Installation, Operating & Maintenance Manual

MARINE AIR CONDITIONING

AIRJET

Installation, Operating & Maintenance Manual

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1. Introduction

This user manual is intended for Airjet 12/24V series water-cooled air conditioner powered by direct current. These units are designed to be used in marine closed environment cooling applications from small to medium sized vessels. They can be used in any application as single block direct expansion units and installed in several rooms separately or ducted, depending on the space available on board.

2. Warnings and precautions for use

The precautions described in this manual must be strictly followed.

All the activities described must be carried out by an installer in accordance with the regulations in force.
Remember that appropriate personal protective equipment (protective gloves, safety glasses) must be worn when installing, maintaining, or servicing the unit.

If in doubt about the installation procedures or operation of the unit, contact your local dealer for assistance and information.

Improper installation or assembly of the unit or an accessory may result in electric shock, short circuit, leakage, or damage to piping or other parts of the unit.

RISK OF ELECTROCUTION

- Before making a connection or touching any electrical components, ***disconnect the power supply.***

NEVER touch any switch with wet fingers: electrical shock is possible. ***Turn off*** all power sources before touching electrical components.
To avoid the danger of electric shock, be sure to turn off the power for at least 1 minute before working on electrical parts. Even after 1 minute, always measure the voltage at the capacitor terminals of the main circuit or electrical parts.

DANGER: DO NOT TOUCH PIPING AND INTERNAL COMPONENTS

- **DO NOT** touch the refrigerant piping, plumbing or internal components during and immediately after operation. The piping and internal parts may be very hot or cold, depending on the operating condition of the unit.

Touching the piping or internal components may cause heat or cold burns. To avoid the risk of injury, allow the piping and internal components to return to an acceptable temperature level, or wear protective gloves if necessary.

WARNING

- DO NOT touch accidentally leaked refrigerant directly, as this can cause severe frost burns.

- DO NOT touch the refrigerant pipes during and immediately after operation, as they can be very hot or very cold, depending on the condition of the refrigerant flowing through the pipes, the compressor and other parts of the refrigeration cycle. If you touch the refrigerant pipes, your hands may be burned or suffer frostbite. To avoid injury, wait until the pipes have returned to room temperature. If it is necessary to touch them, be sure to wear suitable gloves.

3. Description of the unit and main components of the refrigeration circuit

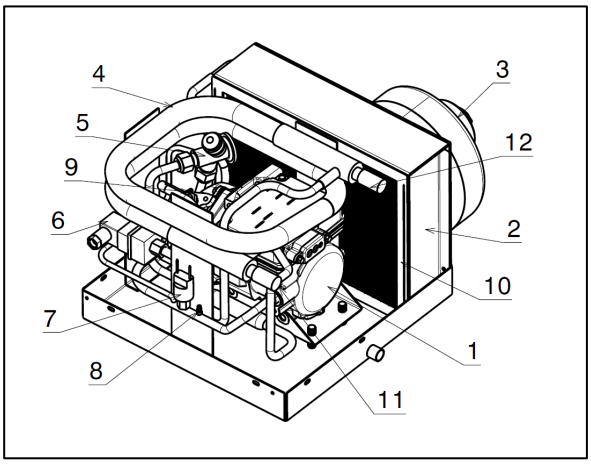

Figure 1 Main Components

1.Compressor
2.Evaporator
3.Fan
4.Sea condenser
5.Expansion valve
6.High pressure switch
7.Low pressure switch
8.Low pressure service outlet
9.High pressure service outlet
10.Air filter
11.Sea water inlet
12.Sea water outlet

The physical state of the refrigerant undergoes changes as it circulates through the appliance. These changes are caused by the following main components of the refrigerant circuit illustrated in the figure above.

- **Compressor**

The compressor works like a pump and circulates the refrigerant. It compresses the refrigerant vapours coming from the evaporator, raising their pressure to a level that makes it possible for them to liquefy, as they are subjected to in the condenser.

