Celest+

User and maintenance manual

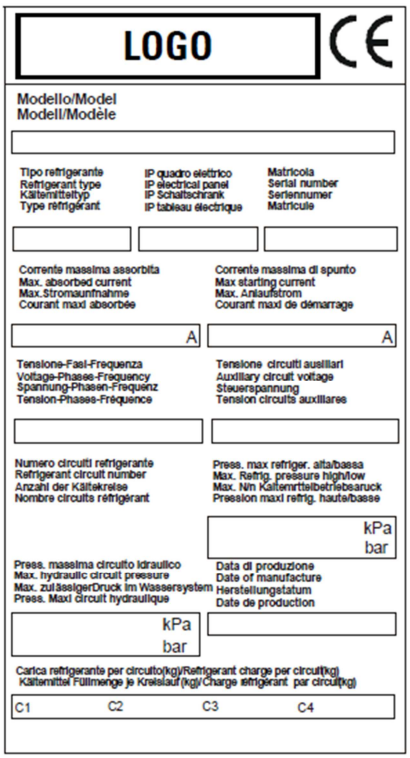
14-05-2013

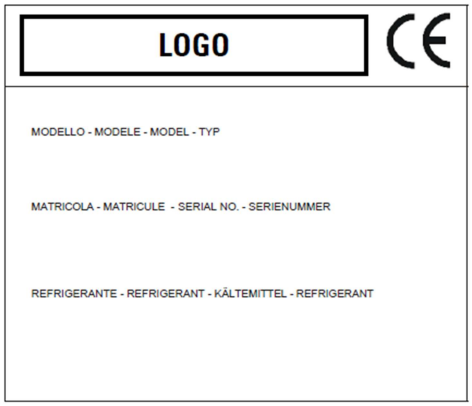
Swegon

Contents

1 INTRODUCTION

For construction features, available models and technical data refer to the technical booklet.
The model, serial number, features, power supply voltage etc. are shown on the labels affixed to the machine (the following images serve as an example).





	The Manufacturer has a policy for constant improvement and reserves the right to make changes and improvements to the documentation of the machines without prior notice.
	The technical booklet and the labels affixed directly on the machine are to be considered an integral part of this manual.

2 SYMBOLS

Below is a description of the main symbols used in this manual and on the labels affixed on the unit.

	Danger symbol; take extreme care.
	Danger symbol; moving mechanical parts.
	Danger symbol; live components.

3 FIELD OF APPLICATION

The "hydronic" version is intended for the cooling/heating of water generally for applications in the field of air-conditioning. The "condensing" and "reversible condensing" versions of the machines are to be connected to ventilating units with direct expansion coils for the cooling/heating of air; the coils and connecting pipes must be designed for use with R410A.
They must be used within the operating limits indicated in the Technical Booklet.

3.1 Overview

Upon installation or whenever interventions must be performed on the refrigeration unit, it is essential to carefully follow the instructions in this manual, comply with the indications shown on board the unit and apply all precautions required.
The pressures in the hydraulic circuit and the electrical components can create risky situations during installation and maintenance interventions.

	Any intervention on the unit must be performed by qualified authorised personnel.
	Warning: before performing any intervention on the unit make sure that the power supply has been disconnected. Refer to the section on maintenance.

Failure to comply with the instructions in this manual and any modification to the unit without written consent, will immediately render the warranty null and void.

4 INSPECTION, UNPACKING, TRANSPORT

4.1 Inspection

Check the unit upon receipt, bearing in mind that it left the factory in perfect condition; report any signs of damage immediately to the transporter and make a note of these on the Delivery Sheet before signing it.
The commercial office or manufacturer should be informed of the extent of the damage as soon as possible.
The Customer must fill in a written and photographic report concerning any relevant damage.

4.2 Unpacking

Disposal of packing material is the responsibility of the receiver and must be carried out in compliance with local and national regulations.

4.3 Lifting and transport

During unloading and positioning of the unit, great care must be given to prevent sudden or violent manoeuvres and not using machine components as strong points. Lift the unit using steel tubes inserted in the relative lifting holes. The unit must be lifted by harnessing it as indicated in figure 1. Use cords or belts that are long enough and spacer bars so as not to damage the sides and lid of the unit. Alternatively, the units can be lifted using a fork-lift truck, inserting the forks in the supporting pallet (fig. 1).

	Attention: In all lifting operations, make sure that the unit is fastened well in order to prevent accidental falls or over-turning.

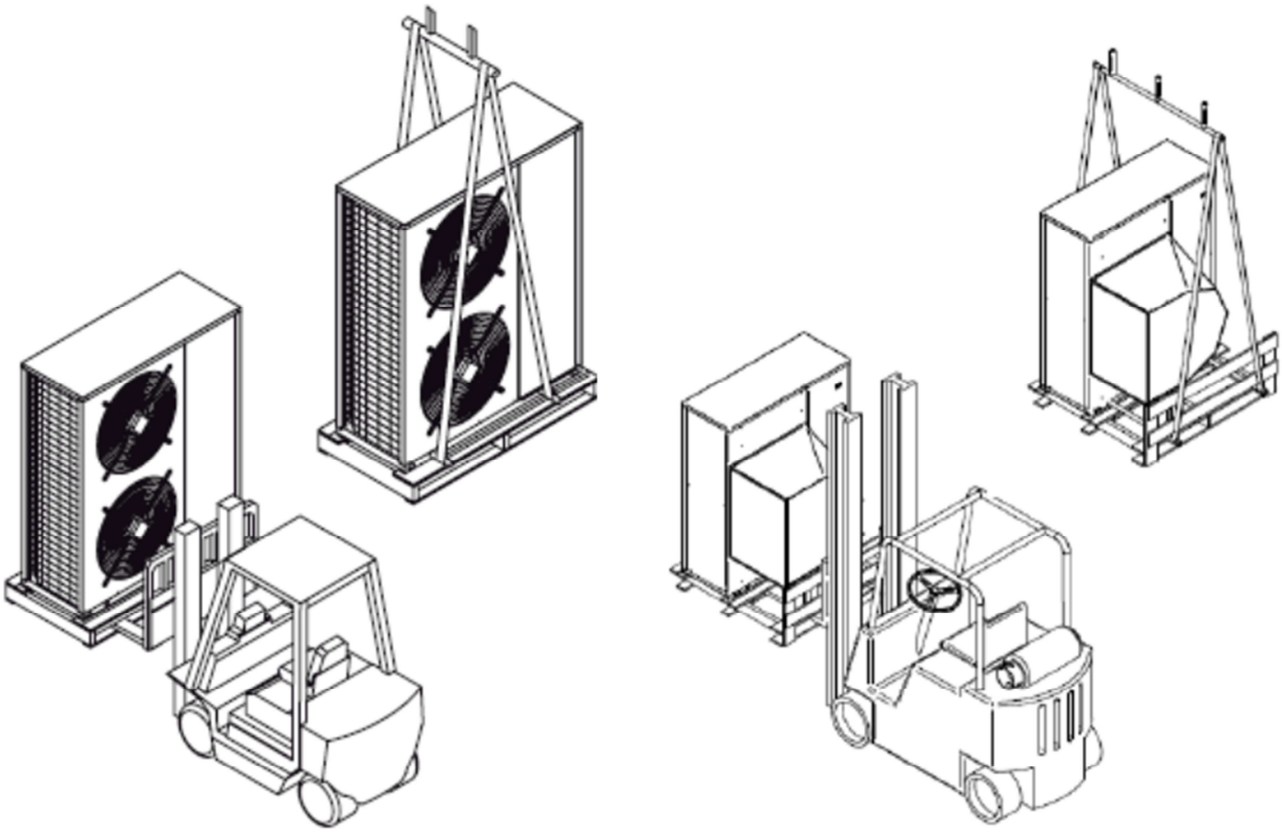


Fig. 1

⚠	The means of lifting, the ropes and harnesses must be selected by staff with suitable specific knowledge and able to assume all responsibilities relative to their use.
⚠	Keep the forks low. Use ballasts in the event of unbalancing. Do not hold protruding parts with your hands.
⚠	It is prohibited to pass under or near the load. The unit must be transported by qualified personnel (forklift operator, slinging personnel), who must wear the necessary personal protective equipment (overalls, safety shoes, work gloves, hard hats, goggles). The Manufacturer declines all responsibility for any accident caused by non compliance with this warning.

