

# Copeland™ Semi-Hermetic Compressor

## Stream for refrigeration applications



User Manual

**Copeland™**  
brand products



**EMERSON™**  
Climate Technologies

## Pioneering Technologies For Best-In-Class Products

Emerson Climate Technologies is the world's leading provider of heating, ventilation, air-conditioning and refrigeration solutions for residential, commercial, and industrial applications, supporting the industry with advanced technology, technical support and training services.

For more than 80 years, we have been introducing innovative technology to the market, from the first semi-hermetic and hermetic compressors in the 1940s and 1950s, the high efficiency Discus™ semi-hermetic and the digital scroll compressor technology of today.

Based on this, we have developed an unequalled range of solutions for the refrigeration and air conditioning markets. In recent years, we have become a major solutions provider to the air conditioning and refrigeration industry. Our range of Copeland™ brand products addresses the diverse needs of all of these markets. With scrolls and semi-hermetic compressors available for all main refrigerants, equipped with smart electronics and capable of modulation, Emerson Climate Technologies has taken compressor technology to new heights.

## Our Vision:

Emerson Climate Technologies, With Our Partners,  
Will Provide Global Solutions To Improve Human Comfort,  
Safeguard Food And Protect The Environment.



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# Safety Information

- Copeland™ brand products semi-hermetic compressors are manufactured according to the latest European safety standards. Particular emphasis has been placed on the user's safety.
- These compressors are intended for installation in systems according to the EC Machines directive. They may be put to service only if they have been installed in these systems according to instructions and conforming with the corresponding provisions of legislation. For relevant standards, please refer to Manufacturers Declaration, available on request.
- These instructions should be retained throughout the lifetime of the compressor.

You are strongly advised to follow these safety instructions.

## Icon Definition

	<b>WARNING</b> This icon indicates instructions to avoid personal injury and material damage.		<b>CAUTION</b> This icon indicates instructions to avoid property damage and possible personal injury.
	<b>High voltage</b> This icon indicates operations with a danger of electric shock.		<b>IMPORTANT</b> This icon indicates instructions to avoid malfunction of the compressor.
	<b>Danger of burning or frostbite</b> This icon indicates operations with a danger of burning or frostbite.	<b>NOTE</b>	This word indicates a recommendation for easier operation.
	<b>Explosion hazard</b> This icon indicates operations with a danger of explosion.		

## About this Manual

- This manual is intended to enable users to ensure the safe installation, starting, operation, and maintenance of semi-hermetic compressors. This manual is not intended to replace the system expertise available from system manufacturers.

## Safety Statements

- Refrigerant compressors must be employed only for their intended use.
- Only qualified and authorized HVAC or refrigeration personnel are permitted to install, commission, and maintain this equipment.
- Electrical connections must be made by qualified electrical personnel.
- All valid standards for connecting electrical and refrigeration equipment must be observed.

## Use Personal Safety Equipment

- The new compressor contains oil and dry air under a pressure of 2.0bar. While releasing pressure before installation, the oil drain plug may pop out under pressure and oil could spurt out.
- Safety gloves, protective clothing, safety boots, and protective eyewear should be worn where necessary.

## General Instructions



### WARNING

**System breakdown! Personal injuries!** Never install a system in the field and leave it unattended when it has no charge, a holding charge, or with the service valves closed without electrically locking out the system.

**System breakdown! Personal injuries!**

Only approved refrigerants and refrigeration oils must be used.



### WARNING

**High body temperature! Burning!** Do not touch the compressor until it has cooled down. Ensure that other materials in the area of the compressor do not get in touch with it. Lock and mark accessible sections.



### CAUTION

**Overheating! Bearing damage!** Do not operate compressors without refrigerant charge or without being connected to the system.



### CAUTION

**Contact with POE! Material damage!** POE lubricant must be handled carefully and the proper protective equipment (gloves, eye protection, etc.) must be used at all times. POE must not come into contact with any surface or material that it might damage, including without limitation, certain polymers, e.g., PVC/CPVC and polycarbonate.



### IMPORTANT

**Transit damage! Compressor malfunction!** Use original packaging. Avoid collisions and tilting.

# Product Description

## Technical Data

Compressor		4MF-13X	4MA-22X	4ML-15X	4MH-25X	4MM-20X	4MI-30X	4MT-22X	4MJ-33X
Number of Cylinders		4	4	4	4	4	4	4	4
Displacement (m <sup>3</sup> /hr)	50 Hz	61.7	61.7	71.4	71.4	78.2	78.2	87.7	87.7
	60 Hz	74.5	74.5	86.2	86.2	94.4	94.4	105.9	105.9
Bore/Stroke (mm)		63.5/56.0	63.5/56.0	68.3/56.0	68.3/56.0	71.5/56.0	71.5/56.0	75.7/56.0	75.7/56.0
Nominal Horse Power (HP)		13	22	15	25	20	30	22	33
Motor Speed (RPM)	50 Hz	1450	1450	1450	1450	1450	1450	1450	1450
	60 Hz	1740	1740	1740	1740	1740	1740	1740	1740
Discharge Service Valve Size		1 1/8"	1 1/8"	1 1/8"	1 1/8"	1 1/8"	1 1/8"	1 3/8"	1 3/8"
Suction Service Valve Size		1 5/8"	1 5/8"	1 5/8"	2 1/8"	2 1/8"	2 1/8"	2 1/8"	2 1/8"
Base mounting (mm)		381X305	381X305	381X305	381X305	381X305	381X305	381X305	381X305
Oil Charge (liter)		3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Net Weight (kg)	Net	177	177	180	187	182	188	183	190
	Gross	202	202	205	212	207	213	208	215

Compressor		4MU-25X	4MK-35X	6MM-30X	6MI-40X	6MT-35X	6MJ-45X	6MU-40X	6MK-50X
Number of Cylinders		4	4	6	6	6	6	6	6
Displacement (m <sup>3</sup> /hr)	50 Hz	99.4	99.4	120.5	120.5	135.1	135.1	153.2	153.2
	60 Hz	120	120	145.4	145.4	163	163	184.9	184.9
Bore/Stroke (mm)		80.6/56.0	80.6/56.0	71.5/57.5	71.5/57.5	75.7/57.5	75.7/57.5	80.6/57.5	80.6/57.5
Nominal Horse Power (HP)		25	35	30	40	35	45	40	50
Motor Speed (RPM)	50 Hz	1450	1450	1450	1450	1450	1450	1450	1450
	60 Hz	1740	1740	1740	1740	1740	1740	1740	1740
Discharge Service Valve Size		1 3/8"	1 3/8"	1 3/8"	1 3/8"	1 5/8"	1 5/8"	1 5/8"	1 5/8"
Suction Service Valve Size		2 1/8"	2 1/8"	2 1/8"	2 1/8"	2 1/8"	2 1/8"	2 5/8"	2 5/8"
Base mounting (mm)		381X305	381X305	381X305	381X305	381X305	381X305	381X305	381X305
Oil Charge (liter)		3.3	3.3	3.3	3.3	3.3	3.3	3.3	3.3
Net Weight (kg)	Net	186	202	215	219	221	223	225	230
	Gross	211	227	240	244	246	248	250	255

**Table 1: Stream compressor range and performance**

Semi-hermetic Stream compressors are suitable for a wide range of applications in the form of either single compressors, condensing units or as multi-compressor equipment. The compressor is only one component which must be combined with many others to build a functional and efficient refrigeration system.

**Therefore the information in this manual relates to all semi-hermetic Stream compressors with standard equipment and accessories only.**

# Design Features

## Compressor Structure

All compressors are fitted with Stream valve plates which cannot be dismantled. To maintain the high capacity of these compressors the correct valve-plate-to-body gasket must always be selected in case of exchange.

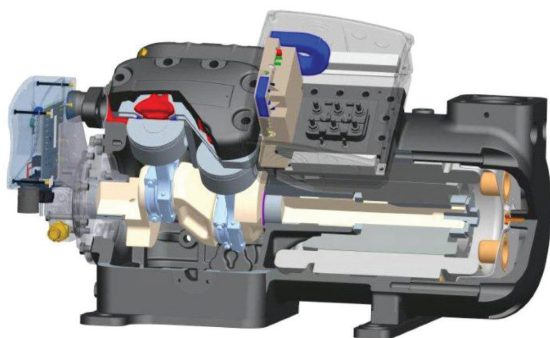


Figure 1

Each cylinder head has 2 plugged 1/8" - 27NPTF tapped holes for connecting high-pressure switches.

These high-pressure switches must be calibrated and tested before putting the compressor into service. They must stop the compressor if the allowable pressure has exceeded.

The complete cylinder head is under discharge pressure.

## Compressor Cooling

Compressor motors must always be cooled, while cylinder head cooling may also be needed at certain operating conditions. All Stream compressors are suction gas-cooled. With suction gas-cooled compressors, the motor is cooled by refrigerant gas that is led over the motor. An additional fan (70W vertical air flow fan) may be required depending upon the operation conditions. Please see Operating Envelopes.

## Demand Cooling

“Demand Cooling”, as the term implies, means liquid refrigerant injection on demand. If a low-temperature R22 or R407F installation is needed, the following compressors can be equipped with demand cooling. Models without demand cooling are also available from Asia. Please contact the representative sales manager in your region for more information.

For Demand Cooling installation, refer to the installation manual in accessory kit. Please see Operating Envelopes.

4MF-13	4ML-15	4MM-20	4MT-22	4MU-25
6MM-30	6MT-35	6MU-40		

## Unloaded Start

With direct starting, the motor of a compressor is switched directly into the mains by means of a switch. The resulting breakaway starting current amounts to multiple times the rated motor current operating maximum, without consideration being given to transient phenomena. In the case of high-powered motors, the breakaway starting currents become so large that they lead to disruptive voltage dips in the mains. Compressors that are subject to current limitation must, therefore, by all means, be equipped with starting load reduction to guarantee perfect starting even when the voltages amount to less than approximately 85% of the voltage on the nameplate.

## Capacity Control

For 4M\* and 6M\* compressors, a mechanical capacity control is available. The system used is blocked suction. Be aware that unloaded operation changes the application range of the compressor.

**NOTE: For the application range of the compressors with capacity control, refer to Technical Information D7.21.2 “Stream semi-hermetic compressor capacity control”.**

## Oil Pumps

The oil pumps used for Stream compressors are independent of their rotating direction. Stream compressors are delivered with CoreSense™ Diagnostics. The oil pump integrates the electronic switch for integrating oil pressure safety functionality.

## Oil Pressure

Normal oil pressure is between 1.05 and 4.2 bar higher than crankcase pressure. Net oil pressure can be read by connecting two pressure gauges to the compressor and comparing the readings. One gauge should be connected to the oil pump. The second gauge should be connected to the crankcase (T-fitting instead of plug on the compressor crankcase) or the suction service valve.

During irregular operating condition, e.g., a blockage of the suction filter, the pressure measured at the suction shut-off valve of the compressor may differ widely from that measured at the crankcase. Therefore, pressure drops have to be avoided.

## Oil Circulation

Oil returns with the suction gases through a suction strainer and separates in the motor chamber reaching the crankcase by way of oil return relief valve in the partition between motor housing and crankcase. This relief valve closes on compressor start-up due to the pressure difference arising between motor side and crankcase, thus, slowing down pressure decrease in the crankcase over a certain period of time. It reduces the foaming of the oil/refrigerant mixture that would occur if the pressure decreased rapidly. The valve does not reopen until the pressure has been equalized by means of a crankcase ventilating valve. This second valve connects the crankcase and suction side cylinder head. It reduces the pressure difference by means of a very small bore in the plate of the valve so slowly that oil foams less and only limited oil/refrigerant foam is transferred to the oil pump.

Four-cylinder compressors have one crankcase ventilating valve on the left cylinder bank, whereas, six-cylinder compressors have two ventilating valves on the left and right cylinder banks.

## Oil level

All compressors are delivered with sufficient oil for normal operation (see Table 2). The optimum oil level should be checked by operating the compressor until the system is stable and then comparing the sight glass reading with the appropriate diagram below. Oil level should be min 1/4 and max 3/4 of sight glass.

For service compressors when an oil regulator is used the oil level should be min 1/4 and max 3/4 of sight glass. The level can also be checked within 10 seconds of compressor shut-down.

For 4M\* and 6M\* compressors, a higher oil level may be accepted when an oil regulator is in use because the oil separator will reduce excessive oil circulation.

