Application Guidelines

Copeland™ Refrigeration Units for CO_2 Applications

OME-4MTL-05X to OME-4MTL-12X

COPELAND™

EMERSON™

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About these guidelines

The purpose of these application guidelines is to provide guidance in the application of Copeland™ refrigeration units for use with natural refrigerant CO_2 (R744). They are intended to answer the questions raised while designing, assembling and operating a system with these products.

Besides the support they provide, the instructions listed herein are also critical for the proper and safe functioning of the refrigeration unit. The performance and reliability of the product may be impacted if it is not used according to these guidelines or is misused.

These application guidelines cover stationary applications only. For mobile applications, contact Application Engineering as other considerations may apply.

1 Safety instructions

Copeland™ CO_2 refrigeration units are manufactured according to the latest European safety standards. Particular emphasis has been placed on the user's safety.

The CO_2 refrigeration units are intended for installation in machines and systems in accordance with the European Machinery Directive MD 2006/42/EC, Pressure Equipment Directive PED 2014/68/EU, Low Voltage Directive LVD 2014/35/EU and Electromagnetic Compatibility Directive EMC 2014/30/EU. They may be put to service only if they have been installed in these systems according to instructions and conform to the corresponding provisions of legislation. For relevant standards please refer to the Manufacturer's Declaration, available at www.climate.emerson.com/en-gb.

These instructions should be retained throughout the lifetime of both the compressor and the refrigeration unit.

You are strongly advised to follow these safety instructions.

1.1 Icon explanation

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

1.2 Safety statements

- **Refrigerant compressors and refrigeration units must be employed only for their intended use. The system has to be labelled according to the applicable standards and legislation.**
- **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.**
- **The national legislation and regulations regarding personnel protection must be observed.**

Use personal safety equipment. Safety goggles, gloves, protective clothing, safety boots and hard hats should be worn where necessary.

1.3 General instructions

WARNING
Pressurized system! Serious personal injuries and/or system breakdown! Accidental system start before complete set-up must be avoided. Never leave the system unattended without locking it out electrically when it is on vacuum and has no refrigerant charge, when it has a holding charge, or when the compressor service valves are closed.
System breakdown! Personal injuries! Only CO_2 and approved refrigeration oils must be used.

WARNING
CO_2 refrigerant! Danger of suffocation! Never release significant volumes of CO_2 or the entire contents of the system into closed rooms. In case of closed room, if possible, keep the room well ventilated and/or install a CO_2 detection device. CO_2 is odourless and colourless, so it cannot be perceived directly in case of emission.

WARNING
Earth leakage current! Electrical shock hazard! This product can cause both AC and DC earth leakage current. To protect against both kinds of leakage current it is recommended to use an AC/DC sensitive RCD **type B or B+** on the power supply side.

WARNING
High surface temperature! Burning! Do not touch the compressor or piping until they have cooled down. Ensure that other materials in the area of the compressor do not come into contact with it. Mark and secure accessible sections.

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

CAUTION
Contact with refrigerant oil! Material damage! POE lubricants 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, eg, PVC/CPVC and polycarbonate.

IMPORTANT
Transit damage! Compressor and/or unit malfunction! Use original packaging. Avoid collisions and tilting.

IMPORTANT
This appliance is not designed to be accessible to the general public according to IEC 60335-2-40.

The contractor is responsible for the installation of the unit and should check the following points:

- sufficient liquid sub-cooling in the line to the expansion valve(s) to avoid "flash-gas" in the liquid line;
- sufficient amount of oil in the compressor (in case of long piping additional oil must be charged).

2 Product description

2.1 General information about Copeland™ CO_2 refrigeration units

Emerson has developed the Copeland CO_2 refrigeration unit to meet primarily the demands of the food retail and food service sectors. It is an air-cooled refrigeration unit that uses the latest Copeland™ Stream transcritical compressors with inverter. All electronic protection and diagnostics features, as well as the controls for the refrigeration unit, are built in the chassis.

Figure 1: Front view Copeland CO_2 refrigeration unit

2.2 EU Ecodesign Directive 2009/125/EC

The European Directive 2009/125/EC with regard to Ecodesign requirements for professional refrigerated storage cabinets, blast cabinets, condensing units and process chillers requires manufacturers to decrease the energy consumption of their products by establishing minimum energy efficiency standards. Copeland refrigeration units are prepared and optimized to meet the requirements of the Ecodesign Directive. The integrated variable speed fan and gas cooler reduce the noise level and energy consumption significantly. This, combined with Copeland Stream CO_2 compressor technology, allows for high-efficiency operation.

These guidelines meet the requirements of Regulation 2015/1095, Annex V, section 2(a), with regard to product information, namely:

- (v) ➔ See chapter 2.6 "Application range"
- (vi) ➔ See chapters 5.4 "Gas cooler fins" and 5.6 "Routine leak testing"
- (vii) ➔ See chapter 4.2 "Charging procedure"
- (viii) ➔ See chapter 7 "Dismantling & disposal"

The Ecodesign overview tables according to Annex V of Regulation 2015/1095/EU for all Copeland CO_2 refrigeration units can be found in **Appendix 4.**

2.3 Main product features and dimensions

The refrigeration units covered in these guidelines are released for CO_2 (R744) refrigerant only. They are available in one cabinet size and are always equipped with one fan.

The units are designed for medium temperature applications only. The inverter is calculated to drive the compressor in subcritical and transcritical applications.

Refrigeration unit	Refrigerant type	Displacement @ 50 Hz (m^3/h)	Cooling capacity* (kW)	Nominal power (kW)	Max. current (A)	PS high side (bar)	PS low side (bar)
OME-4MTL-05X	R744	4.62	8.69	11	19	120/90	90
OME-4MTL-07X		6.15	11.80	14	22		
OME-4MTL-09X		7.44	14.25	16	27		
OME-4MTL-12X		9.54	18.80	18	33	130/90	

** Cooling capacity declared at ambient temperature 32 °C, evaporating temperature -10 °C, suction temperature 0 °C and compressor frequency 50 Hz*

Table 1: CO_2 refrigeration unit technical data

Refrigeration unit	Outer dimensions length/width/height with closed cover (mm)	Weight (kg)	Liquid receiver size (litres)
OME-4MTL-05X	1579 / 954 / 1109	440	24.9
OME-4MTL-07X		450	
OME-4MTL-09X		462	
OME-4MTL-12X		473	

Table 2: CO_2 refrigeration unit features

The figures hereafter show the overall physical dimensions of the CO_2 refrigeration units in millimetres.

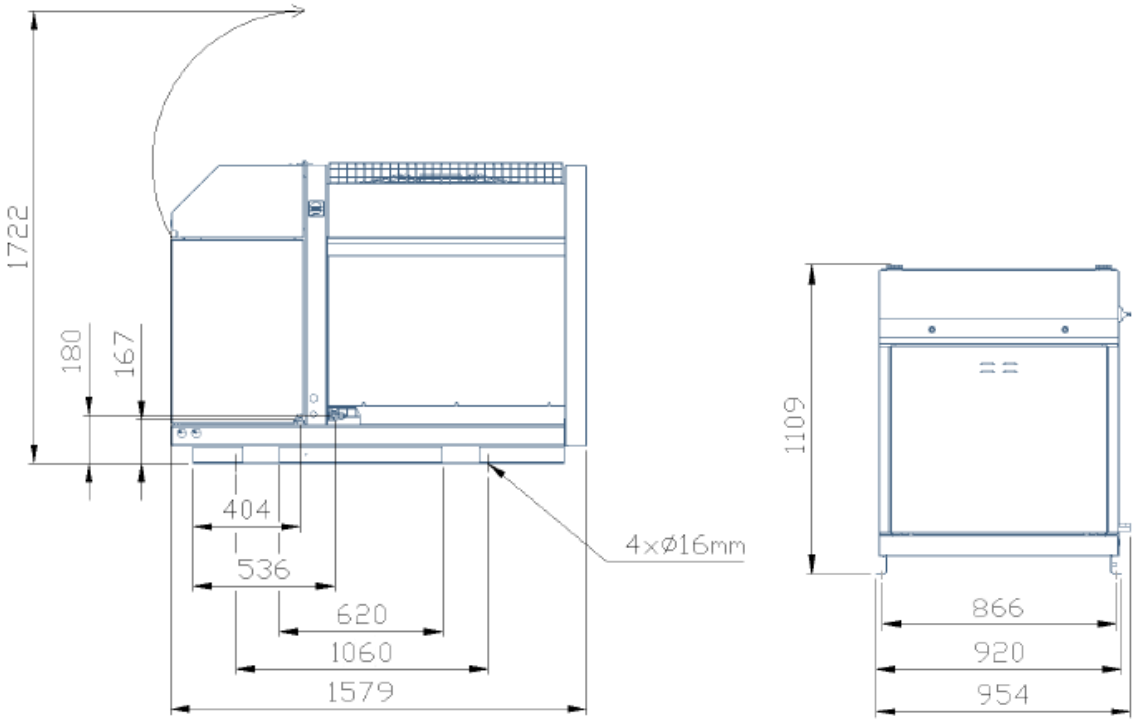


Figure 2: Dimensions of models OME-4MTL-05X, OME-4MTL-07X, OME-4MTL-09X & OME-4MTL-12X

***NOTE:* When the electrical cabinet cover is open the total height is 1722 mm. This must be taken into account when deciding on the unit location, to ensure easy access to the electrical cabinet.**

2.4 Product nameplate

The refrigeration unit nameplate shows model designation and serial number, as well as nominal power and safety pressures.

The compressor has its own nameplate with all electrical characteristics.

Figure 3: Nameplate of CO_2 units

2.5 Nomenclature

The model designation contains the following technical information about Copeland CO_2 refrigeration units:

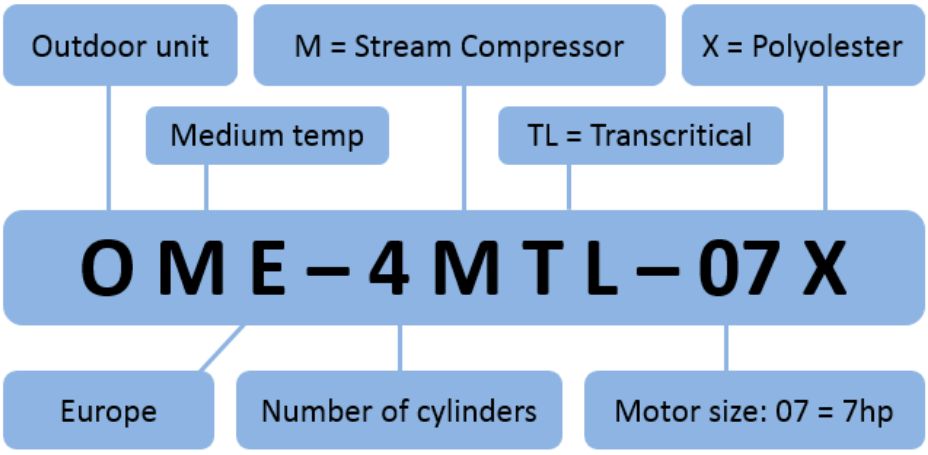


Figure 4: Nomenclature of CO_2 units

2.6 Application range

2.6.1 Qualified refrigerant and oil

Oil recharge values can be taken from Copeland Select software available at www.climate.emerson.com/en-gb.

Qualified refrigerant	**R744 (CO_2)**			
Qualified servicing oil	POE Emkarate RL 68 HB			
Oil charge (litres)	OME-4MTL-05X	OME-4MTL-07X	OME-4MTL-09X	OME-4MTL-12X
	1.5	1.5	1.5	2.3

Table 3: Qualified refrigerant and oil

***NOTE:* Use only lubricants that are qualified for the product. The use of non-approved lubricants can damage the product and will result in loss of warranty!**

***NOTE:* The polyolester oil is very hygroscopic. Never keep the system open to the ambient. If for some reason there is no refrigerant in the system, it is recommended to charge the system with a protective gas, eg, inert gas N_2.**

The recommended quality for carbon dioxide purity class is 4.0 [(≥ 99.99 %) H_2O ≤ 10 ppm, O_2 ≤ 10 ppm, N_2 ≤ 50 ppm] or higher.

The characterization of R744 (CO_2) according to EN 378-1 is safety class A1, not flammable, ODP = 0 and GWP = 1. High concentrations of CO_2 are dangerous. This refrigerant is odourless and colourless. Therefore the use of CO_2 detectors is required.

CO_2 is heavier than air. As a result, local concentrations (especially at floor level or in deeper slots, ie, CO_2 pockets) can be higher than average values in the machine room. The ventilation system must take this into account.

2.6.2 Application limits

WARNING
Oil dilution due to low superheat! Compressor breakdown! Low suction superheat leads to oil dilution. Always operate the system with adequate superheat to avoid oil viscosity decrease. Additional measures in system design might help to avoid unacceptable lubrication conditions.

For the application envelope, please refer to Select software at www.climate.emerson.com/en-gb.

2.6.3 Recommendations for minimum suction superheat – Lubrication conditions

The operation of CO_2 compressors / units at conditions where the viscosity of the oil is low might become very harmful with regard to compressor lifetime expectancy. Indicators like oil temperature and discharge temperature must be observed to judge about the lubrication conditions. Depending on the application (low temp, medium temp, parallel compression, etc.…) different minimum suction superheat values should be respected to secure maximum protection of the compressor. In general, higher superheat on the suction inlet of a compressor provides higher safety, but the limits for the maximum allowable discharge temperature should be considered as well (superheat has a direct impact on discharge temperature). For medium temperature applications, an absolute minimum of 10 K is recommended.

Particular attention should be paid to the following points:

- Measuring the suction superheat becomes more critical with larger diameters on the suction tube. Ensure proper positioning of sensor. Sensor sleeves must be used with large diameters.
- The oil temperature is measured by the dedicated unit sensor and can be read out from the Visograph display in the service menu.
- The discharge temperature is observed by the unit controller. The temperature on the discharge line should never exceed 135 °C (measured directly after the compressor shut-off valve). The temperature of the discharge gas on the outlet of the valve plate is 10-15 K higher than the temperature on the discharge line.

2.6.4 Pressure levels of CO_2 vs. other refrigerants

Figure 5 below compares the evaporating pressures of R744 to those encountered with R410A and R404A. It can be observed that R744 systems will require to operate at much higher pressures than conventional systems.

Note that below a pressure of 5.2 bar, solid and gaseous R744 phases may co-exist at low temperature. This behaviour is totally different from that observed with traditional refrigerants, and will have important consequences on the operation, servicing and maintenance of a system working with R744.

Gaseous R744 is 1.5 times heavier than air. Therefore, when released to the air it will concentrate at low elevations.

R744 will form "dry ice" at -56.6 °C. One kg of dry ice has the cooling capacity of 2 kg of ordinary ice. Gaseous or liquid R744 stored under pressure will form dry ice through an auto-refrigeration process if rapidly depressurized.

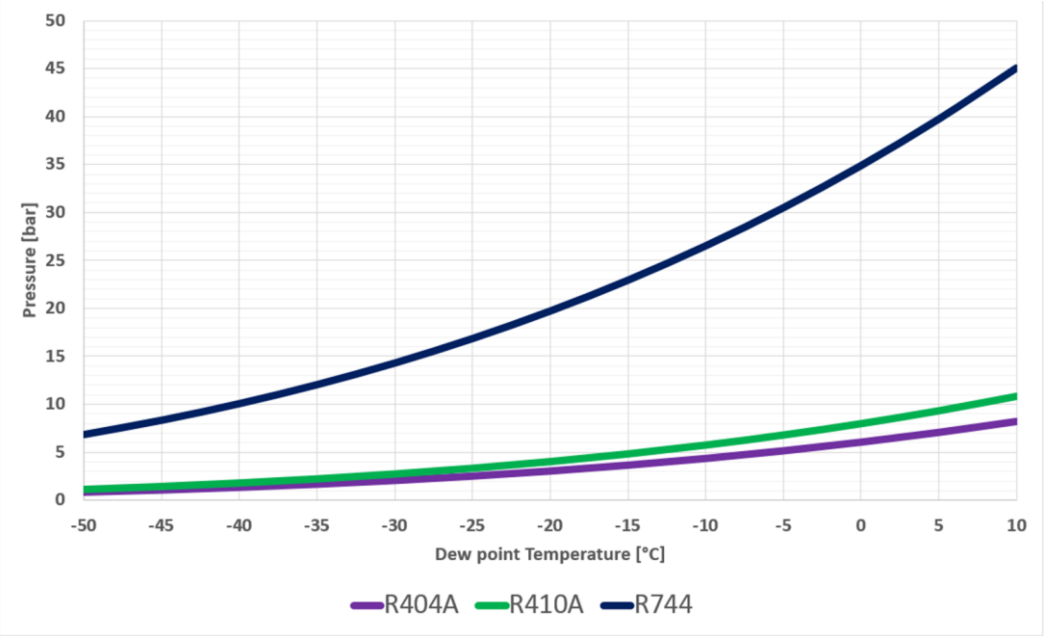


Figure 5: Pressure levels of CO_2

Figure 6 shows the thermodynamic properties (p-h-diagram) of R744. Compared to other fluids traditionally used as refrigerants, its critical point at 31 °C is very low and its critical pressure at about 73.6 bar is high.

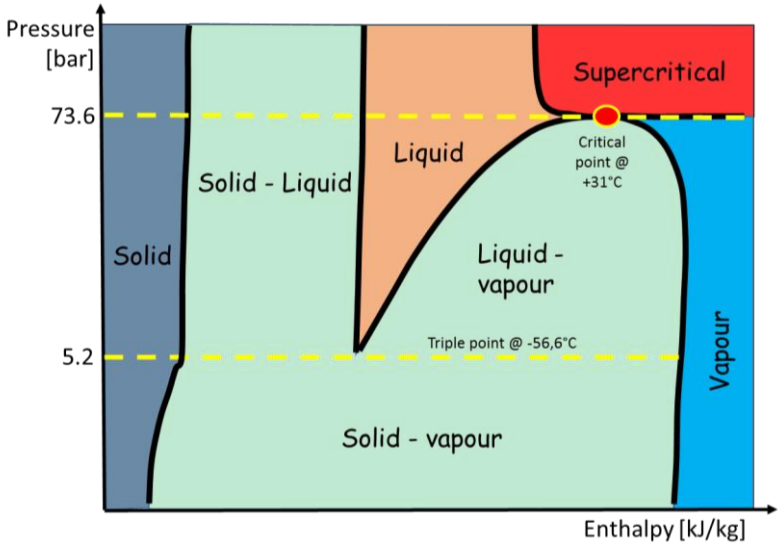


Figure 6: Pressure/enthalpy diagram CO_2

2.7 P&I diagram for CO_2 units

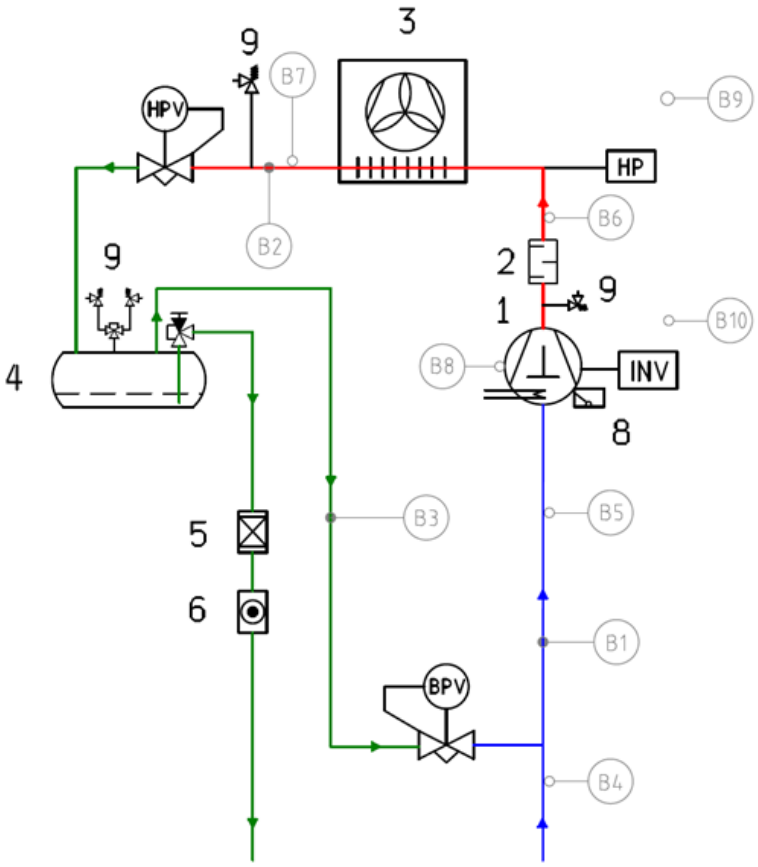


Figure 7: P&I diagram for CO_2 units

Position	Description	Position	Description
1	Copeland Stream compressor	**INV**	Compressor inverter
2	Discharge muffler	**B1**	Suction pressure
3	Gas cooler	**B2**	Discharge pressure
4	Flash tank	**B3**	Liquid receiver pressure
5	Filter dryer	**B4**	Suction gas temperature unit
6	Sight glass	**B5**	Suction gas temperature compressor
8	OW5 oil watch	**B6**	Discharge line temperature
9	Pressure relief valve	**B7**	Gas cooler temperature
HPV	High pressure valve	**B8**	Oil temperature
BPV	Bypass valve	**B9**	Ambient temperature
HP	High pressure limiter	**B10**	Cabinet temperature

Table 4: Legend of the P&I diagram for CO_2 units

2.8 Main components description

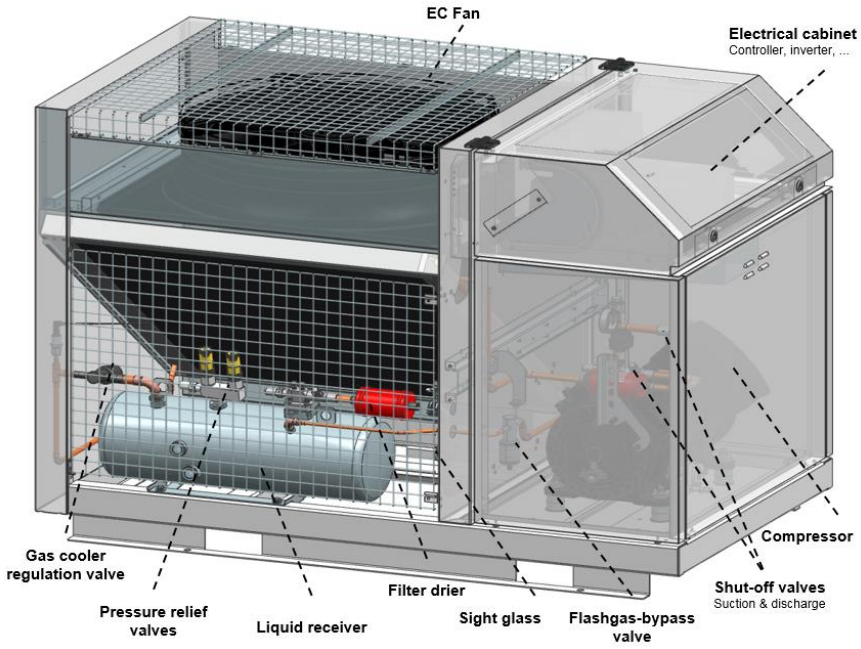


Figure 8: Main components of CO_2 unit

2.8.1 Compressor

The compressor is installed in the chamber below the electrical cabinet. The standard delivery is with shut-off valve on discharge, Copeland Protection module, oil watch system connected to one of the sight glass connections. One additional sight glass on the opposite side of the compressor allows for a visual check of the oil level. A third sight glass located in the crankcase cover will give an indication that there is oil on the inlet of the oil splasher.

