant from both the high and low side of the system. Failure to do so may result in serious personal injury.

- Check the high and low pressure side with pressure gauge to make sure there is no pressure inside.
- Heat joint area until the braze material softens and pull out the tube.

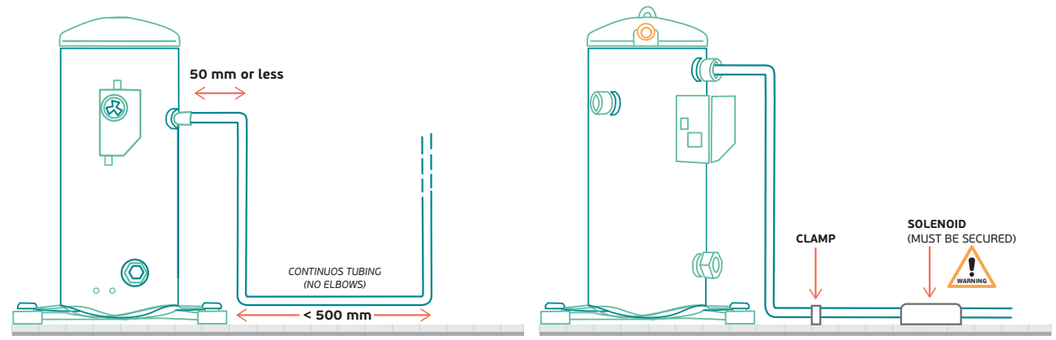
As there is a check valve close to discharge connector, take care to not overheat it and prevent brazing material to flow into it.
Compressor mounting must be selected based on application. Consideration must be given to sound reduction and tubing reliability. Some tubing geometry or “shock loops" may be required to reduce vibration transferred from the compressor to external tubing.

9.12.5 TUBING SELECTION

Proper tube design must be taken into consideration when designing the tubing connecting of the scroll to the remaining system. The tubing should provide enough “flexibility” to allow normal starting and stopping of the compressor without exerting excessive stress on the tube joints. In addition, it is desirable to design tubing with a natural frequency away from the normal running frequency of the compressor. Failure to do this can result in tube resonance and unacceptable tubing life, *Figure* ***9.12*** shows examples of acceptable tubing configurations.

The examples are intended only as guidelines to depict the need for flexibility in tube designs. In order to properly determine if a design is appropriate for a given application, samples should be tested and evaluated for stress under various conditions of use including voltage, frequency, and load fluctuations, and shipping vibration. The guidelines above may be helpful; however, testing should be performed for each system designed.

Figure ***9.12 Tubing configurations***



Notes:

- *The above tubing configurations are guidelines to minimize tube stress.*
- *Follow similar guidelines for discharge tubing and oil return tubing if needed.*
- *In case of tube length of over 500 mm is required, intermediate clamps may be necessary.*
- *Do not hang weights on tubing (e.g. filter drier on suction tubing), allowed positions for weight hanging is close to clamps or header.*
- *Tube runs of less than 200 mm is not recommended.*
- *Pipe connection to compressor should be made as short as possible (e.g. 50 mm or less) but still assuring a proper braze joint.*

The above tubing recommendations are base on the lowest possible amount of joints. The use of continuous tubing is preferred.

Recommendations:

Use the copper tube special for refrigeration application, make sure there are no residual moisture, dust and impurities inside the copper tube, keep clean and dry. Remove the plug until to use it. Use special tool - tube cutter to cut the copper tube. Never cut the copper tube with a saw. Vacuum from both high pressure side and low pressure side, make sure all valves (including liquid line solenoid valve) are “on”.

Vacuum standard: Suggest to vacuum the system to below 60Pa (500umHg). Use vacuum gage to measure the vacuum degree. The gage should be put on the far end of the pump.

Never use scroll compressor to vacuum the system. During the brazing copper tube, charge the dry nitrogen into the tube continuously to avoid forming the oxide skin inside the copper tube.

9.13 CONNECTIONS

Scroll compressor connectors (suction, discharge and injection) are made of copper plated steel. They are more robust and less prone to leaks than copper tubes. Connectors are delivered with fitted rubber plugs.

Embraco offers 2 connection types: brazing and Rotolock, as per follow Table:

*Table **9.13 Available connections***

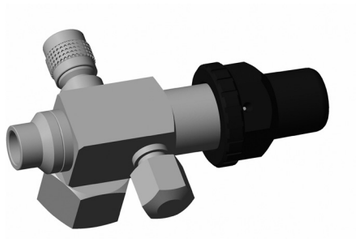
CONNECTIONS	BRAZING CONNECTION		ROTOLOCK CONNECTION	
	I.D. mm		I.D. inches	
SHELL SIZE	Suction	Discharge	Suction	Discharge
2 - 6 HP	22.35 - 22.45	12.87 - 12.97	1 1/4“	3/4"
7 -13 HP	28.83	22.47	1 3/4"	1 1/4"

9.14 ROTOLOCK VALVES

Embraco offers as additional accessories Rotolock valves. Available sizes and tightening torques are indicated in below Table:

*Table **9.14 Available connections***

ROTOLOCK VALVE	ODS	TIGHTENING TORQUE (Nm)
3/4" - 16UNF	1/2"	40
	3/8"	
1 1/4"-12UNF	5/8"	90
	3/4"	
	7/8"	
	1 1/8"	
1 3/4"-12UN	1 1/8"	120
	1 3/8"	

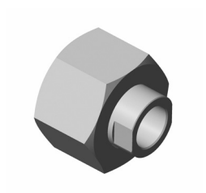


9.15 ADAPTERS

Brazing connections can be converted to thread Rotolock connection using additional accessory – Adapter, for both suction and discharge connectors. Available sizes and tightening torques are indicated in below Table:

*Table **9.15 Adapter specification***

ADAPTER	ODS	TIGHTENING TORQUE (Nm)
3/4" - 16UNF	3/8"	40
1 1/4"-12UNF	5/8"	90
	7/8"	
1 3/4"-12UN	1 1/8"	120



IMPORTANT

It is recommended to periodically check all type of connections (piping, Rotolock, fixing).

10. ELECTRICAL SPECIFICATIONS

10.1 MOTOR TYPES

CAUTION

Each compressor model has specific electrical components, indicated in the compressor Technical Datasheet in **Embraco Product Selector** on **www.embraco.com**

Avoid usage of different components.

CSR (CSCR) (**C**apacitive **S**tart & **R**un - **C**apacitor **S**tart **C**apacitor **R**un)

This motor has a start capacitor and a run capacitor. The start capacitor is connected in parallel with the run capacitor during the compressor start-up and it is disconnected by a starting relay (voltage type) at the end of the starting; the run capacitor is permanently connected in series with the start winding. Both running and start windings remain connected even after the motor starts.

3Ø (Three-phase)

Three-phase winding with star connections, this motor doesn't need a starting device.

WARNING

Operation of motor-compressor at different rated voltage than assigned (marked on the label) may result in improper function of motor-compressor, missing actuation of overload protection or even to damage or motor-compressor and/or its accessories.

It is allowed compressor operation within Voltage working range indicated in below Table:

VOLTAGE CODE	RATED VOLTAGE & FREQUENCY	VOLTAGE WORKING RANGE (*)		MINIMUM STARTING VOLTAGE (*) (**)	
		50HZ	60HZ	50HZ	60HZ
C	220V 50Hz 1~	198V – 242V	--	187V	--
O	380-420V 50Hz / 460V 60Hz 3~	342V – 462V	414V – 506V	323V	391V

WARNING

(*) With compressor working or starting within the approved Operating Envelopes, see *Figure **8.4***

(**) Minimum starting voltage refers to the minimum voltage at the compressor pins during the compressor start, It does not represent the voltage at the power supply outlet.

