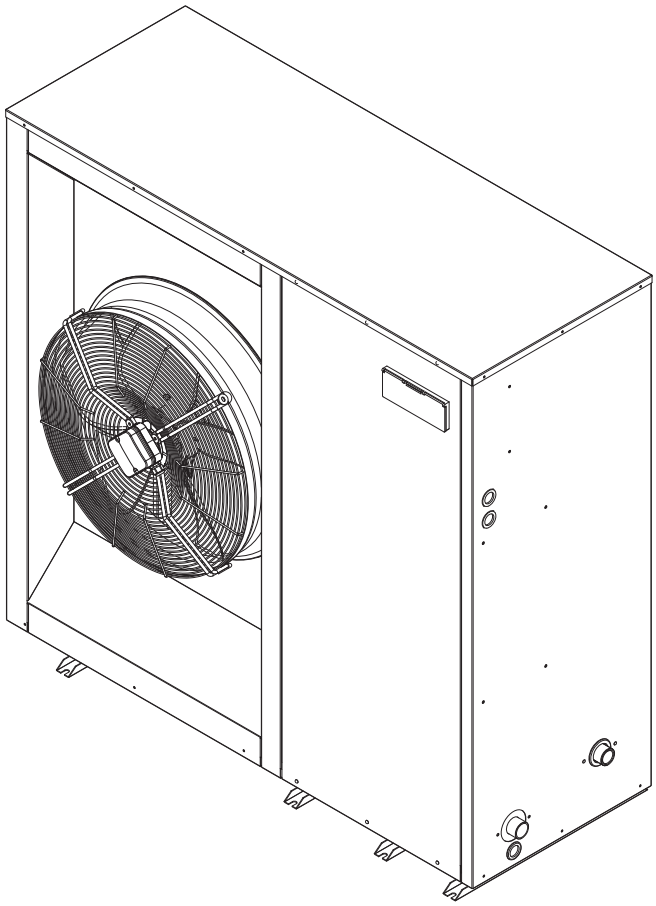
Ferroli

RMA² HE

AIR-WATER CHILLERS AND HEAT PUMPS
FOR OUTDOOR INSTALLATION



CE

INSTALLATION AND OPERATION MANUAL

Dear Customer,
Thank you for having purchased a FERROLI product. It is the result of many years of experiences and of particular research studies and has been made with top quality materials and advanced technologies. The CE mark guarantees that the products satisfy all the applicable European Directives.
The qualitative level is kept under constant control and FERROLI products therefore offer SAFETY, QUALITY and RELIABILITY.
Due to the continuous improvements in technologies and materials, the product specification as well as performances are subject to variations without prior notice.

Thank you once again for your preference
FERROLI S.p.A

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GENERAL FEATURES

CONTAINS FLUORINATED GREENHOUSE GASES COVERED BY THE KYOTO PROTOCOL:
- R410A (GLOBAL WARMING POTENTIAL GWP = 2088)

General specifications

• This manual and the wiring diagram supplied with the unit must be kept in a dry place and ready to hand for future consultation when required.
• This manual has been compiled to ensure that the unit is installed in the correct way and to supply comprehensive information about how to correctly use and service the appliance. **Before proceeding with the installation phase, please carefully read all the information in this manual, which describes the procedures required to correctly install and use the unit.**
• Strictly comply with the instructions in this manual and conform to the current safety standards.
• The appliance must be installed in accordance with the laws in force in the country in which the unit is installed.
• Unauthorized tampering with the electrical and mechanical equipment will **VOID THE WARRANTY.**
• Check the electrical specifications on the identification plate before making the electrical connections. Read the instructions in the specific section where the electrical connections are described.
• If the unit must be repaired for any reason, this must only be done by a specialized assistance center recognized by the manufacturer and using geuine spare parts.
• The manufacturer also declines all liability for any damage to persons or property deriving from failure of the information in this manual to correspond to the actual machine in your possession.
• Proper uses: this series of chillers is designed to produce cold or hot water for use in hydronic systems for conditioning/ heating purposes. The units are not suitable for the production of domestic hot water.
Any use differing from this proper use or beyond the operating limits indicated in this manual is forbidden unless previously agreed with the manufacturer.
• The prevention of the risk of fire at the installation site is the responsiblity of the end user.