All electrical wiring is pre-assembled in the factory. A pressure relief valve (135 bar) is installed directly on the compressor. A pressure limiter is installed on the discharge side of the compressor in compliance with EN 378 requirements.

2.8.2 Electrical cabinet

The electrical cabinet is located on the edge above the compressor chamber beside the fan. All electrical components such as main unit controller, inverter, contactors, transformers, wiring terminals and fuses are installed in this area. The electrical cabinet is covered by a hinged upper shell which can be fixed at two different opening angles.

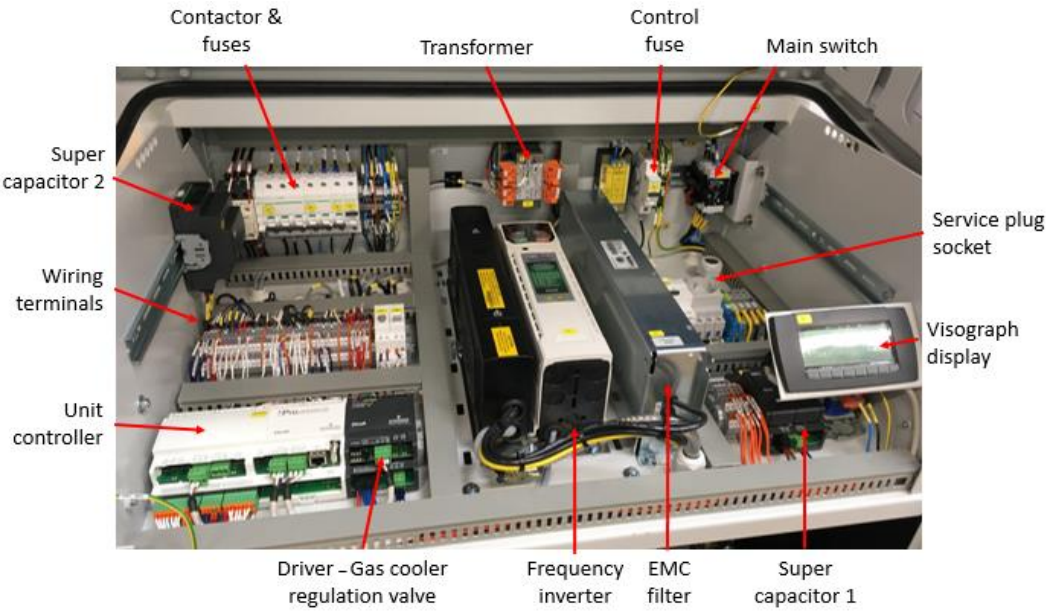


Figure 9: Electrical cabinet

2.8.3 Liquid receiver

The liquid receiver (24.9 litres for the whole range of units) is installed below the gas cooler. It is equipped with a shut-off valve on the outlet and a safety group (2 pressure relief valves 90 bar, connected to a switch-over valve).

There are 2 sight glasses in the shell of the liquid receiver to check the refrigerant level.

2.8.4 Fan

The gas cooler of the Copeland CO_2 refrigeration unit is equipped with an EC fan.

Fan		Power input (W)	Maximal current (A)	Air flow (m^3/h)
Unit	Description			
OME-4MTL-05X	FN071-6IQ.BD.V7P3	280	1.4 - 1.0	7100
OME-4MTL-07X	FN071-ZIQ.DG.V7P3	660	3.4 - 2.4	11950
OME-4MTL-09X				
OME-4MTL-12X				

Table 5: Fan specifications

Technical data	
Supply frequency	50/60 Hz
Supply voltage	200-277 V
Min to max ambient temperature	-35 to +60 °C
ErP 2015	Yes
IP class	IP54
Fan motor type	EC
Fan blades	Plastic

Table 6: Fan technical data

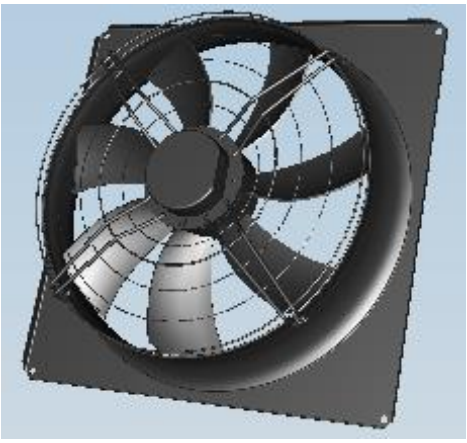


Figure 10: Fan design

2.8.5 Gas cooler regulation valve (HPV)

The high-pressure regulation valve is installed between the gas cooler and the liquid receiver. It regulates the high pressure for optimum COP in transcritical operation.

The driver for the stepper motor valve is installed in the electrical cabinet.

The driver for the HPV is an XEV20D. It gets a signal from the unit controller – see **section 2.9 "CO2 Unit control – General"**.

2.8.6 Bypass valve (BPV)

The bypass valve is installed between the flashtank and the suction line to the compressor. Without the bypass valve there is a risk of unacceptably high pressure in the flashtank in case the ambient temperature exceeds 35 °C. The bypass valve is aimed at keeping the flashtank pressure below a set level defined by parameter **GC20** (factory-set at 35 bar) at all times.

If a system does not require cooling capacity and the ambient temperature around the unit is high, the pressure in the flashtank section will increase. When reaching a critical pressure limit defined by parameter **GC78** (factory-set at 40 bar) inside the flashtank during compressor stop, the compressor will start and perform a short pumpdown cycle to reduce the pressure level in the flashtank area.

2.8.7 Design pressures

IMPORTANT
Piping design pressure! Risk of CO_2 blow-off! The CO_2 refrigeration unit liquid and suction line piping is designed for a design pressure (PS) of 90 bar as pressures around 85 bar can occur during normal operation. The installer must always consider the system liquid and suction lines in terms of maximum operating pressure. If the system piping design pressure is lower than 90 bar, additional safety devices are required. The CO_2 unit can control different receiver pressures depending on the application (parameter **GC20**).

The unit has 2 different pressure areas:

- The design on suction side is made for a maximum allowable absolute pressure of 90 bar at standstill. The section after the high-pressure valve (liquid line, liquid receiver, filter dryer, sight glass) to the liquid line outlet of the unit is approved for an absolute pressure of 90 bar at standstill too.
- A ½" fitting is pre-installed in the suction line for an additional pressure relief valve.
- The area with discharge pipe, gas cooler and high-pressure regulation valve is approved for a maximum allowable absolute pressure of 120 bar for models OME-4MTL-05X to OME-4MTL-09X and 130 bar for OME-4MTL-12X.

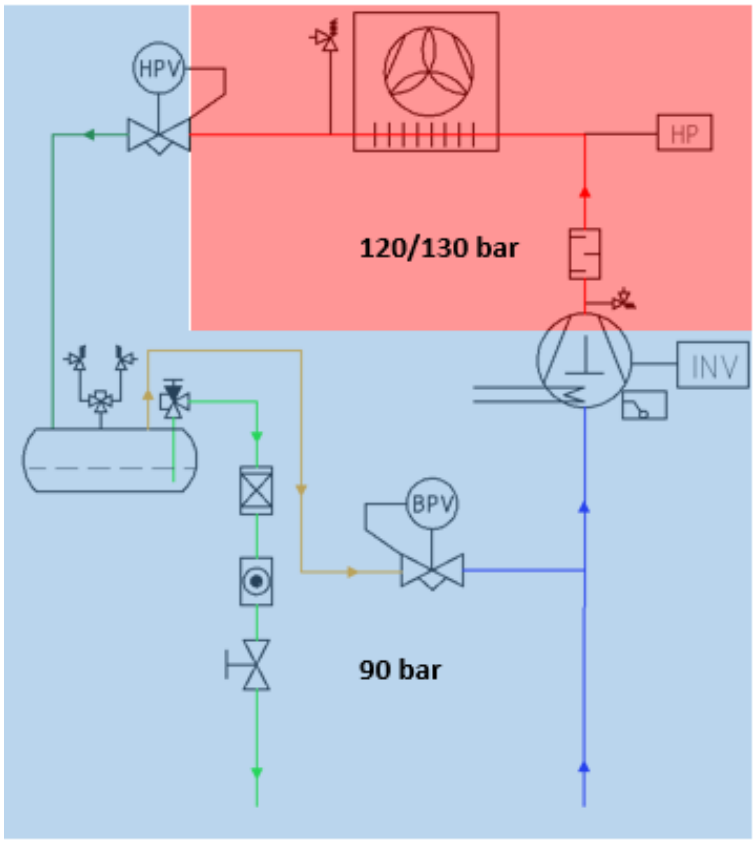


Figure 11: Design pressures of CO_2 unit

The TS values of the Copeland CO_2 refrigeration units can be found in **Table 7** below. The TS value describes the temperature of the refrigerant (CO_2) for which the system is designed.

Refrigeration cycle part	TS range (°C) TS_{min} to TS_{max}	PS (bar)
Low pressure side	-20 to 0	60
	0 to +45	90
High pressure side	-20 to 0	60
	0 to +140	120 (130 for OME-4MTL-12X)
Intermediate side	-20 to 0	60
	0 to +45	90

Table 7: TS values of the Copeland CO_2 refrigeration units

***NOTE:* The design pressure PS is a safety-related value. The restrictions for reliable operation of the unit are defined by the application envelope which can be found in Select software at www.climate.emerson.com/en-gb.**

2.8.8 Housing

Copeland CO_2 refrigeration units have a new, unique design. They are equipped with an electrical cabinet located above the compressor chamber with a hinged cover for easy and service-friendly access. The electrical cabinet and the compressor area are accessible independently. The fan has vertical air flow and is protected by a safety grid. The gas cooler, liquid receiver and connected parts are freely accessible by the service technician.

The housing is designed to withstand a 300-hour salt spray test according to standards ASTM B-117, ASTM D-1654 and ČSN EN ISO 9227.

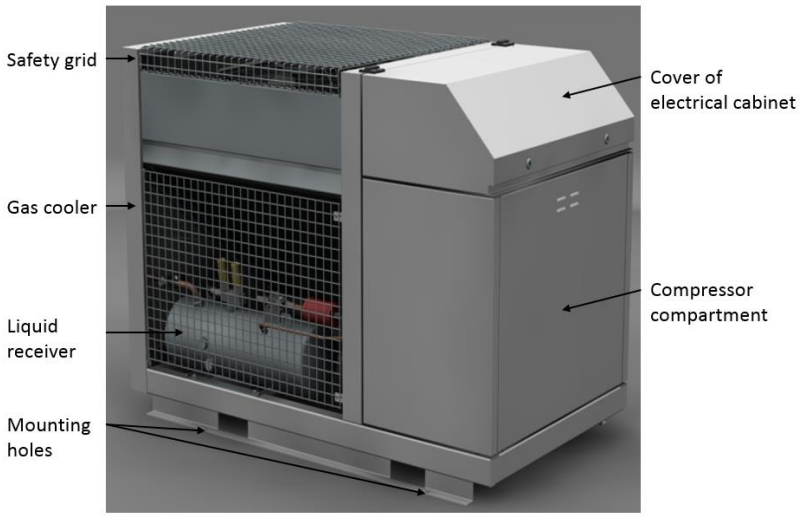


Figure 12: Overview of the unit housing

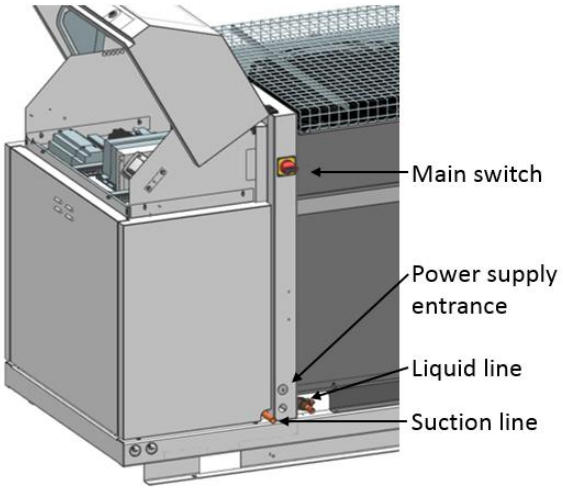


Figure 13: Position of the connections

2.8.9 Exploded view of the CO_2 unit

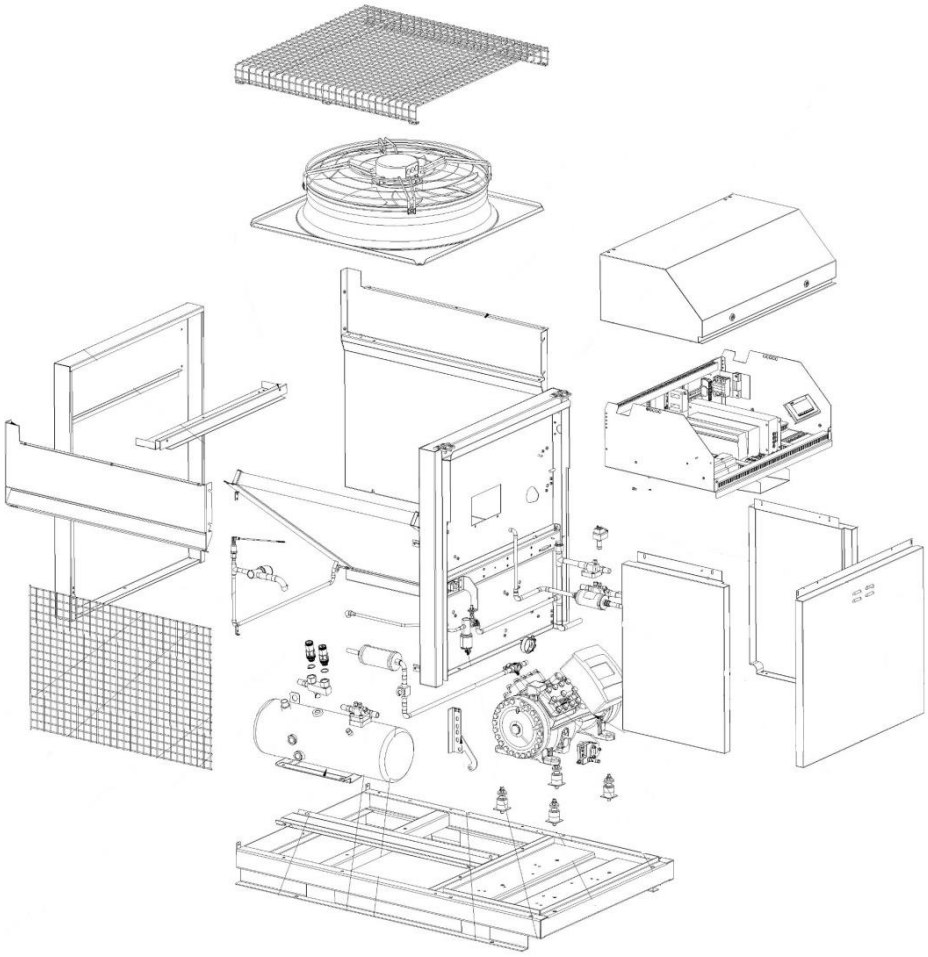


Figure 14: Exploded view of the unit

2.9 CO_2 Unit control – General

Copeland CO_2 refrigeration units are equipped with a Dixell iPro controller IPG215D and a Visograph display. The IPG215D controller manages the compressor variable frequency drive through 0-10 V and a digital signal. It also handles the high-pressure regulation which is done by a stepper motor valve, driven by a standard driver device, controlled by iPro through CAN Bus. The stepper motor valve driver can operate two valves simultaneously. The controller can handle gas cooler pressure and liquid receiver pressure in parallel.

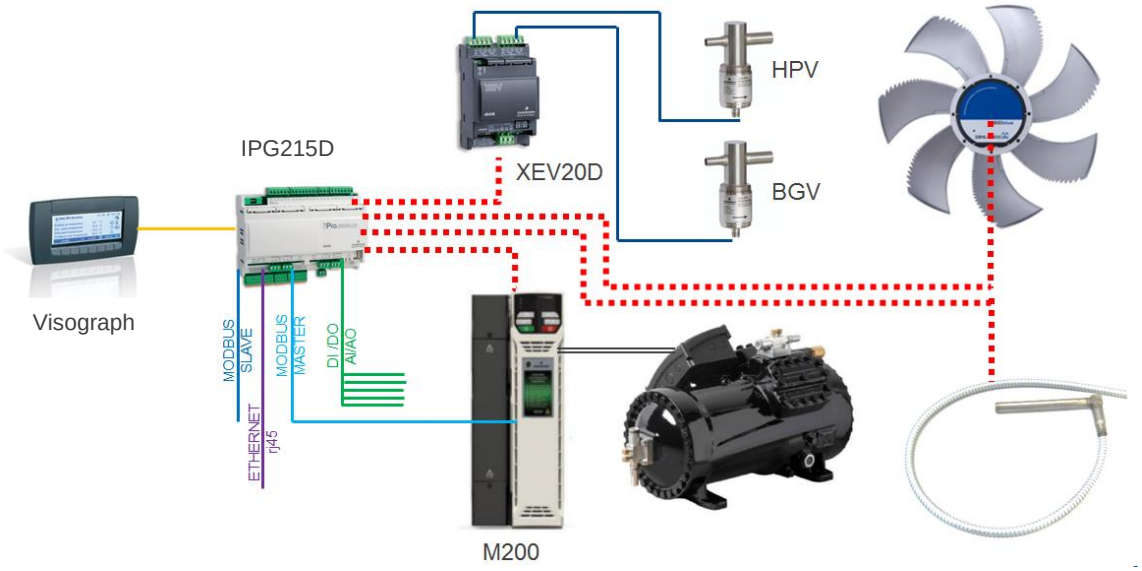


Figure 15: CO_2 unit controller schematics

2.9.1 IPG215D controller description

The iPro controller is a standard IPG215D Dixell controller. A detailed manual can be found at www.climate.emerson.com/en-gb.

The controller is factory-set for -10 °C evaporating temperature. To achieve the required temperatures, Emerson recommends to change only the evaporating temperature as the rest of the parameters are already pre-set.

***NOTE:* The other factory settings can be found in Technical Information TI_Unit_CO2_02 "Copeland™ CO_2 Refrigeration Units – iPro IPG215D Controller Parameter List".**

2.9.2 Visograph display description

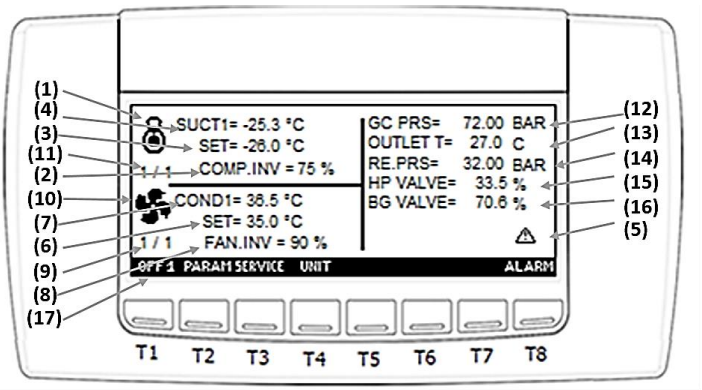


Figure 16: Visograph display

OFF1	To switch the controller off. Press for 10 seconds to switch the controller off (enabled only if parameter OT5 = yes)
PARAM	To enter the parameter programming menu
SERVICE	To enter the service menu
UNIT	Measurement unit: to switch the probe visualization and setpoint from pressure to temperature and vice versa
ALARM	To enter the alarm menu

Table 8: Key functions

Position	Description	Comments
1	Compressor symbol	
2	Percentage of analog output for frequency compressor	For frequency compressor. Displays the percentage of the analog output driving the inverter.
3	Suction pressure setpoint	
4	Current value of suction pressure	
5	Alarm	Displayed when an alarm occurs in suction or gas cooler section
6	Condensing pressure setpoint	
7	Current value of condensing/ gas cooler pressure	
8	Percentage of analog output for EC fan	For fan inverter. Displays the percentage of the analog output driving the inverter.
9	Number of activated fans	
10	Fan symbol	
11	Number of activated compressors and steps	
12	Gas cooler pressure	The same value is displayed in "Stage Gas Cooler Info"
13	Outlet temperature	The same value is displayed in "Stage Gas Cooler Info"
14	Receiver pressure	
15	Gas cooler regulation valve (HPV) % opening	
16	Flash gas regulation valve (BGV) % opening	
17	Operating mode	

Table 9: Display description – Legend

2.10 How to use the IPG215D controller

2.10.1 How to change parameters

Press the **PARAM** key to access the programming menu.

