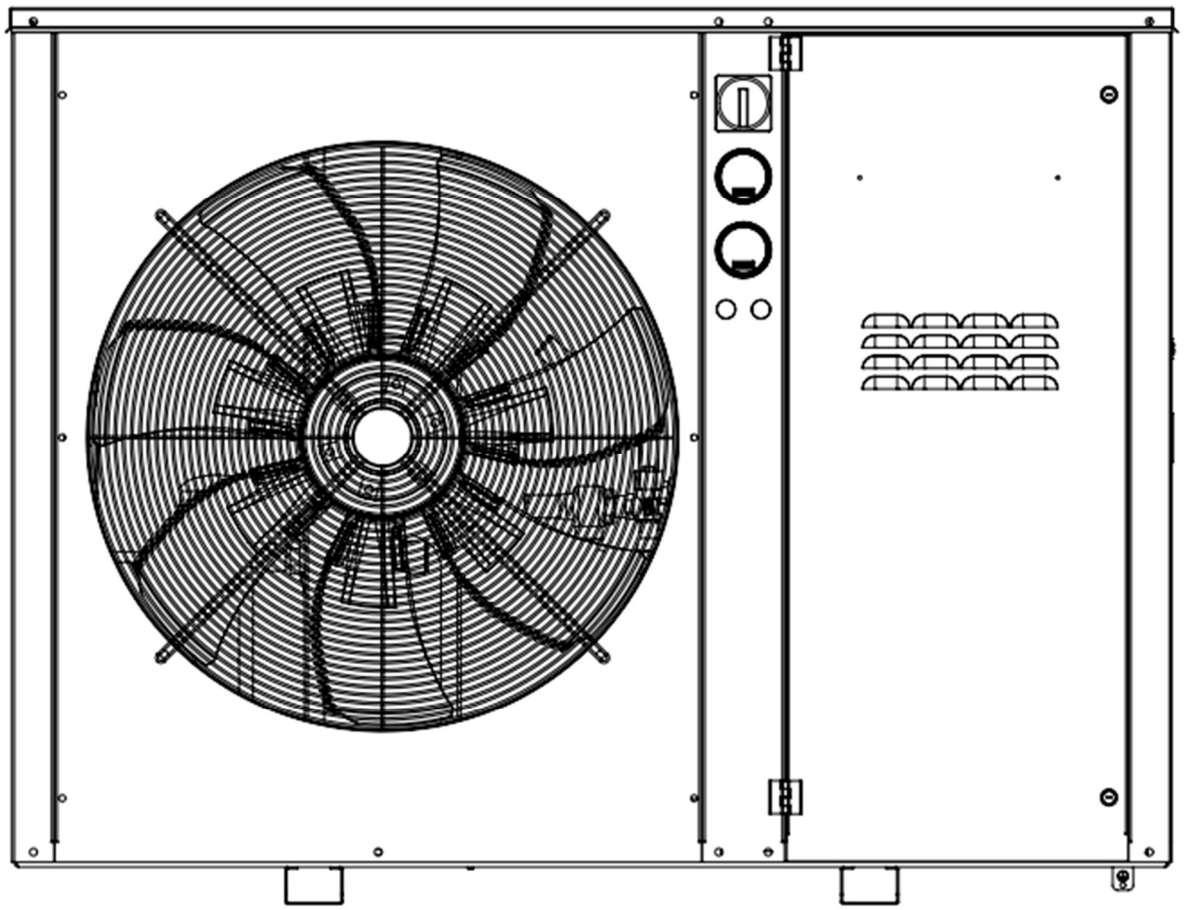
Panasonic

iCO2RE

Condensing units manual

Model No.

OCU-CRC060A08 **OCU-CRC060A08-C** **OCU-CRC060A08-P**
OCU-CRC060A08-CP



Original manual
25.08 Rev.03-EN

Table of contents

Overview of Symbols

Below is a summary of the pictograms used in this document. They refer to operating recommendations, technical information, and safety guidelines. They indicate potential hazards for the user and the device, as well as possible consequences resulting from failure to follow the instructions.

- Indicates possibility of death or serious injury

- Risk of electric shock
- Indicates the possibility of minor injury or damage to properties.

- Risk of explosion.
- Risk of hand injury.
- Risk of fire.

- Risk of entrapment
- Risk of collision.
- Risk of falling load.

- Risk of burn – contact with hot surfaces, steam, or flame may cause skin burns.
- Risk of frostbite – contact with extremely cold surfaces or substances (e.g., liquid CO_2) may damage tissue.

- Protective clothing must be worn

- Recommended action

- Grounding – electric shock
- Additional grounding required

- Electrical and electronic equipment, including refrigeration systems, must be disposed of in accordance with Directive 2012/19/EU (WEEE).

General safety notes

All work related to the refrigeration plant should be performed by qualified personnel. Persons performing assembly, service, maintenance, dismantling and leakage tests should have appropriate authorization required in the country of installation of the unit, in the scope of performed works.

It is particularly important that all employees responsible for operation and service works related to the cycle and refrigerant have received adequate training in the operation of supercritical refrigeration systems using carbon dioxide as a refrigerant.

The unit is designed to work under electrical voltage. It can be used only by employees with proper qualifications. Exercise extreme caution when conducting service work.

Note: After opening the door, the electrical components can be accessed directly. Danger of electric shock.
If it is necessary to conduct service works under voltage, make sure that the compressor operating switch is disconnected before proceeding.

Personnel performing assembly and service works must be equipped with personal protection equipment, such as protective gloves, safety glasses, helmet, appropriate clothing, etc.

Persons performing work involving an open flame must be properly trained and exercise particular caution due to the high risk of fire. Before starting work, appropriate fire extinguishing equipment must be prepared for use in case of an emergency.

The operation/servicing of the refrigeration system requires the use of components (refrigeration pressure gauges, flexible hoses, etc.) designed to work with supercritical carbon dioxide as a refrigerant. Using components that are unsuitable may lead to their rupture, and therefore, may cause injury or, in extreme cases, death.

Carbon dioxide is an asphyxiant gas. It should be checked whether the system requires the use of carbon dioxide detectors and mechanical emergency ventilation. For this purpose, follow the guidelines in European standards EN 378-1 and EN 378-3The unit should be installed in a well-ventilated place.

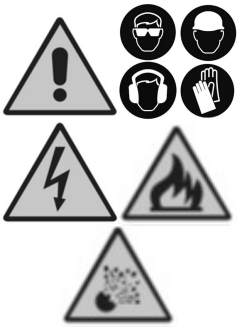
Prior to dispatch, the unit is filled with nitrogen at a pressure of 10 bar ± 2bar. Before starting the assembly work, check if the unit is still filled with gas by connecting the pressure gauge to the service valves of the unit. If overpressure is detected, discharge the gas into the atmosphere. In the absence of overpressure, check that the unit has not been damaged and unsealed during transport.

The unit is supplied with all electronic expansion valves in the open position (controller plugs disconnected). This allows for proper vacuuming and initial charging. Before liquid charge or starting the compressor place the valve plugs in the appropriate place in the controller (sticker on electrical box: “ATTENTION”) and power the unit . If the unit has already been powered, it is necessary to position the valves (using the reset button when the compressor is not working and the unit is powered or by turning the main power supply of the unit off and after 20 second on again).

The controller does not directly detect the current position of the electronic expansion valves. It does not respond to a break in the circuit between the valve coil and the controller - it is prohibited to remove or disconnect the coils while the unit is operating. If you suspect that the electronic expansion valves have lost their position, emergency stop the compressor (S1 down), make sure that the coils are correctly connected and press the RESET button (B2) on the controller, then start again unit (S1 up)

Procedure in case of injuries and emergencies

In the event of injuries or an accident during installation or maintenance work, the following steps must be taken:



- Secure the area of the incident – do not attempt to operate the device if there is a risk of leakage, electric shock, fire, or explosion.
- Provide first aid to the injured person in a safe location.
- Immediately call emergency services (tel. 112) or the appropriate local authority, clearly informing them about the nature of the incident and the potential hazard.
- Use protective equipment in accordance with EN 378-3 standards.

Terms and definitions

Strength test pressure — Symbol: **PT** — pressure used during strength pressure testing of the refrigeration system and/or any of its parts.
DISCHARGE – compressor discharge side.
Maximum allowable pressure— Symbol: **PS** — maximum permissible pressure specified by the manufacturer. This is the limit value of the working pressure that must not be exceeded in the system both during its operation and idle time.
RECEIVER – liquid refrigerant receiver.
Section — a well-defined part of the system giving the possibility of be cut off, for which the following parameters will be common: maximum permissible pressure, minimum permissible temperature, maximum permissible temperature and safety units.
HP Section *(high-pressure section)* — part of the compressor from the second discharge through the oil separator, the gas cooler to the pressure control valve in the gas cooler (HPV). PS = 120 bar.
LP Section *(low-pressure section)* — the rest of the compressor. PS = 80 bar.
HPV — Gas cooler pressure control valve.
RPV — Liquid receiver pressure control valve.

Tampering with the unit

It is forbidden to interfere with the cooling system, electrical system or software of the unit without the consent of the manufacturer. It is forbidden to upload settings or firmware from other units (other OCU models or the same model but with a different firmware). Any change to the default settings may result in incorrect operation of the unit and its damage, for which the manufacturer is not responsible. Make changes responsibly, and if in doubt, contact the manufacturer for default settings or more information.

Foundation of the unit

Detailed description of requirements concerning the foundation can be found in chapter 2.3 *„Place of assembly - main rules related to OCU-CRC060A08 installation”*

1. Unit description

The unit is a transcritical system designed to operate with a refrigeration installation, using R744 (CO_2) as the refrigerant. It is intended for cooling cold rooms, freezer rooms, refrigerated furniture, and technological processes. The unit automatically adjusts its cooling capacity based on ambient conditions and current demand. The unit is equipped with safety devices and has undergone leak, electrical, and functional testing. The unit is used to condense vapors or to cool the refrigerant gas (carbon dioxide). Low-pressure superheated refrigerant vapor is drawn in by the compressor, where it is compressed and its pressure and temperature are increased. The compression is performed in two stages, with interstage cooling. The compressed gas then flows through a gas cooler where, depending on the ambient temperature, it cools or condenses:

- If the ambient temperature is high (above 20°C), it is only possible to cool the gas, and its condensation occurs while lowering its pressure when flowing through the HPV valve located behind the gas cooler.
- If the ambient temperature is low (below 20°C), the refrigerant may condense.

The condensed refrigerant vapor then flows into the receiver. If the liquid is formed by the expansion of the cooled gas, a gas fraction has also been created, which is released through the RPV valve to the compressor's suction or the second compression stage, depending on the unit model and current operating conditions. From the receiver, the refrigerant in the liquid form is distributed to evaporators located on the system, where it is expanded and evaporated, thus receiving heat from the cooled medium. The superheated steam is sucked in again by the compressor of the unit.

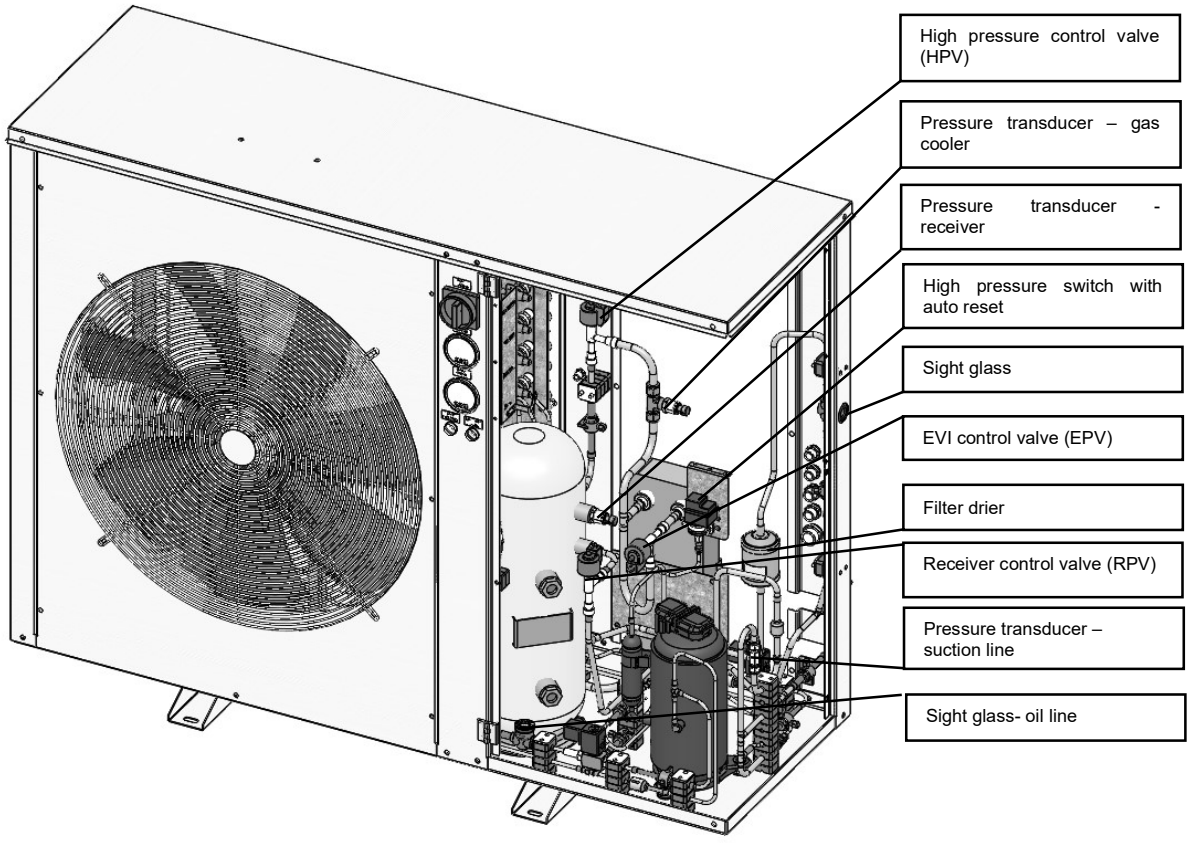


Figure 1.1 The main components of the unit

1.1 Working range and envelope

The transcritical unit is designed to work in ambient temperature ranging from -20°C to 43°C. Do not allow the unit to operate outside the permissible operating range. The compressor working envelope is shown below. Operation outside the envelope may damage the compressor.

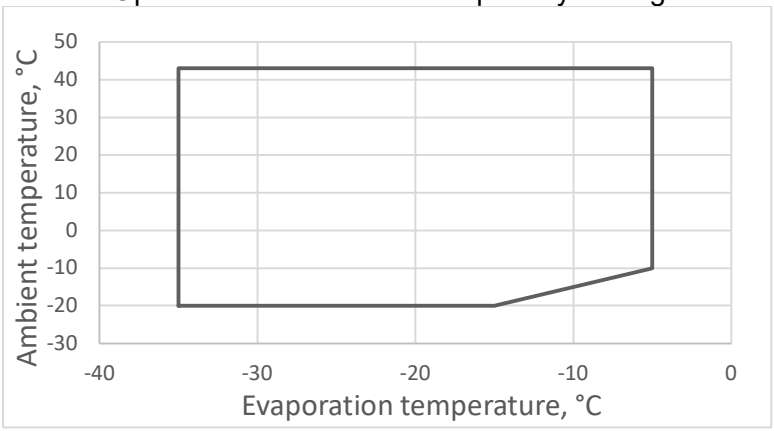


Diagram 1.1 Transcritical unit operation envelope

1.2 Type code description OCU-CRC060A08

This Operation and Maintenance Manual can be applied with OCU-CRC060A08 standard units together with options:

OCU - C R C 060 A 0 8 - C* P*

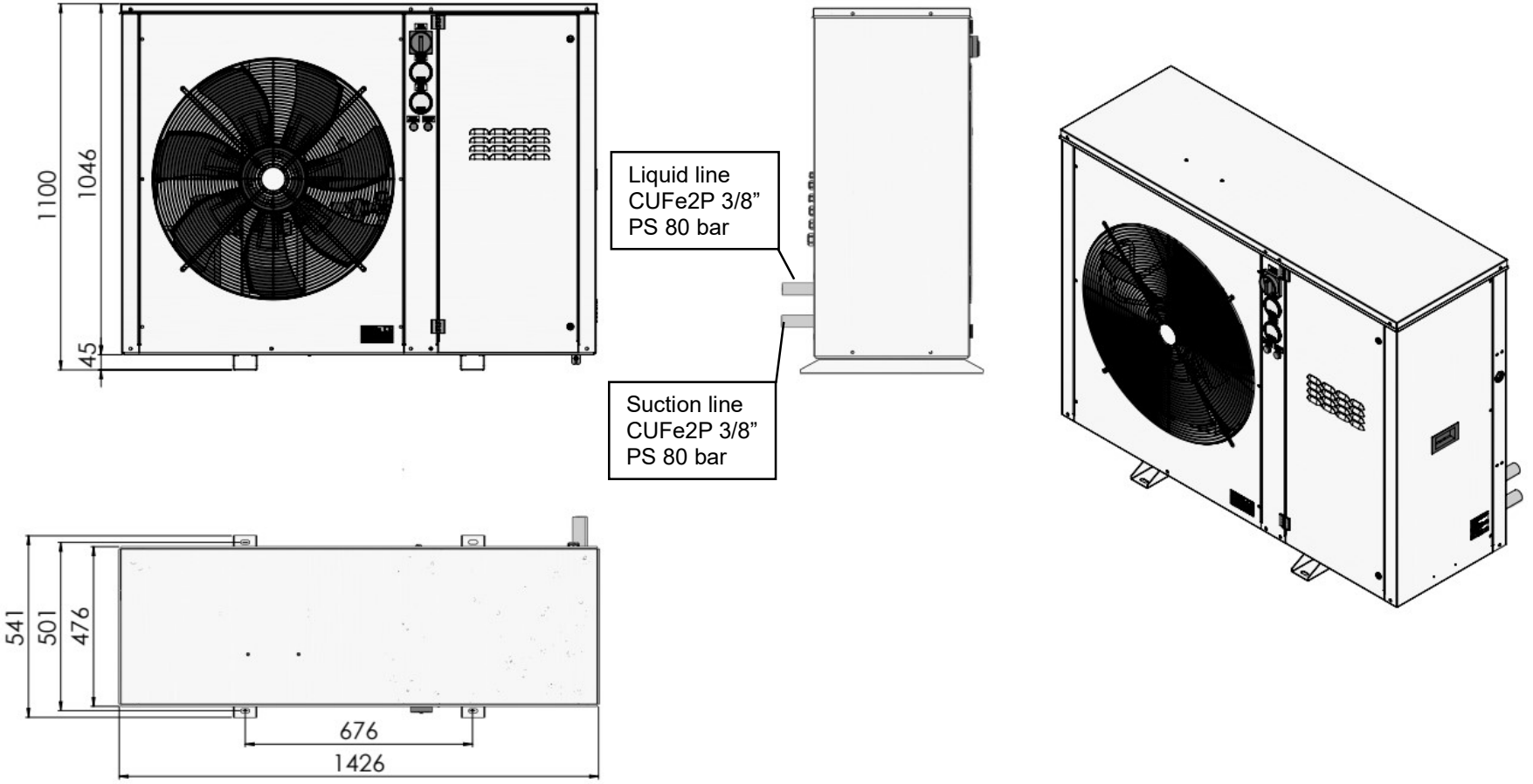
- P = HP Fan
- C = Anti – Corrosion Coating
- 8 = 3 Phase, 400V, 50Hz
- 0 = Original
- A = MT/LT
- 060 = kW x 10 (conditions T_{amb}=32°C), MT/LT & MT: - 10°C ,
- C = Customizable Model
- R = Rotary + Inverter
- C = R744
- OCU = Outdoor with Integrated Condenser

* possible options

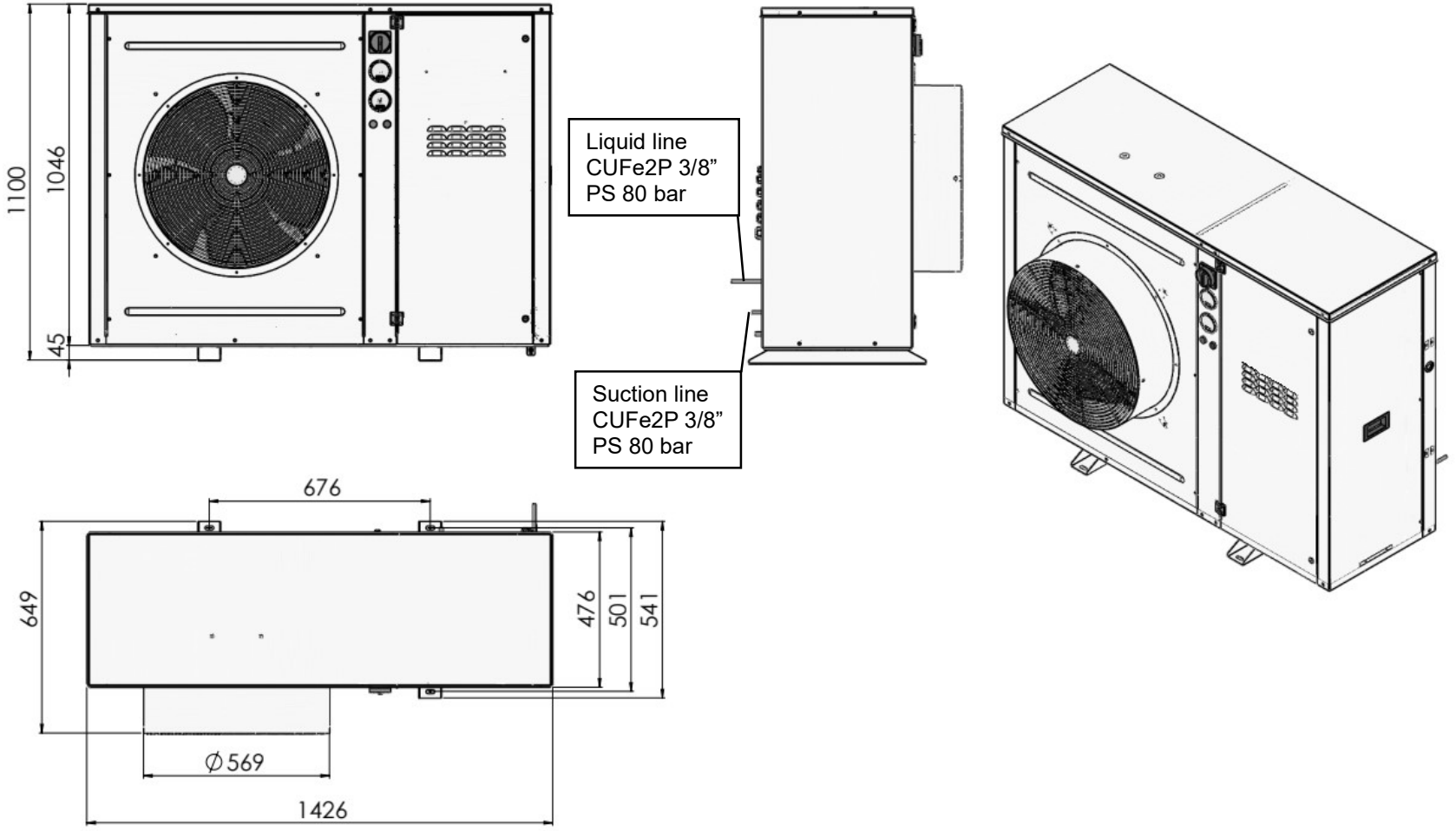
1.3 Technical data for all possible options

				OCU-CRC060A08 OCU-CRC060A08-C	OCU-CRC060A08-P OCU-CRC060A08-CP
Compatible refrigerants				R744	
PED category				II	
Application			MT or LT	MT / LT	
SEPR cooling at ET -10 °C AT 32 °C				2,78	
SEPR freezing at ET -35 °C AT 32 °C				—	
Annual electricity consumption at ET -10 °C AT 32 °C			kWh/a	13371	
Annual electricity consumption at ET -35 °C AT 32 °C			kWh/a	17883	
Nominal operating current at ET -10 °C MT / -30 °C LT AT 32 °C and 230 - 400 V 50 Hz			A	9,4	11,2
Maximum operating current (in the most loaded phase at 230 - 400 V 50 Hz)			A	11,2	14,6
Maximum power consumption			kW	5	5,8
Dimensions		W x H x D	mm	1426 x 1100 x 541	1426 x 1100 x 649
Gross weight			kg	200	
Sound level at 10 m			dB(A)	41,5	-
Condenser	Fans x diameter		mm	1x710	1x560
	Air flow		m^3/h	1x5700	1x8 200
	Fan static pressure		Pa	N/A	120
	Fan power supply		V / ph / Hz	220 - 240 / 1 / 50-60	220 - 240 / 1 / 50-60
	Fan power consumption		W	280	1x1 050
	Nominal fan amperage		A	1x1,2	1x4,6
Compressor	Model			C-CV303H0T	
	Volumetric flow		m^3/h	1,15 - 2,30	
	Rotation range		rps	40 - 80	
	Current	Full load amperage	A	16	
		Peak current limit / Locked rotor amperage	A	30 / —	
	Oil type			DAPHNE PZ68S (PAG)	
	Crankcase heater power consumption		W	1x40	
Oil charge			dm^3	0,6 + 0,6	
Connections		Suction	mm	9,53	
		Liquid	mm	9,53	
Liquid receiver			dm^3	10	
CU power supply	Voltage		V / ph / Hz	380 - 420 / 3 / 50	
	Recommended minimum cable cross-section		mm^2	4 x 4	
	Recommended minimum protection			C20	
Maximum recommended pipe distance			m	40	
Maximum height distance		Evaporator above	m	5	
		Evaporator below	m	10	
Which pipes needs to be insulated		Suction / liquid / both		Both	
Recommended insulation thickness		Suction	mm	32	
		Liquid	mm	19	
Evaporation temperature		Min ~ Max	°C	-35 ~ -5	
Ambient temperature		Min ~ Max	°C	-20 ~ -43	
PS line		Suction	bar	80	
		Liquid	bar	80	

1.4 Unit drawing for models OCU-CRC060A08 and OCU-CRC060A08-C



1.5 Unit drawing for models OCU-CRC060A08-P and OCU-CRC060A08-CP



2. Design recommendations

2.1 Security measures

Because carbon dioxide in high concentrations is an asphyxiant gas, the place of installation should be protected against the effects of its possible leakage to the environment. In order to select the required security measures appropriately, follow the instructions in European standard EN 378. In particular, pay attention to:

- Refrigerant leaks may cause the concentration of carbon dioxide to rise above the permissible level, hence carbon dioxide sensors should be installed near the system.
- Oxygen depletion sensors should not be used.
- The sensors should be mounted at a height of about 20–40 cm above the floor.
- Any leaks must be signaled with sound and light alerts.
- If it is necessary to install emergency ventilation in the part of the plant, it must be ensured that the air is removed from the lower part of the plant.
- Emergency ventilation should be supplied from a different source than detectors and carbon dioxide leak alarms.

2.2 Maximum allowable pressure

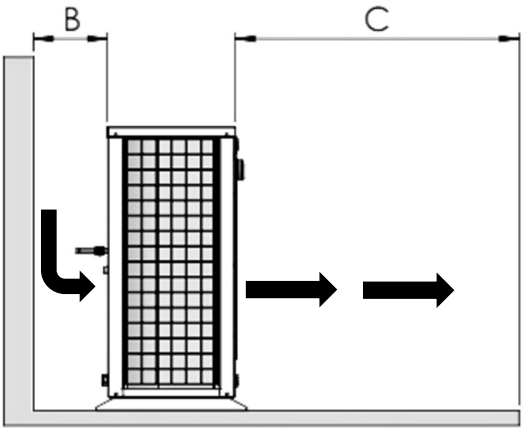
- The maximum allowable pressure of the suction and liquid parts of the unit is 80 bar.
- The maximum allowable pressure of all components installed in the liquid line of the system should be at least 80 bar.
- The maximum allowable pressure of all components installed on the suction line of the plant (including evaporators) should be at least 60 bar. The recommended value is 80 bar — it allows you to take full advantage of the unit‘s functionality.
- The suction part of the system must be secured with a set of safety valves with a setting corresponding to the maximum allowable pressure of the weakest element on the line. For example, if the maximum allowable pressure of the weakest element (evaporator or valve) is 60 bar, the safety valves should have a setting of not more than 60 bar.
- The maximum permissible setting of the safety valve on the suction line is 80 bar.
- To install the plant use the pipelines and components adapted to work with carbon dioxide as a refrigerant.
- All assembled components should have a declaration of conformity with the relevant directives adequately to the intended use of a given component (pressure, electric, machine, etc.)
- The maximum allowable pressure of other parts of the plant must be specified. The liquid section and the suction section can be treated independently.
    - The maximum permissible pressure of a given section is determined by the component with the lowest maximum allowable pressure (PS) in this section.
    - Information on the maximum permissible pressure (PS) of a given component or pipeline is given by the manufacturer in the technical specification.