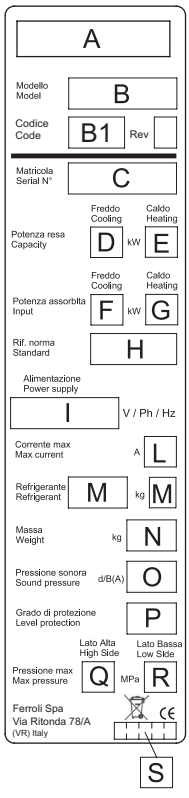
Declaration of conformity

The company hereby declares that the machine in question complies with the matters prescribed by the following Directives:

•	Machine Directive	**2006/42/CE**
•	Directive governing pressurized vessels (PED)	**97/23/CE**
•	Electromagnetic compatibility Directive (EMC)	**2004/108/CE**
•	Low voltage Directive (LVD)	**2006/95/CE**

Unit dataplate

The figure shows the fields reported on the unit dataplate :



A - Trademark
B - Model
B1 - Code
C - Serial number
D - Capacity in cooling
E - Capacity in heating (heat pump)
F - Power input in cooling
G - Power input in heating (heat pump)
H - Reference standard
I - Power supply
L - Maximum absorbed current
M - Refrigerant type and charge weight
N - Weight empty unit
O - Sound pressure level at 1 metre
P - IP protection level
Q - Maximum pressure - high pressure side
R - Maximum pressure - low pressure side
S - PED certification body

GENERAL FEATURES

Unit description

This series of air-water chillers and heat pumps satisfies the cooling and heating requirements of residential plants of small and medium size.
All the units are suitable for outdoor installation and can be applied to fan coil plants, radiant floor plants and high efficiency radiators plants.
The refrigerant circuit, contained in a compartment protected from the air flow to simplify the maintenance operations, is equipped with scroll compressor mounted on damper supports, brazed plate heat exchanger, thermostatic expansion valve, reverse cycle valve, axial fans with safety protection grilles, finned coil made of copper pipes and aluminium louvered fins. The circuit is protected by high and low pressure switches and differential pressure switch on the plate heat exchanger.
The plate heat exchanger and all the hydraulic pipes are thermally insulated in order to avoid condensate generation and to reduce thermal losses.
All the units can be equipped with variable speed fans control that allows the units to operate with low outdoor temperatures in cooling and high outdoor temperature in heating and permits to reduce noise emissions in such operating conditions.
The low noise acoustic setting up (AS) is obtained, starting from the base setting up (AB), reducing the rotational speed of the fans and mounting sound jackets on the compressors.
All the units are supplied with an outdoor temperature sensor, already installed on the unit, in order to realize the climatic control.
All the units are provided with a phase presence and correct sequence controller device.
All the units are accurately built and individually tested in the factory. Only electric and hydraulic connections are required for installation.

Unit identification code

The codes that identify the units and the meaning of the letters used are described below.

RMA² HE IP 26.1 VB AB 0M5

Unit type

IR - Unit suitable for hydronic plant installation operating as chiller
IP - Unit suitable for hydronic plant installation operating as reversible heat pump
BR - Unit suitable for hydronic plant installation with brine solutions operating as chiller
BP - Unit suitable for hydronic plant installation with brine solutions operating as reversible heat pump

Unit model

N° compressors

Unit version

VB - Base version
VP - Pump version
VA - Tank version

Power supply

5 - 400 V - 3N - 50 Hz

Operating range

M - Medium temperature. The unit is suitable to be installed in temperate climates.

Refrigerant type

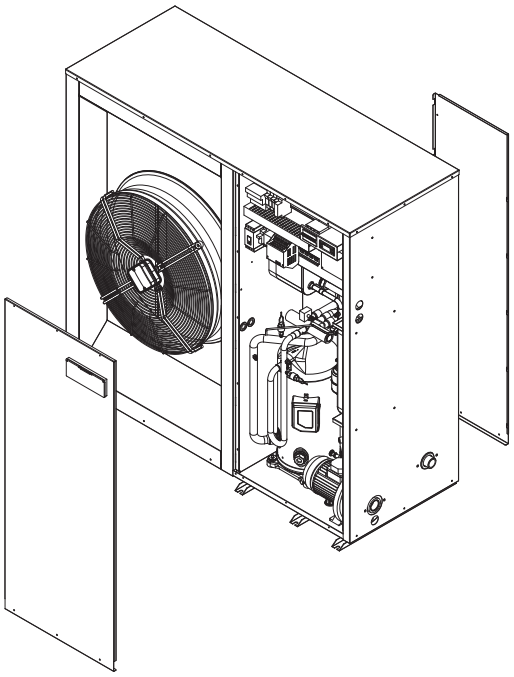
0 - R410A

Acoustic setting up

AB - Base setting up
AS - Low noise setting up

Description of components

External structure. Basement, supporting structure and lateral panels are made of galvanized and painted sheet-steel (colour RAL 7035) to guarantee good resistance to atmospheric agents. Accessibility to internal parts is possible removing the frontal panel. For extraordinary manteinances also the rear panel can be removed.



Refrigerant circuit. It is contained inside a compartment separated from the air flow to simplify maintenance and control operations.