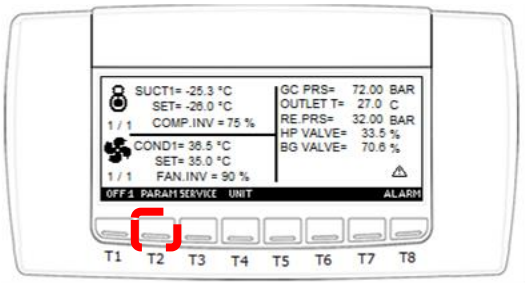


Figure 17: Parameter key

The device provides 2 programming levels:

- **Pr1** with direct access – press **Pr1** to enter this menu;
- **Pr2** protected with a password – password set to **12** by factory.

If the password function is enabled, the following interface will be displayed when pressing the Pr2 key:

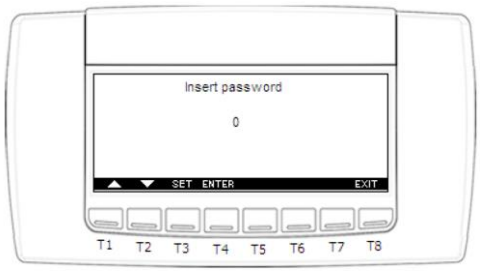


Figure 18: Password setting

To enter password:

1) Press the **SET** key
2) Use the **UP** and **DOWN** keys to enter password **12**
3) Press the **SET** key to confirm password. The following interface will be displayed:

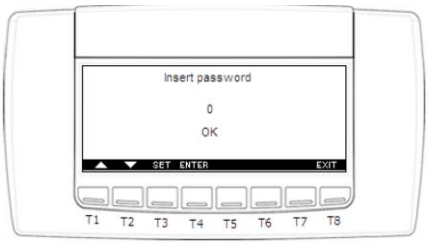


Figure 19: Password confirmation

4) Press **ENTER** to access the Pr2 menu

2.10.2 Parameter grouping

The parameters are grouped in sub-menus.

No.	Parameter grouping	No.	Parameter grouping
1	Setpoint (SETC1, SETF1)	28	Analog outputs 4 (AO4_1- AO4_26)
2	Compressor rack setup (CF1, CF16)	29	Analog outputs 5 (AO5_1- AO5_26)
3	Regulation (CF18, CF20-CF22, CF24)	30	Analog outputs 6 (AO6_1- AO6_26)
4	Display (CF26-CF27)	31	Auxiliary outputs (AR1-AR18)
5	Analog inputs (AI1-AI31)	33	Superheat alarms (ASH1- ASH16)
6	Safety digital inputs (SDI1-SDI3)	34	Gas leak detector (GLD1-GLD20)
7	Digital inputs (CDI1, CDI3)	35	Other (OT1 – OT6)
8	Compressor function (RC1-RC4, RC35-RC38, RC45)	36	DI configuration (DIC1- DIC20)
9	Compressor safety (SL1-SL11, SL14-SL15)	37	DO configuration (DOC1- DOC15)
10	Fan function (RC9-RC33, RC43, RC47-RC55)	38	AO configuration (AOC1- AOC6)
11	Fan safety (SL12, SL13, SL16)	41	AI configuration (AIC1- AIC10)
12	Fan setting for max COP (RC56-RC61)	42	Copeland Protection module configuration (CO1-CO2, CO16-CO17)
13	Fan regulation band optimization with frequency compressor (RC62-RC69)	43	ECM (ECM01-ECM9)
14	Operating mode scheduling (OMS1-OMS21)	44	XEV02 (XEV1-XEV4)
15	Alarms configuration (AC1-AC2)	45	M200 (VFD1-VFD33)
16	Compressor alarms (AL1-AL21)	46	M200 (INV1-INV33)
17	Fan alarms (AL24-AL43)	47	HTR (HTR1-HTR4)
23	Dynamic setpoint suction (DSP1- DSP4)	48	EPM (EPM1-EPM18)
24	Dynamic setpoint gas cooler (DSP9-DSP11)	49	Gas cooler heat reclaim (HTRC1-HTRC13)
25	Analog outputs 1 (AO1_1- AO1_26)	50	Gas cooler (GC1-GC64)
26	Analog outputs 2 (AO2_1- AO2_26)	51	Manual pumpdown (SPF1, SPF2)
27	Analog outputs 3 (AO3_1- AO3_26)	52	Unit protection (DLT1-DLT24)

Table 10: Parameter grouping

***NOTE:* The parameter sub-menu will be visible only if at least one parameter in the group is visible in Pr1 or Pr2.**

Press the **SET** key to access a menu. The parameters and their respective values will be displayed (see **Figure 20** below).

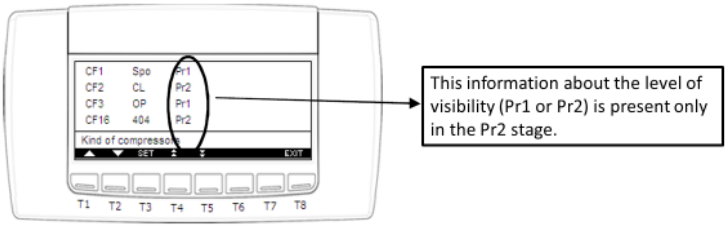


Figure 20: Parameter level information

1) Press the **SET** key and use the **UP** and **DOWN** keys to modify a value
2) Press the **SET** key again to store the new value
3) Use the **UP** and **DOWN** keys to move to the next parameter

NOTE: **The Pr2 or Pr1 message is present only in the Pr2 menu. It is possible to modify the level of each parameter by changing Pr2 to Pr1 and vice versa.**

NOTE: **After pressing the EXIT key, the previous screen will be displayed again.**

2.10.3 "Service" menu

The main functions of the controller are available from the "Service" menu and are listed below:

- check the values of analog outputs;
- check the status of compressor relays;
- operate a maintenance session;
- check the status of safety and configurable digital outputs;
- check the values of the probes;
- set the real-time clock;
- start a pumpdown;
- set the password and enable it for a defined menu;
- set the language;
- check the values of superheat probes;
- configure IP/Modbus address;
- manage / configure files;
- check the parameters of XEV20, XEV02, ECM, M200 and energy meter if these devices have been configured;
- manage the log files;
- execute evacuation
- etc…

The following sub-menus are also available:

Probes	Copeland Protection setup	File management configuration
Analog outputs	Copeland Protection information	ip/mdb address configuration
Output (om)	Log file management	Real-time clock
Loads status	Update Visograph	Language
Digital inputs	M200 status	Password
Superheat (inactive)	Energy meter status	Gas cooler information
Pumpdown	XEV02 status	
Compressor service circuit 1	Controller online/offline	

Table 11: Sub-menu overview

2.10.4 How to enter the "Service" menu

Press the **SERVICE** key to enter the "Service" menu.

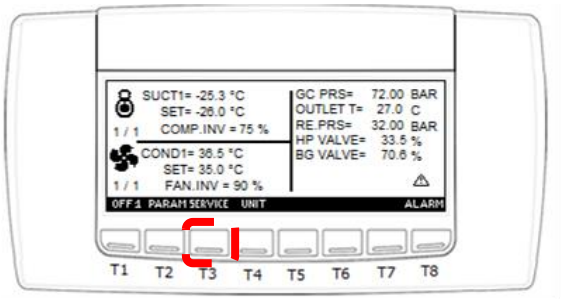


Figure 21: "Service" key

The following interface will be displayed:

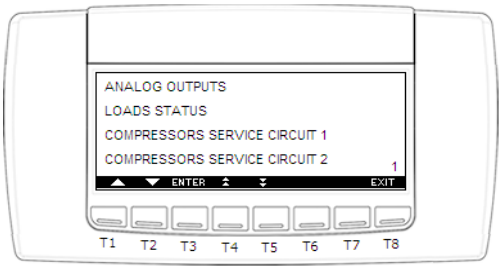


Figure 22: "Service" menu

2.10.5 How to check the values of analog outputs

1) Enter the "Service" menu
2) Use the **UP** and **DOWN** keys to select the "Analog outputs" sub-menu
3) Press **ENTER**

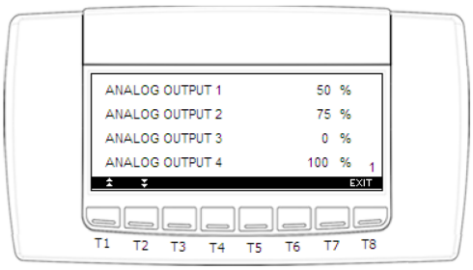


Figure 23: "Analog outputs" screen

Analog output	Factory setting	Description	Wiring diagram	Function
AOC1	2 - 0-10 V output inverter 1 suction – Circuit 1	VF Drive M200	X1: 25 / 21	OUT1
AOC2	5 - 0-10 V output inverter gas cooler – Circuit 1	Fan speed	X1: 25 / 22	OUT2
AOC3	0 - Not used	Reserved	X1: 25 / 23	OUT3
AOC4	0 - Not used			
AOC5	0 - Not used			
AOC6	0 - Not used			

Table 12: Analog outputs overview

2.10.6 How to check the status of the relays / loads

1) Enter the "Service" menu
2) Use the **UP** and **DOWN** keys to select the "Loads status" sub-menu
3) Press **ENTER**. The "Loads status" sub-menu displays the status of the of the relays in the following format:

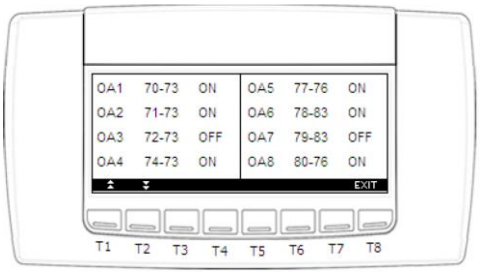


Figure 24: "Loads status" screen

Digital output	Factory setting	Description	Wiring diagram	Function	
DOC1	C1 - Inverter 1 suction - Circuit 1	Compressor (VF drive) on – Signal "Run"	X1: 71 / 70	RL1	OA1
DOC2	0 - Not used		X1: 71 / 72	RL2	OA2
DOC3	0 - Not used		X1: 71 / 73	RL3	OA3
DOC4	46 - Alarm	ALR1 – Alarm / Level 1	X1: 80 / 76	RL4	OA4
DOC5	0 - Not used	ALR2 – Alarm / Level 2	X1: 80 / 77	RL5	OA5
DOC6	0 - Not used	ALR – General alarm / Active if ALR1 or ALR2	X1: 80 / 78	RL6	OA6
DOC7	0 - Not used		X1: 80 / 79	RL7	OA7
DOC8	0 - Not used		X1: 80 / 81	RL8	OA8
DOC9	C58 - Inverter free - Circuit 1	For fan DI – Delay adjustable	X1: 86 / 84	RL9	OA9
DOC10	0 - Not used		X1: 86 / 85	RL10	OA10
DOC11	C49 - Auxiliary output 1	Compressor heater	X1: 90 / 87	RL11	OA11
DOC12	0 - Not used	Reserved (heat recovery, solenoid control)	X1: 90 / 88	RL12	OA12
DOC13	0 - Not used	Reserved (heat recovery, solenoid control)	X1: 90 / 89	RL13	OA13
DOC14	0 - Not used	Reserved (heat recovery, solenoid control)	X1: 90 / 91	RL14	OA14
DOC15	0 - Not used		X1: 90 / 92	RL15	OA15

Table 13: Digital outputs

2.10.7 How to perform a maintenance using the "Compressors service" sub-menus

The "Compressors service" sub-menus allow to perform a maintenance session consisting of:

- disabling an output;
- checking and (possibly) erasing the running hour of a load.

***NOTE:* Disabling an output will exclude it from the regulation.**

***NOTE:* The "Compressors service" sub-menu can be protected by a password.**

1) Enter the "Service" menu
2) Use the **UP** and **DOWN** keys to select the "Compressors service circuit 1" or "Compressors service circuit 2" sub-menu
3) Press **ENTER**

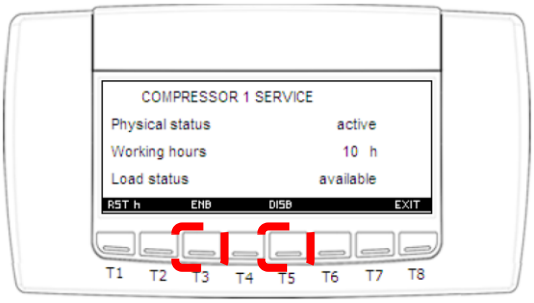


Figure 25: "Compressor 1 service" menu

<u>To disable an output during a maintenance session:</u>

1) Enter the "Compressor service circuit 1" sub-menu
2) Use the **UP** and **DOWN** keys to select the "Load status" sub-menu
3) Press the **SET** key

<u>To enable or disable a load for regulation:</u> Press one of the following keys as per **Figure 25**:

- **ENB** to enable the load for regulation
- **DISB** to disable the load for regulation

<u>Regulation with some outputs disabled:</u> If some of the outputs are disabled, they will be excluded from the regulation, and regulation will be performed with the other outputs.

<u>To display the running hours of a load:</u> The controller memorises the running hours of each load. To see how long a load has been working:

1) Enter the "Compressor service circuit 1" sub-menu
2) Use the **UP** and **DOWN** keys to select the "Load status" sub-menu and refer to **Figure 25** for screen layout.

To erase the running hours of a load: After a maintenance session, it is usually useful to erase the running hours of a load. Follow the steps below:

1) Enter the "Compressor service circuit 1" sub-menu
2) Use the **UP** and **DOWN** keys to select the "Load status" sub-menu
3) Press the **SET** key
4) Press the **RST** key to erase the running hours

To exit: Press the **EXIT** key to go back to the "Service" menu.

2.10.8 How to check the values of digital inputs

1) Enter the "Service" menu
2) Use the **UP** and **DOWN** keys to select the "Digital inputs" sub-menu
3) Press **ENTER**

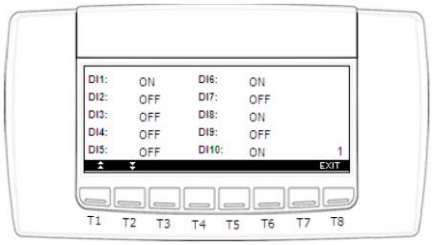


Figure 26: "Digital inputs" screen

Digital input	Factory setting	Description	Wiring diagram	Function
DIC1	o63 - Inverter suction 1 safety	VF drive failure NO >> Normally open, closed if failure	X1: 40	DI1
DIC2	0 - Not used	HP switch NC >> Normally closed, open if high pressure	X1: 41	DI2
DIC3	0 - Not used	Oil alarm NC >> Normally closed, open if oil alarm	X1: 42	DI3
DIC4	0 - Not used	Motor winding temperature alarm (KRIWAN) NC >> Normally closed, open if motor temperature alarm	X1: 43	DI4
DIC5	0 - Not used	VF drive under power NC >> Normally closed, open if drive is not powered	X1: 44	DI5
DIC6	0 - Not used	Fan alarm Closed after power on, open if fan alarm	X1:	DI6
DIC7	0 - Not used	Fan alarm 2nd input Closed after power on, open if fan alarm	X1: 46	DI7
DIC8	0 - Not used	Operation mode Potential free contact controlled by user	X1: 47	DI8
DIC9	0 - Not used		X1: 48	DI9
DIC10	0 - Not used		X1: 49	DI10
DIC11	0 - Not used			DI11
DIC12	o60 - Safety inverter gas cooler - Circuit 1			DI12
DIC13	0 - Not used			DI13
DIC14	0 - Not used			DI14
DIC15	o57 - Oil frequency compressor suction - Circuit 1			DI15
DIC16	0 - Not used			DI16

Digital input	Factory setting	Description	Wiring diagram	Function
DIC17	o58 - Safety frequency compressor suction - Circuit 1			DI17
DIC18	o59 - Thermal safety of frequency compressor			DI18
DIC19	o74 - External alarm 1			DI19
DIC20	C95 - Operating mode 2			DI20

Table 14: Digital inputs overview

2.10.9 How to check the values of the probes

1) Enter the "Service" menu
2) Use the **UP** and **DOWN** keys to select the "Probes" sub-menu
3) Press **ENTER**. The "Probes" sub-menu displays the probe values in the following format:

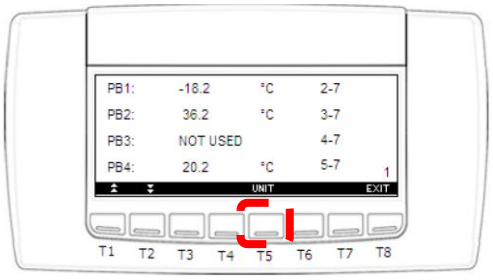


Figure 27: "Probes" menu

***NOTE:* To change the measurement unit for probes PB1, PB2, PB3 and PB4, press the UNIT key as per Figure 27.**

Analog input	Name in wiring diagram	Description	Signal	Wiring diagram	Probe type
AIC1	B1	Suction pressure	4-20mA	X1: 16 / 2	PT5-150
AIC2	B2	Gas cooler pressure	4-20mA	X1: 16 / 3	PT5-150
AIC3	B3	Liquid receiver pressure	4-20mA	X1: 16 / 4	PT5-150
AIC4	B4	Unit suction line temperature	NTC	X1: 7 / 5	NT6-55
AIC5	B5	Compressor suction line temperature	NTC	X1: 7 / 6	NT6-55
AIC6	B6	Discharge line temperature	PTC	X1: 7 / 10	S6H
AIC7	B7	Gas cooler outlet temperature	NTC	X1: 7 / 11	NT6-55
AIC8	B8	Oil temperature	NTC	X1: 7 / 12	NT6-55
AIC9	B9	Ambient temperature	NTC	X1: 7 / 13	NG6
AIC10	B10	Cabinet temperature	NTC	X1: 7 / 14	NG6

Table 15: Probes overview

***NOTE:* The temperature/resistance tables for NTC & PTC sensors are available in Appendices 2 & 3.**

2.10.10 How to set the date and time

1) Enter the "Service" menu
2) Use the **UP** and **DOWN** keys to select the "Real-time clock" sub-menu
3) Press **ENTER**
4) Use the **UP** and **DOWN** keys to set the day
5) Press **SET** to confirm and move to the time setting
6) Follow the same procedure to set the date and time
7) Press **SET** to confirm

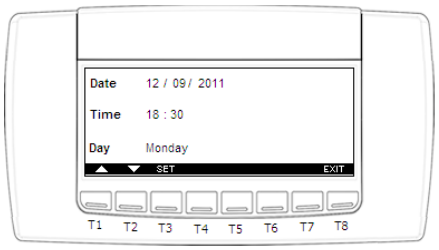


Figure 28: "Real-time clock" display

2.10.11 How to check the operating values of the frequency inverter M200

1) Enter the "Service" menu
2) Use the **UP** and **DOWN** keys to select the "M200 status" sub-menu
3) Press **ENTER**

2.10.12 Controller setting

IMPORTANT
Never adjust the suction pressure to a value that is outside of the envelope approved by Emerson.

To change the suction pressure:

1) Press the **PARAM** key to access the programming menu
2) Use the **UP** and **DOWN** keys to select the **Pr1** menu
3) Press **Pr1** to enter this menu
4) Select setpoint (**SETC1**)
5) Use the **UP** and **DOWN** keys to adjust **SETC1** to the required suction pressure

***NOTE:* No change to the HPV (gas cooler high-pressure valve) setting on the controller is required before starting the unit.**

2.10.13 Manual compressor run

IMPORTANT
Manual compressor runs are intended for maintenance purposes only!
Only qualified personnel and certified companies are allowed to perform a manual compressor run as it can force the compressor to operate outside of the approved envelope. In any case special care shall be taken when performing one. In particular, never run the compressor for more than 2 minutes.

During a manual compressor run, all the safety features remain active: the controller run signal is bypassed. Besides, during manual operation the HPV and BGV valves are closed, unless this was manually overwritten.

To manually run the compressor, check first that the **SB2** switch is switched to "I" then switch on the **SB1** switch. The compressor will immediately start at minimal speed.

