EMICON
AIR CONDITIONING AND INDUSTRIAL APPLICATION

Scroll Compressor

RAE-PAE Kc/Ka

Air- cooled liquid chillers and air- water heat pumps with cycle inversion on refrigerant side

Installation, Functioning, Service

Emicon A.C. S.p.A. has the right to modify its own products and its own documentation without prior advice

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SUMMARY

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1. INTRODUCTION

Units from the **RAE Kc/Ka** ranges are single-block liquid air-cooled chillers, suitable for external installation. Units from the **PAE Kc/Ka** ranges are single-block air –water heat pumps with cycle inversion on refrigerant side, suitable for external installation. Such units are equipped with one or more independent cooling circuits, as well as hermetic scroll compressors with R410A. They are suitable for cooling water for any application and fluids of any type, such as e.g. glycol water, to be used in industrial processes.

1.1. Preface

This document (here in after: Manual), whose original text has been written in Italian language, in compliance with European norms, gives all necessary information to correctly execute and with no risk, installation , start-up, daily use, regulation , servicing and disposal of the unit it refers to .We suggest to read the manual in full, along with all attached documents, which are an integral part, before carrying out any operation on the unit and to the follow prescriptions described in the Manual. The non compliance with these indications during installation, functioning, servicing, reparation and disposal of the unit, can cause great damage to people, objects and the environment. In case of doubt on correct interpretation of the instructions of the Manual, please ask for all necessary questions to Emicon A.C. S.p.A. (from here following: Manufacturer). The units must be installed, managed, serviced and disposed in compliance with laws and local regulations.

1.2. Symbols

In the manual, the following symbols are used, so as to mark necessary information and avoid situations that can be dangerous for people safety and health, for integrity objects and the environment and the operation of the equipment.

Indicates a forbidden operation , as it could damage the operation of the unit.

Indicates an important information for the correct use of unit.

Indicates a risk for people, objects or environment

Indicates an electrical risk, for object, people and environment.

1.3. Reference laws and norms

Unless differently specified, units described in this manual are in compliance with relevant legislation of European Community and, in particular, with following safety requirements:

- 97/23/CE (PED),
- 2004/108/CE (Electromagnetic compatibility),
- 2006/42/CE (Units directive),
- 2006/95/CE (Low tension directive).

Compliance with the above directives is indicated on Conformity declarations and specified with CE branding, as stated on the Identification Tag, described in following paragraph. To guarantee its compliance with the above directories, the unit it is designed, built and tested according to the norms prescriptions listed in the conformity certicates.

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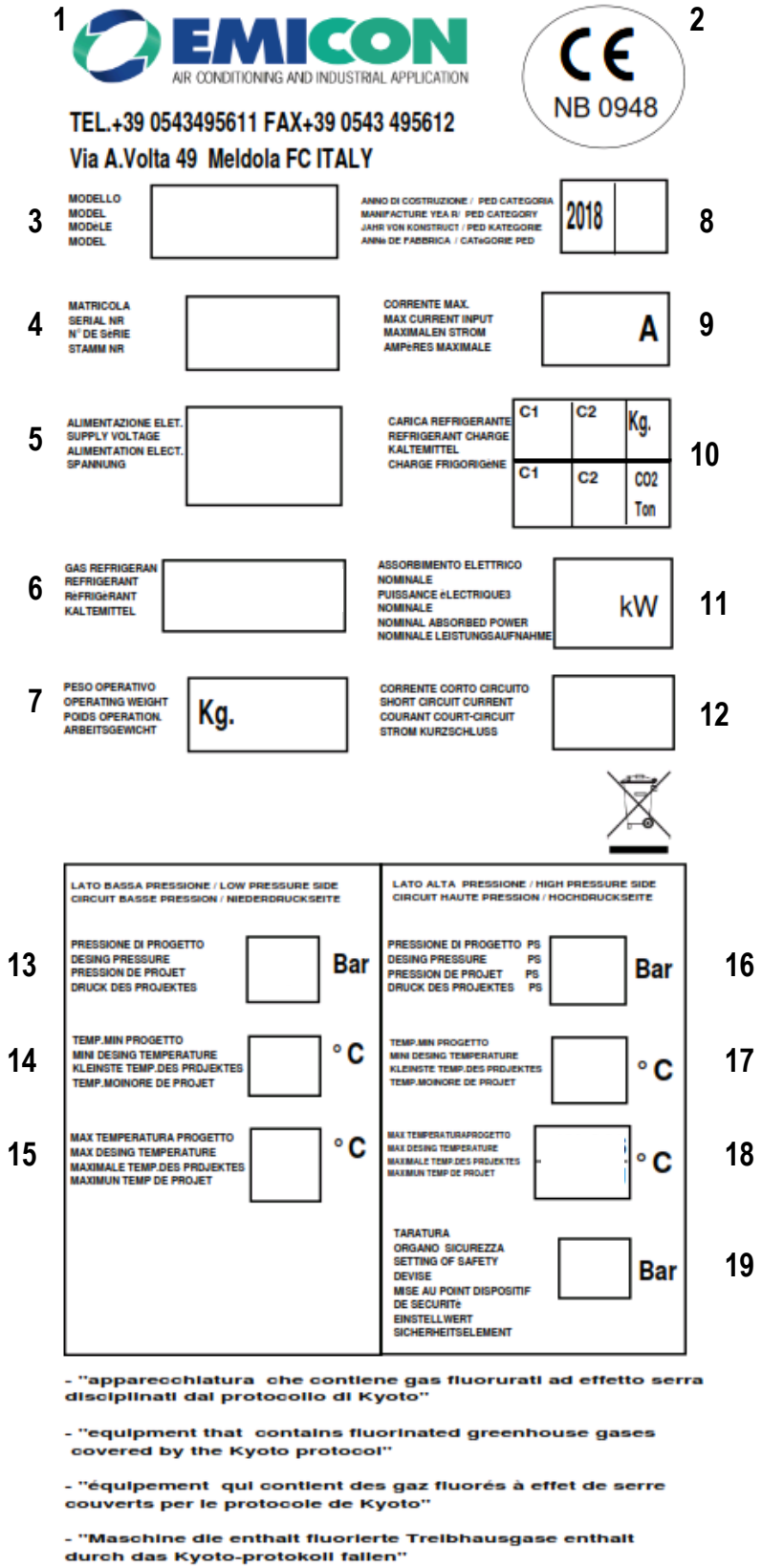
1.4. Identification Tag

The equipment is identified through an undeletable label on the external panel of the electrical board (here in after: Identification Tag). It is possible to see a sample of the identification tag in image 1.1, with the description of the listed information, in conformity with applicable EU regulation.



1	Manufacturer's name and address
2	CE mark and the Notified Organization identification number which released the PED certification
3	Model
4	Serial number
5	Supply voltage
6	Refrigerant
7	Operating weight
8	Manufacture year / PED category
9	Max current input
10	Refrigerant charge
11	Nominal absorbed power
12	Short circuit current
13	Design pressure
14	Min. design temperature
15	Max design temperature
16	Design pressure
17	Min. design temperature
18	Max. deign temperature
19	Setting of safety device

Warranty

The Manufacturer guarantees the units, in compliance with General Sales conditions and, eventually, with the contract agreements.

Manufacturer warranty will expire, in the event the manual indications are not attentively respected. .

The Manufacturer declines any responsibility for any damage to people, animals, objects or the environment, due to mistakes in the installation , servicing or setting, i.e. an inappropriate use of the unit, not explicitly described in our Manual..

At first startup, it is necessary to fulfill the first startup report attached to the manual and send a copy to the Manufacturer, so as to make warranty valid. .

1.5 Manual readership

This manual, with all attached documents, is delivered along with the units it refers to.It should therefore be stored by the owner or the responsible person for unit management (here in after: Owner), in an suitable place. For this reason, in the internal part of the electrical board panel, a plastic compartment is available to store the manual, so as to make it always available for reading, and store it properly. All persons working on the unit must be acquainted with the information and the indications of the present manual.

The non compliance with indications stated in the manual during installation , functioning mode, servicing, reparation and unit disposal, may cause serious damage to people, objects and to the environment.

In case of loss or deterioration, new documentation will have to be inquired directly to the Manufacturer.

1.6 Personnel requirement

Any operation on the units and, in particolar, on the cooling circuit, must be executed exclusively by specialised personnel, adequately trained, properly equipped with individual safety devices so as to be able to handle refrigerant fluids, in compliance with local laws and regulations in force. Servicing and reparation requiring personnel with specific skills (as electricians, programmers, welders and so on), must be done under the supervision of experienced personnel in handling cooling units and plants.Personnel operating with refrigerants must be adequately trained to acquire skills concerning safety aspects related to handling such substances. This includes, among others, following topics:

- Knowledge of the legislation, regulation and local norms regarding refrigerants;
- Detailed knowledge and training in dealing with refrigerants and invidual safety devices thare are required and/or necessary;
- Knowledge and training in pressure drop prevention, usage of containers, (charging, searching pressure drop, recharging and disposing of said refrigerants)

Personnel must be able to understand and carrying out the local regulations in pratctical cases.
To do that, it is necessary to train the staff in respect of the local regulations in force.

1.7 Dangerous areas

There may be areas within the units that are potentially dangerous, such as:

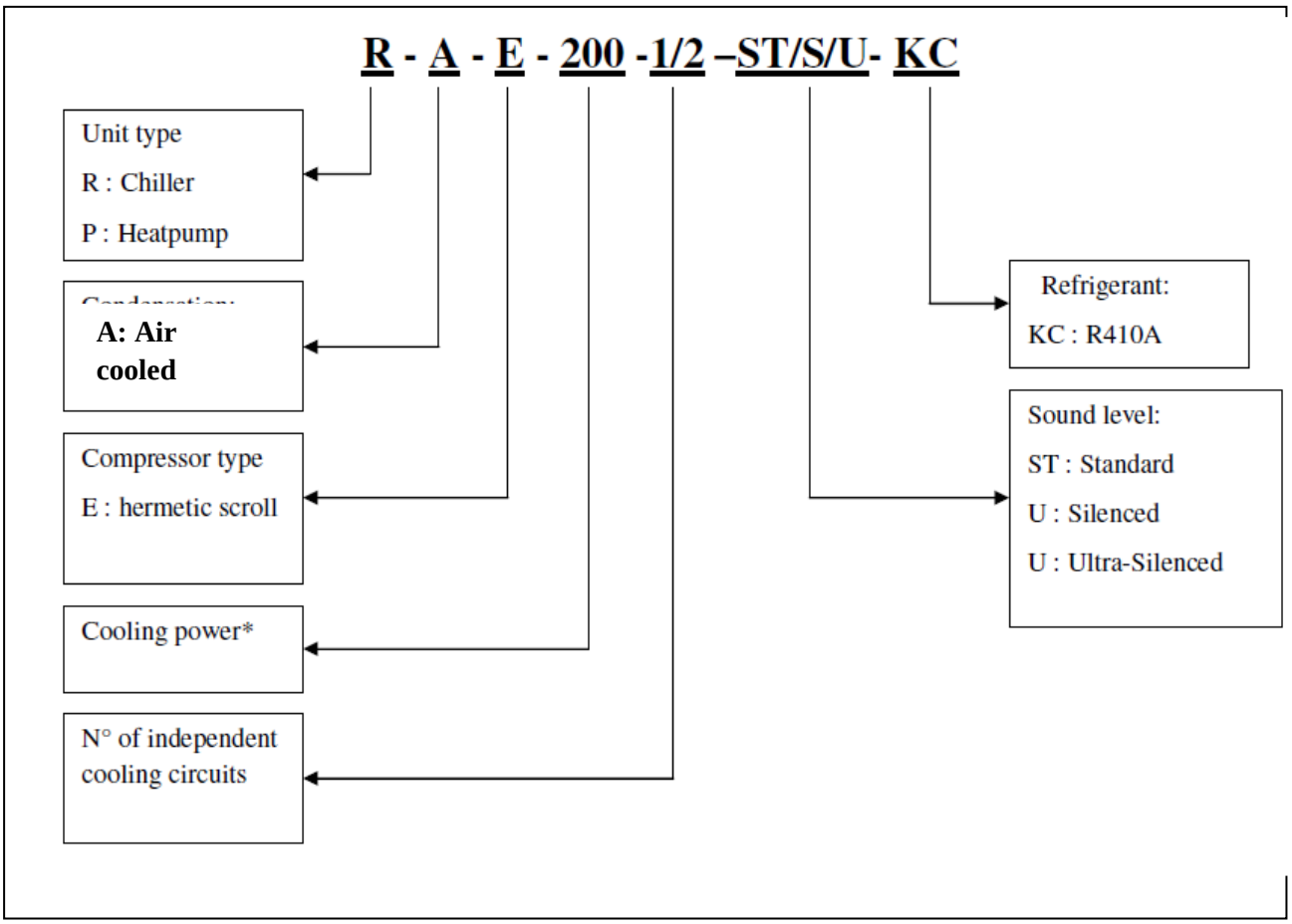
- Components that are subject to electrical tension,
- Mechanical devices moving
- Surfaces with high temperatures
- Sharp edges or cutting elements
- Components containing high pressure fluids

Whenever possible, dangerous elements are made inaccessible by protecting them adequately with a cover, which should be removed by qualified personnel only, adequately instructed and certified.In case such protections are not present, dangerous areas and surfaces are adequately signalled.