10.2 ELECTRICAL COMPONENTS TYPES

CAUTION

The electrical components specified for each Embraco compressor model are indicated in the Technical Datasheet or **Embraco Product Selector** on **www.embraco.com**

The type of electrical components for each type of electric motor is indicated in Table 10.2. and is supplied as compressor equipment.

WARNING

Use of other electrical components than the ones approved by Embraco (listed in the Technical Datasheets and in **Embraco Product Selector** on **www.embraco.com** for each specific model) or their exclusion may damage the compressor and other parts and cause serious injury to persons.

CSR boxes are delivered without connection cables as their length depends on installation where will be assembled. Recommended wire section for connection cables is 11 AWG as indicated in below *Table **10.2***.

*Table **10.2 Electrical components types***

MOTOR TYPE	PROTECTOR	STARTING DEVICE	CAPACITORS		CSR BOX
	INTERNAL	VOLTAGE RELAY	START	RUN	RECOMMENDED WIRE SECTION
SINGLE PHASE CSR	✓	✓	✓	✓	11AWG
3 PHASE	✓	X	X	X	X

10.2.1 ELECTRICAL COMPONENTS SPECIFICATION OF SINGLE PHASE

APPLICATION	EMBRACO MODEL	START CAPACITOR	RUN CAPACITOR	STARTING DEVICE
MBP	**SE6015GK-C**	160µF 330V	60µF 450V	HLR3800-3E3D
	SE6018GK-C	160µF 330V	60µF 450V	HLR3800-3E3D
	SE6021GK-C	160µF 330V	60µF 450V	HLR3800-3E3D
	SE6026GK-C	250µF 330V	80µF 450V	HLR3800-3H3D
	SE6030GK-C	250µF 330V	80µF 450V	HLR3800-3H3D
LBP	**SE2006GK-C**	160µF 330V	60µF 450V	HLR3800-3E3D
	SE2008GK-C	160µF 330V	60µF 450V	HLR3800-3E3D
	SE2010GK-C	160µF 330V	60µF 450V	HLR3800-3E3D
	SE2012GK-C	250µF 330V	80µF 450V	HLR3800-3H3D
	SE2014GK-C	250µF 330V	80µF 450V	HLR3800-3H3D

10.3 ELECTRICAL CONNECTIONS AND WIRING DIAGRAMS

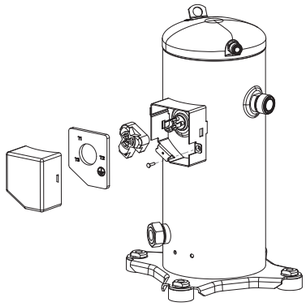
CAUTION

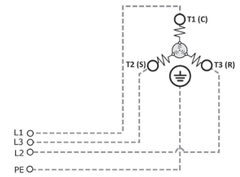
The electrical connections to the compressor must be carried out according to the wiring diagrams indicated below or in the **Embraco Product Selector** on **www.embraco.com**

Wiring diagram is printed in compressor plastic cover, including indication of terminals.

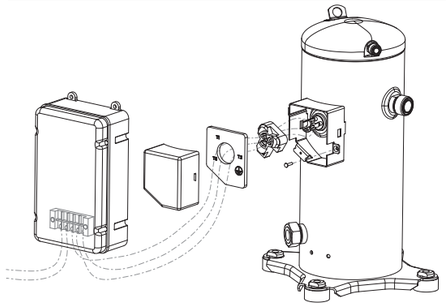
*Figure **10.3a Wiring diagrams***

SM31_3 PHASE





SM30 - CSR SINGLE PHASE



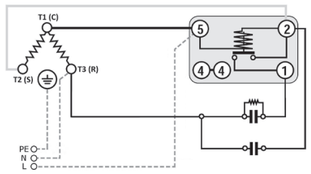


*Figure **10.3b Wiring diagrams keys***

	POTENTIAL RELAY		SINGLE PHASE MOTOR
	RUN CAPACITOR		EARTH CONNECTION
	START CAPACITOR	——	CONNECTION SUPPLIED
	3-PHASE MOTOR	- - - - -	CONNECTION TO BE MADE BY THE CUSTOMER (NOT SUPPLIED)

10.4 MOTOR PROTECTION

Compressors are protected against overheating by the conventional inherent internal line break motor protection, mounted on the motor windings.

The OLP (Overload protector) detects unusual motor temperature rise and/or abnormal high current input. The OLP trip is influenced by several factors - working conditions, suction gas density/ temperature, supply voltage, etc.

10.4.1 OVERLOAD PROTECTOR PARAMETERS

*Table **10.4.1***

MODEL	PHASE	DISC TEMPERATURE °C		TIME CHECK (A)	RESET TIME (SEC)
		OPEN (±5 °C)	CLOSE (±9 °C)		
SE6015GK-SE6021GK	Single phase	105	61	65	2~10
SE2006GK-SE2010GK					
SE6026GK-SE6030GK	Single phase	115	61	78	2~10
SE2012GK-SE2014GK					
SE6015GS	Three phase	115	60	25	3~10
SE2006GS-SE2008GS					
SE6018GS-SE6021GS	Three phase	120	60	32	3~10
SE2010GS					
SE6026GS-SE6030GS	Three phase	120	60	42	3~10
SE2012GS-SE2014GS					
SE6036GS	Three phase	145	60	41	3~10
SE2017GS					
SE6043GS	Three phase	140	60	52	3~10
SE2020GS					
SE6053GS-SE6067GS	Three phase	140	70	78	3~10
SE6078GS-SE6089GS	Three phase	120	60 ± 10	90	3~10
SE2023GS-O	Three phase	140	60	52	3~10
SE2028GS-O	Three phase	140	70	78	3~10
SE2031GS-O	Three phase	140	70	78	3~10
SE2039GS-O	Three phase	120	60 ± 10	90	3~10

10.5 DEGREE OF PROTECTION

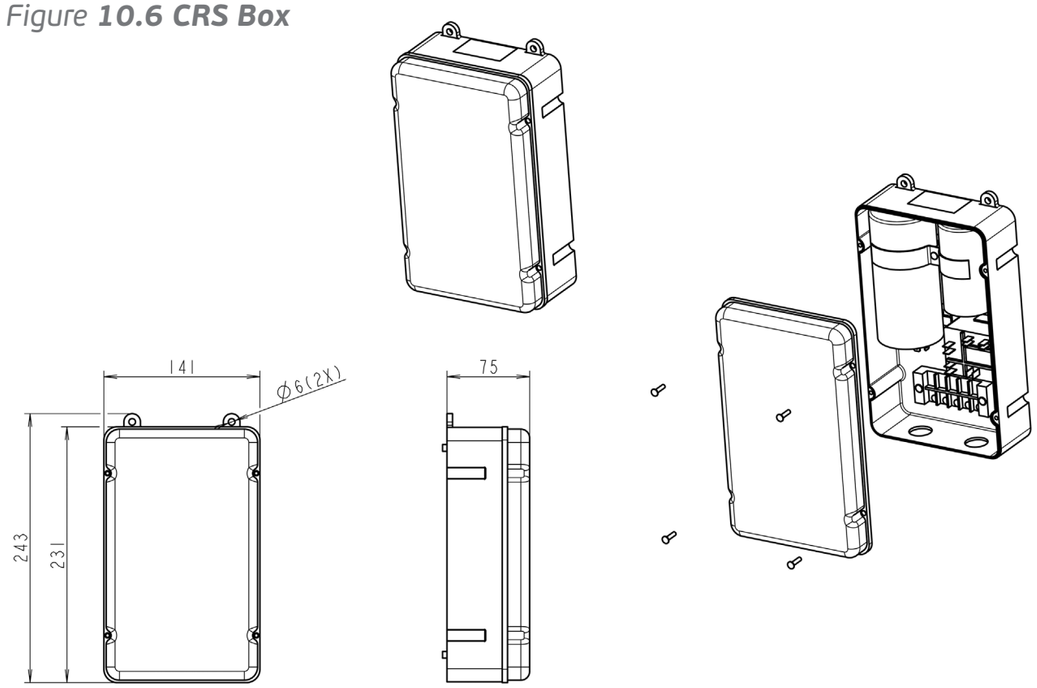
The degree of protection provided by the terminal cover and CSR box supplied with the compressor is IP21, where:

2 – protected against solid objects over 12.5 mm (fingers or similar)

1 – protected against vertically falling drops of water or condensation

10.6 CSR BOX

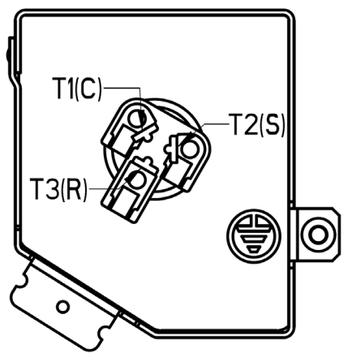
*Figure **10.6 CRS Box***



10.7 FUSITE PIN

Fusite pin orientation for both single-phase and three-phase scroll compressors is the same, shown in *Figure **10.7*** and in gasket inside of the terminal box.

*Figure **10.7 Fusite pin***



Legend

T1 (C): Common

T2 (S): Start

T3 (R): Run

10.8 TERMINAL COVER MOUNTING AND REMOVAL

It is not allowed to run the compressor without terminal cover properly fixed on the terminal fence.

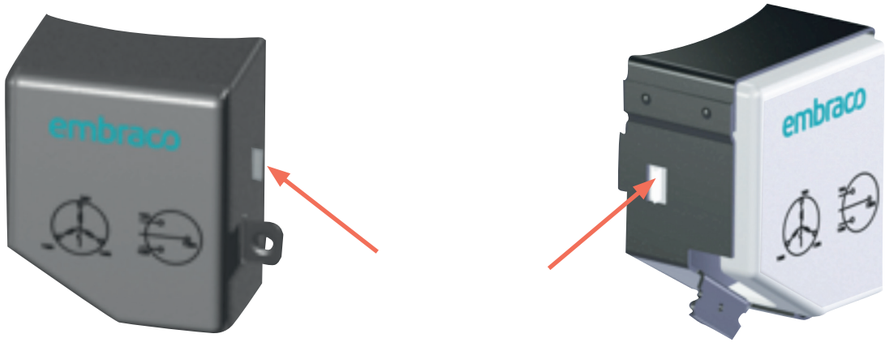
Before connecting a compressor, make sure that terminal cover for electrical protection is properly seated.

The non-use or improper positioning of the terminal cover may expose the electrical technician the risk of electric shock and fire.

Before removing the terminal cover, check if the compressor is disconnected from the mains and disconnect all electrical components of compressors.

The terminal cover is properly fixed if side teeth lock-on holes on terminal fence.
Cover removing has to be provided with appropriate tool (e.g. screwdriver) pushing side teeth.

Figure 10.8 Terminal cover



10.9 THREE-PHASE ROTATION DIRECTION

Scroll compressors are directional dependent: i.e., they will compress in one rotational direction only. On single phase compressors, this is not an issue since they will only start and run in the proper direction (except as described in the Brief Power Interruptions, Chapter **10.10**). Three-phase scrolls, however, will rotate in either direction depending on the power of the phasing. So there is a 50/50 chance of connected power being "backwards."

Verification of proper rotation can be made by observing that the suction pressure drops and the discharge pressure rises when the compressor is energized. Additionally, if operated in reverse the compressor is noisier and its current draw is substantially reduced compared to tabulated values.

Although operation of scroll in reverse direction for brief periods of time is not harmful, continued operation could result in failure. All three-phase compressors are wired identically internally. Once the correct phasing is determined for a specific system or installation, connecting properly phased power leads to the same fusite terminals will maintain the proper rotation.

10.10 BRIEF POWER INTERRUPTIONS

Brief power interruptions (less than 0.5 second) may result in powered reverse rotation of single-phase refrigeration scroll compressors. High-pressure discharge gas expands backward through the scrolls at power interruption causing the scroll to orbit in the reverse direction. If power is reapplied while this reversal is occurring, the compressor may continue to run noisily in the reverse direction for several minutes until the compressor internal protector trips. This has no negative effect on durability. When the protector resets, the compressor will start and run normally. Recommended is to use a timer which can sense brief power interruptions and lock the compressor out of operation for two minutes. A three minutes time delay is also suggested on three phase models to prevent frequent start/stop.

10.11 ELECTRICAL SUPPLY LINE AND CABINET SUPPLY CABLE

The electrical supply line of the finished product must be protected against over-current, short-circuit, short-to ground. A Residual-Current Circuit Breaker (RCCB) must be adopted. Design, components and installation must comply with the applicable National and International Standards and regulations. The compressor must be properly connected to ground.

Cables of the installation and of the compressor must be designed for appropriate temperature, due to ampere load, and for voltage drop (see *Table **10.1***) taking into consideration the max input current of the finished product and the compressor LRA (Locked Rotor Amp), indicated for each model in the compressor label and **Embraco Product Selector** on **www.embraco.com** and in Chapter **10.13**

In any case, the supply cable, as well as all other installation cables, must be designed and protected in order to comply with the applicable International standards and regulation, as well the National Standards and regulations of the country where the system will operate.

For the compressor connection to the electrical supply line and for maintenance/ repairing operation, refer also to Appendix 1 - Recommendations - safety instruction for compressor installation.

10.12 MAXIMUM TEMPERATURE OF ELECTRIC MOTOR WINDINGS

The temperature of the motor windings should not exceed 130°C max. under normal running conditions.

The wiring temperature can be measured while the compressor is running through suitable equipment, or through the method of ohmic resistance measurement, by disconnecting the compressor supply.

The compressor shall be connected to the supply line only when the hermetic terminal cover is properly fixed. When the compressor is energized, all the electrical measures must be done outside the cover.