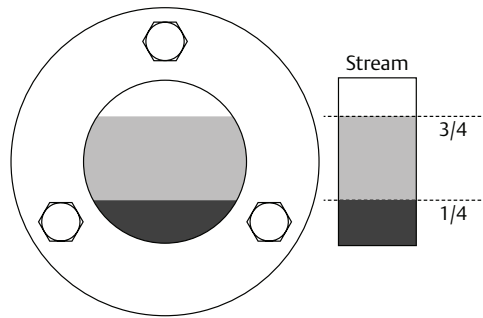
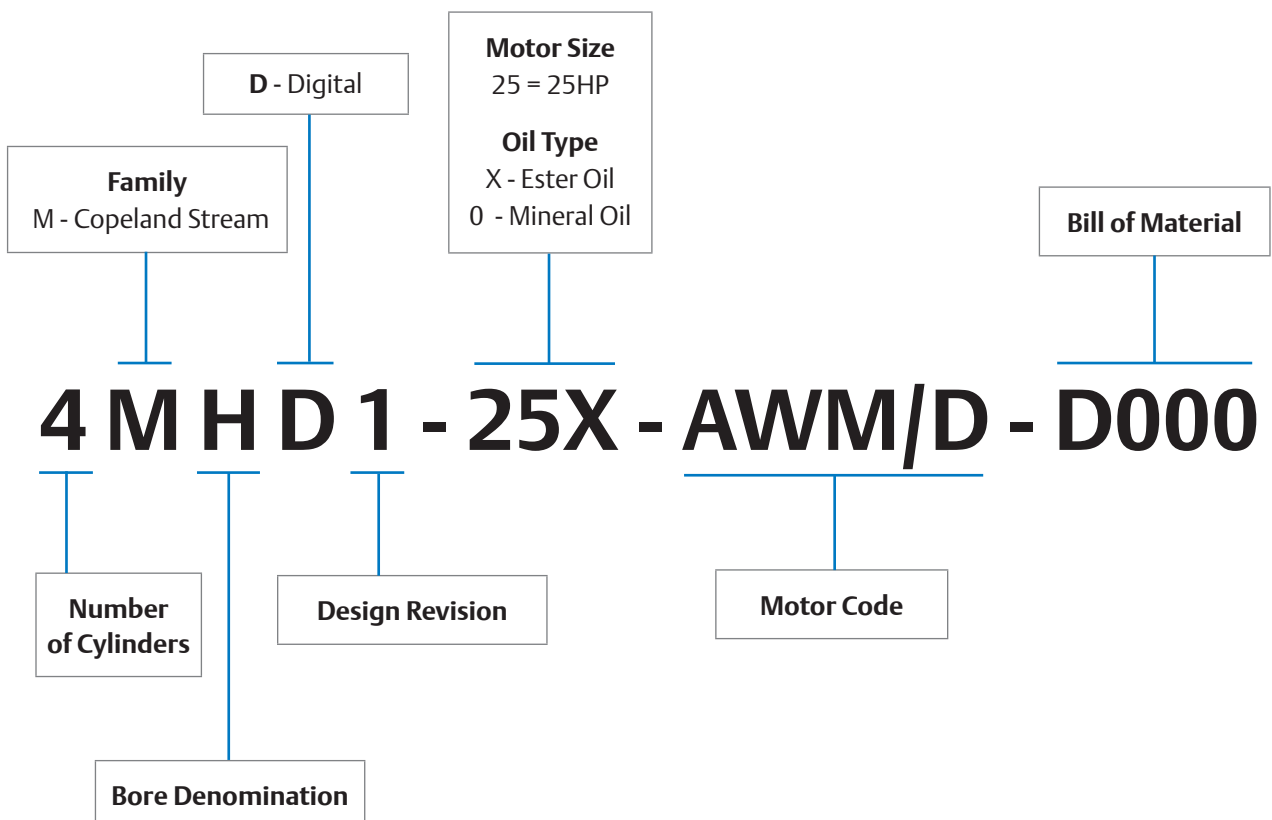


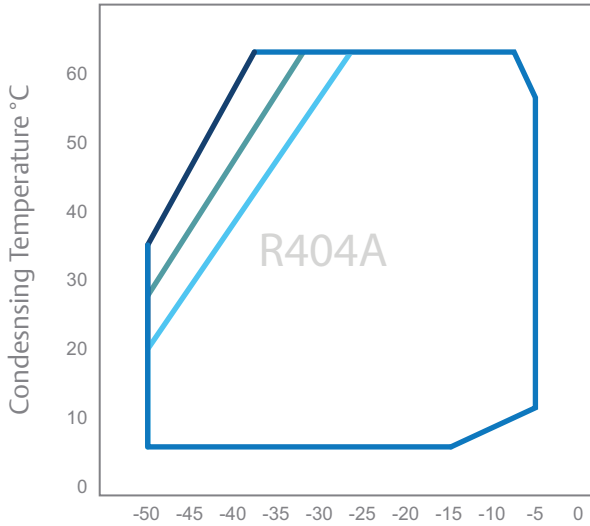
Figure 2: 4M\* and 6M\* compressors

## Nomenclature



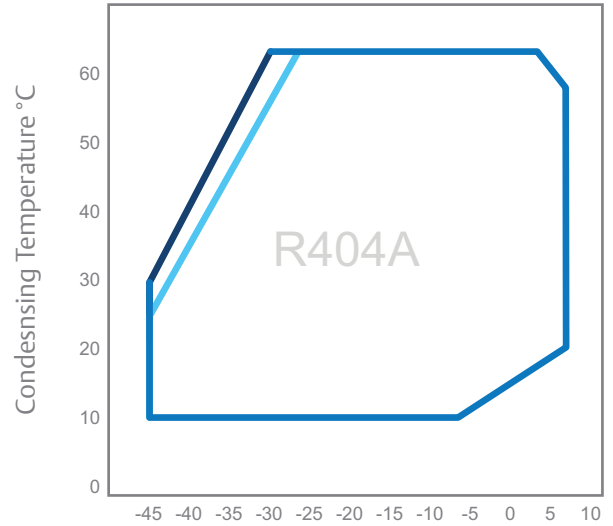
# Operating Envelopes

4MF1-13X, 4ML1-15X, 4MM1-20X, 4MT1-22X  
6MM1-30X, 6MT1-35X, 6MU1-40X



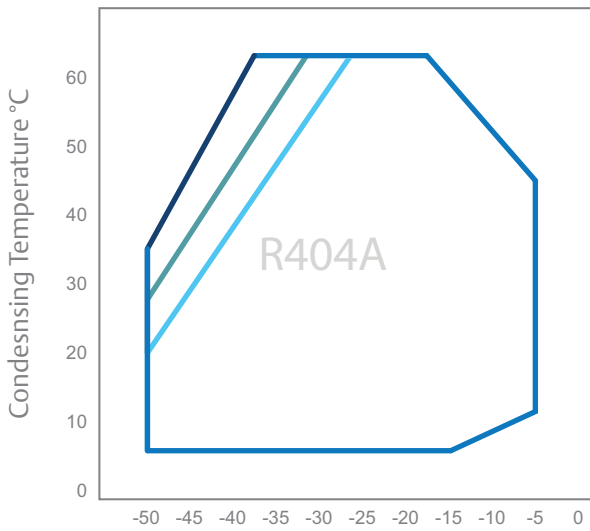
- 20K Suction Superheat
- 0°C Return Gas Temperature
- 20°C Return Gas Temperature

4MA1-22X, 4MH1-25X, 4MI1-30X, 4MJ1-33X, 4MK1-35X  
6MI1-40X, 6MJ1-45X, 6MK1-50X



- 0°C Return Gas Temperature
- 20°C Return Gas Temperature

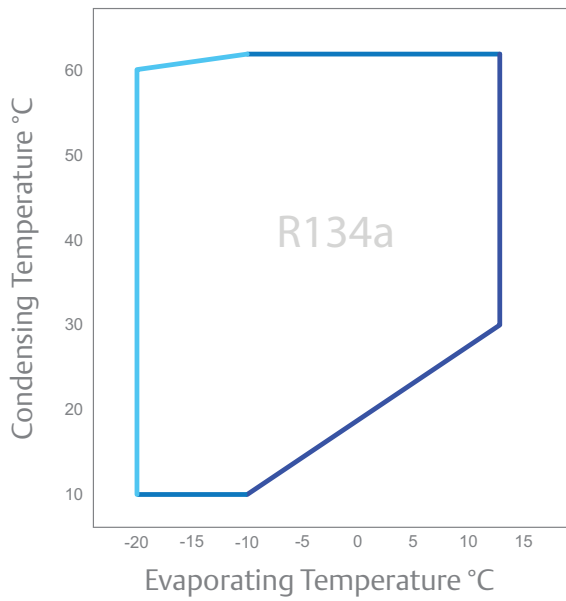
4MU1-25X



- 20K Suction Superheat
- 0°C Return Gas Temperature
- 20°C Return Gas Temperature

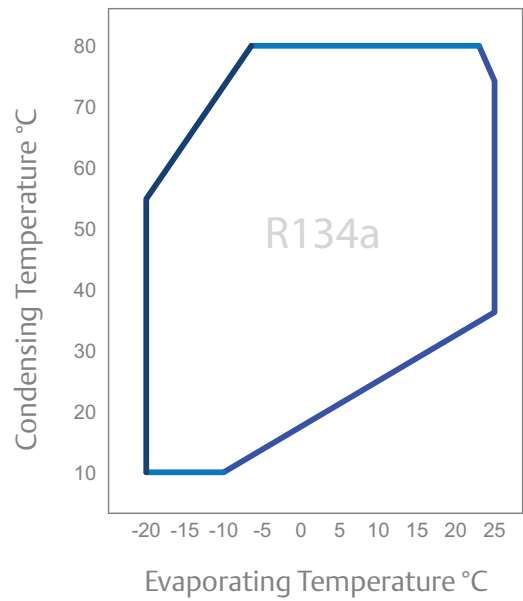


4MF1-13X, 4ML1-15X  
 4MM1-20X, 4MT1-22X, 4MU1-25X  
 6MM1-30X, 6MT1-35X, 6MU1-40X



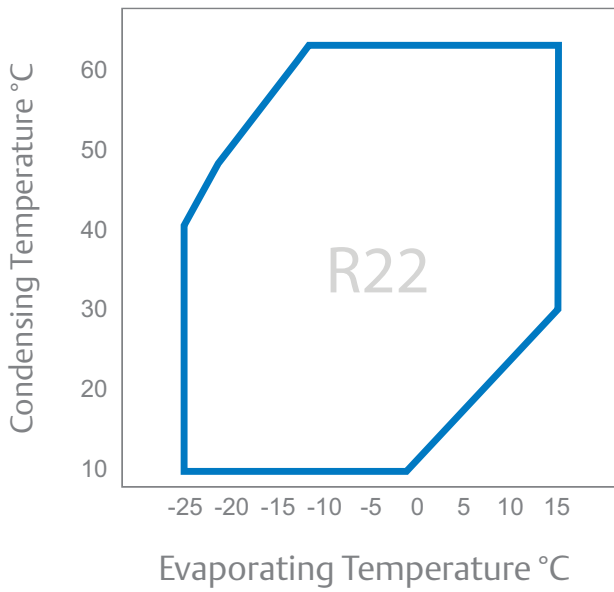
— 25°C Return Gas Temperature

4MA1-22X, 4MH1-25X  
 4MI1-30X, 4MJ1-33X, 4MK1-35X  
 6MI1-40X, 6MJ1-45X, 6MK1-50X



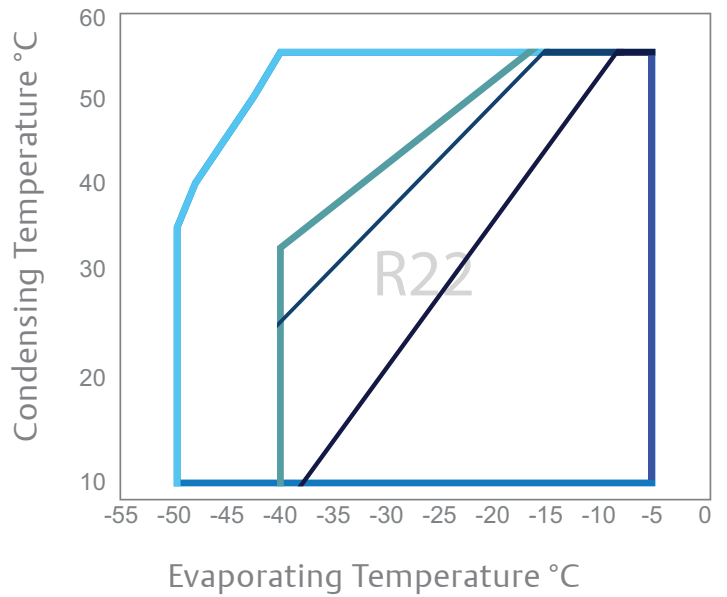
— 20K Suction Superheat

4MA1-220, 4MH1-250, 4MI1-300, 4MJ1-330



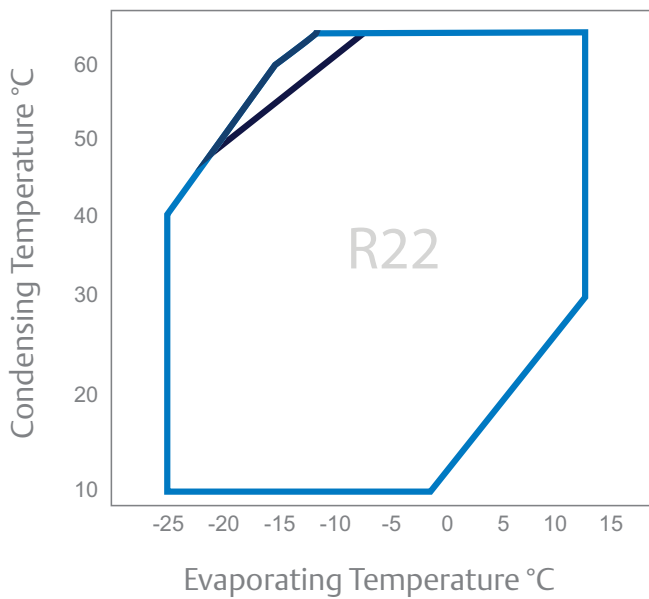
— 20°C Suction Gas Return+Fan+Liquid Injection