- **Condenser**

The function of the condenser is to change the state of the refrigerant from gaseous to liquid. The absorbed heat of the gas in the evaporator is dissipated through the condenser and the vapour condenses to liquid.

- **Filter**

The purpose of the filter, which is installed downstream of the condenser, is to retain impurities that could block the pipes and to dispose of moisture in the gas.

- **Expansion valve**

The liquid refrigerant from the condenser enters the evaporator after passing through an expansion valve. This valve brings the pressure of the liquid refrigerant to a pressure at which it can easily evaporate in the evaporator by absorbing the heat from the cooling process fluid.

- **Evaporator**

The function of the evaporator is to absorb heat from the fluid passing through it by cooling it. This is made possible by the evaporation of the fluid from the condenser.

- **Water inlet/outlet connections**

The water inlet/outlet connections allow easy connection of the appliance to the system's water circuit which leads to the points of use.

For further details of the components used see § **5.3 Connecting the units to the pipework**

4. Symbols used

The warnings in this manual are classified according to their severity and likelihood of occurrence.

DANGER

Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. Can also be used to indicate dangerous practices

NOTICE

Indicates situations that can only cause damage to equipment or property

INFORMATION

This symbol identifies useful tips or additional information

Other types of hazards are represented with special symbols.

5. Installations – General Standards

5.1. Example of installation

The following figure shows an example of a standard unit installation

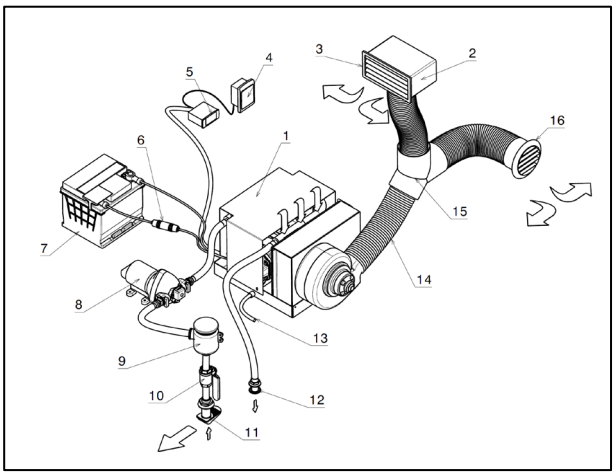

Figure 2 Standard installation example

1.Unit
2.Junction box
3.Swivelling and lockable discharge port
4.Remote terminal
5.Wall control
6.Fuse holder
7.12V DC battery
8.Sea pump
9.Sea filter
10.Ball valve
11.Sea inlet
12.Outer casing discharge
13.Condensate drain
14.Flexible insulated pipe 80/100
15.Y-connector
16.Adjustable and lockable circular discharge outlet 100

The Instructions and precautions to be carried out in the assembly of the unit are detailed in the following paragraphs

Handling

ATTENTION

In order to avoid damage to the unit, never handle the unit by the components of the refrigeration or hydraulic circuit (e.g., pipes). Remove the unit from its packaging by firmly grasping either the sea condenser and fan or the steel structure. Never grasp the unit by other piping. See figure.

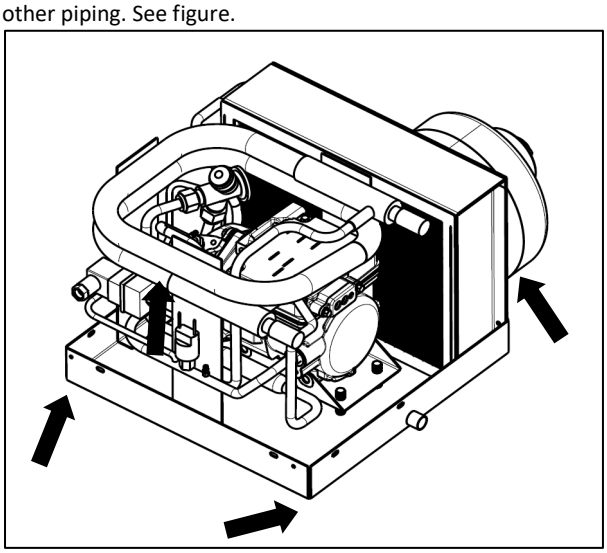

Figure 3 Unit Pickup Points

5.2 Positioning of the units

AIRJET line air conditioners must be installed inside the room to be conditioned in a place that allows proper air circulation (free suction section) and that is easily accessible for maintenance operations.