The ohmic resistance measurement method requires the compressor to be stabilized at the ambient temperature and the availability of instruments for measuring the ohmic resistance (digital Ohmmeter, Whetstone's bridge) and the temperature.

a) Measure the ohmic resistance Rf of the main winding (run) between the pins of the hermetic terminal C "common" and R "run". Measure the corresponding stabilized reference temperature Tf.

b) Measure the ohmic resistance Rc of the main winding (run) between the pins C and R with hot motor, at the working conditions to which you intend to measure the motor temperature.

c) Calculate the above hot motor temperature Tc with the following formula:

Calculation formula for **Cu winding**:

$$Tc = \frac{(Rc - Rf)}{Rf} (234,5 + Tf) + Tf$$

Where:

Tc = Unknown temperature with hot motor

Tf = Motor temperature measured at the stabilized reference temperature

Rc = Measured ohmic resistance, corresponding to the Tc temperature

Rf = Measured ohmic resistance, corresponding to the Tf temperature

Table 10.13a Electrical data of three phase motor (380V 50Hz), R449A

APPLICATION	MODEL	Rated load amps RLA (A)	Locked rotor amps LRA (A)	Max operating current MOC (A)	Run Winding Resistance (±10%) at 25°C (Ω)
MBP	SE6015GS-O	3,1	22	5,2	6,7
	SE6018GS-O	4,4	45	6,4	3,3
	SE6021GS-O	4,6	45	6,9	3,3
	SE6026GS-O	6	60	9,2	3,3
	SE6030GS-O	6,4	60	10,3	2,45
	SE6036GS-O	7,1	60	12,2	2,45
	SE6043GS-O	8,2	65	14,3	1,9
	SE6053GS-O	10,9	117	17,3	1,09
	SE6056GS-O	11,2	117	18,4	1,09
	SE6067GS-O	12,6	117	21	1,09
	SE6078GS-O	13,7	121	23,6	1,06
	SE6085GS-O	14,5	121	26,5	1,06
	SE6089GS-O	15,1	121	27,6	1,06
LBP	SE2006GS-O	2,2	22	3,8	6,7
	SE2008GS-O	2,6	22	4,4	6,7
	SE2010GS-O	4	45	5,8	3,3
	SE2012GS-O	5,2	60	7,5	2,45
	SE2014GS-O	5,6	60	8,8	2,45
	SE2017GS-O	5,9	60	10,3	2,45
	SE2020GS-O	6,6	60	12,1	1,9
	SE2023GS-O	9	117	18	1,09
	SE2028GS-O	9,6	117	20,1	1,09
	SE2031GS-O	10,3	121	22,7	1,09
	SE2039GS-O	11,1	121	25,6	1,06

Table 10.13b Electrical data of single motor (220V 50Hz), R449A

APPLICATION	MODEL	Rated load amps RLA (A)	Locked rotor amps LRA (A)	Max operating current MOC (A)	Run Winding Resistance (±10%) at 25°C (Ω)	Start Winding Resistance (±10%) at 25°C (Ω)
MBP	SE6015GK-C	8,4	76	16,2	0,7	1,4
	SE6018GK-C	9,8	76	17,2	0,7	1,4
	SE6021GK-C	10,9	76	19	0,7	1,4
	SE6026GK-C	13,3	109	25,7	0,5	1,3
	SE6030GK-C	14,6	109	28,1	0,5	1,3
LBP	SE2006GK-C	5,1	76	13,4	0,7	1,4
	SE2008GK-C	6,6	76	14,2	0,7	1,4
	SE2010GK-C	7,7	76	16,2	0,7	1,4
	SE2012GK-C	9,9	109	21,3	0,5	1,3
	SE2014GK-C	10,5	109	23,3	0,5	1,3

10.14 DEFINITIONS

Maximum operating current (MOC) is the maximum current value which compressor can operate steadily.

Locked Rotor Amperage (LRA) is the total current input ones compressor motor is locked at its maximum rated voltage.

Rated Load Amperage (RLA) is the value established from MCC (Maximum continuous current) and means that if that value is up to certain limit, the protector must trip.

The scroll compressor needs a **Run-in period minimum 72 hours** to give its full performances, usually under low load or normal load, to settle mechanical parts into a stable position. During this run-in the power input can be slightly higher than normal conditions.

10.15 HIGH POTENTIAL (HI-POT) TESTING

Scroll compressors are configured with the motor below the compressor. As a result when liquid refrigerant is within the compressor shell the motor can be immersed in liquid refrigerant to a greater extent than with compressors with the motor mounted above the compressor. When compressors are Hi-pot tested and liquid refrigerant is in the shell, they can show higher levels of leakage current than compressors with the motor on top because of the higher electrical conductivity of liquid refrigerant than refrigerant vapor and oil. This phenomenon can occur with any compressor when the motor is immersed in refrigerant. The level of current leakage does not present any safety issue. To lower the current leakage reading the system should be operated for a brief period of time to redistribute the refrigerant to a more normal configuration and the system Hi-pot tested again. Under no circumstances should the Hi-pot or Meg-ohm test be performed while the compressor is under a vacuum.

10.16 ELECTRICAL CONNECTIONS

Avoid excessive shocks on the pins of the compressor. The force to insert the terminals of the electrical components or supply line must be along the axis of pins: transversal forces not aligned with the pins or moments exerted on the pins can bend them or cause cracks in the glass insulation. These cracks can lead to glass breaks, refrigerant/oil leakages and short circuits.

Avoid using the electrical components to get multiple connections on their terminals: the excessive force necessary to fix all them together may damage the components. If multiple connections are needed. use the terminal board (part of CSR box) provided by Embraco for its compressors or other external terminal boards (complying with the electrical safety standards) to be fix on the installation. For other solutions, contact Embraco Technical Support team.

Position of electrical box in the application – it is mandatory to be in vertical direction, to assure correct functionality of relay (see *Figure* ***10.16***).

Figure ***Electrical box position***

10.17 SCREWS TIGHTENING TORQUE

The connection screws on CSR box, terminal board and plastic hermetic terminal are supplied with a clamping torque of 1÷2Nm (10 ÷ 20 kgcm). The same torque is proposed to be used for their tightening when used.

Grounding screw M5x12 is assembled on compressor hermetic terminal with a tightening torque 1÷2Nm (10÷20 kgcm).

10.18 ELECTRICAL INSULATION

All compressors are tested for dielectric strength and electrical insulation to ground according to requirements IEC/EN 60335-2-34 (to be used with IEC/EN 60335-1) (latest edition).

Note: *dielectric strength and compressor insulation to ground are different when the compressor is tested in the air or in a system charged with refrigerant, due to the dielectric characteristics of the refrigerant.*

11. STARTING PROCEDURE

11.1 SYSTEM CLEANLINESS

Cleanness and reduced humidity level in all the components of the refrigeration system are the primary concerns for the compressor good running and life. Many of contaminants are small to pass through a mesh screen and can cause damage within a bearing assembly.

During the manufacturing process, circuit contamination can be caused by:

- brazing oxides and flux
- particles from burrs of piping
- moisture and air

Recommended impurity level of the circuit after vacuum dehydration:

RATED POWER	≤2.2 Kw	2.2~4.5 Kw	4.5~6.0 Kw	> 6.0 Kw
IMPURITY	500 mg	500 mg	600 mg	1100 mg

11.2 MOISTURE REMOVAL

One of the disadvantages of polyolester oil (POE) is that it is hygroscopic. Only brief exposure to ambient air can cause moisture absorbation, to make it unacceptable for use in a refrigeration system. As it holds moisture, it is more difficult to remove it through the use of vacuum. Compressors supplied contain oil with low moisture content, and it may rise during the assembly process. Therefore it is recommended to use properly sized filter-drier in whole system, which uses POE oil. This will maintain the moisture level in the oil less than 50 ppm.

If moisture content of the oil in refrigeration system reaches unacceptably high levels, corrosion and copper plating may occur. The system should be evacuated down to 0.3 mbar or lower. If there is uncertainty of the moisture content in the system, an oil sample should be tested for moisture.
Oil sight glass can help to indicate of moisture of refrigerant.

11.3 SYSTEM EVACUATION

An important step in effectively cleaning a system before operation is proper evacuation. Air is very detrimental to refrigeration systems and must be removed before start up and after field service. Blowing out lines with dry nitrogen may remove a major part of the air from a system, but if air is trapped in the compressor during installation it is practically impossible to remove from the compressor by purging with nitrogen.