5 UNINTENDED USE

The machine must not be used:
- in an explosive atmosphere;
- in an inflammable atmosphere;
- in extremely dusty environments;
- by untrained personnel;
- in non-compliance with the Standards in force;
- with improper installation;
- with power supply defects;
- with total or partial failure to comply with the instructions;
- with lack of maintenance and/or use of non-original spare parts;
- with modifications or other interventions not authorised by the Manufacturer;
- when the work area is not kept free from tools and other objects;
- when the work area is not clean enough;
- in presence of abnormal vibrations in the work area.

6 SAFETY MEASURES

The machine complies with Directives 2006/42 EC, 2004/108 EC, 2006/95 EC and 97/23 EC and applicable Technical Standards as stipulated in the Declaration of Conformity that constitutes an integral part of this manual.

6.1 Definition of dangerous area

The machine must be accessed only by authorised operators.

- The external dangerous area is identified by a space of about 2 metres around the machine. If the unit is positioned in an unprotected place, which can be easily reached by unqualified personnel, access to this area must be prohibited by a special protection.
- The internal dangerous area can be accessed by entering the machine. For no reason must access inside the machine be allowed to unqualified personnel and before having disconnected the voltage.

6.2 Safety provisions

All the units are designed and built in compliance with the Pressure Equipment Directive (97/23 EC), so as to ensure maximum safety. Comply with the following provisions in order to prevent possible risks:

- this product contains pressurised parts, live components, moving mechanical components and surfaces at extreme temperatures that, in certain situations, can pose a risk: all maintenance must be entrusted to qualified personnel with the necessary authorisation, in accordance with the regulations in force. Before carrying out any operation, make sure that the appointed personnel has full knowledge of the documentation supplied with the unit.
- Always have a copy of the documentation near the unit.
- The operations shown in this manual must be integrated with the procedures found in the user instruction manuals of the other systems and devices incorporated in the machine. The manuals contain all the necessary information to handle the devices safely and the possible operating modes.
- Use the suitable protection (gloves, helmet, protective glasses, accident-prevention shoes etc.) for any maintenance or control operation performed on the unit.
- Do not wear loose clothing, ties, chains, watches, etc., which can get caught in moving machine parts.
- Always use tools and protective equipment in excellent state.
- There are very hot parts in the compressor compartment; be careful, therefore, when working in the immediate vicinity not to touch any components of the unit without the necessary protection.
- Do not operate in the drain path of the safety valves.
- If the units are positioned in places that are not protected and can be easily reached by unqualified persons it is mandatory to install suitable protections.
- The user is obliged to consult the installation and use manuals of the systems, incorporated and attached to this manual.
- There may be potential risks that are not evident. Warning and signs are therefore envisioned in the machine.
- It is prohibited to remove the warnings.

It is forbidden to:

- remove or make safety guards ineffective;
- tamper with and/or modify, even partially, the safety devices installed on the machine

If an alarm is signalled and consequently the safety devices are activated, the operator must request the immediate intervention of qualified maintenance technicians. Any accident can lead to serious injury or death.
The safety devices must be checked according to the guidelines found in the attached instruction manuals. Verification and inspections must be performed by persons who are authorised in writing by the employer.
A copy of the verification results must be left on the machine or in its proximity. Any accident can lead to serious injury or death.
The manufacturer does not assume any liability for damage/injury to persons, pets or objects deriving from the re-use of individual parts of the machine for functions of assembly different to the original situation. It is prohibited to tamper with/replace one or more parts of the machine without authorisation.
The use of accessories, tools or consumables other than those recommended by the Manufacturer relieves the latter from civil or criminal liability.
Machine decommissioning and demolition must be carried out by suitably trained and equipped personnel.

6.3 Installation in areas with explosive atmospheres

The machines do not fall under the application field of the ATEX Directive 94/9/EC – Presidential Decree n. 126 of 23/3/98.

6.4 Protective devices

The machine is equipped with technical protection measures against hazards that cannot be reasonably eliminated or sufficiently limited through design.
It is forbidden to:

- remove or make safety guards ineffective;

– tamper with and/or modify, even partly, the safety devices installed on the machine.

6.5 Lighting

This should make it possible to carry out installation and maintenance without incurring risks due to areas of darkness.

6.6 PERSONNEL QUALIFICATIONS – OBLIGATIONS

The user must know and apply the prescriptions regarding occupational safety, in compliance with Directives 89/391/EC and 1999/92/EC.
The knowledge and comprehension of the manual are indispensable for reducing risks and for improving the health and safety of the workers.
The operator must have a suitable degree of education to perform the various activities throughout the technical lifespan of the machine.

	The operator must be trained on possible anomalies, malfunctions or dangerous conditions for himself or others and in any case, he must comply with the following prescriptions: - stop the machine immediately by acting on the emergency button/s; - refrain from any intervention that goes beyond his duties and technical knowledge; - inform the manager immediately and do not take personal initiatives.

6.7 Various warnings

Comply with the regulations in force concerning the safety devices on the machine and the personal protective equipment.
The Technical File is maintained at the manufacturer's location.
The manufacturer does not assume any liability for any damage/injury to persons, pets or objects deriving from the failure to comply with the Safety Standards and recommendation contained in the documentation supplied.
In addition to this manual are other documents and labels affixed directly on the machine that also provide important information. Consult these other documents when required.

7 POSITIONING AND INSTALLATION

The following must be taken into account when choosing the unit's place of installation and making the relative connections:
– size and origin of the hydraulic piping;
– location of the power supply;
– accessibility for maintenance or repair operations;
– solidity of the support surface;
– ventilation of the air-cooled condenser;
– orientation and exposure to solar radiation: keep the condensing coil out of direct sunlight whenever possible;
– do not position the unit in a way that strong winds favour air recirculation at the condensing coil;
– do not position the machine on dark coloured land (e.g. tarred surfaces) so as not to cause functioning overheating;
– possible sound reverberation.

It is obligatory to observe the clearances specified in the dimensional drawing of the unit.
The unit must always be anchored to the ground.
Provide a solid base on which to position the unit. This support must be perfectly flat and horizontal. Its dimensions must be suitable for those of the unit. This precaution is indispensable when the unit is to be positioned on unstable ground (various lands, gardens etc.). Figure 2 illustrates the structure of a typical support slab.

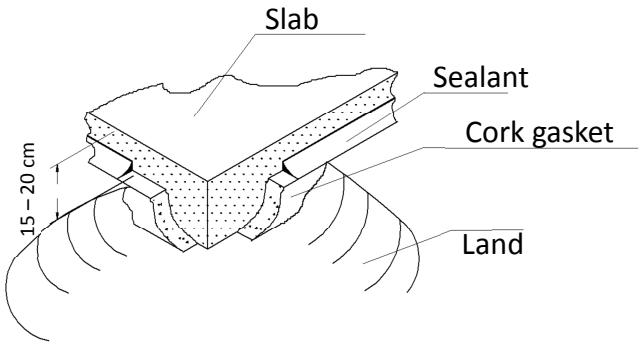


Fig. 2

The slab must be:
– made in suitable foundation with a height of about 15-20 cm with respect to the surrounding land,
– supplied with a cork gasket suitably sealed along the perimeter,
– flat, horizontal and able to support 150% of the operational weight of the machine.
– at least 30 cm longer and wider than the machine.

Although the unit transmits low levels of vibrations to the supporting structure, it is advisable to lay a sheet of hard rubber between the base of the unit and the supporting surface.
If better insulation is required, it is advisable to use the anti-vibration supports which are available as accessories.
In the event of installation on roofs or intermediate floors, the unit and the piping must be isolated from the walls and ceilings. The units should not be positioned in proximity of private offices, bedrooms or areas where low sound emissions are required. To prevent excessive sound reverberation, do not install the unit in narrow or confined spaces.
The machine equipped with standard coils should not be installed in an environment where there is an aggressive chemical atmosphere, in order to avoid the risk of corrosion.
Particular care should be taken to avoid atmospheres containing sodium chloride, which can aggravate corrosion due to galvanic currents; a machine with untreated coils must not, for any reason, be installed in a marine environment.
In the case of a marine or highly polluting industrial environment, it is necessary to request coils with anti-corrosion surface treatment or copper-copper or copper-tinned copper coils.
In any case, please contact our commercial office to define the most suitable solution.