The unit must be firmly anchored to a fixed horizontal support by means of the special stainless-steel brackets supplied (provide one bracket on each side of the base, or 2 brackets on each of the long sides), so as to avoid movement during the most severe conditions. The brackets must be inserted on the edge of the condensation tray and fixed to the horizontal plane using self-tapping screws or through-bolts (see Fig.4).

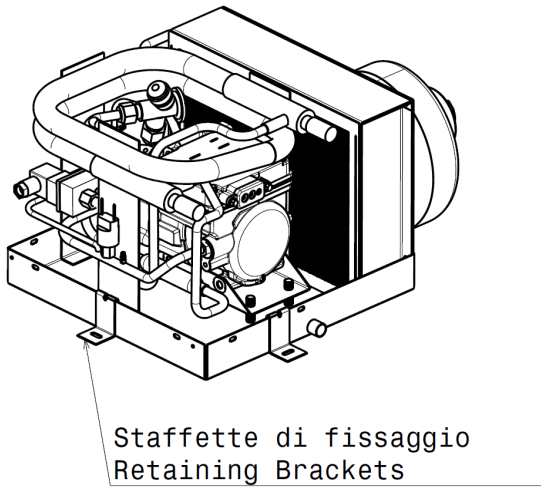

Figure 4 Example of unit fixing points

It is recommended to install the unit on anti-vibration mounts in order to limit the transmission of vibrations induced by the operation of the machine to the hull structure. Care must be taken when choosing supports that have sufficient capacity to support the weight of the machine.
Although the air conditioner is extremely quiet, it is always a good idea to consider noise emissions when choosing the position.

5.3 Connecting units to pipelines

The connection of the unit to the sea water circuit piping is made by directly connecting the piping to the appropriate inlets and outlets identified in ***Fig.1*** of this manual. In any case, the connection between the sea water pipe and the condenser must be secured using a pair of stainless-steel clamps for each connection.

It is recommended that all connections are made in such a way that they can be easily removed to insulate the machine during maintenance or repairs.
The condensate drainage pipework should be connected as in ***Fig.2*** and secured using the stainless steel or plastic ties provided with the unit.

5.3.1 Sea water circuit

The best solution for the sea water circuit is to use a sea inlet reserved exclusively for the air conditioning system. It is advisable to use a paddle sea inlet with filtering grooves with convexity in a direction that favors the pressure in the cooling circuit for the use of the air conditioner also while sailing if the sea state allows it (**see Figure 5. Installation of sea water inlet**). If the boat does not have a free sea inlet, it is advisable to install it as close as possible to the keel - especially for planning boats - in order to avoid or, at least, limit as much as possible the entry of air into the circuit during navigation.
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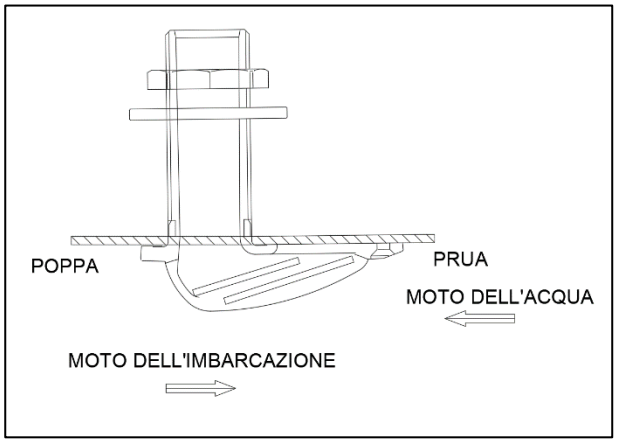