Triple evacuation of the system or compressor, as required, is strongly recommended (twice to 1500 microns and finally to 500 microns), breaking the vacuum each time with 2.07bar (rel) (30 PSIG) dry nitrogen. The vacuum pump must be connected to both - the high and low sides of the system through properly sized coactions, since restrictive service connections may make the process so slow as to be unacceptable, or may lead to false readings because of pressure drop through the fittings.

11.4 DEEP VACUUM OPERATION

Do not run a refrigeration scroll compressor in a vacuum.
Do not carry out any evaluation or test of insulation (dielectric strength or hi-pot test) with compressor under vacuum. It may result in damages of the insulation system and, consequently, in shortening the insulation life.

Do not run a compressor before the refrigerant charge. Failure to follow these advices can result in permanent damage to the compressor. A low-pressure control is required for protection against vacuum operation. See the section on pressure controls for the proper set points.

Scroll compressors should never be used to evacuate refrigeration or air conditioning systems.

11.5 DEHYDRATION

The scroll compressors have a drying process on their production line, before receiving the oil charge. The residual humidity after drying is indicated in below table.

Table **11.5** ***Dehydration process***

RATED POWER	≤2.2 KW	2.2~4.5 KW	4.5~6.0 KW	> 6.0 kW
MOISTURE	80 mg	100 mg	120 mg	140 mg

11.6 CHARGING PROCESS

Do not power on the compressor before charging refrigerant. Use the scale to control charge quantity. One liquid drier is recommended to connect between refrigerant cylinder and manifold to prevent moisture into system during charging. Connect refrigerant cylinder to both high and low side of the refrigeration system, power on the solenoid valve if possible (do not power on the compressor at this time). Invert refrigerant cylinder if needed to ensure only liquid can be charged into both high and low sides. Charge the refrigerant to the system as much as needed (at least 70% of total needed). Disconnected the high side charge port, turn on the compressor, and continue charge the liquid from the low side until the refrigerant is enough for the system.

Never close the suction service valve when compressor is running.

11.7 OIL CHARGE

The quantity and type of oil charged into the compressors are indicated in the compressor label and Technical datasheet in the **Embraco Product Selector** on **www.embraco.com**

Oil used with scroll compressors is Polyolester (POE) Emkarate RL32H and is applicable for all approved refrigerants used with compressor. The initial oil charge and recharge volumes are indicated in *Table* ***11.7***. Compressors are supplied with oil.

Table **11.7** ***Oil charge and recharge volume***

COMPRESSOR SIZE	INITIAL OIL CHARGE VOLUME (L)	RECHARGE VOLUME (L)
2-6 HP	1.4	1.25
7-13 HP	2.7	2.6

Systems with POE oil should not be open to the air for more than 3 minutes. Don´t remove the suction and discharge rubber plugs until the compressor is ready to braze.

POE oil absorbs moisture from atmosphere. To remove it follow instruction in Chapter **11.2** – Moisture removal.

During the compressor running, oil is pumped out from the compressor. The system must be designed in order to carry the oil back to the compressor; however a certain amount of oil may remain inside the system.

The minimum quantity of oil inside the compressor that guarantees the correct lubrication is no less than half of initial oil charge volume.
Oil quantities below the minimum prescribed level will not allow the oil pumping and will cause wear, leading to the eventual seizure of the mechanical parts.

System prototypes have to be checked for the oil remaining into the line tubes, condenser, evaporator and other parts after running in all the expected conditions that may happen in the field, assuring that the compressor contains in all conditions at least the quantity of oil indicated in above *Table* ***11.7***.

11.7.1 OIL MANAGEMENT FOR RACK APPLICATION

Scroll refrigeration compressors may be used on multiple compressor parallel rack applications. This requires the use of an oil management system to maintain proper oil level in each compressor. The sight glass connection supplied can accommodate the mounting of the oil control devices.

11.8 SCROLL FUNCTIONAL CHECK

Refrigeration scroll compressors do not have internal suction valves. It is not necessary to perform functional compressor tests to check how low the compressor will pull suction pressure. This type of test may damage a scroll compressor. The following diagnostic procedure should be used to evaluate whether a scroll compressor is functioning properly.

- Verify proper unit voltage.
- Normal motor winding continuity and short to ground checks will determine if the inherent overload motor protector has opened or if an internal short to ground has developed. If the protector has opened, the compressor must cool sufficiently to reset.
- With service gauges connected to suction and discharge pressure fittings, turn on the compressor. If suction pressure falls below normal levels, the system is either low on charge or there is a flow blockage.
- Single-Phase Compressors - If the suction pressure does not drop and the discharge pressure does not raise to normal levels the compressor is faulty.
- Three-Phase Compressors - If the suction pressure does not drop and the discharge pressure does not rise, reverse any two of the compressor power leads and reapply power to make sure the compressor was not wired to run in the reverse direction.

The compressor current draw must be compared to publish compressor performance curves at the compressor operating conditions (pressures and voltages). Significant deviations (±20%) from published values may indicate a faulty compressor.

11.9 STARTING SOUND LEVEL

During compressor start the sound level of compressor is slightly higher than during normal running operation.

3-phase motor reverse wires connection is characterized by initial noise. To correct reverse rotation. disconnect power and switch any two of the three power wires at the unit contractor. Never switch wires at the compressor terminals

Table **11.9** ***Compressor sound level***

COMPRESSOR MODEL		Sound Power (dBA)		Sound Power with Noise jacket (dBA)		Maximum Running Sound (dBA)
MBP	LBP	50Hz	60Hz	50Hz	60Hz	
SE6015-SE6021	SE2006-SE2010	71	73	68	70	75
SE6026-SE6036	SE2012-SE2017	73	75	70	72	77
SE6043	SE2020	74	76	71	73	78
SE6053-SE6056	SE2023	75	77	69	71	76
SE6067-SE6078	SE2028-2031	76	78	70	72	77
SE6085-SE6089	SE2039	77	79	71	73	78

Note: *Tested in Rated condition of EN12900*

11.10 SOUND GENERATION IN REFRIGERATION SYSTEM

Noise and vibrations coming from system or service may come from these sources:

- sound radiation – extend by air
- mechanical vibrations – extended along the parts of the unit and structure
- gas pulsation – distributed by cooling medium (refrigerant)

12. MAINTENANCE (COMPRESSOR REMOVAL AND REPLACEMENT)

The replacement of a compressor is an onerous task and requires an accurate diagnosis of the system before deciding to proceed with it.

Improper procedures to remove the failed compressor and install a new one, may cause injury to person, release of refrigerants and oil to the environment, fire and damages to propriety.

When repairing a refrigeration system, replacing a compressor and installing a new ones, follow all applicable international regulation and standards (like EN 378-4 or similar), and the local ones, as well as the safety warnings and recommendations indicated in these installation instructions.

The compressor replacement must be carried out in properly ventilated ambient. Disconnect the system from the electrical power.

Ground the installation:

- Check the conditions of the electrical wirings and connections, with special care to the ground wire; replace eventual damaged parts.
- Check the system for leakages with leak detector suitable for the refrigerant used on the system and having a sensitive of at less than 3 g/year.
- Remove the protective shield to access the compressor.
- Remove the compressor terminal covers and disconnect all the compressor electrical components.

Recover the entire refrigerant charge before removing the compressor (if the line tubes are cut when the system contains even fractions of the refrigerant charge. it will cause a rapid release of refrigerant mixed with oil, with pollution to the environment and possible injury due to inhalation of gas or frostbite).