2.3 Place of assembly - main rules related to OCU-CRC060A08 installation

- OCU-CRC060A08 transcritical unit is designed to work in ambient temperature ranging from -20°C to 43°C. Do not allow the unit to operate outside the permissible operating range. More information is defined in section 1.1 *„Working range and envelope of OCU-CRC060A08”* Operation and Maintenance Manual.
- The ambient temperature in which the unit is operated must not exceed 43 °C. To reduce the risk of exceeding this temperature is recommended to put unit under a canopy or inside a room where free air flow can be ensure.
- The units should be placed in such a place where it is not exposed to direct sunlight and other heat sources (radiators, central heating units, heating plates, stoves) with the provision of free air flow through the condenser.

For 1-fan units
B ≥ 250 mm

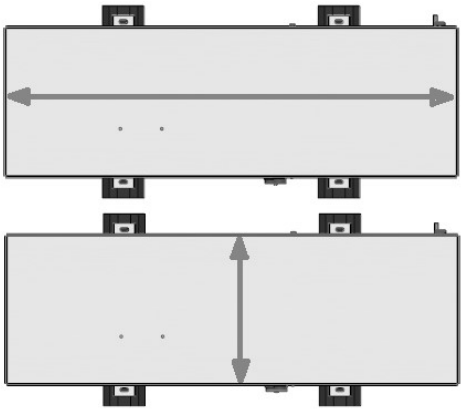
For 2-fan units
B ≥ 350 mm



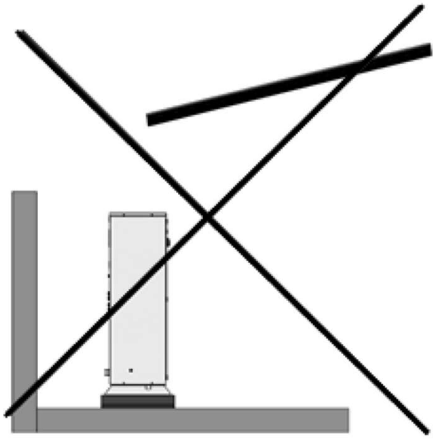
C = At least 1x the unit height not less than 800 mm

Figure 2.1 Diagram of correct location of unit

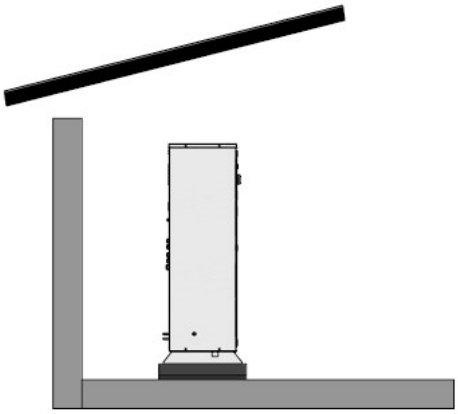
- If the units are installed in closed rooms, adequate ventilation should be provided — 15,000 m^3/h.
- The unit should be placed away from heat sources.
- The unit should not be installed in places where the prevailing wind direction is opposite to the outlet air direction. In case of exposure to such wind, it is recommended to use a partition.
- Limitation of excessive exposure to sunlight
  - Mounting the unit on the north or east side is recommended.
  - If it is not possible to mount the unit on the north or east side, it is recommended to install the unit under a roof.
  - Installation on large-area roof slopes, in particular those covered with materials that strongly absorb solar radiation (e.g. black felt) is not recommended.
- The units should be accessible only to duly qualified personnel.
- Due to the possibility of opening safety valves and the accompanying noise, it is recommended to install the units away from busy crossings, e.g. streets.
- The unit is a noise source, the value of which is given in the product technical data sheet. Additional objects may contribute to the amplification of the generated sound. When installing the unit, take into account the surroundings and the distance to buildings that may be bothered by this noise.
- It should be placed on a rigid, level floor of adequate load capacity, and then leveled.
- Choice of location for unit installation should be done regarding potential nuisance for outsiders.
- The floor must be horizontal, strong, stable and rigid enough to transfer the entire mass of the unit and eliminate vibrations and interferences.
- Each unit leg must be supported on vibration isolator – see recommended in chapter 2.6 *„Unit support and vibration isolators”*
- Each unit leg must be evenly supported.
- The location of the unit must enable access for conducting service and maintenance works.
- The unit must be leveled. Incorrect assembly of the unit will void the warranty.
- Maximum allowable tilt in both planes is equal to 10 mm/m.



- Slope of the roof has to ensure correct operation of the unit, especially during snowfall.

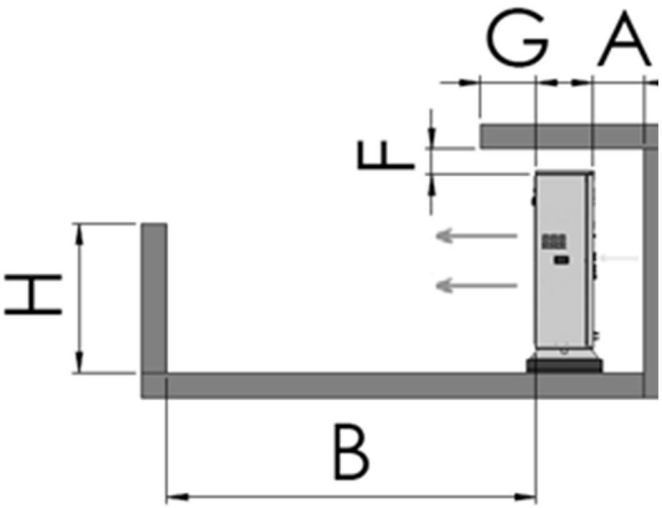


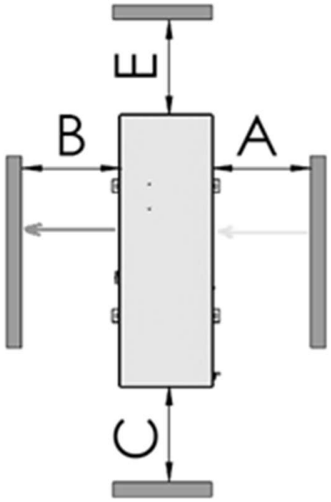
Incorrect placement in relation to the roof may result in the formation of snowdrifts near the unit



The roof protects the unit against the accumulation of snowdrifts

2.4 Required distances from walls or partitions



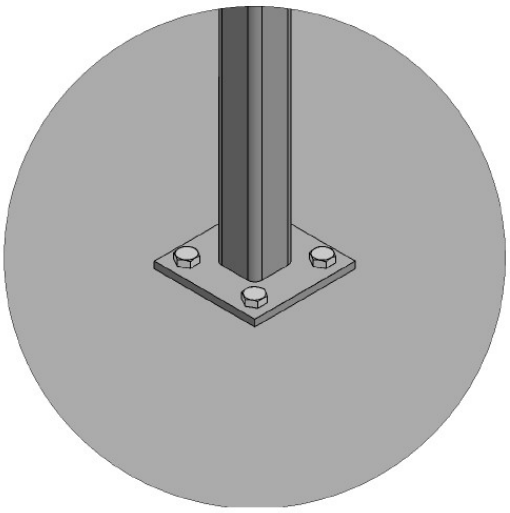


Dimension	Value
A	Min. 400 mm
B	Min. 1500 mm
C	Min. 400 mm
E	Min. 400 mm
F	Min. 400 mm
G	Max. 800 mm
H	Max. 1200 mm
Each time when determining the location of montage, the service space for the unit should be taken into account for the purpose of repair and inspection.	

2.5 Unit positioning

Aspects listed below must be considered regarding to unit placement:

- The unit must be place on stable surface.
- In case of considerable tilt the unit must be installed on dedicated frame or support.
- In case of placement the unit on a frame, it is necessary to attach the frame to the stable surface and the unit to the frame.

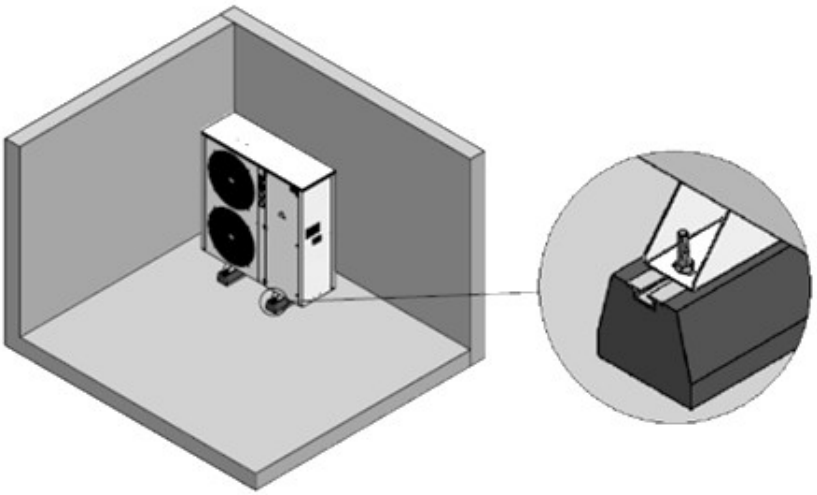


- Fixing the unit to stable surface in case of vibration isolators is required. Vibration isolators must be used in accordance with manufactured guidelines.
- The unit should be installed with supports/vibration isolators recommended by the manufacturer.

Unit could be installed in few combinations, including ground, roof and wall. Figures below show mounting suggestions and installation guidelines.

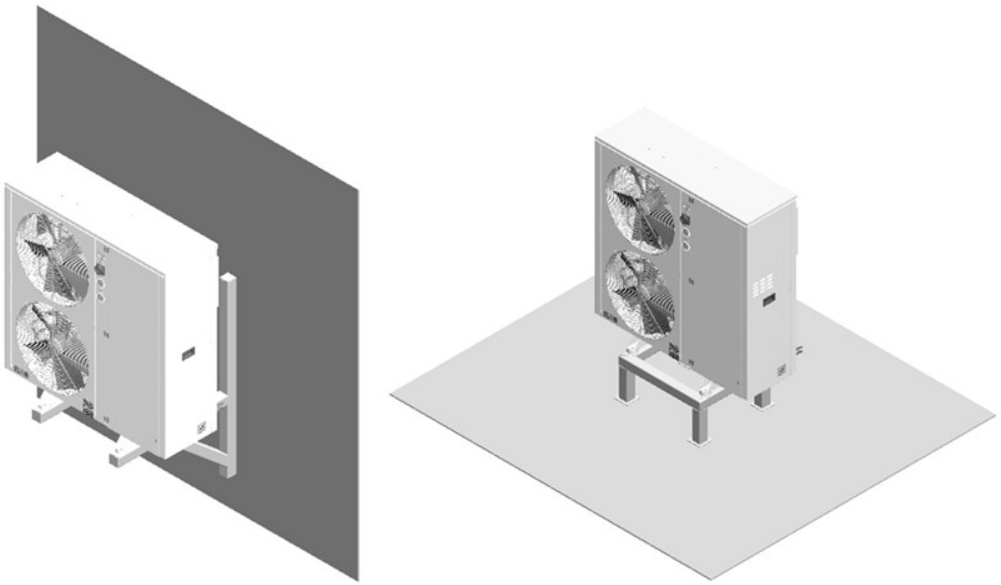
Ground

Unit could be position on rubber blocks RB60 in case of stable surface with no significant tilt. On condition of no possibility of unit positioning with rubber block application, vibration isolators GN 148 should be considered. More information related to recommended model could be found in section 2.6 *„Unit support and vibration isolators”.* All requirements listed before are still appliable.



Roof

Unit could be placed on room coated with soft material. In this case support frame should be considered. Frame could be used to unit positioning. Vibration isolators GN 148 should be installed applied. More information related to recommended model could be found in section 2.6 *„Unit support and vibration isolators*". All requirements listed before are still appliable.



Wall

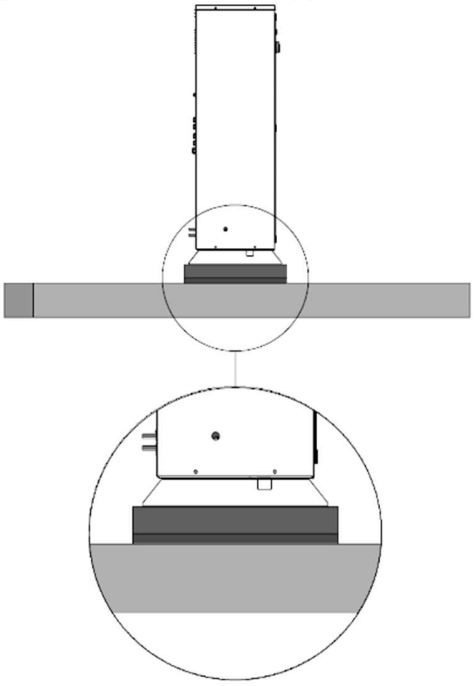
Unit could be mounted on a wall. Wall durability must be considered before installation. Hazard of vibration transmission form the unit to wall exist and must be take taken into account. Vibration isolators GN 148 should be installed applied. More information related to recommended model could be found in section 2.6 *„Unit support and vibration isolators."* All requirements listed before are still appliable.

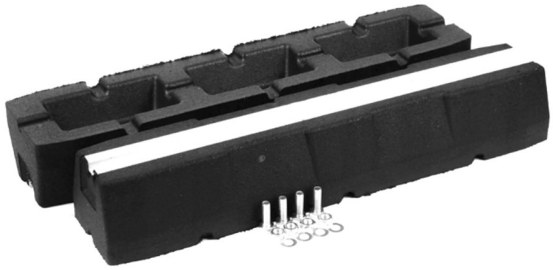
2.6 Unit support and vibration isolators

Two possibilities to support the unit could be considered:

Rubber blocks Castel Engineering RB60

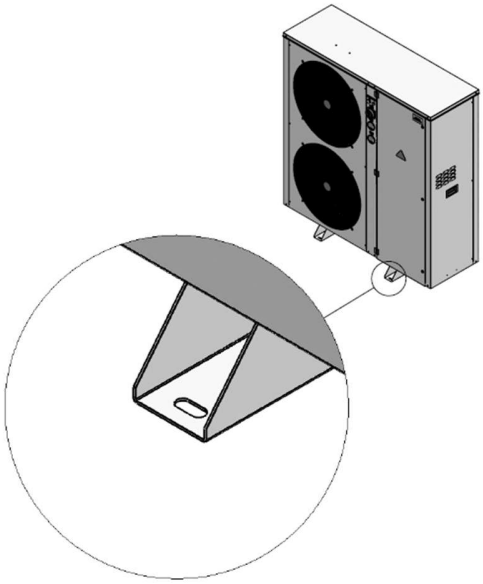
The rubber blocks support is made of sorted recycling rubber SBR with embedded aluminium profile. Unit must be supported on full surface of the foot provides stability.





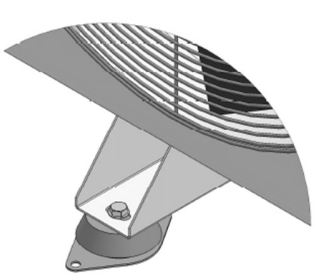
Vibration isolators Elesa+Ganter

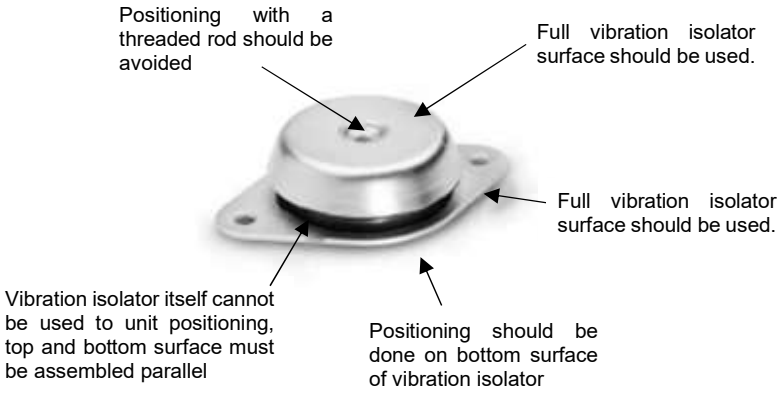
Fixing the unit by means of dedicated holes in the feet of unit. Supporting the unit on each foot is required (2 supports per each foot). Selection of vibration isolators involves unit mass and compressor operating frequency.



Positioning of the unit with adequate frame design is recommended. If there is no such a possibility unit could be positioned with elements placed between vibration isolator and

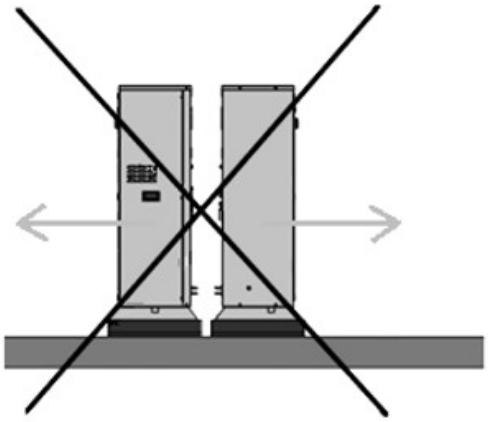
frame/support/ground. Positioning the unit with a threaded rod, nuts and washers are not recommended. While positioning support on the full surface of the vibration isolator should be provided. M10 bolts are used to fix vibration isolator to the unit. Vibration isolator itself cannot be used to unit positioning, top and bottom surface must be assembled parallel.

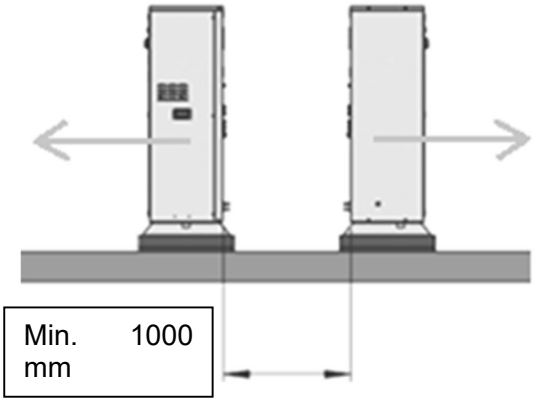




2.7 Requirements for montage beside another unit

- Providing sufficient distance in case of placing the units with condensers facing each other.



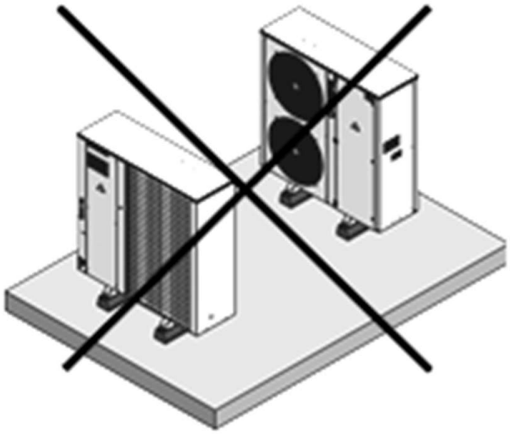


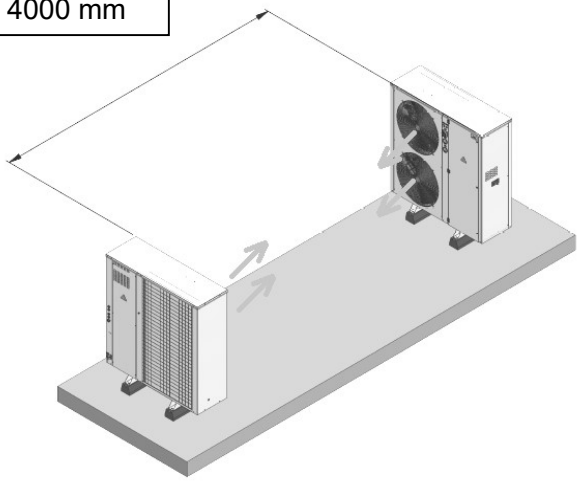
Too short distance between the condensers may result in increase of condensing temperature and shortened lifetime of the unit.

Maintaining minimum distance between the condensers does not increase condensing temperature.

- Providing sufficient distance in case of placing the units with the outlet air streams facing each other.

Min. 4000 mm

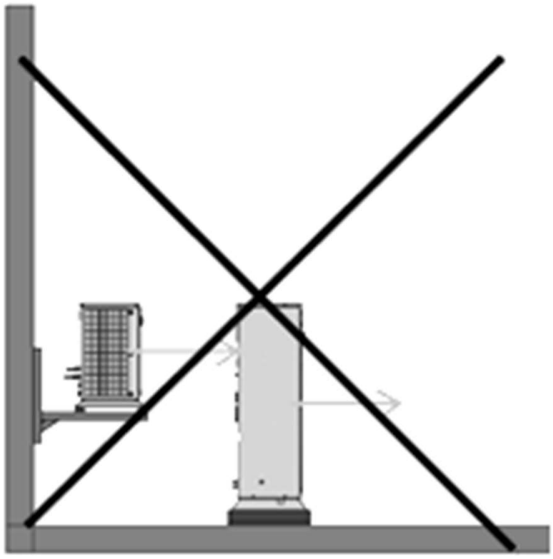


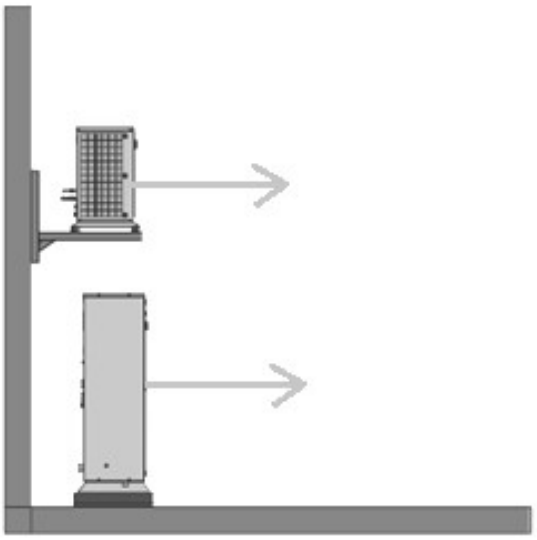


Placing outlet air streams in front of each other may cause improper operation of the unit.

Placing the units in front of each other, maintaining the minimum distance, does not cause negative air turbulences.

- Separation of inlet and outlet air streams of different units

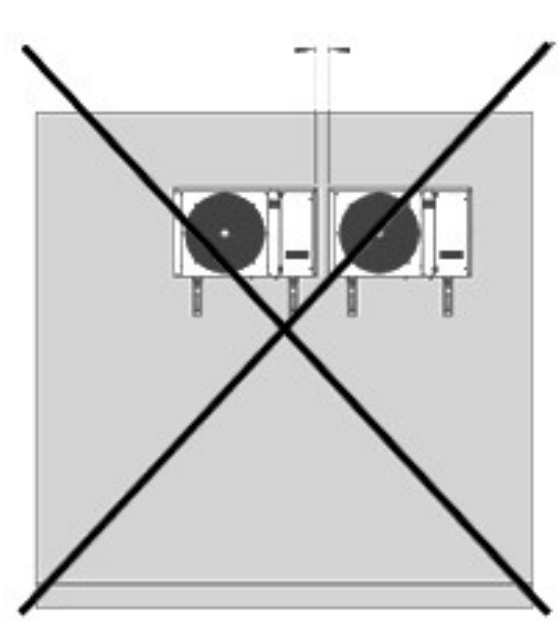




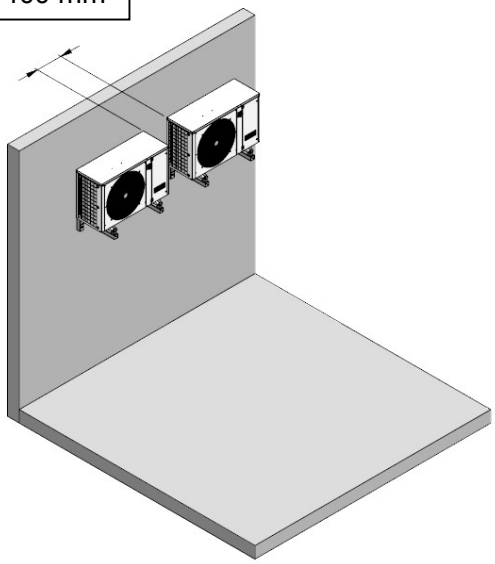
Mixing inlet air stream of unit with outlet air stream of another unit may cause improper operation of units.

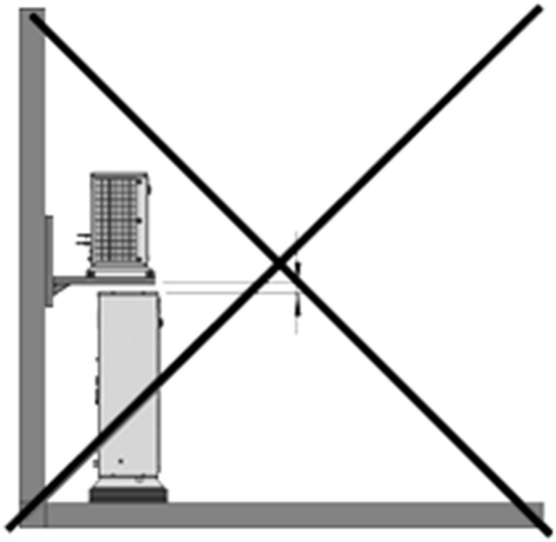
Placing the units with maintained spacing will not cause mixing of inlet and outlet air streams.

- Providing minimum distances from other units.

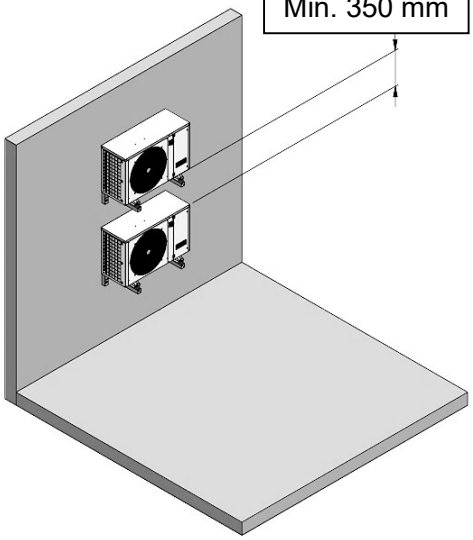


Min. 400 mm





Min. 350 mm

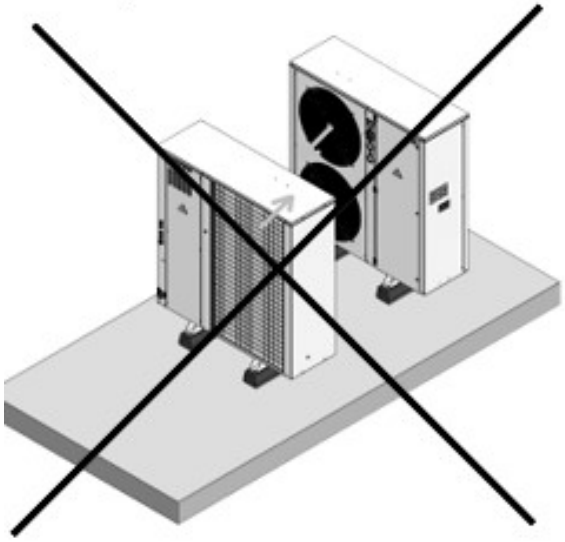


Too short distance between units may cause improper operation of the units and makes service activities harder to perform.