7.1 Spaces for installation

The service spaces to comply with are shown on the dimensional drawings attached to the documentation of the machine.
The condensing coil must be allowed adequate space for the airflow at both the intake and the exhaust side.
In order to prevent poor unit capacity or even interruptions in unit operation it is absolutely essential to avoid the recirculation of air between the intake and the exhaust.
High walls near the unit may interfere with its proper functioning.
Units should be installed a minimum of three metres apart.
It is advisable to leave sufficient space between the units for removing their larger components such as the exchangers, compressors or pumps.

7.2 Anti-vibration mounts (optional)

In order to reduce vibrations transmitted to the structure, it is recommended to install the machine on rubber or spring anti-vibration mounts, supplied as an accessory.
The dimensional layout with the contact patch, attached to the machine, shows the position and load of each anti-vibration mount.
The anti-vibration mounts must be applied before positioning the machine on the ground.

7.2.1 Rubber anti-vibration mounts

The anti-vibration mount consists of an upper metal bell in which there is a screw to fasten the unit base. The anti-vibration mount is fastened to the base through the two holes on the flange. The anti-vibration flange bears a number (45,60,70 ShA) that identifies the hardness of the rubber support.
The dimensional layout with the contact patch, attached to the machine, shows the position and load of each anti-vibration mount.

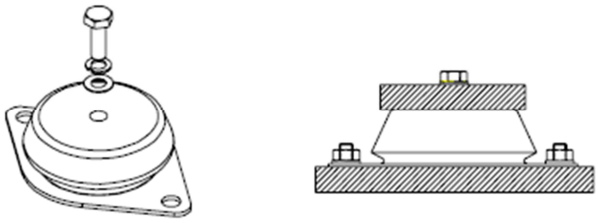


Fig. 3: Rubber/metal anti-vibration mounts, particularly suitable to dampen the vibration stress.

7.3 General recommendations for hydraulic connections

When setting up the hydraulic circuit for the evaporator, it is good practice to comply with the following prescriptions and in any case with the national and local regulations (refer to the layouts included in the manual).
fit the piping to the chiller using flexible joints in order to prevent transmission of the vibrations and compensate heat dilation. (Proceed on the pumps unit in the same way).
Install the following components on the piping:

- stop cocks, temperature and pressure indicators for routing maintenance and unit inspection.
- sample points on the input and output pipes to read the temperature, if temperature indicators are not present.
- shut-off valves (gate valves) to isolate the unit from the hydraulic circuit.
- metal mesh filter with openings not wider than 1 mm, on the exchanger inlet pipe to protect the exchanger against slag or impurities in the pipes.
- vent valves, to locate in the highest parts of the hydraulic circuit, in order to allow to bleed the non-condensables.
- expansion tank and automatic charging valve for maintenance of the system pressure and to compensate heat dilation.
- drain valve and where necessary, drain tank to empty the system for maintenance operations or seasonal breaks.

⚠	It is mandatory to comply with these prescriptions to facilitate the hydraulic connection operations, maintenance and access to the electrical panel.
⚠	It is highly recommended to install a safety valve on the hydraulic circuit. If serious anomalies should arise in the system (e.g. a fire breaks out), this allows the system to be drained, thereby preventing any explosion. Always connect the drain to a pipe with a diameter that is no less than that of the valve opening and direct it towards the areas where the jet cannot harm anyone.
⚠	It is mandatory to install the flow meter supplied with the unit in line with the chilled water outlet connection.
⚠	It is obligatory to assemble the metal mesh filter on the water inlet pipe. If any of the above are missing, the warranty is cancelled immediately.
⚠	It is highly recommended to install a safety valve on the hydraulic circuit. In the event of serious anomalies in the system (e.g. fire) it allows to drain the system, thus preventing any explosions. Always connect the drain to a pipe with a diameter that is no less than that of the valve opening and direct it towards the areas where the jet cannot harm anyone.
⚠	Use two keys to tighten the hydraulic connections (see fig. 3).

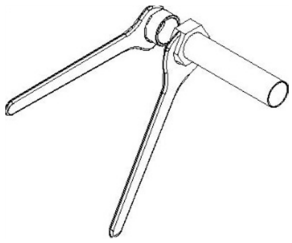
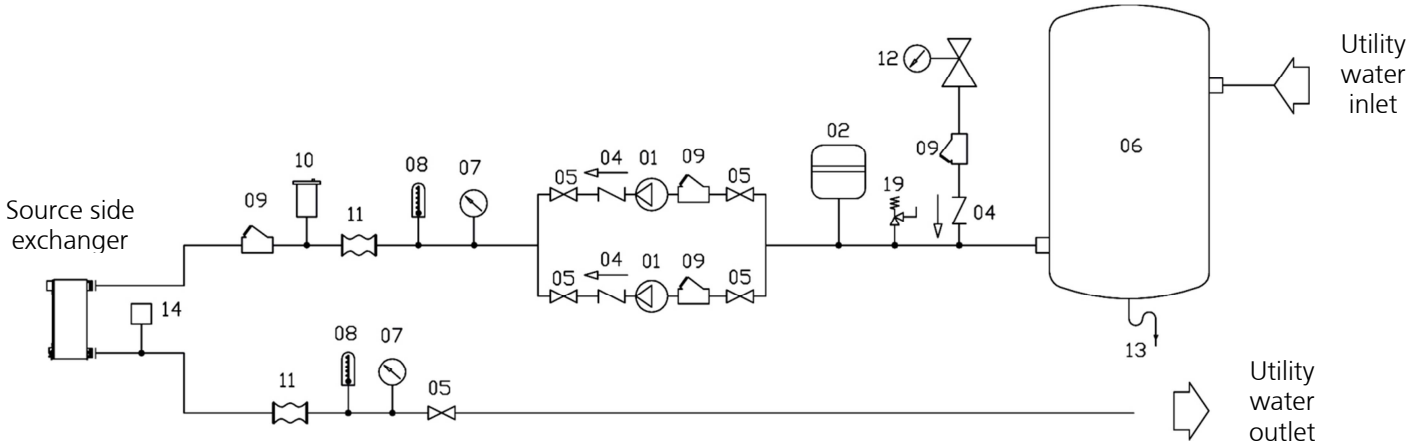


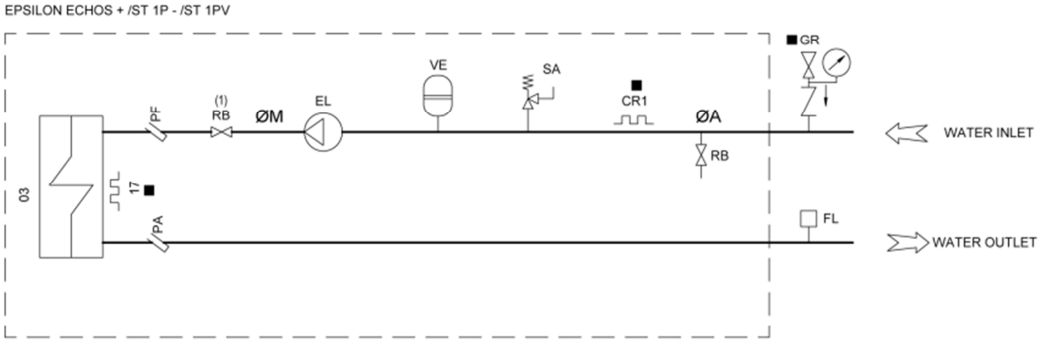
Fig. 3

7.3.1 Recommended hydraulic circuit



01 Circulation pump
02 Expansion tank
04 Non-return valve
05 Ball cock
06 Tank
07 Manometer
08 Thermometer
09 Water filter
10 Bleed valve
11 Flexible coupling
12 Plant filling unit
13 Water outlet
14 Flow meter
19 Safety valve