2 DESCRIPTION

2.1 Nomenclature RAE/PAE KC range

In following scheme, the meaning of the elements corresponding to the unit nomenclature:



* Cooling power is calculated at evaporator water conditions +12°C / + 7°C with an external air temp of +35°C and 50% HR

2.2 RAE-PAE Kc/Ka Versions:

Chiller RAE-PAE KC range is available in 3 different versions:

- Standard Version - ST
- Silenced Version: S
- Ultra-Silenced Version – U

- High Temperature Version - HT

2.2.1 Standard Version (ST)

The units are suitable for open-air installation on the building covering or at ground level. Connecting the hydronic module (option) they become full-fledged, fully-equipped cooling plants. 18 models are available for standard version, with a nominal cooling power between 70 and 620 kW.

2.2.2 Silenced Version (S)

Same version as standard, but with soundproof compressors casing, while the fans are star-connected, so as to reduce rotation speed. An hydronic module is also available. 18 models are available for silenced version, with a nominal cooling power between 70 and 630 kW.

2.2.3 Ultrasilenced Version (U)

The remarkably low sound level is reached on U versions without sacrificing performance or working limits.

This is done by:

- Adopting refrigerant/air exchangers with wider surfaces than those of the units in standard version.
- Soundproof compressor casing with higher thickness of the soundproof material;
- Fan speed control through variable fixed drive.

18 models are available for the ultrasilenced version, with a nominal cooling power between 70 and 630 kW.

2.2.4 High Temperature Version (HT)

Unit designed for high hot water temperature, suitable to use R134a Refrigerant.

2.3 RAE Kc/Ka Models with total /partial heat recovery

2.3.1 Models with Total Heat Recovery (RT)

Each model of the RAE Kc/Ka range is available in total heat recovery version. In such setting, each cooling circuit is equipped with a refrigerant/water exchanger on gas discharge line. Such exchanger, installed in parallel to the air condenser, it is dimensioned to recover 100% condensing heat for hot sanitary water production.

2.3.2 Models with Partial Heat Recovery (RP)

In this configuration, a refrigerant/water heat exchanger is installed on each cooling circuit on gas discharge line. Such exchanger, placed in series and before the air condenser, is sized to recover about 20% of the condensing heat to produce hot sanitary water at medium / high temperatures.

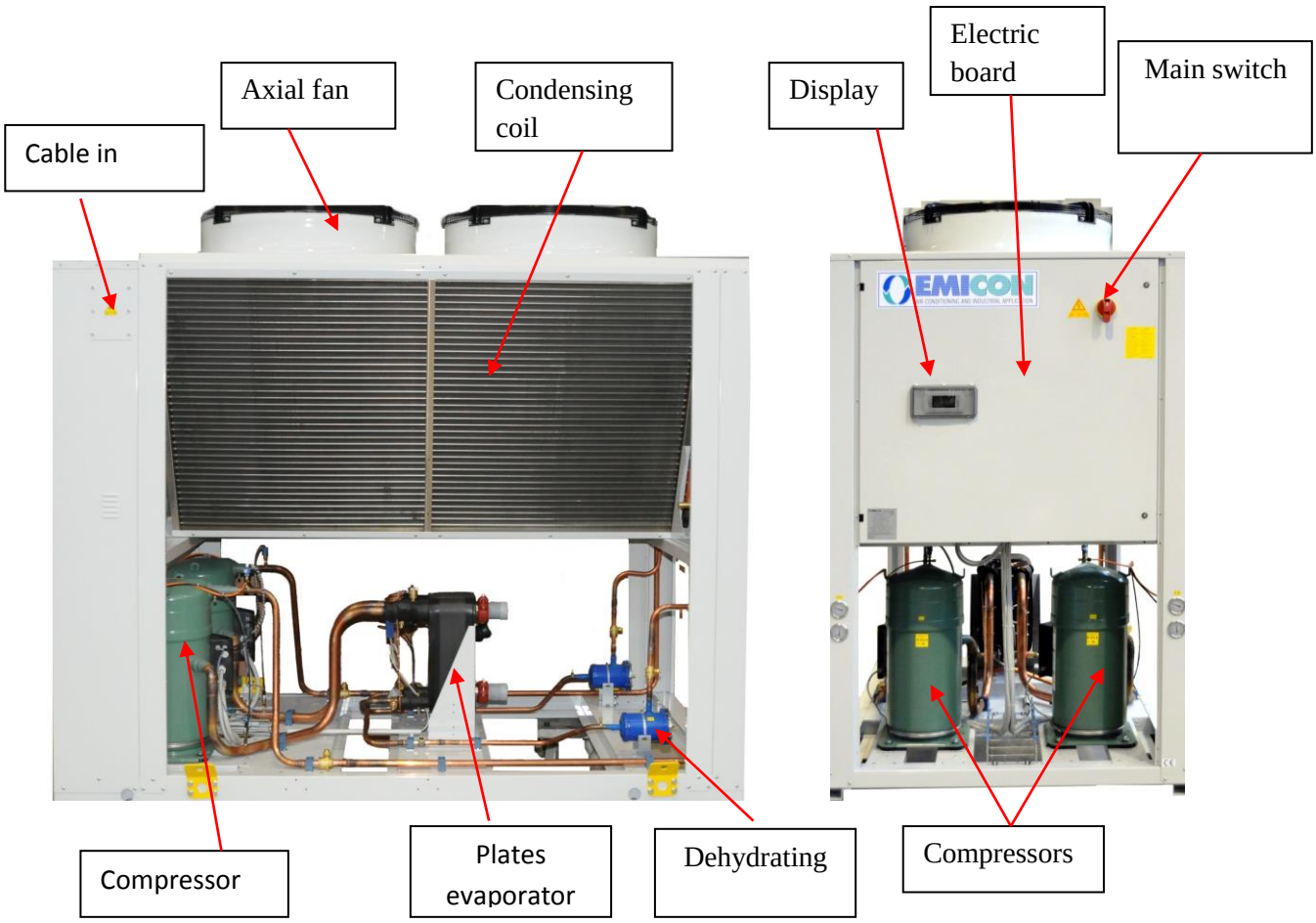
2.4 Main components

Units from RAE-PAE Kc/Ka range are made up of following key components:

- Containment chassis in moulded steel sheet metal, bent, galvanised and painted or a load bearing structure made of a alluminium profiles.
- Compressors, mounted on rubber dampers and crankcase heaters
- Evaporator with brazed plates and thermal insulation.
- Condenser: finned core made up of pipes in copper and aluminium fins
- Cooling circuit made of thermostatic expansion valve, liquid level probe, dehydrating filter, safety organ, antifreezing thermostat, high and low pressure thermostat
- Electrical board, CE compliant, with general sectioner, automatic switches, contactor, motor safety switches, auxiliary low tension circuits, as well as processor control.
- Signaling and command microprocessor that allows managing workload and alarms of the units.

In following paragraphs specific features are shown for the main components of the unit. In image 2.1 a picture is shown to identify the main elements that make the unit.

Figure 2.1: Main components



PAE Kc/Ka units are also equipped with 4-way valves and liquid receiver.

2.4.1 Frame

Unit frame is made of elements in galvanised steel of great thickness, assembled through stainless steel rivets. All galvanised steel elements are protected on the surface by powder coating of white RAL 7035 colour. The load bearing elements are assembled so as to make a solid frame, capable to support unit components, and support stressing that may arise during handling and unit operation .Components are installed within the structure, so as to be easily accessible on the front to make possible all necessary procedures during operation and servicing of the unit.

2.4.2 Scroll Compressors

All models are provided with Scroll compressors with refrigerant R410A or R134a on one or two independent cooling circuits, as a tandem or trio version. Compressors of all models are mounted on rubber dampers and equipped with:

- Direct start motors, cooled by aspirated refrigerant gas;
- Oil crankcase heater
- Electronic device for motor protection with external module;
- Charged with polyester oil

- Terminal board for compressors has IP54 protection degree.

Activation and deactivation of compressors is controlled by microprocessor of the control system of the units, which consequently sets cooling-heating power.

2.4.3 Condensing coils

Heat exchange external condensing coils are made with microfined copper pipes positioned in staggered rows, mechanically expanded into an aluminum finned pack. Pipes surfacing of the fins are studied and made so as to maximise thermal global heat exchange coefficient (Turbo-fin), by maintaining air pressure drop at an acceptable level. Pipes are connected with each other, so as to compose circuits with enough length to avoid excessive pressure drop, by allowing enough refrigerant speed. The maximum operating pressure of the condenser coils is 45 bar Freon side. Coils are subject to the tightness test and cleaned before installation by the Manufacturer.

2.4.4 Evaporators

Plate evaporators are in stainless steel and thermically isolated by a closed-cell flexible material of high thickness. Max operating pressures are 6 relative bar at water side and 42 relative bar at refrigerant side. Water flow to the exchangers is assured by a flussostatic control with a differential pressure switch. Evaporators are subject to tightness test and cleaned by the manufacturer before their installation

2.4.5 Condenser Fans

Condenser fans are of the axial type, with three phase electric motor directly coupled to the impeller blades with wing profile, specifically studied to avoid turbulence in the air detachment area, by allowing maximum efficiency with the lowest possible sound level.Each fan is equipped with antiinjury protection in painted galvanised steel, painted after construction. Fans are totally closed, with protection degree IP54 and protection thermostat, flooded in windings.

2.4.6 Cooling circuit

Each cooling circuit of the RAE-PAE Kc/Ka units is equipped with:

- Safety valve (integrated in the compressor);
- Dehydrating filter
- Sight glass
- Solenoid valve
- Thermostatic valve (electronic type as an option) ;
- Safety valves on high pressure side (if required);
- Shut-off valves on liquid line;
- High and low pressure gauges;
- High and low pressure switch;
- Temperature probes at inlet and outlet of the evaporator;

The above components are connected in a closed circuit by pipings and copper fitting. Permanent joints between components are either soldered or brazed by qualified operators and process.

2.4.7 Electrical board

The electrical board of the units, compliance with European norms 2006 / 95 / CE, is built inside a metal cabinet with IP54 protection degree for external installation, suitably separated by the air flow compartment.

Main features are :

- Power triphase 400V / 3ph / 50Hz supply on all units except for special requests ;
- Secondary low tension 24Vac circuit with isolating transformer;
- Mechanical main switch of lock-door type;

- Automatic protection switches
- Terminal board for signal and command free contacts.