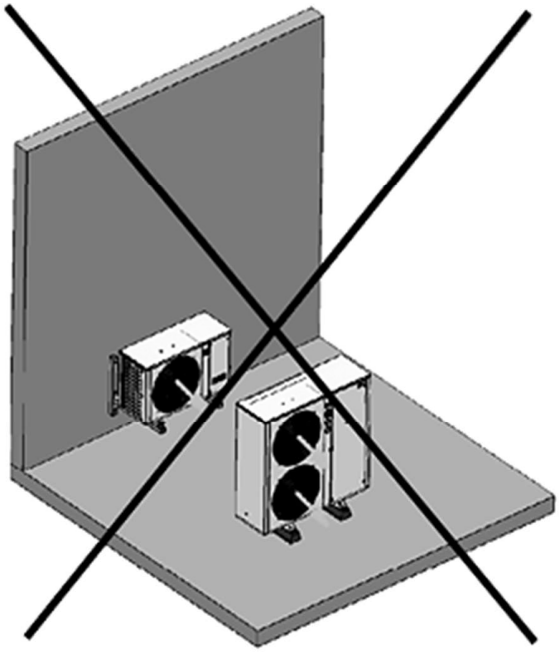
Placing the units maintaining minimum distances does not cause improper operation of the unit and makes service activities easier to perform.

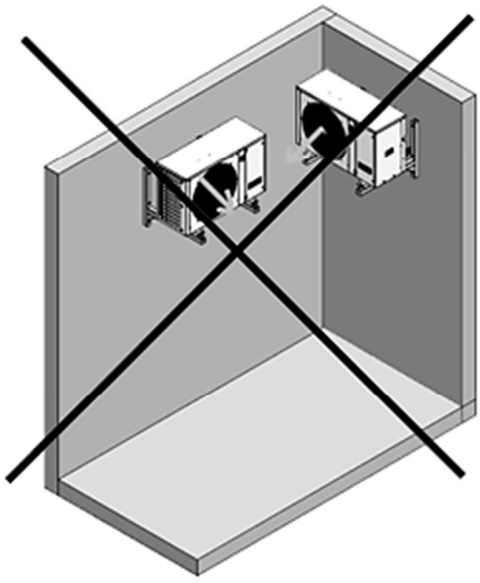
2.8 Examples of incorrect placement of the unit

- Placing the units in a way that causes outlet air streams to face each other without maintaining minimum required distance

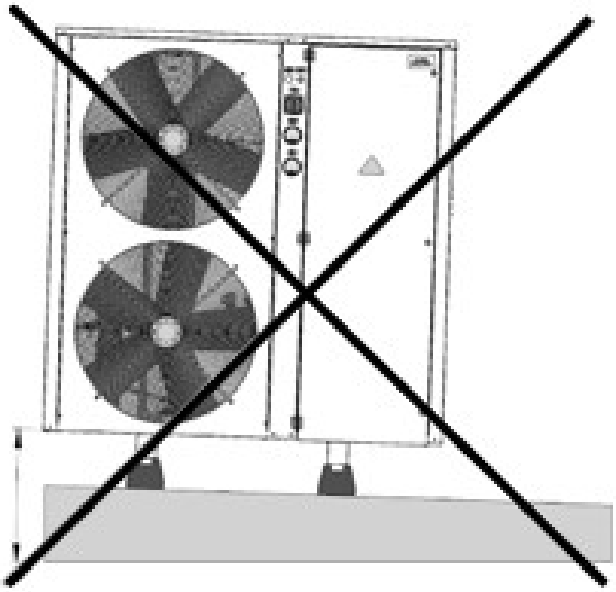


- Placing the units in a way that causes one unit to suck outlet air stream from another unit

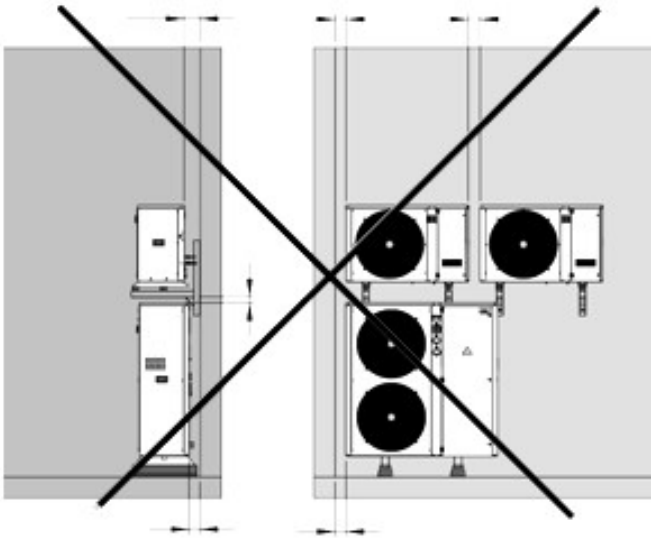




- Incorrect leveling of the unit



- Too short distances from partitions or other units



2.9 Pipelines arrangement – general requirements

- The personnel performing the connections in the system should have adequate permits to perform the works, depending on the type of connections (soldering or welding).
- The connections made should be compatible with the approved connection technologies.
- The materials used must have a maximum allowable pressure in accordance with the permissible pressure of a given section of the plant.
- It is recommended to install piping systems from CuFe2P copper alloys.
- All connectors and fittings should also be made of CuFe2P.
- To connect individual components of the system, use adhesives recommended by manufacturers of these components.
- Pipelines must be brazed with the nitrogen flow to avoid oxidation.
- In systems using carbon dioxide as a refrigerant, it is necessary to insulate both the suction and liquid lines.

- It is recommended to insulate the pipelines only after performing a leak test of the plant.
- The installer should select a proper piping diameter to ensure both acceptable pressure drops and oil return. Wrong piping diameters can cause compressor damage
- Before proceeding with pipeline assembly, take into account any design recommendations.
- It is recommended to wrap the pipelines only after performing a leak test of the plant.
- In the case of long pipelines, special attention should be paid to thermal expansion. The coefficient of thermal expansion for CuFe2P (K65) is 0.0176 mm/m K.
- Required distances between supports for pipelines depend on pipe size, according to the table below:

Outer pipe diameter (d)	Maximum distance between supports
d ≤ 1/2”	1 meter
1/2” < d ≤ 7/8”	2 meters
7/8” < d ≤ 2 1/8”	3 meters
2 1/8” < d ≤ 2 5/8”	4 meters

- When the evaporator is located lower than the condensing unit, about 0.5% slope of suction line towards the unit and use of oil traps is required.
- Insulation of suction and liquid pipeline with proper pipe covering is required. Protection against external factors and weather conditions must be considered, including birds and UV protection.
- The sections of the liquid line in which the liquid can be cut off should be protected against unplanned, excessive pressure increase (e.g. with a by-pass line or a safety valve).
- Evaporators and suction line fragments that can be cut off should be protected against unplanned, excessive pressure increase (e.g. with a by-pass line or a safety valve).
- The unit has its maximum allowable installation length (between the unit and evaporator) of 40m. Exceeding that limit is possible only after approval by your local supplier

On the suction line, a mechanical suction filter should be installed in front of the unit to protect the unit from contamination. The selected filter must not cause excessive drop of the refrigerant pressure, and the maximum allowable pressure PS should be higher than the setting of the safety valve used on the suction part of the plant. To ensure the best possible protection of the OCU unit, it is recommended to place the filter as close as possible to the refrigerant inlet to the unit.

On the liquid line, at the inlet to the expansion element in the installation before the evaporator, it is recommended to place a mechanical filter to protect the expansion element. Otherwise, waste from the installation could reduce or block the flow.

2.9.1 Oil trap

On the suction pipe at the outlet from the evaporator, behind the space provided for mounting the temperature sensor of the electronic expansion valve, a siphon is installed, in which the oil-and-refrigerant mixture is collected. The siphon of the suction pipeline ensures that the oil is entrained upwards, but not more than three meters high.

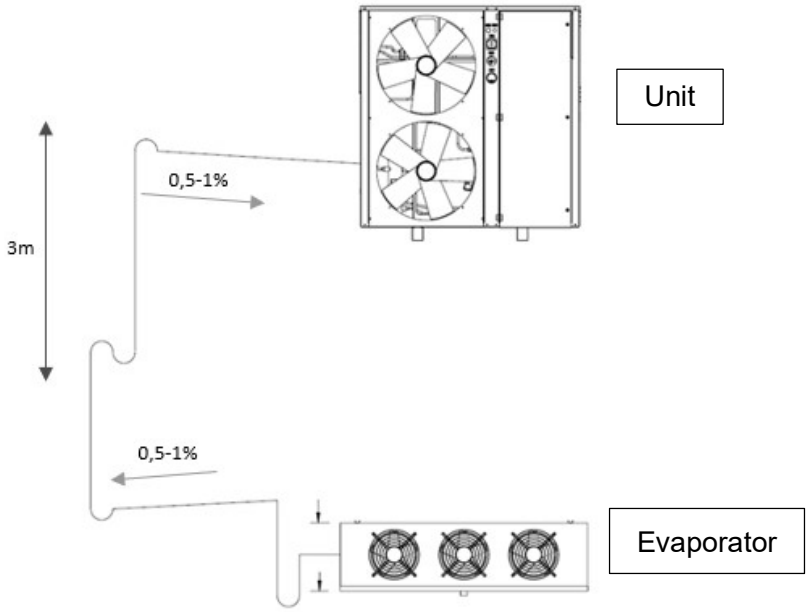


Figure 2.2 Principle of oil siphon operation and routing of suction line in the case of a relative height difference of up to 6 m. In case of height in range 6 – 10m (max. height) oil siphon in every 2m is required.

To reduce a risk of flooding the compressor with liquid refrigerant due to incomplete evaporation of the refrigerant in the evaporator, always use the siphon behind the evaporator, the highest point of which is above the evaporator, and a liquid separator on the suction.

It is necessary to maintain proper spacing between oil traps in case of a height difference between the unit and the evaporator. For a height difference of up to 6 meters, oil traps must be installed every 3 meters. For a height difference of 6 to 10 meters, oil traps must be installed every 2 meters. It is prohibited to install the unit with a height difference of more than 10 meters between the unit and the evaporator.

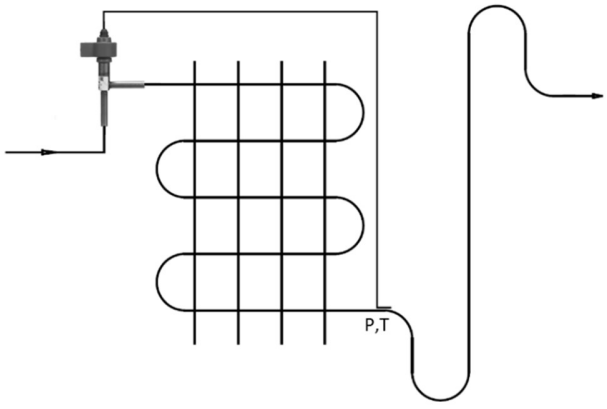


Figure 2.3 Location of siphon in the system.

The placement of the suction pipe outlet on the evaporator depends on the height difference between the compressor and the evaporator. The pipeline must be routed differently when the evaporator is on the same level as the compressor, and differently when the compressor is below the evaporator. This is very important because of proper return of oil from the evaporator and due to better evaporation of the refrigerant in the evaporator and reducing the risk of flooding the compressor with a liquid refrigerant.

If the evaporator is located above the compressor, which is often the case in large systems, it is recommended to pump down the refrigerant before stopping the compressor.
If the evaporator is situated below the compressor, oil traps should be made on the vertical sections.

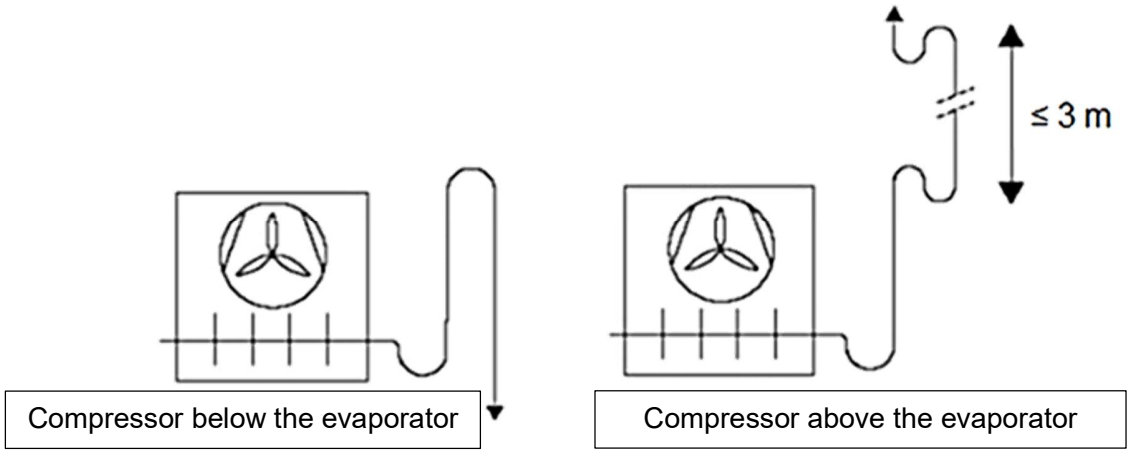


Figure 2.4 Pipeline routing depending on compressor location relative to evaporator. On the right, for a relative height difference of up to 6m. In case of height in range 6 – 10m (max. height) oil siphon in every 2m is required.

3. Transport and storage

Warning: Danger of injury!

Block stacking is not allowed.

During transport and storage, unit should be transported exclusively on a palette.
Lifting by means of sling belts attached to palette is permissible.

Lifting and moving the unit should be performed using units designed for this (forklift, crane, etc.). Machines used for lifting the unit must meet the requirements of Directive 2006/42/EC, have adequate load capacity and be approved for use.

Never go under a suspended unit.

Unless the unit is transported manually, maintain safe distance from the transported unit of at least 1.5 m.

Tilting the unit is not allowed. The unit must stand levelled.

Store the unit in shaded area in temperatures between -25°C and +50°C.

The unit with package shall not be subjected to rain, corrosion environment or direct sunlight.

After unpacking, make a judgement whether the unit is undamaged and complete. Noticed discrepancies should be reported to supplier.

During transport and storage, the unit should be protected against humidity and dust (e.g. foil, carton)

Use of pipes, condenser collecting pipes or fittings to lift the unit is forbidden.

4. Assembly

4.1 Safety notes

Lift and move the unit using equipment designed for this purpose (forklift, crane, etc.)

The staff operating the hoisting equipment should have appropriate qualifications.

When moving the unit, the operator should use appropriate tools to protect the unit against shaking and damage.

4.2 Place of installation of the unit

- Before installing the unit, please read the section 2.5 “Unit positioning”
- After receiving the unit, check that:
  - It was not damaged during transport (each unit is packed),
  - There are no leaks in the unit (each unit is filled with dry nitrogen around at a pressure of approx. 10 bar),
  - The components of the unit (pipelines, pressure switch, etc.) have not been damaged,
  - The compressor has the correct amount of oil; if it has an oil sight glass, it should be filled up to ¾ of its volume,
  - The equipment matches the order.
- If the unit is installed in a seismic zone, the installer should follow all the required regulations.
- After installation, sufficient space should be left around the unit to allow performing maintenance works.

4.3 Location of service valves in the unit

The service valves are located inside the unit, in the left part of the compressor chamber. Each valve is protected by a brass nut protecting the process connection and a plastic cap that covers the rotalock service key grip.

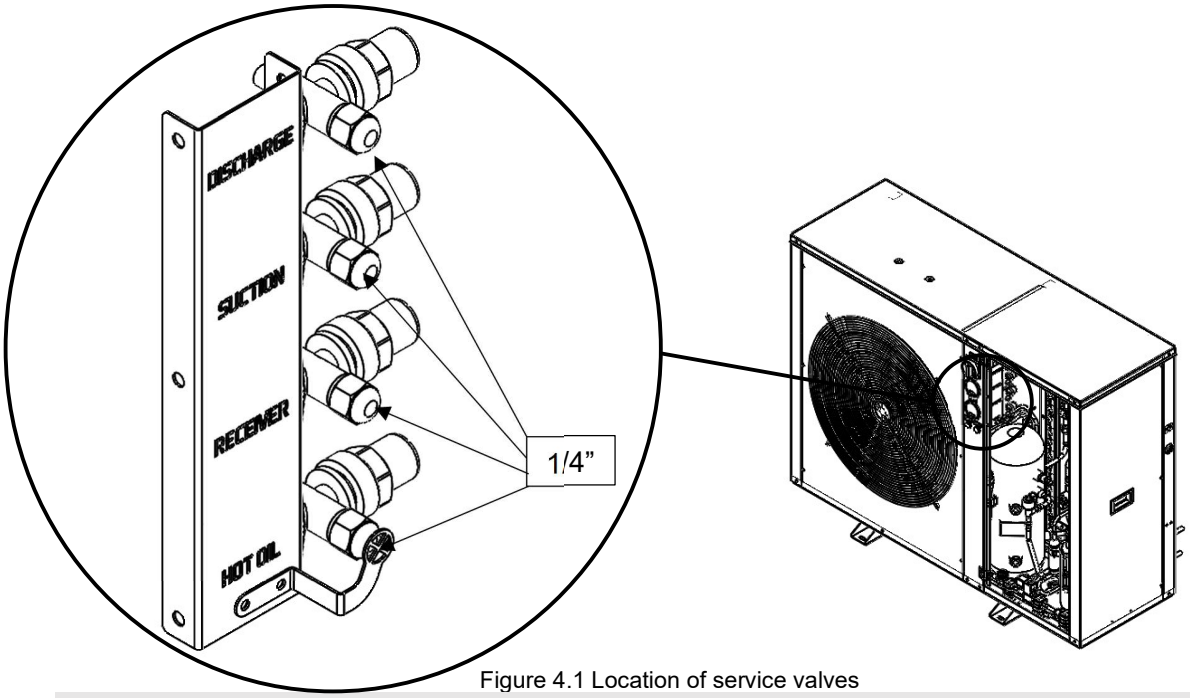


Figure 4.1 Location of service valves

4.3.1 Identification of service valves

DISCHARGE - service valve with a process connection on the discharge side of the compressor, between the compressor and the oil separator.

RECEIVER - service valve with a process connection between the receiver and the filter drier.

SUCTION - service valve with a process connection on the suction side of the compressor, between suction line shut-off valve and suction line check-valve.

HOT OIL - service valve with connection on the side of the oil circuit between the oil cooler and the oil sight glass.

5. The test of strength and leak-tightness

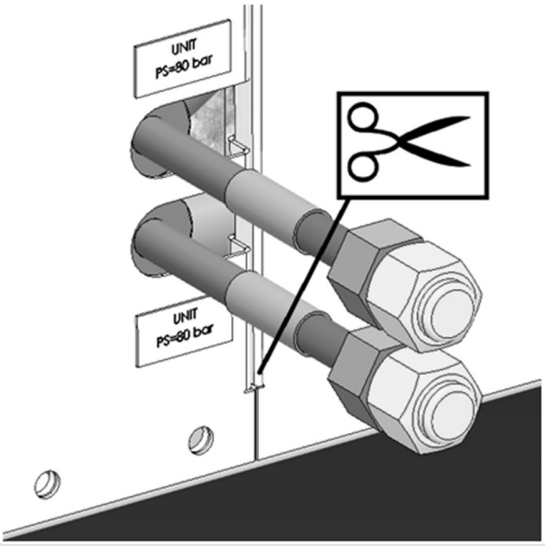
Before starting work, read the general safety notes.

After connecting the unit to the system, it is necessary to carry out a test of the strength of the system and then a leak test.

The device is equipped with sealed connections terminated with 3/8" SAE-type fittings, secured with threaded service caps. Before connecting to the system, the service caps must be carefully unscrewed, which will result in a controlled release of pressure (approximately 10 bar of nitrogen). Next, the SAE fittings should be cut off in accordance with the installation procedure.

Due to the risk of leakage at the evaporator expansion valve(s), it is recommended to install an additional ball valve on the suction line of the system. This will facilitate the diagnosis of the source of internal leakage, allowing determination of whether the issue lies within a component of the condensing unit or improper operation of the expansion valve in the system.
It is important to avoid situations where a section of the system could be isolated without proper protection—appropriate safeguards must be applied.

The condensing unit should not be left open to the surrounding atmosphere. It must be connected to the completed system immediately during the commissioning process. The entire system should then remain under positive pressure to eliminate the risk of moisture ingress.



5.1 Safety notes

The personnel performing the strength test must have the appropriate permits and qualifications for conducting the test.

The personnel performing the strength test must be equipped with personal protective equipment, such as protective gloves, safety glasses, helmet, appropriate clothing, etc.

Do not use flammable, explosive, toxic or highly chemically active gases for the pressure test of the system (including oxygen — in contact with oil, the mixture may ignite or explode and cause injury or even death).

Use inert gases, such as dry nitrogen, for pressure testing.

The system must not be approached when the system pressure exceeds the maximum allowable system pressure (PS). Rupture of the system may cause injury.

It is necessary to use a reducer to achieve the test pressure (at least 90 bar).

5.2 Introductory information

- The delivered unit has passed the strength and leakage tests. There is no need to repeat the tests for the unit itself, provided there was no interference in the unit‘s cooling system.
- During the strength test, the safety valves on the receiver and on the suction line should be screwed out, and the stubs for their connection on the system should be plugged.
- After successful tests, the safety valves must be screwed into appropriate connections on the system.
- The strength and leak-tightness tests should be documented in the form of a test report.

5.3 Tools and materials needed

- A set of pressure hoses adapted to the pressures that will be applied during the test (at least 90 bar).
- A set of refrigeration pressure gauges adapted to the pressures that will be applied during the test (at least 90 bar).
- Cylinders with dry nitrogen (4.0) in an amount that allows obtaining the test pressure in the entire system.
- Key for Rotalock valves
- Pressure regulator that allows to obtain pressure of at least 90 bar.
- Plugs in place of the installation of safety valves (1/2” NPT).

Detailed list of service tools needed for commissioning is available in chapter 16.2 *„Basic service tools recommended for OCU-CRC060A08”*

5.4 Strength test

Before commencing, read the safety notices and the introductory information. The strength test involves exceeding, in a controlled manner, the maximum allowable pressure (PS) by 10%, in order to ensure that the system will not leak/rupture up to the safety valves set point.

- When performing the strength test, unscrew the safety valves located on the receiver of the unit and the suction part of the system.
- The personnel involved in conducting the strength test should be kept to a minimum. At least two people are needed to perform the test: One person is performing the test, and the other one is supervising.
- No unauthorized persons are allowed near the system during the strength test. If parts of the system are ruptured, there is a risk of injury.
- During the strength test, it is forbidden to stay near the test part of the system. If parts of the system are ruptured, there is a risk of injury.
- After safety valve replacement, fresh thread adhesive should be applied.

If a leak is found, lower the pressure by 10 bar, wait to ensure that there is no system degradation, and then locate the leak.

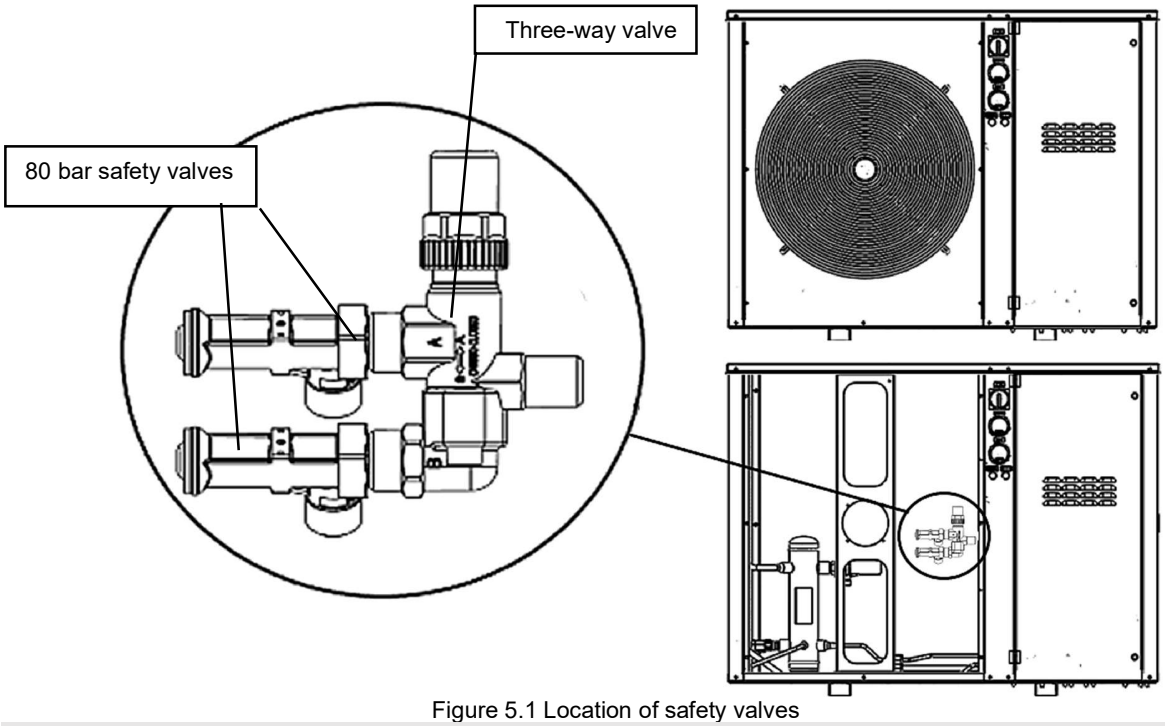


Figure 5.1 Location of safety valves

5.4.1 Achieving the strength test pressure

The final pressure of the strength test should be achieved gradually, with incrementation of the setting on the pressure reducer. Do not approach the unit without first reducing the pressure below the maximum allowable pressure (PS).

Before starting the test, check the following:

- Correct connection of test instruments.
- The nitrogen cylinder valve should be closed.
- The nitrogen reducer should be set to the minimum operating pressure.
- The valves of refrigeration gauges should be turned off.

Nitrogen should be released from the plant through the unconnected low pressure valve on the pressure gauges set.

In order to obtain the test pressure:

1. Check that all valves within individual section should be opened.
2. Open the nitrogen cylinder valve.
3. Open the shut-off valve on the pressure reducer. The output pressure must not exceed 25 bar.
4. Open the high-pressure valve gradually on the set of refrigeration gauges. The system should start filling with nitrogen.
5. After equalizing the pressures, the system can be filled to the maximum allowable pressure (PS) level. Do not exceed the maximum allowable pressure of the tested part of the system (PS). The recommended rate of pressure increase is approx. 5 bar/min.
6. It is recommended to stop filling the system approximately every 20 bar, wait 2–3 minutes, and then inspect the system for leaks and damage.
7. Check if there has been a pressure increase in the neighboring sections. If there is an increase in pressure, check the positions of the shut-off valves of each section.
8. After reaching the maximum allowable pressure of a given section of the system (PS), it is possible to start filling the system to the level of the strength test pressure (PT).
9. Open the high pressure valve minimally. The rate of pressure increase from the maximum allowable pressure (PS) to the test pressure (PT) should not exceed 1 bar/min.

10. After reaching the test pressure, close the valve on the reducer and the valve on the nitrogen cylinder. Leave the unit for 30 minutes.
11. After 30 minutes, gradually reduce the pressure in the system to the maximum allowable pressure (PS).
12. Inspect all walls and connections.
13. The result of the test is considered positive if no cracks, permanent deformations, tears or leaks were found during the test.
14. Proceed to the next section test, taking into account the maximum pressure of the section.