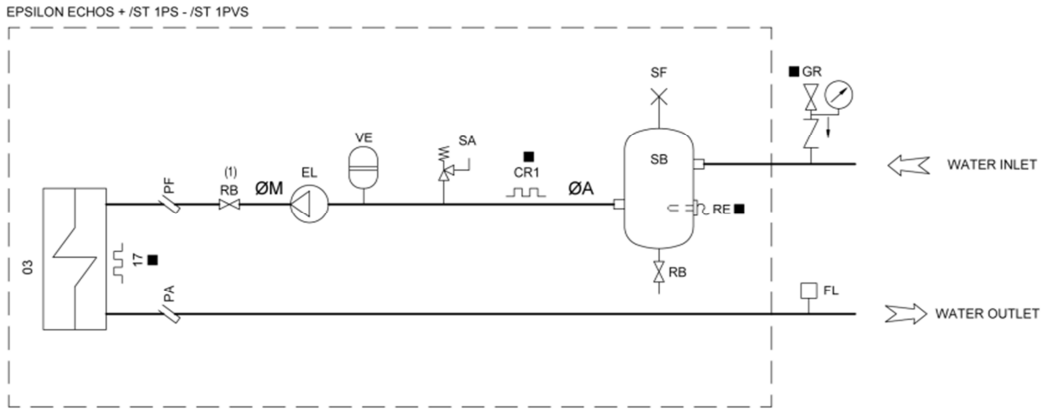
7.3.2 ST 1P - ST 1PM - ST 1PV set-ups



03 Evaporator
17 Electrical heater
CR Heating cable
EL Electric pump
FL Flow meter
RB Cock
PA Well for anti-freeze probe

PF Well for water inlet probe
SA Safety valve
RE Tank electrical heater
SB Storage tank
SF Bleed valve
VE Expansion tank

7.3.3 ST 1PS - ST 1PMS - ST 1PVS set-ups



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PF Well for water inlet probe
SA Safety valve
RE Tank electrical heater
SB Storage tank
SF Bleed valve
VE Expansion tank

8 HYDRAULIC CONNECTION

8.1 Hydraulic connection to the exchanger

⚠	It is of fundamental importance that the water inlet is installed where the connection is marked with the following plate:  CHILLED WATER Otherwise, the evaporator could freeze as the anti-freeze thermostat check would be annulled.
⚠	If the integrated inverter is not provided with the machine (i.e. is supplied directly by the manufacturer), the hydraulic circuit should be set up in such a way as to guarantee a constant flow of water to the exchanger in all operating conditions. If this is not the case, the risk of refrigerant returning in the liquid state to the compressor input would be run, with the danger of breakage of the same.
⚠	Warning: during the hydraulic connections, never operate with naked flames near or inside the unit.

8.2 Minimum water content in the plant.

The compressors can run intermittently; this is because the amount of cooling power required by the unit is not generally the same as that provided by the machine.
It is necessary to guarantee inertia on the system such to limit oscillation of the water temperature within the limits that do not compromise the good functioning of the unit and, at the same time, guarantee good stability at the water flow temperature. The mathematical formula below is for calculating the minimum water content on the side of the plant:

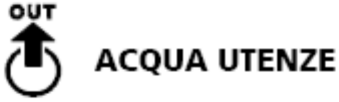
$$V_{min} \geq P_{tot} \times 4$$

V_{min}: water content of the plant [l]
P_{tot} : Power capacity of the unit [kW]

If the above mentioned volumes are not reached, a storage tank must be set up for its capacity together with that of the system to reach the relative valueV_{min}.
This tank does not require particular set-ups. It must however be carefully isolated like all chilled water pipes, in order to prevent condensation and not to affect system performance.

8.3 Instructions for mounting the water flow meter

– Clean the pipes making sure that any metal residue cannot interfere with correct operation of the flow meter.
– Connect the flow meter to the male threaded outlet coupling on the evaporator (fig. 4) bearing this label:



Seal the connection with Teflon tape.

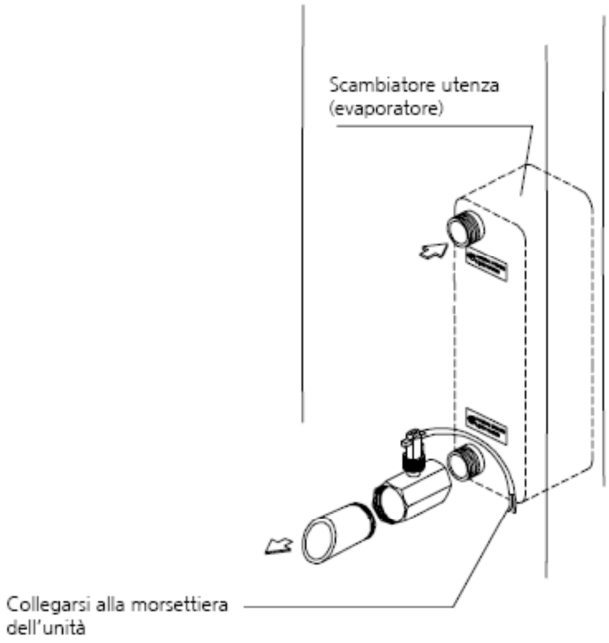


Fig. 4

- Make sure that the flow meter (plastic body) is securely fastened on the metal coupling with the plastic locking ring, and that the arrow on the flow meter points in the direction of the flow of water.
- Make sure to put the O-ring seal between the locking ring and the metal fitting. The O-ring is provided in the plastic cover that protects the rod of the flow meter.
- Connect the hydraulic circuit to the other end of the "T" fitting.
- Feed the electrical cable of the flow meter through the hole in the structural steelwork and connect the flow meter to the terminals in the electric control board as indicated in the electrical diagram.
- To disassemble the flow meter, unscrew the plastic locking ring. When reassembling the flow meter, put the ring seal between the metal fitting and the plastic part (see fig. 5).

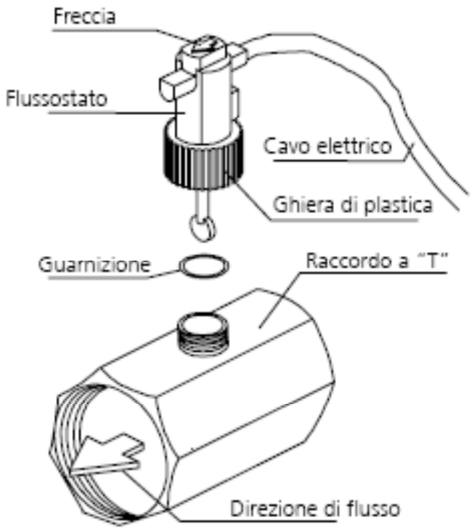


Fig. 5

8.4 Water flow rate to the exchangers

The nominal water flow rate refers to a thermal gradient of 5 °C between the inlet and outlet.
The maximum water flow rate refers to a thermal gradient of 4 °C: anything higher could cause too great a pressure drop and the risk of damage to the evaporator.
The minimum flow rate accepted is that with a pressure drop no less than 10 kPa. Lower flow rate values could cause evaporation temperatures that are too low with safety intervention and unit stop.
In any case, refer to the specific Technical Booklet for the permitted conditions for the flow of water in and out of the exchangers.

8.5 Composition of the water

Dissolved substances in the water can cause corrosion in the heat exchangers. It is mandatory to verify that the water parameters comply with this table:

Total hardness	2.0 to 6.0 °F
Langelier index	- 0.4 to + 0.4
pH	7.5 to 8.5
Electrical conductivity	10 to 500 □S/cm
Organic elements	-
Hydrogen carbonate (HCO_3^-)	70 to 300 ppm
Sulphates (SO_4^{2-})	< 50 ppm
Hydrogen carbonate / Sulphates (HCO_3^-/SO_4^{2-})	> 1
Chlorides (Cl^-)	< 50 ppm
Nitrates (NO_3^-)	< 50 ppm
Sulphuric acid (H_2S)	< 0.05 ppm
Ammonia (NH_3)	< 0.05 ppm
Sulphites (SO_3), free chlorine (Cl_2)	< 1 ppm
Carbon dioxide (CO_2)	< 5 ppm
Metal cations	< 0.2 ppm
Manganese ions (Mn^{++})	< 0.1 ppm
Iron ions (Fe^{2+} , Fe^{3+})	< 0.2 ppm
Iron + Manganese	< 0.5 ppm
Phosphates (PO_4^{3-})	< 2 ppm
Oxygen	< 0.1 ppm

If water is used that does not meet the criteria in the table, the warranty is immediately rendered null and void.
It is mandatory to set up a system that eliminates the possible organic substances in the water that could pass through the filter and settle in the heat exchangers, which would lead to malfunction and/or damage in time.
If the water used in the unit contains organic substances, the warranty is immediately rendered null and void.