Inside the electrical box, equipped with a general main switch, following main components are provided:

- contactors,
- automatic switches for overload protection ,
- transformer
- numbered conducers ,
- low tension auxiliary circuits,
- terminal board,
- electronic control and management cards

All units are safety tested for the protection circuit, insulation resistance and tension test (dielectric stiffness)

2.4.8 Control system

Control for the unit is made by management software stored on the electronic microprocessor, which is made of:

- An electronic control card with a terminal board for transmission of working parameters, and the activation of the command devices.
- An user interface card with setting buttons and display for visualization of the operation status and the alarm messages.

The electronic control card manages different devices installed on the unit, according to the values of the working parameters, by having following main functions:

- Unit ON/OFF from keypad or from remote.
- Alert and alarm status management and storage.

Interface user display for the microprocessor allows, among other things, to visualize following information:

- Set parameters for regulation;
- Functioning vairbles values;
- Digital and analogue input and output status
- Operation units status,
- Alert and alarm

Possibility to interface to EMS/BMS systems

2.5 Testing

Once the unit has been completed, its circuit is put through a test, as established in the Manufacturer Quality Warranty system, a test of mechanical resistance to pressure and a tightness test.

Before shipping the unit is completely tested.

2.6 Accessories

Here are the main accessories:

Symbol	Description
A	Amperometer: Electrical device to measure the electrical current absorbed by the unit.
AE	Electrical power supply different than standard: 230 V three-phase, 460 V three-phase. Frequency 50/60 Hz.
BT	Low ambient temperature operation (down to -20°C): Electronic device for the continuous modulating voltage control of the condensing pressure through the vairtion of the fan rotation speed, allowing the unit operation down to -20°C ambient temperature. (included in U version)
CF	Soundproofed compressors cabinet with standard material: Insulation of compressors by a cabinet coated with 25 mm thick sound and fireproofing material. (Available only for STANDARD version)
CFU	Soundproofed compressors cabinet with higher thickness material: Compressor insulation with high-density sound and fireproofing materials of higher thickness. (Already included in SILENCED version)
CS	Compressors inrush counter: Electromechanical device positioned inside the electrical board, recording the total inrush starts of compressors.
GP	Condensing coil protection grid: Metal grid to protect against accidental impacts.
GP2	Anti-intrusion grid: Metal protection grid to protect compressors and exchangers. (not available with CF, CFU and CFT)
GP3	Anti-intrusion grid with compressors cabinet: Anti-intrusion metal protection grid coupled with soundproofed compressor cabinet (only available with CF and CFU).
I1	Victaulic insulation on pump side: Insulation of the joints by close-cell polyurethane material, to prevent condensation, pump side.
I2	Victaulic insulation buffer tank side: Insulation of the joints by close-cell polyurethane material, to prevent condensation, buffer tank side.
IG	Watch card: electronic card to program hourly switch and rotation between two units after a preset amount of time.
IH	RS 485 Serial interface: Electronic card to be connected to the microprocessor to allow connection of the units to supervision systems, for a remote control and monitoring of the unit. (Alternative to IH LON or IWG)
IH LON	LON Protocol serial interface: Electronic card to be connected to the microprocessor to allow connection of the units to supervision systems with LON protocol, for a remote control and monitoring of the unit. (Alternative to IH or IWG)
IM	Seawood packing: Fumigated seawood case and protection bag with hygroscopic salts, suitable for long sea transports.
IWG	SNMP or TCP/IP Protocol serial interface: Electronic card to be connected to the microprocessor to allow connection of the units to supervision systems with SNMP or TCP/IP protocol, for a remote control and monitoring of the unit. (Alternative to IH or IH LON)
MF	Phase monitor: Electronic device that checks the correct sequence and/or the lack of one of the 3 phases, switching off the unit if necessary.
MV	Buffer tank module: Of suitable capacity complete with expansion vessel, safety valve, water gauge, water charge and discharge valves, air purging valves, check valves for filter service operation .
P1	Pump group: Chilled water pump group made of a single pump, expansion vessel, safety valve water gauge, water charge and discharge valves, air purging valves, electric control of the pump.The pump is of enbloc 2-pole type for standard and S versions, 4-pole for U version.
P1H	Higher available pressure pump group: Chilled water pump group made of a single pump, expansion vessel, safety valve water gauge, water charge and discharge valves, air purging valves, electric control of the pump.
P2	Double pump group (only one working): Chilled water pump group made by two pumps in parallel, expansion vessel, safety valve, water gauge, water charge and discharge valves, air purging valves, water shut-off valve on suction and check valve on discharge for each single pump, electric control of the pump. The pumps are centrifugal and of mono-bloc 2-pole type.
P2H	Higher available pressure double pump group (only one working): Chilled water pump group made by two higher available pressure pumps in parallel, expansion vessel, safety valve, water gauge, water charge and discharge valves, air purging valves, water shut-off valve on suction and check valve on discharge for each single pump, electric control of the pump. The pumps are of enbloc 2-pole type for standard and S versions, 4-pole for U version
PT	In-line twin pump group (only one working): Chilled water pump group made by a twin pump group with a single impeller body and two separate electric motors. The hydronic kit is made by an expansion vessel, safety valve, water gauge, water charge and discharge valves, air purging valves, electric control of the pump. The pumps are of enbloc 2-pole type for standard and S versions, 4- pole for U version. (Not available for one-fan units).

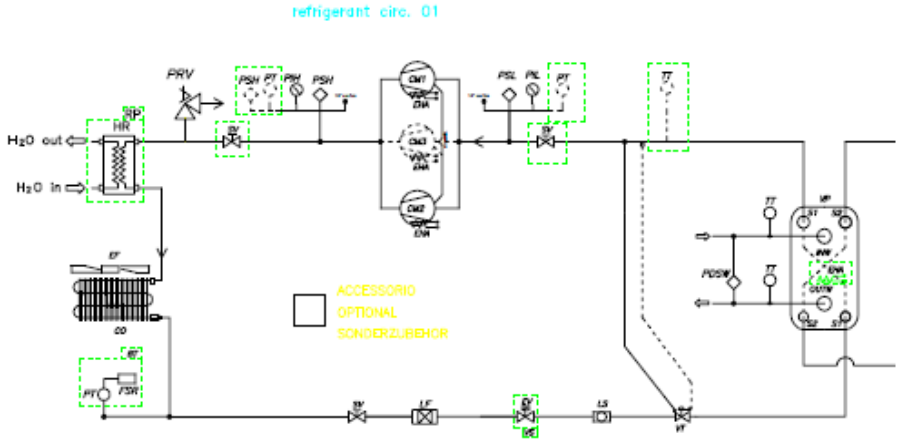
PA	Rubber-type vibration dampers: Bell-shaped vibration dampers supports for isolating the unit (supplied in kit), made of base and bell in galvanized steel and natural rubber mixture.
PM	Spring-type vibration dampers: Spring-type vibration dampers supports, for isolating the unit (supplied in kit), mainly indicated for installation in difficult and aggressive environments. Made of two steel plates containing a suitable quantity of harmonic steel springs.
PQ	Remote display: Remote terminal, allowing to display the temperature and humidity values detected by probes, the status of digital inputs and outputs, alarm condition, remote ON/OFF and also the possibility to remotely program parameters in microprocessor.
RA	Anti-freeze heater on evaporator: Electrical heater installed on the evaporator, in order to prevent freezing, provided with thermostat.
RD	Shut-off valve on discharge side: They are used to isolate compressors during service operation .
RF	Power factor correction system cosfi ≥ 0,9: Electrical device made by suitable condensers for compressor rephasing that ensure a cosfi value ≥ 0,9, so to reduce absorption from electrical network.
RH	Shut-off valve on suction side: They are used to isolate compressors during service operation .
RL	Compressor overload relays: Electromechanical protection devices against compressors overload.
RM	Condensing coil with pre-painted fins: Double-layer treatment of condensing coils with epoxy
RP	Partial heat recovery: (about 20%) of condensing heat through a refrigerant/water plate exchanger (desuperheater) always in series to the compressors. It is used when you want to partially recover condensing heat capacity for production of sanitary water.
RR	Copper/Copper coil: Special condensing coils with copper pipes and fins.
RT	Total heat recovery: (100%) of condensing heat by refrigerant/water heat exchanger in alternative and in parallel to the condensing air section. It is used when you want to completely recover condensing heat capacity for production of sanitary water or for heating applications. It is necessary to consider option BT.
RV	Personalized copperpainting in alternative RAL colour
TE	Electronic thermostatic valve: Electronic thermostatic valve that reduces the response times of the unit. Useful in case of frequent changes on cooling demand, so as to improve efficiency.
V	Voltmeter: Electrical device measuring the electrical voltage of the unit power supply.
VB	Brine Version: Unit suitable for working with evaporator outlet water temperatures lower than 0°C.A 20 mm evaporator insulation will be provided.
VS	Solenoid valve: Electromagnetic solenoid valve on each cooling circuit to cut off the liquid line at compressors switch-off.

2.7 Functional Drawing

General hydraulic circuit diagram of the unit is shown in Figure 2.2, any more specific diagram will be attached to the Manual.

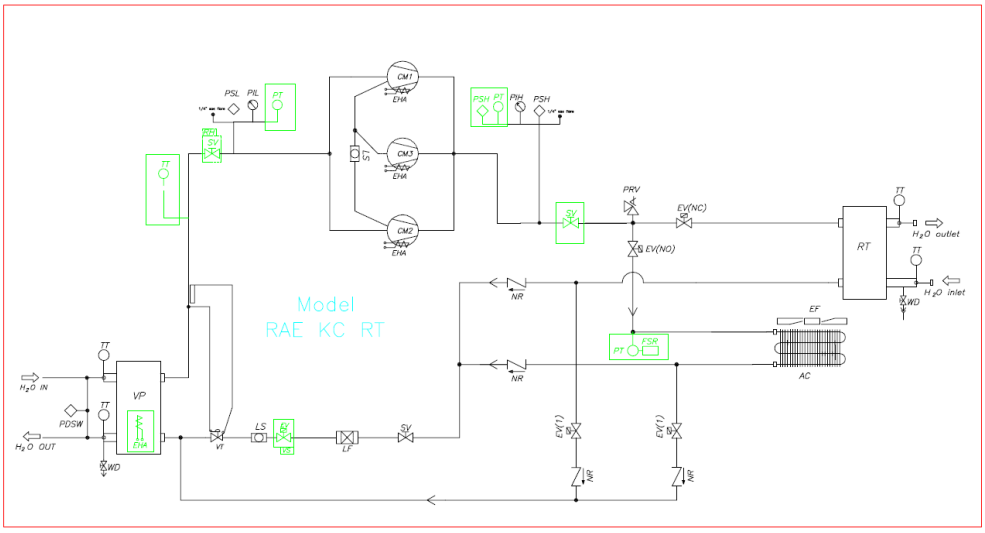
Unit functional Drawings

Figure 2.2: Cooling circuit drawing RAE_Kc (std vers. and with partial recovery (optional RP))



CM1-	Scroll Compressors	**CO**	Air condenser
LF	Dehydrating filter	**LS**	Sight glass
VT	Electronic expansion valve	**VP**	User side heat exchanger
SV	Shut-off valve	**EV**	Solenoid Valve
PRV	Safety valve	**EF**	AC Axial fan
HR	Heat recovery	**EHA**	Crankcase heater
PSH	High pressure switch	**PSL**	Low pressure switch
PT	High pressure transducer	**PIH**	High pressure gauges
PIL	Low pressure gauges	**PDSW**	Water side differential pressure switch
TT	Temperature probe		

Figure 2.3: Cooling circuit drawing RAE_Kc (std vers. and with TOTAL heat recovery, option RT)



CM1-CM2-	Scroll Compressors (single) tandem or	**CO**	Air condenser
LF	Dehydrating filter	**LS**	Sight glass
VT	Electronic expansion valve	**VP**	User side heat exchanger
SV	Shut-off valve	**EV**	Solenoid valve
PRV	Safety valve	**EF**	AC Axial fan
RT	Total heat recovery	**EHA**	Crankcase heater
PSH	High pressure switch	**PSL**	Low pressure switch
PT	High pressure transducer	**PIH**	High pressure gauges
PIL	Low pressure gauges	**PDSW**	Water side differential pressure switch
TT	Temperature probe		