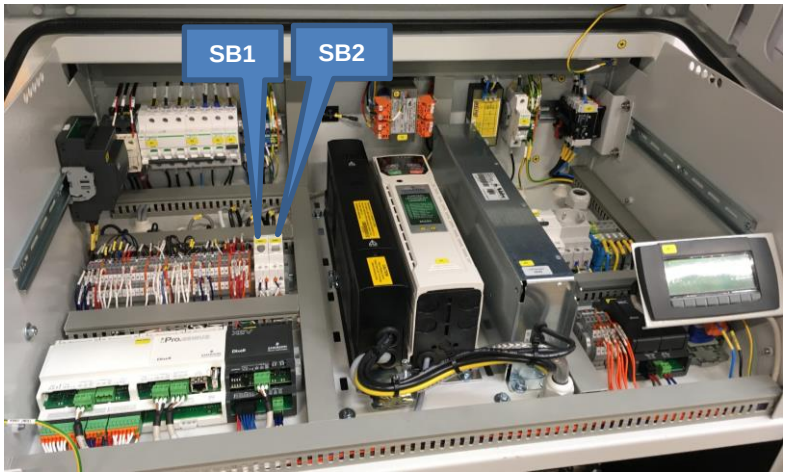


Figure 29: Manual compressor operation

2.10.14 How to reset the controller to factory settings

1) Enter the "Service" menu
2) Use the **UP** and **DOWN** keys to select the "Conf file management" sub-menu
3) Press the **SET** key. The parameter map will be transferred from "Backup.conf" file to "default_10D.conf" file.

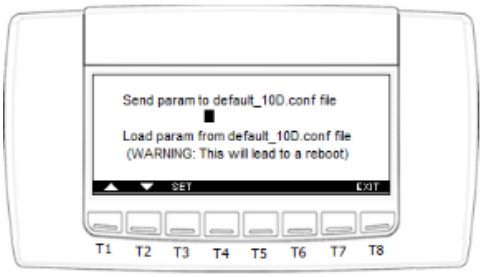


Figure 30: Reset to factory settings

The controller will reboot, and the parameters will be reloaded from the "Param_model.conf" file.

2.10.15 How to save user's settings

NOTE: **Saving the user's settings will overwrite the factory settings!**

To update the back-up file with the current parameter map:

1) Enter the "Service" menu
2) Use the **UP** and **DOWN** keys to select the "Conf file management" sub-menu
3) Press the **SET** key
4) Use the **UP** and **DOWN** keys to select the "Send parameters to Backup.conf file" sub-menu
5) Press the **SET** key

To load the parameters from the "Backup.conf" file to the iPro rack:

1) Enter the "Load parameters from Backup.conf file" sub-menu
2) Press the **SET** key. The parameters will be loaded from the "Backup.conf" file.

The iPro rack will reboot and the parameters will be reloaded to the "Conf file management" file.

2.10.16 Data logging

The controller will continuously store all the alarms in an endless loop – maximum log file size 1MB.

No	Variable	Description
1	Suction pressure (bar)	SuctPrss_BAR
2	Condensing pressure (bar)	Cond/GCPrss_BAR
3	Liquid receiver pressure (bar)	LiqRecPrss_BAR
4	Suction temperature unit (°C)	Aux2Temp_C
5	Suction temperature compressor (°C)	SuctTemp_C
6	Discharge line temperature (°C)	DLT_C
7	Gas cooler outlet temperature (°C)	GCoutletTemp_C
8	Oil temperature (°C)	Aux3Temp_C
9	Ambient temperature (°C)	DynCondTemp_C
10	Cabinet temperature (°C)	ThermTemp_C
11	Inverter output voltage	Comp_PCT
12	Fan output voltage	Fan_PCT
13	HPV valve opening	HPV_PCT
14	BGV valve opening	BGV_PCT
15	Inverter M200 output power	M200power_kW
16	Inverter M200 output frequency	M200freq_Hz

Table 16: Data logging parameters (in addition to the date and hour)

There are 4 log files, of which only 3 can be exported:

- AccessLog
- AlarmLog
- ParamLog
- ParamAlarmLog

The ParamLog and ParamAlarmLog files contain the same variables, but:

- the ParamLog file has a fixed sampling rate (5 minutes);
- the ParamAlarmLog file stamps the info every time an alarm starts or stops.

2.10.17 Active alarm(s) log menu

***NOTE:* This function is not available from the Visograph screen.**

The iPro rack can store up to 1 MB of alarm data in a log file, including the start and end dates of each alarm. This file can be exported through the Dixell website integrated on a memory card or via the USB port using the "Log file management" sub-menu.

To save the alarm log file into a USB key:

1) Enter the "Service" menu
2) Use the **UP** and **DOWN** keys to select the "Log file management" sub-menu
3) Press **ENTER**
4) The following interface will be displayed: "Send alarm log to usb" (see **Figure 31**)

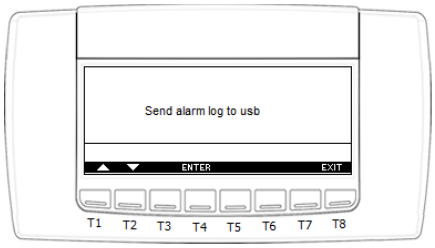


Figure 31: Alarm log

5) Use the **UP** and **DOWN** keys to select the function
6) Press **ENTER**. If the USB key is not ready the following message will be displayed:
   - "Warning! USB not ready".
7) To save the log file, follow the steps as described on the display. At the end of the process, one of the following messages will be displayed:
   - "Send completed successfully!" ➔ Saving was successful.
   - "Send error!" ➔ Saving failed.

2.11 IPG215D controller – Functionality

The IPG215D controls the complete refrigeration unit. It provides a lot of customization features like alarms and special operating modes. Thanks to the high degree of flexibility, the user can either use the factory-set alarms or set up his own alarms according to the application requirements.

The following functionalities are pre-programmed:

- suction pressure control
- fan speed / gas cooler control
- alarms

The refrigeration unit is able to operate in both subcritical and transcritical modes. The setpoint for switching from subcritical to transcritical operation is adjustable (**GC1**). The factory setting for this trigger point is 27 °C, measured over gas cooler outlet sensor B7 (**AIC7**). The (adjustable) hysteresis (**GC2**) for the (**GC1**) setpoint is 1 K.

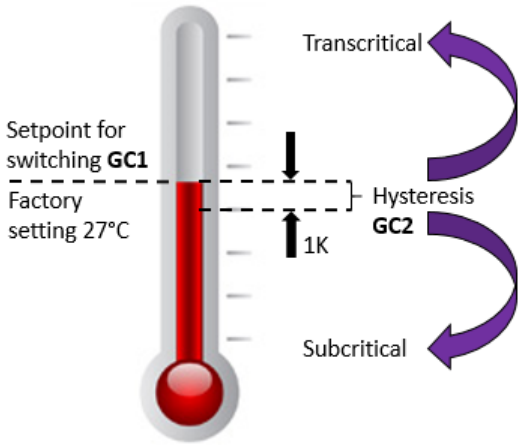


Figure 32: Switching from transcritical to subcritical mode

***NOTE:* A system control very close to the critical point may result in a loss of capacity and unstable system behaviour. This can be overcome by setting GC3 to a higher value (76-80 bar) or by dynamic offset using parameters GC16 and GC17.**

2.11.1 Suction pressure control

2.11.1.1 Standard suction pressure control

The setpoint for suction pressure control is parameter **SETC1**, the factory setting is -10 °C.

SETC1 **Compressor Circuit 1 setpoint**
Range: -15 to -5 °C
Unit: (°C)

Depending on the number of evaporators, ie, on the suction side internal volume, a rapid decrease of the suction pressure during compressor start might occur. This can result in low-pressure cut-out before reaching stable regulation conditions. The acceleration of the compressor speed can be adjusted by decreasing the value of **SETC1**.

2.11.1.2 Automatic pumpdown

If parameter **SPF4** is set to "**yes**" a pumpdown will be performed before stopping the compressor. If it is set to "**no**", only the manual pumpdown and the automatic pumpdown during the bypass optimization function will be performed.

SPF1 **Compressor setpoint during pumpdown**
Range: -70 to -10 °C
Unit: (°C)

Parameter	Description	Level	Min value	Max value	Factory setting
SETC1	Compressor Circuit 1 setpoint	Pr1	-15 °C	-5 °C	-10 °C
SPF1	Differential to be subtracted from the compressor setpoint	Pr1	0 K	20 K	8 K
SPF2	Compressor capacity during pumpdown	Pr1	0 % (min speed 25 Hz)	100 % (max speed 60 Hz)	0 %
SPF3	Pumpdown maximum time	Pr1	0 min	25 min	3 min
SPF4	Automatic pumpdown	Pr1			yes
SPF5	Pumpdown offset	Pr2	0 K	40 K	20 K

Table 17: Pumpdown parameters

2.11.2 Pumpdown mode

The pumpdown function of the CO_2 refrigeration unit does not work in the same way as in units using standard refrigerants. Based on the ambient temperature and the compressor setpoint, the controller calculates two different pumpdown setpoints:

- setpoint based on ambient temperature = T_{Amb} – SPF5
- setpoint based on compressor setpoint = SETC1 – SPF1

The lowest pumpdown setpoint will always be applied. The following diagram illustrates the controller logic:

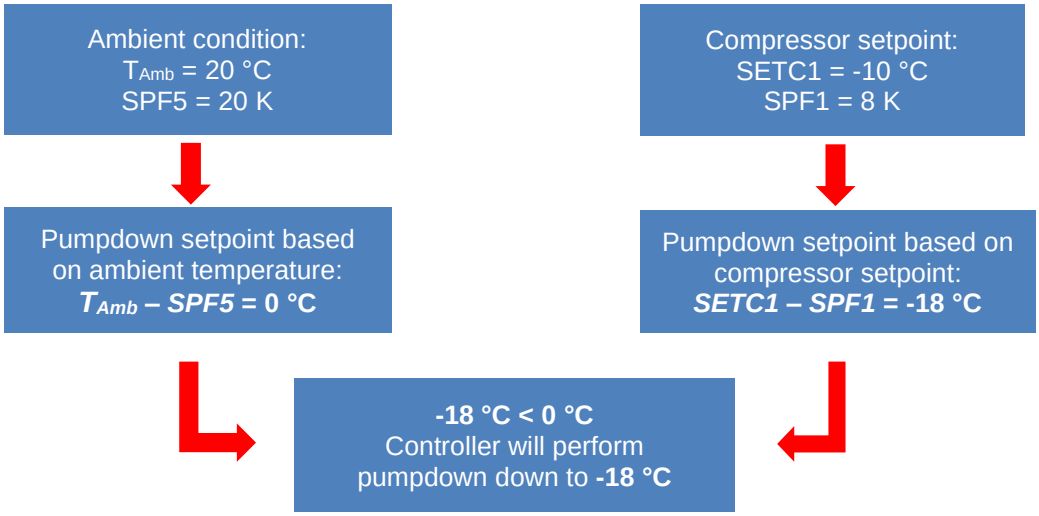


Figure 33: Controller logic for the pumpdown function with factory settings

***NOTE:* The pumpdown setpoint will never be lower than allowed by parameter RC02, ie, -25 °C, reached when T_{Amb} = -5 °C.**

2.11.3 Fan speed / gas cooler control

2.11.3.1 Subcritical operation

Typically, with gas cooler outlet temperatures below 27 °C **(B7 = AIC7 < GC1 - GC2)**, the system operates in subcritical mode.

- The CO_2 refrigerant condenses inside the gas cooler.
- The gas cooler outlet temperature is read by the probe **AIC7** (= B7), which defines the fan speed.
- The gas cooler valve HPV will keep a certain sub-cooling of the refrigerant (about 2-3 K) in order to create pressure differential between the gas cooler and the flash tank.
- The fan speed setpoint (related to the gas cooler outlet temperature) is +5 °C with a proportional band of +5 K (setpoint ± 2.5 K). In other words, above 7.5 °C, the fan will always run at full speed, while below 2.5 °C, the fan will always run at minimum speed.

SETF1 **Gas cooler Circuit 1 setpoint**
Range: +5 to +25 °C
Unit: (°C)

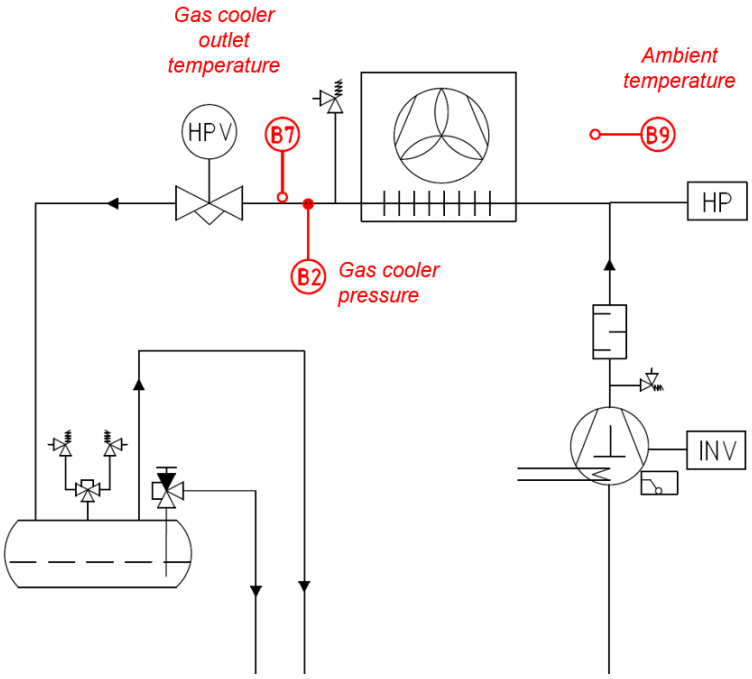


Figure 34: Sensoring in subcritical mode

2.11.3.2 Transcritical operation

Typically, with gas cooler outlet temperatures above 27 °C **(B7 = AIC7 > GC1)**, the system operates in transcritical mode.

- According to the gas cooler outlet temperature detected by the **AIC7** (= **B7**) probe, the high-pressure valve modulates to maintain a pressure that maximizes the COP (Coefficient of Performance).
- The fan speed setpoint is +5 °C with a proportional band of +5 K.

2.11.3.3 Transcritical operation with flash-gas bypass

In transcritical operation mode in CO_2 systems, the liquid receiver becomes a flashtank, in which the liquid phase is separated from the gas phase. In high ambient conditions, the amount of gas will increase due to the thermodynamic properties of CO_2. Flashgas ratios of 50 % or more are not unusual. Typically, the flash-gas is removed to the compressor suction side to keep the pressures in the flashtank at acceptable levels.

Bypassing flash-gas will reduce the mass flow coming from the cold rooms/cabinets. This necessary process will however reduce the overall system efficiency. The bypass valve limits the maximum pressure in the flashtank to 43 bar (adjustable with parameter **GC20** according to application and piping design).

- The fan speed setpoint is +5 °C with a proportional band of +5 K.

2.11.4 Alarms

In the event of an alarm, the alarm symbol will be flashing on the main display.

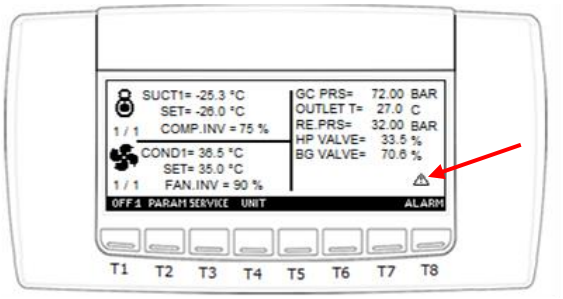


Figure 35: Flashing alarm symbol

Press the **ALARM** key to enter the "Alarm" menu:

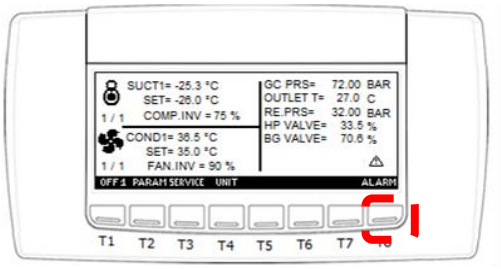


Figure 36: "Alarm" key

The header of the corresponding menu will be flashing. Four alarm menus are available from the display:

- Compressor alarms Circuit 1
- Fan alarms Circuit 1
- Alarms Circuit 1
- Generic alarms

An additional alarm menu is available from the controller internal webpage.

1) Use the **UP** and **DOWN** keys to select the desired alarm section
2) Press **ENTER** to confirm and access the alarm sub-menu

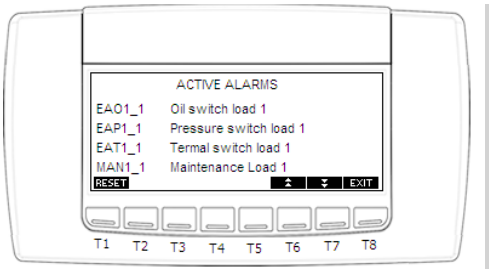


Figure 37: Active alarms screen

The alarm menu will display the active alarm in the following format:

- Column 1: Alarm code
- Column 2: Alarm description

Several alarms are pre-programmed in the unit. The configuration can easily be adjusted to the user's needs. The factory settings only consider a general compressor alarm (Parameter **AL09** "Relay for temperature/pressure compressors alarms"), and a general fan alarm, both connected to "**ALR**".

Alarm	Factory setting	Description	Wiring diagram	Function	
ALR1		ALR1	X4: 80 / 76	ALR1	R4
ALR2		ALR2	X4: 80 / 77	ALR2	R5
ALR3		ALR	X4: 80 / 78	ALR	R6
ALR4		Reserved	X4: 80 / 79	ALR4	R7
ALR5		Reserved	X4: 80 / 81	ALR5	R8
PFC	Potential free contact (source 24 V AC (69))	Operation mode	X4: 69 / 47		
PFC	Potential free contact (source 24 V AC (69))	Not used	X4: 69 / 48		
PFC	Potential free contact (source 24 V AC (69))	Not used	X4: 69 / 49		

Table 18: Alarm overview

Compressor alarm: The activation of the relay for temperature/pressure compressor alarms can be set in the "Compressor alarms" menu.

Parameter **AL10** allows for an additional alarm for "Running hours for compressor maintenance" (factory setting >> 0 = not used). To activate the maintenance alarm change **AL10** from "nu - not used" to **ALR1** or **ALR2**.

Fan alarm: The activation of the relay for temperature/pressure fan alarms can be set in the "Fan alarms" menu.

***NOTE:* The OME-4MTL-05X will not trigger any fan alarm because there is no alarm contact in the fan in this model.**

Alarm for faulty probe: Another alarm is connected to "ALR" in case a probe is faulty. Parameter **AL11** "Alarm relay for faulty probe" is set to **ALR**.

2.12 IPG215D controller – Peripheral devices

The unit controller interacts with several devices inside the electrical cabinet. These guidelines only provide general information about and short descriptions of the peripheral devices. Dedicated technical documentation (manuals, operating instructions) for those devices is available at www.climate.emerson.com/en-gb.

2.12.1 Variable frequency drive M200

The Emerson variable frequency drive M200 has been designed for applications that require flexible integration with systems via industrial Ethernet protocols and fieldbuses, together with advanced RFC-A open-loop motor control. Connection to RS485 networks using Modbus RTU allows for communication with the unit controller.

The M200 frequency inverter uses the 0…10 V input signal of the controller to adjust the compressor speed to the requirements. For more details see the M200 Inverter Handbook.

***NOTE:* The variable frequency drive should not be used to change the system settings. All required changes and adjustments can be made directly on the system controller via the Visograph display.**

2.12.2 XEV20D Stepper valve actuator

The XEV20D stepper valve actuator communicates with the unit controller via CAN Bus. It is intended either for bipolar stepper valves or unipolar stepper valves. Both the gas cooler regulation valve and the bypass regulation valve are driven by the XEV20D. The address of the XEV20D has to be set to 3 (dip switches: ON, ON, OFF, OFF).

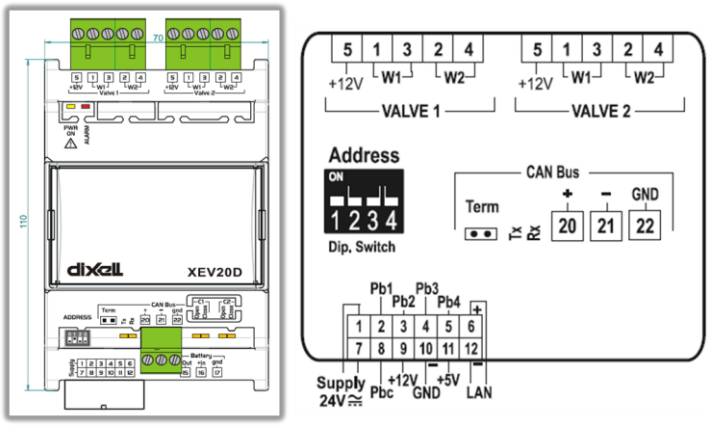


Figure 38: XEV20D stepper valve actuator

2.12.3 Main contactor and circuit breakers

The components of the electrical main load circuit are located in the left back area of the electrical cabinet. Before commissioning some electrical components need power supply to enable heating up the compressor oil sump. Power supply is also needed to manually open the gas cooler high pressure valve (HPV) and the bypass valve (BPV) on demand, eg, for tightness test and evacuation procedure.

***NOTE:* For safety reasons never switch the F1 (compressor) or F3 (fans) circuit breaker on without a minimum refrigerant charge inside the system.**

***NOTE:* The unit main switch must always be switched on to provide power to the control chain and dedicated electrical components.**

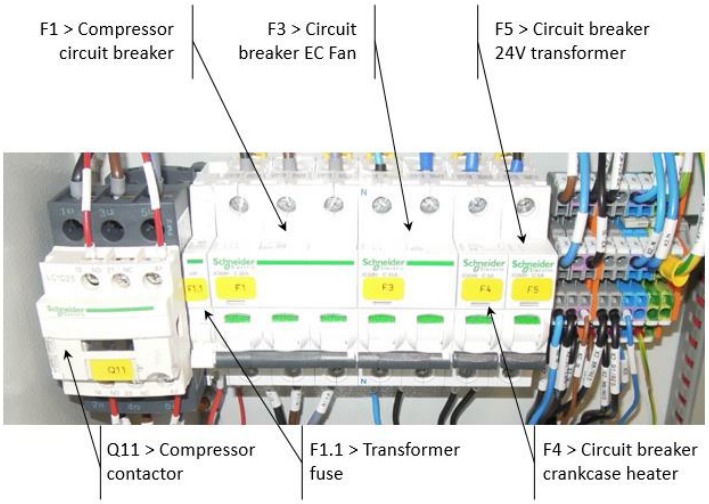


Figure 39: Main contactor and circuit breakers

2.13 Compressor safety

2.13.1 Compressor motor protection

Copeland CO_2 refrigeration units are equipped with a Stream 4MTL compressor including Copeland Protection technology.