8.6 Operation with water to the evaporator at low temperature (chiller unit)

With temperatures below 5°C, it is good practice to operate with water and anti-freeze mixtures and alter the relative safety devices (anti-freeze, etc.), which must be carried out by qualified authorised personnel or by the manufacturer.
The glycol percentage in weight is determined depending on the desired temperature of the chilled water (see Table 5).

Minimum ambient temperature or liquid outlet temperature (°C)	0	-5	-10	-15	-20	-25	-30	-35	-40
Freezing point (°C)	-5	-10	-15	-20	-25	-30	-35	-40	-45
Anti-freeze	% in weight								
Ethylene glycol	6	22	30	36	41	46	50	53	56
Propylene glycol	15	25	33	39	44	48	51	54	57
Temp -20	T -20°C					---			
Temp -40	T -40°C								
Temp -60	T -60°C								
Tifoxite	40			50	60	63	69	73	-
Freezium	10	20	25	30	34	37	40	43	45
Pekasol 50	50		59	68	75	81	86	90	-

Table 5 - Freezing point for water-anti-freeze mixture

	If environment temperatures are expected to be less than the freezing point of water, it is important to use anti-freeze mixtures in the above mentioned percentages.
	In the case of units with pump units applied in plants with a per 30% glycol, it is necessary to request during the order phase a technical check to assess the compatibility of the pumps and find the best solution which could require use of a specific hydraulic module or the application of pumps with seals and special electric motors.

8.7 Operation with water to the condenser at low temperature (heat pump unit)

The standard units are not designed to run with the flow of water to the condenser at too low a temperature (refer to the technical booklet for the limits). In order to operate below this limit, the unit could require structural modifications. In the event of these necessities, contact our company.

8.8 Discharge of the safety valves

The cooling circuit is equipped with safety valves: some standards prescribe that the drain of such valves is taken outside via a relevant pipe, which must have a diameter at least equal to that of the valve drain and its weight must not burden the valve.

	Warning: always convey the drain to areas where the jet cannot cause harm anyone.

9 CONNECTIONS FOR SPLIT UNITS

	Warning: the following operations require pipes to be pressurised and soldered connections that must be carried out by specialised personnel with the necessary qualifications according to the applicable regulations.

The sizing and execution of the cooling lines affect the reliability and performance of the product. The following paragraphs list a few suggestions when implementing the cooling lines, however, the installer is responsible for ensuring they are executed correctly.

9.1 Cooling connections

The LE (condensing) and LE/HP (reversible condensing) units with separate sections need to be connected to the evaporator or condenser with refrigerant piping.
For the units in the version with separate sections, the route of the refrigerant piping depends on the positioning of the lines and the structure of the building.
In any case, the pipes must be as short as possible in order to minimise the pressure drops and the amount of refrigerant in the circuit; the maximum pipe length and maximum difference of level of the refrigerant piping are indicated in table 3.
Our Company is happy to provide any information you require in this regard.

Sizes	9-15	20-26-30
Maximum permitted length of refrigerant piping	20 m	30 m
Maximum difference of level between the sections with Celest+ at top level in relation to the evaporating/condensing coil	15 m	30 m
Maximum difference of level between the sections with Celest+ at bottom level in relation to the evaporating/condensing coil	8 m	8 m

TABLE 3 - Maximum length and difference of level of refrigerant piping

9.2 Set-ups for the realisation of the refrigerant lines

According to the position relative to the condensing and evaporating sections, there are some arrangements to follow regarding the realisation of the refrigerant line.
The diameter of the pipes in relation to the size and version is indicated in Table 4.
Brazing should be carried out by qualified personnel taking care not to overheat the cocks and other components of the machine's refrigerant circuit.
All the refrigerant lines should be insulated with insulating material a minimum of 9 mm thick; an absence of insulation on the refrigerant lines can result in a loss of efficiency and the formation of condensation or ice on the pipes, and can compromise correct operation of the unit.

9.3 LE versions: evaporating section at a level lower than that of the condensing section.

Siphons must be present on the vertical tracts of the intake line at at least every 5 metres to make return of the oil to the compressor easier.
In the horizontal tracts of the intake line envision a gradient equal to at least 1% to favour oil return to the compressor.

See fig. 6.

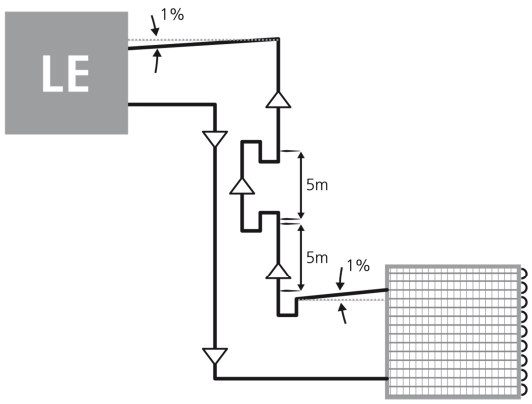


Fig. 6

9.4 LE versions: evaporating section at a level higher than that of the condensing section.

Realise a siphon on the intake line that is as high as the evaporator with the purpose of preventing the fall of liquid refrigerant towards the compressor when the unit is at a standstill.
In the horizontal tracts of the intake line envision a gradient equal to at least 1% to favour oil return to the compressor.
See fig. 7.

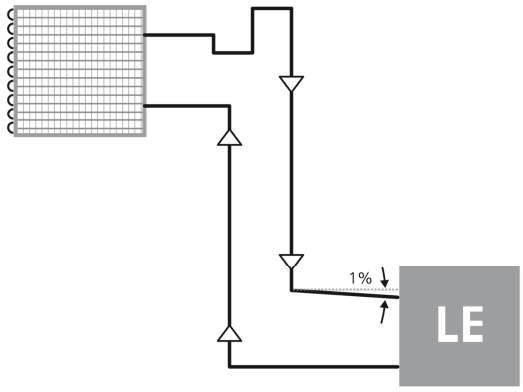


Fig. 7

9.5 LE/HP versions: evaporating/condensing section at a level lower than that of the condensing/condenserless section.

Siphons must be present on the vertical tracts of the intake line at at least every 5 metres to make return of the oil to the compressor easier.
Siphons must be present on the vertical tracts of the liquid (flash) line at at least every 5 metres to make return of the oil to the compressor easier.
In the horizontal tracts of the intake line envision a gradient equal to at least 1% to favour oil return to the compressor (as above).
See fig. 8

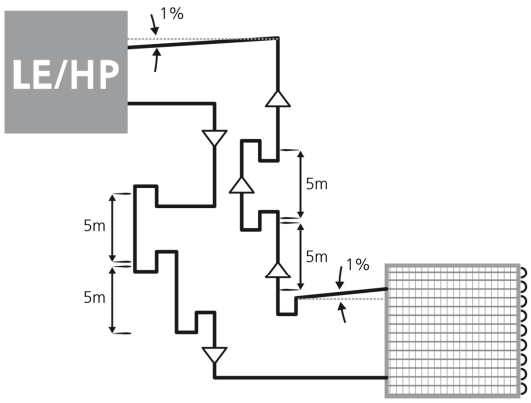


Fig. 8

9.6 LE/HP versions: evaporating/condensing section at a level higher than that of the condensing/condenserless section.

Realise a siphon on the intake line that is as high as the evaporator with the purpose of preventing the fall of liquid refrigerant towards the compressor when the unit is at a standstill.
Siphons must be present on the liquid (flash) line at at least every 5 metres to make return of the oil to the compressor easier.
In the horizontal tracts of the intake line envision a gradient equal to at least 1% to favour oil return to the compressor.
See fig. 9.