To recover the refrigerant use a suitable recovery units and apparatus, follow the instruction of the producers and the applicable regulations.

The only acceptable practices on refrigerant removed from systems are recovery, reuse, recycling and reclamation. All the applicable standards and regulations for these operations must be followed.

Avoid venting refrigerants in the ambient. In several countries there are legal obligations on technicians to prevent this incorrect operation and to act minimizing leaks and repair systems with leaks as soon as possible.

To remove the refrigerant:

- Refrigerant has to be recovered from both high and low pressure sides. Connect the hose (with Schrader connection) to the recovery unit in order to start the refrigerant recovery procedure.
- Use a filter dryer at the entry of the recovery unit.
- Adhere the instructions of the recovery machine producer. Go down with recovery up to a residual pressure of 0.3 abs bar (make reference to EC 842 or equivalent applicable regulations).
- Be careful not to exceed the maximum charge indicated on the recovery vessel for the specific refrigerant. Overcharges can lead to vessel explosion.
- Unsolder the line tube from the compressor.
- Remove the compressor from the installation base plate, follow the instruction of Chapter **12**
- In case the compressor has to be returned to Embraco, follow the instruction of Chapter **13**
- Purge the system using OFDN (oxygen-free-dry-nitrogen) only.

12.1 COMPRESSOR REPLACEMENT PROCEDURE

Do not perform unnecessary tests before install or start a new compressor. All tests have been already carried out in the production lines and labs

- Change the dryer, as the refrigeration system has been opened.
- For the assembling of a new compressor and brazing, follow the procedure of Chapter **9.12**.
- Brazing requires specific trained personnel and brazing procedure approvals.
- Assemble the electrical components according to the wiring diagram of *Figure **10.3a***.
- When replacing a compressor do not use the electrical components installed on the replaced compressor. Use new components supplied with the new compressor and check the correspondences with the ones prescribed for the specific compressor model as listed in the **Embraco Product selector** on **www.embraco.com** Connect the components with the care indicated in Chapter **10.3** – Electrical connections and wiring diagrams.
- After assembly, the system shall be tested for leakages by pressurizing. Pressure must be according to the applicable regulation and to the design pressure of the system components in order to avoid injuries and damages.
- When testing the low pressure side of the system, pressure to the compressor shell must not exceed 16 bar (see Chapter **11.3** – System evacuation).

It is allowed to charge the system only with the refrigerant which must correspond with the refrigerant officially approved, indicated in *Table **6.2***
When the charge procedure is finished, fix strongly the cap on the Schrader valve (or pierce strongly the service tube, cut the Schrader valve and close the tube by brazing (eventually use a lockring cap).
Fix properly the compressor terminal cover and ensure the compressor and the system is grounded before supply voltage.

After repairing, the system should be checked for leakages, use leak detector specific for the adopted refrigerant, with a sensitivity of less than 3 g/year and run for analyzing the performance and Watt/Amps input.
For compressor, refer to the Technical datasheet in the **Embraco Product selector** on **www.embraco.com**
For entire application refer to data that the cabinet manufactures should provide.

12.2 UNBRAZING SYSTEM COMPONENTS

If the refrigerant charge is removed from a scroll unit by bleeding the high side only it is sometimes possible for the scrolls to seal, preventing pressure equalization through the compressor. This may leave the low side shell and suction line tubing pressurized. If a brazing torch is then applied to the low side, the pressurized refrigerant and oil mixture could ignite as it escapes and contacts the brazing flame. It is important to check both the high and low sides with manifold gauges before un-brazing.

In the case of an assembly line repair remove the refrigerant from both the high and low sides. Instructions should be provided in appropriate product literatures and assembly areas.

13. HOW TO RETURN SUPPLIED PRODUCTS TO EMBRACO EUROPE

For the warranty on products supplied by Embraco, refer to what is indicated in the sales conditions.
The validity of the warranty (if applicable) is subject to the results of the analysis carried out in Embraco on the returned compressors. A technical report of the analysis will be send to the customer.
Customer may participate in the analysis.

The return (and delivery terms) of compressors to Embraco for technical analysis has to be agreed between Embraco Sales Department and the Customer. The delivery conditions and documents shall be according to the Embraco Sales Department instructions.

To ensure a timely analysis and the correct definition of the root causes of the problem, Embraco request to observe the following rules:

- Disassembly the compressor from the system, following the instruction of Chapter **12**.
- Disconnect the supply wirings from the compressor terminals without remove the electrical components.
- Cut the line tubes at least 50 mm away from the compressor ports (do not unsolder) and close them with the specific rubber taps or by brazing.
- Do not carry out potential destructive tests (i.e. Dielectric strength test) and do not remove the oil from the compressor.
- Do not abrade or eliminate the nameplate.
- Indicate on the compressor top with a marker (or on an adhesive label) the reasons of the replacement; it is sufficient macro-indication like:
  - noisy
  - leakages on tube/shell (evidencing the leak point)
  - does not start (specify in which conditions)
  - does not cool the system
  - OPL trips
  - grounded
  - short circuit
  - motor winding interrupted
- Handle with care, to avoid damages of the compressor and its electrical components.
- All materials must be properly packaged according to the type of shipment and in order to avoid damages during transport. Consult the shipping agency before delivery.
- Do not return defective compressors as a consequence of mishandling.
- Do not return open compressors or tampered components; (to avoid erroneous diagnosis, the compressor must be opened with suitable tools, available at Embraco factories).

The material that does not correspond to the above requirements may be considered not valid for analysis and may void the warranty.
All the materials that, after analysis, appear to be working and are free of quality problems, can neither be returned nor replaced (the complete analysis involves the opening of the compressor and its disassembling).
The analyzed product, before its disposal, remains available for the customer for a maximum period of 30 days starting from the date of the Technical Report issued by the Sales and delivered to the customer.

14. COMPRESSOR DISPOSAL

Disposal of refrigerating systems, its parts and components shall be undertaken in accordance with the system producer's instructions and with national regulations.

For recovery, reuse, recycling and reclamation of the refrigerant follow EN 378-4 or similar standards, as well as the applicable local regulations.

Use the correct equipment and method for removal the compressor.

Drain out the oil from the compressor and treat it according to the applicable regulations.
Dispose the compressor according to applicable regulations.
The compressors shall be stored in ambient properly ventilated.
When necessary, an expert in dealing with safe disposal of refrigerants and oils should be consulted.

15. COMPRESSOR PACKAGING

15.1 MULTIPLE (INDUSTRIAL) PACKAGING

This type of package consists of a shipping pallet with dimensions of 1100 mm x 1100 mm on which is positioned the carton box with compressors inside and an internal separators to prevent any compressor movements. On the top carton box is placed wooden top board and secured with straps (see *Figure* ***15.1***).
Compressors are in one layer.

Electrical components and accessories are included in the package:

- one plastic bag with grommets and sleeves
- CSR box – depending on ordered Bill of material code, is placed close to compressor.

Number of compressors per pallet: 16 pcs for models 2-6HP or 12 pcs for models 7-13HP.

15.2 SINGLE PACKAGING

Complete pallet package consists of a shipping pallet of 1100 mm x 1100 mm on which in multiple carton box are placed single carton boxes with compressors, internal separator to prevent any compressor movement. secured with straps (see *Figure* ***15.2***).

Electrical components and accessories are included in the single package:

- one plastic bag with grommets and sleeves
- CSR box – depending on ordered Bill of material code

Number of compressors per pallet: 9 pcs.

Wooden pallet and carton boxes are created to comply with recycling regulations and are treated according to ISPM No.15. The wooden top board placed on top of each carton box is made of plywood.