The hermetic scroll **compressor** (1) is mounted on damper supports and is protected against overtemperatures and overcurrents. It is equipped with an electrcal heater, that is activated when the compressor turns off, to keep the compressor crankcase oil temperature high enough to prevent migration of the refrigerant during winter stops and to evaporate any liquid present in the crankcase, in order to prevent possible liquid rushes on starting (only heat pump units, accessory for cooling only units).

The **plant side heat exchanger** (2) is a brazed stainless steel plate heat exchanger, properly insulated to avoid condensate generation and to minimize thermal losses, and protected by a differential pressure switch that detects whatever water flow lack. It is moreover protected against freeze danger by an antifreeze electrical heater.

The **source side heat exchanger** (3) is a finned coil realized with grooved copper pipes and aluminium fins with notched profile to increase the heat exchange coefficient. A tray is obtained in the basement to collect the condensate generated in heating mode.

The **expansion device** (4), a thermostatic expansion valve with external equalizer, allows the unit to adjust itself to the different operating conditions keeping steady the set superheating.

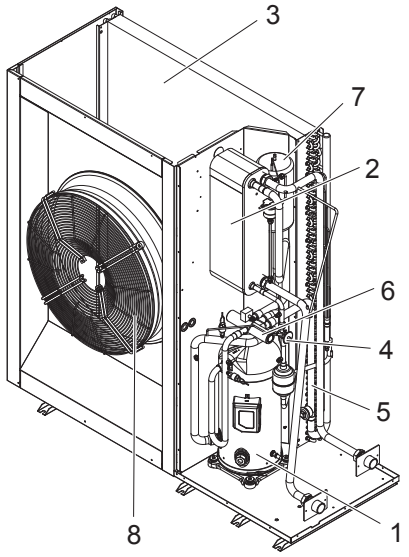
The refrigerant circuit of each unit contains moreover solid core hermetic **filter dryer** (5) to restrain impurity and moisture residuals that could be present in the circuit, **high and low pressure switches** in order to assure the compressor to operate inside the permitted limits, **4 way reverse cycle valve** (6) to allow operating mode change reversing the refrigerant flow (only heat pump models), **liquid receiver** (7) to compensate the different refrigerant charge required in heating and in cooling mode (only heat pump models) and **pressure connections** SAE 5/16" - UNF 1/2" - 20 equipped with pin, gasket and blind nut, as required for the use of R410A refrigerant (they allow the complete check of the refrigerant circuit: compressor inlet pressure, compressor outlet pressure and thermostatic expansion valve upstream pressure).

The axial **fans** (8) are contained in a sheet nozzle and are equipped with a safety grille. The fans rotational speed can be modulated continuosly by an inverter (option) to control the condensation pressure (in cooling) and the evaporation pressure (in heating) in order to extend the operating limits of the unit and to reduce noise emissions.

Hydraulic circuit. All the pipes are thermally insulated to avoid condensate generation and minimize thermal losses. The circuit can be equipped with different kind of circulation pump (option). In that case the circuit is also equipped with expansion vessel and air vents. It is also possible to integrate inside the unit a buffer tank arranged as buffer on the flow towards the plant (option). In that case the circuit is equipped not only with expansion vessel and air vents, but also with safety valve, automatic air vent and drain cock.

Electrical panel. It contains all the power, control and security components necessary to guarantee the unit to work properly. The unit is managed by a microprocessor controller to which all the electrical loads and the control devices are connected. The user interface, placed on the frontal panel, allows to view and to modify, if necessary, all the parameters of the unit.

All the units are supplied with an outdoor temperature sensor, already installed on the unit, in order to realize the climatic control.



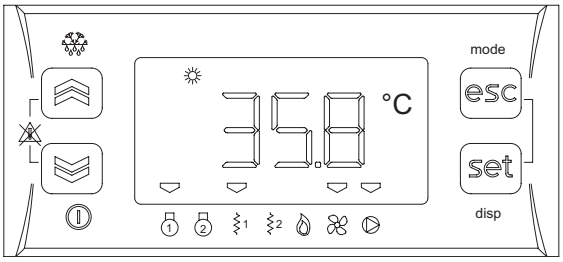
GENERAL FEATURES

Control system

The unit is managed by a microprocessor controller to which, through a wiring board, all the electrical loads and the control devices are connected. The user interface is realized by a display and four buttons that allow to view and, if necessary, modify all the operating parameters of the unit. It's available, as an accessory, a remote control that reports all the functionalities of the user interface placed on the unit.