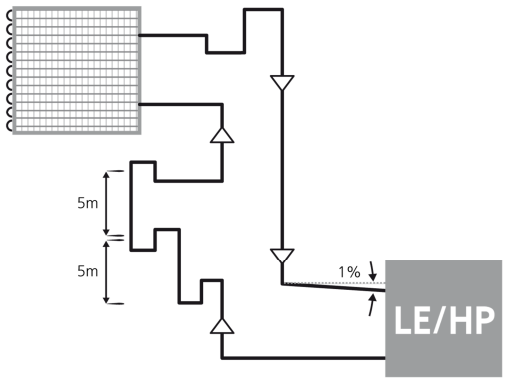


Fig. 9

Model Celest+	Version	Length 10 m		Length 20 m		Length 30 m	
		Ø inlet mm	Ø flash (mm)	Ø inlet mm	Ø flash (mm)	Ø inlet mm	Ø flash (mm)
9	LE: LE/HP:	12	10	12	10	-	-
15		16	12	16	12	-	-
20		22	16	22	16	22	16
26		22	16	22	16	22	16
30		28	16	28	16	28	16

TABLE 4 - RECOMMENDED DIAMETER OF THE PIPING

9.7 Variation in capacity in relation to the length of the cooling lines

Figure 10 shows the indicative loss of cooling capacity for each metre of length of the cooling lines.

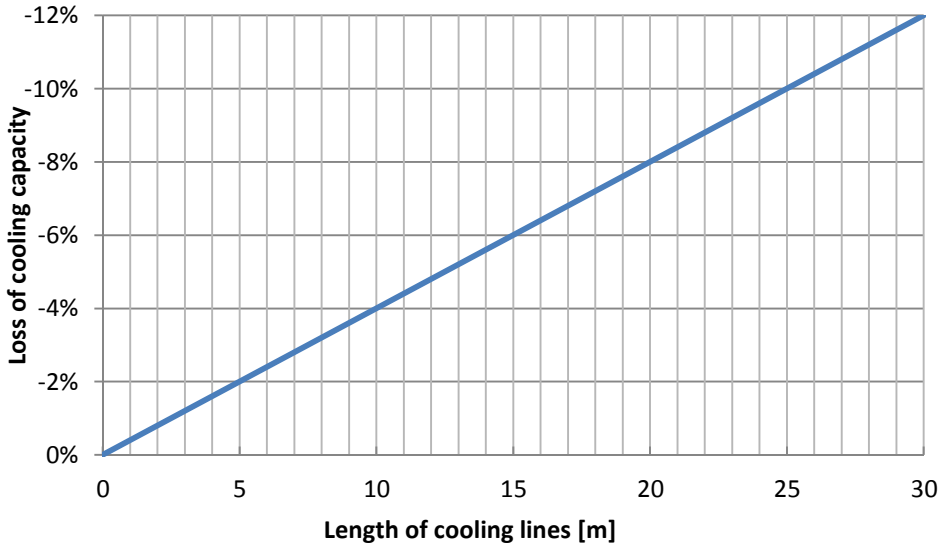


Fig. 10

9.8 Refrigerant load for LE and LE/HP units

The units are pre-filled with a load of R-410A refrigerant at the factory; the load of refrigerant is calculated theoretically for a 10m cooling line and has to be adjusted during initial start-up according to the volume of the evaporating or evaporating/condensing coil connected, and according to the length of the connecting lines; the load filled at the factory does not consider the volume of the evaporating/condensing coil connected because this is not known a priori. Table 5 indicates the additional loads of refrigerant for each metre of a cooling line measuring more than 10m.

⚠	Warning: the refrigerant loads are purely indicative and calculated theoretically. The actual load could differ from that stipulated. The refrigerant load will be confirmed and/or adjusted during the initial start-up (by the authorised assistance centre)

Diameter (mm)	Gas (kg/m)	Liquid (kg/m)
12	0.007	0.074
16	0.014	0.139
18	0.019	0.182
22	0.029	0.285
28	0.045	0.445

TABLE 5 - Additional R-410A gas loads per metre of linear piping

10 ELECTRICAL CONNECTIONS

10.1 Overview

- The electrical connections must comply with the information shown on the wiring diagram attached to the unit and the regulations in force in the place of installation.
- The earth connection is mandatory by law. The installer must connect the earth cable using the relevant PE clamp on the earth bar situated in the electric control board.
- Verify that the power supply voltage corresponds to the nominal data of the unit (voltage, number of phases, frequency) stated on the plate on the machine.
- The power supply voltage must not undergo variations over ±5% and the unbalance between the phases must always be less than 2%. If this should not occur, contact our technical dept. in order to select the relevant protections.
- Check that the line is connected with the correct sequence of the phases.
- To feed in the electrical cables, use the hole in the structural steelwork indicated by the relative label. The power cord is fed in through the bottom part of the electric control board of the unit.
- The control circuit power supply derives from the power line via a transformer situated in the electric control board. The control circuit is protected by relevant fuses.

	Use power cable fixing systems that resist traction and twisting stress.
	Make sure there is no voltage present before performing any operation on electric parts.
	The section of the cable and the line protections must comply with that indicated in the wiring diagram and the relevant table attached to the unit.
	The resistances must be inserted at least 12 hours before the initial start-up and takes place automatically when the master switch is closed.
	The unit must be made to operate with those limits; failure to do so will immediately void the warranty.

10.2 Powering the resistances of the compressor guard

To power the resistances of the guard:
1. Make sure that the phase sequence is correct (if the "PHASE MONITOR" accessory is not present)
2. Close the main switch by turning it from OFF to ON.
3. Check that "OFF" appears on the display.
4. Make sure the unit is "OFF" and that the external consent is open
5. Leave the machine in these conditions for at least 12 hours to power the guard resistances.

10.3 Potential free contacts

The following potential free contacts are available:
- 1 contact for the cumulative alarm;
- 1 potential free contact for every compressor (option)
- 1 potential free contact for the pump (option).

10.4 Circulation pump electric connections

In order to run the unit, the external consent has to be closed (refer to the electrical diagram provided with the unit).
The unit can only be started after the circulation pump of the hydraulic system is running, when applicable.
The contacts of the external consents must be short circuited if not needed for system requirements.

	If the external pump is controlled by an external controller, the pump must be started before the unit and stopped after it the latter shuts down with a recommended minimum advance/delay of 5 minutes.

10.5 Control of the fans speed

The unit is equipped as standard with a fan speed control device. In this way, it is possible to operate with rather low external temperatures, reducing the air flow rate to the condenser and allowing the unit to operate with acceptable functioning parameters.
This device can also be used to reduce the sound emissions of the unit when the external air temperature tends to decrease (e.g. during the night).
This control is calibrated and inspected in the factory.

	Warning: the speed control calibrations must never be modified. If this is required, please contact the manufacturer.

10.6 Microprocessor control

Refer to the control manual supplied with the unit.

11 START-UP

	The machine should be started up only by qualified personnel authorised by the manufacturer.

11.1 Preliminary verifications

- Check that the electrical connection has been implemented correctly and that all clamps are tightly fastened.
- Check that the voltage on the RST clamps is 400 V ± 5% (or that of the unit plate in the event of special voltages). If the voltage is subject to frequent variations, contact our technical dept. for the selection of relevant protections.
- Check that the gas pressure in the cooling circuits is shown on the control display or manometers (if applicable).
- Check that there are no refrigerant fluid leaks, if necessary using the leak detector.
- Check the correct power supply of the guard resistances.

	The resistances must be inserted at least 12 hours before the initial start-up and takes place automatically when the master switch is closed.

To check the correct functioning of the resistances, check that the lower part of the compressors is hot and in all cases is at a temperature of 10 - 15 °C above the ambient temperature.

- Check that the hydraulic connections have been made correctly, respecting the indications on the input/output plates on the machine.
- Check that the hydraulic system has been bled, thereby eliminating all residual air and loaded gradually, opening the vent devices in the upper part, which the installer would have set up together with an expansion tank of adequate capacity.

	Before starting-up, verify that all the closing panels of the unit are in place and secured with the relative fastening screw.
	Warning: all the units are pre-loaded with refrigerant gas, so the refrigerant circuit is pressurised.

11.2 Verifications during operation

- Check that the sequence of the phases is correct. This can be verified by making sure that the supply pressure increases and the intake pressure decreases when the compressor is started up. Otherwise, the phase sequence is incorrect and the compressors are rotating in the wrong direction; it is therefore important to quickly restore the correct phase sequence. If the compressor is repeatedly started up and shut down in the wrong direction, and the phase sequence is not corrected, the compressor will be permanently damaged.
- Check that the evaporator inlet water temperature is near to the electronic control set value.
- For the unit is supplied with pump unit, if the pump should be noisy, close the flow cock until normal functioning has been restored. This can occur when the pressure drop in the system is largely offset from the pump static pressure.