Figure **15.2.1** ***Multi packaging***

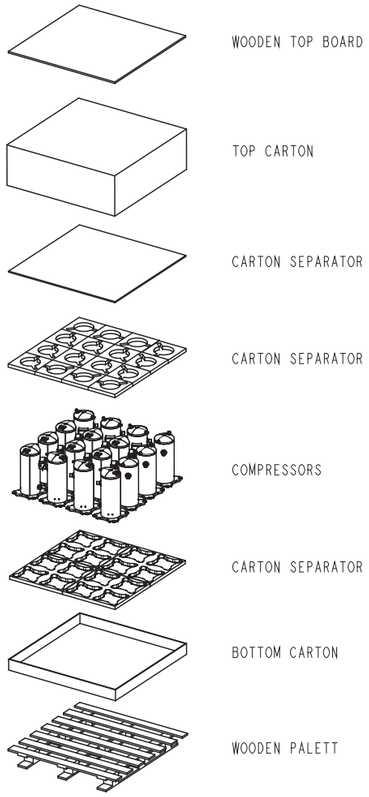
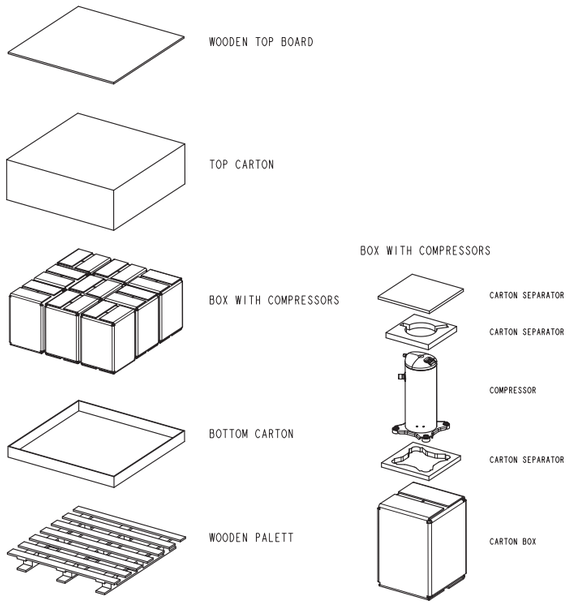


Figure **15.2.2** ***Single packaging***



On compressor carton boxes are sticked labels with Bill of material code and Serial Number, including its bare code (Type 39).

Figure **15.2.3** ***Packaging Barcode***

16. HANDLING. TRANSPORTATION AND STORAGE

16.1 HANDLING

Due to compressor weight it is recommended to handle with compressors using cranes and hooks.
Use of improper handling can result in person injuries.

Compressors are equipped with a hanger tab to be used for compressor manipulation.

Avoid using of hanger tab to manipulate with complete unit, once compressor is assembled in.

Compressor must be handled in vertical position, with a maximum inclination of 15° from vertical.
Maximum running inclination of 5° from vertical is allowed.

The handling of scroll packages must be done only by forklift with due care, to avoid damages of the package and compressors. Access is available from all four sides of the package. It is recommended the use of forks having a length adequate to the size of manipulated goods.

16.2 STORAGE

Failure to follow these instructions can result in property damages and people injuries Compressors are equipped with a hanger tab to be used for compressor manipulation.

The storage of pallets can be done by placing maximum of 1 pallet upon another; maximum stocking allowed - 2 pallets.

Risk of pallets collapse and personal injuries, stacking higher than the recommended maximum can cause accidents.
Move pallets, packages and compressors only with appropriate mechanical or handling equipment according to the weight.

Keep the packages in the upright position. Keep the packaging dry at all times.

Do not stack single boxes on top of each other or on top of multi packaging.

All packages must be stored in places protected from humidity and bad weather.
Embraco does not take any responsibility for occasional damages to the package and to the finished product resulting from not observing these instructions. For the solution of potential positioning problems during assembling and transport, consult the Embraco Technical support team.

16.3 STORAGE CONDITIONS

Compressors and electrical components should be stored in closed ambient, protected against rain, water drops, dust and contaminants; air humidity should not exceed 80 %. Salty sea ambient (transport by vessel, load, unload) are admitted only for the periods of transportation and custom clearance; storage on the sea board should be avoided.

There is no any limitation for storage, however we suggest to store compressors in house with ambient temperature: min -10°C / max 40°C. For limited periods (like transportation in containers in tropical areas) temperature up to 70°C is admitted.

In case of storage in low temperature, it is not necessary to stabilize compressors before its installation to the system.

In case of system storing in low temperature, prior to its run, follow recommendations in Chapter **8.5** - Low ambient operation.

Even if properly stored, after prolonged storage period (over 5 years) the oil on the cinematic parts of the compressor may dry, making the first start of the compressor difficult and the tube plugs may deteriorate allowing air/humidity enter into the compressors.

In case of longer storage time, before using the compressors contact the Embraco Technical support team.

16.4 TRANSPORTATIONS

The transportation of all types of packaging must be done with the compressor in upright position.

Maximum number of layers allowed during transportation is 2 layers (icon indication available on packaging), with maximum weight 2000 kg

Incorrect transport can cause compressor or its parts deformation. Before to use compressors which are suspected of improper transport or damaged, contact Embraco Technical Support Team.

16.4.1 SHIPMENT BY CONTAINER

The predominant method of transport is by container of which there are two different types for capacity and length: 20 ft (about 6.1 m) and 40 ft (about 12.2 m). The standard container used by Embraco is the 20 ft, which allows in comparison to the 40 ft, a higher ratio weight/volume and consequently a better utilization of the internal volume (the number of the compressors in a 40 ft container is limited by the admitted total weight).

Payload max 24 tons. Follow local limits.

16.4.2 SHIPMENT BY TRUCK

The transportation of compressors by truck is the most common system for highway or short distances where the stresses on the product are reduced. This type of transportation, if made without the necessary precautions on load steadiness and travel on uneven roads can cause stresses to compressors with possible damages.

16.4.3 ACCEPTABLE COMPRESSOR POSITIONS DURING TRANSPORTATION OF FINISHED PRODUCT

Compressors allowed transportation position - in upright position.

In case the compressors are lying during the transportation or assembly of the finished products, oil will enter in the suction tube, causing problematic brazing of the line tubes and hazardous fumes.

16.4.4 ACCELERATION DURING TRANSPORT AND HANDLING

Maximum allowable rate of deceleration/acceleration: 1g

Generally we advise against the rail transportation because during the shunting, stress to the compressors from decelerations or acceleration can cause stator deformation or breaking of compressors components.

Rail transportation is allowed only for a full container shipment. LCL (Less Than Container Load) is not allowed.

For conditional approval of specific cases please contact Embraco Logistics or Technical support team.

APPENDIX 1
SAFETY RECOMMENDATIONS FOR COMPRESSOR INSTALLATION

Flammable – risk of fire.

High voltage – risk of electric shock.

Toxic – risk of intoxication.

GENERAL RECOMMENDATIONS

Only trained personnel can perform diagnostic and maintenance procedures on refrigeration systems.

Installation and repair requires special training, technical information, special tools and special equipment.

Make sure in advance if the environment for maintenance is adequate and airy. Tools and process equipment should be available. The required Personal Protective Equipment (PPE) must be used by the technician.

Before starting maintenance or diagnostics, first make sure that the cooling system is disconnected from the mains.

After disconnecting the system from the mains, wait for the compressor to cool down. Only perform maintenance or diagnostic procedures with the cold compressor (25 ° C ± 5 ° C).