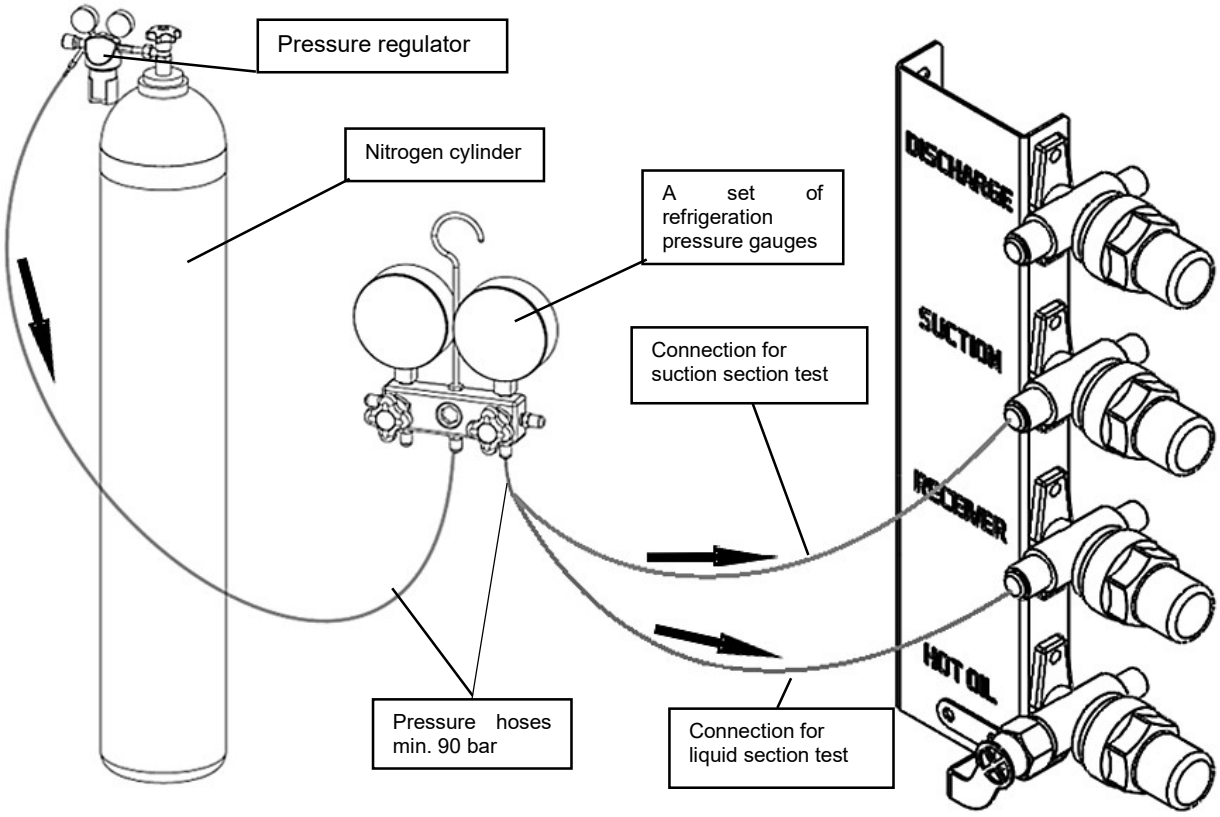


Figure 5.2 Connecting components for strength and leakage tests

5.5 Pressure drop caused by leaks or pressure equalization in the system

During the strength and leakage tests, pressure drops can be observed, which may result from pressure equalization in the tested section of the system or leakage.

In the case of pressure equalization, the rate of pressure drop decreases over time until the pressure stabilizes. In the case of leaks, the rate of pressure drop remains at a similar level and the pressure does not stabilize.

Below is an example diagram showing the differences for both cases. The exact rate of change in pressure can vary depending on the size of the system, the size of the leak, the filling rate and other factors.

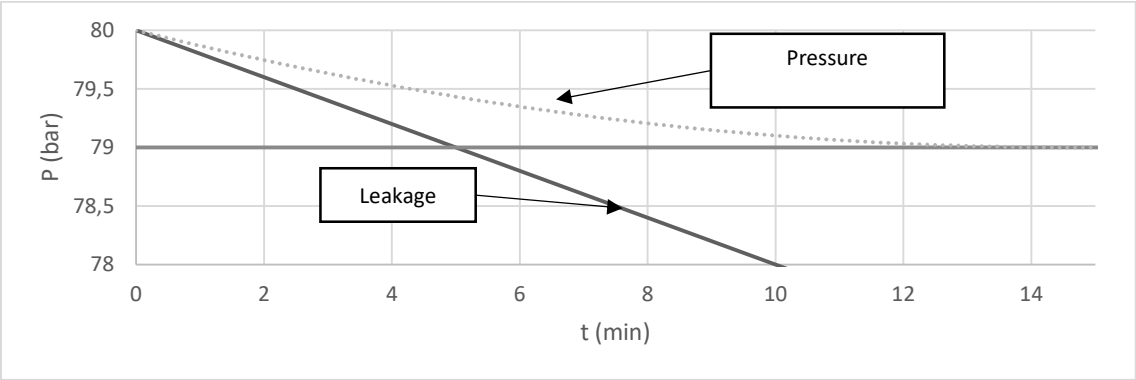


Diagram 5.1 Pressure drop in case of leaks and pressure equalization

5.6 Leak-tightness test

The leak-tightness test should be conducted at the pressure inside the system not greater than the maximum allowable system pressure (PS). For refrigerants with GWP <150, leak-tightness means that there is no leakage detectable by a method that allows to obtain accuracy of 10^{-3} Pa m^3/s or better, e.g. applying water to the test surface with an admixture of a foaming agent or using a spray to detect leaks on the inspected surface. Other methods of leak-tightness testing can be found in European standard EN 1779. Lower pressures are allowed while maintaining the minimum required accuracy. Each leak should be removed and the repaired section should be subjected to a new strength and leak-tightness test.

5.7 Completion of tests

After successful testing of strength and leak-tightness, the safety valves should be reinstalled on the system and a report on the performed tests should be prepared. After assembly of the safety valve, check the tightness of the connection, e.g. using water with a foaming agent or a special solution. The system is ready for filling with the refrigerant.

6. Preparing the system for filling

Before starting work, read the general safety notes. In systems using carbon dioxide as a refrigerant, it is very important to remove any residual nitrogen, air and moisture form the system. In particular, it is important to thoroughly dry the system, because moisture in contact with carbon dioxide forms carbonic acid, which can lead to damage of the system.

6.1 Refilling oil in the installation

The installation should always be refilled with PZ68S oil.

In the event of a leak in the system or due to the opening of the safety valve, it is required to add the missing oil in the system till the oil alarms in the unit disappear. Do not overcharge unit with the oil.

To support this process, PANASONIC provides a dedicated tool in the form of the online R744 PANASONIC charge calculator, which enables precise calculation of the required amount of additional oil. This tool is available on the PANASONIC PROCLUB platform.

In order to refill oil:

1. Refilling oil can be carried out only after emptying CO2 from the system according to procedure described in section 9.2 *„Emptying the system”*.
2. Close the shut-off valves on the unit.
3. Connect the vacuum pump with a flexible hose to the open DISCHARGE service valve.
4. Connect one end of the hose to the open HOT OIL service valve. Make sure the SUCTION service valve is closed.

5. Place the other end in a vessel with the correct amount of oil. The vessel should be above the service valve so that it can flow down to the unit by gravity.
6. Switch on the vacuum pump. The oil in the vessel will be sucked in by the unit. Avoid sucking air into the unit.
7. After sucking in the whole amount of oil, plug the end of the hose with your finger so that all the oil in the hose flows into the unit.
8. Close the HOT OIL and DISCHARGE valves.
9. Turn off the vacuum pump.
10. The unit is ready for vacuum preparation procedure described in chapter 6.5 *„Vacuum preparation”*.

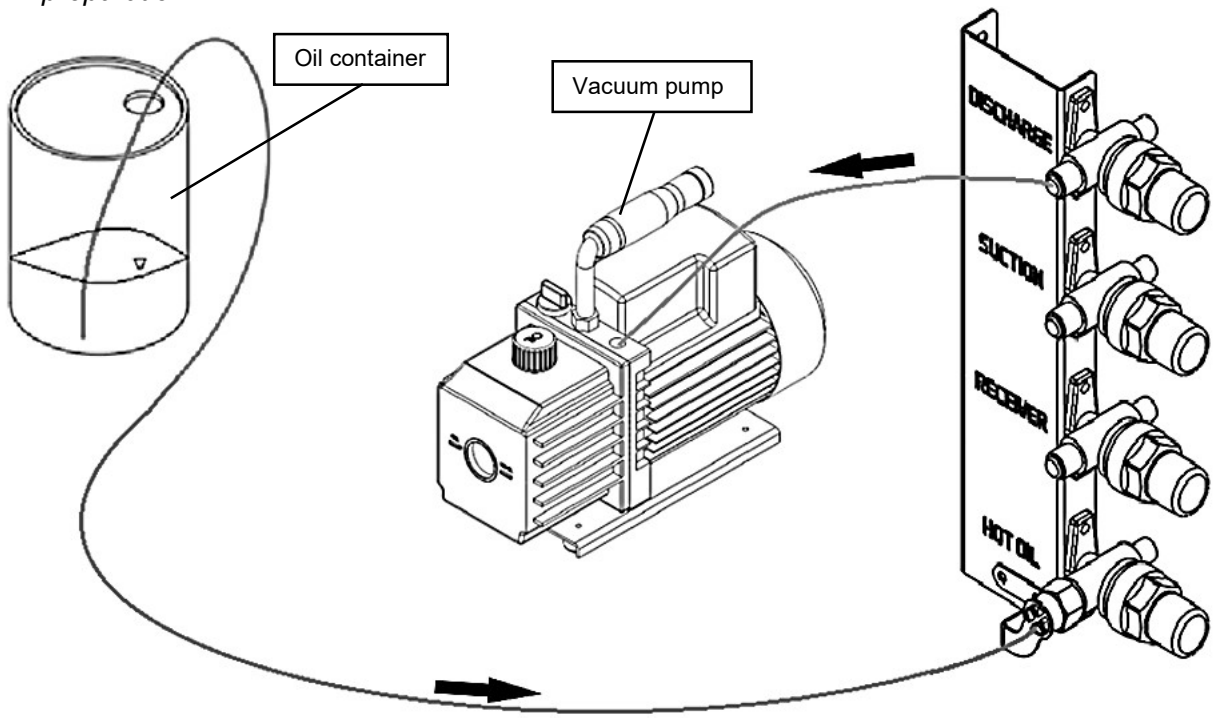


Figure 6.1 Connection of components when adding oil.

6.2 Tools and materials needed

- Vacuum pump, allowing to obtain a vacuum of 0.02 mbar.
- Pressure hoses. In order to accelerate the preparation of the vacuum, it is recommended to use hoses with enlarged inside diameter (e.g. 3/8” SAE + Adapters 1/4” SAE > 3/8” SAE).
- Vacuum gauge with sufficient degree of accuracy.
- A set of refrigeration pressure gauges
- Key for Rotalock valves
- A set of flat keys.
- A nitrogen cylinder with reducer.
- Adapter for connecting pressure hoses to the nitrogen cylinder reducer.

6.3 Recommended accuracy of the vacuum gauge

1. Analog vacuum gauge:

- Accuracy class: 1
- Minimum measuring range: 0–150 mbar
- Absolute error: 0.02 mbar

2. Digital vacuum gauge:

- Minimum measuring range is 0–50 mbar

- Accuracy ± 10 microns + 10% of the measured value in the range from 100 to 1000 microns (1 mbar ≈ 750 micron)

6.4 Connection of the set

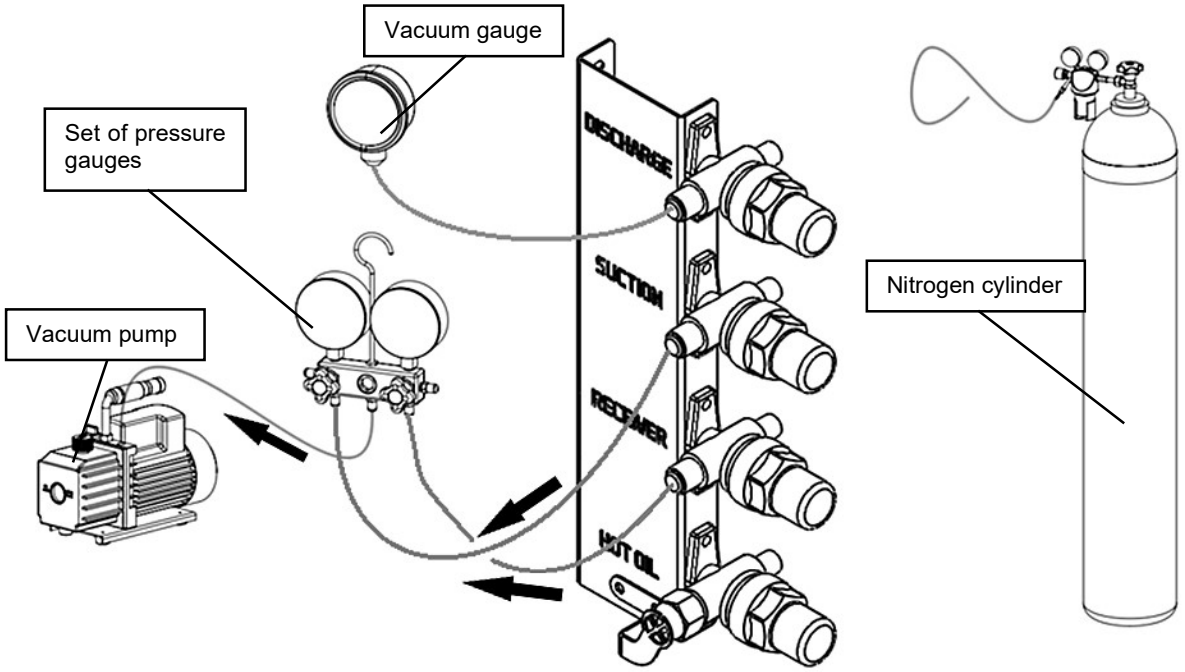


Figure 6.2 Connecting components for vacuum preparation

1. Open all service valves in the unit to a small degree to ensure that there is no overpressure in the system (excessive opening may lead to oil loss). If necessary, keep the valves open until the system pressure equalizes to atmospheric pressure.
2. Close service valves on the unit.
3. Connect the vacuum pump to the middle connector of the pressure gauge set.
4. Using flexible hoses, connect the low pressure connector of the pressure gauge set with a service valve marked **SUCTION**.
5. Using flexible hoses, connect the high pressure connector of the pressure gauge set with a service valve marked **RECEIVER**.
6. Connect pressure gauge to the **DISCHARGE** section.
7. Open all valves on the plant:
   a. HPV and RPV control valves in the unit (manually using dedicated service magnets or valve controller)
   b. Shut-off valves
   c. Expansion valves on the system, on evaporators (manually using dedicated service magnets or valve controller)
8. The set is ready to create the vacuum in the system.

6.5 Vacuum preparation

If there is a vacuum inside the system, do not perform any compressor motor insulation checks or start the compressor. It may damage it.

In order to ensure thorough drying of the system, it is recommended to fill the system with dry nitrogen several times and drain the system. To do this, follow these instructions:

1. Open the **SUCTION**, **RECEIVER**, **DISCHARGE** service valves on the unit.
2. Open the valves of the pressure gauge set.

3. Start the vacuum pump. The system pressure should decrease.
4. When the pressure on the vacuum gauge reaches the desired value, close the service valve to which it is connected (DISCHARGE).
5. Disconnect the vacuum gauge.
6. Connect a hose from the nitrogen cylinder (from the reducer) to the free service valve (DISCHARGE).
7. Open the valve on the nitrogen bottle and reducer.
8. Slightly loosen the nitrogen hose nut at the service valve in order to push the air remaining in the hose through the nitrogen.
9. Carefully tighten the nitrogen hose nut on the service valve.
10. Close the valves on the pressure gauge set.
11. Open the service valve (DISCHARGE). The system should start filling with nitrogen.
12. Fill the system to approx. 5 bar and then close the valve on the nitrogen bottle.
13. Close the service valve (DISCHARGE) and disconnect the hose from the nitrogen bottle. Leave the system for a few minutes.
14. Minimally open the service valve (DISCHARGE) and empty the nitrogen from the system.
15. When the system pressure is near atmospheric, reconnect the vacuum gauge and fully open the service valve. Make sure that the system pressure does not exceed the permissible overload pressure of the vacuum gauge and does not damage the system.
16. Open the valves on the pressure gauge set again and start draining the system again.
17. Repeat the procedure described in items 4–16 three times.
18. After three repetitions of steps 4–16, leave the vacuum pump turned on until a vacuum of **2 mbar (1500 micron)** is achieved.
19. After creating the vacuum, close all service valves, turn off the vacuum pump and leave the system for about two hours.
20. Check that there is no moisture or leaks in the system, as instructed in section *6.6 „Is there moisture in the system?"*
21. If no moisture or leaks are found, the system can be filled.

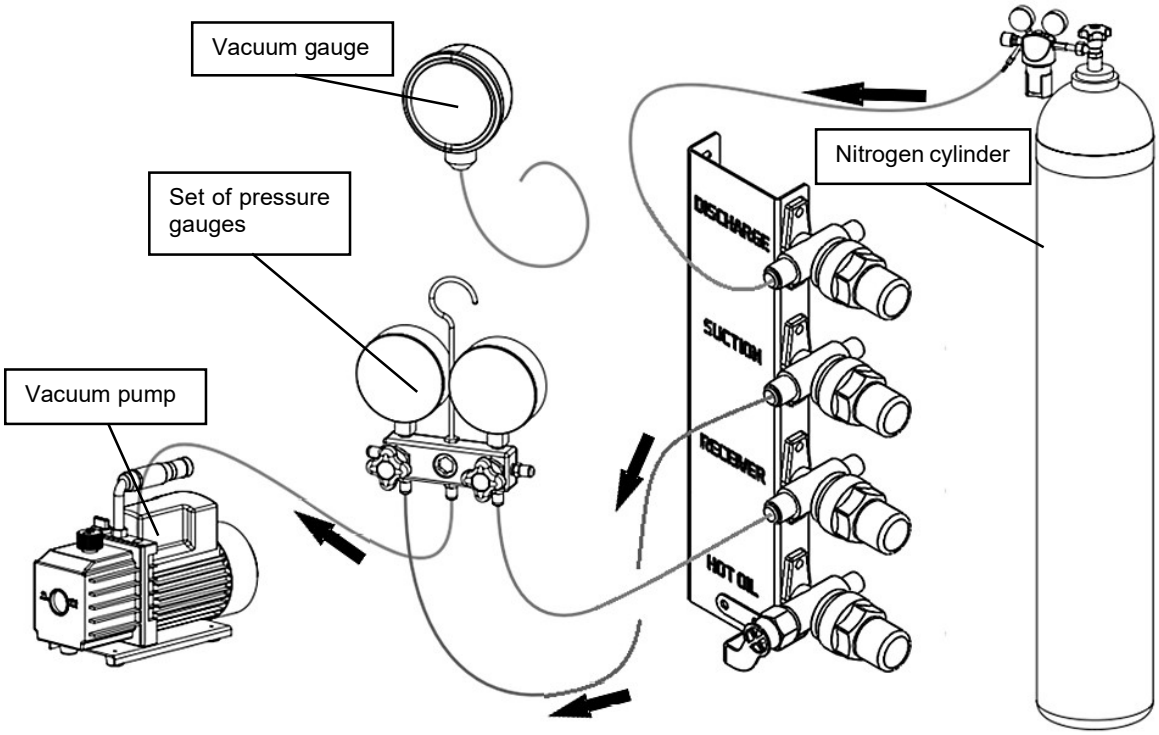


Figure 6.3 Connecting components for flushing system with dry nitrogen

6.6 Is there moisture in the system?

Check the vacuum level about two or three hours after completing the system evacuation process. If there is an increase in pressure, it may indicate the presence of moisture or leakage in the system.

The presence of moisture in the system can be determined by accurately measuring the vacuum pressure inside the system. If there is moisture in the system, after some time the pressure in the system will increase to the level of steam saturation pressure for a given ambient temperature, e.g.:

- If the ambient temperature of the system is 20 °C and there is moisture in the system, the pressure in the system will increase to about 23.4 mbar
- If the ambient temperature of the system is 40 °C and there is moisture in the system, the pressure in the system will increase to about 73.8 mbar

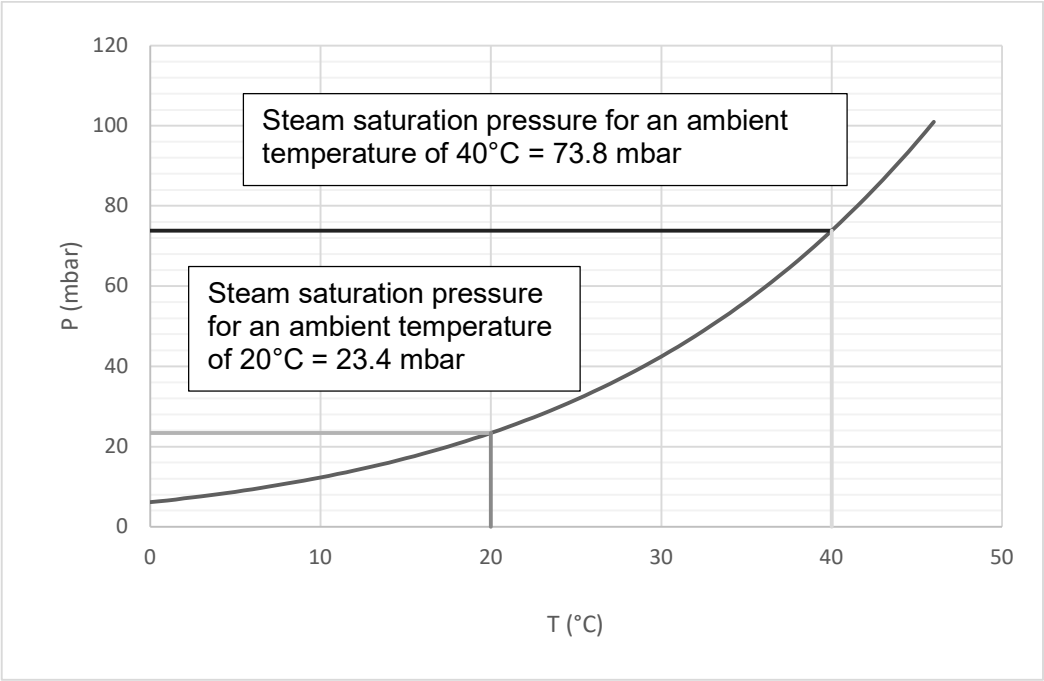


Diagram 6.1 Steam vapor saturation pressure depending on temperature

If, however, there is a leak in the system, the pressure inside the system will continue to increase until it equalizes with atmospheric pressure.

Example Steam saturation pressure at an ambient temperature of 20°C is 23.4 mbar. If at an ambient temperature of 20°C, after creating the vacuum and waiting for two or three hours, the system pressure is:

- Greater than 23.4 mbar, then there is leak in the system.
- Equal or lower than 23.4 mbar, the system is hermetic, but there is moisture in it.
- Less or equal to 2 mbar, the system is tight and free of moisture.

Below is an example of a pressure increase in time in the case of leakage and in the case of the presence of moisture in the system (the times shown in the graph are approximate and largely depend on the size of the system).

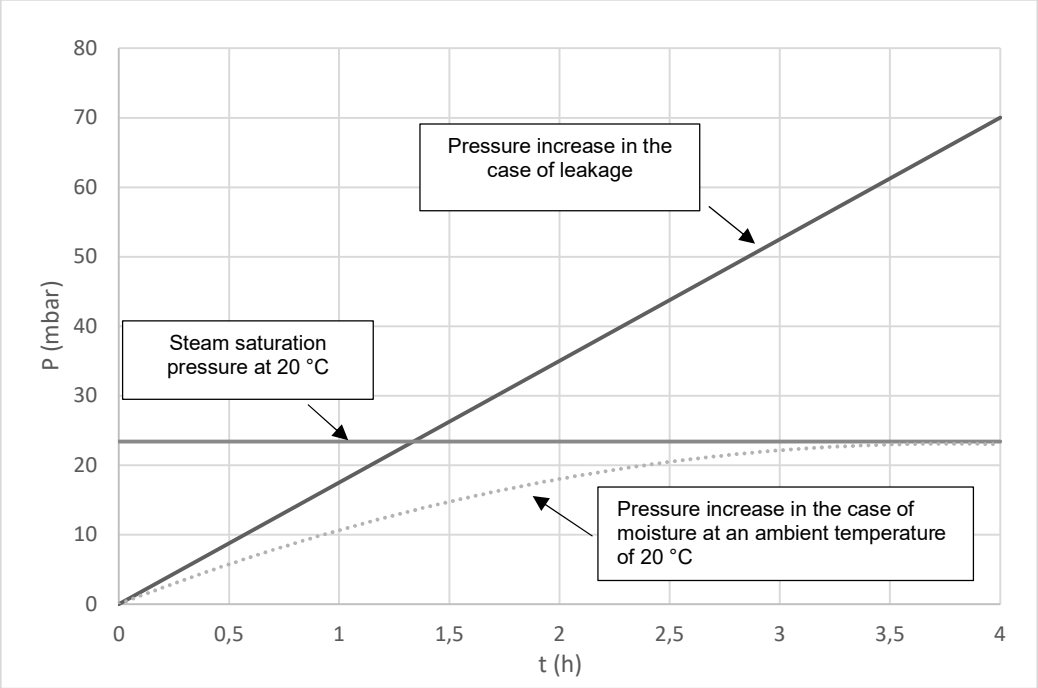


Diagram 6.2 Example increase in vacuum pressure if there is moisture or leakage in the system at an ambient temperature of 20°C

7. Filling the system

7.1 Safety notes

The personnel filling the system must be equipped with personal protection equipment, such as protective gloves, safety glasses, helmet, appropriate clothing, etc.

The personnel filling of the system should have appropriate qualifications for the operation of systems using supercritical carbon dioxide as a refrigerant.

Never use burners to heat the cylinder.

During filling operations cylinders should be secured against tipping and equipped with a collar.

Cylinders must not be placed near heat sources.

7.2 Required tools

- Cylinder containing carbon dioxide with a purity class of at least 4.5, with a valve in the gas section or a double valve for the gas and liquid section.
- Optionally, additional cylinder containing carbon dioxide with a purity class of at least 4.5, equipped with a valve in the liquid section.

- A set of refrigeration pressure gauges adapted to work with supercritical carbon dioxide (upper range of a high pressure gauge must be at least 160 bar)
- A set of flexible hoses for connecting refrigeration pressure gauges to the unit, suitable for operation with supercritical carbon dioxide (maximum allowable pressure at least 160 bar)
- Key for Rotalock valves
- Flexible hose for connecting refrigeration pressure gauges with a cylinder or cylinder adapter.
- Refrigerant scale with an accuracy of ± 0.01 kg.

7.3 Before filling

In the case of systems using carbon dioxide as a refrigerant it is very important to accurately determine the correct amount of refrigerant to be used for filling. It is not recommended to fill the system more than it is required. In order to determine the correct charge of the system please refer to the chapter 7.4 ”Calculating the amount of R744 charge and oil charge”
When filling the system, the amount of refrigerant allowed into the system should be carefully controlled by means of a scale. Do not allow the installation to be overcharged. The amount of refrigerant required for proper operation of the unit should be calculated by the installer (if necessary, consult with with your local supplier)

7.4 Calculating the amount of R744 charge and oil charge

Each unit model has specific limitations regarding the maximum amount of refrigerant and the maximum installation length. Therefore, before starting the system, the refrigerant amount must be carefully calculated.
To support this process, PANASONIC provides a dedicated selection and calculation tool, available online on the PANASONIC PROCLUB platform.

If there are any doubts regarding the calculations or how to use the calculator, please contact your local supplier.