The main functions available are :

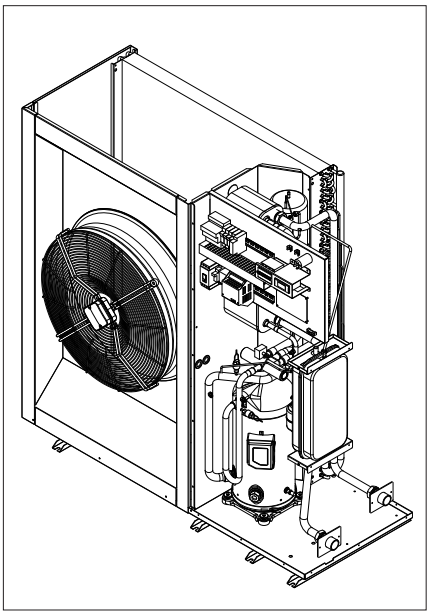
- water temperature management (through set point adjustment)
- adaptive function
- climatic control in heating and in cooling mode (automatic set point adjustment according to outdoor air temperature)
- dynamic defrost cycle management according to outdoor air temperature
- alarm memory management and diagnostic
- fans management by means of continuous rotational speed control
- pump management
- integrative electrical heaters management in heating mode (2 step logic)
- compressor and pump operating hours recording
- serial communication through Modbus protocol
- remote stand by
- remote cooling-heating
- general alarm digital output



Versions

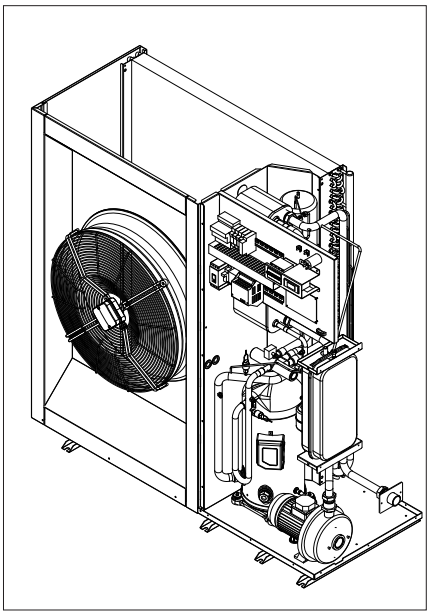
Each model can be supplied in three different versions to satisfy the application requirements of the plants. The unit is always supplied assembled, wired and factory tested.

The version is automatically identified by the option "Storing and pumping module" selected.



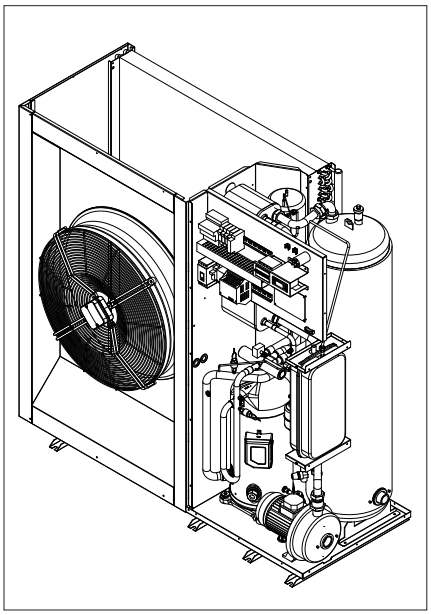
Base Version - VB

The unit does not contain neither circulating pump nor tank. Therefore a proper water flow through the plate heat exchanger must be guaranteed to prevent internal safety devices activation. In any case the pump, if properly sized, can be connected to the electrical panel of the unit and managed by the controller of the unit.



Pump Version - VP

The unit contains a circulating pump, air vents, expansion vessel and drain cock.



Tank Version - VA

The unit contains a tank (arranged as buffer on the flow towards the plant), safety valve, circulating pump, air vents, expansion vessel and drain cock.
The tank is also arranged for the installation of antifreeze or integrative electrical heaters.