The compressors shall be powered only in electrical installations with a ground fault circuit interrupter (GFCI) circuit breakers or residual current device (RCD), according to the country technical requirement.

Correct grounding is required for the use of compressors.

Failure to shut down the mains compressor during maintenance procedures and to apply a system without a ground fault circuit interrupter (GFCI) or residual current device (RCD), according to the country technical requirements, may cause serious physical hazards by electric shock and/or fire to the technician.

Failure to disconnect the compressor from the mains may, in the event of a short circuit in the region of the hermetic terminal of the compressor, cause expulsion of the hermetic pins causing leakage of the cooling fluid.

1 • ELECTRICAL ACCESSORIES

Before removing the protective plastic cover from the electrical components, check if the compressor is disconnected from the mains and that starting and / or running capacitors are used.

Never handle any electrical accessory with the compressor connected to the mains. Failure to shut down the mains compressor during maintenance procedures and to apply a system without a ground fault circuit interrupter (GFCI) or residual current device (RCD), according to the country technical requirements, may cause serious physical hazards by electric shock and/or fire to the technician.

Starting and / or running capacitors must be handled with care, as they may cause electric shock even when disconnected.

When it is necessary to remove the capacitors, carefully disconnect these components with extra attention to the exposed electrical terminals. The capacitor must be discharged before handling.

Check that the capacitance range (µF) printed on the starting and running capacitor label (if applicable) comply with the compressor data sheet that is installed in the system.
The ACV Voltage value printed on the capacitor label must be equal to or greater than the value specified in the compressor data sheet. If one of the values (ACV Voltage and / or Capacitance) is not in accordance with the compressor specification, replace the capacitor.

Application of an unsuitable capacitor and / or application of unspecified relay starting devices may cause the capacitor to overheat. Overheated capacitors are subject to rupture which can lead to leakage of overheated material that can lead to burns.

When necessary to disconnect the electrical components of the hermetic compressor terminal, remove the relay starting device by applying longitudinal effort to the pins. Never apply transverse forces to the pins of the hermetic compressor terminal

Improper removal of these accessories may cause poor electrical connection, damaging the hermetic compressor terminal, and causing refrigerant and oil leakage.

Compare the printed code on the relay with the compressor data sheet. If the code is different, replace the component. There are no universal or similar electrical accessories always use the one specified in the compressor's data sheet.

Not specified relay starting device may cause the capacitor to overheat. Overheated capacitors are subject to rupture which can lead to leakage of overheated material that can lead to burns.

The use of relay starting device other than specified can generate short circuit in the hermetic compressor terminal, causing the expulsion of hermetic pins causing refrigerant and oil leakage.

1.1 • ELECTRICAL INSTALLATION

In order to assure appropriate motor-compressor operation, it must be installed in electrical installation system (grid) with sufficient current capacity with respect to motor-compressor rated load amperage and locked rotor current. Otherwise, possible problems may occur due to current breaker or fuse intervention or due to starting ability issues caused by voltage drop over the line.

Appliance installation must be established by trained personnel only.

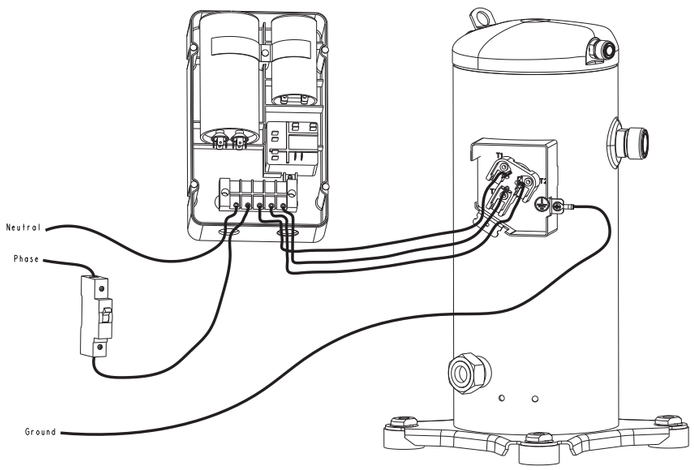
Before operation, motor-compressor must be grounded (appropriate earth connection must be established).

Always follow connection diagram scheme in order to assure motor-compressor safety and correct operation.

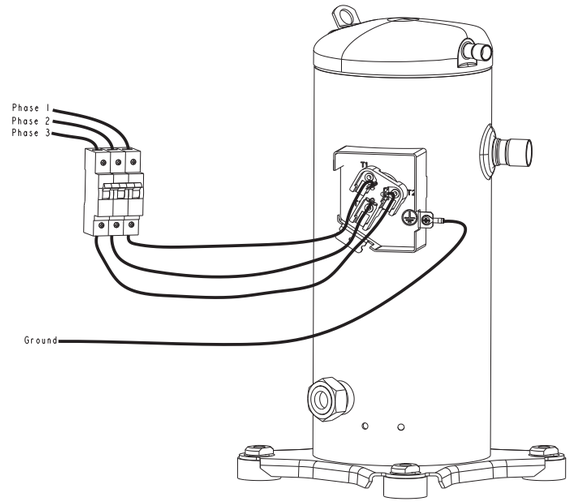
Only approved electrical accessories have to be used, corresponding to specific model of motor-compressor.

Motor-compressor may not be connected to other voltage and frequency than assigned on the motor-compressor label.

In case of fuse or circuit breaker reaction. never replace or reset before checking ground fault (short circuit to ground). Blown fuse or tripped circuit breaker could be indicator of ground fault situation.



In single-phase installations with internal overload protector, the Phase wire must be protected by a circuit breaker and connected directly to common pin. The neutral wire must be connected to the relay starting device. The system must be grounded.



In the case of two-phase installations, it is mandatory to use a 2-pole circuit breaker, because in case of a short circuit both phases of power supply are protected. The system must be grounded.

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Failure to use a 2-pole circuit breaker leaves the compressor susceptible to short circuit in the region of the hermetic compressor terminal, which may cause the hermetic pins to be ejected causing the refrigerant and oil to leak.

Never operate motor-compressor without grounding.

Application of a system without grounding may expose the technician to risk of electric shock.

2 • COMPRESSOR

If you need to replace the compressor, be aware of the following safety recommendations:

I. Make sure the compressor is disconnected from the mains.

Failure to shut down the compressor from the mains during maintenance procedures may expose the technician to risk of electric shock and fire.

II. Never remove the compressor before removing all refrigerant from the system. For this, the use of a fluid collecting machine is recommended.

III. Use a pipe cutter to disconnect the compressor tubes. Under no circumstances use the flame of the torch to disconnect the compressor tubes.

IV. In case of compressor burning and / or internal contamination of the system, clean the piping with a suitable solvent applied according to the solvent manufacturer's technical guidelines.

Failure to comply with the solvent manufacturer's technical guidelines may expose the technician to fire hazards and intoxication.

V. Before connecting a compressor, make sure that:

- *The voltage at the compressor label is suitable for the mains and the electrical installation complies with item 1.1*

The application of a compressor in incorrect voltage may cause short circuit in the hermetic compressor terminal, causing the expulsion of hermetic pins causing refrigerant and oil leakage.

- *The plastic cover for electrical protection is properly seated.*

The non-use or improper positioning of the plastic cover may expose the electrical technician the risk of electric shock and fire.

VI. Always use electrical accessories (components) supplied with new spare compressor. Do not use electrical components from replaced compressor.

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REFRIGERATION CLUB

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