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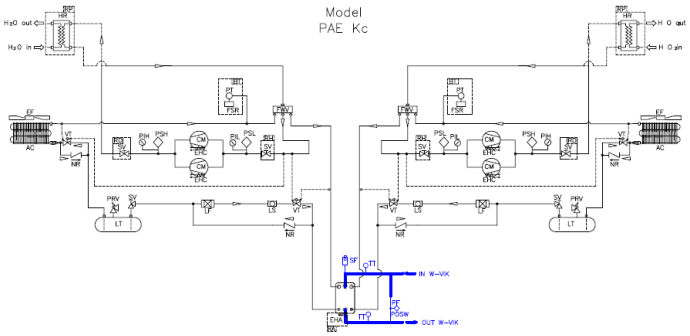
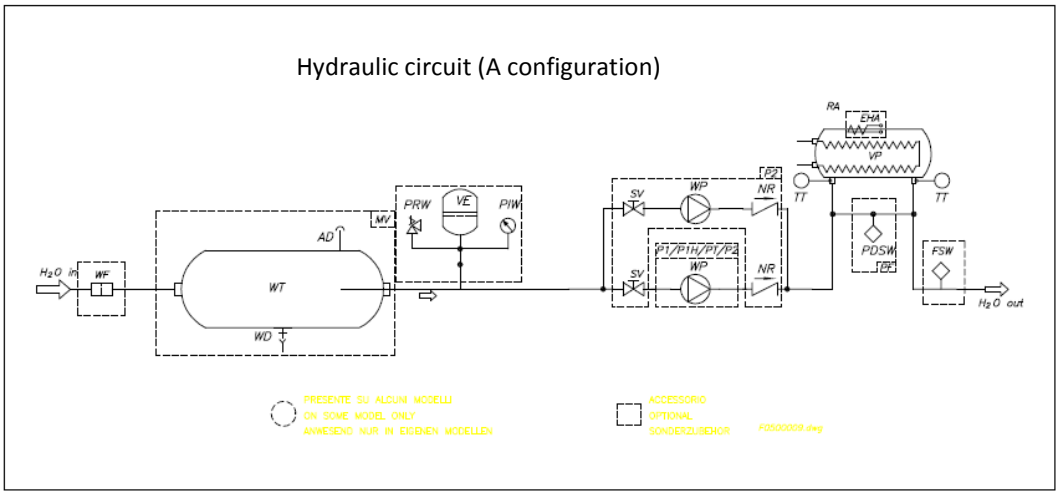
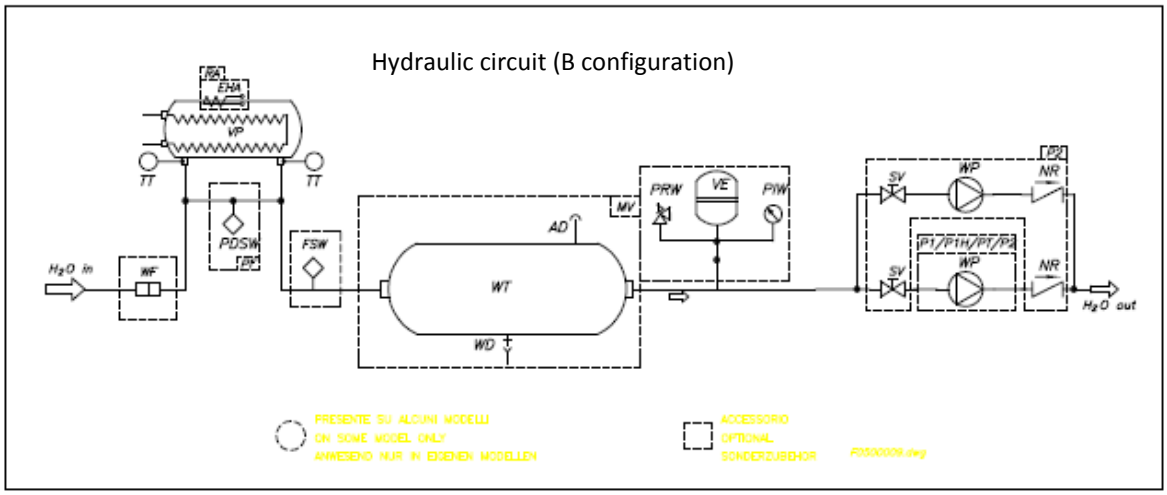


CM1-CM2	Scroll Compressors	**AC**	Evaporating-condensing air coils
LF	Dehydrating filter	**LS**	Sight glass
VT	Electronic expansion valve	**VP**	User side heat exchanger
SV	Shut-off valve	**EV**	Solenoid Valve
PRV	Safety valve	**EF**	Axial fans
HR	Heat recovery	**EHA**	Crankcase heater
PSH	High pressure switch	**PSL**	Low pressure switch
PT	High pressure transducer	**PIH**	High pressure gauges
PIL	Low pressure switch	**PDSW**	Water side differential switch
TT	Temperature sensor	**NR**	Non-return valve
FWV	4-way inversion valve	**LT**	Liquid receiver

Figure 2.5-2.6: RAE Kc hydraulic circuit (A-B configuration)





EHA	Antifreeze evaporator resistance	**PDSW**	Water side differential pressure switch
WF	Water inlet filter (suggested)	**FSW**	Paddle water flow switch
TT	Temperature sensor	**WT**	Storage Buffer tank
WD	Water discharge	**AD**	Automatic air purging valve
PRW	6 bar Safety valve	**VE**	Expansion vessel
PTW	Water gauges	**SV**	Sphere valves
WP	Circulation pump	**NR**	Non return valves

2.8. Wiring diagram

Available with the Manual is a diagram of electrical circuits for power and control of the unit, of the terminal box and its related table, which sums up the features of the used components.

2.9. Sound emission

The unit does not require operators, being able to function in a fully automated way.

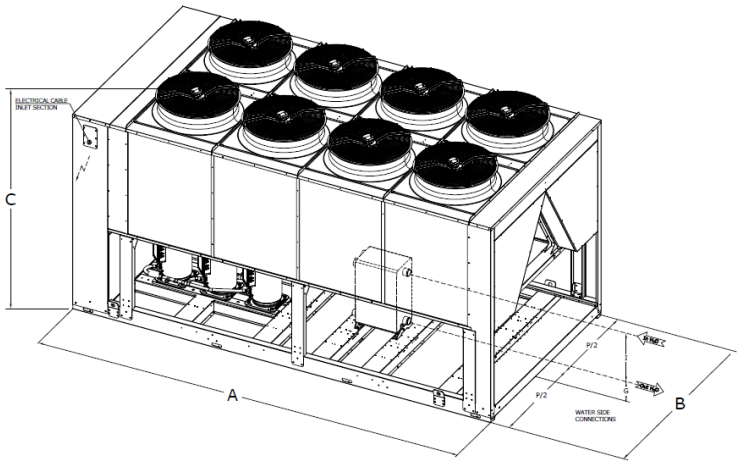
It is therefore not necessary to provide sound data for sound pressure at 1 m from the unit (and precisely the electrical board), as in the technical datasheet an average sound pressure is indicated, at full load conditions.

2.10. Dimensional drawing

In the table below, dimensions for each RAE-PAE Kc/Ka. model are indicated, as in figure 2.7

2.10.1. RAE-PAE Kc/Ka Range

Figure 2.7: Generic dimensional drawing RAE-PAE Kc/Ka



SERIES	***RAE Kc/Ka***																	
MODEL	801	1001	1301	1501	1702	2002	2302	2502	2902	3202	3402	3602	3802	4102	4902	5202	5602	6102
VERSION	**ST**																	
A (mm)	1620	1620	2660	2660	2660	3700	3700	3700	3700	3700	4740	4740	4740	5780	5780	3770	4750	4750
B (mm)	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	2375	2375	2375
C (mm)	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2530	2530	2530
VERSION	**S/U**																	
A (mm)	1620	2660	2660	2660	3700	3700	3700	3700	4740	4740	5780	5780	5780	5780	4750	4750	5700	5700
B (mm)	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	2375	2375	2375	2375
C (mm)	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2530	2530	2530	2530

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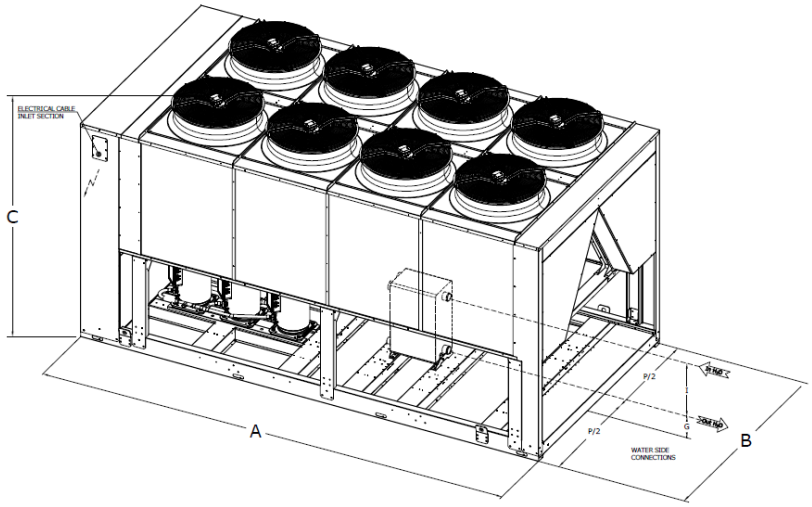


SERIES	PAE Kc/Ka																	
MODEL	801	1002	1302	1502	1702	2002	2302	2502	2902	3202	3402	3602	3802	4102	4902	5202	5602	6102
VERSION	**ST**																	
A (mm)	1620	2660	2660	2660	3700	3700	3700	4740	4740	4740	5780	5780	5780	5780	4750	4750	5720	5720
B (mm)	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	2375	2375	2375	2375
C (mm)	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2530	2530	2530	2530
VERSION	**S**																	
A (mm)	2660	2660	2660	2660	3700	3700	4740	4740	5780	5780	5780	4750	4750	4750	4750	5720	5720	5720
B (mm)	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	1370	2375	2375	2375	2375	2375	2375	2375
C (mm)	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2420	2530	2530	2530	2530	2530	2530	2530

3. INSTALLATION

The positioning of the unit must be done accordingly to local laws and regulations.

3.1. Identification

The units can be identified by the Identification Tag, as illustrated and described in par. 1.4, which is applied inside the electrical board.

The correct identification of the unit through the serial number, is very important for any operation on the unit and, in particular, must be always communicated to the manufacturer service department.

3.2. Receipt and inspection

It is necessary to verify at delivery, through visual inspection, that the unit has been correctly shipped. In case of any defect, it will be necessary to accept the goods with reserve, by describing on the transportation document, any anomalies, and make it sign by the carrier.

Any claims concerning delivered material will have to be forwarded to the Manufacturer within 8 days from goods receipt, by e-mail, fax or registered mail

3.3. Handling

Handling of the units must be executed by experienced personnel, by suitable equipments for unit weight and dimensions. During handling, the units have to be always kept in a vertical position, with the basament parallel to the soil.

Weight of some models could be unbalanced, therefore it is necessary to verify the stability of the unit, before starting handling.

To move the device, please follow indications as per above image:

Lift the unit vertically, without sudden movements and with an adequate speed for its charge, so as to preserve the integrity of the structure.

In case of use of a forklift, forks will have to be distanced at max possible distance. If the lifting is done by pulleys or ropes, it will be necessary to avoid any pressure on the unit that may cause damages or breaking.