All relevant electrical protection features are covered by the Emerson M200 variable frequency drive. For more details see the M200 Inverter Handbook.

The discharge line temperature is monitored and controlled by the controller.

The different areas of the system are limited by different design pressures (PS) – see **section 2.8.7 "Design pressures"** for details. There are different levels of protection and control to keep the pressures within the approved envelope at all times.

2.13.2 High-pressure safety (type-approved pressure limiter)

A type-approved pressure limiter (according to EN 12263) with automatic reset is installed on the compressor. It is a normally-closed switch from Alco Controls.

The pressure cut-out is set to 114 bar and the cut-in to 107 bar for models OME-4MTL-05X, OME-4MTL-07X and OME-4MTL-09X. The cut-out and cut-in values are set to 123 bar and 117 bar respectively for OME-4MTL-12X.

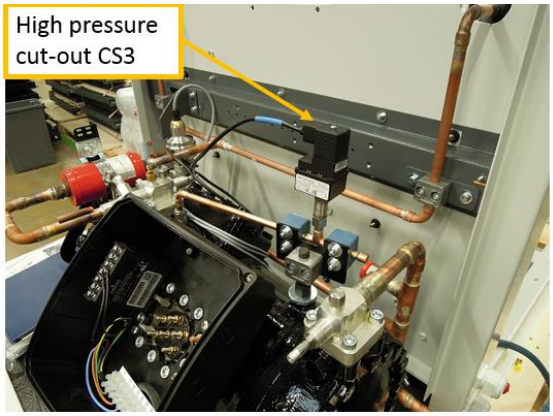


Figure 40: High-pressure limiter

2.13.3 High-pressure safety control

There are 3 pressure transmitters assembled in the unit. These transmitters are used for system control purposes as well as for safety. They are located on the suction side (B1 = **AIC1**), between the gas cooler and the high-pressure regulation valve (B2 = **AIC2**), and on the liquid receiver outlet (B3 = **AIC3**).

The factory setting of the high pressure is slightly below the activation setpoint of the high-pressure safety switch.

The transmitter on the liquid receiver is also used to limit the liquid receiver pressure during operation by means of the bypass valve.

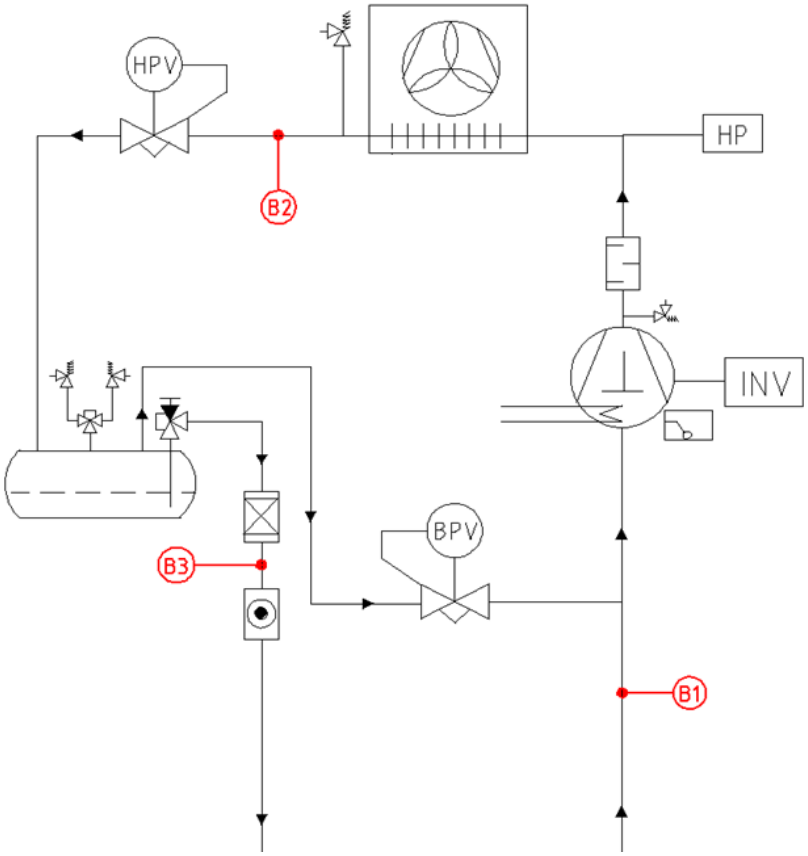


Figure 41: Pressure transmitters in the CO_2 unit

2.13.4 Pressure relief valve – High-pressure side

A pressure relief valve (120 bar for OME-4MTL-05X to OME-4MTL-09X, 130 bar for OME-4MTL-12X) is installed in the gas cooler outlet. This valve protects the high-pressure side including the gas cooler. In case of blocked HPV the high-pressure limiter will switch the compressor off before the pressure relief valve opens.

The pressure relief valve will reach 100 % of blow-off capacity when the maximum allowable pressure PS on the high-pressure side of the unit is exceeded by 10 % (opening at 1.0 x PS, max capacity at 1.1 x PS).

The thread connection on the pressure relief valve is M24 x 1.5 (NPT thread for OME-4MTL-12X).

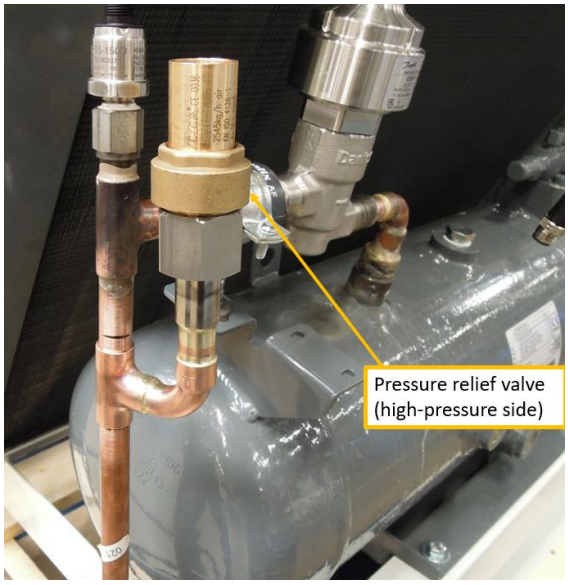


Figure 42: Pressure relief valve on high-pressure side

2.13.5 Pressure relief valve – Liquid receiver

There are two pressure relief valves (90 bar) on the liquid receiver, connected through a changeover valve. The pressure relief valve (PRV) protects the unit intermediate pressure side against overpressure (pressure above intermediate pressure side PS). The PRV will reach 100 % of its blow-off capacity when the maximum allowable pressure PS of the unit intermediate pressure side is exceeded by 10 % (opening at 1.0 x PS, maximum capacity at 1.1 x PS). The changeover valve makes the PRV replacement possible without charge removal.

In normal operation, the changeover valve is set up in such a way that the left PRV (**Figure 43**) is under system pressure, while the right PRV is isolated from the system pressure by an internal part of the valve. This is a leak-proven set-up and must be kept. If the PRVs have to be replaced or checked for leakage, follow the instructions in **chapter 5 "Maintenance & repair"**.

Figure 43: Liquid receiver with safety group

Figure 44: Pressure relief valves with changeover valve

2.13.6 Low-pressure safety control

As on discharge and liquid sides, a suction pressure transmitter (B1 = **AIC1**) provides information about suction pressure to the system controller. This value is used to evaluate the load requirement and to protect the unit / system against low pressure on suction side.

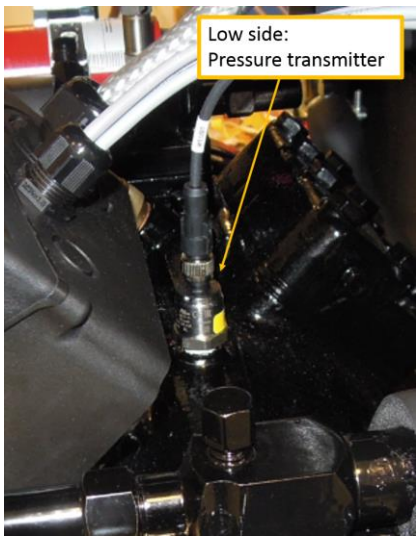


Figure 45: Low side pressure transmitter

2.14 Oil level monitoring device – OW5 TraxOil

The compressor in the Copeland CO_2 refrigeration unit is equipped with an Emerson OW5 TraxOil oil level monitoring system. This device is intended to prevent the compressor from operating with insufficient oil. The OW5 uses a hall sensor to measure the oil level. Unaffected by foaming oil or light, a magnetic float changes its position according to the oil level. The hall sensor converts the magnetic field changes into an equivalent signal, which is used by the integrated electronic controller to monitor and display the actual oil level with LEDs.

In case of low oil level and after a delay time of 120 seconds the OW5 will generate an alarm which will make the unit controller stop the compressor immediately.

This alarm can be displayed on the Visograph like any other alarm of the unit.

Figure 46 below depicts the sight glass level control zones. **Table 19** describes the LED code legend. **Figure 47** shows the OW5 TraxOil mounted on the compressor.

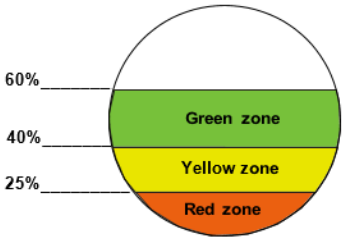


Figure 46: Sight glass level control zones

LEDs	Status	Function	Alarm
●	Oil level in green zone (60 - 40 %)	OK	
● ●	Oil level in green zone (60 - 40 %)	OK	
●	Oil level in yellow zone (40 - 25 %)	Warning	
●	Oil level in red zone (25 - 0 %)	Alarm	Yes, delay 20 to 120 sec

Table 19: LED code legend

Figure 47: OW5 TraxOil mounted on the compressor

3 Installation

WARNING
High pressure! Injury to skin and eyes possible! Be careful when opening connections on a pressurized item. Never install the unit at such a height that if the pressure relief valve opens, the gas flow can reach an individual's head.

IMPORTANT
Always install the unit in such a way that all installation, commissioning and servicing works can be carried out safely and easily.

Copeland CO_2 refrigeration units are delivered with a holding charge of neutral gas.

The refrigeration unit should be located in such a place to prevent any dirt, dust, plastic bag, leaves or papers from covering the gas cooler and its fins.

A clogged gas cooler will increase the refrigeration temperature and/or the gas cooler outlet temperature which could lead to a high-pressure switch tripping. Clean the gas cooler fins on a regular basis.

The unit must be installed without restricting the airflow. Harmful environmental conditions like very low or high temperatures should also be avoided.

The place of installation has to be level and horizontal. The unit must be secured to the ground to avoid any movement of the base frame. The ground needs to be designed for the weight of the unit. It might be necessary to install additional vibration absorbers between the unit and the ground to avoid the transmission of vibration to the rest of the building.

The place of installation should be sufficiently lit and should allow easy access for service and maintenance work.

In case of installation in a machine room, standard EN 378-3 and all additional national regulations shall be observed.

A risk assessment of the place of installation has to be conducted before actual system installation. It should be documented for local authorities and should contain safety-related measures to avoid risks. The risk assessment of the unit itself has been performed by the manufacturer.

3.1 Refrigeration unit handling

3.1.1 Transport and storage

WARNING
Risk of collapse! Personal injuries! Move units only with appropriate mechanical or handling equipment according to weight. Keep in the upright position. Respect stacking loads according to **Figure 48**. Do not stack anything on top of the unit packaging. Keep the packaging dry at all times.

Respect the maximum number of identical packages which may be stacked on one another, where "n" is the limiting number:

- **Transport: n = 0**
- **Storage: n = 0**

Figure 48: Maximum stacking loads for transport and storage

3.1.2 Weights

Unit	Net weight (kg)
OME-4MTL-05X	440
OME-4MTL-07X	450
OME-4MTL-09X	462
OME-4MTL-12X	473

Table 20: Weights

3.1.3 Lifting

Always lift the unit by points marked with red arrows on pictures below.

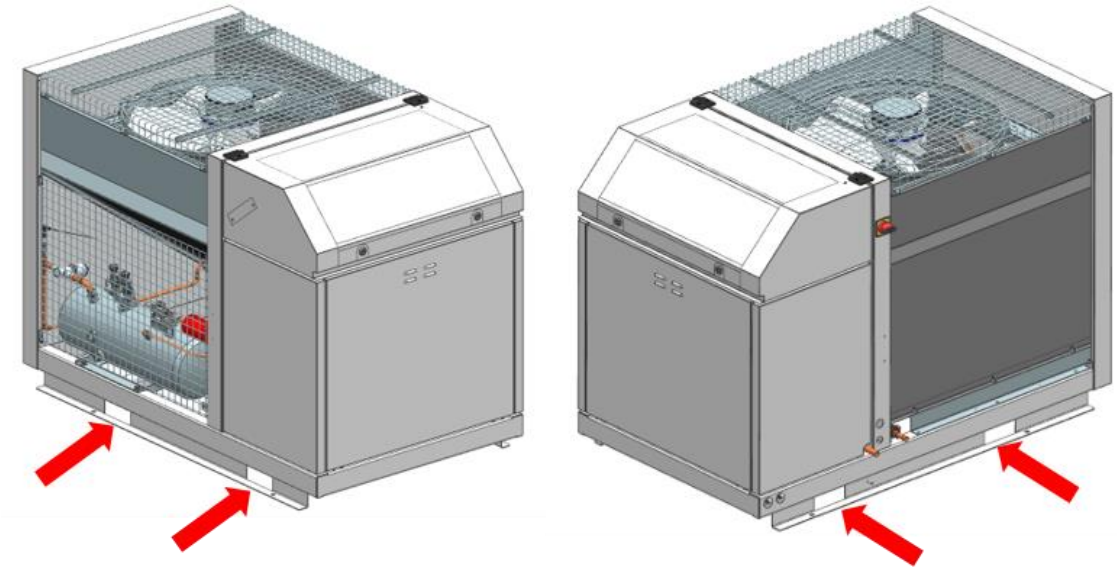


Figure 49: Lifting points for CO_2 units

When lifting the unit with slings, always use the spreader bar mounted above the unit to avoid squeezing the unit.

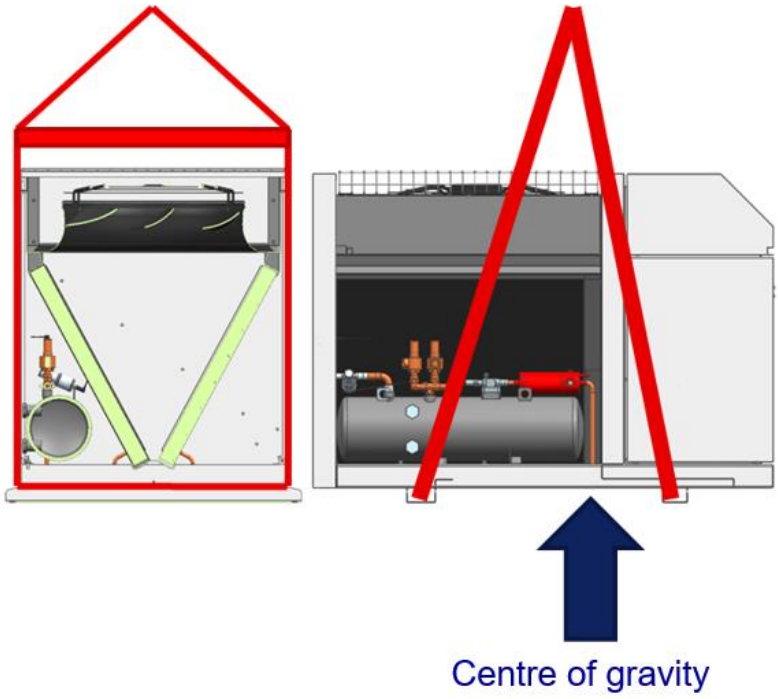


Figure 50: Lifting unit with slings and centre of gravity

3.2 Refrigeration piping connections

3.2.1 Refrigeration piping installation and connections

WARNING
High pressure! Risk of personal injury! The units are pressurized with dry air. Be careful when opening connections on a pressurized item.

IMPORTANT
Tubing quality! Installation contamination! All interconnecting piping should be of refrigeration grade, clean, dehydrated and must remain capped at both ends until installation. Even during installation, if the system is left for any reasonable period of time, eg, 2 hours, pipes should be re-capped to prevent moisture and contaminant from entering the system.
Connection sizes! Unsuitable refrigerant flow rate! Do not assume that the service connection sizes on the unit (at the service valves) are in fact the correct size to run the interconnecting refrigeration pipes. The service valve sizes have been selected for convenience of installation and in some cases these may be considered too small. However, for the very short pipe run within the units these service connection sizes are adequate. All interconnecting piping should be sized to satisfy the duty required.

IMPORTANT
Piping design pressure! Risk of CO_2 blow-off! The CO_2 refrigeration unit liquid and suction line piping is designed for a design pressure (PS) of 90 bar as pressures around 85 bar can occur during normal operation. The installer must always consider the system liquid and suction lines in terms of maximum operating pressure. If the system piping design pressure is lower than 90 bar, additional safety devices are required. The CO_2 unit can control different receiver pressures depending on the application.

The pipes should be sized to ensure optimum performance and good oil return. The sizing must also take into account the full capacity range through which a particular unit will need to operate.

The piping on the unit is made of K65, a high copper alloy tube designed for high operating pressures. This kind of tube is more rigid than a standard copper tube; this must be considered for the design and fixation of the piping system.

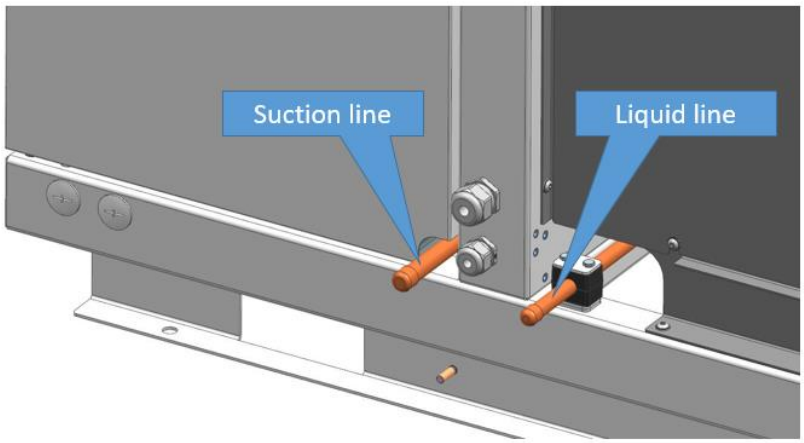


Figure 51: Piping connections

Unit	Suction line (ODS)	Liquid line (IDS)
OME-4MTL-05X	3/4" (19.05 mm)	5/8" (15.875 mm)
OME-4MTL-07X		
OME-4MTL-09X	7/8" (22.23 mm)	
OME-4MTL-12X		

Table 21: Piping connections sizes

3.2.2 Brazing recommendations

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 minimises any entry of contaminants and moisture.

1) Remove the liquid connection cap – see **Figure 51**.
2) Remove the suction connection cap – see **Figure 51**.
3) Care should be taken to avoid the holding charge releasing too quickly.
4) Be sure tube fitting inner surface and tube outer surface are clean prior to assembly.
5) Both tubes are extended from the refrigeration unit housing, therefore Emerson recommends isolating the housing by using a wet cloth on the copper tubing.
6) Use a double-tipped torch.

Recommended brazing materials: see **Table 22** below and recommendations specific to K65 at: http://www.wieland-thermalsolutions.com/commonmedia/content/media/en/prospekte_2/gbrohre/prospekte/untersuchungsergebnisse_wieland_k65_11.pdf

Brazing alloy	DIN EN ISO 17672	DVGW* number	Working temperature (°C)	Composition (% by weight)				
				Ag	Cu	Zn	Sn	P
BrazeTec 4576	Ag145	DV-0150CM0043	670	45	27	25.5	2.5	-
BrazeTec 3476	Ag134	DV-0150CM0045	710	34	36	27.5	2.5	-
BrazeTec 4404	Ag244	DV-0150CM0044	730	44	30	26	-	-
BrazeTec S 15	CuP284	-	700	15	80	-	-	5
BrazeTec S 5	CuP281	-	710	5	89	-	-	6
BrazeTec S 2	CuP279	DV-0105CL0475	740	2	91.7	-	-	6.3
Flux	**DIN EN 1045**	**DVGW* number**	**Active temperature (°C)**	**Comments**				
BrazeTec h	FH10	DV-0101AU2227	550-970	Flux residues are corrosive and must be removed				

** DVGW = German Technical and Scientific Association for Gas and Water*

Table 22: Extract of the recommendations for acceptable brazing alloys and flux

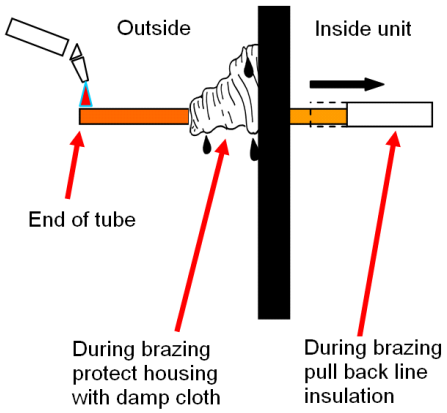


Figure 52: Brazing – Sectional view

3.3 Electrical connection

WARNING
Earth leakage current! Electrical shock hazard! This product includes a three-phase frequency drive. Additional protection devices could be necessary. This must be decided by the electricicty network supplier or by the electrician company which provides the electrical connection.