Figure 5 Installation of the sea water inlet

Alternatively, it is possible to use an existing suction line for on-board services (e.g., serving the bathrooms or a generic sea water pump) with a T-connector and a dedicated gate valve, provided that the section of the sea water line is sufficient for the simultaneous supply of the sea circuit of the air conditioning and the other utilities. In this case, it is always advisable to fit a clapet check valve upstream of the filter in order to make this line independent from those of the other services.

WARNING

It should also be noted that under no circumstances should sea water for the air conditioning system be sucked in from the engine or generator cooling circuit, as the powerful pumps of such equipment would overcome the head of the sea air conditioning circuit circulation pump, preventing it from working properly.

In the case of installation of more than one unit, it is possible to use a single sea water inlet, provided that it is suitably sized (in case of doubt contact Thermowell Technical Department).
The sea water circuit must be as short as possible, without siphons or choked bends that could prevent the priming of the electric pump or increase the pressure drop in the circuit itself with a consequent decrease in the efficiency of the chiller. The part of the pipework between the sea inlet valve (or the suction T on the service line) and the electric pump must be as short as possible; a full bore shut-off valve must be installed in this section to interrupt the flow of water and facilitate maintenance operations. This valve should always be closed before the boat is hauled out to leave the pump full of water, so that it can be reactivated when the boat is launched; it should then be checked that it is reopened immediately after the boat has been launched and before any use of the system.

The seawater filter must always be installed under head upstream of the pump on the suction line. It is advisable to install the filter in a position where it can be easily seen, cleaned, and inspected; during operation, it also acts as a warning light to check the passage of sea water in the circuit.

After a cleaning operation it is necessary to:

- *Always purge the air from the top of the filter and ensure that the circuit is properly filled.*

The use of the filter prevents the entry of impurities and dirt into the pump and the machine, safeguarding its operation and durability. The absence of the filter in the seawater circuit is a condition for the forfeiture of the pump and cooling unit warranty.

WARNING

Whenever you leave the boat, the sea water circuit must be closed by means of a special tap in order to avoid dangerous situations due to possible accidental damage to the circuit components.

The seawater circuit must run continuously uphill to the unit, both in the section from the sea inlet to the pump and in the section from the pump to the unit itself. After passing through the heat exchanger, the circuit may still be uphill or downhill, up to the discharge into the sea, which must always be kept above the waterline so that the circuit is self-purging of any air bubbles.

The seawater inlet and outlet are marked by special labels. The connection between the pipe and the other components of the circuit (sea inlet, gate valve, filter, conditioning unit, sea discharge) must be made using stainless steel hose clamps (preferably two on each connection).

The discharge of water overboard above the waterline should be positioned in such a way as to minimise the noise of the gush, so as not to disturb your boat and neighbors. Once the system is in operation, it is important to check that the water flows properly through the drain. If the drain is to be positioned below the waterline, a ball valve and/or non-return valve must be installed upstream of the drain; in this case, it is advisable to install a pump that is oversized with respect to the system's demand (approximately 15-20%), in order to overcome the resistance exerted by the sea water on the drain circuit. It should be borne in mind, however, that the installation of the drain under head causes difficulties in cleaning the circuit.

Fig.6 and ***Fig.7*** show all the examples and errors to be avoided during installation.