4MF1-130, 4ML1-150, 4MM1-200, 4MT1-220,  
4MU1-250, 6MM1-300, 6MT1-350, 6MU1-400



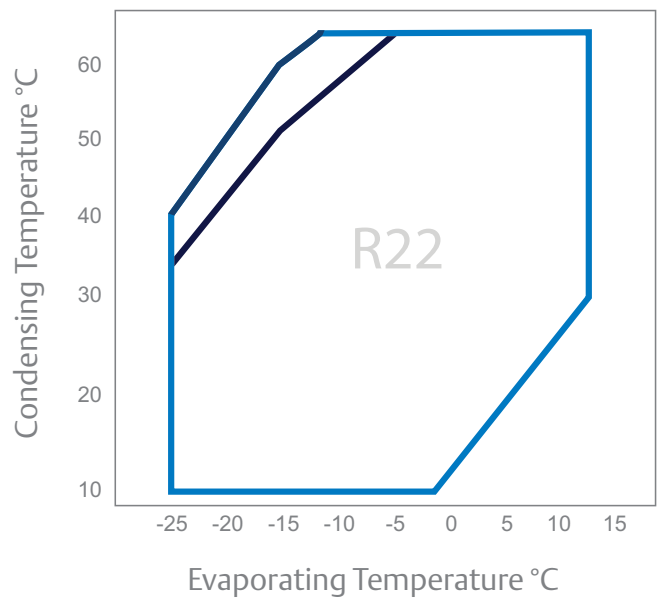
— 20°C Return Gas Temperature+Fan+Demand Cooling  
 — 20K Suction Superheat+Fan  
 — 20K Suction Superheat  
 — 20°C Return Gas Temperature

4MK1-350, 6MI1-400, 6MJ1-450



— 20K Suction Superheat  
 — 20°C Return Gas Temperature

6MK1-500



— 20K Suction Superheat  
 — 20°C Return Gas Temperature

# Nameplate Information

All important information for identification of the compressor is printed on the nameplate located below the compressor oil pump. The type of refrigerant used should be stamped on the nameplate by the installer.

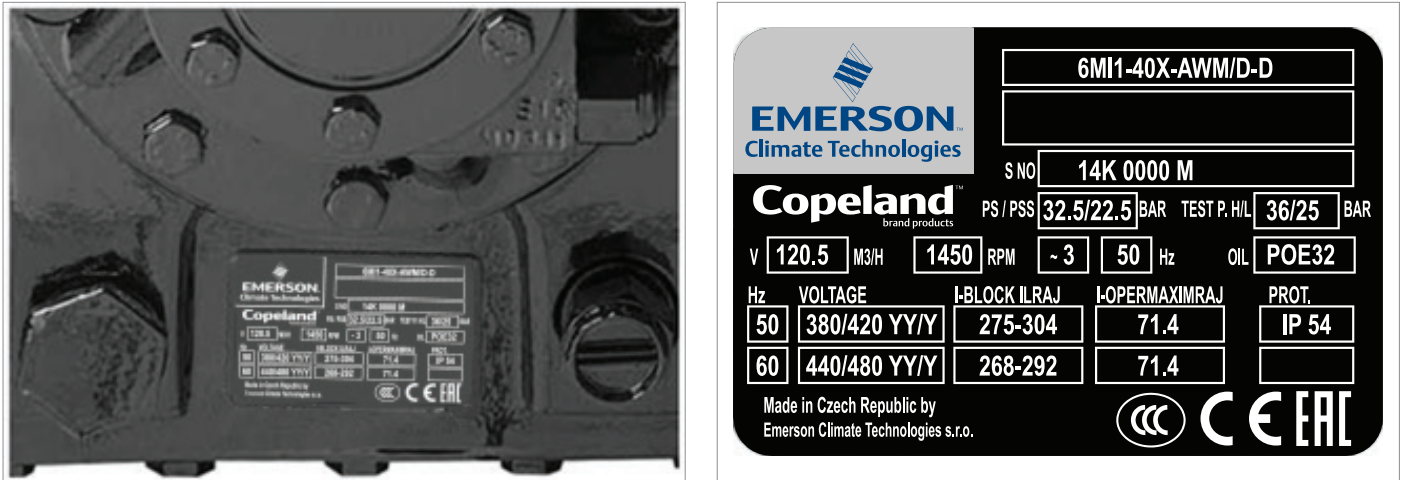


Figure 3

The date of production indicates the year and week of production. The year and month of production are also part of the serial number (Jan. = A, Feb. = B, ... Dec. = L).

## Application Range

### Qualified Refrigerants and Oils

**IMPORTANT**

It is essential that the glide of refrigerant blends (primarily R407C) is carefully considered when adjusting pressure and superheat controls.

Oil recharge values can be taken from Copeland™ brand products Selection Software on [www.EmersonClimateAsia.com](http://www.EmersonClimateAsia.com)

<b>Qualified Refrigerants</b>	R404A, R407A, R407C, R407F, R134a, R507	R22
<b>Copeland™ Brand Products Standard Oil</b>	Emkarate RL 32 3MAF	Karamay 32BYMO
<b>Servicing Oil</b>	Emkarate RL 32 3MAF Mobil EAL Arctic 22 CC	Karamay 32BYMO, Suniso 3GS Shell 22-12, Texaco Capella WF32

Table 2: Qualified refrigerants and oils for recharging and topping up

**To Recharge:**

When the compressor is completely empty of oil, the amount of oil to be “recharged” is typically 0.12 litre less than the original oil charge (oil will already be around the system).

**To Top up:**

During commissioning, planned maintenance or servicing, add oil so that the compressor oil level is correct.

# Installation Guidelines

**WARNING**  
**High pressure! Injury to skin and eyes, possible!** Be careful when opening connections on a pressurized item.

## Compressor Handling

### Delivery

Please check whether the delivery is correct and complete. Any deficiency should be reported immediately in writing.

- Suction and discharge shut-off valves
- Oil charge, oil sight glass
- Mounting kit
- CoreSense™ Diagnostics module
- Holding charge up to 2.5 bar(g) (dry air)

### Transport and Storage

**WARNING**  
**Risk of collapse! Personal injuries!** Move compressors only with appropriate mechanical or handling equipment according to weight. Keep in the upright position. Stack and transit as shown below. Keep the packaging dry at all times.

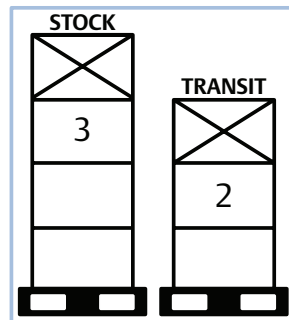


Figure 4

Compressors are delivered on pallets. Cooling fans are delivered in separate cartons. Accessories may be mounted or delivered loose. Solenoid valves are never mounted.

### Positioning and Securing

#### IMPORTANT

**Handling damage! Compressor malfunction!** Only use the lifting eyes whenever the compressor requires positioning. Using discharge or suction connections for lifting may cause damage or leaks.

If possible, the compressor should be kept vertical during handling. For safety reasons, two lifting eyes should be fitted before moving a compressor (½" - 13 UNC). Otherwise refer to drawings on **Figure 5** to see how to apply other lifting methods.

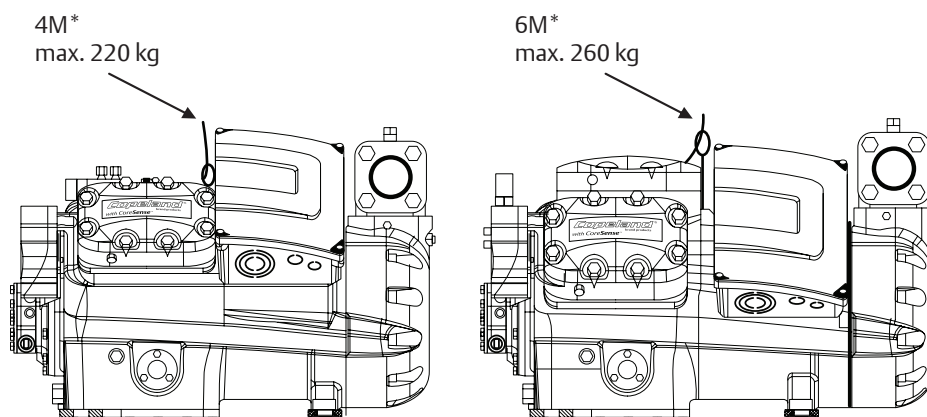


Figure 5

In order to avoid refrigerant leaks or other damage the compressors should not be lifted by the service valves or other accessories.

## Installation Location

Ensure the compressors are installed on a solid level base.

## Mounting Parts

To minimize vibration and start/stop impulses, flexible mounting should be used. For this purpose, one set of spring mounting parts for each of the Stream models is delivered with each 4M\* and 6M\* compressor.

Due to differences in weight (cylinder/motor side), different springs have to be used on both sides. Springs have different colours for easier identification: violet on motor side and orange on cylinder side.

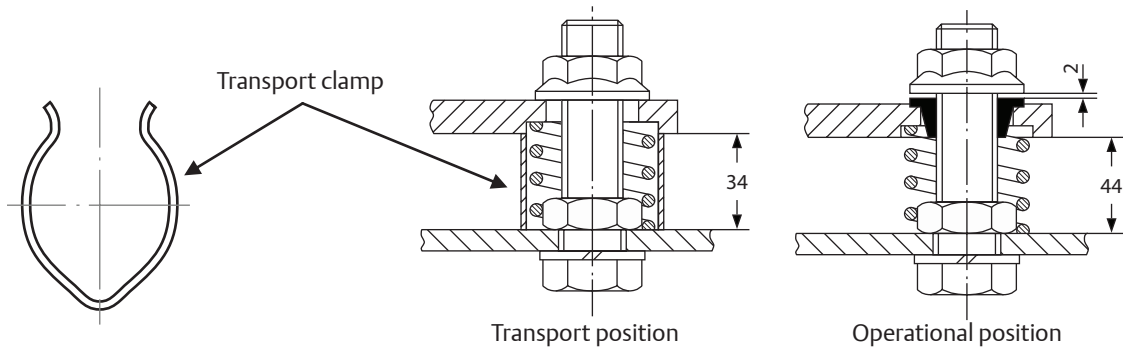


Figure 6

When Stream compressors are mounted in racks, rubber mounting parts should be used. A compressor may be rigidly mounted, i.e., without springs. In this case, more shock and vibration loading will be transmitted to the frame, so flatness of mounting location is very important. If the installation requires a very high level of vibration absorption, additional vibration absorbers - available on the market - can be fitted between the rails and the foundation.

TWIN compressors are fitted to U mounting rails using rubber pads.

Rubber mounting parts can be delivered as a variation instead of the spring mounting parts, or as a separate kit.

Unevenness in the mounting surface will have to be taken by the rack and/or the compressor bottom plate/feet. Excessive unevenness can result in too high mechanical stress to the system and could damage the compressor or rack. Therefore, the flatness of the mounting location is essential. In addition, both vibration/shock and mechanical stress to compressor can be avoided by using rubber mounting parts.