11.3 Checking the refrigerant load

- Check, after a few hours of operation, that the liquid warning light is green: if it is yellow, there is humidity in the circuit. In this case, the circuit must be dried by qualified authorised personnel.

– Check that bubbles do not appear at the liquid indicator. The continuous passage of bubbles can indicate the lack of refrigerant and the need for top-up. The presence of just a few bubbles is permitted, however, especially when the compressor is working at a rate other than the nominal one.

11.4 Alarms

	Repeatedly resetting the alarms without understanding and resolving the problems that have caused the alarms could permanently damage the machine. Always contact the technical assistance service when an alarm occurs!

12 CALIBRATING THE CONTROL COMPONENTS

	The control equipment should be serviced by qualified and authorised staff only. Incorrect calibration settings can cause serious damage to the unit and injuries to people.

The control equipment is entirely calibrated and tested in the factory before the unit is shipped. However, after the unit has been working for a reasonable period of time, the safety devices should be checked. The calibration settings are shown in Table 2.

Control and safety components	Activation set point	Differential	Reset
Safety valve setting	45.5 bar	-	-
High pressure switch setting	40.5 bar	4 bar	
High pressure transducer setting	39.5 bar		Manual
Low pressure transducer setting	1.5 bar		(Controller) manual
Anti-freeze alarm setting	4 °C	6 °C	(Controller) manual
Evaporator heater setting	5 °C	1 °C	Automatic
Defrost start setting	2.5 bar		
Defrost end setting	28.5 bar		

Defrosting can also be done in other ways which can be selected on the control; check, in this case, the correct setting of the start and end thresholds with reference to the control manual.

13 DECOMMISSIONING

13.1 Seasonal shutdown

– Disconnect the voltage using the machine master switch/main isolating switch.
– Drain the hydraulic system (unless it contains glycol water)
– Repeat the start-up procedure on the successive start-up

13.2 Emergency stop

To stop in an emergency, turn OFF the main switch. This turns off the power to the entire machine.

	If the unit does not start up: never modify the internal electrical connections, otherwise the warranty is immediately rendered null and void.
	It is recommended not to disconnect the voltage from the unit during short stop periods in order to leave the compressors guard heating resistances powered; do so only in the case of prolonged stops (e.g. seasonal shutdowns).
	Warning: do not stop the unit by pressing the machine's main switch: this device should be used to isolate the unit from the power supply when it is no longer live, i.e. when the unit is OFF. Moreover, by removing the voltage entirely from the unit, the guard resistances would not be powered, thUs jeopardising the integrity of the compressor on re-start.

14 PERIODIC MAINTENANCE AND INSPECTIONS

14.1 Warnings

	All the operations described in this chapter must always be carried out by qualified and authorised personnel.
	Before performing any intervention on the unit or accessing internal parts, make sure that the power supply has been disconnected.
	Warning: the inverter of the compressor contains various parts that remain live for a few minutes after the power supply has been disconnected at the main switch. Before carrying out any maintenance: – turn off the machine at the main switch; – wait at least 5 minutes; – always use a suitable multimeter to make sure that there is no dangerous voltage at the heads of the clamps; – always make sure that the motor of the compressor has completely stopped. Freely rotating motors can create dangerous voltage at the clamps of the inverter even when this is not powered; – check that the dissipator is not hot: coming in contact with the dissipator can cause serious burns.
	The flow pipes and compressors are hot. Pay particular attention when operating in the vicinity.
	Pay special attention when operating in the proximity of the finned coils as the aluminium fins are particularly sharp.
	The compressors, the flow pipes and the dissipator of the inverter are hot. Pay particular attention when operating in the vicinity.

14.2 Overview

It is good practice to carry out periodic inspections to verify the proper operation of the unit:

OPERATION	RECOMMENDED FREQUENCY
Check functioning of all control and safety appliances as described previously.	Monthly
Check the tightness of the electric terminals both in the power panel and in the compressors' terminal boards. The mobile and fixed contacts of the remote controls must be cleaned periodically and must be replaced whenever they show signs of deterioration.	Monthly
Control the refrigerant load via the liquid indicator	Monthly
Verify that there are no oil leaks from the compressor	Monthly
Check that there are no water or water and glycol mixture leaks in the hydraulic circuit.	Monthly
If the unit is to remain out or service for a long period, drain the water from the pipes and the heat exchanger. This operation is necessary whenever room temperatures are lower than the freezing point of the fluid used throughout the standstill period	Seasonal
Verify the filling of the water circuit	Monthly
Verify the operation of the flow meter	Monthly
Check the heater of the compressor guard	Monthly
Clean the metal filters in the hydraulic pipes	Monthly
Clean the finned battery and the metal filters, if present, using compressed air in the opposite direction to the passage of air. If it is clogged, use a jet of water taking care not to bend or damage the fins of the coil.	Monthly
Perform the defrosting test	Monthly
Verify the state, fastening and balance of the fans	4 months
Check the humidity indicator on the liquid indicator (green = dry, yellow = humid). If the indicator is not green, as indicated on the indicator label, replace the filter.	4 months
Ensure that the noise emitted by the machine is regular	4 months
Clean the outlets of the condensate drip tray	Monthly

14.3 Protection of the environment

The law regarding the regulations of use of stratospheric ozone depleting substances prohibits the dispersion of refrigerant gases in the environment and obliges holders to recover them and return them to the dealer or special collection centres at the end of their operational life.
Refrigerant R410A is included among the substances subject to special monitoring by law and must be handled as described above.

	Particular attention is therefore recommended during maintenance operations in order to reduce refrigerant leaks as much as possible.

15 DISPOSAL OF THE UNIT

When the unit has reached the end of its intended duration and must be removed and replaced, a number of measures must be taken:

- the refrigerant gas it contains must be recovered by specialised staff and sent to collection centres;
- the lubricating oil of the compressors must also be recovered and sent to the collection centres;
- the unit's structure and components, if no longer usable, should be taken down and divided by type of material; this regards in particular copper and aluminium parts, of which there are fair amounts in the unit.

This is to ease collection, disposal and recycling centres and minimise environmental impact.

16 REFRIGERANT

16.1 R410A REFRIGERANT SAFETY DATA SHEETS

1.	1.1	Identification of the preparation	SUVA* 410A Refrigerant

IDENTIFICATION ELEMENTS OF THE SUBSTANCE OR THE PREPARATION		ASHRAE Refrigerant number designation	R410A
2. COMPOSITION / INFORMATION ON INGREDIENTS	Chemical nature of the preparation		% in weight – Case No. – CE No.
	Difluoromethane (R32) Pentafluoroethane (R125)		50 75-10-5 200-839-4 50 354-33-6 206-557-8
3. HAZARDS IDENTIFICATION	3.1	Greatest dangers	The vapours are heavier than air and can cause suffocation by reducing the oxygen available for respiration.
	3.2	Specific dangers	Rapid evaporation of the liquid can cause freezing. It can cause cardiac arrhythmia.
4. FIRST-AID MEASURES	4.1	Eyes	Rinse thoroughly with abundant water for at least 15 minutes and seek medical attention.
		Skin	Wash immediately with abundant water. Remove all contaminated garments immediately.
		Inhalation	Go into the fresh air. Use oxygen or artificial respiration if necessary. Do not administer adrenalin or similar substances.
		General information	Do not administer anything to persons that have fainted.
5. FIRE-FIGHTING MEASURES	5.1	Extinguishing means that are appropriate	Any.
	5.2	Specific dangers	Pressure increase.
	5.3	Specific methods	Spray water on the containers/tanks to cool them down.
6. ACCIDENTAL RELEASE MEASURES	6.1	Individual precautions	Evacuate staff to a safety area. Ensure adequate ventilation. Wear protective equipment.
	6.2	Environmental precautions	Evaporates.
	6.3	Methods of cleaning	Evaporates.
7. HANDLING AND STORAGE	7.1	Handling	Ensure adequate ventilation and/or extraction in workplace. Recommendations for safe use: Only use well-aired places. Do not inhale vapours or aerosol.
	7.2	Storage	Rapid evaporation of the liquid can cause freezing. It can cause cardiac arrhythmia.
8. EXPOSURE CONTROLS / PERSONAL PROTECTION	8.1	Control parameters	Difluoromethane: Exposure limits recommended by DuPont: AEL(8-h and 12-h TWA) = 1000 ml/m3; DuPont (1999).
	8.2	Respiratory protection	For rescue and for maintenance works in tanks, use autonomous breathing apparatus. The vapours are heavier than air and can cause suffocation by reducing the oxygen available for respiration.
		Protection for hands	Rubber gloves.
		Protection for eyes	Protective safety glasses.
		Hygiene measures	Do not smoke.
9. STABILITY AND REACTIVITY	9.1	Stability	No decomposition if used according to the relevant instructions.