Copeland CO_2 refrigeration units can cause earth leakage currents, both AC and DC, due to the presence of an inverter and an EMC filter in the system. An AC/DC-sensitive Residual Current Device (RCD) should be used on the power supply side. The RCD can be either **type B or B+**.

A delay of at least 50 ms should be incorporated to prevent spurious trips. The leakage current is likely to exceed the trip level if not all the phases are energized simultaneously.

3.3.1 Power supply connections

WARNING
Electrical cabinet cover open! Danger of electric shock! Always make sure that the cover of the electrical cabinet is properly closed before starting the unit.

The electrical connection of the refrigeration unit to the power supply must be made by qualified technicians in compliance with the valid electrical standards, eg, DIN EN 60204-1.

Additionally, the voltage drop and line temperatures must be considered for cable selection. The nominal power and maximum current are shown in **Table 23** hereunder:

Unit	Nominal power (kW)	Maximum current (A)	Power supply
OME-4MTL-05X	11	19	3 / N / PE 50 Hz 400 / 230 V TN-S
OME-4MTL-07X	14	22	
OME-4MTL-09X	16	27	
OME-4MTL-12X	18	33	

Table 23: CO_2 unit nominal power and current

Copeland CO_2 units are designed to be connected to one of the following power supplies:

- TN-S system with 380-420 V / 3 Ph / 50 Hz + N + PE **or**
- TN-C system with 380-420 V / 3 Ph / 50 Hz + PEN

A voltage tolerance of ± 10 % is acceptable.

The circuit breaker and the main switch on the backside of the unit must be switched off before opening the hinged front cover and connecting the power supply cable.

The power cable should enter the electrical box through a rubber grommet.

***NOTE:* When a TN-C system is applied a jumper (part of the delivery) must be added between N & PE (X5.N & X5.PE) as per Figure 53.**

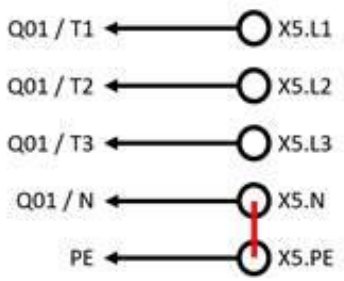


Figure 53: Power supply terminals with jumper

3.3.2 Electrical wiring

Ensure that the neutral wire "N" and the ground protection wire "PE" are connected to the main switch before commissioning.

3.3.3 *Electrical protection standard (protection class)*

- Units: IP class IPX4.
- Stream 4MTL compressor terminal box: IP54 according to IEC 34.
- Fan: IP54 according to IEC 34.

3.4 Location & fixings

IMPORTANT
Dust and dirt contamination! Unit life reduction! The unit should always be installed in a location where clean airflow is ensured. External fouling of the gas cooler fins leads to high condensing temperatures or pressures and will reduce the lifetime of the unit.

It is mandatory to keep a clearance space around the unit as shown in **Figure 54**, dimensions in red colour. Both service access and airflow have been considered in making these recommendations. Sufficient space must be provided between the units to protect them from recirculation of hot air from a neighbouring gas cooler.

Where multiple units are to be installed in the same location, the contractor needs to consider each individual case carefully. There can be many variations in terms of number of units and available space and it is not in the scope of these guidelines to cover each individual case. However, in general terms, air bypass around each gas cooler and between the units should always be avoided.

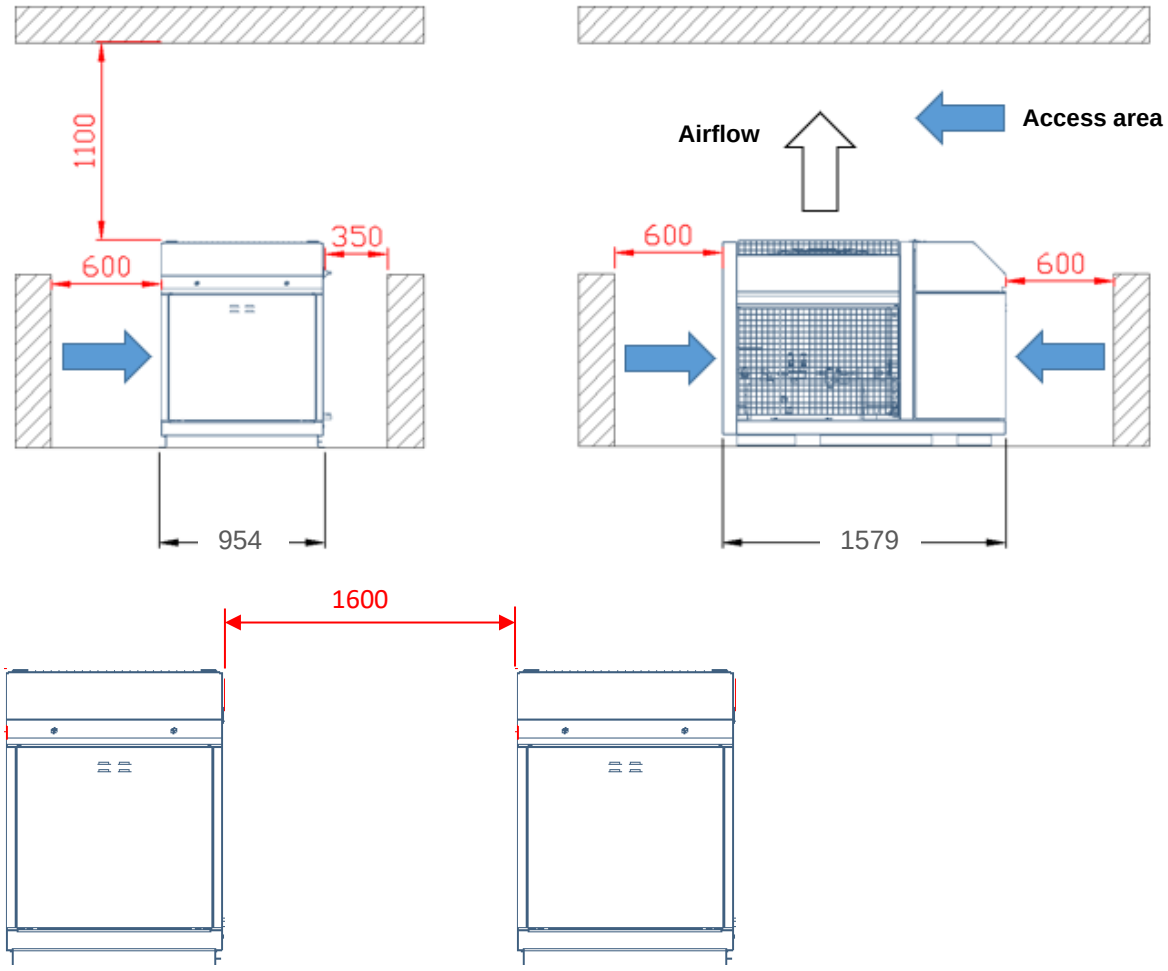


Figure 54: Distances required for unit installation (in mm)

Ideally, the unit should be mounted level on a solid concrete slab with anti-vibration pads between unit feet and concrete – see **Figure 55**. However, the refrigeration unit has also been designed for wall mounting on suitable brackets. In this case, it is equally important that the dimensional guidelines given in **Figure 54** are followed and that additional consideration is given for possible air recycling if

units are installed one above the other. Wall mounting brackets are not included in the standard delivery.

Figure 55: Unit mounted on concrete slab with anti-vibration pads

Other factors to consider in finding a proper installation site are the direction of the prevailing wind and the exposure to sunlight:

- If the air leaving the gas cooler faces the prevailing wind, the airflow through the gas cooler can be impeded, causing high refrigeration temperatures and ultimately resulting in reducing the lifetime of the unit. A baffle is a remedy for this situation.
- Direct sun exposure should be reduced as much as possible. Shade should be provided over the unit if South-facing.

4 Start-up & operation

WARNING
High pressure! Risk of personal injury! Always keep sufficient distance from the pressure relief valve to avoid serious injury in the event of a sudden pressure release.

WARNING
Hot surfaces! Burning! Do not touch the compressor heads or discharge line as their surfaces can reach high temperatures both during operation and at standstill.

WARNING
High noise level! Risk of hearing damage! In case of pressure release of the pressure relief valve, a sudden, intense sound is produced which can damage the inner ear and cause hearing loss. Wear earplugs or other protective devices when involved in any work on or near the unit.

Before commissioning, ensure that all valves on the refrigeration unit are fully opened. Only qualified personal and certified companies are allowed to perform installation, commissioning, service and maintenance work.

4.1 Evacuation

IMPORTANT
The evacuation procedure is based upon achieving an actual system vacuum standard and is NOT TIME DEPENDENT! The installation has to be evacuated with a vacuum pump before commissioning. 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. The system must be evacuated down to less than 3 mbar. If required break the vacuum with dry nitrogen. Pressure must be measured using a vacuum pressure 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.

IMPORTANT
Care must be taken that all components (solenoids, expansion devices, regulators, shut off valves, etc…) in the refrigeration cycle, which separate a part of the installation when de-energized, are manually opened to guarantee successful evacuation in the whole piping system.

***NOTE:* The controller must be turned on before starting the evacuation.**

***NOTE:* For proper evacuation, both the HPV and BPV regulating valves must be opened using the evacuation mode in the unit controller.**

To activate the evacuation mode:

1) Press the **SERVICE** key to enter the "Service" menu

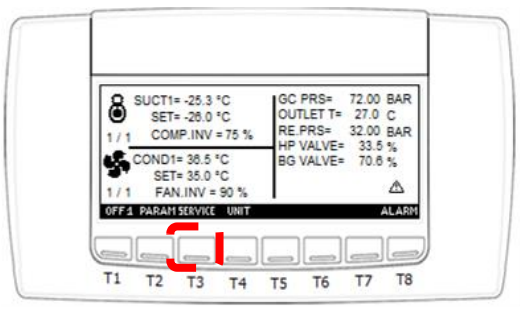


Figure 56: Service key

2) Use the **UP** and **DOWN** keys to select the "Evacuation mode" sub-menu
3) Press **ENB** to enable the evacuation mode (see **Figure 57**):

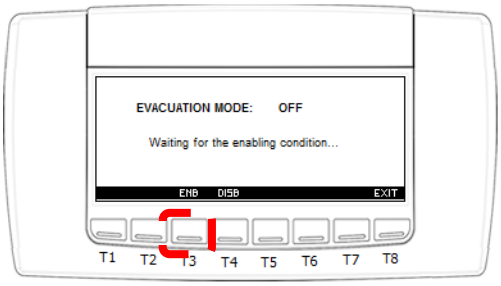


Figure 57: Evacuation mode

Starting the evacuation function:

The evacuation mode will start when pressing the **ENB** key only if all 3 of the following conditions are met:

- suction pressure probe **P1 value < SPF6**
- gas cooler pressure probe **P2 value < SPF6**
- flash tank pressure probe **P3 value < SPF6**

***NOTE:* SPF6 = Pressure setpoint to stop evacuation mode (factory-set to 10 bar).**

The **ENB** key will remain visible all the time. If the evacuation function is enabled but one of the above conditions is not met, the following message will be displayed:

- "Enabling condition for Evacuation Mode not met, waiting for it"

Subsequently:

1) The HP and BP valves open directly at 100 % (the evacuation mode has priority over the valves override function).
2) The compressor is switched off (safety timers are ignored).
3) The fan is switched off, while auxiliary outputs are not influenced (safety timers are ignored).
4) The alarms are disabled except for the communication alarms.

Stopping the evacuation function:

The evacuation mode will be deactivated when

1) one of the 3 pressures probes **P1, P2 or P3 > SPF6 or**
2) the **DISB** key is pressed.

When the evacuation function is stopped, the controller returns to its previous status, ie, Off or regulation.

***NOTE:* As long as the evacuation function is active, the evacuation label will flash on the main display – see Figure 58 below. After pressing the EXIT key, the previous screen will be displayed again.**

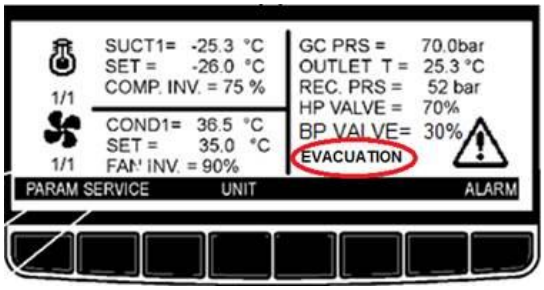


Figure 58: Evacuation mode

***NOTE:* If one of the 3 probes (suction pressure, gas cooler pressure or flash tank pressure) is not configured or in error, the evacuation mode cannot be executed.**

4.2 Charging procedure

4.2.1 Refrigerant charging procedure

IMPORTANT
CO_2 refrigerant! Risk of dry ice! It is important to charge gaseous CO_2 to a pressure level well above the triple point of the refrigerant, ie, 5.185 bar(a) to avoid dry ice. A gaseous pre-charge of 10 bar in the whole system is common practice.
Inadequate charge! Overheating! The compressor design requires system charging as quickly as possible with liquid refrigerant into the liquid line. This will avoid running the compressor under conditions whereby insufficient suction gas is available not only to cool the motor but also to limit the discharge line.

Pre-charging must be done with gaseous refrigerant both on suction and discharge/liquid sides, through the service valve on the liquid receiver and the suction shut-off valve on the compressor. It is important to charge gaseous CO_2 to an absolute pressure level above the triple point of the refrigerant, ie, 5.185 bar to avoid dry ice formation. A gaseous pre-charge of 10 bar in the whole system is common practice.

After pre-charging gaseous CO_2, the main quantity of refrigerant can be charged liquid to the service connection port on the liquid receiver. It is advisable to pre-fill the suction side with a partial charge to avoid vacuum operation during initial start-up. Further charging can be carried out by carefully filling refrigerant through the suction line while simultaneously checking the sight glasses (on liquid receiver and after filter drier in liquid line) when the system is in operation.

The refrigerant charge might vary depending on system size. The proper amount of refrigerant shall be charged by a qualified technician during unit commissioning based on actual application needs. In order to prevent system overcharge for high ambient temperatures Emerson recommends charging the liquid receiver only up to 60 % considering a typical piping length of 30 meters.

- In high ambient conditions (above 30 °C), charge until liquid refrigerant is visible in the upper sight glass of the liquid receiver.
- In low ambient conditions (below 10 °C), charge until liquid refrigerant is visible in the lower sight glass of the liquid receiver.
- For any temperature between these values, charge until the liquid refrigerant level is between the two sight glasses.

***NOTE:* Never charge the system to a liquid level higher than the upper sight glass of the liquid receiver.**

***NOTE:* In order to meet the requirements of the Ecodesign Directive 2009/125/EC with regard to efficient system operation, ensure the refrigerant charge is sufficient.**

4.2.2 Oil charging procedure

Copeland CO_2 refrigeration units are supplied with a compressor oil charge only. After commissioning, the oil level should be checked and topped up if necessary.

***NOTE:* The oil level should be approximately halfway up the sight glass.**

As mentioned in **section 2.6.1 "Qualified refrigerant and oil"**, Emerson recommends charging with polyolester Emkarate RL 68 HB.

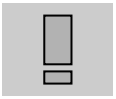
Additional oil charging is done through the Schraeder valve located on the suction shut-off valve.

The compressor is equipped with an OW5 TraxOil to prevent it from running with an insufficient oil level – see **section 2.14 "Oil level monitoring device – OW5 TraxOil"**. In case of low oil level, the controller will immediately shut the compressor down. The compressor will automatically start again when an appropriate amount of oil is applied.

4.3 Maximum compressor cycle

The factory settings of the system controller take into account the maximum number of permitted starts and stops of the compressor, as well as the running time and minimal downtime. Emerson recommends to change these settings only in exceptional cases, eg, when the liquid line pressure cannot be kept by the factory settings.

4.4 Checks before starting & during operation



IMPORTANT
Liquid valves not fully opened! Liquid trap! Both valves on the liquid line should be fully opened in order to prevent liquid trapping.

Before a system runs for the first time:

- Check that the valves on the liquid line are fully open except for HPV and BPV valves.
- Set the essential parameters of the electronic controller in the programming level 1 (compressor cut-out/cut-in settings, condensing fan setpoint….) according to the required application.
- Carry out visual inspection.
- Perform control tests to ensure all controls operate correctly, including any manual backup system.
- Check also the following:
  - ✓ Documentation for the system and its marking, especially pressure equipment
  - ✓ Installation of safety devices
  - ✓ Set pressure of all safety devices and other pressure cut-outs
  - ✓ Compressor and oil reservoir oil levels
  - ✓ Cores fitted in filter dryers
  - ✓ Pressure test records
  - ✓ All valves open/closed as required for operation

After start-up and when operation conditions have stabilised:

- It is recommended to check the oil level in the compressor and to add oil if necessary to ensure a sufficient oil level (halfway up the sight glass).
- The following should also be checked:
  - ✓ Refrigerant level
  - ✓ Oil level in oil reservoir
  - ✓ Expansion valve superheat
  - ✓ Regulating valves in both subcritical and transcritical modes
  - ✓ Operating pressure of receiver pressure regulating valve
  - ✓ Operation of any auxiliary cooling unit

5 Maintenance & repair

5.1 General considerations

WARNING
Maintenance and service work! Risk of personal injury! All instructions in these application guidelines must be followed carefully. Please also refer to **section 1.3 "General instructions"**.

It is recommended to perform a basic maintenance programme every six months (cleaning the gas cooler, checking the refrigerant level, tightening the screws in the electrical cabinet, etc…).

Always check the latest requirements in the latest version of these application guidelines available on www.climate.emerson.com/en-gb before performing maintenance. The minimum requirements for maintainance given by EN 378 need to be considered as well.

As part of standard servicing and maintenance it may be necessary to open the unit housing and covers.

5.2 Opening the unit housing

WARNING
Isolating switch "On"! Electrical shock hazard! Turn off the main power supply to de-energise the unit before undertaking any task on electrical equipment.
High voltage! Electrical shock hazard! There is a risk of electric shock if mains-supplied equipment is disconnected and the wire ends are open. The open ends may carry a potentially lethal voltage until the internal capacitors have discharged. This can take up to 10 minutes.
Electrical covers open! Electrical shock hazard! Always make sure that the compressor e-box cover and the electrical cabinet cover are properly closed before restarting the unit. In all cases, if metal covers with grounding connections have been removed, eg, for maintenance, all grounding connections have to be reconnected before unit operation when the covers are put back in place.

WARNING
Hot surfaces! Burning! Do not touch the compressor heads or discharge line as their surfaces can reach high temperatures both during operation and at standstill.

CAUTION
Unauthorized parts! Unit damage! Only parts authorized by Emerson can be used for maintenance and replacement.

5.2.1 To open the electrical cabinet

WARNING
High voltage! Electrical shock hazard! Turn off the main power supply to de-energise the unit before opening the cabinet or undertaking any task on the electrical equipment. Never open the electrical cabinet in rainy weather if the isolating switch is on.

Release the locks located on both sides of the electrical cabinet and lift the cover.

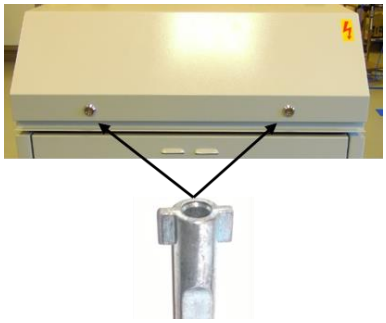


Figure 59: Position of the locks

5.2.2 To open the compressor chamber

- Unscrew the two screws located on the top of the compressor chamber cover, unplug the green/yellow grounding cable by pulling, then lift the cover.

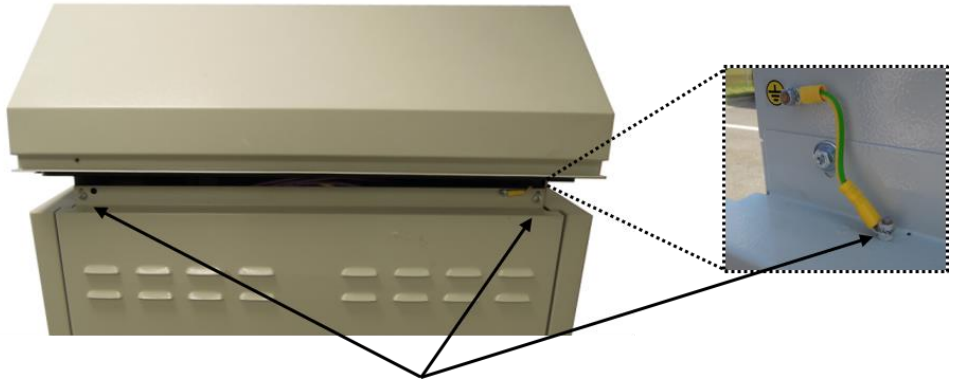


Figure 60: Opening the compressor chamber

5.2.3 To remove the fan safety grid

WARNING
Uncovered rotating parts! Personal injuries! Always de-energize the unit before removing the gas cooler fan grid. Never start the unit or run the fan with no safety grid on the fan.

- The grid can be removed only when the unit is turned off.
- To remove the grid, unscrew the six screws securing the grid and lift it off.