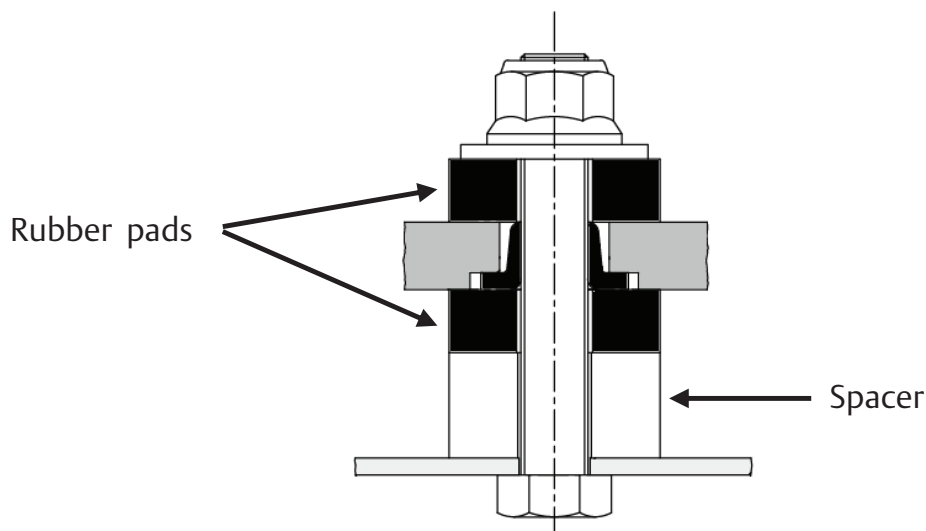


Figure 7

**NOTE:** For rigid mounting on rack with rubber mounting parts, the nuts should be tightened to the rubber surface without rubber deformation to keep efficient operation of the rubber. The maximum applicable torque without rubber deformation is 50Nm.

## Pressure Safety Controls

### High-pressure Control

A high-pressure control with a maximum cut-out setting of 28 bar(g) is required. The high-pressure cut-out should have a manual reset feature for the highest level of system protection.

### Low-Pressure Control

The normal minimum cut-out setting is 0.1 bar(g) for R404A. The low-pressure cut-out should have a manual reset feature for the highest level of system protection.

### Maximum Operating Pressures

Maximum operating pressures according to EN 12693 shown on the compressor nameplate are obligatory and must not be exceeded.

**NOTE: The compressor operating range may be restricted for various reasons. Check the application range limitations in Copeland® brand products Selection Software on [www.EmersonClimateAsia.com](http://www.EmersonClimateAsia.com).**

- High-pressure side (HP): 28.0 bar
- Low-pressure side (LP): 22.5 bar

## Brazing Procedure

### IMPORTANT

**Blockage! Compressor breakdown!** Maintain a flow of oxygen-free nitrogen through the system at very low pressure during brazing. Nitrogen displaces the air and prevents the formation of copper oxides in the system. If allowed to form, the copper oxide material can later be swept through the system and block screens such as those protecting capillary tubes, thermal expansion valves, and accumulator oil return holes.

**Contamination or moisture! Bearing failure!** Do not remove the plugs until the compressor is set into the unit. This minimizes any entry of contaminants and moisture.

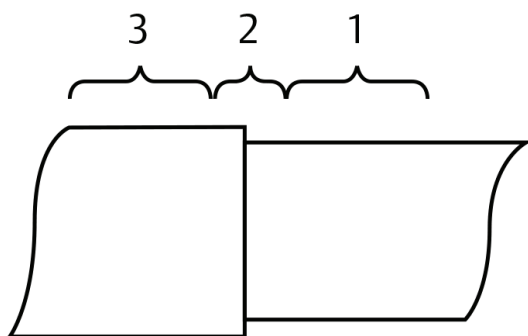


Figure 8: Suction tube brazing

- The copper-coated steel tubes on Stream compressors can be brazed in approximately the same manner as any copper tube.
- Recommended brazing materials: any silfos material is recommended, preferably with a minimum of 5% silver. However, 0% silver is acceptable.
- Be sure tube fitting inner diameter and tube outer diameter are clean prior to assembly.
- Using a double-tipped torch, apply heat in area 1.
- As the tube approaches brazing temperature, move the torch flame to area 2.

- Heat area 2 until braze temperature is attained, moving the torch up and down and rotating around the tube as necessary to heat the tube evenly. Add braze material to the joint while moving the torch around the joint to flow braze material around the circumference.
- After the braze material flows around the joint, move the torch to heat area 3. This will draw the braze material down into the joint. The time spent heating area 3 should be minimal.
- As with any brazed joint, overheating may be detrimental to the final result.

### To Disconnect:

Heat joint areas 2 and 3 slowly and uniformly until the braze material softens and the tube can be pulled out of the fitting.

### To Reconnect:

Recommended brazing materials: Silfos with minimum 5% silver or silver braze used on other compressors.

## Screens



### CAUTION

**Screen blocking! Compressor breakdown!** Use screens with at least 0.6 mm openings.

The use of screens finer than 30 x 30 mesh (0.6 mm openings) anywhere in the system should be avoided with these compressors. Field experience has shown that finer mesh screens used to protect thermal expansion valves, capillary tubes or accumulators can become temporarily or permanently plugged with normal system debris and block the flow of either oil or refrigerant to the compressor. Such blockage can result in compressor failure.

## Electrical Connection

### General Recommendations

The compressor terminal box has a wiring diagram on the inside of its cover. Before connecting the compressor, ensure the supply voltage, the phases and the frequency match the nameplate data.

### Electrical Installation

#### Three-phase Motors

All compressors can be started direct-on-line.

The necessary position of bridges for direct-on-line start (depending on type of motor and/or mains voltage) is shown in page 16, Wiring Diagrams.

#### Star / Delta Motors (Y/ $\Delta$ ) – Code E

With the help of bridges, this motor is interchangeable for star (Y) or delta ( $\Delta$ ) operation. It is suitable for two voltages, eg, 230V in delta, 400V in star connection. If the supply voltage and the nominal voltage of the motor in  $\Delta$ -connection are identical, the star connection motor can also be used for starting (remove the bridges!).

#### Part winding Motors (YY/Y) – Code A

PWS motors contain two separate windings (2/3 + 1/3) which are internally connected in star and operated in parallel. You cannot change the voltage by changing the electrical connections as the motor is only suitable for one voltage.

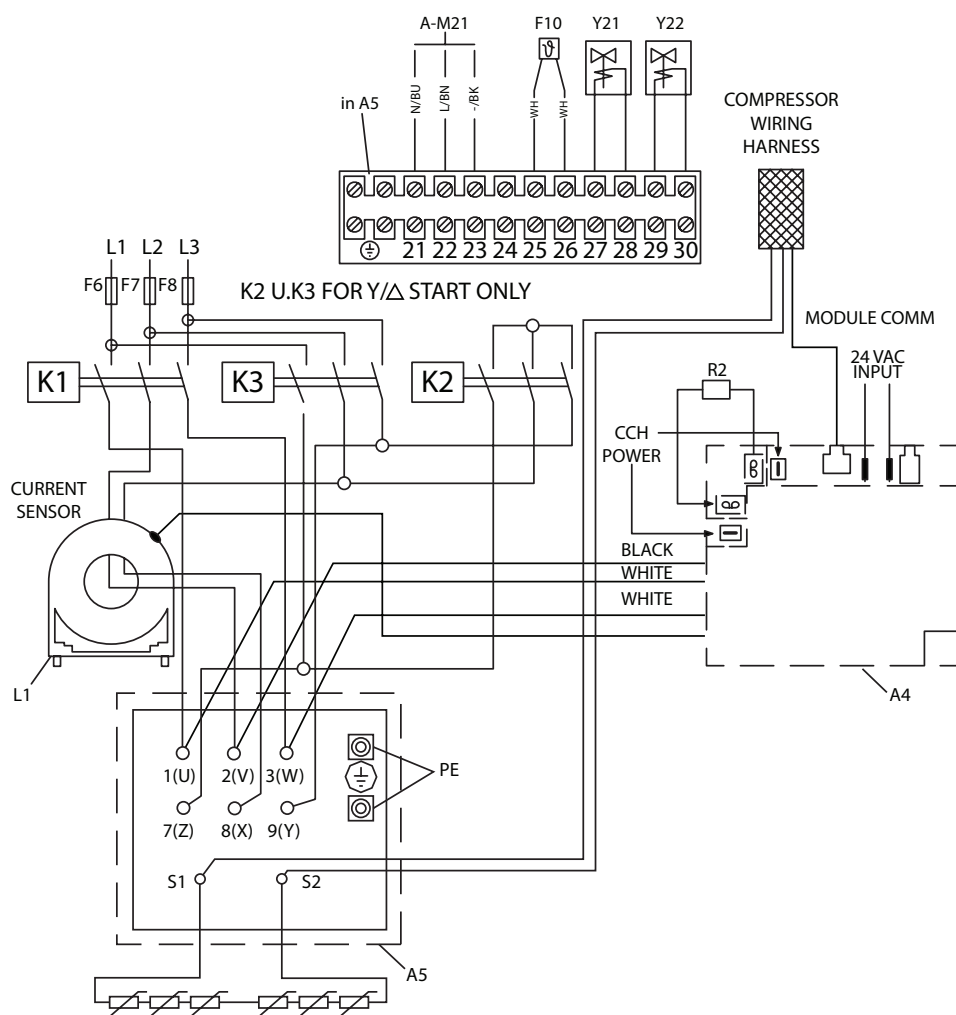
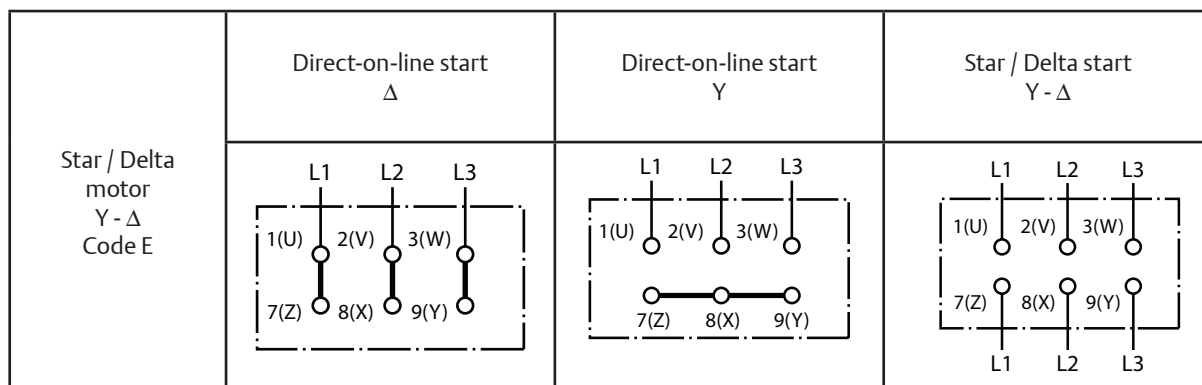
The first part winding, i.e., the 2/3 winding on terminals 1-2-3, can be used for part-winding start (remove the bridges!). After a time delay of  $1 \pm 0.1$  seconds, the second part winding, i.e., the 1/3 winding on terminals 7-8-9, must be brought on line.





## Wiring diagram for Star / Delta motors (EW---)

Star / Delta motors can be connected direct-on-line or Star / Delta start.



- |           |                           |           |                                   |
|-----------|---------------------------|-----------|-----------------------------------|
| A4 .....  | Sensor module             | K2 .....  | Y - Contactor M1                  |
| A5 .....  | Terminal box compressor   | K3 .....  | Contacteur M1                     |
| CCH ..... | Crankcase heater          | M2 .....  | Fan motor/condenser               |
| F6 .....  | Fuse for control circuit  | M21 ..... | Fan motor/condenser               |
| F7 .....  | Fuse for control circuit  | R2 .....  | Crankcase heater                  |
| F8 .....  | Fuse for control circuit  | Y21 ..... | Solenoid valve capacity control 1 |
| F10 ..... | Thermal protection switch | Y22 ..... | Solenoid valve capacity control 2 |
| K1 .....  | Contacteur M1             |           |                                   |

Figure 10

## Protection Devices

Independently from the internal motor protection, fuses must be installed before the compressor. The selection of fuses has to be carried out according to VDE 0635, DIN 57635, IEC 269-1 or EN 60-269-1.

## CoreSense™ Diagnostics

CoreSense™ Diagnostics for all 4M\* and 6M\* Stream semi-hermetic compressors combines oil and motor protection into one module, replacing OPS1/2 and the electronic module INT69TM. In addition, it provides advanced protection such as high discharge temperature, locked rotor, single/missing phase, voltage imbalance and low voltage protection. The module is capable of communication via Modbus® protocol. An external overload protection is not necessary.