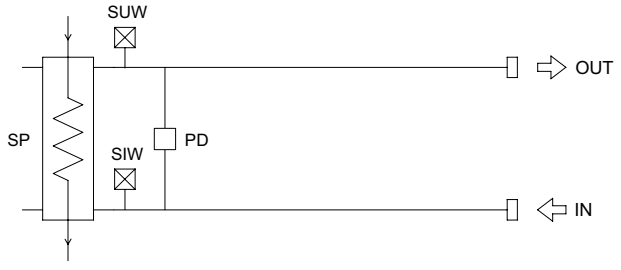
ACCESSORIES AND OPTIONAL EQUIPMENT

Options

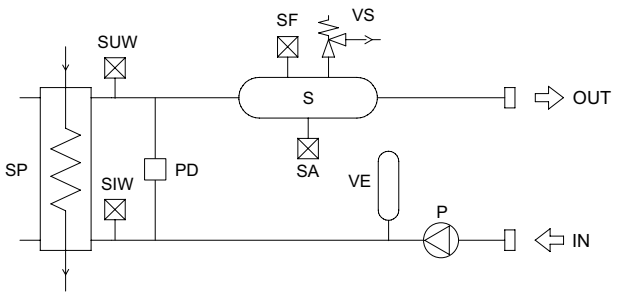
Storing and pumping module	**Standard pump**	Allows the circulation of the water on the plant side.
	High head pump	Allows the circulation of the water on the plant side and guarantees a higher available static head, suitable for high pressure drop plants.
	Modulating pump	Allows the circulation of the water on the plant side with the possibility to set the rotational speed of the pump in order to get the requested flow rate without the necessity to install other setting devices.
	Tank and standard pump	Allows the circulation of the water on the plant side. The thermal inertia of the buffer tank allows to reduce the number of compressor starts and to guarantee a more stable flow temperature.
	Tank and high head pump	Allows the circulation of the water on the plant side and guarantees a higher available static head, suitable for high pressure drop plants. The thermal inertia of the buffer tank allows to reduce the number of compressor starts and to guarantee a more stable flow temperature.
	Tank and modulating pump	Allows the circulation of the water on the plant side with the possibility to set the rotational speed of the pump in order to get the requested flow rate without the necessity to install other setting devices. The thermal inertia of the buffer tank allows to reduce the number of compressor starts and to guarantee a more stable flow temperature.
Electrical heaters	**Antifreeze**	Activated together with the antifreeze electrical heater of the plate heat exchanger, it has the task to keep the water in the buffer tank at a temperature high enough to avoid ice generation during winter.
	Integrative	Integrate or replace the heating power supplied by the heat pump and are managed by the unit controller with a 2 step logic. They are also activated as antifreeze electrical heaters. Available only for the VA version.
Soft starter		Reduces the compressor start current.
Compressor power factor correction		Allows to reduce the phase shift between the absorbed current and the power supply voltage keeping it above the value of 0,9.
Fans control	**Modulating control (condensation / evaporation control)**	The fans rotational speed can be modulated continuosly by an inverter to control the condensation pressure (in cooling) and the evaporation pressure (in heating) in order to extend the operating limits of the unit and to reduce noise emissions.
Electrical loads protection	**Fuses**	Allows to protect the electrical loads with fuses.
	Thermal magnetic circuit breakers	Allows to protect the electrical loads with thermal magnetic circuit breakers simplifying the maintenance operations.

Hydraulic scheme

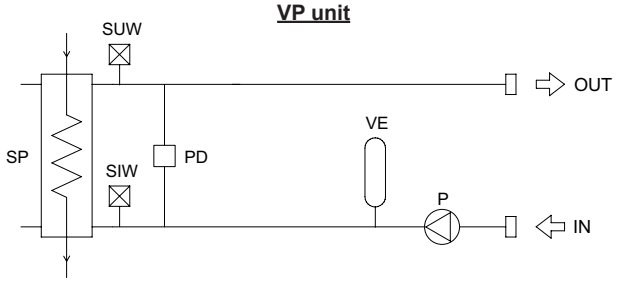
VB unit



VA unit



VP unit



ITEM	DESCRIPTION
P	PUMP
PD	DIFFERENTIAL PRESSURE WATER
S	STORAGE TANK
SA	WATER DRAIN VALVE
SF	VALVOLASFIATO AIR
SIW	PROBE WATER INLET
SP	HEAT EXCHANGER
SUW	PROBE WATER OUTLET
VE	EXPANSION TANK
VS	SAFETY VALVE

ACCESSORIES AND OPTIONAL EQUIPMENT

Accessories

Supplied accessories

Rubber vibration dampers	Allow to reduce the transmission to the unit support plane of the mechanical vibrations generated by the compressor and by the fans in their normal operating mode.
Coil protection grille	Protects the external surface of the finned coil..
Remote control	It is suitable for wall mounting and reports all the control and visualization functions available on the user interface placed on the unit. It therefore allows the complete remote control of the unit.
Modbus serial interface on RS485	It allows to communicate with the unit controller and to view the operating conditions of the unit through Modbus communication protocol. The RS485 serial line ensures the signal quality up to distances of about 1200 meters (that can be extended by means of proper repeaters).
Programmer clock	It allows the unit to be turned on and off according to a set program, through the digital input available on the unit wiring board (remote stand by).
Phase sequence and voltage controller	It checks not only the presence and correct order of the power supply phases but also the voltage level on each phase and avoid the unit to operate with voltage levels outside the permitted limits.
Water flow switch	Allows to detect the water flow lack through the plate heat exchanger and operates as an integration of the protecion offered by the differential pressure switch (standard).