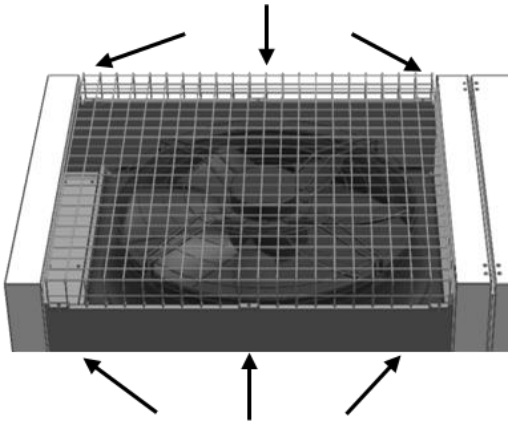


Figure 61: Opening the fan safety grid

5.2.4 To access the inner parts of the gas cooler

- The side panel can be removed only when the unit is turned off.
- To remove the side panel, unscrew the three screws located below the gas cooler first, then unscrew all the remaining screws and remove the cover by lifting it off.

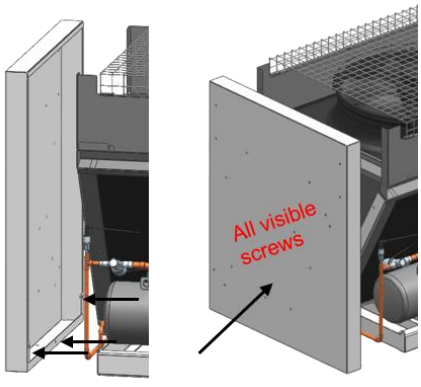


Figure 62: Accessing the inner parts of the unit

5.3 Replacing a compressor

WARNING
Isolating switch "On"! Electrical shock hazard! Turn off the main power supply to de-energise the unit before undertaking any task on electrical equipment.
High voltage! Electrical shock hazard! There is a risk of electric shock if mains-supplied equipment is disconnected and the wire ends are open. In this case the open ends may carry a potentially lethal voltage until the internal capacitors have discharged. This can take up to 10 minutes.
Compressor e-box cover open! Electrical shock hazard! Always make sure that the compressor e-box cover is properly closed before restarting the unit.

WARNING
Toxic fumes! Danger of suffocation! In case of fire toxic fumes can be released by burning non-metallic parts. Avoid inhaling the fumes.

CAUTION
Inadequate lubrication! Bearing destruction! Exchange the accumulator (if present in the system) 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, most contaminated oil will be removed with the compressor. The rest of the oil is cleaned by means of a liquid line filter dryer. A 100 % activated alumina suction line filter dryer is recommended but must be removed after 72 hours. **It is highly recommended to replace the suction accumulator, 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 compressor 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.

- Before any intervention, de-energize the refrigeration unit and allow for the capacitors in the drive to discharge; this can take up to 10 minutes.
- Close valves to isolate the unit from the system.
- Recover the refrigerant from the unit and make sure that the compressor is not under pressure.
- Release the compressor mounting parts then lift it to replace with a new compressor.

NOTE: **For more detailed instructions, please refer to the compressor application guidelines.**

5.4 Gas cooler fins

CAUTION
Sharp gas cooler fins! Personal injuries! Be careful when cleaning the gas cooler fins. Always use protective gloves and an appropriate brush.

CAUTION
Acid cleaning! Corrosion of gas cooler fins! Do not use acidic solutions to clean the coil. After cleaning, the fins should be brushed lightly with a proper fin comb.

Gas cooler fins become dirty over time as ambient air is induced to the gas cooler. Dirty coil surfaces result in high condensing temperatures and poor unit performance. Regular cleaning is recommended, the frequency of doing so being dependent on the installation and the surrounding environment. As a general guide, it is advisable to do this at least once every two months.

As a general rule and for a clean environment Emerson recommends that the fins be cleaned with liquid detergent diluted with clean water. The refrigeration unit has a well-designed chassis with falling levels towards a large drainage hole, and provided the unit is installed level, any cleaning solution should be able to drain away. A light brush downward (in the direction of the fins) should be done before washing to remove heavy deposits.

***NOTE:* In order to meet the requirements of the Ecodesign Directive 2009/125/EC with regard to efficient system operation, ensure the heat exchangers remain clean at all times.**

5.5 Electrical installation

WARNING
Isolating switch "On"! Electrical shock hazard! Turn off the main power supply to de-energise the unit before undertaking any task on electrical equipment.

All condensing units will generate some degree of vibration. Copeland CO_2 refrigeration units are no exception. Over time, due to these slight vibrations and to temperature fluctuations within the unit housing, electrical terminations might become loose. The components most likely to be affected are the main terminal strip and the compressor contactor. It is recommended to check the main electrical terminations for tightness and to carry out a visual inspection of the low voltage crimped terminals at least once every 6 months.

A list of additional checks for the electrical cabinet is given in the table below:

Maintenance schedule	Frequency	Procedure
Visual inspection of the integrity of the equipment	Yearly	Check main switch, wiring, cables, other components
Checking the LOTO (lock out, tag out) function of the main switch	Before any maintenance and/or servicing	Lock the main switch and test for not starting
Checking the function of current protection	Twice a year	Pressing the test button on the current protector
Ground coupling measurement	Yearly	Measurement of all ground connections – see wiring diagram
Backup battery test	Yearly	Stop the unit, turn off the main switch, LEDs V1 and V2 on XEV20D must flash and light up for at least 3 sec.
Backup battery replacement	Every 10 years	Replace the backup battery
Cleaning the inside of the electrical cabinet from dust	Twice a year (as needed)	Use of a vacuum cleaner

Table 24: Maintenance schedule for electrical cabinet

5.6 Routine leak testing

All joints inside the system should be leak-tested as part of a regular maintenance schedule.

***NOTE:* In order to meet the requirements of the Ecodesign Directive 2009/125/EC with regard to efficient system operation, ensure the refrigerant and oil charges are sufficient.**

5.7 Gas cooler fan & motor

A yearly inspection of these items is recommended. Fastenings can become loose; bearings may wear out and fans may require cleaning of solid deposits that can cause rotational imbalance.

Motors come with lifelong lubrication bearings that do not require lubricating on a routine basis, but just need to be checked for wear.

5.8 Pressure relief valves

5.8.1 PRV blow-off

After a blow-off, a pressure relief valve (PRV) is not 100 % tight anymore. Therefore it needs to be replaced. Do not keep it on the unit anymore.

5.8.2 Regular maintenance and check

Once per year:

- Visual check according to EN 378.
- Leakage test, internal and external. Please follow the instructions:
  - Remove brass cap (deflector) from pressure relief valves (PRV).
  - Use a bubble test and check if there is any leak between the connection of the changeover valve and the PRV or if there is any internal leak from the PRV.
  - If no leak is observed, the connection is fine. No further action is required.
  - If a leak is observed, the PRV must be replaced.
  - The old PRV must not be re-tightened.

Once every 2 years:

The pressure relief valves have to be replaced.

5.8.3 PRV replacement on liquid receiver

Follow the instructions below to replace the PRV on the liquid receiver:

- Make sure that the changeover valve on the leak side is closed. **Figure 63** shows the configuration with PRV 1 closed while **Figure 64** shows the configuration with PRV 2 closed.
- Remove the deflector from the PRV.
- The thread connections on pressure relief valves on the liquid receiver, connected through a changeover valve, are NPT.
- Clean and degrease the thread.
- A new teflon tape must be used with the new PRV to ensure tightness.
- The recommended torque is 40 Nm. Apply the torque on the PRV body, not on the deflector. Make sure to hold the changeover valve body while the PRV is being released/fastened to avoid thread connection release between changeover valve and liquid receiver.
- Conduct a leak test to verify tight connection between PRV, changeover valve and liquid receiver. The changeover valve must be in open position (spindle in the middle).
- Mount the deflector – hand tight (1 to 5 Nm).
- The changeover valve must be fully open (spindle out) when the unit is running.

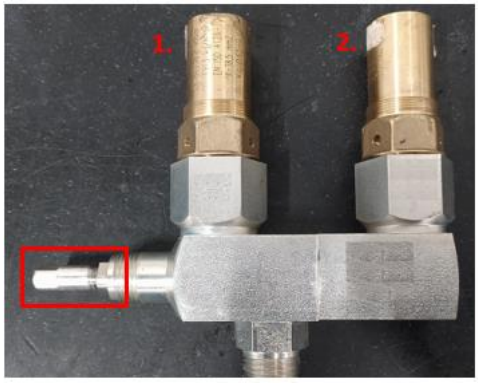


Figure 63: Changeover valve – Shaft in open position

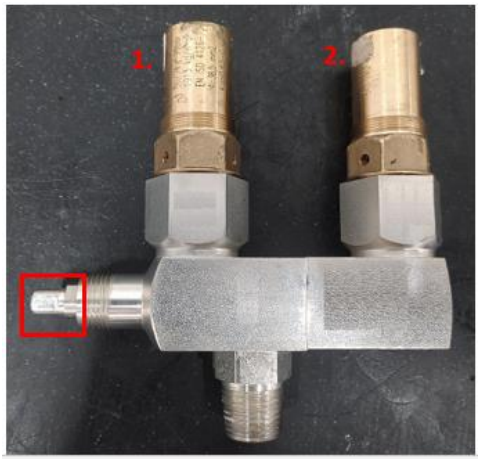


Figure 64: Changeover valve – Shaft in closed position

5.9 Pressure switch CS3

The CS3 pressure switch is TÜV EN 12263-approved and can withstand 2 million cycles. If the pressure switch is defective, it must be replaced. A new copper gasket must be used. The recommended torque is 15 Nm. Do not apply torsional force to housing assembly during mounting.

6 Certification & approval

- Copeland CO_2 Stream refrigeration units comply with the Low Voltage Directive LVD 2014/35/EU. The compliance is verified through harmonized standards:
  - EN 60335-1: Household and similar electrical appliances – Safety, General Requirements.
  - EN 60335-2-89: Household and similar electrical appliances – Safety, Particular requirements for commercial refrigerating appliances with an incorporated or remote refrigerant condensing unit or compressor.
- Copeland CO_2 Stream refrigeration units comply with the Electromagnetic Compatibility Directive EMC 2014/30/EU. The compliance is verified through harmonized standards:
  - EN 61800-3: Adjustable speed electrical power drive systems - Part 3: EMC requirements and specific test methods
  - EN 61000-2-12: Electromagnetic compatibility (EMC) Part 2-12: Environment – Compatibility levels for low-frequency conducted disturbances and signalling in public medium-voltage power supply systems.
  - EN 61000-3-3: Electromagnetic compatibility (EMC) – Part 3-3: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems, for equipment with rated current 16 A per phase and not subject to conditional connection.
  - EN 61000-3-11: Electromagnetic compatibility (EMC) Part 3-11: Limits – Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems. Equipment with rated current ≤ 75 A and subject to conditional connection.
- The Copeland CO_2 Stream refrigeration units and their piping comply with the Pressure Equipment Directive PED 2014/68/EU. Applied harmonized standards:
  - EN 378-2: Refrigerating systems and heat pumps – Safety and environmental requirements Part 2: Design, construction, testing, marking and documentation.
- The Copeland CO_2 Stream refrigeration units and their associated spare parts and accessories comply with the RoHS Directive 2011/65/EU, (EU) 2015/863 on the Restriction of the use of certain Hazardous Substances in electrical and electronic equipment (recast).
- Conformity Declarations for components are available as far as required.
- The Manufacturer's Declaration of Incorporation has to be respected when incorporating these products into a machine.

7 Dismantling & disposal

Removing oil and refrigerant:

- **Do not disperse in the environment.**
- **Use the correct equipment and method of removal.**
- **Dispose of oil and refrigerant in compliance with national legislation and regulations.**

Dispose of compressor and/or unit in compliance with national legislation and regulations.

Appendix 1: IPG215D controller alarm menu

Alarms Circuit 1					
Code	**Name on Visograph**	**Description**	**Cause**	**Action**	**Reset**
LP1	**EOL1**	Low-pressure-switch alarm in Circuit 1	Low-pressure switch Input 1 (the input is configured as DIC = 51 Low-pressure Circuit 1)	▪ All compressors in Circuit 1 are turned off. ▪ Fans follow SL16.	**Automatically** if the number of activations is less than AL12 in the AL13 time when the input is disabled. - Compressors restart working according to the working algorithm. **Manually** if AL12 activations happened in the AL13 time. When the input is disabled: - Turn the device off and on again or reset the alarm manually from the Visograph. - Compressors restart working according to the working algorithm.
HP1	**EOH1**	High-pressure switch alarm in Circuit 1	High-pressure switch Input 1 (the input is configured as DIC = 50 High-pressure Circuit 1)	▪ All compressors in Circuit 1 are turned off. ▪ All fans in Circuit 1 are turned on. Inverter fan / linear inverter for fan at maximum speed.	**Automatically** if the number of activations is less than AL29 in the AL30 time when the input is disabled. - Compressors and fans restart working according to the working algorithm. **Manually** if AL29 activations happened in the AL30 time. When the input is disabled: - Turn the device off and on again or reset the alarm manually from the Visograph. - Compressors and fans restart working according to the working algorithm.

Alarms Circuit 1					
Code	**Name on Visograph**	**Description**	**Cause**	**Action**	**Reset**
LAC1	**LAC1**	Minimum pressure (temperature) alarm for compressors in Circuit 1	▪ If AC1 = REL: Suction pressure or temperature ≤ SETC1 - AL3 ▪ If AC1 = ABS: Suction pressure or temperature ≤ AL3	Only signalling	**Automatically** as soon as the pressure or temperature reaches: ▪ If AC1 = REL: SETC1 - AL3 + differential value (differential = 0.3 bar or 1 °C) ▪ If AC1 = ABS: AL3 + differential value (differential = 0.3 bar or 1 °C)
LAF1	**LAF1**	Minimum pressure (temperature) alarm for fans section in Circuit 1	▪ If AC2 = REL: Gas cooler pressure or temperature ≤ SETF1 - AL24 for time AL26 ▪ If AC2 = ABS: Gas cooler pressure or temperature ≤ AL24 for time AL26	Only signalling	**Automatically** as soon as the pressure or temperature reaches: ▪ If AC2 = REL: SETF1 - AL24 + differential value (differential = 0.3 bar or 1 °C) ▪ If AC2 = ABS: AL24 + differential value (differential = 0.3 bar or 1 °C)
HAC1	**HAC1**	Maximum pressure (temperature) alarm for compressors in Circuit 1	▪ If AC1 = REL: Suction pressure or temperature ≥ SETC1 + AL4 ▪ If AC1 = ABS: Suction pressure or temperature ≥ AL4	Only signalling	**Automatically** when the pressure or temperature ≤ ▪ If AC1 = REL: SETC1 + AL4 - differential value (differential = 0.3 bar or 1 °C) ▪ If AC1 = ABS: AL4 - differential value (differential = 0.3 bar or 1 °C)
HAF1	**HAF1**	Maximum pressure (temperature) alarm for fans section in Circuit 1	▪ If AC2 = REL: Gas cooler pressure or temperature ≥ SETF1 + AL25 for AL26 delay ▪ If AC2 = ABS: Suction pressure or temperature ≥ AL25 for AL26 delay	If AL27 = yes ▪ Compressors in Circuit 1 switch off with a delay from 2 different steps AL28. ▪ All fans in Circuit 1 are turned on. Inverter fan / linear inverter for fan at maximum speed.	**Automatically** when the pressure or temperature ≤ ▪ If AC2 = REL: SETF1 + AL25 – differential value (differential = 0.3 bar or 1 °C) ▪ If AC2 = ABS: AL25 - differential value (differential = 0.3 bar or 1 °C)

Alarms Circuit 1					
Code	**Name on Visograph**	**Description**	**Cause**	**Action**	**Reset**
LL1	**LL1**	Liquid level alarm in Circuit 1	Proper digital input enabled (the input is configured as DI1 = 109 liquid level Circuit 1) After delay CDI1	Only signalling	**Automatically** as soon as the input is disabled
PrSH1	**PRSH1**	Pre-alarm for superheat in Circuit 1	Superheat 1 is ≤ ASH1 + ASH2 **and** ≥ ASH2	Only signalling	**Automatically** when superheat exceeds ASH1 + ASH2 + hysteresis
ALSH1	**ALSH1**	Alarm for superheat in Circuit 1	Superheat 1 is ≤ ASH2	Depends on ASH4.	**Automatically** when superheat exceeds ASH5 + ASH2
LPC1	**LPC1**	Electronic pressure switch for low temperature / pressure in Circuit 1	Pressure/temperature < AL21	▪ Disables the compressors. ▪ Fans follow SL16.	**Automatically** when the pressure/temperature exceeds AL21 + differential
PR1	**PREG1**	Suction probe failure alarm in Circuit 1	Suction probe failure or out of range, eg, the probe is configured as AIC = 1 NTC probe regulation suction Circuit 1	▪ The compressors are activated according to the AL14/AL15 parameters. ▪ Fans follow SL16.	**Automatically** as soon as the probe restarts working
PR3	**PREG3**	Condensing probe failure alarm in Circuit 1	Condensing probe failure or out of range, eg, the probe is configured as AIC = 2 NTC probe regulation condensing Circuit 1	▪ Fans are activated according to the AL31 parameters. ▪ Compressors are off. ▪ HPV is GC34/GC35 depending on the mode.	**Automatically** as soon as the probe restarts working
Floodback 1	**FBSH1**	Floodback alarm in Circuit 1	ASH2 > superheat (suction pressure & suction temperature) for 90 minutes	Only signalling	**Automatically** when superheat exceeds ASH2

Compressor alarms					
Code	**Name on Visograph**	**Description**	**Cause**	**Action**	**Reset**
EAO (for each compressor)	**EAO (for each compressor)**	Compressor safety alarm for oil switch load	Oil switch load input activation (the input is configured as DIC = 1 Oil pressostat compressor Circuit 1) *NOTE*: With step compressors the input for each compressor has to be used.	▪ The corresponding compressor is turned off (with step compressors all relays referred to the input are disabled). ▪ Fans follow SL16.	**Automatically** as soon as the input is disabled
ETO (for each compressor)	**ETO (for each compressor)**	Compressor safety alarm for thermal switch load	Thermal switch load input activation (the input is configured as DIC = 3 Thermal safety compressor Circuit 1) *NOTE*: With step compressors the input for each compressor has to be used.	▪ The corresponding compressor is turned off (with step compressors all relays referred to the input are disabled). ▪ Fans follow SL16.	**Automatically** as soon as the input is disabled
EPO (for each compressor)	**EPO (for each compressor)**	Compressor safety alarm for pressure switch load	Pressure switch load input activation (the input is configured as DIC = 2 Safety pressostat compressor Circuit 1) *NOTE*: With step compressors the input for each compressor has to be used.	▪ The corresponding compressor is turned off (with step compressors all relays referred to the input are disabled). ▪ Fans follow SL16.	**Automatically** as soon as the input is disabled
MANT	**MANT**	Compressor maintenance alarm	A compressor has worked for the time set in the AL10 parameter	Only signalling	**Manually:** reset the running hours of the compressor (see chapter 2.9.7 "How to perform a maintenance using the "Compressors service" sub-menus")

Generic alarms					
Code	**Name on Visograph**	**Description**	**Cause**	**Action**	**Reset**
P1	**P1**	Probe failure alarm	Probe 1 failure	Only signalling	**Automatically** as soon as the probe restarts working
P2	**P2**	Probe failure alarm	Probe 2 failure	Only signalling	**Automatically** as soon as the probe restarts working
P3	**P3**	Probe failure alarm	Probe 3 failure	Only signalling	**Automatically** as soon as the probe restarts working
P4	**P4**	Probe failure alarm	Probe 4 failure	Only signalling	**Automatically** as soon as the probe restarts working
P5	**P5**	Probe failure alarm	Probe 5 failure	Only signalling	**Automatically** as soon as the probe restarts working
P6	**P6**	Probe failure alarm	Probe 6 failure	Only signalling	**Automatically** as soon as the probe restarts working
P7	**P7**	Probe failure alarm	Probe 7 failure	Only signalling	**Automatically** as soon as the probe restarts working
P8	**P8**	Probe failure alarm	Probe 8 failure	Only signalling	**Automatically** as soon as the probe restarts working
P9	**P9**	Probe failure alarm	Probe 9 failure	Only signalling	**Automatically** as soon as the probe restarts working
P10	**P10**	Probe failure alarm	Probe 10 failure	Only signalling	**Automatically** as soon as the probe restarts working
BURST	**ALBST**	Burst disc alarm	DIC(i) = 72 activation	Only signalling	DIC(i) = 72 deactivation
PHASE	**ALPHS**	Phase failure alarm	DIC(i) = 73 activation	Only signalling	DIC(i) = 73 deactivation
EXT[i]	**EXT[i]**	External alarm (i)	DIC(i) = 74 (or 75 - 76 - 77) activation	Only signalling	DIC(i) = 74 (or 75 - 76 - 77) deactivation
LIQ LVL	**LIQ LVL**	Receiver level alarm	80 % < Liquid level input < 15 % for 45 min	Only signalling	**Automatically** when 15 % < Liquid level < 89 %
REC FLOAT	**REC FLOAT**	Receiver high pressure alarm	Contact closure from receiver rupture disc	Only signalling	Must be cleared manually on site
OIL DIFF HI	**OIL DIFF HI**	Alarm to change oil separator switching element	Contact closure from change oil separator input > 1 minute	Only signalling	**Automatically** when DI is false

Generic alarms					
Code	**Name on Visograph**	**Description**	**Cause**	**Action**	**Reset**
GLeak1 [2-3-4]-PreAlr	**PRGLK1 [2-3-4]**	Gas leak pre-alarm 1 [2-3-4]	If value of gas leak detector 1 [2-3-4] probe > GLD1 [GLD6-GLD11-GLD16] and gas leak detector 1 [2-3-4] probe < GLD2 [GLD7-GLD12-GLD17]	Relay set in GLD4 [GLD9-GLD14-GLD19] is on.	When value of gas leak detector 1 [2-3-4] probe ≤ GLD1 – GLD3 [GLD6 – GLD8; GLD11 – GLD13; GLD16 – GLD18]
GLeak1 [2-3-4]-Alarm	**GLK1 [2-3-4]**	Gas leak alarm 1 [2-3-4]	If value of gas leak detector 1 [2-3-4] probe > GLD2 [GLD7-GLD12-GLD17]	Relay set in GLD5 [GLD10-GLD15-GLD20] is on.	When value of gas leak detector 1 [2-3-4] probe ≤ GLD2 - GLD3 [GLD7 - GLD8; GLD12 - GLD13; GLD17 - GLD18]
E-box_T	**E-box_T**	E-box temperature probes not correct	If DLT9 = AIC1 and AIC1 is configured as a pressure probe	Only signalling	When the temperature in the e-box is correctly detected again by the probe **OR** the e-box temperature protection function is disabled
LoPrRt	**LoPrRt**	Compressor operates out of envelope	The pressure ratio is below the DLT6 parameter for the DLT7 time	Only signalling	**Automatically** as soon as the pressure ratio is higher than DLT6 + DLT8
DLT temp	**DLT temp**	High temperature in discharge line	DLT21 > DLT1 – DLT2 for the delay DLT3	Only signalling	**Automatically** as soon as the DLT21 < DLT1 – DLT2 – 1 °C

Fan alarms					
Code	**Name on Visograph**	**Description**	**Cause**	**Action**	**Reset**
AL_AO (for each fan)	**LOAX_Y (X=1 ÷ 12, Y=3 ÷ 4)**	Fan safety alarm	Safety switch load input activation (the input is configured as DIC = 37 Fan 1 safety Circuit 1)	▪ The corresponding fan is turned off. ▪ The compressor / inverter compressor is turned off.	**Automatically** as soon as the input is disabled.