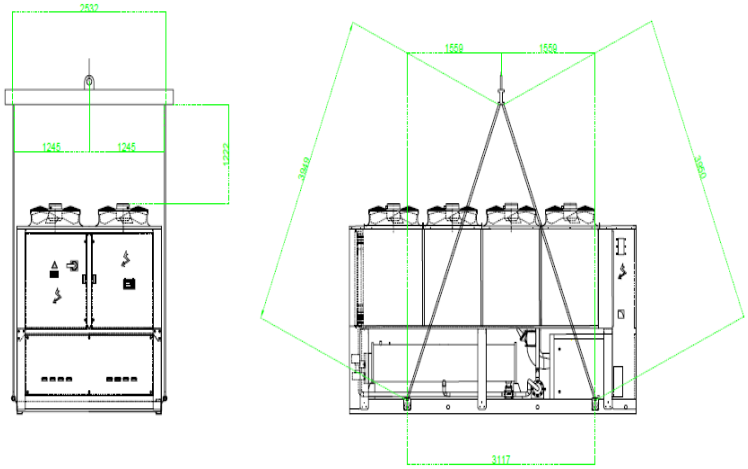
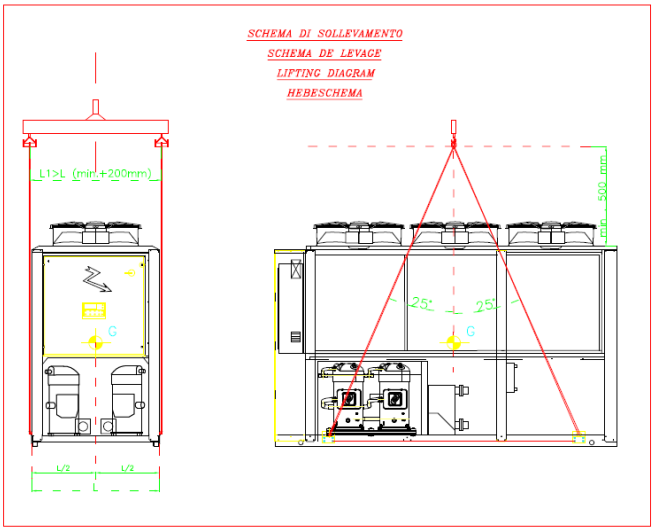


Figure 3.1-3.2: Lifting drawings



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Lifting devices , cables , ropes and strips , used for the handling of the unit ,must be done in compliance with local laws and regulations

Before starting handling for positioning , it is advisable to identify optimal path, by keeping dimensions and weight of the unit into consideration, of the available devices and the dimensions of the accessories.

3.4. Positioning

The installation of the unit must be done at the owner in charge and will have to be executed under his responsibility. A correct installation requires a project by a professional and the realization by expert personnel with the necessary information.

In the environment where the unit is installed, there must not be any aggressive substances, nor substances that are incompatible with copper, carbon steel, aluminum and other materials used for producing the unit. In case of doubt, it will be necessary to carry out specific chemical analyses and send the results to the Manufacturer, so as to find all necessary solutions and measures.

Installation of the unit must be done in compliance with local laws and regulations.

Before proceeding with positioning , it is necessary to verify that:

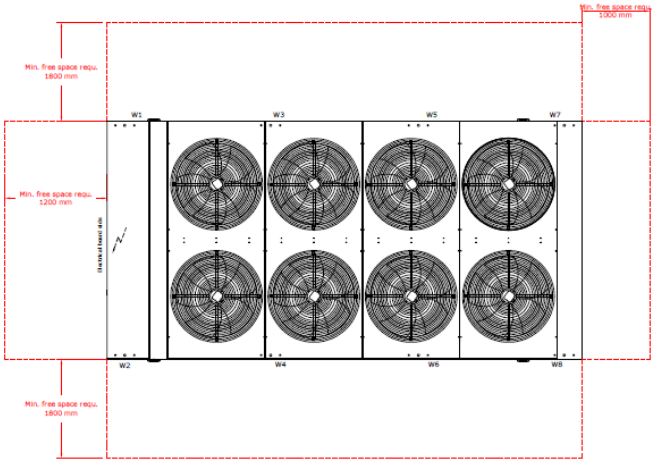
- the basement is capable to sustain in a stable way the weight of the units in working configuration;
- around the unit there is enough space for ordinary and extraordinary servicing as shown in Figure 3.3;
- hydraulic and electric connections have been properly arranged

The unit is designed for outdoor installation and operation

The support of the units in operation, must be horizontal: a max inclination of 5° in length and width direction is anyway acceptable.

Units does not require any special base, as it can be simply installed on the basement.

Figure 3.3: Spacing



* It is necessary to respect indicated distances, also for any side hydraulic connections.

Before proceeding with installation , it is advised to verify that the features of the unit, which are stated in attached documentation to the Manual, comply with the project.

3.5. Hydraulic circuit

The unit is designed to be connected to a chilled and or hot water distribution network, depending on chillers or heat pumps. Piping must be made by expert personnel.

In the environment where the unit is installed, there must not be any aggressive substances, nor substances that are incompatible with copper, carbon steel, aluminum and other materials used for producing the unit. In case of doubt, it will be necessary to carry out specific chemical analyses and send the results to the Manufacturer, so as to find all necessary solutions and measures.

The hydraulic system must be sized by a professional, and realized by qualified personnel, in compliance with local regulation in force.

Diameters of the hydraulic connections are stated in Table 3.1 and on the dimensional drawing attached to the Manual. Piping diameters must be sized to keep circuit pressure drop within acceptable limits

Table 3.1: Ø hydraulic connections RAE Kc/Ka range

RAE_Kc/Ka	**Hydraulic piping dimenioning**						
Models as STANDARD	**RAE_ST**	**801**	**1001**	**1301**	**1501**	**1702**	**2002**
Hydraulic connections dimensions							
Water connection diameters	DN	2 x 50 VIK	2 x 50 VIK	2 x 65 VIK	2 x 65 VIK	2 x 65 VIK	2 x 65 VIK
Partial heat recovery water side connection dimensions	INCH	2 x 1" M GAS	2 x 1" M GAS	2 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS
Total heat recovery water side connection dimensions	DN	4 x 50 VIK	4 x 50 VIK	4 x 50 VIK	4 x 50 VIK	4 x 50 VIK	4 x 65 VIK
Models - version SILENCED/ ULTRA-SILENCED	**RAE_S/U**	**801**	**1001**	**1301**	**1501**	**1702**	**2002**
Hydraulic connections dimensions							
Water connection diameters	DN	2 x 50 VIK	2 x 50 VIK	2 x 65 VIK	2 x 65 VIK	2 x 65 VIK	2 x 65 VIK
Partial heat recovery water side connection dimensions	INCH	2 x 1" M GAS	2 x 1" M GAS	2 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS
Total heat recovery water side connection dimensions	DN	4 x 50 VIK	4 x 50 VIK	4 x 50 VIK	4 x 50 VIK	4 x 50 VIK	4 x 65 VIK
RAE_Kc/Ka	**Hydraulic piping dimenioning**						
Models as STANDARD	**RAE_ST**	**2302**	**2502**	**2902**	**3202**	**3402**	**3602**
Hydraulic connections dimensions							
Water connection diameters	DN	2 x 65 VIK	2 x 65 VIK	2 x 65 VIK	2 x 65 VIK	2 x 80 VIK	2 x 80 VIK
Partial heat recovery water side connection dimensions	INCH	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 2" M GAS

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Total heat recovery water side connection dimensions	DN	4 x 65 VIK	4 x 65 VIK	4 x 65 VIK	4 x 65 VIK	4 x 80 VIK	4 x 80 VIK

Models - version SILENCED/ ULTRA-SILENCED	**RAE_S/U**	**2302**	**2502**	**2902**	**3202**	**3402**	**3602**
Hydraulic connections dimensions							
Water connection diameters	DN	2 x 65 VIK	2 x 65 VIK	2 x 65 VIK	2 x 65 VIK	2 x 80 VIK	2 x 80 VIK
Partial heat recovery water side connection dimensions	INCH	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 2" M GAS
Total heat recovery water side connection dimensions	DN	4 x 65 VIK	4 x 65 VIK	4 x 65 VIK	4 x 65 VIK	4 x 80 VIK	4 x 80 VIK

RAE_Kc/Ka	**Hydraulic piping dimenioning**						
Models as STANDARD	**RAE_ST**	**3802**	**4102**	**4902**	**5202**	**5602**	**6102**
Hydraulic connections dimensions							
Water connection diameters	DN	2 x 80 VIK	2 x 80 VIK	2 x 80 VIK	2 x 80 VIK	2 x 80 VIK	2 x 80 VIK
Partial heat recovery water side connection dimensions	INCH	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS
Total heat recovery water side connection dimensions	DN	4 x 80 VIK	4 x 80 VIK	4 x 80 VIK	4 x 80 VIK	4 x 80 VIK	4 x 80 VIK

Models - version SILENCED/ ULTRA-SILENCED	**RAE_S/U**	**3802**	**4102**	**4902**	**5202**	**5602**	**6102**
Hydraulic connections dimensions							
Water connection diameters	DN	2 x 80 VIK	2 x 80 VIK	2 x 80 VIK	2 x 80 VIK	2 x 80 VIK	2 x 80 VIK
Partial heat recovery water side connection dimensions	INCH	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS
Total heat recovery water side connection dimensions	DN	4 x 80 VIK	4 x 80 VIK	4 x 80 VIK	4 x 80 VIK	4 x 80 VIK	4 x 80 VIK

Table 3.2: Ø hydraulic connections for range PAE Kc/Ka

PAE_Kc/Ka	**Hydraulic piping dimenioning**						
Models as STANDARD	**PAE_ST**	**801**	**1002**	**1302**	**1502**	**1702**	**2002**
Hydraulic connections dimensions							
Water connection diameters	DN	2 x 50 VIK	2 x 50 VIK	2 x 50 VIK	2 x 50 VIK	2 x 65 VIK	2 x 65 VIK
Partial heat recovery water side connection dimensions	INCH	2 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS

Models - version SILENCED/ ULTRA-SILENCED	**RAE_S/U**	**801**	**1002**	**1302**	**1502**	**1702**	**2002**
Hydraulic connections dimensions							
Water connection diameters	DN	2 x 50 VIK	2 x 50 VIK	2 x 50 VIK	2 x 65 VIK	2 x 65 VIK	2 x 65 VIK
Partial heat recovery water side connection dimensions	INCH	2 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS

PAE_Kc/Ka	Hydraulic piping dimenioning						
Models as STANDARD	**PAE_ST**	**2302**	**2502**	**2902**	**3202**	**3402**	**3602**
Hydraulic connections dimensions							
Water connection diameters	DN	2 x 65 VIK	2 x 65 VIK	2 x 65 VIK	2 x 80 VIK	2 x 80 VIK	2 x 80 VIK
Partial heat recovery water side connection dimensions	INCH	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS
Models - version SILENCED/ ULTRA-SILENCED	**RAE_S/U**	**2302**	**2502**	**2902**	**3202**	**3402**	**3602**
Hydraulic connections dimensions							
Water connection diameters	DN	2 x 65 VIK	2 x 65 VIK	2 x 65 VIK	2 x 80 VIK	2 x 80 VIK	2 x 80 VIK
Partial heat recovery water side connection dimensions	INCH	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS	4 x 1" M GAS

PAE_Kc/Ka	Hydraulic piping dimenioning						
Models as STANDARD	**PAE_ST**	**3802**	**4102**	**4902**	**5202**	**5602**	**6102**
Hydraulic connections dimensions							
Water connection diameters	DN	2 x 80 VIK	2 x 80 VIK	2 x 80 VIK	4 x 80 VIK	4 x 80 VIK	4 x 80 VIK
Partial heat recovery water side connection dimensions	INCH	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS
Models - version SILENCED/ ULTRA-SILENCED	**RAE_S/U**	**3802**	**4102**	**4902**	**5202**	**5602**	**6102**
Hydraulic connections dimensions							
Water connection diameters	DN	2 x 80 VIK	2 x 80 VIK	2 x 80 VIK	4 x 80 VIK	4 x 80 VIK	4 x 80 VIK
Partial heat recovery water side connection dimensions	INCH	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS	4 x 2" M GAS

Here below some general indications, to be followed, in order to complete hydraulic circuit..