Factory mounted accessories

Coil protection grille	Protects the external surface of the finned coil..
Coils protection kit (for transport)	It is a sheet of polystyrene which increases protection of the finned coil during transport.
Casing Kits protection (for transport)	Consisting of 4 profiles cardboard that increase the protection of the casing of the unit during transport.
Modbus serial interface on RS485	It allows to communicate with the unit controller and to view the operating conditions of the unit through Modbus communication protocol. The RS485 serial line ensures the signal quality up to distances of about 1200 meters (that can be extended by means of proper repeaters).
Phase sequence and voltage controller	It checks not only the presence and correct order of the power supply phases but also the voltage level on each phase and avoid the unit to operate with voltage levels outside the permitted limits.
High and low pressure gauges	2 pressure gauges allow visualization of high and low refrigerant gas pressure.
Pressure transducer*	It consists of a transducer, which allows operation of the control condensation, evaporation and defrost by reading the pressure.
Crankcase heaters compressor oil	(standard for IP and BP units, ccessory IR and BR units) consist of electrical heaters heating oil compressors.

NOTES

* This accessory can be selected only for units with modulating fan control.

TECHNICAL DATA AND PERFORMANCE - BASE VERSION (VB)

Technical data

Frame	1			2			
Model	**19.1**	**22.1**	**26.1**	**30.1**	**35.1**	**40.1**	U.M.
Power supply	400 - 3N - 50	400 - 3N - 50	400 - 3N - 50	400 - 3N - 50	400 - 3N - 50	400 - 3N - 50	V-ph-Hz
Refrigerant							
Type	R410A	R410A	R410A	R410A	R410A	R410A	-
Compressor							
Type	scroll	scroll	scroll	scroll	scroll	scroll	-
Quantity	1	1	1	1	1	1	n°
Power steps	0 - 100	0 - 100	0 - 100	0 - 100	0 - 100	0 - 100	%
Plant side heat exchanger							
Type	stainless steel brazed plates	stainless steel brazed plates	stainless steel brazed plates	stainless steel brazed plates	stainless steel brazed plates	stainless steel brazed plates	-
Quantity	1	1	1	1	1	1	n°
Source side heat exchanger							
Type	finned coil	finned coil	finned coil	finned coil	finned coil	finned coil	-
Quantity	1	1	1	1	1	1	n°
Fans							
Type	axial	axial	axial	axial	axial	axial	-
Quantity	1	1	1	1	1	1	n°
Diameter	630	630	630	800	800	800	mm
Maximum rotational speed	900	900	900	900	900	900	rpm
Total installed power	0,6	0,6	0,6	1,8	1,8	1,8	kW
Plant side hydraulic circuit							
Expansion vessel volume VP - VA	10	10	10	10	10	10	l
Tank volume - VA	85	85	85	85	85	85	l
Safety valve set * - VP - VA	3	3	3	3	3	3	bar
Standard pump (option)							
Type	centrifugal pump	centrifugal pump	centrifugal pump	centrifugal pump	centrifugal pump	centrifugal pump	-
Installed power	0,6	0,6	0,6	0,8	0,8	0,8	kW
High head pump (option)							
Type	centrifugal pump	centrifugal pump	centrifugal pump	centrifugal pump	centrifugal pump	centrifugal pump	-
Installed power	0,9	0,9	0,9	1,6	1,6	1,6	kW
Modulating pump (option)							
Type	centrifugal pump with inverter	centrifugal pump with inverter	centrifugal pump with inverter	centrifugal pump with inverter	centrifugal pump with inverter	centrifugal pump with inverter	-
Installed power	0,6	0,6	0,6	0,8	0,8	0,8	kW
Integrative electrical heaters in the tank (option)							
Installed power	6,6	6,6	6,6	6,6	6,6	6,6	kW
Power steps	2	2	2	2	2	2	n°

NOTES
*: Standard version for VA, to be installed by the customer for VP version.

TECHNICAL DATA AND PERFORMANCE - BASE VERSION (VB)

NET NOMINAL performances - Base setting up (AB) - Standard plants - EUROVENT certified data