Compressor with inverter alarms					
Code	**Name on Visograph**	**Description**	**Cause**	**Action**	**Reset**
INVO (for suction inverter)	**INVO (for suction inverter)**	Inverter safety alarm for oil switch load	Oil switch load input activation (the input is configured as DIC = 57 Compressor oil inverter suction Circuit 1)	▪ The corresponding inverter is turned off. ▪ Fans follow SL16.	**Automatically** as soon as the input is disabled
INVT (for suction inverter)	**INVT (for suction inverter)**	Inverter safety alarm for thermal switch load	Thermal switch load input activation (the input is configured as DIC = 59 Thermal safety inverter suction Circuit 1)	▪ The corresponding inverter is turned off. ▪ Fans follow SL16.	**Automatically** as soon as the input is disabled
INVP (for suction inverter)	**INVP (for suction inverter)**	Inverter safety alarm for pressure switch load	Pressure switch load input activation (the input is configured as DIC = 58 Safety inverter suction Circuit 1)	▪ The corresponding inverter is turned off. ▪ Fans follow SL16.	**Automatically** as soon as the input is disabled
MANTINV (for suction inverter)	**MANTINV (for suction inverter)**	Inverter maintenance alarm	An inverter has worked for the time set in the AL10 parameter	Only signalling	**Manually:** reset the running hours of the inverter (see chapter 2.9.7 "How to perform a maintenance using the "Compressors service" sub-menus")
INVERTER1 (for suction inverter)	**INVERTER 1 (for suction inverter)**	Suction 1 [2] inverter alarm	DIC(i) = 63 activations	▪ DOC(i) = 1 is turned off. ▪ AOC(I) = 2 to 0 V or 4mA. ▪ Fans follow SL16.	**Automatically** as soon as the input is disabled

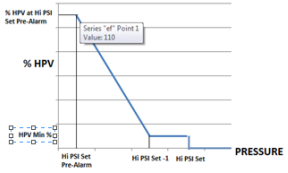
Gas cooler alarms					
Code	**Name on Visograph**	**Description**	**Cause**	**Action**	**Reset**
PreHP Rec	**PreHP Rec**	High pressure on CO_2 receiver pre-alarm	GC28 > AIC98 (AIC99) > GC29	(Priority on probe failure alarms) The % of the valve updates every second in order to reach the correct percentage. If the receiver pressure value is between the values GC29 and GC28 – 1 (bar), the % of valve opening is as follows:  	**Automatically** as soon as the HP REC is active or as soon as AIC98 (AIC99) < GC29 – GC30
HP REC	**HP REC**	High pressure on CO_2 receiver alarm	AIC98 (AIC99) > GC28	(Priority on probe failure alarms) The HPV will close (0 %). The BGV will open to a user-defined % set by parameter GC37.	**Automatically** as soon as AIC98 (AIC99) < GC28 – GC30
LP REC	**LP REC**	Low pressure on CO_2 receiver alarm	AIC98 (AIC99) < GC31	The HPV will have a minimum opening to a user-defined % set by GC36. If the PID % is greater than GC36, then the PID % will be the valve % output. The BGV will close.	**Automatically** as soon as AIC98 (AIC99) > GC31 + GC32
OA-XEV20D	**OA-XEV20D**	XEV20D off-line alarm	The XEV20D is used and loses communication	Only signalling	The communication is recovered automatically

Table 25: Alarm code overview

Appendix 2: Temperature / resistance curve for NTC

Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)
-50	329500	-20	67770	10	17960	40	5827	70	2228	100	973.1
-49.5	320200	-19.5	66170	10.5	17600	40.5	5728	70.5	2195.5	100.5	960.75
-49	310900	-19	64570	11	17240	41	5629	71	2163	101	948.4
-48.5	302200	-18.5	63055	11.5	16900	41.5	5533.5	71.5	2131.5	101.5	936.5
-48	293500	-18	61540	12	16560	42	5438	72	2100	102	924.6
-47.5	285350	-17.5	60110	12.5	16230	42.5	5346.5	72.5	2069.5	102.5	913
-47	277200	-17	58680	13	15900	43	5255	73	2039	103	901.4
-46.5	269600	-16.5	57325	13.5	15590	43.5	5167.5	73.5	2009.5	103.5	890.15
-46	262000	-16	55970	14	15280	44	5080	74	1980	104	878.9
-45.5	254850	-15.5	54690	14.5	14985	44.5	4995.5	74.5	1952	104.5	868.05
-45	247700	-15	53410	15	14690	45	4911	75	1924	105	857.2
-44.5	241000	-14.5	52195	15.5	14405	45.5	4830	75.5	1896.5	105.5	846.6
-44	234300	-14	50980	16	14120	46	4749	76	1869	106	836
-43.5	228000	-13.5	49830	16.5	13850	46.5	4671	76.5	1842.5	106.5	825.75
-43	221700	-13	48680	17	13580	47	4593	77	1816	107	815.5
-42.5	215800	-12.5	47590	17.5	13320	47.5	4518	77.5	1790.5	107.5	805.55
-42	209900	-12	46500	18	13060	48	4443	78	1765	108	795.6
-41.5	204400	-11.5	45465	18.5	12810	48.5	4371	78.5	1740.5	108.5	785.95
-41	198900	-11	44430	19	12560	49	4299	79	1716	109	776.3
-40.5	193700	-10.5	43450	19.5	12325	49.5	4229.5	79.5	1692	109.5	766.95
-40	188500	-10	42470	20	12090	50	4160	80	1668	110	757.6
-39.5	183500	-9.5	41520	20.5	11860	50.5	4093	80.5	1644.5		
-39	178500	-9	40570	21	11630	51	4026	81	1621		
-38.5	173750	-8.5	39670	21.5	11415	51.5	3961	81.5	1599		
-38	169000	-8	38770	22	11200	52	3896	82	1577		
-37.5	164600	-7.5	37915	22.5	10990	52.5	3833.5	82.5	1555		
-37	160200	-7	37060	23	10780	53	3771	83	1533		
-36.5	156050	-6.5	36250	23.5	10580	53.5	3711	83.5	1512		
-36	151900	-6	35440	24	10380	54	3651	84	1491		
-35.5	148000	-5.5	34670	24.5	10190	54.5	3593.5	84.5	1471		
-35	144100	-5	33900	25	10000	55	3536	85	1451		
-34.5	140400	-4.5	33170	25.5	9816	55.5	3480.5	85.5	1431		
-34	136700	-4	32440	26	9632	56	3425	86	1411		
-33.5	133250	-3.5	31745	26.5	9456.5	56.5	3371.5	86.5	1392		
-33	129800	-3	31050	27	9281	57	3318	87	1373		

Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)
-32.5	126550	-2.5	30390	27.5	9112.5	57.5	3266.5	87.5	1354.5		
-32	123300	-2	29730	28	8944	58	3215	88	1336		
-31.5	120200	-1.5	29105	28.5	8783	58.5	3165.5	88.5	1318		
-31	117100	-1	28480	29	8622	59	3116	89	1300		
-30.5	114200	-0.5	27880	29.5	8467.5	59.5	3068	89.5	1283		
-30	111300	0	27280	30	8313	60	3020	90	1266		
-29.5	108500	0.5	26705	30.5	8163.5	60.5	2973.5	90.5	1249		
-29	105700	1	26130	31	8014	61	2927	91	1232		
-28.5	103100	1.5	25580	31.5	7871	61.5	2882.5	91.5	1216		
-28	100500	2	25030	32	7728	62	2838	92	1200		
-27.5	98010	2.5	24510	32.5	7591	62.5	2794.5	92.5	1184		
-27	95520	3	23990	33	7454	63	2751	93	1168		
-26.5	93180	3.5	23495	33.5	7323	63.5	2709.5	93.5	1152.5		
-26	90840	4	23000	34	7192	64	2668	94	1137		
-25.5	88635	4.5	22525	34.5	7066	64.5	2628	94.5	1122.5		
-25	86430	5	22050	35	6940	65	2588	95	1108		
-24.5	84345	5.5	21600	35.5	6819.5	65.5	2549.5	95.5	1093.5		
-24	82260	6	21150	36	6699	66	2511	96	1079		
-23.5	80295	6.5	20725	36.5	6583	66.5	2473.5	96.5	1065		
-23	78330	7	20300	37	6467	67	2436	97	1051		
-22.5	76470	7.5	19890	37.5	6356	67.5	2400	97.5	1037.5		
-22	74610	8	19480	38	6245	68	2364	98	1024		
-21.5	72855	8.5	19090	38.5	6138.5	68.5	2329.5	98.5	1011.2		
-21	71100	9	18700	39	6032	69	2295	99	998.4		
-20.5	69435	9.5	18330	39.5	5929.5	69.5	2261.5	99.5	985.75		

Table 26: Temperature / resistance curve for NTC

Appendix 3: Temperature / resistance curve for PTC

Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)
-65	420.6	-35	589	-5	772.8	25	990	55	1240.5	85	1524.5	115	1841
-64.5	423.57	-34.5	591.8	-4.5	776.15	25.5	993.9	55.5	1244.95	85.5	1529.5	115.5	1846.5
-64	426.54	-34	594.6	-4	779.5	26	997.8	56	1249.4	86	1534.5	116	1852
-63.5	429.51	-33.5	597.4	-3.5	782.85	26.5	1001.7	56.5	1253.9	86.5	1539.55	116.5	1857.5
-63	432.48	-33	600.2	-3	786.2	27	1005.6	57	1258.4	87	1544.6	117	1863
-62.5	435.45	-32.5	603.05	-2.5	789.6	27.5	1009.55	57.5	1262.9	87.5	1549.65	117.5	1868.5
-62	438.42	-32	605.9	-2	793	28	1013.5	58	1267.4	88	1554.7	118	1874
-61.5	441.39	-31.5	608.75	-1.5	796.4	28.5	1017.45	58.5	1271.9	88.5	1559.75	118.5	1879.5
-61	444.36	-31	611.6	-1	799.8	29	1021.4	59	1276.4	89	1564.8	119	1885
-60.5	447.33	-30.5	614.45	-0.5	803.25	29.5	1025.4	59.5	1280.95	89.5	1569.9	119.5	1890.5
-60	450.3	-30	617.3	0	806.7	30	1029.4	60	1285.5	90	1575	120	1896
-59.5	453.27	-29.5	620.2	0.5	810.15	30.5	1033.4	60.5	1290.05	90.5	1580.15	120.5	1901.4
-59	456.24	-29	623.1	1	813.6	31	1037.4	61	1294.6	91	1585.3	121	1906.8
-58.5	459.21	-28.5	626	1.5	817.05	31.5	1041.4	61.5	1299.2	91.5	1590.4	121.5	1912.2
-58	462.18	-28	628.9	2	820.5	32	1045.4	62	1303.8	92	1595.5	122	1917.6
-57.5	465.15	-27.5	631.85	2.5	823.95	32.5	1049.45	62.5	1308.4	92.5	1600.65	122.5	1923
-57	468.12	-27	634.8	3	827.4	33	1053.5	63	1313	93	1605.8	123	1928.4
-56.5	471.09	-26.5	637.7	3.5	830.9	33.5	1057.55	63.5	1317.6	93.5	1611	123.5	1933.8
-56	474.06	-26	640.6	4	834.4	34	1061.6	64	1322.2	94	1616.2	124	1939.2
-55.5	477.03	-25.5	643.6	4.5	837.95	34.5	1065.7	64.5	1326.8	94.5	1621.35	124.5	1944.6
-55	480	-25	646.6	5	841.5	35	1069.8	65	1331.4	95	1626.5	125	1950
-54.5	482.97	-24.5	649.55	5.5	845	35.5	1073.85	65.5	1336.05	95.5	1631.7	125.5	1955.3
-54	485.94	-24	652.5	6	848.5	36	1077.9	66	1340.7	96	1636.9	126	1960.6
-53.5	488.91	-23.5	655.5	6.5	852.05	36.5	1082.05	66.5	1345.4	96.5	1642.15	126.5	1965.9
-53	491.88	-23	658.5	7	855.6	37	1086.2	67	1350.1	97	1647.4	127	1971.2
-52.5	494.85	-22.5	661.55	7.5	859.2	37.5	1090.3	67.5	1354.75	97.5	1652.65	127.5	1976.5
-52	497.82	-22	664.6	8	862.8	38	1094.4	68	1359.4	98	1657.9	128	1981.8
-51.5	500.79	-21.5	667.6	8.5	866.4	38.5	1098.55	68.5	1364.15	98.5	1663.15	128.5	1987.1
-51	503.76	-21	670.6	9	870	39	1102.7	69	1368.9	99	1668.4	129	1992.4
-50.5	506.73	-20.5	673.65	9.5	873.6	39.5	1106.9	69.5	1373.6	99.5	1673.7	129.5	1997.7
-50	509.7	-20	676.7	10	877.2	40	1111.1	70	1378.3	100	1679	130	2003
-49.5	512.2	-19.5	679.8	10.5	880.85	40.5	1115.25	70.5	1383.05	100.5	1684.35	130.5	2008
-49	514.7	-19	682.9	11	884.5	41	1119.4	71	1387.8	101	1689.7	131	2013
-48.5	517.25	-18.5	686	11.5	888.1	41.5	1123.6	71.5	1392.55	101.5	1695.05	131.5	2018
-48	519.8	-18	689.1	12	891.7	42	1127.8	72	1397.3	102	1700.4	132	2023

Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)	Temp (°C)	Resistance (Ω)
-47.5	522.35	-17.5	692.2	12.5	895.4	42.5	1132.05	72.5	1402.1	102.5	1705.75	132.5	2028
-47	524.9	-17	695.3	13	899.1	43	1136.3	73	1406.9	103	1711.1	133	2033
-46.5	527.45	-16.5	698.4	13.5	902.75	43.5	1140.55	73.5	1411.7	103.5	1716.45	133.5	2038
-46	530	-16	701.5	14	906.4	44	1144.8	74	1416.5	104	1721.8	134	2043
-45.5	532.6	-15.5	704.65	14.5	910.15	44.5	1149.05	74.5	1421.3	104.5	1727.15	134.5	2048
-45	535.2	-15	707.8	15	913.9	45	1153.3	75	1426.1	105	1732.5	135	2053
-44.5	537.8	-14.5	711	15.5	917.6	45.5	1157.55	75.5	1430.95	105.5	1737.85	135.5	2058
-44	540.4	-14	714.2	16	921.3	46	1161.8	76	1435.8	106	1743.2	136	2063
-43.5	543.05	-13.5	717.35	16.5	925.05	46.5	1166.05	76.5	1440.65	106.5	1748.55	136.5	2068
-43	545.7	-13	720.5	17	928.8	47	1170.3	77	1445.5	107	1753.9	137	2073
-42.5	548.35	-12.5	723.7	17.5	932.55	47.5	1174.7	77.5	1450.35	107.5	1759.25	137.5	2078
-42	551	-12	726.9	18	936.3	48	1179.1	78	1455.2	108	1764.6	138	2083
-41.5	553.65	-11.5	730.15	18.5	940.05	48.5	1183.4	78.5	1460.1	108.5	1769.95	138.5	2088
-41	556.3	-11	733.4	19	943.8	49	1187.7	79	1465	109	1775.3	139	2093
-40.5	558.95	-10.5	736.6	19.5	947.6	49.5	1192.05	79.5	1469.9	109.5	1780.65	139.5	2098
-40	561.6	-10	739.8	20	951.4	50	1196.4	80	1474.8	110	1786	140	2103
-39.5	564.3	-9.5	743.1	20.5	955.25	50.5	1200.8	80.5	1479.75	110.5	1791.5	140.5	2107
-39	567	-9	746.4	21	959.1	51	1205.2	81	1484.7	111	1797	141	2111.6
-38.5	569.75	-8.5	749.65	21.5	962.9	51.5	1209.55	81.5	1489.65	111.5	1802.5	141.5	2116
-38	572.5	-8	752.9	22	966.7	52	1213.9	82	1494.6	112	1808	142	2120.2
-37.5	575.25	-7.5	756.2	22.5	970.55	52.5	1218.35	82.5	1499.55	112.5	1813.5	142.5	2124.5
-37	578	-7	759.5	23	974.4	53	1222.8	83	1504.5	113	1819	143	2128.8
-36.5	580.75	-6.5	762.8	23.5	978.3	53.5	1227.2	83.5	1509.5	113.5	1824.5	143.5	2134.1
-36	583.5	-6	766.1	24	982.2	54	1231.6	84	1514.5	114	1830	144	2137.4
-35.5	586.25	-5.5	769.45	24.5	986.1	54.5	1236.05	84.5	1519.5	114.5	1835.5	144.5	2141.7

Table 27: Temperature / resistance curve for PTC

Appendix 4: Overview tables – Regulation 2015/1095/EU

Compressor - Copeland Selection Software, 7.13 AX Int / 42710 (12/16), gascooler - lab measurement, suction superheat 10K			5-Dec-16
Model: OME-4MTL-05X	Refrigerant: R744 Dew Point		SI
Evaporating Temperature	t	-10	°C
Annual electricity consumption	Q	22254	kWh/y
Seasonal energy performance ratio	SEPR	2.93	
Parameters at full load and ambient temperature 32°C			
Capacity (rated)	P_A	10.61	kW
Power Input (rated)	D_A	7.21	kW
COP (rated)	COP_A	1.47	
Parameters at part load and ambient temperature 25°C			
Capacity (declared)	P_B	10.21	kW
Power Input (declared)	D_B	5.08	kW
COP (declared)	COP_B	2.01	
Parameters at part load and ambient temperature 15°C			
Capacity (declared)	P_C	8.59	kW
Power Input (declared)	D_C	3.06	kW
COP (declared)	COP_C	2.80	
Parameters at part load and ambient temperature 5°C			
Capacity (declared)	P_D	7.32	kW
Power Input (declared)	D_D	1.78	kW
COP (declared)	COP_D	4.10	
Parameters at full load and ambient temperature 43°C			
Capacity	P_3	-	kW
Power Input	D_3	-	kW
COP	COP_3	-	
Other items			
Capacity control		Invertor	
Degradation coefficient	Cds	0.25	
Contact details	Emerson Climate Technologies - European Headquarters - Pascalstrasse 65 - 52076 Aachen, Germany Phone: +49 (0) 2408 929 0 - Fax: +49 (0) 2408 929 570 - Internet: www.emersonclimate.eu		

COPELAND™

Compressor - Copeland Selection Software, 7.13 AX Int / 42710 (12/16), gascooler - lab measurement, suction superheat 10K — 5-Dec-16

Model: OME-4MTL-09X Refrigerant: R744 Dew Point SI

Evaporating Temperature	t	-10	°C
Annual electricity consumption	Q	34809	kWh/y
Seasonal energy performance ratio	SEPR	3.02	
Parameters at full load and ambient temperature 32°C			
Capacity (rated)	P_A	17.12	kW
Power Input (rated)	D_A	11.60	kW
COP (rated)	COP_A	1.48	
Parameters at part load and ambient temperature 25°C			
Capacity (declared)	P_B	15.05	kW
Power Input (declared)	D_B	7.33	kW
COP (declared)	COP_B	2.05	
Parameters at part load and ambient temperature 15°C			
Capacity (declared)	P_C	12.91	kW
Power Input (declared)	D_C	4.73	kW
COP (declared)	COP_C	2.73	
Parameters at part load and ambient temperature 5°C			
Capacity (declared)	P_D	12.29	kW
Power Input (declared)	D_D	2.75	kW
COP (declared)	COP_D	4.47	
Parameters at full load and ambient temperature 43°C			
Capacity	P_3	-	kW
Power Input	D_3	-	kW
COP	COP_3	-	
Other items			
Capacity control		Invertor	
Degradation coefficient	Cds	0.25	

Contact details

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