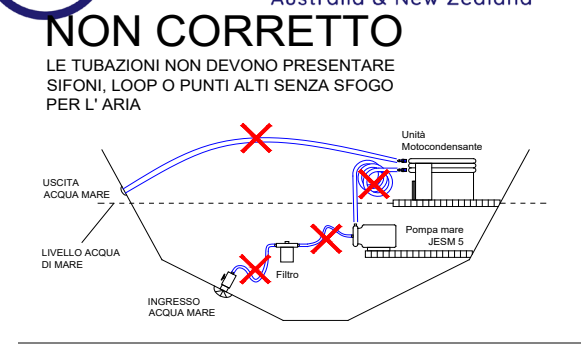

Figure 6 Example of Incorrect Sea Water installation

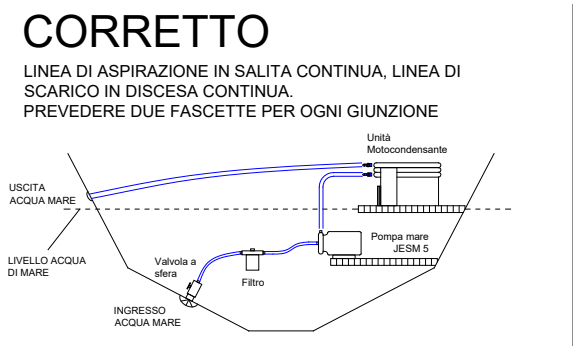

Figure 7 Example of Correct Sea Water Installation

5.3.2 Air distribution circuit

For the air distribution circuit, a high quality insulated flexible ducting reinforced with an internal steel spiral is used. The air inlets must be mounted as high as possible in order to ensure optimal air circulation in the room, preventing the air from flowing back directly to the air intake grille or to the thermostat. If this is not possible, install the nozzles at the bottom but with the jet pointing upwards. The connection between the air conditioner and the outlet is made through the flexible duct supplied and secured using the plastic clamps.

The same procedure must be adopted to connect the duct to any branch T's for air distribution in adjacent rooms. The distribution of the treated air towards the delivery outlets can be done using rigid ducts already present in the boat structure, as long as they have a suitable section and anti-condensation insulation.

To ensure correct operation of the machine, the length of the pipes must not be exceeded, avoiding bends which, if present, must have a large radius and must be free of bottlenecks as far as possible.

Flexible air ducts should be mounted directly on the fan outlet and those bent at right angles should be avoided as they significantly restrict air flow. An example of a correct installation is shown in ***Fig.8***.

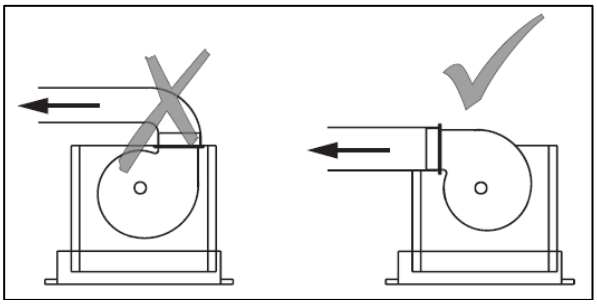

Figure 8 Example of connection of the air duct to the fan

For the installation of more than one supply outlet with connection through a branch T, it is suggested to facilitate the farthest outlet by adjusting the baffle on the inside of the Y or T. In case of doubt contact Thermowell Technical Department.

The suction section of the air conditioner is equipped with a filter. The unit must be mounted so that the filter can be easily removed for maintenance. In some cases, it may be necessary to also duct the air intake. In these cases, it is advisable to contact Thermowell's technical department.

5.3.3 Condensate drainage circuit

The base on which the air conditioners rest also acts as a condensation collection tank that collects the condensation produced during operation. This tank is equipped with two small stainless-steel pipes located on the two short sides of the casing, to which the condensation discharge pipe is connected. Use the stainless-steel clamps supplied to make the connection. The unit must be positioned compatibly with the need to create a condensation discharge line with a downward slope (generally as low as possible in the room to be air-conditioned (for example under a seat or bunk). It is therefore necessary to install the units at a suitable height to provide a certain slope to the drain line mentioned above.

Care must be taken when installing the condensation drainage system as the operation of the air conditioner can produce a significant amount of condensation which, if not drained properly, could cause damage to the boat's furnishings.