Do not exceed the values indicated by the PANASONIC online system charge calculator.
This tool must always be used to determine the required refrigerant and oil charge. Exceeding these values or the unit’s limits may result in improper operation and, ultimately, damage to the equipment.

Always use the R744 PANASONIC on-line system charge calculator.

7.5 Preparation of the system filling set

When connecting the service valves, ensure they remain closed at all times. It is very important to remove residual atmospheric air from all hoses and pressure gauge sets before filling the system.

As carbon dioxide hoses usually do not have shut-off valves, the following steps are recommended.

7.5.1 Pre-filling and filling with gas cylinder.

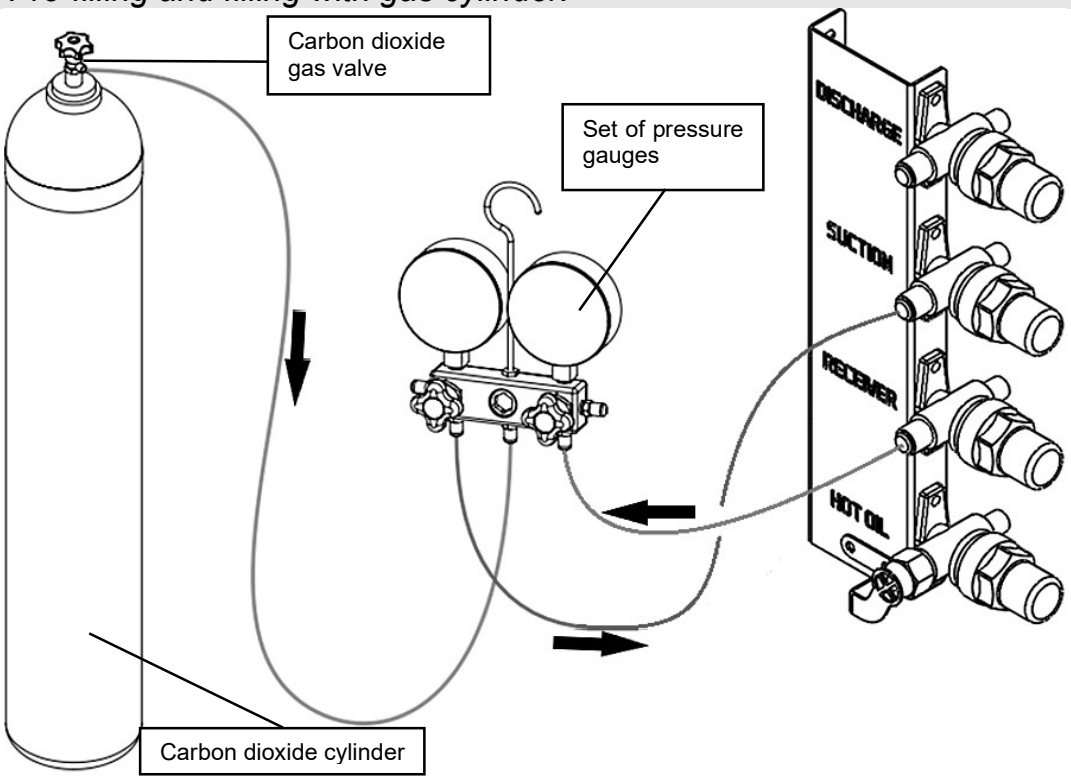
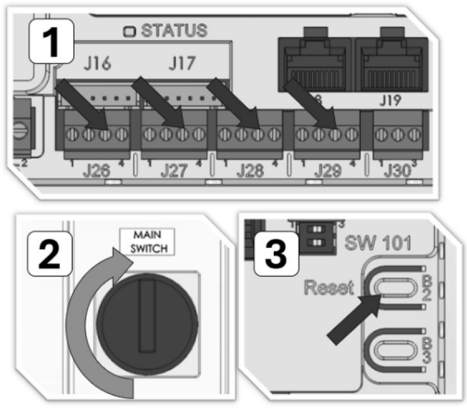


Figure 7.1 Connecting components for gas filling

1. The cylinders should be connected to the middle connector of the pressure gauge set, with a hose adapted to the pressure in the cylinder.
2. Using flexible hoses, connect the low pressure connector of the pressure gauge set with a service valve marked **SUCTION**. Tighten the hose nut at the service valve by hand, leaving a small leakage.
3. Using flexible hoses, connect the high pressure connector of the pressure gauge set with a service valve marked **RECEIVER**. Tighten the hose nut at the service valve by hand, leaving a small leakage.
4. Ensure that the valves on the low pressure side and the high pressure side of the pressure gauge set are closed.
5. Minimally open the gas valve on the carbon dioxide cylinder.
6. Open the valve of the low pressure section of the pressure gauge set. Gas should start to escape at the service valve of the unit, labeled **SUCTION**. Carbon dioxide from the pressurized cylinder pushes out the remaining air from the pressure hoses. If the flow is insufficient, the pressure hose nut can be further loosened to release the air out of the hoses more quickly.
7. After a few seconds of flushing, only carbon dioxide should remain in the hoses. Fully tighten the pressure hose nut on the service valve.
8. Close the valve on the low pressure section of the pressure gauge set.
9. Repeat steps 6–8 for the high-pressure section and the service valve labeled **RECEIVER**
10. Close all service valves on the unit.
11. Close all the expansion valves of evaporators on the system and all electronic expansion valves in the unit.

Before start final charge procedure close all electronic expansion valves (the unit is supplied with all expansion valves opened (controller plugs disconnected). Before starting the compressor or liquid charge place the valve plugs in the appropriate place in the controller (sticker on electrical box: “ATTENTION”) and power the unit . If the unit has already been powered, it is necessary to position the valves (using the reset button (B2) no. 3 when the compressor is not working and the unit is powered or by turning the main power supply of the unit off and after 20 second on again no.2).



12. The system is ready for filling.

7.5.2 Filling with liquid (not recommended)

Filling with liquid can only be done after pre-filling (with gas) to 10 bar.

Before start liquid charge procedure close all electronic expansion valves (the unit is supplied with all expansion valves opened (controller plugs disconnected).

In order to improve the liquid filling process, it is recommended not to connect a set of pressure gauges; instead connect the cylinder directly to the unit.

1. The cylinder should be connected with flexible hoses with a service valve in the unit marked with the label RECEIVER. The flexible hose must be adapted to the pressure prevailing in the cylinder and the unit. Tighten the hose nut on the valve on the cylinder by hand, leaving a small leakage. Fully tighten the nut at the service valve.
2. Open the RECEIVER service valve on the unit. Gas should start to escape from the valve on the cylinder. Carbon dioxide from the unit under pressure pushes residual air from pressure hoses. If the flow is insufficient, the pressure hose nut can be further loosened to release the air out of the hoses more quickly.
3. After a few seconds of flushing, only carbon dioxide should remain in the hoses. Fully tighten the pressure hose nut on the cylinder.
4. Close the RECEIVER service valve.
5. The system is ready for filling with liquid.

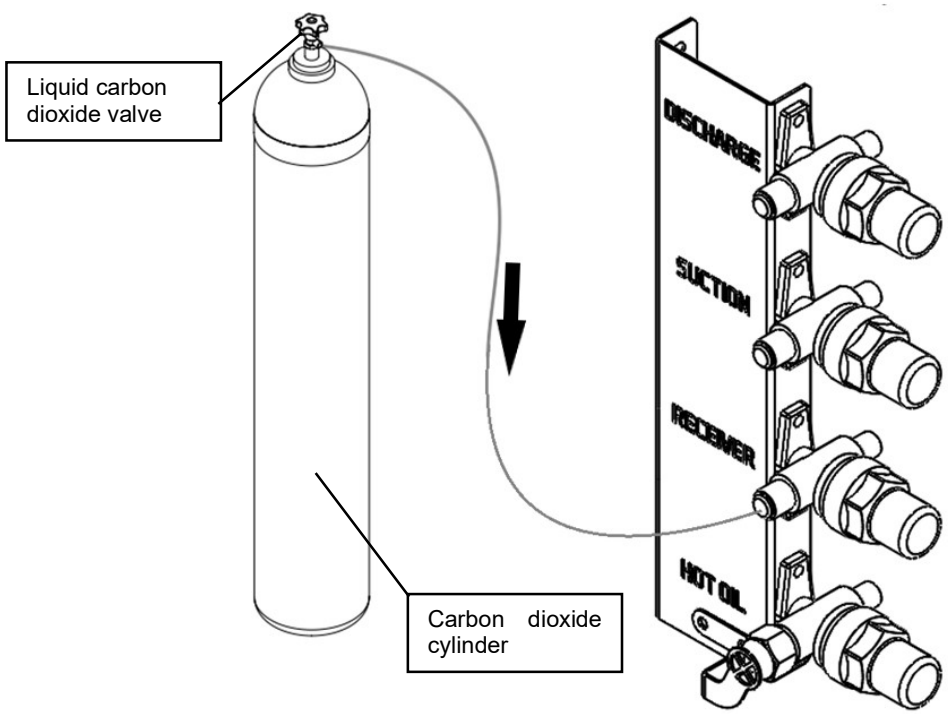


Figure 7.2 Connecting components for filling with liquid

7.6 Filling

Every time before servicing, make sure that the service hoses do not contain any residual air. For this purpose, refer to procedures 7.5.1 or 7.5.2 depending on the selected filling method. If there is a vacuum in the system, pre-filling must be done first. When filling the system, monitor the amount of refrigerant fed to the system. Do not allow the system to overload.

7.6.1 Pre-filling

If all steps from sections 5 *„The test of strength and leak-tightness”*, 6 *„Preparing the system for filling”* and 7.5.1 *„Pre-filling and filling with gas cylinder”,* have been completed, proceed to pre-fill the system. ”

Since in the pre-filling phase the pressure in the system is lower than the pressure of the triple carbon dioxide point, there is a risk of dry ice creation, which can lead to clogging of the flexible hoses or parts of the system. To avoid this, the system should be filled with carbon dioxide gas to a pressure of at least 10 bar.

Before starting the pre-filing operation, make sure that all possible valves on the refrigerant side in the system and in the unit (ball, regulating, expansion) are open. Ensure that gas can flow freely to every part of the system.

1. Open the SUCTION and RECEIVER service valves. The gas in the hoses between the service valves and the set of refrigeration pressure gauges will flow into the system.
2. Slowly open both valves on the refrigeration gauge set. The gas from the cylinder will flow into the system.
3. Continue filling until 10 bar overpressure is achieved in both pressure gauges.
4. Close the valves on the pressure gauge set.
5. If a cylinder with a liquid phase valve is available, go to section 7.6.2 *„Filling with liquid (not recommended) ”*, otherwise, go to the section 7.6.3 *„Gas prefilling (recommended)”*.

7.6.2 Filling with liquid (not recommended)

Take special care when filling the system with liquid carbon dioxide. Liquid must not be cut off in the filling hose. It may lead to excessive pressure increase and rupture of the cut-off section.

Special care should be taken when handling liquid refrigerant. Contact with a liquid refrigerant may cause frostbite.

It is forbidden to fill the suction part of the system with liquid.

Filling with the liquid fraction can only be done when the carbon dioxide in the system is at an overpressure of at least 10 bar. Liquid filling may only be started after "flushing" the pressure hoses in accordance with procedure 7.5.2 *„Filling with liquid"*. During filling, the pressure in the receiver should be monitored and it should never exceed the permissible values. The expansion valves for evaporators on the system should be closed.

1. Ensure that the service valve on the unit, marked with the **RECEIVER** label, is open.
2. Open the liquid fraction valve on the cylinder.
3. Liquid carbon dioxide should begin to flow into the receiver of the unit.
4. If the filling process has stopped (the cylinder's weight is not decreasing), it may mean that the pressure in the cylinder and in the unit is equal and that it will no longer be possible to fill the unit with liquid. In such case:
    a. Replace the cylinder with a new one. Remember to remove any residual air from the pressure hoses before resuming the filling
    b. Heat the cylinder using the band heater installation, increasing the pressure in the cylinder.
5. Close the shut-off valve on the cylinder with the refrigerant, when it reaches the desired filling level
6. Close the service valve on the unit and immediately loosen the hose nut at the service valve to unseal and release the contained liquid carbon dioxide.

Do not allow pressure to build up in the hose. The liquid phase in a small closed volume can cause a large increase in pressure and, in extreme cases, burst the hose. Exercise caution when in contact with liquid carbon dioxide. It may cause frostbite.

7. Go to the gas filling section.

7.6.3 Gas prefilling (recommended)

Start gas filling only after "flushing" the pressure hoses in accordance with procedure 7.5.1 *„Pre-filling and filling with gas"* or immediately after pre-filling in accordance with the procedure 7.6.1 *„Pre-filling"* The purpose of gas filling is to obtain the same gas pressure at each system location, while paying attention to the maximum allowable pressure of each section and the value of carbon dioxide saturation pressure at ambient temperature.

Before starting the pre-filling operation, ensure that all possible valves on the refrigerant side in the system and in the unit (ball, control valves) are open.

The expansion valves for evaporators on the system should be closed.

1. Open the valve on the gas cylinder.
2. Open the service valves labeled **SUCTION** and **RECEIVER** on the unit
3. Gradually open the low and high pressure section valves on the refrigeration gauge set.
4. The cylinder and system pressures should equalize.

5. Monitor the system pressure. Do not exceed the maximum permissible pressure of each section.
6. Do not exceed the carbon dioxide saturation pressure for ambient temperature to avoid refrigerant condensation on the suction line of the compressor.
7. Due to the flow of carbon dioxide from the cylinder to the system, the pressure in the cylinder is reduced. It may happen that the pressure drop will make it impossible to fill the system from the connected cylinder. In such case, replace the cylinder with a new one; remember to remove any residual air from the pressure hoses before resuming the filling.
8. If, despite the above steps, it is not possible to fill the system with sufficient volume, go to the final filling step.

7.6.4 Final filling with gas.

- Final filling can only be done when the entire system is ready for commissioning:
  - The system is pre-filled with refrigerant
  - Evaporators are powered and ready to run
  - Unit is powered and ready to run
  - In order to accelerate filling of the system, it is recommended to maximally lower the set point of the unit. Forcing a lower suction pressure results in a greater pressure difference, and consequently — acceleration of the refrigerant flow.
- The final filling involves the use of reduced pressure in the suction line of the unit while the unit is in operation. The pressure in the suction part of the system is lower than in the cylinder, thanks to which it is possible to fill the system with gas.
- Start final gas filling only after “flushing” the pressure hoses in accordance with procedure 7.5.1 *„Pre-filling and filling with gas”* or immediately after gas filling in accordance with the procedure 7.6.3 *„Gas prefilling”.*
- Final filling can only be done using a gas-type refrigerant fed to the suction part of the system.

1. Close the valve on the service pressure gauge set on the high pressure side
2. Turn off the **RECEIVER** service valve on the unit.
3. Carefully loosen the hose nut and wait for the pressure to equalize.
4. Open the gas valve on the refrigerant cylinder.
5. Open the valve on the pressure reducer. The set pressure should be higher than the pressure in the suction pipe during operation of the unit (35–40 bar).
6. Open the low pressure valve on the pressure gauge set.
7. Open the service valve on the unit **SUCTION** side.
8. Turn on the unit‘s operation permit switch. After the required idle time (typically about 5 minutes), the unit controller will send an operation permit signal to the evaporators and then start the unit.
9. The pressure in the suction line will decrease and the gas from the cylinder will flow into the system.
10. Continue filling the system until the required filling level is achieved.
11. Due to the flow of carbon dioxide from the cylinder to the system, the pressure in the cylinder is reduced. It may happen that the pressure drop will make it impossible to fill the system from the connected cylinder. In such case, replace the cylinder with a new one; remember to remove any residual air from the pressure hoses before resuming the filling.
12. After achieving the optimum filling, close the service valve on the suction part of the unit **SUCTION** and on the gas cylinder. Carefully open the high pressure valve in the pressure gauge set by releasing pressure from the set. After pressure equalization, disconnect the hoses from the unit.

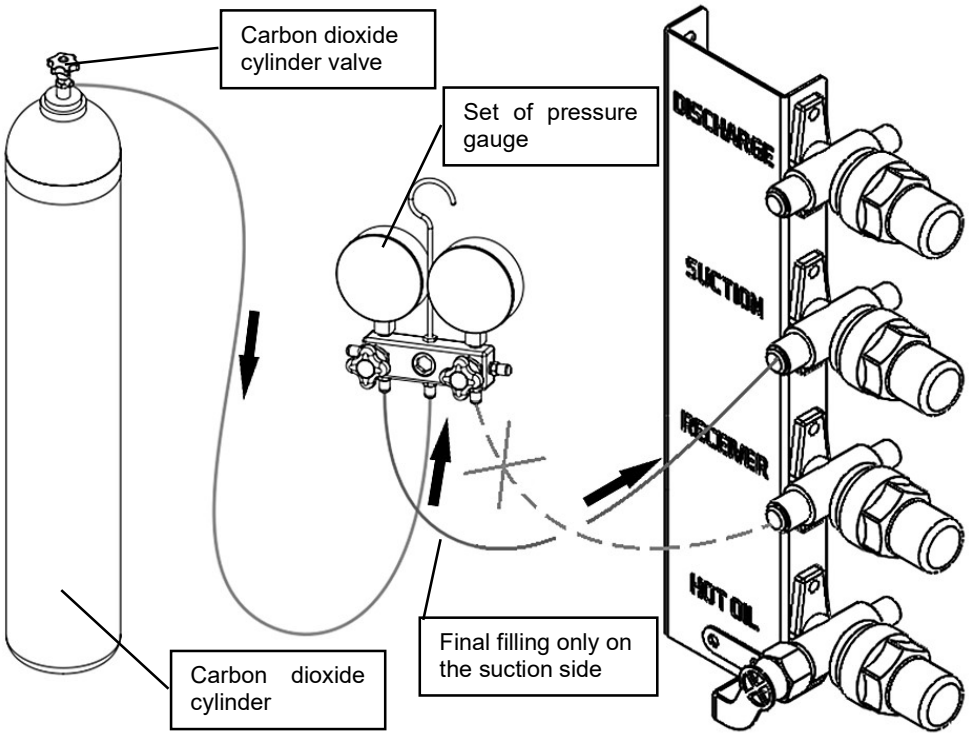


Figure 7.3 Final filling only on suction side of system

8. Operation

8.1 Before commissioning the system

Before commissioning the system, check:

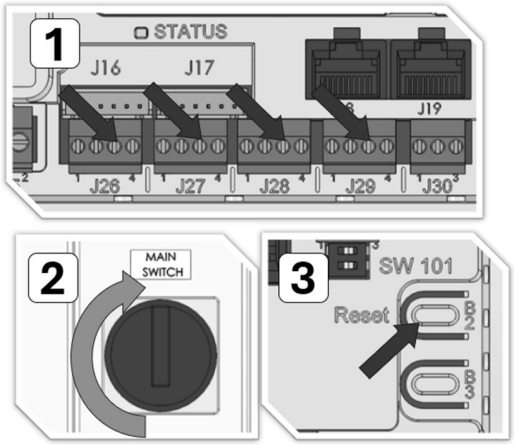
- Correct electrical connection of the unit, in accordance with the electrical section of the 10 *„Electrical power supply."*
- Ball valves on the unit should be open.
- Service valves should be closed.
- The coils of control valves on the unit should mounted on the valves.
- Place the valve plugs in the appropriate place in the controller (sticker on electrical box: "connect after prefilling")
- Coils of expansion valves at evaporators should be mounted on the valves.
- Position electronic expansion valve using the reset button when the compressor is not working and the unit is powered or by turning the main power supply of the unit off and after 20 second on again). The unit is supplied with all electronic expansion valves in the open position (controller plugs disconnected). If the unit has already been powered, it is necessary to position the valves. If the unit has not been powered when the expansion valve plugs are connected, the valves will automatically position the first time power is applied.
- Control of expansion valves at evaporators should be set in automatic mode (parameterized and ready for operation).
- Parameters of the unit controller.

8.2 After commissioning the system

- All service valves in the system should be fitted with blanking caps.
- After commissioning, put seals on the caps of all ball valves before putting the system into service.

ATTENTION

The controller does not directly detect the current position of the electronic expansion valves. It does not respond to a break in the circuit between the valve coil and the controller - it is prohibited to remove or disconnect the coils while the device is operating. If you suspect that the electronic expansion valves have lost their position, emergency stop the compressor (S1 down), make sure the coils are connected correctly and press the RESET button (B2) on the controller, then restart the unit (S1 up).



8.3 Regular checks

- Once a month, it is recommended to check:
  - Cleanliness of the gas cooler
  - Filling level the system
  - Operation parameters
    - Cooler superheat controller.
    - Pressure and temperature.
    - Sight glass reading.
    - Leak-tightness.
  - Refrigerant sight glass reading
  - Status of electrical connections
  - Alarm history
  - General condition of the unit
- At least once a year, it is recommended to clean the gas cooler in the unit.

8.4 Cleaning

During cleaning of the fins, there is a risk of cuts – sharp edges.
Protective gloves must be worn

- When cleaning the gas cooler, be very careful not to bend or damage the fins of the exchanger.
- It is recommended to clean the gas cooler with:
  - Compressed air.
  - Brush made of non-metallic materials.
- Avoid all aggressive detergents that can corrode copper, aluminum and steel. Use only dedicated cleaning agents.

9. Service works

9.1 Planned shutdown of the refrigeration unit

In the case of a planned shutdown of the refrigeration unit, it is permissible to leave it idle under specific environmental conditions. Due to the risk of excessive pressure increase in the system, which may cause the safety valves to activate, the unit may be taken out of operation only if the ambient temperature does not exceed the limit value of 25°C. The device must be located in a properly ventilated area to ensure that, in the event of safety valve activation, the permissible concentration of carbon dioxide in the air is not exceeded.

For temporary shutdowns of up to 3 months, the following guidelines must be observed:

- Safety valves must be installed and operational.
- All ball valves must remain in the open position to allow pressure equalization within the system.
- The unit should be monitored for ambient temperature increases.
- If the permissible ambient temperature is exceeded, the unit must be started or measures must be taken to reduce the pressure.

If the planned shutdown period exceeds 3 months:

- The refrigerant must be drained according to the procedure described in Section 9.2.

9.2 Emptying the system

Carbon dioxide is an asphyxiant gas. Gas may not be emptied in closed rooms. It may lead to suffocation.

Because carbon dioxide is a gas with little potential to create the greenhouse effect (compared to other refrigerants), it may be released into the atmosphere.
As a rule, no recovery of carbon dioxide from the system is required.
The system should be emptied through a service valve connected to the section in which gas carbon dioxide is present, which will prevent oil loss and blockage of the outlet with dry ice.
Start from discharging the refrigerant from the high and low pressure section to the level of the lowest maximum allowable pressure in the system. Slowly release the refrigerant through the DISCHARGE service valve. Do not allow excessive gas outflow due to the possibility of oil entrainment.
Then open all shut-off, control and expansion valves to ensure that the system is completely empty:

- Gas cooler pressure control valve (HPV)
- Receiver pressure control valve (RPV)
- ECO valve
- Expansion valves on evaporators
- Shut-off valves on evaporators (if exists)

When the system pressure drops to approx. 5 bar, dry ice will form from the liquid residue inside the system. Its residues can still evaporate for a relatively long time. In order to speed up this process, it is recommended to stop the emptying and fill the system to about 7–10 bar with dry nitrogen; this will cause the dry ice to slowly change back into liquid and accelerate its evaporation. After about fifteen minutes, the system can be fully emptied.
After emptying, close all open service valves. The system should not be left in a depressurized state. This may cause moisture to enter the system.

9.3 Disposal of refrigeration equipment and systems

Electrical and electronic devices, including refrigeration systems, must be disposed of in accordance with Directive 2012/19/EU (WEEE) and national environmental protection regulations. The device and its packaging must not be discarded with household waste. Packaging should be sorted for recycling, and the device should be delivered to an authorized e-waste collection point or returned to the retailer when purchasing a new device.

The crossed-out wheeled bin symbol indicates that the product is subject to selective waste collection. Proper disposal supports resource recovery and protects human health and the environment.

The device contains refrigerant under high pressure.

Do not dispose of the device with the refrigerant and oil inside**, as this may pose a risk of fire or explosion.

Incorrect disposal may result in legal penalties in accordance with applicable legislation.

9.4 Replacement of the filter drier

The location of the filter drier is shown in the refrigeration diagram in chapter 15.2 *„Cooling diagram."* The filter type can be found in the spare parts list — annex 15.1 *„List of spare parts."*
If the system is found to be wet, based on the liquid line sight glass reading, the filter drier should be replaced in accordance with the following procedure.
Procedure for replacing the filter drier:

1. Empty the system from the refrigerant in accordance with the procedure 9.2 *„Emptying the system."*
2. After the installation is completely empty proceed with desoldering the used filter and installing a new filter (the filter type is included in the spare parts list)
3. Conduct the strength test described in chapter 5 *„The test of strength and leak-tightness"*, verifying the strength of the newly made connection from sub-point 2 at a test pressure of PS + 10% = 88 bar
4. Conduct the leak-tightness test, verifying the tightness of the newly made connection soldered from sub-point 2.
5. Prepare the system for filling, which includes creating vacuum Fill the system.

9.5 Replacing the safety valve

The unit has one types of safety valves. It is mounted on the receiver through a three-way valve.

Before replacing any safety valve, stop and disconnect the unit from the power supply. The valves are located in the gas cooler chamber, and the accidental start-up of the unit, and consequently the activation of the fans, can lead to personal injury.

9.5.1 Replacing the safety valve on the oil separator

Replacing the safety valve on the receiver does not require releasing the refrigerant from the system due to the use of a three-way diverter valve. Replacing the safety valve on the oil separator Replacing the safety valve on the oil separator requires first removing the refrigerant from the HP section. To do this, close the ball valve on the compressor's second discharge and the ball valve behind the gas cooler control valve (HPV). Slowly release the refrigerant through the DISCHARGE service valve. Do not allow excessive gas outflow due to the possibility of oil entrainment. After equalizing the pressure with atmospheric pressure, the valve can be

dismantled. When installing a new valve, ensure to set the valve to **120 bar**. The screwed connection should be sealed with a dedicated paste. Once the valve is mounted, the connection can be checked for tightness by filling the section with nitrogen. Next vacuum must be created. Close the service valve. Open the ball valves cutting off the section. Feed 0.5–1.5 kg of refrigerant to the unit, while monitoring the liquid line sight glass and the system operation. Feed the refrigerant as described in section 7.6.4 *„Final filling with gas."*

9.5.2 Replacing the safety valve on the liquid receiver

Replacing the safety valve on the receiver does not require releasing the refrigerant from the system due to the use of a three-way valve. The three-way valve operating instructions are provided in the annex. 15.4 "Simplified electrical diagram". The safety valve on the receiver can only be replaced with a different valve with a setting of 80 bar.

9.6 Compressor replacement

The compressor can only be replaced after the carbon dioxide system has been emptied according to the procedure described in chapter 9.2 *Emptying the system"*. The compressor is connected to the system using flexible SAE hoses. Replacing the compressor involves unscrewing these hoses from the compressor body.