- Choose the piping path so as to contain, as much as possible, pressure drop.
- Position and clamp pipings so as to allow inspection and servicing.
- The material used for realizing the plant must have a nominal pressure > PN6 water side.
- During plant installation, you must take all necessary precautions to avoid dirt and debris in the pipings.
- Circulation water pump must be able to provide requested water flow with a suitable head pressure against the pressure drops of the circuit in all possible operating conditions.
- Hydraulic circuit must work at a pressure between 1,5 e 6 bar, so it is necessary to equip it with one or more membrane expansion vessels, with adequate volume and pre-charge pressure.

In case the hydraulic circuit has been designed to work at pressure <1,5 bar (for example, open circuit plants or >6 bar, it will be necessary to inform the Manufacturer, with whom it will be possible to plan different measures to solve the problem.

- The plant must be protected by a safety valve of adequate size, and setting pressure < 6 bar.
- Along the circuit, in particular on the highest points, there must be all necessary devices for air discharge

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- Plant must be equipped, in appropriate points, with connections for emptying.
- System must be equipped with connections for filling with water and, if provided, with antifreeze substances
- At the end of the procedures to build the circuit, it must be cleaned with suitable substances, to avoid that dirt or debris comes inside and causes damages or anomalies during working period.
- For the connection of the units to the hydronic plant, make sure to use indicated areas in the attached drawing.

The plant must be protected by a safety valve of adequate size, and setting pressure < 6 bar .

3.5.1. Connection to hydraulic circuit

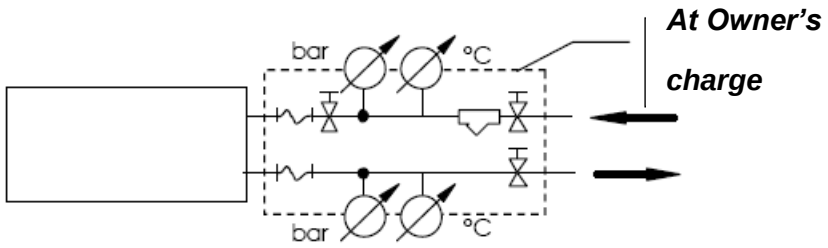
Connections of the unit to the hydraulic circuit must be executed by an expert and qualified technician, in compliance with local regulations in force.

It is important that connection of the unit to the plant is executed so that refrigeration fluid circulates across the evaporator in the right direction. On this purpose,pipings must be connected by following the indications close to the connections on the unit.

For the connection of the pipes to the evaporator, it is advisable to respect following indications:

- Connect pipings as in fig. 3.3

Fig. 3.4: Connection of the units to the hydraulic system with pump group user side



- To avoid transmission of vibration and to allow thermal dilation, you must install anti-vibration filets on pipings;
- To avoid particles and dirt coming inside, it is necessary to install on the unit inlet a mechanical washable filter, with dimension < 2 mm and with adequate nominal diameter to contain pressure drop.
- It is advised to insert shut-off valves before and after of the filter, so as to make quicker and easier the necessary cleaning procedures;
- Positioning of thermometers and gauges close to the inlet and outlet connections, makes it easier to verify if it is working properly;
- The cooling water plant must be covered by anti-condensing, closed-cell material, with thermal insulation features, steam tightness, of adequate thickness to the worst possible conditions, during operation and during stops;

- For the connection of the units to the hydraulic plant, it is necessary to use provided connections indicated in the drawing attached to the Manual;

- Once the building of the circuit and the installation have been completed, it is necessary to have a tightness test, so as to identify any eventual leak and repair them, before filling and startup. .

After check of the tightness of the system executed with water , if the plant is started after a long time, or if the external temperature is close to 0°C or less, it will be necessary to remove some water from the circuit or to insert an adequate quantity of antifreeze liquid.

You must be sure that compressors of the units can start only after the operation of the evaporator water circulation pumps. This is possible, for example, by using an electrical interblock. (as in the wiring diagram attached to the manual)

3.5.2. Filling the hydraulic circuit

Once the hydraulic system has been realized, the connection of the units and the tightness of the system have been assured, you must proceed with filling the circuit, through the following steps:

a) Open all present purge valves.
b) Connect the circuit to an hydraulic supply network, possibly in a permanent way, through an automatic filling unit with a manometer, as well as non-return valves. .
c) If the circuit works on an antifreeze mix, add the correct amount of antifreeze fluid, based on the volume of the plant and the concentration to achieve.
d) Charge water in the plant through the filling unit.
e) Verify all present air discharge valves, by closing them, when there is no more air inside, but only water.
f) Once all purge valves are closed, continue to charge water, until a pressure between 1,5 and 6 bar is reached.
g) Stop charging water, activate circulation pumps, and make them work for two hours, so to let the air flow to higher points provided with purges.
h) Switch off the pumps and discharge the air which has eventually accumulated, by opening all purge valves one by one. .
i) Charge water in the circuit so as to bring pressure to its original value.
j) Repeat steps from g) to i) until all purge valves expel only water.

3.5.3. Use of antifreeze mixture

In case it is possible that, during working period, fluid temperature goes down 4°C or, during stops, can get close to 0°C, it will be necessary to introduce in the hydraulic circuit an antifreeze mixture, with a freezing point sufficiently lower than the minimum temperature.

Some liquids are harmful if ingested, or may cause irritations if coming to contact with skin and mucus. Therefore, when handling such substances, it is necessary to respect safety indications on the container and its related working instructions, or, anyway, it is always advisable to wear protection glasses and rubber gloves. Therefore, it is necessary to make sure that such substances never get to mouth.

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It is forbidden to use aggressive antifreeze mixes, or uncompatible with copper, carbon steel and other materials of the plant;

E.g., in Table 3.2 we indicated the freezing temperatures for different ethylene glycol concentration in water .Values on this table are an indication and must be used only as a reference. In some cases, suppliers may deliver the product in a solution, therefore it is necessary to refer to dilution percentages indicated by the antifreeze fluid supplier

Table 3.2: Freezing temperature for ethylene glycol

	Concentration of ethylene glycol in the mix **(as [kg/kg])**							
	5%	***10%***	***15%***	***20%***	***25%***	***30%***	***35%***	***40%***
Volume concentration (l/l)	***4,4%***	***8,9%***	***13,6%***	***18,1%***	***22,9%***	***27,7***	***32,6***	***37,5***
Freezing temperature (°C)	***-1,4***	***-3,2***	***-5,4***	***-7,8***	***-10,7***	***-14,1***	***-17,9***	***-22,3***

The use of mixtures with glycol concentration lower than necessary, may cause freezing and breaking of the hydraulic circuit and, in particular, of the evaporator. The use of unnecessarily high concentrations, instead, may lead to a reduction of unit performance and, in particular, of its energy efficiency. Fluid in the hydraulic circuit must be periodically analyzed, and especially during the beginning of the cold season, to verify its composition and its concentration. All fluid present in the plant will have to be replaced within the period indicated by the producer of the antifreeze mixture, or at least each two years.

It is absolutely forbidden to discharge the antifreeze mixture in the environment; it must be therefore disposed by experts (disposal services), in compliance with the laws and local regulations.

3.6. Electrical connections

The electrical plant for the unit power supply must be dimensioned by a certified professional and realized by qualified personnel, on charge of the Owner, in compliance with local regulations in force.Unit power supply cable must be protected by an automatic switch of suitable size and characteristics, as well as compliant with local regulations in force .The system must be realized so that it is possible to cut off power supply, without interrupting other services such as lighting, ventilation, alarms and safety systems.

Any operation on the electrical circuit of the units, must be carried out by expert and adequately personnel, certified in compliance with laws and local regulations in force..

Before operating on the electrical system, it is necessary to read the wiring diagram attached to the Manual.

You must verify that tension and frequency are the ones indicated on the unit and on the wiring diagram attached to the Manual.

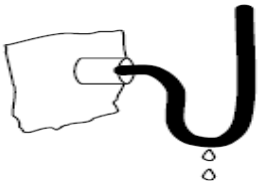
You must use a power supply cable of adequate section (and length as short as possible, to avoid excessive voltage drops).

To dimension section of the power supply, size and the intervention threshold of the automatic switch, you must refer to the data on the wiring diagram attached to the Manual.

3.6.1. Connection of the electrical power supply

The units must be powered by a 4 wire cable (3 phase + GND), if tension of power supply is 400V / 3ph / 50Hz + GND. Special power supply may be possible on request (Verify on the unit and the electrical diagram). Connect the phases to the inlet clamp of the main switch and the earth conductor to the suitable clamp. Use a power supply cable of adequate section (and length as short as possible, to avoid excessive voltage drop). Protect the cable with an automatic switch of adequate size and characteristics. The section of the power supply cable and the size of the automatic switch , can be detected on the attached components table, on which the size of the general switch is also indicated. The position of the inlet for the power supply cable is indicated on the dimensional diagram of the unit attached to the Manual. The cable entry must be adequately protected in compliance with local regulations in force.

In case power supply cable comes close to the inlet point of the units on the top, it will be necessary to execute a bend, as shown in the image.



Before operating on the electrical plant, you must visually verify that all circuits of the unit have not been damaged during transport. Specifically, it is necessary to verify that all screws of single clamps have been properly tightened and that cable isolation is correct and well preserved. Conductors for the power supply cable phases must be connected to the free clamps entering the main switch; Earth conductor will be fixed to the clamp, which has been especially developed (and identified by PE symbol).

3.6.2. Connection to the terminal box user side

A terminal box user side is available where dry contacts are to be found for:

- General alarm (1);
- Unit remote ON/OFF (2).

Figure 3.5: Example

.Please read wiring diagram to verify the exact numbering of the corresponding clamps. Inside of the electrical board, a terminal box is available, in which you will find digital and analogue signals, concerning operation of the units. Since the configuration of the terminal box may vary from unit to unit, it is necessary to refer to the wiring diagram attached to the Manual. As example, clamps in Figure 3.5 for their own specific free contacts are:

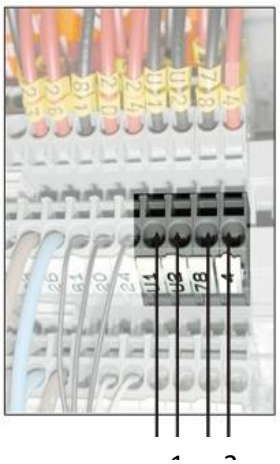


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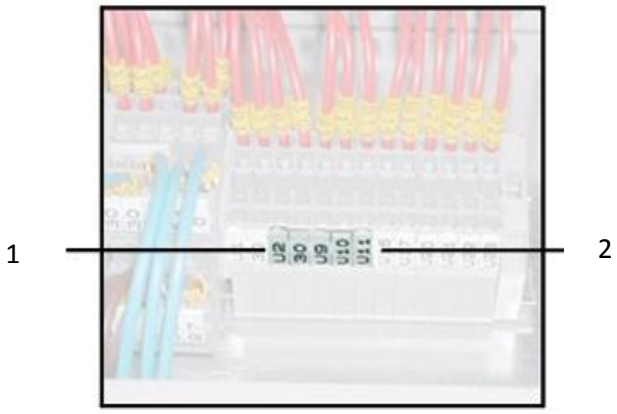
Figure 3.6: Contacts available in the terminal box user side



(1)	Inlet digital (free contact)	U2-30	Remote ON/OFF: Open = unit OFF Closed = unit ON
(2)	Outlet digital (free contact)	U9-U10	General alarm: contact NO (Closed = alarm)
	Outlet digital (free contact)	U10-U11	General alarm: contact NC (Open = alarm)

If, at the end of the phase inversion, some components are rotating in the wrong direction, it will be necessary to verify, and eventually make sure, that the sequence of the power supply conductors for the single user is correct, as described in previous paragraph.If the circulation pump is not controlled by the microprocessor of the units, it is advisable to connect an auxiliary contact for the teleruptor of the pump to the ON/OFF remote clamps on the electrical board (see enclosed Diagram), so that the units can start only when the pump is working.