	Frame	1			2			
	Model	**19.1**	**22.1**	**26.1**	**30.1**	**35.1**	**40.1**	U.M.
	Cooling A35W7 (source : air in 35°C d.b. / plant : water in 12°C out 7°C)							
	Cooling capacity	20,1	22,3	26,1	31,5	36,6	41,3	kW
	Power input	6,51	7,15	8,29	10,3	11,9	13,5	kW
IR	EER	3,09	3,12	3,15	3,06	3,08	3,06	W/W
	ESEER	3,44	3,48	3,51	3,44	3,45	3,45	W/W
	Water flow rate plant side	3466	3844	4496	5439	6315	7138	l/h
	Pressure drops plant side	26	32	26	37	32	41	kPa
	Cooling A35W7 (source : air in 35°C d.b. / plant : water in 12°C out 7°C)							
	Cooling capacity	19,7	21,9	25,6	30,9	35,9	40,5	kW
	Power input	6,45	7,08	8,20	10,2	11,8	13,4	kW
	EER	3,05	3,09	3,12	3,03	3,04	3,02	W/W
	ESEER	3,40	3,46	3,47	3,42	3,40	3,40	W/W
	Water flow rate plant side	3398	3775	4410	5337	6194	7001	l/h
IP	Pressure drops plant side	25	31	25	36	31	39	kPa
	Heating A7W45 (source : air in 7°C d.b. 6°C w.b. / plant : water in 40°C out 45°C)							
	Heating capacity	21,2	23,5	27,4	33,3	38,6	43,8	kW
	Power input	6,21	6,82	7,89	9,79	11,3	12,9	kW
	COP	3,41	3,45	3,47	3,40	3,42	3,40	W/W
	Water flow rate plant side	3603	3995	4661	5651	6556	7427	l/h
	Pressure drops plant side	28	34	28	40	34	43	kPa

NET NOMINAL performances - Base setting up (AB) - Standard plants

	Frame	1			2			
	Model	**19.1**	**22.1**	**26.1**	**30.1**	**35.1**	**40.1**	U.M.
	Heating A2W45 (source : air in 2°C d.b. 1°C w.b. / plant : water in 40°C out 45°C)							
	Heating capacity	17,5	19,5	22,7	27,5	31,9	36,2	kW
IP	Power input	6,12	6,70	7,78	9,62	11,1	12,7	kW
	COP	2,86	2,91	2,92	2,86	2,87	2,85	W/W
	Water flow rate plant side	2971	3312	3859	4678	5430	6147	l/h
	Pressure drops plant side	19	24	19	28	24	30	kPa

Data declared according to **EN 14511**. The values are referred to units without options and accessories.

NET NOMINAL performances - Base setting up (AB) - Radiant plants

	Frame	1			2			
	Model	**19.1**	**22.1**	**26.1**	**30.1**	**35.1**	**40.1**	U.M.
	Cooling A35W18 (source : air in 35°C d.b. / plant : water in 23°C out 18°C)							
	Cooling capacity	26,1	28,9	33,9	40,8	47,4	53,5	kW
	Power input	6,67	7,35	8,49	10,60	12,2	13,9	kW
IR	EER	3,91	3,93	3,99	3,85	3,89	3,85	-
	Water flow rate plant side	4517	4998	5856	7076	8209	9291	l/h
	Pressure drops plant side	43	52	43	62	53	67	kPa
	Cooling A35W18 (source : air in 35°C d.b. / plant : water in 23°C out 18°C)							
	Cooling capacity	25,5	28,4	33,2	40,0	46,5	52,5	kW
	Power input	6,60	7,27	8,40	10,5	12,1	13,7	kW
	EER	3,86	3,91	3,95	3,81	3,84	3,83	-
	Water flow rate plant side	4414	4912	5736	6938	8055	9102	l/h
	Pressure drops plant side	41	50	41	59	51	64	kPa
	Heating A7W35 (source : air in 7°C d.b. 6°C w.b. / plant : water in 30°C out 35°C)							
	Heating capacity	21,6	24,0	28,0	34,0	39,4	44,7	kW
IP	Power input	5,24	5,76	6,66	8,28	9,57	10,9	kW
	COP	4,12	4,17	4,20	4,11	4,12	4,10	-
	Water flow rate plant side	3686	4097	4783	5794	6720	7611	l/h
	Pressure drops plant side	29	36	29	42	36	46	kPa
	Heating A2W35 (source : air in 2°C d.b. 1°C w.b. / plant : water in 30°C out 35°C)							
	Heating capacity	17,9	19,9	23,3	28,2	32,6	37,1	kW
	Power input	5,15	5,64	6,54	8,10	9,39	10,7	kW
	COP	3,48	3,53	3,56	3,48	3,47	3,47	-
	Water flow rate plant side	3051	3394	3977	4817	5571	6326	l/h
	Pressure drops plant side	20	25	21	30	25	32	kPa

Data declared according to **EN 14511**. The values are referred to units without options and accessories.