	9.2	Conditions to avoid	The product is not inflammable on contact with the air in normal temperature and pressure conditions. Under pressure with air or oxygen, the mixture can become inflammable. Some HCFC or HFC and chlorine mixtures can become inflammable or reactive in certain conditions.
	9.3	Materials to avoid	Alkaline metals, alkaline earth metals, granulated metal salts, Al, Zn, Be, etc. in powder.
	9.4	Dangerous decomposition products	Halogen acids, traces of carbonyl halides,
10. TECHNICAL INFORMATION	10.1	Acute toxicity	Difluoromethane: CL50/inhalation/4 hours/on rat = >760 ml/l Pentafluoroethane (R125): CL50/inhalation/1 hour/on rat = >3480 mg/l
	10.2	Local effects	Concentrations substantially over the TLV value can cause narcotic effects. Inhalation of high concentration decomposition products can cause respiratory failure (pulmonary oedema).
	10.3	Long term toxicity	It has not shown carcinogenic, teratogenic or mutagenic effects in the experiments on animals.
	10.4	Specific effects	Rapid evaporation of the liquid can cause freezing. It can cause cardiac arrhythmia.
11. ECOLOGICAL INFORMATION	11.1	Ecotoxicity-related effects	Pentafluoroethane (R125): Global warming potential of the halocarbons; HGWP; (R-11 = 1) = 0.84 Ozone depletion potential; ODP; (R-11 = 1) = 0
12. DISPOSAL CONSIDERATIONS	12.1	Rejects waste/ unused products	Usable with re-conditioning.
	12.2	Contaminated containers	The depressurised recipients should be returned to the supplier.
13. TRANSPORT INFORMATION	N° O.N.U.		3163
	ADR/RED		3163 Gas, compressed, n.o.s. (Difluoromethane, Pentafluoroethane) 2, ADR.

16.2 IMPORTANT INFORMATION REGARDING THE REFRIGERANT USED

This product contains fluorinated greenhouse gases included in the Kyoto protocol. Do not dispose of such gases in the environment
Type of refrigerant: **R410A**
GWP value: **1975**
GWP is the global warming potential
The amount of refrigerant is shown on the plate with the name of the unit. It is possible that routine inspections will be required to check for leaking refrigerant in accordance with local and/or European standards. Contact your local dealer for additional information.

17 APPENDIX

17.1 APPENDIX FOR THE 1PV MODEL

The 1PV model provides for the presence of a variable flow circulator or pump (depending on size).
In either case, adjustment is carried out at constant Δp as the flow range varies.

Variable flow circulator (sizes 9-15)
The variable flow pump adjusts the pressure head within the operating limits of the circulator itself in order to keep it constant with the value set as the flow range varies. The pressure head can be set by turning the red wheel located on the electric motor of the circulator.
To adjust the pressure head, turn the red wheel with a screwdriver in order to set the desired pressure head only in the right sector (indicated with ② in fig. 1):
2 = minimum circulator pressure head
10 = maximum circulator pressure head (100%)

⚠	For any operation, refer to the circulator manual.
⚠	The setting operation of the pressure head must be carried out by authorised personnel only.
⚠	Setting an incorrect pressure head value can cause malfunctions and damage to the machine and to the system.
⚠	The central position (indicated with ① in fig. 1) stops the circulator.
⚠	The left sector (indicated with ③ in fig. 1) adjusts the variable pressure head circulator based on the flow range. Do not use this setting as it may cause unit malfunction.

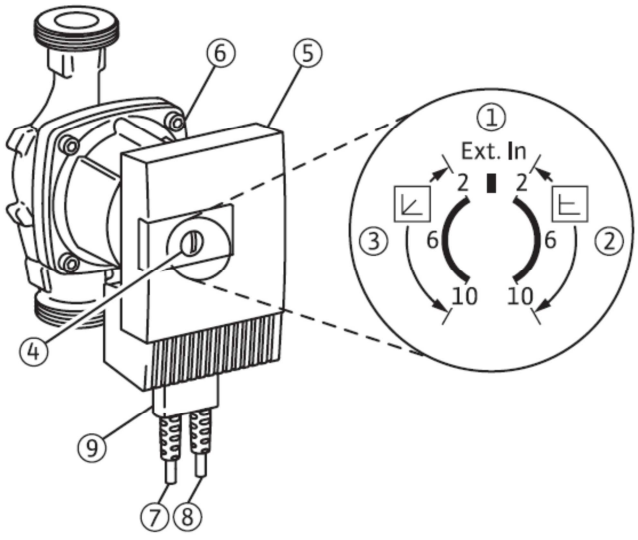


Fig. 1

Variable flow pump (sizes 20-26-30)
The variable flow pump adjusts the pressure head within the operating limits of the pump itself in order to keep it constant with the value set as the flow range varies. The pressure head can be set by turning the adjusting screw located on the electric motor of the pump.

The pump is factory-set at the highest pressure.
To adjust the pressure head, remove the protection cap (indicated with ③ in fig. 2) and turn the adjustment screw clockwise with a screwdriver, in order to increase the pressure, or anticlockwise to reduce it.
Once the desired pressure head value has been set, replace the protective cap.

⚠	For any operation, refer to the pump manual.
⚠	The setting operation of the head must be carried out by authorised personnel only.
⚠	Setting an incorrect head value can cause malfunctions and damage to the machine and to the system.

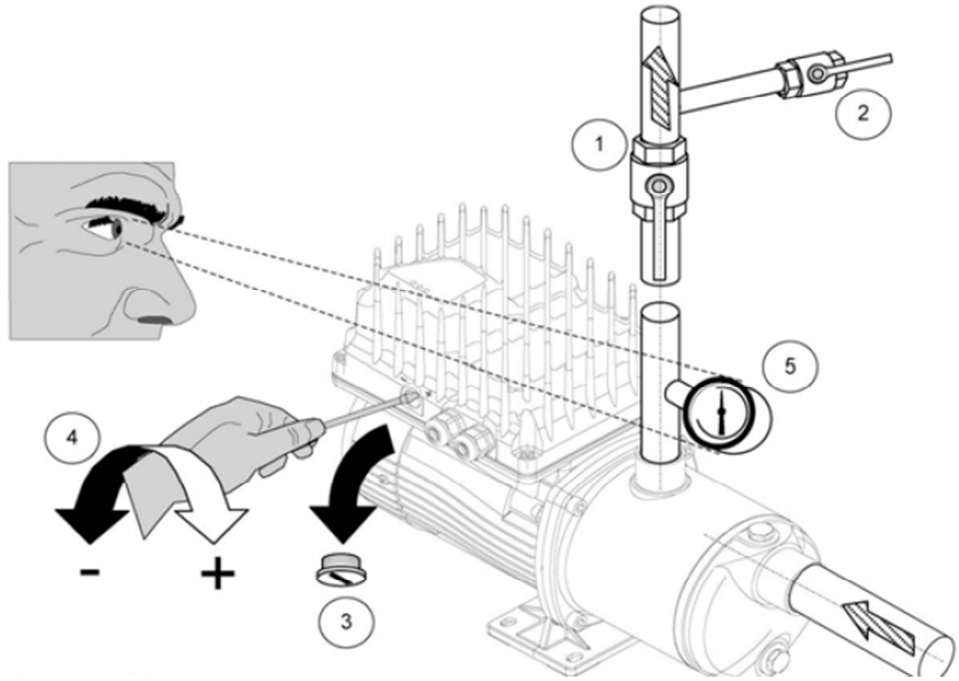


Fig. 2

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