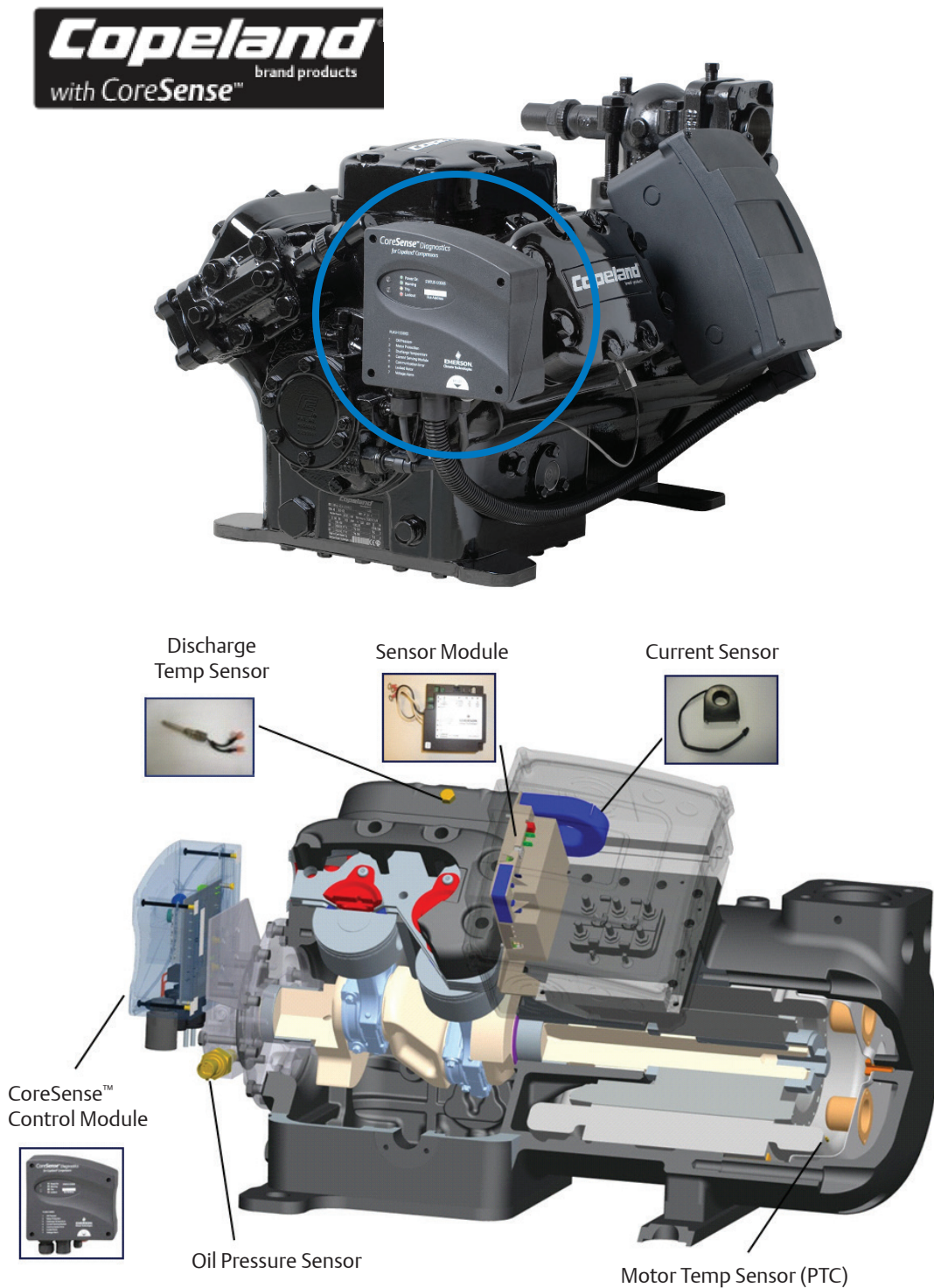


Figure 11: CoreSense™ Diagnostics Module

For the electrical connection of the CoreSense™ Diagnostics module, please refer to wiring diagram below:

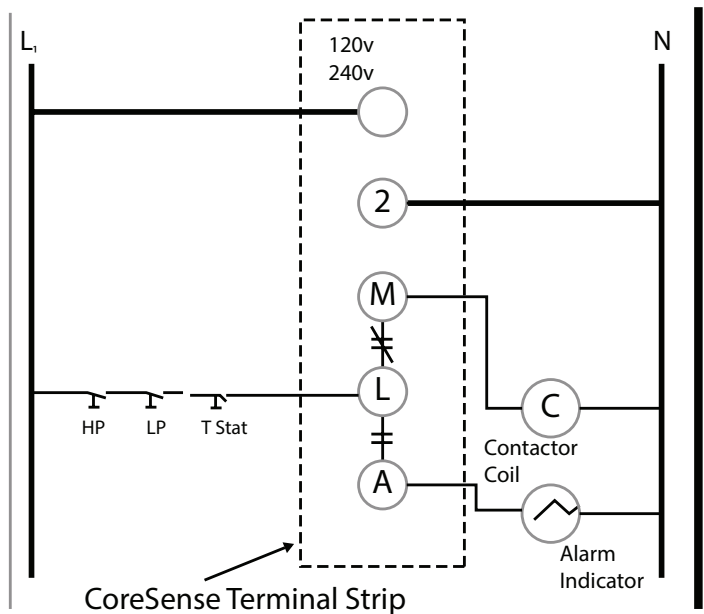


Figure 12: CoreSense™ Wiring Diagram

**NOTE:** For more information, please refer to Technical Information D7.8.4 “CoreSense™ Diagnostics for Stream refrigeration compressors”.

### Crankcase Heaters

**IMPORTANT**

**Oil dilution! Bearing malfunction!** Turn the crankcase heater on 12 hours before starting the compressor.

- A crankcase heater is used to prevent refrigerant migrating into the body during standstill periods. Heaters for 4M\* and 6M\* compressors are screwed into a sleeve (see Figure 13).
- The crankcase heater is available in 230V.
- The operation of crankcase heater is controlled by the CoreSense™ Diagnostics module.

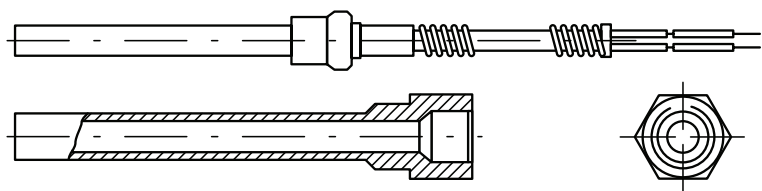



Figure 13: 100 Watt crankcase heater element

# Start-up Leak Checking, Evacuation, and Charging

 **WARNING**  
**Diesel effect! Compressor destruction!** The mixture of air and oil at high temperature can lead to an explosion. Avoid operating with air.

## Leak Test

The suction shut-off valve and discharge shut-off valve on the compressor must remain closed during pressure testing to prevent air and moisture from entering the compressor. The test pressure (dried nitrogen) must not exceed 20.5 bar, provided no other system component's pressure is lower. In this case, the lower pressure is the test pressure.

## System Evacuation

Before the installation is put into commission, remove the holding charge then evacuate with a vacuum pump. Proper evacuation reduces residual moisture to 50 ppm. The installation of adequately sized access valves at the furthest point from the compressor in the suction and liquid lines is advisable. To achieve undisturbed operation, the compressor valves are closed and the system is evacuated down to 0.3 mbar / 0.225 Torr. Pressure must be measured using a vacuum pressure (Torr) gauge on the access valves and not on the vacuum pump. This serves to avoid incorrect measurements resulting from the pressure gradient along the connecting lines to the pump. Then, the compressor must be evacuated.

Due to the factory holding charge of dry air, the compressor is under pressure (about 1 to 2.5 bar). This is to indicate the compressor does not leak.


When plugs are removed from the compressor in order to connect a pressure gauge or to fill in oil, the plug may pop out under pressure and oil can spurt out.

## Preliminary Checks - Pre-starting

Discuss details of the installation with the installer. If possible, obtain drawings, wiring diagrams, etc. It is ideal to use a check-list but always check the following:


- Visual check of the electrics, wiring, fuses etc.
- Visual check of the plant for leaks, loose fittings such as TVX bulbs, etc.
- Compressor oil level
- Calibration of HP and LP switches and any pressure actuated valves
- Check setting and operation of all safety features and protection devices
- All valves in the correct running position
- Pressure and compound gauges fitted
- Correctly charged with refrigerant
- Compressor electrical isolator location and position

## Charging Procedure

 **CAUTION**  
**Low suction pressure operation! Compressor Damage!** Do not operate with a restricted suction. Do not operate with the low-pressure cut-out bridged.

The system should be liquid-charged through the liquid-receiver shut-off valve or through a valve in the liquid line. The use of a filter drier in the charging line is highly recommended. The majority of the charge should be placed in the high side of the system to prevent bearing washout during first-time start on the assembly line.

## Initial Start-up

 **CAUTION**  
**Oil dilution! Bearing malfunction!** It is important to ensure that new compressors are not subjected to liquid abuse. Turn the crankcase heater on 12 hours before starting the compressor.  
**High discharge pressure operation! Compressor damage!** Do not use compressor to test opening set point of high-pressure cut-out.

- The compressor must be equipped according to our technical documentation considering the application intended. Make sure of this before start-up.
- For brazing connections where dissimilar or ferric metals are joined, a silver alloy rod with a minimum of 30% silver shall be used being either flux coated or with a separate flux.
- Bolt torque settings are listed in **Appendix 2**.
- With the exception of rubber-coated metallic gaskets (Wolverine) all gaskets should be oiled before fitting. O-rings should also be oiled.

**A compressor should never be operated beyond its approved application range! Check by consulting the appropriate data sheet. To avoid motor damage the compressor MUST NOT be started, nor may high-potential testing be carried out under vacuum.**

## Minimum Run Time

Emerson Climate Technologies recommends a maximum of 10 starts per hour. The most critical consideration is the minimum run time required to return oil to the compressor after start-up.

## Recommended Inverter Range

Stream compressors are released for inverter applications from Control Techniques or other brands available on the market. Over a frequency range, the compressor system combination can have frequency bands with higher vibration. The degree of vibration and frequency bands are highly dependent on the system. To help reduce these vibration levels, rubber mounting should be used on all inverter driven compressors.

Active oil management should be used for all inverter driven compressors.

# Maintenance

## Exchanging the Refrigerant

Qualified refrigerants and oils are given in Application Range (Qualified Refrigerants and Oils).

It is not necessary to replace the refrigerant with a new one, unless contamination due to an error such as topping up the system with an incorrect refrigerant is suspected. To verify correct refrigerant composition, a sample can be taken for chemical analysis. A check can be made during shut down by comparing the refrigerant temperature and pressure using precision measurements at a location in the system where liquid and vapour phases are present and when the temperatures have stabilised.

In the event that the refrigerant needs replacing, the charge should be recovered using a suitable recovery unit.

In the event that R22 in a system with mineral oil is to be replaced with R407C or R404A, the oil must also be changed.

**NOTE: Please refer to Technical Information C7.26.1 “Refrigerant Changeover from HCFC to HFC Refrigerants”.**

## Replacing a Compressor



### CAUTION

**Inadequate lubrication! Bearing destruction!** Exchange the accumulator after replacing a compressor with a burned out motor. The accumulator oil return orifice or screen may be plugged with debris or may become plugged. This will result in starvation of oil to the new compressor and a second failure.

In the case of a motor burnout, the majority of contaminated oil will be removed with the compressor. The rest of the oil is cleaned through the use of suction and liquid line filter driers. A 100% activated alumina suction line filter drier is recommended but must be removed after 72 hours. **It is highly recommended that the suction accumulator be replaced if the system contains one.** This is because the accumulator oil-return orifice or screen may be plugged with debris or may become plugged shortly after a compressor failure. This will result in starvation of oil to the replacement compressor and a second failure. When a single compressor or tandem is exchanged in the field, it is possible that a major portion of the oil may still be in the system. While this may not affect the reliability of the replacement compressor, the extra oil will add to rotor drag and increase power usage.

## Lubrication and Oil Removal



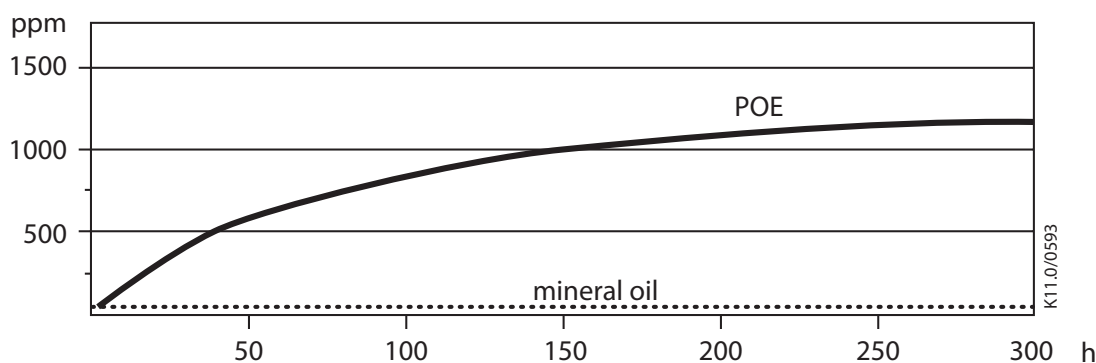
### CAUTION

**Chemical reaction! Compressor destruction!** Do not mix up ester oils with mineral oil and/or alkyl benzene when used with chlorine-free (HFC) refrigerants.

The compressor is supplied with an initial oil charge. The standard oil charge for use with refrigerants R404A / R407A / R407C / R407F / R134a is a polyolester (POE) lubricant Emkarate RL 32 3MAF. In the field the oil level could be topped up with Mobil EAL Arctic 22 CC if 3MAF is not available. The standard mineral oil for R22 is Suniso 3GS.