The following hose types are used for each section of the system:

- Discharge line: 5/16"–1/4" SAE hose
- Suction line: 3/8" SAE hose
- Oil line: 5/16"–1/4" SAE hose

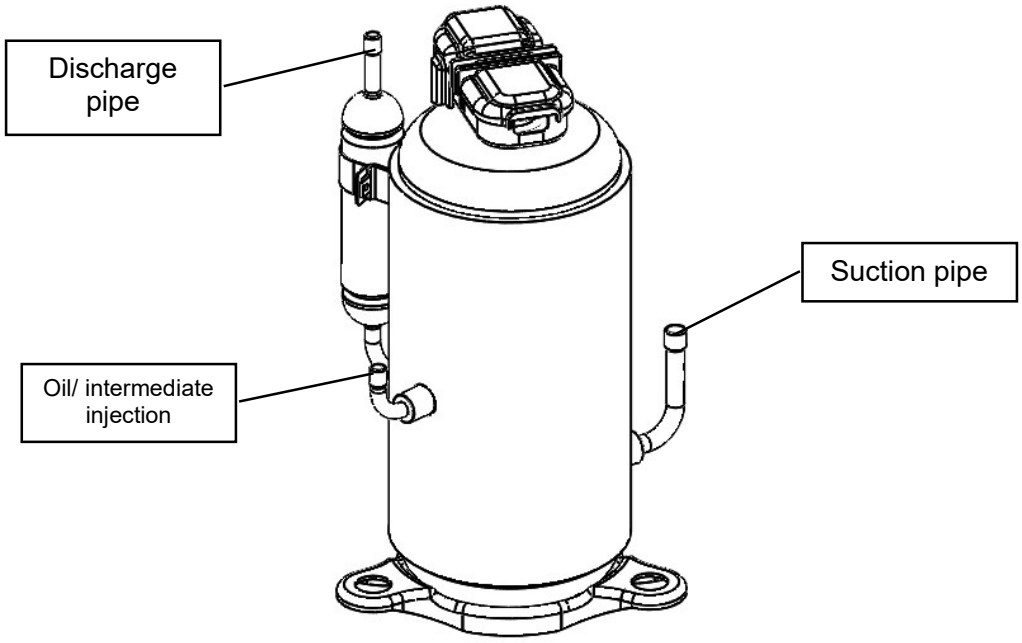


Figure 9.1 Compressor connections

9.7 Pressure transducer replacement

The unit is equipped with three pressure transducers of the same type, located on the suction, discharge, and liquid sections. The transducers operate within a range of 0–160 bar (Ratiometric) and feature a 7/16-20 UNF-2B connection. If a pressure transducer needs to be replaced, the system overpressure must first be released.

The pressure transducers are equipped with push pins. For the suction and discharge transducers, the cooperating service valves are fitted with a Schrader-type valve, which isolates the system from the environment upon transducer removal. The transducer mounted on the liquid receiver does not use a Schrader valve due to the design of the intermediate adapter. It is strictly forbidden to remove the transducer mounted on the receiver while the system is under overpressure.

9.8 Warranty

Details of the warranty provided for the purchased refrigerating units are described in the warranty terms on the warranty card and in the general terms of sale.

10. Electrical power supply

10.1 Safety notes

1. Unauthorized persons should not have physical access to the unit.
2. The unit is powered with life-threatening voltage. Any manipulations near the electrical cabinet, as well as in the vicinity of cooling units, may only be conducted by qualified and authorized personnel who have appropriate professional qualifications and comply with any health and safety rules.
3. The condensing unit should be under constant supervision.

10.2 Protection class of the unit (shock protection)

The unit is made in protection class I.
OCU units have a complete electrical installation and have been tested at the factory.
The user only needs to properly connect the power supply.

Due to the fact that the generator's inverter has a leakage current exceeding 3.5mA, an additional protective connection of the generator should be provided (in accordance with IEC 61800-5-1) in the form of a separate PE cable (yellow-green) with a cross-section not smaller than the cross-section of the power cables connected to the a separate terminal (or housing if such a connection is provided), or use a reinforced PE cable (cross-section of at least 10 mm2).

Residual current unit (RCD)
If a residual current unit (RCD) must be used as additional protection against electric shock (requirement due to the location of the generator installation), only a type B RCD (with delay) can be used on the power supply side of the generator.
If a type A residual current circuit breaker is present in the power supply circuit but is not used to protect the generator, it may be necessary to use a circuit breaker with a higher tripping current (100mA or 300mA).

10.3 Notes on commissioning

1. Commissioning of the unit should be entrusted to persons with appropriate qualifications in the area of refrigeration and electrical installations.
2. Check the condition of electrical screw connections regularly.
3. Only careful commissioning of the refrigeration system guarantees its safe and long-lasting operation.

The electric connection of the unit should be made by a trained and qualified person.

All cables and fuses used must comply with appropriate regulations and standards.

Power connection

The power cord should be connected to the terminals marked –Xz on the electric panel of the unit.

The use of electric wires with too small cross-section may result in voltage drops, increased power consumption and malfunction of short-circuit and overload protection. This can lead to damage of the compressor and condenser fans and is a risk to health and life

Before the first commissioning or after a long standstill of the unit, check that the electric cables supplying the unit are not damaged and that the screw connections of the electrical components are not loosened!

The unit has capacitors that remain energized (slowly discharged) after the power supply is disconnected. After disconnecting the power supply, wait 15 minutes before starting any repair or service work!

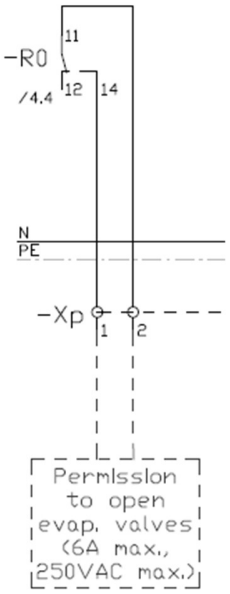
10.4 Unit power

The units have a switch labeled –S1 on the electrical board for controlling the unit operation permit.

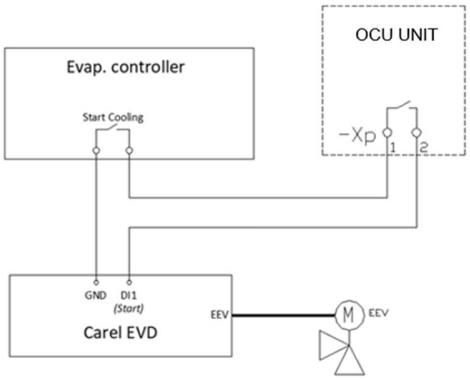
10.5 Operation permit clamps for refrigeration appliances

In CO2 systems pressure difference play a more important role than in HFC systems due to the generally higher pressure level. For this reason, it is very important to protect the compressor against low superheating and liquid that may escape from the evaporators if the compressor is not running. Therefore, PANASONIC requires that all OCU CO2 units need be connected to the evaporator controllers so that only the unit can enable the cooling process to start (allowing the expansion valves to open or opening the solenoid valve on the evaporator liquid line).

The unit is equipped with clamps on the electrical board, labeled -Xp: 1,2, for communication with refrigeration appliances. These connectors should be connected to the controllers in all appliances installed in the system. The signal “permission to open evaporation valve” is designed to prevent the appliances from opening their expansion valves when the unit is not ready for operation. This avoids a dangerous situation related to the presence of liquid on the compressor suction.



An example of a connection when using the Carel EVD superheat controller:



- Connect the signal from the PANASONIC unit in series with the Start signal on digital input 1 (DI1) of the EVD controller
- It is also possible to use a digital input with the "Stop cooling" (or "Forced closing") function in the cabinet/chamber controller (if the controller supports such a signal, there is a free digital input for it)
- The signal should be connected to the controllers of all evaporators (furniture/refrigeration chambers) in the installation.
- If there is more than one evaporator, it may be necessary to use an additional relay to "multiply" the signal to the other evaporators.

10.6 Commissioning

Begin the procedure after checking the correctness of the installation, performing the strength and leak-tightness tests, creating vacuum, connecting to the electrical network and filling the system with refrigerant.

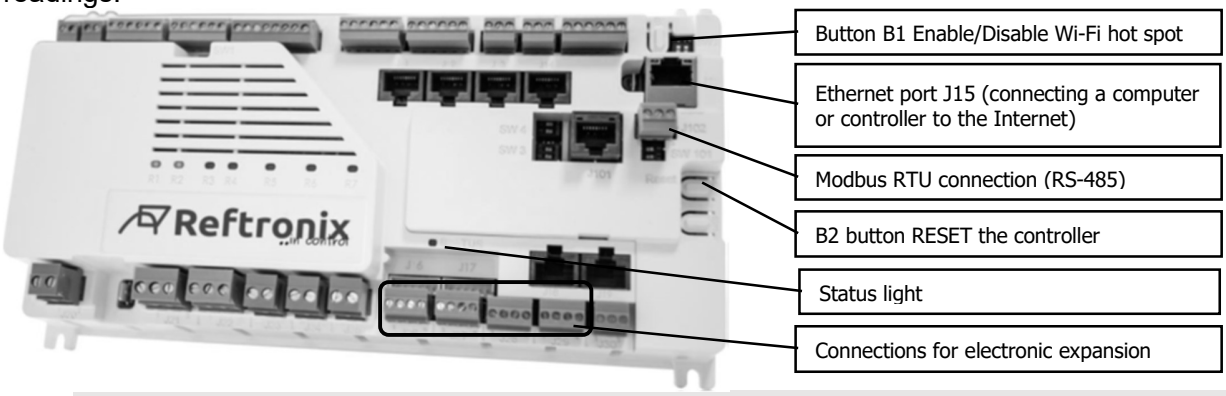
1) Make sure that the S1 switch is set to “0”.
2) Check if all shut-off valves are open.
3) Activate the power supply of the unit.
4) Wait for the compressor to warm up, i.e. to a temperature of 20 K above ambient temperature, or for 12 hours.

5) Switch on the external operation permit signal.
6) Switch the S1 switch to operating mode.

11. Reftronix controller operation

11.1 General information

Operation of the unit is controlled by an electronic parameterized controller dedicated for CO2 applications. The controller is designed to maintain the compressor suction pressure at the user-defined level; it controls the operation of the converter compressor, gas cooler fan and HPV/RPV valves. The controller performs the functions described above based on pressure and temperature readings.



11.2 Connection with controller

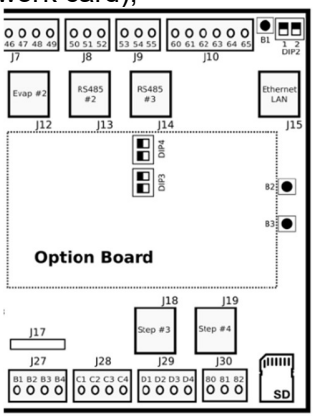
Dedicated software allows two forms of connection with the controller:

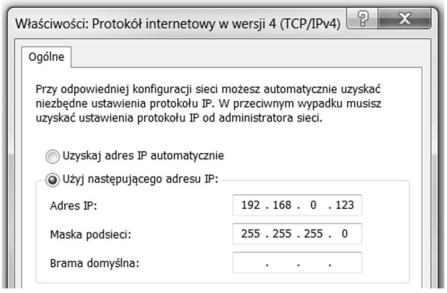
1) Standard, wired Ethernet connection (using a computer),
2) Wireless connection, via the built-in Wi-Fi module (using a computer, tablet or phone),

11.2.1 Ethernet connection

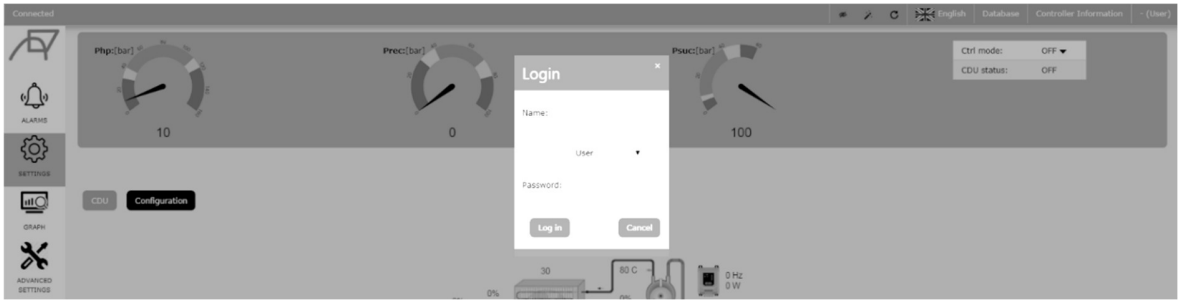
Connection algorithm:

- On the computer, in the local area connection settings, enter the IP address of the same group as the controller e.g. 192.168.10.123,
- Using an Ethernet cable, connect the controller to the computer
  (use only the J15 socket, marked with the red square; using another socket may damage the network card),





- in the web browser, enter the following address: 192.168.10.100, and press Enter,
- when the connection is established correctly, the following view of the controller's control panel with the login screen will appear on the monitor screen,

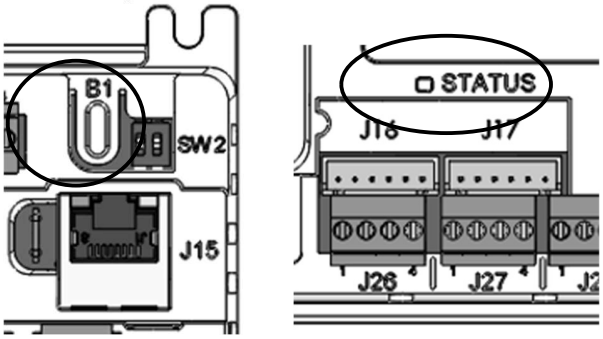


- in the Name field you can enter any user name; it is recommended to enter initials, as this will be used for tracking any changes made by the user. Next choose one of the available user types:
    - User — preview of basic work parameters, login without a password,
    - Service — preview of basic work parameters and the possibility of changing selected parameters, default password: 1111.

11.2.2 Wi-Fi Connection

Connection algorithm:

- Press and hold the B1 button (indicated by the circle below) for about 10 seconds until the LED8 starts flashing faster (at a rate of approx. 5 times per second); LED8 is located above the J16 connector of the expansion valve.



- Wi-Fi access point, called *CDU_XXXX* (last 4 digits of the serial no. of Reftronix), will be activated; find it in the available Wi-Fi networks on the unit and connect to it using the following password: *Reftronix*,

- in the web browser, enter the following address: 192.168.10.1, and press Enter,
- when the connection is established correctly, the view of the controller's control panel with the login screen will appear on the monitor screen,
- in the Name field you can enter any user name, e.g. initials, as this will be used for tracking any changes made by the user. Next choose one of the available user types:
    - User — preview of basic work parameters, login without a password,
    - Service — preview of basic work parameters and the possibility of changing selected parameters, default password: 1111.
- after completion of the maintenance works, switch off the Wi-Fi access point by pressing and holding the B1 button until the LED8 starts flashing slower (at a rate of approx. 1 time per second); the access point will turn off automatically after 15 minutes of user inactivity in the Internet browser.

11.3 Control panel of the controller

Description of the main desktop functions:

Status of the connection with the controller

Settings wizard

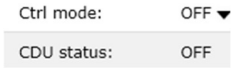
Refresh page

Select the available version

Manage driver parameter database

Information about the controller and software update

Change user and logout



CDU status bar and selection of the operating mode

Return to the top of the page

List of alarms

Preview of key parameter values

Preview charts

The control panel shows the following real-time pressure data in graphical form: Php — discharge pressure, Prec — pressure in the liquid receiver, Psuc — suction pressure (pressure behind the evaporator).

1016	Compressor suction pressure	-40
1018	P_suc [bar]	100

Parameter descriptions are easily accessible after hovering over them with the mouse cursor.

1006	Act. Cpr Cap [%]	0
1007	T0 ref [C]	0
1015	T_dis [C]	80

Parameters with a number on a black background are editable parameters. To change their value, click on the number, enter the desired value, add a comment and confirm with the “Update” button.

11.4 Description of key operation parameters of the unit

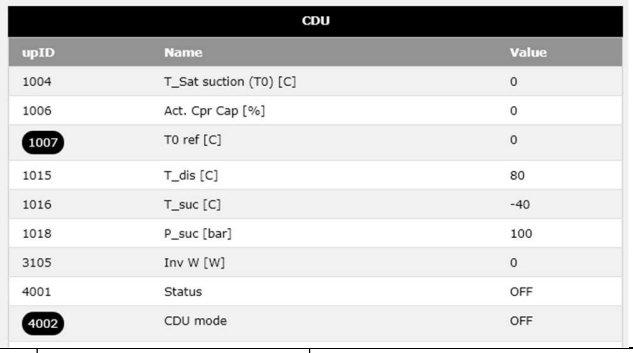
PANASONIC COLD CHAIN POLAND Sp. z o.o. is not responsible for any parameter values entered by the user. All modifications should be conducted with full awareness of the introduced change, based on knowledge and experience, taking into account any foreseeable consequences of such action. Each parameter change affects the operation of the unit and can lead to incorrect

operation and/or damage. Changing the settings or software of the frequency inverter results in immediate loss of warranty.

The units put on sale are already configured with settings for the Reftronix controller and inverter. Modification of settings, if necessary, should be carried out only to a limited extent and may include changing settings such as: suction evaporation pressure upID 1007, pump down limit upID1009, unit status OFF/AUTO/PUMP DOWN/VACUUM mode upID4002, receiver pressure reference (optionally, suggested limits:40-55bar) upID 4204, settings in the evaporator group: upID 102-119, thermostat A upID 5102-5134 and settings related to defrost upID 6102-6125. If it is necessary to change parameters other than those mentioned above, the customer is obliged to consult the proposed changes with the unit manufacturer, and any unauthorized changes are made at his own risk.

The parameters: suction evaporation pressure upID 1007 and pump down limit upID1009 should be modified simultaneously maintaining the temperature difference of 8-12K and taking into account the operating envelope of the modified unit. If the cold room is activated (upID5102=Thermostat), similarly change the chamber temperature parameter: upID5121 and upID5120

11.4.1 Section: Settings - CDU



CDU

upID	Name	Value
1004	T_Sat suction (T0) [C]	0
1006	Act. Cpr Cap [%]	0
1007	T0 ref [C]	0
1015	T_dis [C]	80
1016	T_suc [C]	-40
1018	P_suc [bar]	100
3105	Inv W [W]	0
4001	Status	OFF
4002	CDU mode	OFF

upID	Name	Description
1007	T0 ref [C]	Suction control reference (saturation temperature)
4002	CDU mode: OFF Auto	Current operating mode of CDU

11.4.2 Section: Settings – CDU – Condenser fan

Compressor 1 MT | Condenser Fan | High pressure | Inverter 1 | MT | Receiver

upID	Name	Value
4101	Condenser Status	Off
4103	Ctrl temp [C]	0
4104	Ctrl ref [C]	0
4110	Fan speed [%]	0
4111	Fan freq [Hz]	0
4114	T_ambient	30
4120	Fan control mode	Off
4121	Min Freq [Hz]	10
4122	Max Freq [Hz]	70
4123	Gain (Kp) [%/K]	10
4124	Tn [S]	60
4125	Diff [K]	2
4126	Diff CprCap [K]	2
4128	Min cap [%]	0
4129	Max cap [%]	100
4130	Manual cap [%]	0
4131	Min Tgc [C]	5
4132	Max Tgc [C]	30

11.4.3 Section: Settings – CDU – High pressure

Compressor 1 MT | Condenser Fan | High pressure | Inverter 1 | MT | Receiver

upID	Name	Value
1006	Act. Cpr Cap [%]	0
4110	Fan speed [%]	0
4203	Prec [bar]	0
4205	Vrec [%]	0
4301	HP Status	Off
4302	HP Mode	Off
4303	Php [bar]	10
4304	Php_ref [bar]	0
4305	Vhp OD [%]	0
4306	Gain [%/bar]	5
4307	Tn [s]	60

11.4.4 Section: Settings – CDU – MT

Compressor 1 MT | Condenser Fan | High pressure | Inverter 1 | MT | Receiver

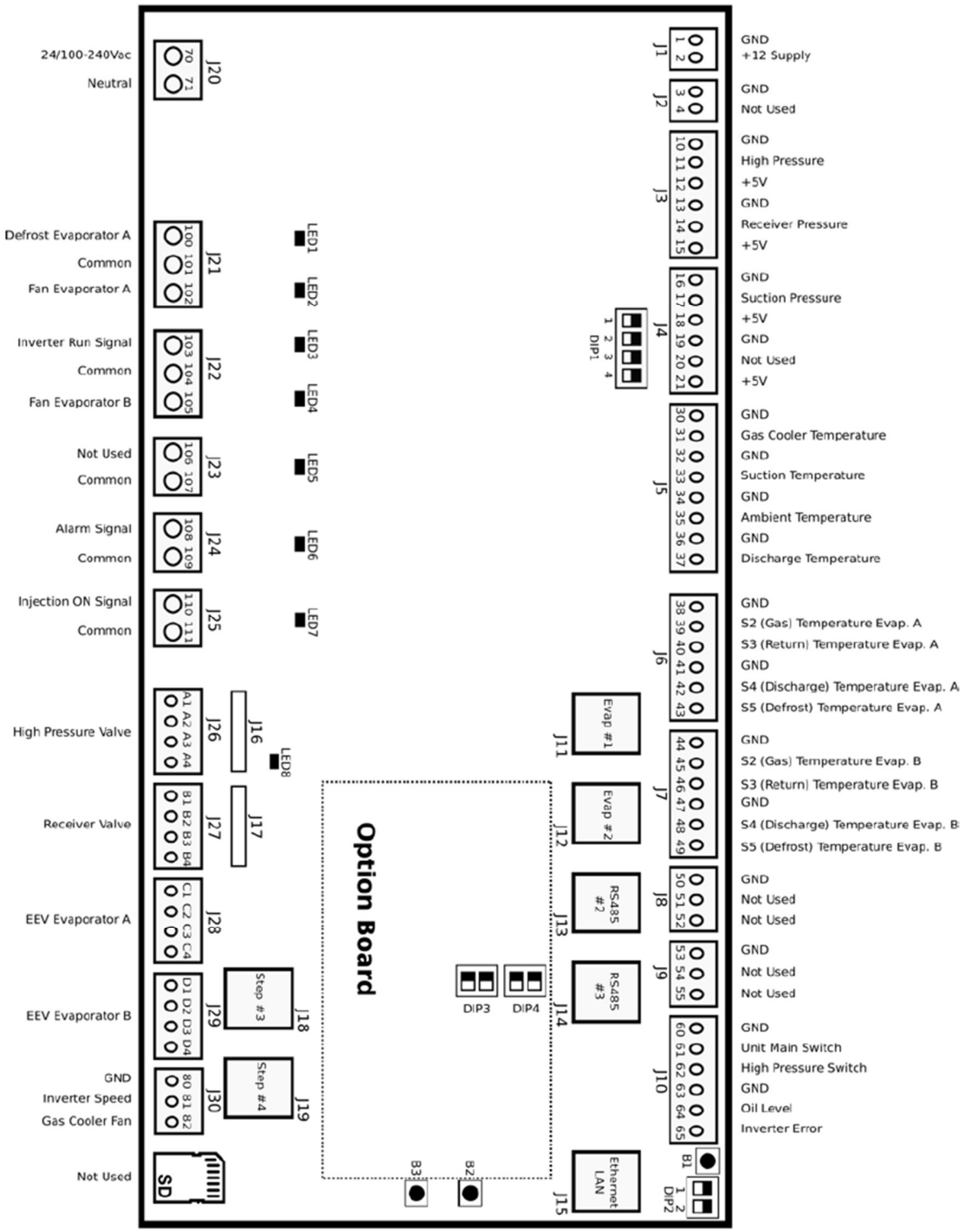
upID	Name	Value
1001	Status	Off
1002	Mode	Off
1004	T_Sat suction (T0) [C]	0
1006	Act. Cpr Cap [%]	0
1007	T0 ref [C]	0
1008	T0 NZ [K]	2
1009	Pumpdown [C]	-20
1010	Max cap [%]	100
1012	Tn [s]	100
1013	Gain (Kp) [%/K]	5

upID	Name	Description
1009	Pumpdown [C]	Pumpdown - temperature limit, compressor stop

11.4.5 Section: Settings – CDU – Receiver

upID	Name	Description
4204	Prec_ref [bar]	Receiver pressure reference

11.4.6 Diagram of the Reftronix Controller Connections



Preview of the readings of temperature sensors and pressure transducers in correlation with the appropriate input is available from the controller panel in the settings — configuration tab. An additional “Show raw measurement” button appears here. Use it to display the current value in units read by the controller before conversion to temperature or pressure.

12. Controller list of alarms

12.1 Condensing unit alarms

Name	Type	Description
High Pressure	CRITICAL	Gas cooler pressure above 'Max Php' UpID 4308 setting. See section 6.4 „Connection of the set"
High Press switch	CRITICAL	High pressure switch activated (STO) Digital Input #2
Low pressure	SERIOUS	Disabled/Not used
Oil level	CRITICAL	Oil valve open too long with no change in oil level
High discharge temp	SERIOUS	Discharge temperature too high
Suction SH Low	SERIOUS	Calculated suction superheat too low
Inverter (extern)	CRITICAL	Only enabled when inverter is connected over ModBus
Low charge	CRITICAL	Low Charge detected
LP switch	CRITICAL	Disabled/Not used
Rec High Pressure	CRITICAL	Receiver High Pressure exceeded UpID 4209
Rec Low pressure	SERIOUS	Receiver Low Pressure exceeded UpID 4210
External MainSw OFF	WARNING	Digital input #1 open

12.2 Room/Evaporator Alarms

Name	Type	Description
Room 1 High temp	CRITICAL	High Temperature Alarm
Room 1 Low temp	WARNING	Low Temperature Alarm
Room 1 Door open	CRITICAL	Door been open for more than 15 minutes
Room 1 Person alarm	CRITICAL	Shortened S2 Sensor
R1 Defrost Time exceed	SERIOUS	Defrost terminated on max time but configured to terminate on temp.
R1 Defrost problem	CRITICAL	Defrost terminated on max time 3 times – Not necessarily consecutive
R1 EEV low superheat	SERIOUS	Low superheat detected
R1 EEV stuck valve	CRITICAL	Check valve wiring
R1 EEV unstable	WARNING	Check valve wiring
Room 2 High temp	CRITICAL	High Temperature Alarm
Room 2 Low temp	WARNING	Low Temperature Alarm
Room 2 Door open	CRITICAL	Door been open for more than 15 minutes
Room 2 Person alarm	CRITICAL	Shortened S2 Sensor
R2 Defrost Time exceed	SERIOUS	Defrost terminated on max time but configured to terminate on temp.
R2 Defrost problem	CRITICAL	Defrost terminated on max time 3 times – Not necessarily consecutive
R2 EEV low superheat	SERIOUS	Low superheat detected
R2 EEV stuck valve	CRITICAL	Check valve wiring
R2 EEV unstable	WARNING	Check valve wiring

12.3 Pressure transducer alarms

Name	Type	Description
P1 Open circuit (Php)	SERIOUS	Check Wiring/Transducer and DIP1 is set correctly
P1 closed circuit (Php)	SERIOUS	Check Wiring/Transducer and DIP1 is set correctly
P1 unstable (Php)	SERIOUS	Check Wiring/Transducer and DIP1 is set correctly
P2 Open circuit (Prec)	SERIOUS	Check Wiring/Transducer and DIP1 is set correctly
P2 closed circuit (Prec)	SERIOUS	Check Wiring/Transducer and DIP1 is set correctly
P2 unstable (Prec)	SERIOUS	Check Wiring/Transducer and DIP1 is set correctly
P3 Open circuit (Psuc)	SERIOUS	Check Wiring/Transducer and DIP1 is set correctly
P3 closed circuit (Psuc)	SERIOUS	Check Wiring/Transducer and DIP1 is set correctly
P3 unstable (Psuc)	SERIOUS	Check Wiring/Transducer and DIP1 is set correctly
P4 Open circuit (Peco)	WARNING	not used
P4 closed circuit (Peco)	WARNING	not used
P4 unstable (Peco)	WARNING	not used