It is also advisable that the condensate drainage pipe descends vertically for at least 3cm from the collection tray (it would be advisable to avoid that the first part of the circuit is straight, as this could cause a deposit of condensate water that could flow back into the tray following the oscillating movements of the boat) and then continues without creating delocalised counter slopes along the boat's interior.
against delocalised slopes along the evacuation line.
The outboard condensate drain must be well above the waterline. If it is not possible to discharge into the sea, discharge into the bilge at the closest possible position to the suction inlet of the regulation bilge pump. In some cases, an additional water collection tank may be created and emptied through a small outboard pump. Its placement in the daily bilge of the engine compartment is strongly discouraged. In any case, once the circuit has been installed, it is advisable to check the efficiency of the evacuation system by pouring water into the collection tray.

6. Functional schemes

6.1. Symbols Used

C	Compressor	
CWR	Condenser	
EWR	Evaporator	
FE	Filter	
MA	High Pressure manometer	
MB	Low Pressure manometer	
PA	Hight Pressure switch	PA
PB	Low Pressure switch	PB
PS	Service sockets	
VA	High pressure safety valve	
VE	Expansion valve	
VL	Liquid line solenoid valve	
VS	Liquid indicator	
	Four-way valve	

6.2. AIRJET Monobloc Unit

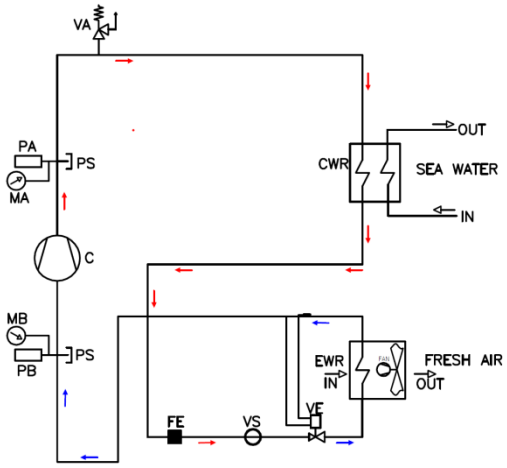

Figure 9 AirJet Sea Water Circuit

7. Safety devices

- **High pressure switch**

The high-pressure switch is installed on the discharge line of the unit and monitors the condensing pressure (pressure at the compressor discharge). When this pressure exceeds the safety range, the high-pressure switch trips and stops the refrigerant circuit.
Once it has tripped, it is automatically reset when it returns to its operating range. If it is tripped a second time, the electronic control stops operation permanently. To restore correct operation, the unit must be switched off and on again after researching and resolving the causes of the malfunction (see Troubleshooting).

- **Low pressure switch**

The low-pressure switch is installed on the suction pipe of the appliance and measures the evaporator pressure (pressure at the compressor inlet). If the pressure is too low, the pressure switch is activated, and the circuit is stopped.
Once tripped, it is automatically reset a first time. If it trips a second time, the electronic control stops the operation permanently. To restore correct operation, the unit must be switched off and on again after researching and resolving the causes of the malfunction (see Troubleshooting).

- **Antifreeze protection**

The frost protection during operation of the unit prevents the water in the evaporator from freezing. When the temperature of the water coming out of the evaporator becomes too low, the general controller deactivates the unit. When the water outlet temperature returns to normal, the unit can be restarted. When frequent frost protection occurs over a period of time, the frost alarm is activated, and the appliance is stopped. It is necessary to manually reset the alarm indicator in the controller

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- **Compressor gas safety release valve**

The gas safety valve is part of the compressor When the pressure rises (>40 Bar) the plug starts to lift and the process medium starts to flow and is forced out radially over the entire surface of the plug. When the pressure drops below the set value (blow-down pressure) the reverse effect occurs and the valve closes completely in a very short time.

- **Compressor overheating protection**

Located on the compressor driver, it stops the compressor when the temperature exceeds 100°C.