3.6.3. Correct phase sequence check

The rotation sense of all electrical motors installed on the units (fans, pumps) is checked and harmonized during the factory test (except for units that cannot be switched on, for example, due to a special power supply). Once the wiring has been executed, it is necessary to verify that the phases have been connected in the correct way. On this purpose, please make sure that all electrical motors run in the correct direction. For units with triphase power supply, in case the rotation direction of some component is incorrect, you must assume that all motors rotate in the incorrect way and, therefore, it will be necessary to disconnect two conductors of the power supply line, and invert the position, on the inlet clamps entering to the main switch.

To avoid wiring errors you must not connect any other conductors of the main switch besides the two involved in the operation.

If, at the end of the inversion of all phases, it is detected that some components run in the incorrect way , it will be necessary to verify, and eventually correct the conductor sequence, for the single user, as described in previous paragraph.

3.7. Safety valves

Outlet connection of external safety valves installed on the units are provided with a threaded end, in order to be connected to an eventual discharge pipe, if the installation project or local regulations in force allow for it. If present, valves must be singularly convoyed, carried out by metal pipings, to a suitable zone where the discharged refrigerant is not causing damages to people or objects.

Refrigerant coming out from the safety valves is at high-pressure and high temperature , discharged at high speed. The flow may cause damages to objects and people.

The opening of the safety valves is signaled by a noise, whose the intensity may cause damages to the hearing of the people nearby.

Pipings must have a diameter not lower than the diameter for the safety discharge valves; refrigerant pressure drop must be as low as possible and, in any case, must not cause any reduction of discharged flow of the valves. The outlet of the pipings must be conformed so to avoid that rainwater, snow, ice, and dirt may accumulate and obstruct the pipings. Valve discharge must be operated at an adequate distance from other devices, plants or sources, the discharged refrigerant must not penetrate accidentally inside buildings. In each case, any piping on the discharge of the safety valves must be installed in compliance with laws and regulations in force.

3.8. Usage pattern for range RAE-PAE Kc/Ka

The nominal waterflow of the standard units refers to a temperature differential of 5°C between inlet ed outlet in relation to the provided cooling power. Maximum allowed flow refers to a temperature differential of 3°C in relation to the project cooling power (higher flow values may cause noise and vibration with damages to the evaporator).The minimum flow refers to a temperature differential of 7°C in relation to cooling power (lower flow values may cause too low in-outlet temperatures with consequent operation of the alarm and stop of the unit)

WORKING LIMITS		
Unit	Temperature water	Temperature air
RAE Kc/Ka Water chiller	Tmin outlet H_2O to the evaporator = 5° C(4) Tmax inlet H_2O to the evaporator = 20° C	T. ext air: vairble from +10 to +42° C(1)
PAE Kc/Ka Heat pump	Tmin inlet H_2O condenser = 25° C(2) Tmax outlet H_2O condenser = 50° C(3)	T.ext air summer: 15 to 42°C T. ext air winter: 20 to -8°C

1. For different usage, please contact Service Department
2. Inferior temperatures may cause anomalies
3. Higher temperatures may cause too low in-outlet temperatures with consequent operation of the alarm and stop of the unit
4. In case water temperature is lower than 5°C (to the outlet of the evaporator), one must use ethylene glycol mixes, and it is also necessary to reset the antifreeze thermostat (always 4°C higher than the freezing point of the mix) and the set-point based on the desired temperature and the temperature differential to the evaporator

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4. OPERATION

Before first startup, it is necessary that personnel is taught, also through the Manual, about the construction, management, operation and servicing of the units, safety measures, and legislation to be followed, any individual protection devices to be prepared, propriety indications to handle the refrigerant

4.1. Documentation

The owner of the units must request authorisation and prepare documentation for installation and operation of the units, in compliance with applicable local laws and regulations. Close to the unit in an adequately protected position, all necessary information must be available to manage and keep safety the system, as requested by local regulations in force. Moreover, if the unit (with a refrigerant charge higher than 3 kg) is installed in the European Community area, you must fulfil a Unit Register (here in after: Register), in compliance with EN 378-4. In such a document, following information about the unit must be indicated:

a) Detail for all servicing and repair jobs;
b) Quantity and type of charged refrigerant (new, reconditioned, or recycled) and quantity of replaced refrigerant on each occasion;
c) Analysis of reconditioned refrigerant, whose result, if available, must be stored in the Register
d) Origin of reconditioned refrigerant;
e) Any modification and substitution of system components;
f) Results of all scheduled tests;
g) Data storing for all relevant inactivity periods .

The Register must be held by the Owner, so that one updated copy is available for personnel during servicing and check tion on the unit.

4.2. Initial checks

Before startup the unit must be visually checked by an expert technician, including following checks:

a) Detection of any damage eventual occured during transportation, storage or handling;
b) Comparison of installation with electrical and hydraulic diagram,
c) Check safety devices and related documentation;
d) Certificates check, of the identification tags and, in general, of provided documentation;
e) Verify that accessible pipings cannot cause any accidental harm to the public;
f) Check the power supply has adequate size and characteristics, in relation to the charge necessity;
g) Check the placing and the status of the valves and of the interception valves;
h) Check integrity of the supports and of the fixing devices;
i) Check the quality of the soldering, of the brazing and other junctions;
j) Check the adequacy of the protections against mechanical damage, heat and moving organs;
k) Check the accessibility for inspection, servicing and the reparation of main components;
l) Check presence and status of the thermal and steam isolation;

The technician who will perform these checks, will have to document them in conformity with local regulations in force.

Before starting unit, at the first startup or after a long break, it is necessary to verify connections and wiring, and also conductor connections. In case of defects, the unit cannot be operated.

Before starting the units, one must verify that following conditions are respected:

- The chiller is positioned on a structure that can sustain it in a stable way;
- Grounding has been properly executed and connected to an efficient electrical system;
- The power supply line is protected by an automatic switch of suitable size and characteristics;
- In presence of an inlet connection to the units, a mechanical filter of suitable dimensions and features must be installed;

It is necessary to verify periodically the cleaning status of the mechanical filter to avoid that an excessive pressure drop may reduce the fluid flow to be cooled..

- The hydraulic plant has been filled in the correct way and air completely removed;

During unit operation , pressure in the hydraulic circuit must be always between 1,5 and 3,5 bar.

- The hydraulic plant has been filled in the correct way and air completely removed;
- Hydraulic connections have been correctly executed and do not have any leak;
- The refrigerate fluid freely circulates and in the correct direction, across the evaporator;
- The refrigerate fluid flow corresponds to the project one;
- Compressor valves and along the cooling circuit are (open or closed) according to the operation mode;
- If necessary, a mix of antifreeze fluid must be present in the requested concentration; ,
- The regulation temperature value and of the anti-freeze alarm, on the microprocessor, have been set on the correct values.
- The design flow to the evaporator must be granted;
- The hydraulic circuit valves are open;
- All safety conditions have been respected;
- The clearance has been considered;
- The wiring has been correctly executed;
- Tension is within a 10% tolerance than the nominal one of the units;
- Shutting of all electrical and hydraulic connections has been properly executed.

4.3. First startup

First startup of the units must be executed by a technician authorized by the Manufacturer.

4.3.1. Switching on

Before commissioning the unit, for the first time or after a long period of inactivity, you must verify that the parameters set on the microprocessor respond to the requested working conditions. To start up the unit, you must turn the general switch to ON position, to supply power to the unit. Then, it will be necessary to push ON/OFF button on the microprocessor keyboard, by turning it into ON.

If the remote ON/OFF contact is closed, any circulation pump controlled by the microprocessor will start. After a delay time, whose value can be set on microprocessor, fans will start and, later on, each compressor according to the requested cooling power to satisfy the necessary heat load and, later, each compressor based on the necessary cooling power to satisfy present thermal load. .

Once the unit has reached a stable operation status, the technician performing the startup will have to detect the operation parameters and verify that:

a) High pressure safety pressure switches, are installed, properly set and correctly working
b) The setup pressure value on the external safety valves is correct and equivalent to the one stated
c) There are no refrigerant leaks

The detected data needs to be registered on the first startup module, attached to the Manual.

A copy of the first startup module, filled out in all applicable fields, must be transmitted to the *Manufacturer, to make the Warranty operational.*

During the first startup *procedure, the technician must verify that the safety devices (high and low pressure pressure switches, regulation thermostat, condensing pressure regulation device, etc...) are properly working.*

4.3.2. Winter stop

If you believe that during unit stop, ambient temperature can go lower, or go close to 0°C, it will be necessary to introduce in the hydraulic circuit an antifreeze mixture with a freezing point sufficiently lower than minimum forecast temperature, as per indications of par. 3.5.3.In case it is not possible to introduce antifreeze mixture in the circuit, it is possible to avoid freezing by installing heating resistances, which can be activated by a thermostat measuring the water or air temperature. In this case, of course, it is necessary to grant water flow continues to flow and, therefore, the pump stays on (if it is controlled by the unit, this should be electrically powered).In some cases, to avoid risk of freezing, it is preferable to completely discharge water from the cooling circuit. In this case, before filling it up again, it will be necessary to proceed with cleaning (see par. 3.5).

4.3.3. Switching off

To switch the unit off, you must press ON/OFF button on the microprocessor keypad, by pressing OFF. If you think the unit is switched off for longer than 24 h, it is necessary to turn the main switch to OFF position to cut off the power supply.

If any anomalies are detected during operation of the units, they will have to be fixed as soon as possible, so to avoid ripercussions on next startup.

4.4. Microprocessor regulation

To modify parameter values, it will be necessary to follow indications on the microprocessor documentation attached to the Manual.

Value modification of the set parameters must be exclusively executed by skilled technicians and, in any case, upon authorisation of the Manufacturer. The set of incorrect values, in fact, may allow unit operation at different conditions from the possible ones and, consequently, may cause damages to the unit and the plant.

5. MAINTENANCE CHECKS

The Owner must make sure that the unit undergoes proper maintenance, as indicated in the Manual in compliance with laws and regulations in force.

Equipment maintenance must be carried out by qualified and trained personnel, equipped with personal protective equipment, as provided by local laws and regulations in force.

In general, any person that is involved in refrigerant handling will have to be equipped, at least, with protective glasses and gloves.

Servicing of the unit must be done so that

a) risk of accidents to people and damages to objects is reduced to a minimum;
b) damages to system components are not caused;
c) functionality and availability of the system are not compromised;
d) any refrigerant leak is identified and solved;
e) energy consumption is reduced to a minimum;

Servicing procedures that do not require any specific refrigeration knowledge, (for example, the clearing of the chiled water coil), may be conducted by personnel with suitable skills, at charge of the Owner.During servicing procedures, only authorised persons can stay close to the units.During servicing procedures, one must verify the label status and the warning on the system and the components; all illegible texts will have to be replaced. It will be forbidden to apply any modification to the units, or any component substitution, without explicit authorisation of the Manufacturer.

Before carrying out any kind of work on the machine, it is necessary to cut off the power supply from the electric panel, by turning the main switch to the OFF position.

Inside the unit there can be areas with high voltage. Access to such areas may be carried out only by qualified and trained personnel, authorized as provided by local laws and regulations in force.

Component surfaces on the compressor's discharge and on the liquid refrigerant line may reach high temperatures and touching them may cause burning.

On board the unit there are sharp parts and cutting edges which, if accidentally hit, may cause cuts or scratches.

In case of doubts on the kind of malfunction detected or on actions to be taken to solve it, please contact the Manufacturer.

Smoking is forbidden while performing maintenance operations on the unit.