12.4 Temperature sensor alarms

Name	Type	Description
T1 Open circuit (Tgc)	SERIOUS	Check wiring/Sensor
T1 closed circuit (Tgc)	SERIOUS	Check wiring/Sensor
T1 unstable (Tgc)	SERIOUS	Check wiring/Sensor
T2 Open circuit (Tsuc)	SERIOUS	Check wiring/Sensor
T2 closed circuit (Tsuc)	SERIOUS	Check wiring/Sensor
T2 unstable (Tsuc)	SERIOUS	Check wiring/Sensor
T3 Open circuit (Tamb)	SERIOUS	Check wiring/Sensor
T3 closed circuit (Tamb)	SERIOUS	Check wiring/Sensor
T3 unstable (Tamb)	SERIOUS	Check wiring/Sensor
T4 Open circuit (Tdis)	SERIOUS	Check wiring/Sensor
T4 closed circuit (Tdis)	SERIOUS	Check wiring/Sensor
T4 unstable (Tdis)	SERIOUS	Check wiring/Sensor
T5 Open circuit (TS2A)	SERIOUS	Check wiring/Sensor
T5 closed circuit (TS2A)	SERIOUS	Check wiring/Sensor
T5 unstable (TS2A)	SERIOUS	Check wiring/Sensor
T6 Open circuit (TS3A)	SERIOUS	Check wiring/Sensor
T6 closed circuit (TS3A)	SERIOUS	Check wiring/Sensor
T6 unstable (TS3A)	SERIOUS	Check wiring/Sensor
T7 Open circuit (TS4A)	SERIOUS	Check wiring/Sensor
T7 closed circuit (TS4A)	SERIOUS	Check wiring/Sensor
T7 unstable (TS4A)	SERIOUS	Check wiring/Sensor
T8 Open circuit (TS5A)	SERIOUS	Check wiring/Sensor
T8 closed circuit (TS5A)	SERIOUS	Check wiring/Sensor
T8 unstable (TS5A)	SERIOUS	Check wiring/Sensor
T9 Open circuit (TS2B)	SERIOUS	Check wiring/Sensor
T9 closed circuit (TS2B)	SERIOUS	Check wiring/Sensor
T9 unstable (TS2B)	SERIOUS	Check wiring/Sensor
T10 Open circuit (TS3B)	SERIOUS	Check wiring/Sensor
T10 closed circuit (TS3B)	SERIOUS	Check wiring/Sensor
T10 unstable (TS3B)	SERIOUS	Check wiring/Sensor

T11 Open circuit (TS4B)	SERIOUS	Check wiring/Sensor
T11 closed circuit (TS4B)	SERIOUS	Check wiring/Sensor
T11 unstable (TS4B)	SERIOUS	Check wiring/Sensor

13. Inverter list of messages and alarms (version with Bonfiglioli)

In the case of another inverter company (Invertek), errors read directly are read by the Reftronix controller, and changing parameters inside the inverter or loading them is only possible after contacting with your local supplier

- Resetting the inverter errors with the STOP button
- View the alarm number by means of the ENT key

Message		Type	Probable causes
READY		Ready to run	
Fehler		Fault active	- Check failure list (F)
ALARM		Alarm Active	- Press ENT to check the alarm list (A)
STOP		No permission to run	- Activated HP safety pressure switch - No starting signal from controller - No 24VDC control voltage on STOA and STOB inverter terminals
A	100	Inverter power supply alarm	- Inadequate supply voltage or lack of one of the supply phases
A	80	Incorrect behavior of the temperature sensor	- Unconnected or defective temperature sensor
A	800 User2	No oil in the lower compressor sight glass (relay circuit R5)	After the delay, the unit will start to attempt to deliver oil. Check the oil level in the oil separator using a built-in sight glass. - too little oil in the system - incorrectly performed installation (lack of oil traps, large elevations, incorrectly selected pipeline diameters) - check the amount of oil in the oil separator - check the effectiveness of injection through the solenoid valve and oil sight glass
F	102	Inverter overload (60 second current)	- Operation of the compressor outside the envelope (too high condensing pressure) - Too high condensing temperature, too low air flow through the condenser - Pouring the compressor with a liquid refrigerant - Damaged compressor
F	103	Momentary overload of the inverter (60 second current)	
F	200	Too high temperature of inverter heatsink	- Improper ventilation of the inverter chamber - Faulty fan on the unit chassis - Faulty inverter fan - Incorrect location of the unit
F	201	Too low temperature of inverter heatsink	- Faulty fan on the unit chassis - Crankcase heater improper operation - Too short waiting time before powering up the unit after power back up (low heat compressor)
F	300	Too high ambient temperature of the inverter	- Improper ventilation of the inverter chamber - Faulty fan on the unit chassis - Incorrect location of the unit

Fs	301	Inverter overload (60 second current)	- Faulty fan on the unit chassis - Crankcase heater improper operation - Too short waiting time before powering up the unit after power back up (low heat compressor)
F	303	Too high the temperature of the inverter capacitors	- Improper ventilation of the inverter chamber - Faulty fan on the unit chassis - Faulty inverter fan - Incorrect location of the unit
F	401	Compressor motor current protection	- Operation of the compressor outside the envelope (too high condensing pressure) - Too high condensing temperature, too low air flow through the condenser - Damaged compressor - Incorrect inverter settings - Lack of one phase in main voltage supply
F	500	Inverter overload	
F	701	Too low power supply voltage	- Incorrect power supply voltage - Lack of one phase power supply - Damaged inverter rectifier bridge
F	1100	Exceeding the maximum frequency / very high frequency spike	- The problem with starting the compressor, check the pressure and shut off valves - Too high suction / discharge pressure difference - Damaged compressor
F	1205	Incorrect signal on STOA and STOB inverter terminals	- Incorrect wiring at the STOA and STOB inverter inlet terminals - Broken wire - Activation of the discharge safety thermostat or safety pressure switch
F	1300	Ground fault	- Short circuit of the inverter output to ground - Moisture inside the chamber - Short circuit inside the compressor
F	3033	Operation with no oil for 30 second	- Check connection correctness on relay circuit R5 - Check level of oil in compressor sight glass
F	3034	Unexpected compressor stop	- Too high discharge pressure - Compressor damaged - To high discharge temperature

To get access to the entire error code library, download the Bonfiglioli Drive Diagnostics application. Below is the QR code to download from the Google Play Store and Apple Store:

Google Play Store

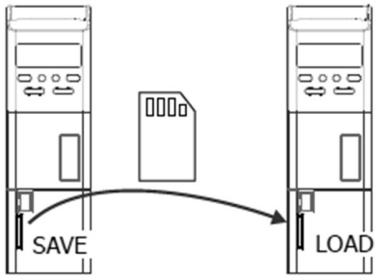
Apple Store

13.1 Storage on a memory card (Bonfiglioli inverter)

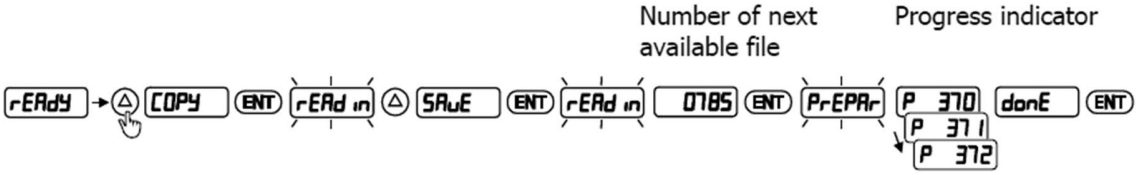
It is forbidden to interfere with the software of the inverter without permission from the manufacturer. All activities should be authorized by Panasonic. It is forbidden to upload settings or firmware from other units (other OCU models or the same model but with a different firmware). Any change to the default settings may result in incorrect operation of the unit and its damage, for which the manufacturer is not

responsible. Make changes responsibly, and if in doubt, contact the manufacturer for default settings or more information.

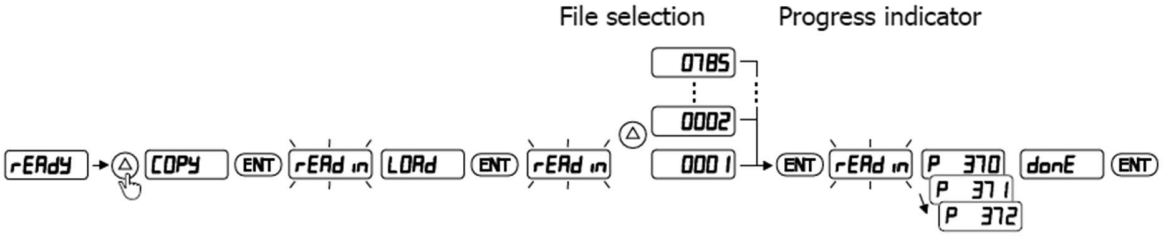
Parameter values of a inverter can be saved on standard memory cards.



To save parameters:

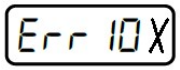
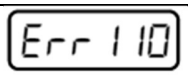
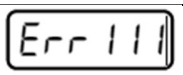


To load parameters:



During this process, if it is not successful, the following errors may be displayed:

noCArd	No memory card plugged.
noFILE	No file with parameter values on memory card.
donE	Parameter values were saved on memory card. Parameter values were uploaded to frequency inverter.
Err001	Insufficient memory. The parameter values were not copied to the memory card com- pletely.
Err002	No more file numbers available.
Err003	Error while writing on the memory card.
Err004	Error while reading from the memory card.
Err005	Data content invalid.
Err006	Fault when loading from memory card, memory card has contact problems. Contact mounting of card.

	Error while writing parameters of LOAD functions. Where instead of X is: Non-permissible parameter value Non-permissible parameter set. (4) Non-permissible write access. Write error EEPROM. Checksum error EEPROM. Value is only allowed to be written at inhibited state.
	Error while writing parameters of LOAD functions. Error parameter type.
	Error while writing parameters of LOAD functions. Unknown parameter. The mentioned parameter is not contained

If an error occurs in the LOAD function while the parameters are written, the error number and the parameter number will be displayed alternately.
Press button "ENT" to continue the function.
Press button "ESC" to cancel the function.

To avoid errors and problems when uploading settings, it is recommended to use an SD card with a maximum capacity of 16GB.

14. Potential installation problems

No.	Symptoms observed	Possible causes	Meauseres to be taken
1.	Compressor is switched off using the high pressure switch	• The system contains air/nitrogen or other undesirable gases.	• Procedure 1
		• Defective gas cooler due to dirt, too high ambient temperatures, lack of proper air flow (damaged fans or protection F2 down)	• Clean the gas cooler. Check and replace damaged fans if necessary. • Check the security position F2. • Check if the unit is working in the envelope of its operation, i.e. the air inlet temperature to the gas cooler does not exceed +43degC
		• Clogged liquid filter, closed ball valves on installation	• Verify the opening of the ball valves on the installation • Procedure 1 (Replace the liquid filter)
		• Evaporator overload	• The unit may be mismatched according to the demand, reduce the load • Possible malfunction of the defrost – the defrost schedule should be changed.
		• Defective expansion or electromagnetic valve	• Check the control signals and operation of the valve. • Incorrect settings in the evaporator controller

			• Procedure 1 (Replace the expansion valve) • Procedure 1 (Replace the stem or the entire solenoid)
		• Moisture in the system	• Procedure 3 (Replace the Filter Drier)
		• System refrigerant overload	• Procedure 2 (Too much refrigerant in the system)
2.	Frequent compressor starts, difficult startups	• Permission to open the evaporators from the unit as recommended in the manual has not been carried out	• Route the control cable from the unit to the evaporator according to the instructions in the manual.
		• Evaporator expansion valve internal leakage	• Dirt on the expansion element • Procedure 1 (clean or replace the evaporator expansion valve, install the mechanical filter before the evaporator expansion element)
		• Leaking check valve on unit suction	• As a result of the failure to install a mechanical filter on the suction line of the system, the internal leakage of the non-return valve occurred • Procedure 1 (Replace the suction check valve on the unit)
3.	Compressor is switched off by the controller due to the low pressure	• Moisture in the system	• Procedure 3 (Replace the Filter Drier)
		• Clogged suction filter	• Procedure 1 (Clean or replace the suction filter)
		• Poor evaporator load	• Possible malfunction of the defrost – the defrost schedule should be changed or the radiator heaters should be damaged. Clean the gas cooler. Check and replace damaged radiator fans if necessary.
		• Defective/to small expansion or • electromagnetic valve	• Check the control signals (m.in. SH and Psuc, Tsuc on the valve controller) and the operation of the valve itself. • Procedure 1 (Replace the expansion valve) • Procedure 1 (Replace the stem or the entire solenoid)
4.	Compressor is switched off by an oil alarm	• There is refrigerant in the oil — the crankcase heater may be faulty	• There is refrigerant in oil in the system – the compressor heater may be damaged. Check the operation of the heater and replace it if necessary. Make sure the heater is running when the compressor is off.
		• Low SH on installation	• Adjust the expansion valve settings.

			• Procedure 1 (The system may be overflowing)
		• No extra portion was added during commissioning	• Procedure 3 (Too little oil)
		• Damaged oil line, damaged oil separator or oil separator valves	• Check the oil lines and oil flow during injection in the sight glass. Procedure 1 (Replace Damaged Parts)
		• Oil loss in the system — leakage on the oil line	• Locate the leak in the oil section. Procedure 1 (Replace Damaged Parts)
		• Oil loss in the system - Poorly run installation (no oil traps, incorrectly selected pipeline diameter)	• Procedure 1 (Installation requires redesign and re-execution according to guidelines)
		• Large fluctuations in the load on the evaporators	• Adjust the expansion valve settings. • Optimize cold store logistics by reducing uncontrolled energy losses. • Procedure 1 (Evaporator expansion valve too small/large)
		• Faulty oil sensor or electrical connection	• Check the electrical signals - verify the oil level by temporarily removing the sensor from the pile (plastic fitting). Silver pile – no oil, Black pile – the right oil level.
5.	Compressor current consumption too high	• Defective gas cooler due to dirt, too high ambient temperatures, lack of proper air flow (damaged fans)	• Clean the gas cooler. Check and replace damaged fans if necessary.
		• Lack of one of the phases or low supply voltage	• Check the power supply. Verify the presence of all phases and the voltage value. If necessary, contact the authority responsible for supplying the facility where the installation is located.
		• Evaporator overload	• The unit may be poorly sized for demand, reduce the load or improve the airflow. • Possible malfunction of the defrost – defrost schedule should be changed.
		• Damage to the compressor due to poor operation	• Procedure 1 (compressor replacement): removing the cause of poor compressor operating conditions, e.g. improper superheat/prolonged operation with many oil alarms.
6.	High suction pressure, normal	• Evaporator overload	• The unit may be poorly sized for demand, reduce the load or improve the airflow.

	value of superheated refrigerant		• Possible malfunction of the defrost or damaged radiator fans – the defrost schedule must be changed.
		• Compressor does not work at full capacity	• Check compressor operation, control signals, and current controller/inverter alarms. • Procedure 1 (Compressor Replacement)
		• Discharge valve EEV- HPV is faulty	• Check the EEV- HPV valve for leaks or mechanical damage. • Procedure 1 (EEV-HPV valve replacement)
		• Clogged suction filter	• Procedure 1 (Clean or replace the suction filter)
7.	High suction pressure, low refrigerant superheat value	• System refrigerant overload	• Procedure 2 (Too much refrigerant in the system)
		• Expansion valve is faulty — the valve does not close	• Check the expansion valve for proper operation. Repair or replace the damaged valve. Verify the control signals.
		• Defective/to big expansion or electromagnetic valve	• Check the control signals (m.in. SH and Psuc, Tsuc on the valve controller) and the operation of the valve itself. • Procedure 1 (Replace the expansion valve) • Procedure 1 (Replace the stem or the entire solenoid)
8.	Low suction pressure, steam superheat high	• Clogged liquid filter • Closed ball valve on installation	• Verify the opening of the ball valves on the installation • Procedure 1 (Replace the liquid filter)
		• Low refrigerant level in the system	• Procedure 2 (charge the correct amount of refrigerant)
		• System moisture	• Procedure 1 (Replace the Filter Drier)
		• Defective expansion or • electromagnetic valve	• Check the control signals and operation of the valve. • Procedure 1 (Replace the expansion valve) • Procedure 1 (Replace the stem or the entire solenoid)
9.	Low suction pressure, refrigerant superheat normal	• Clogged suction filter	• Procedure 1 (Clean or replace the suction filter)
		• Low evaporator load	• Possible malfunction of the defrost the defrost schedule needs to be changed, Clean the gas cooler. Check

			and replace damaged fans if necessary, • Procedure 1 (Replace the expansion valve) • Procedure 1 (Replace the stem or the entire solenoid)
10.	Too high pressure in the gas cooler, high temperature of refrigerant at the discharge	• Defective gas cooler due to dirt, too high ambient temperatures, lack of proper air flow (damaged fans or protection F2 down)	• Clean the gas cooler. Check and replace damaged fans if necessary. Check the security position F2. Check if the unit is working in its work envelope, i.e. the air inlet temperature to the gas cooler does not exceed +43°C. Ensure that the unit works in its work envelope.
11.	Too high pressure in the gas cooler, low temperature of refrigerant at discharge	• System refrigerant overload	• Procedure 2 (Too much refrigerant in the system)
		• Moisture in the system	• Procedure 3 (Refrigerant Change) • Procedure 1 (Replace the Filter Drier)
12.	Low pressure in the gas cooler, high temperature of refrigerant at the discharge	• Leak in the system	• Procedure 1 (Clean or replace the suction filter)
		• Low refrigerant level in the system	• Procedure 2 (charge the correct amount of refrigerant)
		• Clogged suction filter	• Procedure 1 (Clean or replace the suction filter)
		• Defective expansion or • electromagnetic valve	• Check the control signals and operation of the valve. • Procedure 1 (Replace the expansion valve) • Procedure 1 (Replace the stem or the entire solenoid)
		• Low refrigerant level in the system	• Procedure 2 (charge the correct amount of refrigerant)
13.	Low pressure in the gas cooler, normal temperature of refrigerant at the discharge	• Compressor does not work at full capacity	• Check compressor operation, control signals, and current controller/inverter alarms. If necessary, replace the compressor according to Procedure 1.
		• Poor evaporator load	• Possible malfunction of the defrost – the defrost schedule should be changed or the radiator heaters should be damaged. Clean the gas cooler. Check and replace damaged radiator fans if necessary.

14.	Low pressure in the gas cooler, low temperature of refrigerant at the discharge	• Fan speed of the gas cooler to high	• Check the settings of the gas cooler fan unit controller
		• To low ambient temperature	• Check if the unit is working in the envelope of its operation, i.e. the air inlet temperature to the gas cooler is not too low. Provide work to the unit in its work envelope.
15.	High RLA current	• System refrigerant overload	• Procedure 2 (Too much refrigerant in the system)
		• The system contains air or other undesirable gases	• Procedure 3
		• Defective gas cooler due to dirt, too high ambient temperatures, lack of proper air flow (damaged fans)	• Clean the gas cooler. Check and replace damaged fans if necessary. Check the security position F2. Check if the unit is working in the envelope of its operation, i.e. the air inlet temperature to the gas cooler does not exceed +43°C
		• Occurrence of oil alarms	• Check the electrical signals - verify the oil level by temporarily removing the sensor from the pile (plastic fitting). Silver pile – no oil, Black pile – the right oil level. Periodic low oil level in the compressor causes high current consumption.
16.	Low RLA current	• Compressor does not work at full capacity	• Check compressor operation, control signals, and current controller/inverter alarms. If necessary, replace the compressor from Procedure 1.
		• Low refrigerant level in the system	• Procedure 2 (charge the correct amount of refrigerant)

Description of procedure:

Procedure 1 – Empty the system of refrigerant. Replace the damaged component (if applicable). Perform a pressure test (if a new connection was made in the refrigeration system), check for leaks, and create/check the vacuum. Refill the system with refrigerant (and oil if required) according to the recommendations.

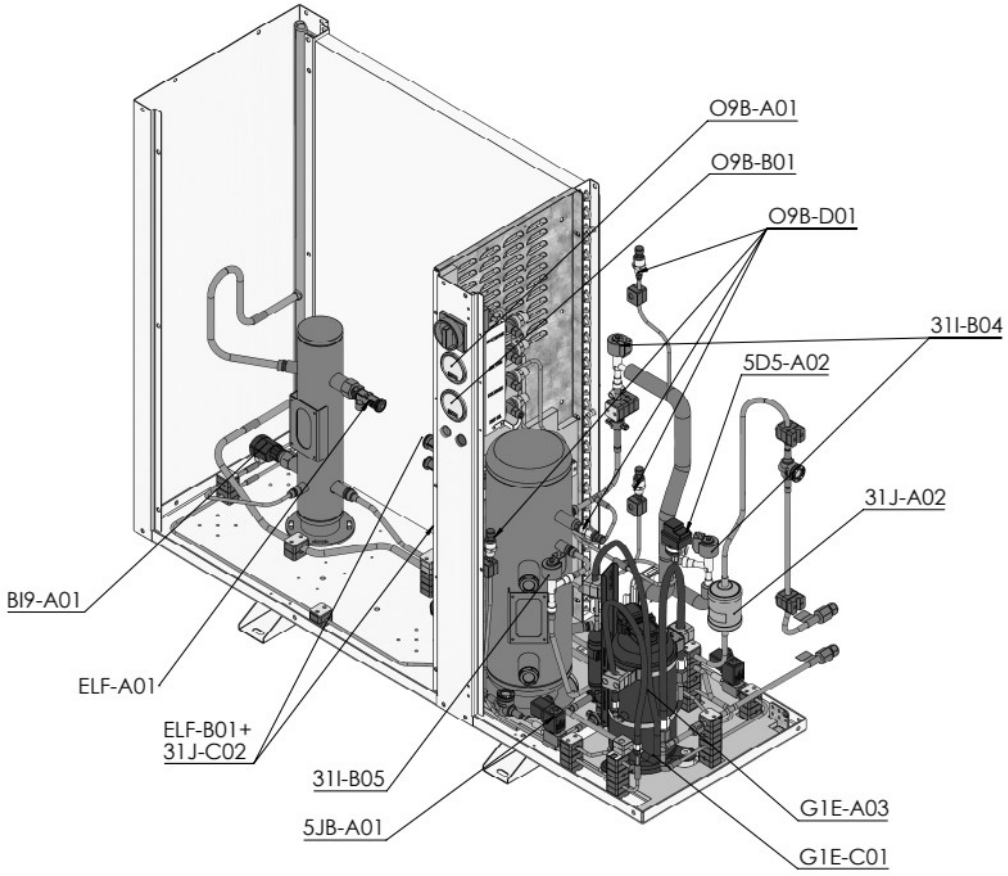
Procedure 2 – Empty the system of refrigerant. Refill the system with refrigerant to an overpressure of approximately 5 bar according to the recommendations.

Procedure 3 – Empty the system of refrigerant. Create and check the vacuum throughout the entire system. Refill the system with refrigerant and an additional portion of oil (if required) according to the recommendations.

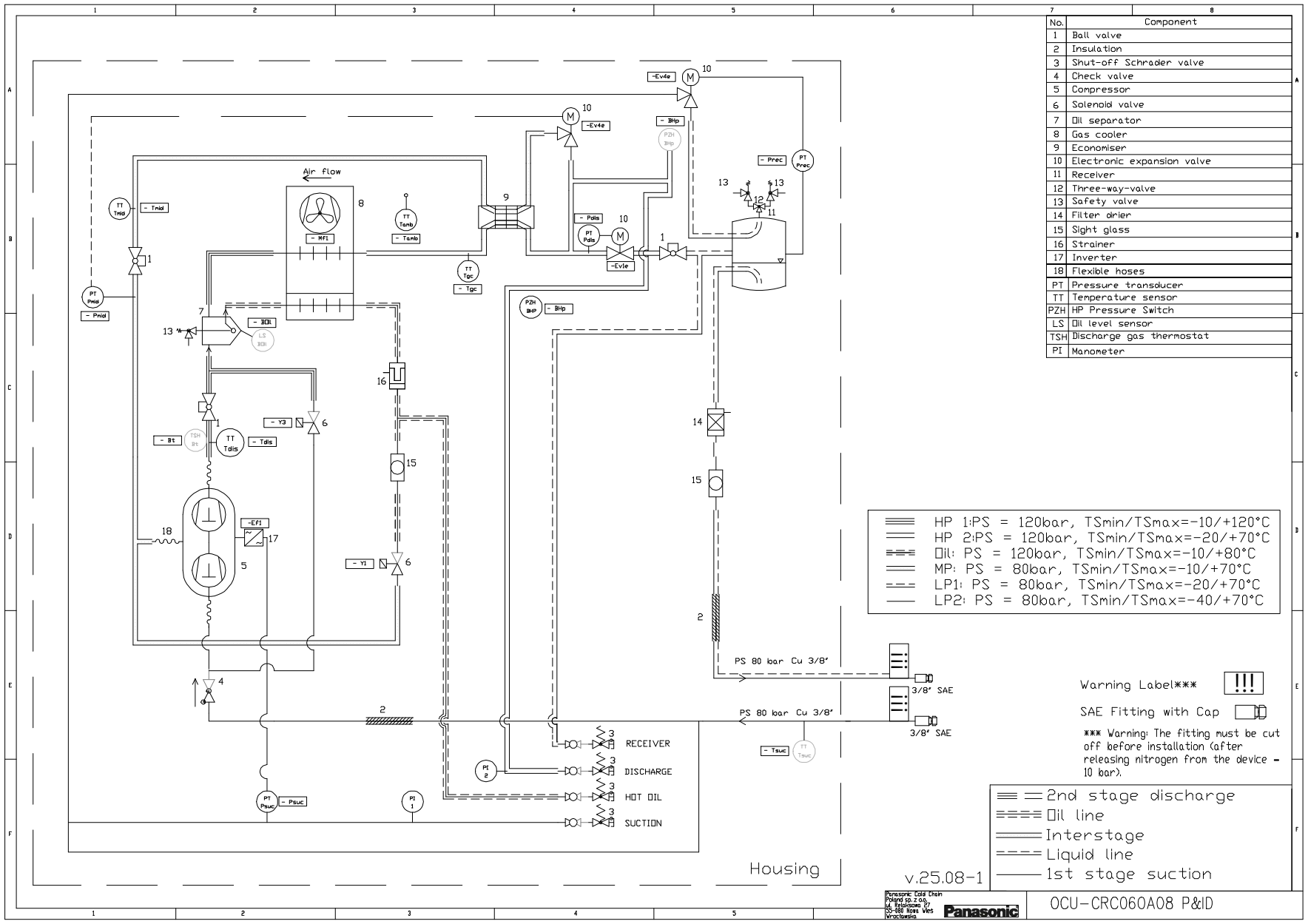
15. Annexes

15.1 List of spare parts

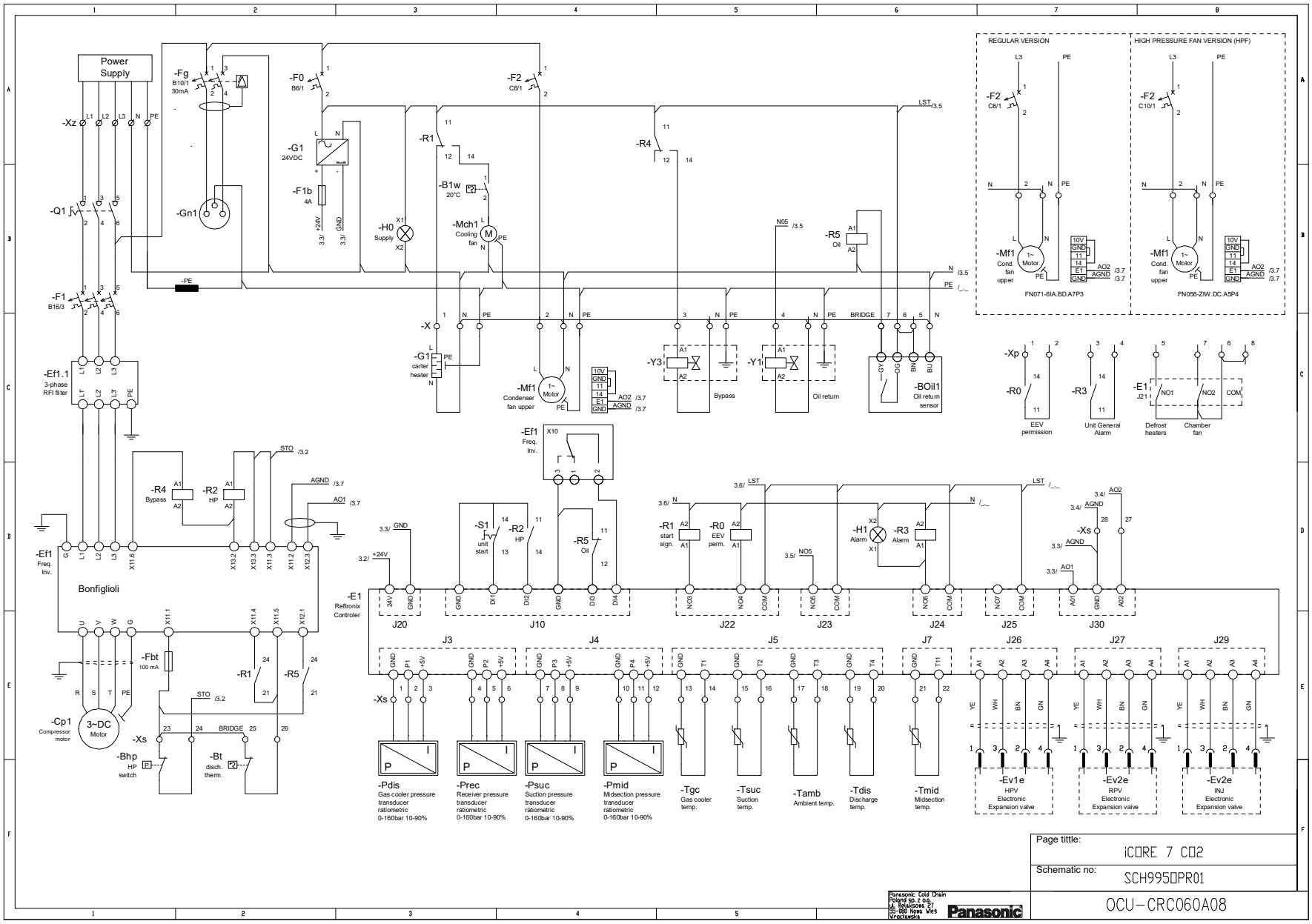
No.	Part code	Name of spare part
1.	2FE-A03	Inverter
2.	31I-A01	Ambient temperature sensor
3.	G1E-A03	Compressor
4.	I56-A01	Controller
5.	G1E-C01	Crankcase heater
6.	R89-A02	EC Fan
7.	31I-B04	Electronic expansion valve
8.	31I-B05	Electronic expansion valve
9.	31J-A02	Filter drier
10.	O9B-A01	Manometer HP
11.	O9B-B01	Manometer LP
12.	G1E-B01	Oil
13.	BI9-A01	Oil level sensor
14.	5D5-A02	Pressure switch
15.	O9B-D01	pressure transducer
16.	ELF-A01	Safety valve 120 bar
17.	ELF-B01	2 x Safety valve 80 bar
18.	5JB-A01	Solenoid valve
19.	9E9-A01	Temperature sensor
20.	31J-C02	Changeover valve