One disadvantage of POE is that it is far more hygroscopic than mineral oil (see Figure 14). Only brief exposure to ambient air is needed for POE to absorb sufficient moisture to make it unacceptable for use in a refrigeration system. Since POE holds moisture more readily than mineral oil it is more difficult to remove it through the use of vacuum. Compressors supplied by Emerson Climate Technologies contain oil with low moisture content, and it may rise during the system assembling process. Therefore, it is recommended that a properly sized filter-drier is installed in all POE systems. This will maintain the moisture level in the oil to less than 50 ppm. If oil is charged into a system, it is recommended to use POE with a moisture content no higher than 50 ppm.

The diagram below compares the hygroscopic characteristics of POE oil with mineral oil (moisture absorption in PPM at 25°C and 50% relative humidity).



**Figure 14: Absorption of moisture in ester oil in comparison to mineral oil in ppm by weight at 25°C and 50% relative humidity (h=hours)**

If the moisture content of the oil in a 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 as to the moisture content in the system, an oil sample should be taken and tested for moisture. Sight glass/moisture indicators currently available can be used with the HFC refrigerants and lubricants; however, the moisture indicator will just show the moisture content of the refrigerant. The actual moisture level of POE would be higher than the sight glass indicates. This is due to the high hygroscopicity of the POE oil. To determine the actual moisture content of the lubricant, samples have to be taken from the system and analyzed.

## Oil Additives

Although Emerson Climate Technologies cannot comment on any specific product, from our own testing and past experience, we do not recommend the use of any additives to reduce compressor bearing losses or for any other purpose. Furthermore, the long term chemical stability of any additive in the presence of refrigerant, low and high temperatures, and materials commonly found in refrigeration systems is complex and difficult to evaluate without rigorously controlled chemical laboratory testing. The use of additives without adequate testing may result in malfunction or premature failure of components in the system and, in specific cases, in voiding the warranty on the component.

## Unbrazing System Components

**WARNING**  
**Explosive flame! Burning!** Oil-refrigerant mixtures are highly flammable. Remove all refrigerant before opening the system. Avoid working with an unshielded flame in a refrigerant charged system.

Before opening up a system, it is important to remove all refrigerant from both the high and low sides of the system. If the refrigerant charge is removed from a unit from the high side only, it is possible for the body to seal, preventing pressure equalization through the compressor. This may leave the low side and suction line tubing pressurized. If a brazing torch is then applied to the low side while the low side and suction line contain pressure, the pressurized refrigerant and oil mixture could ignite when it escapes and contacts the brazing flame. To prevent this occurrence, it is important to check both the high and low sides with manifold gauges before unbrazing. Instructions should be provided in appropriate product literature and assembly (line repair) areas. If compressor removal is required, the compressor should be cut out of system rather than unbrazed.

## Dismantling and Disposal



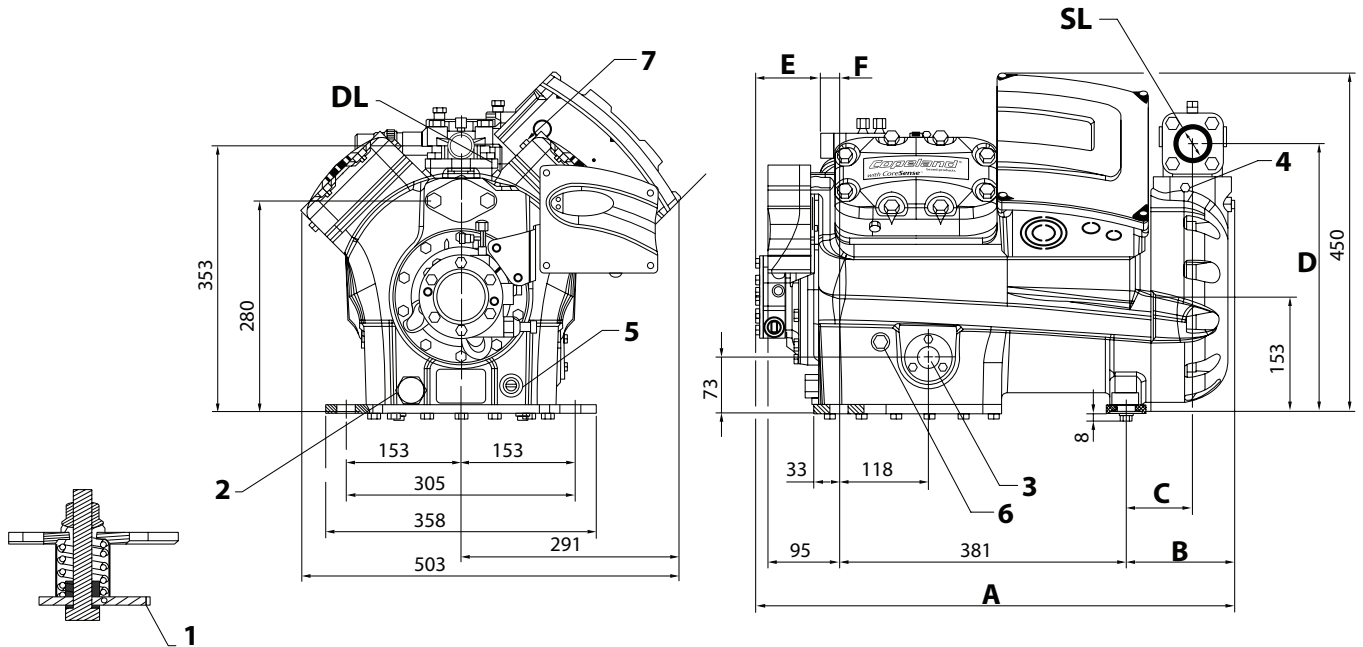
### Removing oil and refrigerant:

- Do not disperse in the environment.
- Use the correct equipment and method of removal.
- Dispose of oil and refrigerant properly.
- Dispose of compressor properly.

# Appendices

## Appendix 1: Stream Compressor Connections

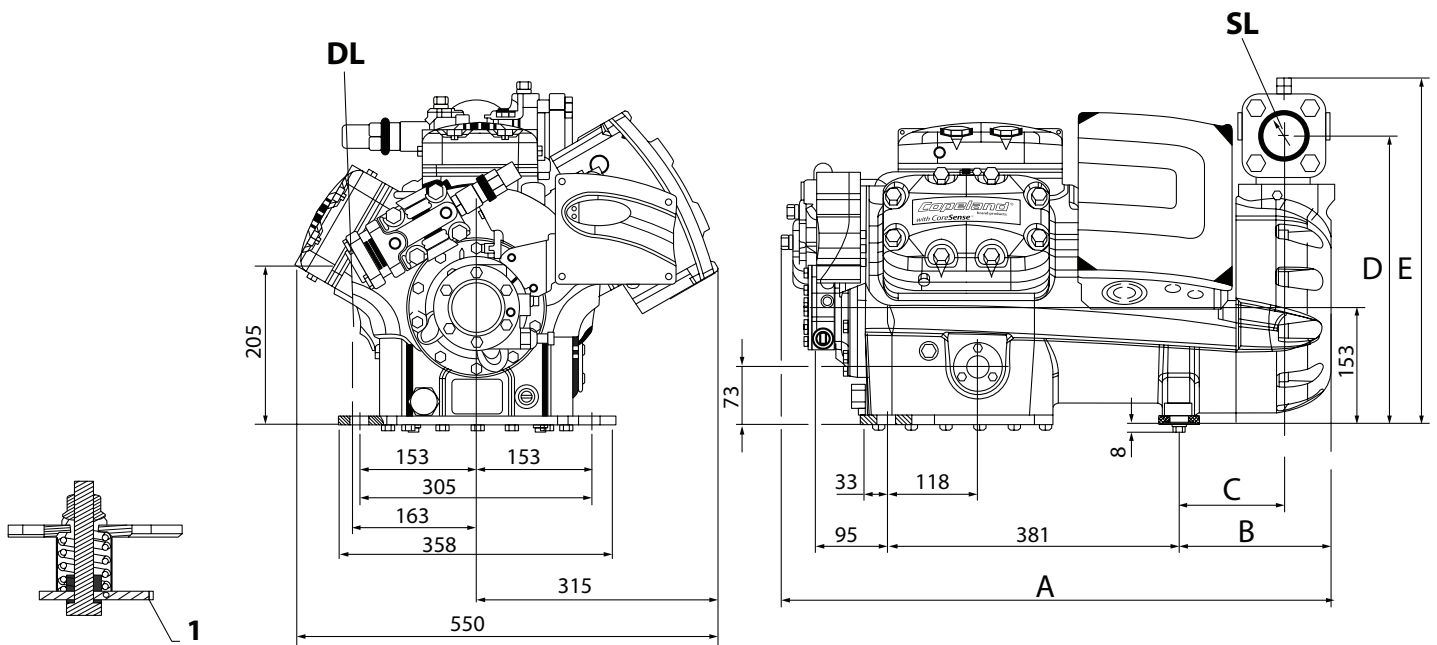
4M* Model	A	B	C	D	E	F
4MF-13X	636	144	88	356	86	25
4MA-22X						
4ML-15X						
4MH-25X	655	163	99	376	86	25
4MM-20X						
4MI-30X						
4MT-22X	655	163	99	376	80	31
4MJ-33X						
4MU-25X						
4MK-35X	687	195	131	376	80	31



SL	Suction line size (sweat) 4MF13X, 4ML15X, 4MA22X, 4MM20X, 4MH25X, 4MI30X	Ø 1 5/8"	DL	Discharge line size (sweat) 4MF13X, 4ML15X, 4MA22X, 4MM20X, 4MH25X, 4MI30X	Ø 1 1/8"
SL	Suction line size (sweat) 4MT22X, 4MJ33X, 4MU25X, 4Mk35X	Ø 2 1/8"	DL	Discharge line size (sweat) 4MT22X, 4MJ33X, 4MU25X, 4Mk35X,	Ø 1 3/8"
1	Base mountings	Ø 25.5 mm	5	Crankcase heater	
2	Magnetic plug	1" - 16 UN	6	Plug low-pressure connection	1/4"
3	Oil sight glass	1/4" - 20 UNC	7	Plug high-pressure connection	1/8"
4	Plug low-pressure connection	1/8"			



6M*Model	A	B	C	D	E
6MU-40X	773	251	187	375	447
6MK-50X	772	251	187	376	447
6MT-35X	724	202	138	376	447
6MJ-45X					
6MI-40X	723	202	138	376	447
6MM-30X					



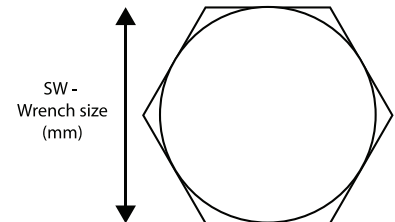
SL	Suction line size (sweat) 6MM30X, 6MT35X, 6MI40X, 6MJ45X	Ø 2 1/8"	DL	Discharge line size (sweat) 6MT35X, 6MU-40X, 6MJ45X, 6MK-50X	Ø 1 5/8"
SL	Suction line size (sweat) 6MK50X, 6MU40X	Ø 2 5/8"	DL	Discharge line size (sweat) 6MI40X, 6MM30X	Ø 1 3/8"
1	Base mountings	Ø 25.5 mm	5	Crankcase heater	
2	Magnetic plug	1" - 16 UN	6	Plug low-pressure connection	1/4"
3	Oil sight glass	1/4" - 20 UNC	7	Plug high-pressure connection	1/8"
4	Plug low-pressure connection	1/8"			

## Appendix 2: Tightening Torques in Nm

Suction shut-off valve	1/2"-13 UNC 53 - 84 Nm SW 19	Discharge shut-off valve	1/2"-13 UNC 53 - 84 Nm SW 19
	5/8"-11 UNC 104 - 164 Nm SW 23.8	Rotalock nut	1 3/4"-12 UNF 41 - 54 Nm SW 50
Bottom plate	3/8"-16 UNC 57 - 68 Nm	Mounting foot	3/8"-16 UNC 57 - 68 Nm
	SW 14.2		SW 14.2
Stator cover	1/2"-13 UNC 68-79 Nm SW 18	Housing cover	3/8"-16 UNC 57 - 68 Nm SW 14.2
Oil pump	5/16"-18 UNC 31 - 37 Nm SW 12.7	Oil sight glass	1/4"-20 UNC 4.5 - 6 Nm SW 11
Oil Pressure Switch	60 - 75 Nm	Magnetic plug	1"-16 UN 102-136 Nm SW 25.4
Terminal stud	10-32 UNF 3-4 Nm SW 9	Terminal stud thermistors	10 - 32 UNF 3.4 - 4 Nm SW 9
	1/4"-28 UNF 5-6.5 Nm SW 10	Mounting plate for terminals	3/8"-16 UNC 57 - 68 Nm SW 14.2
Cylinder head	1/2"-13 UNC 129-149 Nm SW 18	Bolt for connecting rod	1/4"-28 UNF 15 - 18 Nm Torx Screws *
Plug 4	1/4"-18 NPTF 27 - 50 Nm SW 17.5		

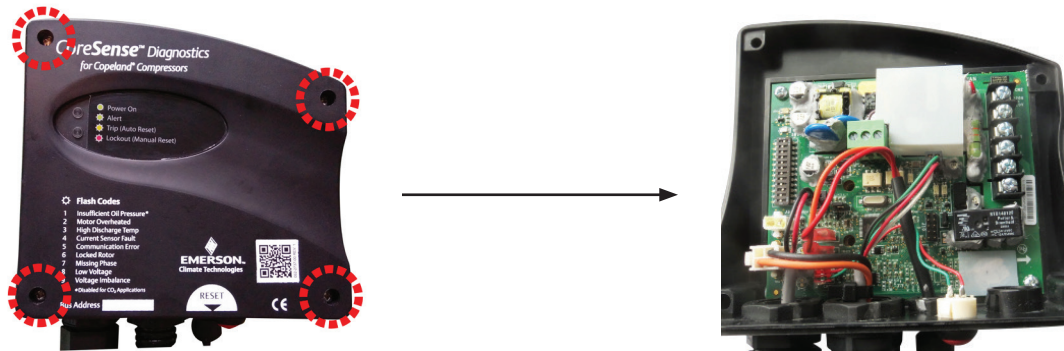
\* In case of replacement of the piston con-rod assemblies, clean the Torx screws and apply Loctite 2701.