- **Compressor low/high voltage protection**

Located on the compressor driver, it stops the compressor when the voltage drops below 10V or exceeds 16V.

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8. Inspection and Maintenance

It is highly recommended that a number of inspections are carried out on the unit at regular intervals in order to maintain its high level of functionality.

At least once a month check that the unit is working properly by leaving it switched on for at least 10 minutes.

Air filter

At least once a year:

inspect the air filter on the unit's evaporator and clean if necessary.

- Remove the fixing clips
- Clean the filter with a jet of pressurized air or use water if necessary.
- Replace the filter with the retaining clips.

Sea water circuit

An inspection of the sea water circuit should always be carried out, especially after a long period of absence.

Every time the unit gets turned on:

Check that water flows regularly in the sea water circuit.

At least once a week:

- Inspect the sea water filter
- Clean if necessary

At least once a month

- Check the entire sea water circuit, from the through-hull fitting to the water outlet, for leaks.
- Check the condensate outflow to ensure that the passage is clear and there are no leaks in the drain line.

ATTENTION *an expert must clean the sea water filter*

- Clean the circuit including the condenser of the unit

Electrical connections

At least once a year, the electrical connections must be checked for possible corrosion of the contacts. The mechanical tightness of the lines must also be checked.

The following part of the manual contains useful information for diagnosing and correcting certain faults that may occur in the equipment.

Before embarking on a diagnosis procedure, a thorough visual inspection of the appliance should be carried out to check that there are no obvious defects, such as loose hydraulic connections or faulty electrical connections.

Careful reading of this part of the manual is recommended before contacting the Service Department.

If a safety device is triggered, stop the appliance, and find out the reason for the triggering of the device before resetting it. Under no circumstances should a safety device be altered from its factory setting. In any case, contact the Service Department if you are unable to identify the cause of the problem.

9. Troubleshooting

Symptom 1: A circuit does not start

POSSIBLE CAUSE	CORRECTIVE OR FOLLOW-UP ACTION
One of the following safety devices has tripped: ✓ *Low Pressure switch* ✓ *High Pressure switch* ✓ *Protection against phase reversal* ✓ *Antifreeze*	*See symptom 2 'One of the following safety devices has tripped*
Timing period for preventing close restarts has not yet elapsed	*The circuit can only be restarted after about 3 minutes.*

Symptom 2: One of the following safety devices has tripped

Low Pressure Switch	
POSSIBLE CAUSE	**CORRECTIVE OR FOLLOW-UP ACTION**
The refrigerant charge is depleted.	*Check for leaks and eliminate them if found. Restore optimum charge*
High Pressure Switch	
POSSIBLE CAUSE	**CORRECTIVE OR FOLLOW-UP ACTION**
The water flow rate through the condenser is too low	*Increase the water flow rate and/or check that the filter is not clogged*
Flow switch trip	
POSSIBLE CAUSE	**CORRECTIVE OR FOLLOW-UP ACTION**
No water flow rate	*Check the sea water pump*
Contactor burnt out	*Contact an authorised technician for replacement*
Possible interruptions of electrical connections	*Contact an authorised technician to restore the correct connection.*
Triggering of frost protection	
POSSIBLE CAUSE	**CORRECTIVE OR FOLLOW-UP ACTION**
Water flow is low	*Increase water flow rate*
The temperature of the water entering the evaporator is low	*Increase incoming water temperature*
Defective probe or instrument	*Check that the probe or measuring instrument is not defective*
Compressor contactor damaged and the circuit always remains closed	*Check the correct state of the contactor*

- **Symptom 3: Unit shuts down shortly after activation.**

POSSIBLE CAUSE	CORRECTIVE OR FOLLOW-UP ACTION
One of the safety devices has tripped	*Check safety devices*
The voltage is too low	*Measure the voltage at the power supply panel and, if necessary, also in the electrical cabinet of the appliance*

ALARMS

WARNING: BEFORE RESETTING AN ALARM, IDENTIFY THE CAUSE OF THE ALARM.