15.2 Cooling diagram



15.3 Simplified electrical diagram

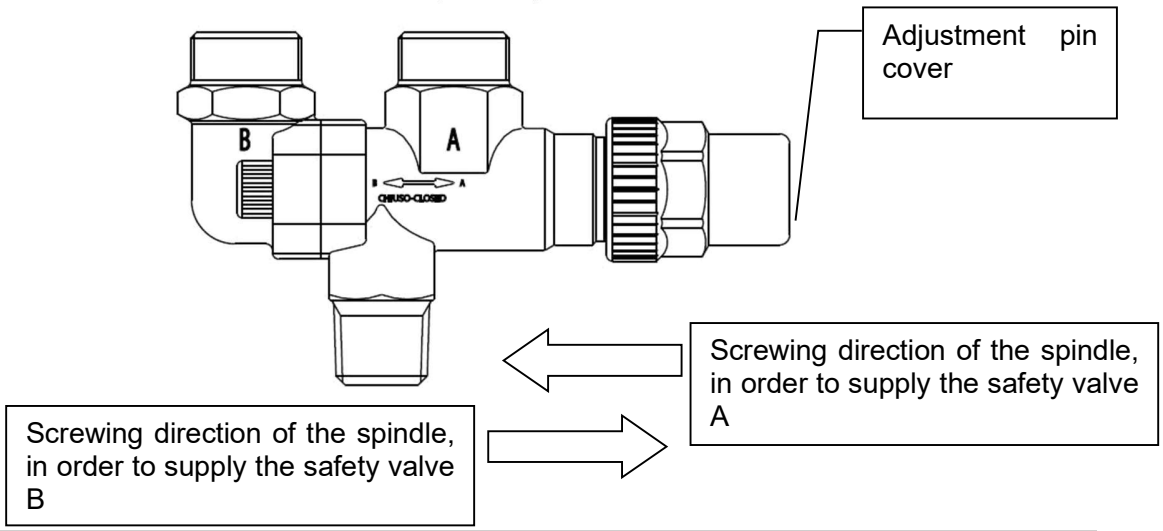


Presented electrical diagram is a simplified general schematic for an each unit. Specific schematic can be download from a Panasonic website. Electrical schematic number can be find on a sticker placed in electrical board. Below is an example of a schematic code. It is always necessary to verify and download the correct schematic for the corresponding unit.

SCHnnn-n – Schematic number **REV.nn** or **Rnn** – revision number.

15.4 Operating instruction for the three-way valve

The three-way valve allows the replacement of the safety valve without emptying the pressure receiver. Before proceeding with the valve power switching procedure, the protective cover of the adjustment pin must be removed. In order to set the opening of the three-way valve in the direction of the safety valve screwed into the A connector, fully screw in the three-way valve pin.
In order to set the opening of the three-way valve in the direction of the safety valve screwed into the B connector, fully screw out the three-way valve pin.

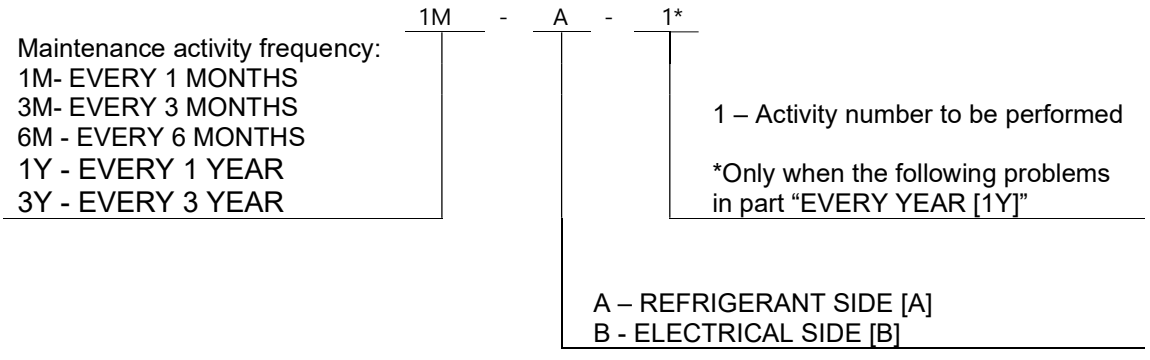


16. Maintenance activities

To ensure efficient and reliable operation of the condensing unit during its lifetime and to avoid hazardous working conditions, please read carefully the hints contained in this chapter. Periodic maintenance, cleaning, and correct use are essential factors to guarantee the full efficiency and safety of the condensing unit.

It is recommended that the user keeps a logbook for the unit and installation. Use the logbook provided in the section 16.5 “Inspection report”

The maintenance interventions and the prescribed operations help prevent problems due to deterioration of the safety measures or resulting from unit downtime.
Periodic inspection of the cooling unit and installation must be carried out in accordance with the logbook provided in the documentation section 16.5 “Inspection report”, as well as the description below, which explains the activity codes.



Maintenance activities description	
EVERY 1 MONTHS [1M] (can be performed by appropriate customer personnel)	
REFRIGERANT SIDE [A]	**ELECTRICAL SIDE [B]**
[1] Check the general external condition of the unit Make sure that the unit stands firmly and is properly supported. If the unit is crooked for any reason, turn it off, find and try to eliminate the cause, and then level the unit. **[2] Visually assess the unit's surroundings** Check that there is nothing near the unit that could adversely affect its operation (unstable objects or equipment in the vicinity that could fall on the unit, surface condition of the gas cooler - contaminants, vegetation covering unit, etc.). If such items are present, secure or remove them. **[3] Compressor and fan noise check** The presence of any suspicious noise, knocking, vibrations, etc. may be a sign of breakage or excessive mechanical clearance between moving parts. In serious situations, the compressor or the fan must be replaced (call the technical personnel).	**[1] Check the operation indicator lights (if applicable)** The indicator lights are located on the unit housing at the pressure gauges, near the main switch. If only white light is on the unit is working correctly. If both lights are off unit is not powered or one of internal short circuit protections is switched off. If the red light is on, it means that unit is in Error state and the unit is off (call the technical personnel).
EVERY 3 MONTHS [3M] (must be performed by qualified technical personnel)	
REFRIGERANT SIDE [A]	**ELECTRICAL SIDE [B]**
[1] Check the condition of the safety valves Check if there is any oil residue around the safety valve outlet, which may be evidence of its activation. **[2] Check for the presence of oil on the separator (if applicable)** Check that the level on the separator is proper – sight glass during operation should be black. If there is an oil sensor mounted on the regulator, check the state of its relay. Make sure, that there are no oil alarms in the controller. **[3] Check the level of oil in the compressor (if the unit has any)** Check the oil injections when the system is fully operational for a few hours and for a few days after starting. If it is necessary to top up,	**[1] Indication of presence of malfunctions and presence of an alarm** Active general alarms are indicated by a red indicator light on the front of the unit **(if applicable)**. The type of alarm (or historical alarms) should be verified after connecting to the Reftronix controller. If there are alarms in history, corrective action may have to be taken – check the description of alarms in the unit manual. **[2] Check communication with the monitoring system** Check communication to monitoring systems by logging in to dedicated Cloud account (if used) - unit can be found in the Reftronix cloud (https://cloud.reftronix.com/) by controller serial number (nameplate of controller). If local monitoring system is used - check presence of

always use only the type of oil indicated on the plate of the unit and in the enclosed documentation. Observe the behavior of the R5 injection relay and the oil flow in the sight glass on the oil line, to check whether the injection works properly. The oil line pipe should be warm during the injection. **[4] Check operating parameters of the unit** Verify pressure value in the liquid receiver, evaporation temperature, suction gas temperature, discharge gas temperature, condensing temperature, level of superheat, the opening ratio of electronic expansion valves on evaporators, current consumption, cycle time, and speed of the compressor, etc. to assess whether the unit works properly. Compare values of the parameters with the values written in the commissioning (start-up) protocol. In case of large deviations, determine the cause and eliminate it. **[5] Refrigerant humidity control** On the liquid sight glass, it is possible to observe a colored moisture-sensitive element that indicates if the refrigerant is dry (green section) or contains moisture (yellow section). In case of humidity indication, immediately stop the unit, carry out the drain procedure of the system, replace filter drier, and fill the system with new refrigerant. **[6] Check the flow through the liquid sight glass** This transparent indicator allows to check the refrigerant charge in the installation. When the system is at full speed, the flow through the sight glass must be continuous and free from foams or gas bubbles. Check the flow only under established operating conditions (not immediately after starting the unit or pump down process). If there are bubbles, there is not enough liquid in the receiver, and probably the value of superheat is high – refill the system with refrigerant. It is also worth to verify the quality of insulation on the liquid line - certain sections on this line may not be properly wrapped.	correct communication in local system (BMS, or other). **[3] Controls and safety units checks** Verify operation of safety control units while unit is **not working (cooling OFF)**: 1. High pressure protection: - disconnect the High Pressure switch electrical plug (-Bhp), - unit should indicate an alarm by red lamp (in controller presence of alarm – HP switch), - after checking connect the plug back. 2. Low pressure protection: - disconnect the plug on suction pressure transducer (-Psuc) - unit should indicate an alarm by red lamp (in controller presence of alarm – P3 sensor disconnected), - after checking connect the plug back. Check if the unit works correctly after performing these operations. **[4] Controller set point** Check if the set point for the controller is as per commissioning documentation. Adjust the setpoint and pump-down limit if necessary for correct evaporator operation.
EVERY 6 MONTHS [6M] (must be performed by qualified technical personnel)	
REFRIGERANT SIDE [A]	**ELECTRICAL SIDE [B]**

[1] Cleaning of gas cooler Clean the gas cooler and intercooler to remove dust, grease, and other surface contaminants. For small or easily removable ones, try to use a bristle brush. When cleaning the gas cooler, be very careful not to bend or damage the fins of the exchanger. If the environment where the unit is installed is very dusty, it may be necessary to clean the unit more frequently in particularly difficult conditions every 3 months **[2] Check for refrigerant and oil leaks** Visually check the entire refrigerant circuit for refrigerant leaks, including circuit of the unit. The leak can also be identified by traces of lubricating oil. If a leak is present, locate the leak, repair it, and perform leak detection test.	**[1] Verification of temperature sensors and pressure transducers** Check positioning of all temperature probes – probes should be tightly mounted on correct pipelines, ambient temp. The probe should not touch the heat exchanger. Check the correct readings of all pressure probes with the external manometers connected (probe readings can be checked in controller interface or through monitoring system – take care that readings in controller are bar absolute). If readings are incorrect – perform calibration or replace faulty transducers. **[2] Check the state of electrical components** Check the tightness of all screwed electrical connections on the electrical board and use the compressed air to clean Inverter fans (on the bottom of inverter) (in a safe manner when the unit is not powered) **[3] Check correct operation of the housing air fan** The compressor chamber is cooled by the fan mounted on a partition to gas cooler section. Additionally, there is a fan behind an electrical plate (inverter cooling). Work of these fans should be checked to assure proper temperature for all the components inside the unit – IMPORTANT: fans are ON only if compressor is ON (on partition fan will be always off if temperature in compressor chamber is below 20°C, controlled by thermostat). **[4] RCD check** Press the “T” (Test) button on -Fg circuit breaker (protection for internal service socket - RCD protection), breaker should trip. If by pressing test, protection did not tripped – replace it.
EVERY YEAR [1Y] (must be performed by qualified technical personnel)	
REFRIGERANT SIDE [A]	**ELECTRICAL SIDE [B]**
[1] Check tightness of soldered and screwed connections Using a foaming agent, thoroughly test all soldered and screwed connections for leaks, especially hoses of compressor **(if applicable)** - check their condition, markings on the caps and connectors, verifying their	**[1] Check the state of electrical components** Check if all electrical components (connectors, circuit breakers, relays, controller, inverter) are not covered in dust – if yes, use clean compressed air to remove the dust.

relative positions, the external condition of the hose, and ensure there are no kinks, abrasions, or contact with other components of the unit. In case of wear or damage, replace the hoses with new ones. **[2] Check the condition of piping insulation** Check the quality of foam insulation on cold sections. If any section of the insulation is damaged or has lost its insulating properties, it should be replaced. Pay special attention to areas where thick layers of ice form. If this occurs, stop the unit, wait until the ice melts, and when the surface is dry, then thermally insulate the area well. **[3*] Cleaning the mechanical filter of oil and suction line** Before cleaning the filters, the system must first be drained of refrigerant (please read the section 9.2 "*Emptying the system*" on draining the system carefully). Dismantle and clean the strainers of both filters, then install clean filters. **[4*] Replace the filter drier** Replace the filter drier in accordance with the procedure described in section 9.4 "*Replacement of the filter drier*". **[5*] Refill the system with new refrigerant** After cleaning mechanical filters and replacing the filter drier, refill the system with new refrigerant in the correct amount. *** Only when the following problems are evident:** **Clean mechanical filter** only when there is a problem with oil injections (become insufficient). **Replace filter drier** only when the color of moisture indicator is yellow. **Refill with new refrigerant** only if the above problems have occurred.	If any screwed electrical connection bears the signs of rust – replace whole component to same type or equivalent (identify probable cause of the accumulation of humidity in this component and inform your Panasonic sales representative about this situation) **[2] Check electrical cables status** Check the condition of the cables inside and outside of the condensing unit (abrasion, burns, deterioration, etc.). Any damaged wire requires immediate replacement by the same type. Check the tightness of the cable glands. **[3] Check the efficiency of the grounding** Check the equalizing connections in the unit: - check if there is no corrosion on equalizing connections (side panels and doors) - it is important that here is good conductivity (Resistance <1 Ohm) between main grounding connection in the unit and unit doors and side panels (can be checked on screws) - check main grounding terminal in the unit and grounding resistance with appropriate instrumentation. **[4] Verification of compressor motor insulation** Before checking the compressor motor insulation: 1. Switch off the unit completely from the powerly and wait for minimum of 5 minutes (discharge of the capacitors in the inverter) 2. Makes sure that after disconnecting wires from the compressor you will be able to connect them in the same way (mark the wires and terminals if necessary)! 1 –U, 2 – V, 3 – W. 3. Disconnect the compressor from the supply wire **[5] After above** – check the motor insulation resistance (one of the phases to ground connection on the compressor), value must be greater than 1MOhm. After insulation check connect back compressor to the supply wire (1 –U, 2 – V, 3 – W).
EVERY 3 YEARS [3Y] (must be performed by qualified technical personnel)	
REFRIGERAT SIDE [A]	**ELECTRICAL SIDE [B]**

[1] Replacement of oil solenoid valve, and compressor bypass solenoid valve Remove the solenoid valves from the oil line and the compressor bypass and replace them with new ones. Make sure that high-pressure refrigerant and oil are removed from these parts to avoid the risk of sudden leakage and ignition of oil during burner operation.	
[2] Diagnose/review and evaluate Carel electronic expansion valves Observe the operation of the electronic expansion valves, their opening degree, and operating range. When stationary, observe for leaks between sections. You can also use a Carel service solenoid to check the valve's ability to change position - (remember to reset the unit after manual operation to position the valves). If abnormalities are observed, replace the defective valve, first making sure that there is no overpressure in the system.	

16.1 Commissioning check list on site.

Commissioning OCU CO_2 unit on site

Date	

Serial number	Unit type	Reference

Name & surname of commissioning person	

A. Preliminary verification of unit and installation		
1. Unpacking the unit and visual inspection, verifying any damage during transport	OK	NG
2. Pressure reading on manometers (**approximately 10 bar** - the unit was filled with dry nitrogen)	OK	NG
3. Unit placement in accordance with the information provided in the manual - *Appendix B*	OK	NG
4. Connect the suction and liquid pipelines with the installation, open suction & liquid ball valves	OK	NG
5. Connect the power supply and Ethernet cable (if monitoring will be used)	OK	NG
6. Connect **permission to open evaporator expansion valves**	OK	NG
7. Put NPT plugs to active safety valves connectors (receiver, suction line)	OK	NG
8. Strength test (30 min.) of the suction line installation **PT = 1.1 · PS** (leave with **PS** for leak test)	OK	NG
9. Close the expansion valves on the evaporators and the shut-off valves on the suction line	OK	NG
10. Strength test (30 min.) of the liquid line **PT = 1.1 · PS** (leave with **PS** for leak test)	OK	NG
11. Liquid and suction side leak test - recommended **12 hours without leakage**	OK	NG
B. Preparing the vacuum and filling with R744 refrigerant		
1. Release of nitrogen through the **DISCHARGE** valve (note: do not allow oil to be dragged)	OK	NG
2. Open all expansion valves and the suction line shut-off valve (point A.9.)	OK	NG
3. Remove the NPT plugs and install the safety valves on the receiver and suction line	OK	NG
4. Create a vacuum, add additional calculated portion of oil (if required) and flush the system with dry nitrogen **(at least once, approx. 2 bar)**	OK	NG
5. Create a vacuum **≤ 2.0 mbar**, verification of moisture content and leaks **(30 min)**	OK	NG
6. Preliminary charge with **gaseous R744** through the **RECEIVER** valve to **~10 bar** (use a scale)	OK	NG
7. Connect the plugs of the electronic expansion valves to the controller, **power on the unit or press RESET button (B2) on the controller(if it was already powered on),** set the **auto** mode	OK	NG
8. Final filling with liquid refrigerant through the **RECEIVER** service valve (may be skipped)	OK	NG
9. Set the **S1** switch to the **ON** position to start the unit	OK	NG
10. Final filling with **gaseous R744** (if point B.8. was skipped) through the **SUCTION** (use a scale)	OK	NG
C. Unit operation		
1. Configuration of final controller settings (T0 setpoint, pump down, defrost - if applicable)	OK	NG
2. Check that the **oil level** and flow through the oil line are correct	OK	NG
3. Verification of the expansion valve opening degree and superheat at the T0 setpoint **(8-12 K)**	OK	NG
4. Verifiation of **permission to open the expansion valves**	OK	NG
5. Check if **monitoring and its functions** (e.g. alarms, notifications) work properly	OK	NG

Comments

PS - pressure strength, bar
PT - test pressure, bar
EEV - electronic expansion valve

Signature

16.2 Basic service tools recommended for OCU-CRC060A08

Service tools for OCU CO2

Refrigerant tools

Magnetic coil set for manual driving of EEV [EEVMAG0000]	OK	N
Solenoid value operating magnet Refco e.g. Refco SVOM-18	OK	N
Ratcheting Service Wrench	OK	N
Digital vacuum gauge e.g. Testo 552 with refrigerant hose 1/4' SAE (with ball valve)	OK	N
2-way aluminum manifold with gauges for CO2 with refrigerant hoses	OK	N
Plugs 1/2 NPT for pressure strenght test + dedicated sealing	OK	N
Refrigeration scale	OK	N
Adapters between cylinders and refrigerant hoses	OK	N
Vacuum pump, allowing to obtain a vacuum of 0.02 mbar	OK	N

Fluids and standard tools

Additional required portion of oil PZ68s	OK	N
Digital multimeter	OK	N
Adjustable wrench 2pcs. or set of flat wrenches	OK	N
Set of screwdrivers	OK	N
Cylinder of R744 with class min. 4.5	OK	N
Cylinder of nitrogen 4.0 with reducer (min. 90bar)	OK	N
Service lamp	OK	N
Idividual protection (gloves, goggles, earmuffs, helmet)	OK	N

Accessiories

Computer + long internet cable (RJ-45)	OK	N
Commissioning report [EN20.01]	OK	N
Commissioning check-list [ACS.CCL.20.01]	OK	N
Manual of unit	OK	N

Comments

16.3 Strength tests report for installation

	…….	……	……	……/……/……r.
Stamp	Name	Surname	Signature	Date of tests report

CO2 INSTALLATION CONNECTED WITH OCU-CRC060A08 MAIN STRENGHT PRESSURE TEST REPORT

- Installation location:

  Address:

  ……

- Investor:

  Address:

  ……

- Unit and installation data

  Unit code: ……

  Serial number: ……

  Diameter of main liquid line: …… mm

  Diameter of main suction line: …… mm

  PS of liquid line section: …… bar

  PS of suction line section: …… bar

No.	Time	Ambient temperature, °C	P_{SUC}, bar	P_{LIQ}, bar	Comments
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					

16.4 Leak-tightness tests

Stamp	Name	Surname	Signature	Date of tests report
	…….	……	……	……/……/……r.

MAIN LEAK AND MOISTURE VERIFICATION BY VACUUM OCU-CRC060A08 REPORT

- Installation location:

  Address:

  ……

- Investor:

  Address:

  ……

- Unit and installation data

  Unit code: ……

  Serial number: ……

  Diameter of main liquid line: …… mm

  Diameter of main suction line: …… mm

  PS of liquid line section: …… bar

  PS of suction line section: …… bar

No.	Time	Ambient temperature, °C	P_{SUC}, bar	P_{LIQ}, bar	Comments
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					
9.					
10.					
11.					
12.					
13.					
14.					

16.5 Inspection reports.

Serial number: ……………………………

Date of unit installation: ………………

Adress:……………………....................

Investor:…………………………………

Example of how to fill in the table:

- Completed
- Not completed
- Does not require

Code description from section 16 "Maintenance activities":

1M - A - 1*

Maintenance activity frequency:
1M- EVERY 1 MONTHS
3M- EVERY 3 MONTHS
6M - EVERY 6 MONTHS
1Y - EVERY 1 YEAR
3Y - EVERY 3 YEAR

A – REFRIGERANT SIDE [A]
B - ELECTRICAL SIDE [B]

1 – Activity number to be performed

*Only when the following problems in part "EVERY YEAR [1Y]"

Maintenance activities code	Period	YEAR					
		20…	20…	20…	20…	20…	20…
1MA1, 1MA2, 1MA3,	EVERY 1 MONTHS [1,2,3…12]	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12
1MB1, 1MB2	EVERY 1 MONTHS [1,2,3…12]	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12	1 2 3 4 5 6 7 8 9 10 11 12
3MA1, 3MA2, 3MA3, 3MA4, 3MA5, 3MA6	EVERY 3 MONTHS [1/4,2/4…4/4]	1/4 2/4 3/4 4/4	1/4 2/4 3/4 4/4	1/4 2/4 3/4 4/4	1/4 2/4 3/4 4/4	1/4 2/4 3/4 4/4	1/4 2/4 3/4 4/4
3MB1, 3MB2, 3MB3, 3MB4	EVERY 3 MONTHS [1/4,2/4…4/4]	1/4 2/4 3/4 4/4	1/4 2/4 3/4 4/4	1/4 2/4 3/4 4/4	1/4 2/4 3/4 4/4	1/4 2/4 3/4 4/4	1/4 2/4 3/4 4/4
6MA1, 6MA2,	EVERY 6 MONTHS [1/2,2/2]	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2
6MB1, 6MB2, 6MB3, 6MB4	EVERY 6 MONTHS [1/2,2/2]	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2	1/2 2/2
1YA1,1YA2,	EVERY 1 YEAR [1]	1	1	1	1	1	1
1YA3*	EVERY 1 YEAR [1]	1	1	1	1	1	1
1YA4*	EVERY 1 YEAR [1]	1	1	1	1	1	1
1YA5*	EVERY 1 YEAR [1]	1	1	1	1	1	1
1YB1, 1YB2, 1YB3, 1YB4, 1YB5	EVERY 1 YEAR [1]	1	1	1	1	1	1
3YA1, 3YA2	EVERY 3 YEARS [3]	3			3		

16.6 Commissioning report

COMMISSIONING REPORT FOR TRANSCRITICAL CO2 UNIT TYPE: OCU-CRC060A08			
UNIT IDENTIFICATION		Unit	Value
Model of unit			
Code and serial no.:			
Type of application / application:			
Purity grade of CO2			
CO2 charge in the system:		kg	
Oil level in sight glass*		%	
Volume of added oil		dm^3	
Type and number of evaporators			
PS for the liquid line section		bar	
PS for the suction line section		bar	
Design evaporation temperature		°C	
SYSTEM PARAMETERS DURING OPERATION		Unit	Value
Ambient temperature during commissioning		°C	
Pressure loss on the suction line**		bar	
Start time of commissioning		hh:mm	
End time of commissioning		hh:mm	
REFRIGERANT CIRCUIT PARAMETERS		Unit	Value
Discharge pressure HP		bar	
Discharge temperature		°C	
Temperature of CO2 at outlet of gas cooler, t_{gc}		°C	
Temperature of air at inlet to gas cooler, t_{amb}		°C	
Temperature difference at gas cooler***, $dT=t_{gc}-t_{amb}$		K	
Receiver pressure		bar	
Suction pressure LP		bar	
Evaporator superheat (for stable conditions)		K	
Vapor temperature at unit suction		°C	
Liquid temperature at EXV inlet (mounted at evaporator)		°C	
Real range of compressor speed regulation by frequency during tests		Hz-Hz	
MISCELLANEOUS		Unit	Value
Compressor amperage on phases L1, L2, L3		A	
Indication of the liquid line sight glass:			
Applied LP safety valves set pressures:		bar	
LP safety valves serial no.:			
Proper compressor operation		☑/☒	☐
• Comment			
Proper installation montage		☑/☒	☐
• Comment			
Proper unit foundation		☑/☒	☐
• Comment			
Compliance of installation with manual		☑/☒	☐
• Comment			

COMMENT OF INSTALLER			
ADDITIONAL INFORMATION			
PHOTOS			
Sent by e-mail	☑/☒	To e-mail address	
	☐	From e-mail address:	
		Date:	
SITE INFORMATION			
Installation contractor company			
Site address			
Town			
Country			
PERSONAL DATA			
Name, Surname			
Date, signature	Date (dd.mm.yyyy) ……	Signature ……	

Adress

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