The ranges of torque values given in this specification are assembly torque. Torque after joint relaxation must be within 15% of the minimum assembly torque unless retorquing is called for and must not be above 10% of the maximum assembly torque.



## Appendix 3: CoreSense™ Diagnostics for Copeland™ Stream Compressors Quick Installation Guide.

1. Remove CoreSense front module cover by unscrewing 4 screws in the corners.

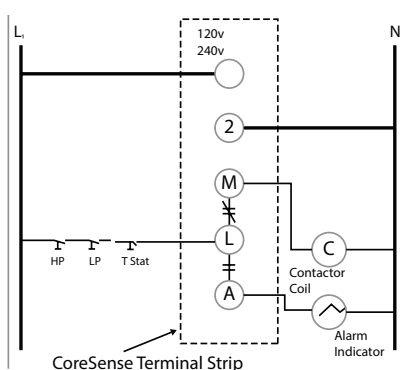


2. Verify DIP-switch settings.

Dip-switch	DIP-switch meaning	Default	Comment
1	Node address	On	Change it only if communication with rack controller is used
2	Node address	Off	Change it only if communication with pack controller is used
3	Node address	Off	Change it only if communication with pack controller is used
4	Node address	Off	Change it only if communication with pack controller is used
5	Node address	Off	Change it only if communication with pack controller is used
6	Node address	Off	Change it only if communication with rack controller is used
7	Communication baud rate	Off	Change it only if communication with rack controller is used (Off: 19200; On: 9600)
8	Communication parity	Off	Change it only if communication with rack controller is used (Off: no parity; On: even parity)
9	Communication with rack controller or service laptop	Off	Change it only if communication with rack controller or service laptop is used (Off: Stand alone mode; On: Communication mode)
10	DLT probe	On	Change it only if DLT probe is disconnected (Off: DLT probe disconnected; On: DLT probe connected)
11	Self test function for oil functionality	TBD	
12	Enable frequency inverter	Off	Change it only if frequency inverter is used (on: frequency inverter is enabled)

3. Check the jumper settings (only if communication with pack controller is used). Please refer to label inside the module or guidelines for more details.

4. Supply 110/220 VAC power to the front module. Make wiring to contactor, line, alarm and protective earth (grounding). For cables use the opening at the bottom right of the module.



Front module wiring diagram



220 VAC  
OR  
110 VAC  
M - Contactor  
L - Line  
A - Alarm  
P - Protective earth

CoreSense™ terminal strip



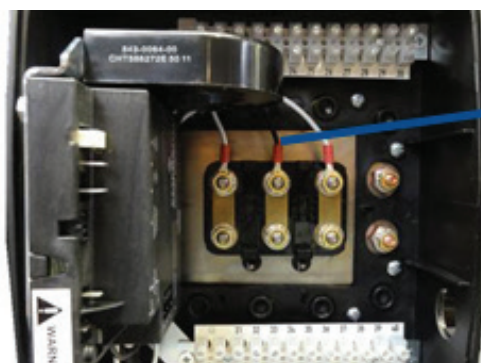
Opening for the cables

5. In case of direct-start connection, L2 power supply lead; in case of part winding connection, L2 and L8 power leads from the customer should go through the current sensor opening in the same direction.



Current sensor opening

6. Make sure that the black lead from the sensor module is always connected to terminal 2 (factory-installed). The black lead from the sensor module must always be connected to that terminal off which the power supply cable is lead through current sensor.



Black lead from sensor module (done in the factory)

7. Supply 24 VAC power to the sensor module. Any class II transformer with 24 VAC output can be used. The sensor module needs 3 VA power input. The transformer is available as an accessory.



24 VAC power supply

8. Connect the crankcase heater to the sensor module (optional). The sensor module has a relay to control the crankcase heater (only 120/240 VAC).

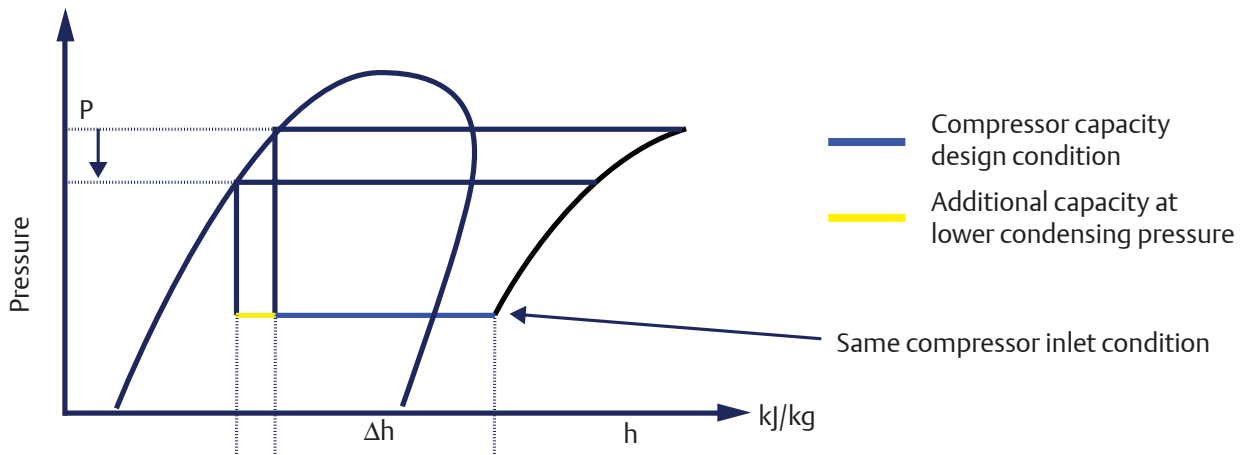


Crankcase heater connection point

## Appendix 4: Stream Semi-Hermetic Compressor Capacity control

Compressors in the higher capacity range need some form of capacity control to accommodate varying refrigeration load. The capacity control kit supplied by Emerson Climate Technologies will reduce the refrigeration capacity along with a similar proportional reduction in power input. This ensures optimum performance even in part load.

Capacity control is also required when the condensing pressure falls with a drop in ambient air temperature. The compressor suction condition, refrigerant volume and mass flow rate will remain unchanged. The capacity will increase due to the increase in  $\Delta h$ , along with the increase in volumetric efficiency (see the pH chart below).



### Methods of Capacity Control

There are many methods of capacity control for semi-hermetic compressors but Emerson Climate Technologies uses the “Blocked Suction method”.

NOTE: Oil circulation in systems with capacity control is more critical.

Advantages:

- Reduces the starting frequency of the compressors;
- Ensure satisfactory operation with optimal capacity data;
- Energy cost saving even at partial load.

Disadvantages:

- Motor is less cooled (refrigerant flow reduced);
- Restriction of the application range;
- Oil circulation is more critical.

All Stream compressor models can be equipped with a mechanical capacity control. Be aware that capacity-controlled operation changes the application range of the compressor.

### Capacity Control

Capacity-controlled 4M\* and 6M\* compressors work on the principle of blocking the suction gas passage to two or more cylinders. They require the use of a special cylinder head, a control valve with solenoid coil, and a special valve plate, too. These items may be ordered factory-installed or in kit form for later installation.

### Inactive Capacity Control

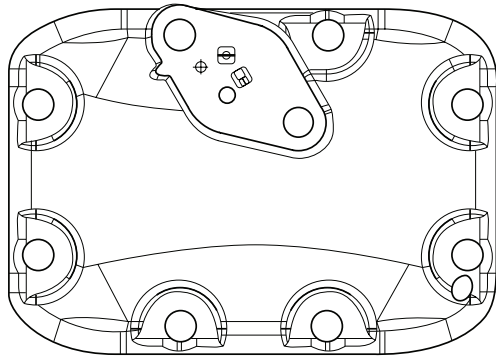
To prevent transport damage the solenoid valves are supplied loose with the compressor and the cylinder head is fitted with a shipping plate. All capacity-control prepared cylinder heads on 4- and 6-cylinder Stream compressors are delivered with the mounted inactive gasket for the capacity controlled port. This will ensure full capacity operation of the compressor if the solenoid control valve is not installed for any reason. To activate the capacity control, the blind flange and the inactive gasket have to be removed and to be replaced by the solenoid control valve and the active gasket which is provided with a control valve kit.

## Retrofit Kit (Conversion Kit)

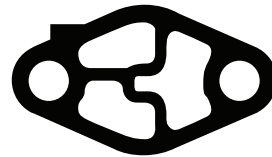
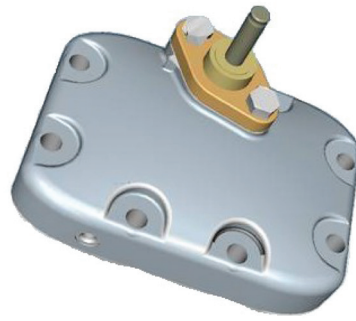
A conversion kit for subsequent installation can also be delivered.

The kit includes:

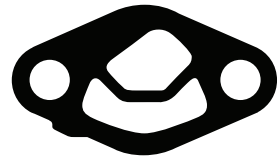
- 1 x cylinder head for capacity control
- 1 x valve plate and gasket kit
- 1 x solenoid valve assembly
- 2 x mounting screws



Capacity Control Cylinder Head



Active Gasket



Inactive Gasket

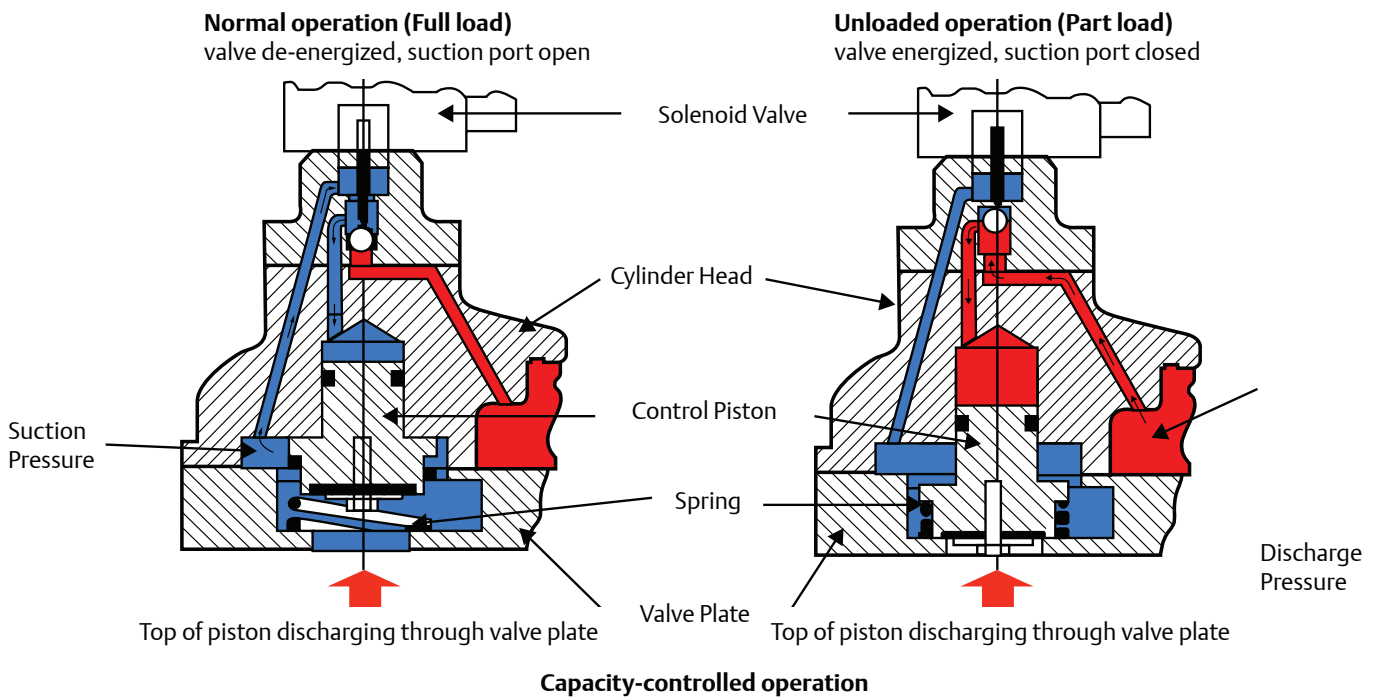
The control valve kit includes the solenoid valve with coil, active gasket and connection pack up.