Alarms indicate a situation potentially dangerous for the integrity of the machine.
Before resetting the alarm, identify and remove the cause of the blockage: a repeated reset may cause irreversible damage.
For this reason, the reset is manual, i.e., a reset from the keyboard is necessary (provided that the cause has been removed).

For further information, consult the enclosed operating manual

10. Electrical Installation

10.1. Cables

Main's power must be supplied by means of a fuse or a switch with a corresponding rating. To make the following connections, use PVC insulated three-core, four-core or multi-core cables with copper conductors laid in accordance with the established conditions. The dimensions of the cables should be selected for 100% of the rated currents of the consumers. This table is a simple reference for correct cable sizing.

FULL LOAD CURRENT		CABLE DIMENSION
[A]		**[mm²]**
80		10mm
100		16mm

The flow rates shown in the above table have been defined at a conventional ambient temperature of 30°C (it is assumed that the temperature may occasionally reach 35°C). If the ambient temperature is lower than the conventional temperature, the flow rate increases, but if the temperature increases, the flow rate decreases. The following table shows these room temperature correction coefficients.

Air Temperature in °C	***Coefficients for flow rate***
10	1,29
15	1,22
20	1,15
25	1,07
30	1
35	0,93
40	0,82
45	0,61
50	0,56

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11. Regulatory references

The main reference standards are listed below:
UNI EN 14511-1:2018 *Air conditioners, liquid chillers, and heat pumps with electrically driven compressors for space heating and cooling, and process cycle chillers with electrically driven compressors - Part 1: Terms and definitions*

UNI EN 14511-2:2018 *Air conditioners, liquid chillers, and heat pumps with electrically driven compressors for space heating and cooling, and process cycle chillers with electrically driven compressors - Part 2: Test conditions*

UNI EN 14511-3:2018 *Air conditioners, liquid chillers, and heat pumps with electrically driven compressors for space heating and cooling, and process cycle chillers with electrically driven compressors - Part 3: Test methods*

UNI EN 14511-4:2018 *Air conditioners, liquid chillers, and heat pumps with electrically driven compressors for space heating and cooling, and process cycle chillers with electrically driven compressors - Part 4: Requirements*

UNI EN 378-1:2017 *Refrigeration systems and heat pumps - Safety and environmental requirements - Part 1: Basic requirements, definitions, classification, and selection criteria*

UNI EN 378-2:2017 *Refrigerating systems and heat pumps - Safety and environmental requirements - Part 2: Design, construction, testing, marking and documentation*

UNI EN 378-3:2017 *Refrigerating systems and heat pumps - Safety and environmental requirements - Part 3: Installation site and personal protection*

UNI EN 378-4:2017 *refrigerating systems and heat pumps - Safety and environmental requirements - Part 4: Operation, maintenance, repair, and recovery*

UNI EN 1736:2009 *Refrigeration plants and heat pumps - Flexible piping elements, vibration isolators, expansion joints and non-metallic pipes - Requirements, design, and installation*

UNI EN 1861:2000 *Refrigeration systems and heat pumps - System flow diagrams and diagrams of piping and instrumentation - Layout and symbols*

UNI EN 12178:2017 *Refrigerating systems and heat pumps - Liquid level indicators - Requirements, testing and marking*

UNI EN 12263:2000 *Refrigerating systems and heat pumps - Safety switching devices for pressure limitation - Requirements and tests*

UNI EN 12284:2004 *Refrigerating systems and heat pumps - Valves - Requirements, testing and marking*

UNI EN 12828:2014 *Heating systems in buildings - Design of water heating systems*

UNI EN 12831-1:2018 *Energy performance of buildings - Method for calculating design heat load - Part 1: Heat load for space heating, Module M3-3*

UNI EN 13136:2019 Refrigeration plants and heat pumps - Pressure relief devices and associated piping - Calculation methods

12. Address

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