5.1 Scheduled servicing

The Owner must make sure that the units is put into adequate inspections, checks, and that scheduled servicing is performed, according to type, size, age and functioning of the system and what is indicated in the Manual.

If any leak detection devices are installed, they will have to be inspectioned at least once a year to make sure that they are working properly.

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During operational lifetime, the unit must be put into inspections and verifications based on laws and local regulations in force. Specifically , if there are no stricter specifications, it will be necessary to follow the indications as in Table 5.1 (see EN 378-4, att. D), with reference to the described cases

Table 5.1: Inspections and verification

Case	Sight inspection (par. 4.2, p.ti a – l)	Pressure test	Leak detection
A	**X**	**X**	**X**
B	**X**	**X**	**X**
C	**X**		**X**
D	**X**		**X**

A.	Inspection following an intervention, with possible effects on mechanical resistance, or after a change of purpose, or after a two-year old stop or longer, it will be necessary to substitute all components that are inadeguate. Please do not make any verification at pressures higher than the design ones.
B.	Inspection after a reparair, *or significant modification of the system or its components. Check can be limited to the involved parts, but if a refrigerant leak is detected, it will be necessary to search for leaks on the entire system* .
C.	Inspection following installation of the unit in a different position than the original one. If any effects on mechanical resistance have to be considered, please make reference to point A.
D.	Refrigerant leak detection following an evidence-based leak suspect. The system must be esamine to detect leaks through direct measures (such as systems that can detect it) or hence indirect ones (for example, by examination of the working parameters), by concentrating on the most likely leak areas (e.g. joints).

If a defect that can compromise reliable operation is found, the unit will not be put into function, before removing the fault.

5.1.1 Leak detection

If no stricter requirements are present, the unit will have to be checked for leaks at least each 3 months ([1]). If, during check, a suspect for a refrigerant leak arises, (Ex. after cooling capacity reduction, or after overheating or subcooling tests), it will be necessary to detect it with adequate devices, repair it and proceed with a new tightness test, in compliance with national legislation in force.The result of the verification and the adopted measures must be stated on the Register.Personnel working on refrigerant leak detection must not use open flames, nor any flame source. Refrigerant leaks must be detected and repaired as soon as possible, by certified personnel in conformity with laws and local regulations in force.

([1]) For units installed on EC territory, leak detection must be done under indications of the CE regulation, 1516/2007.

5.1.2 Safety pressure switches check

If no stricter requirements are present, safety high pressure switches must be inspected on site at least each twelve months, to verify that they have ben well configurated and that they work properly, and that they are also installed in compliance with applicable laws.

5.1.3 Safety valves check

If no stricter requirements are present, external safety valves must be inspectioned on site at least each twelve months, to check their tightness. If a leak is detected, the valve will have to be substituted. Each five years, valves must be inspectioned to verify that they are in good state and that the working pressure, printed on the valve, is readable, that they are installed and that they have suitable characteristics to guarantee system safety in compliance with regulations in force.

5.1.4 Refrigerant fluid check

Refrigerant/liquid exchanger fluid must be inspectioned at least each six months , to check composition and detect any refrigerant presence.

5.1.5 *Noise and vibration check*

You must check, at least monthly, that the unit does not make any unusual noises and that pipings are not subject to unusual vibration that may cause breaking.

5.2. Ordinary servicing

5.2.1. Overloading protection check

Devices for the protection from current must be inspectioned to check integrity and functionality .

You can proceed with fuse replacement only by turning off power supply to the units, turning general sectioner on position OFF.

It is forbidden to by-pass fuses used on the units, or replace them with higher breaking capacity ones.

Fuses can reach very high temperatures that may cause burns, if not handled with the given precautions.

Fuses with blade contacts, used in case of high current, must be substituted, by using the correct handle, which is standard on the unit. The use of inadequate tools, in fact, may cause damages to the device or to the operator.

In case of configurable devices (thermal relays or engine savers), you must verify that the set absorption value is not higher than the one reported on the identification tag of the component to be protected.

5.2.2. Contactor check

Contactors used to activate electrical loads must be inspectioned to check integrity, contact status and functionality of the coil .It will be also required to verify that electrical cables are fixed tightly and correctly in their own terminals.When necessary, dust and debris have to be eliminated before causing noisy and unreliable device operation. In Table 5.2, you can find a summary of the scheduled servicing operations with their own programming, in which it is required to submit the unit, to guarantee a correct and reliable operation

over time.

Table 5.2: Periodic servicing operations

OPERATION	SCHEDULED						
	Each day	Each month	Each 2 months	Each 6 months	Each year	Each 5 years	When request.
ELECTRICAL SYSTEM AND CONTROL DEVICES							
Check that the unit properly works and that there are no alarms	**X**						
Visual inspection of the unit		**X**					
Check noise and vibration of the units		**X**					
Check functionality of safety devices and interlocks.				**X**			
Check performance of the unit				**X**			
Check electrical absorption of each component (compressors, fans, ecc.)				**X**			
Check power supply tension				**X**			
Check cable fixing in each terminal				**X**			
Check integrity of the cable isolation					**X**		
Check state and operation of the contactors					**X**		
Check microprocessor and display operation			**X**				
Check microprocessor parameter values					**X**		
Clean electrical and electronic components from any dust					**X**		
Check probe and transducer operation and setting					**X**		
Check refrigerant level evaporator probe							
Check configuration for refrigerant level evaporator probe					**X**		
COOLING COIL , FANS and COOLING CIRCUIT							
Sight inspection of the coil		**X**					
Fin cleaning					**X**		
Cleaning/ replacing air filters			**X**				
Clean condensate /and condensate sump			**X**				
Clean humidifier cylinder							

Check waterflow		X					
Check noise and vibration for fans		X					
Check fan tension				X			
Check fans electrical connections					X		
Check operation and setting for fan speed regulation system					X		
Check operation for 3 way valve					X		
Check there is no air in the cooling circuit		X					
COMPRESSORS							
Compressor sight inspection		X					
Check compressor vibrations and noise		X					
Check compressor tension				X			
Check compressor electrical connections					X		
Check compressor cable status and their fixing inside terminal boxes				X			

Monthly and daily procedures may be executed by Owner of the plant. Other interventions will have to be executed by certified and trained personnel.

IT IS forbidden to touch the unit barefoot or with wet or humid body parts.

IT IS forbidden to perform any clearing operation, before having disconnected the unit from the electrical supply network, by turning the general sectioner on OFF.

Operations on the cooling circuit must be executed by adequately trained and qualified technicians , certified in compliance with laws and local regulations in force.

When one operates on the units, one must use requested individual protection devices. Specifically, it is necessary to wear at least protective glasses, gloves, helm and antiinjury shoes.

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5.3. Damage detection

Damage detection is shown on the control microprocessor which, other than signalling alarm conditions, visualises any current problem.

In Table 5.3, the most common malfunctioning reasons are stated and, for each, most likely causes and possible solutions. In case of an alarm, before any reparation, it is advisable to verify that

- Operation conditions are equivalent to the planned ones and, in any case, they must respond to unit operational limits.
- All component electrical wires are stably fixed in each terminal (as in attached wiring diagram);
- Parameter set values are coherent with the current working conditions (please refer to the attached microprocessor Manual).

Table 5.3: Troubleshooting

MALFUNCTIONING	LIKELY CAUSE	SUGGESTED ACTIONS
1. Unit is not working	a. Unpowered electrical board	Verify tension for each power supply phase Verify that general sectioner is closed (position ON)
	b. Auxiliary circuit is not powered	Verify auxiliary circuit fuses (see Electrical Diagram)
	c. Microprocessor is not starting the unit	Verify electrical connections to the microprocessor Verify temperature set value
	d. External contact to unit startup missing	Verify that ON/OFF remote contact is closed (see Electrical Diagram) Enable contact for unit startup from terminal user display.
2. High pressure switch	a. Condensing pressure control system is not efficient (if present)	Verify setting and functionality of the system for control of the condensing.
	b. One or more condensing fans out of order	Verify intervention of the internal heating protection for the fans that are not working, replace the defect fans.
	c. High pressure switch badly set	Replace high pressure switch
	d. Discharge pressure too high	See point 8
3. Low pressure switch	a. Low pressure switch badly set	Replace low pressure switch
	b. Suction pressure too low	See point 7
4. Compressor not working	a. Automatic switch	Reset automatic switch , verify compressor winding

	b. Compressor internal protection	Verify resistance of all compressor windings.After reset, measure tension and absorption. . Verify that operation parameters are within nominal range
	c. Contactor not working	Verify contacts and oontactor coil
5. Noisy compressor	a. Liquid return to the compressor	Verify functionality and overheating of the expansion valve
	b. Compressor damaged	Replace compressor
6. Compressor high suction pressure	a. Heating load > than planned	Verify consistency of ambient heating load
	b. Discharge pressure too high	See point 8
	c. Liquid refrigerant return to compressor suction	Verify that thermostatic valve overheating is correct Verify that bulb probe is well positioned, fixed and isolated
7. Compressor low suction pressure (Likelihood of brine on the coil)	a. Ambient temp too low	See point 3
	b. Airflow too low or absent	Verify functioning fan
	c. Refrigerant filter obstructed	Verify refrigerant filter
	d. Thermostatic valve badly set of defect	Verify that overheating of the themrostatic valve is correct Verify integrity of rhe thermostatic element
	e. Insufficient refrigerant charge	Verify any leak and restore charge
	f. Discharge pressure too low	See point 9
8. High discharge compressor pressure	a. Air to condenser is too hot	Verify for any recirculation air presence
	b. Low condensing airflow	Verify absence of obstacles to free flow of air on finned exchanger
	c. Suction pressure too high	See point 6
	d. Finned pack condenser is clogged	Remove material
	e. Refrigerant level on circuit too high: condenser partially flooded	High refrigerant subrcooling: discharge refrigerant from circuit
	f. Air non-condensable or gas in the circuit	The flow sensor shows gas bubbles: compressor discharge temperature is high: the circuit must be uncharged and recharged after executing vacuum
9. Low compressor discharge pressure	a. Condensing pressure control system is not efficient	Verify setting and functionality of the condensing control system
	b. Suction pressure too low	See point 7

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10. Probe alarm	a. The probe corresponding to the alarm code is faulty or disconnected	Verify connection of the faulty probe and its functionality . Replace probe.
11. Fans not starting	a. Power supply cut off / black out	Verify the general sectioner and the power supply cable
	b. Open protection switch	Reset protection switch and verify amps and absorption of the motor.
	c. Transformer activated	Verify any short circuits on the auxiliary circuit
	d. Faulty contactor	Fix or replace contactor
	e. Fans are not powered	Verify fans power supply circuit
	f. Fans overload protection halts their functioning	Verify if the rotor is blocked, if power supply is not adequate, or if thare has been a phase loss
	g. Unpowered microprocessor (display OFF)	Verify any short circuits on the auxiliary circuit
	h. Unit rurned off (position OFF)	Set position ON from keypad

5.4. Extraordinary servicing

Repairs of the units will have to be executed by adequately qualified and informed personnel, equipped with individual protection devices, in conformity with laws and local regulations in force.

No modifications to the units or components replacement are allowed without explicit Manufacturer authorisation.

Procedures carried out by personnel with different skills (such as welders, electricians, programmers, etc) must be executed under the supervision of personnel with the necessary refrigeration skills.

During brazing and welding procedures, one must remove parts that might be damaged by heat and protect them by wrapping components with wet cloths.

When interventions that require dismounting of valves or interception valves, it is advisable to replace joints with new ones.

6. DEMOLITION AND DISPOSAL

At the dismission of the units, it is necessary to split parts for separate collection. Such activity must be executed by specialised disposal companies, in respect of environment laws. Normally, the unit does not contain dangerous fluids for people, objects or the environment, as it works with water .

In case the unit has worked with an antifreeze mix, collect the whole flow and deliver it to a specialised disposal centre.

It is forbidden to waste the antifreeze mix of the unit in the environment.

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