### Normal Operation Full Load

When the solenoid coil is not energized the top of the control piston is vented to suction pressure allowing the piston to be lifted by means of a spring. The compressor draws gas from all cylinders and reaches full cooling capacity.

### Capacity-Controlled Operation (Part Load)

When the solenoid coil is energized the top of the control piston is forced down by gas at discharge pressure blocking the suction gas passage into the cylinders thus enabling the compressor to run with a reduced capacity.



Solenoid valve coil voltage:

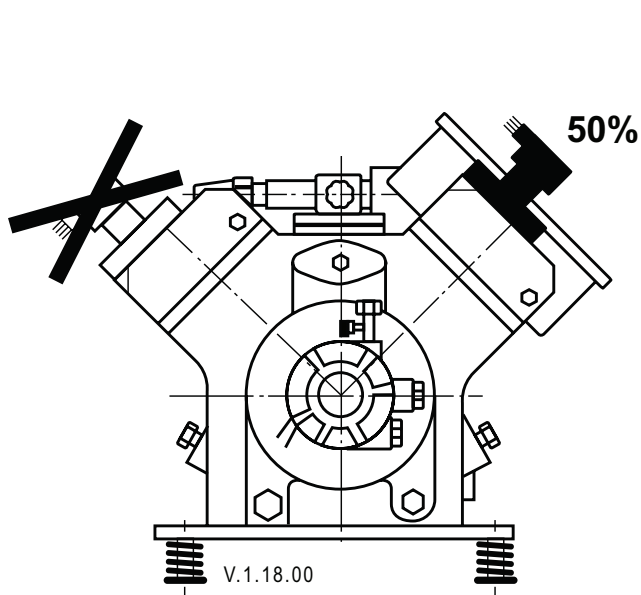
- 208-240 V / 1 Ph / 50 / 60 Hz

Protection class: IP 55 (evaluation according to IEC 34)

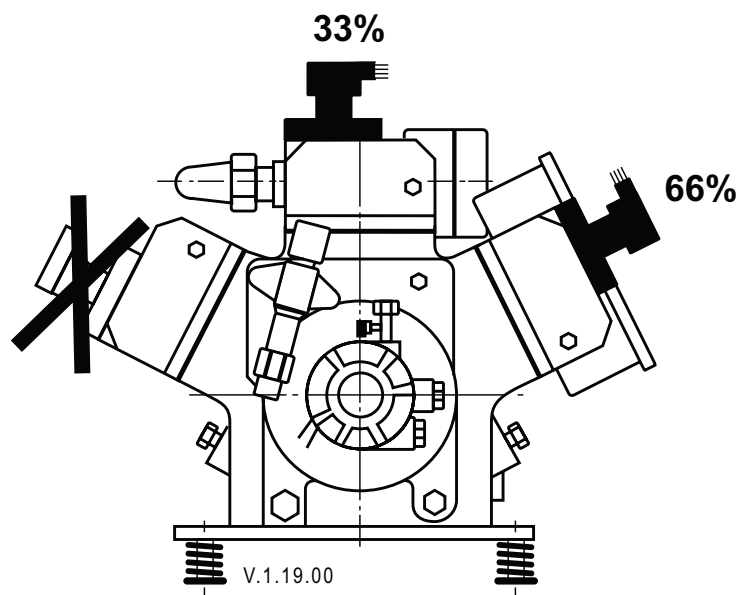
## Capacity Control Position

Capacity control must be fitted in the following positions:

- 4M\* 50% terminal box side
- 6M\* 1st step 33% upper cylinder head
- 6M\* 2nd step 66% terminal box side



Capacity control position 4M\*



Capacity control position 6M\*

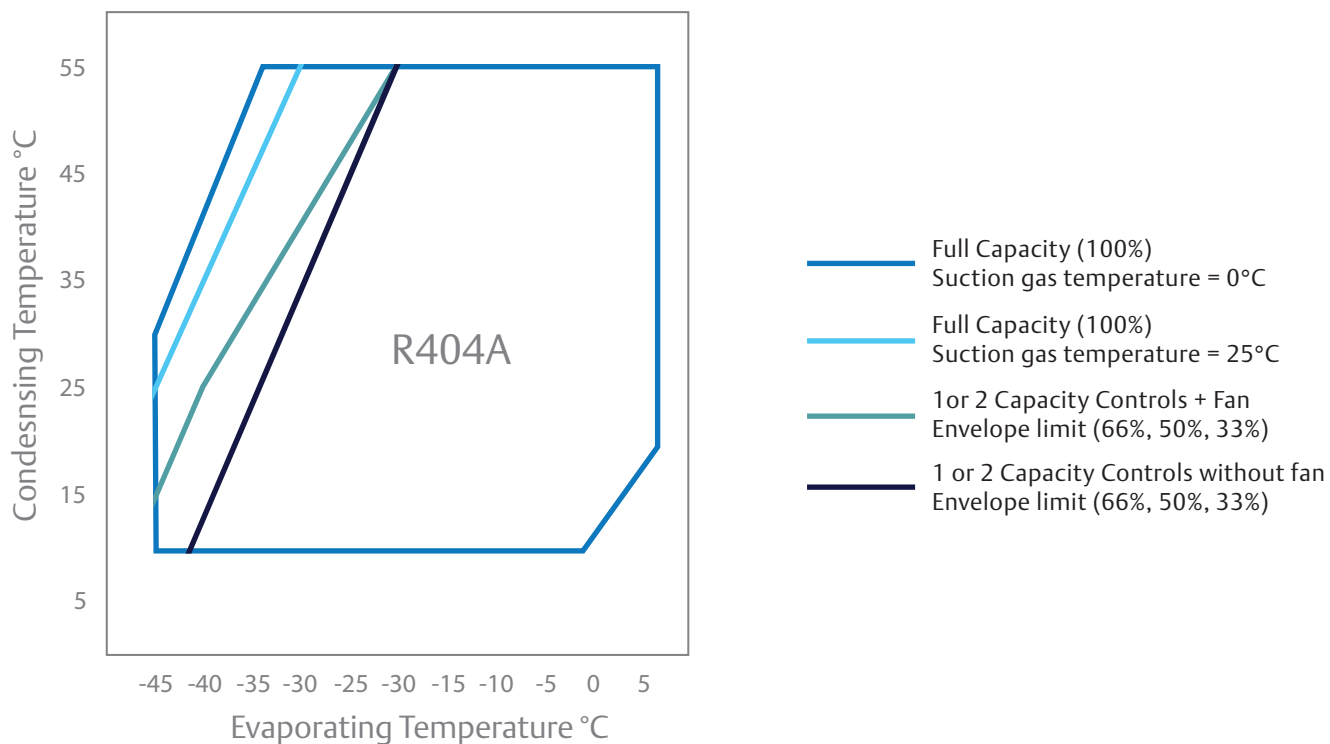
## R404A Capacity Control Selection Table

Compressor	Number of cylinders with capacity control	Capacity regulation step			Remaining refrigeration capacity % (average values)		Remaining power input % (average values)		Figure Nr
		0	1	2	Application range				
					HM	ML	HM	ML	
4MA1-22X	2	100%	50%		52		59		5
4MH1-25X	2	100%	50%		52		59		5
4MI1-30X	2	100%	50%		52		59		5
4MJ1-30X	2	100%	50%		52		59		5
4MK1-32X	2	100%	50%		52		59		5
4MF1-13X	2	100%	50%			52		59	6
4ML1-15X	2	100%	50%			52		59	6
4MM1-20X	2	100%	50%			52		59	6
4MT1-22X	2	100%	50%			52		59	6
4MU1-25X	2	100%	50%			52		59	6
6MI1-40X	2/4	100%	66%	33%	68/34		70/41		5
6MJ1-45X	2/4	100%	66%	33%	68/34		70/41		5
6MK1-50X	2/4	100%	66%	33%	68/34		70/41		5
6MM1-30X	2/4	100%	66%	33%		68/34		70/41	6
6MT1-35X	2/4	100%	66%	33%		68/34		70/41	6
6MU1-40X	2/4	100%	66%	33%		68/34		70/41	6

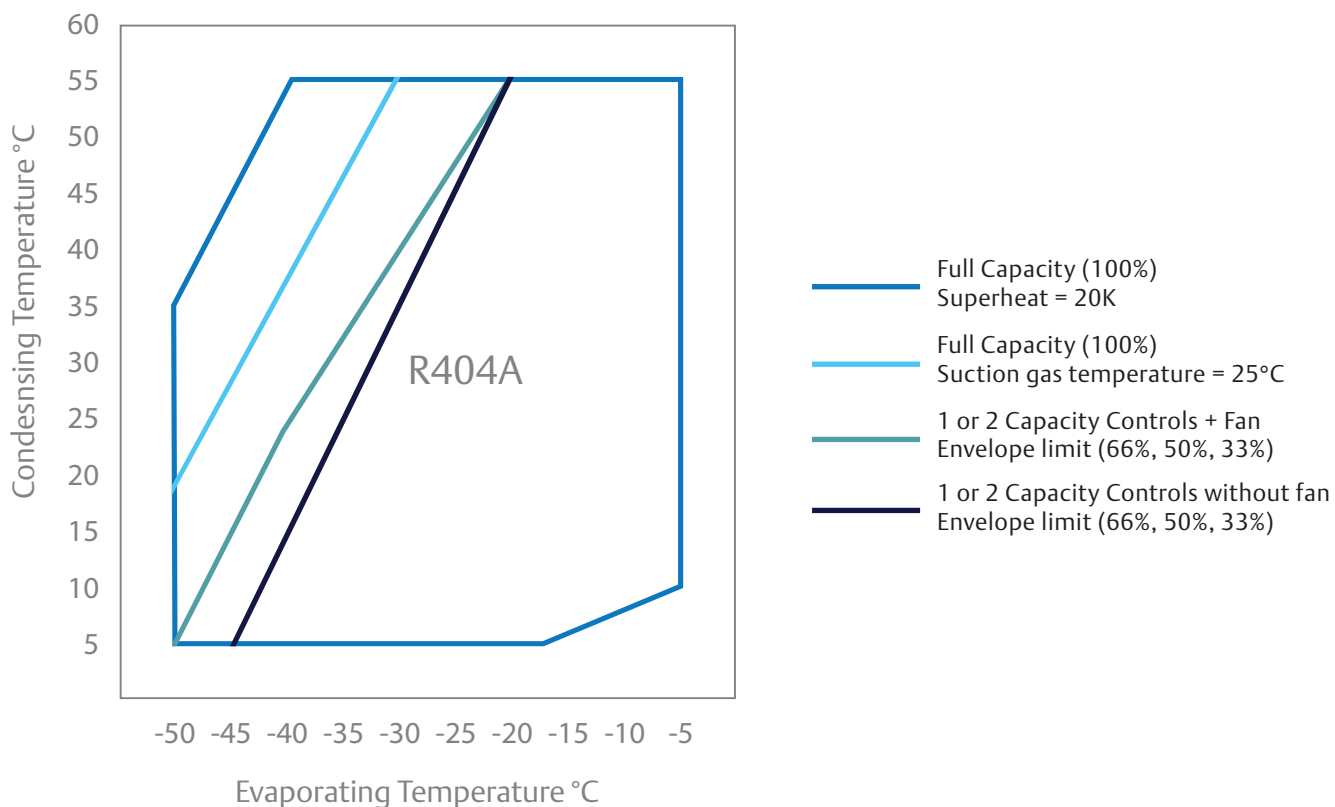
HM = high and medium temperature  
ML = medium and low temperature

## R404 Application Range

Application envelope for High and Medium temperature 4M\* and 6M\* models with R404A



Application envelope for Medium and Low temperature 4M\* and 6M\* models with R404A









## General Information

Technical data are correct at the time of printing. Updates may occur, and should you need confirmation of a specific value, please contact Emerson Climate Technologies™ stating clearly the information required.

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The suitability for this has to be assured from the plant manufacturer, which may include making appropriate tests.

### Note:

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