TECHNICAL DATA AND PERFORMANCE - BASE VERSION (VB)

NET NOMINAL performances - Low noise setting up (AS) - Standard plants - EUROVENT certified data

	Frame	1			2			
	Model	**19.1**	**22.1**	**26.1**	**30.1**	**35.1**	**40.1**	U.M.
IR	**Cooling A35W7** (source : air in 35°C d.b. / plant : water in 12°C out 7°C)							
	Cooling capacity	19,3	21,4	25,1	30,3	35,2	39,8	kW
	Power input	7,02	7,71	8,94	11,1	12,8	14,4	kW
	EER	2,75	2,78	2,81	2,73	2,75	2,76	W/W
	ESEER	3,06	3,10	3,12	3,07	3,08	3,09	W/W
	Water flow rate plant side	3329	3689	4324	5234	6074	6864	l/h
	Pressure drops plant side	24	29	24	35	30	38	kPa
IP	**Cooling A35W7** (source : air in 35°C d.b. / plant : water in 12°C out 7°C)							
	Cooling capacity	18,9	21,0	24,6	29,7	34,5	39,0	kW
	Power input	6,95	7,63	8,84	11,0	12,7	14,3	kW
	EER	2,72	2,75	2,78	2,70	2,72	2,73	W/W
	ESEER	3,03	3,07	3,09	3,04	3,05	3,05	W/W
	Water flow rate plant side	3260	3621	4238	5131	5954	6726	l/h
	Pressure drops plant side	23	28	23	34	29	36	kPa
	Heating A7W45 (source : air in 7°C d.b. 6°C w.b. / plant : water in 40°C out 45°C)							
	Heating capacity	20,1	22,3	26,1	31,7	36,7	41,7	kW
	Power input	5,95	6,54	7,56	9,38	10,9	12,4	kW
	COP	3,38	3,41	3,45	3,38	3,37	3,36	W/W
	Water flow rate plant side	3415	3790	4439	5378	6232	7069	l/h
	Pressure drops plant side	25	31	25	36	31	40	kPa

NET NOMINAL performances - Low noise setting up (AS) - Standard plants

	Frame	1			2			
	Model	**19.1**	**22.1**	**26.1**	**30.1**	**35.1**	**40.1**	U.M.
IP	**Heating A2W45** (source : air in 2°C d.b. 1°C w.b. / plant : water in 40°C out 45°C)							
	Heating capacity	16,5	18,5	21,6	26,1	30,2	34,3	kW
	Power input	5,87	6,43	7,46	9,22	10,7	12,1	kW
	COP	2,81	2,88	2,90	2,83	2,82	2,83	W/W
	Water flow rate plant side	2817	3142	3671	4439	5139	5839	l/h
	Pressure drops plant side	17	22	18	25	22	28	kPa

Data declared according to **EN 14511**. The values are referred to units without options and accessories.

NET NOMINAL performances - Low noise setting up (AS) - Radiant plants

	Frame	1			2			
	Model	**19.1**	**22.1**	**26.1**	**30.1**	**35.1**	**40.1**	U.M.
IR	**Cooling A35W18** (source : air in 35°C d.b. / plant : water in 23°C out 18°C)							
	Cooling capacity	25,0	27,8	32,6	39,3	45,6	51,5	kW
	Power input	7,18	7,91	9,14	11,4	13,1	14,8	kW
	EER	3,48	3,51	3,57	3,45	3,48	3,48	-
	Water flow rate plant side	4328	4809	5633	6818	7900	8930	l/h
	Pressure drops plant side	40	48	40	57	49	62	kPa
IP	**Cooling A35W18** (source : air in 35°C d.b. / plant : water in 23°C out 18°C)							
	Cooling capacity	24,5	27,2	31,9	38,6	44,8	50,5	kW
	Power input	7,10	7,81	9,04	11,2	12,9	14,7	kW
	EER	3,45	3,48	3,53	3,45	3,47	3,44	-
	Water flow rate plant side	4242	4706	5513	6681	7745	8759	l/h
	Pressure drops plant side	38	47	38	55	47	60	kPa
	Heating A7W35 (source : air in 7°C d.b. 6°C w.b. / plant : water in 30°C out 35°C)							
	Heating capacity	20,5	22,8	26,6	32,3	37,4	42,5	kW
	Power input	5,02	5,52	6,38	7,92	9,17	10,5	kW
	COP	4,08	4,13	4,17	4,08	4,08	4,05	-
	Water flow rate plant side	3497	3891	4543	5503	6377	7234	l/h
	Pressure drops plant side	26	32	27	38	33	42	kPa
	Heating A2W35 (source : air in 2°C d.b. 1°C w.b. / plant : water in 30°C out 35°C)							
	Heating capacity	16,9	18,9	22,1	26,7	31,0	35,2	kW
	Power input	4,93	5,42	6,28	7,76	9,00	10,3	kW
	COP	3,43	3,49	3,52	3,44	3,44	3,42	-
	Water flow rate plant side	2897	3223	3771	4560	5297	6000	l/h
	Pressure drops plant side	19	23	19	27	23	29	kPa

Data declared according to **EN 14511**. The values are referred to units without options and accessories.

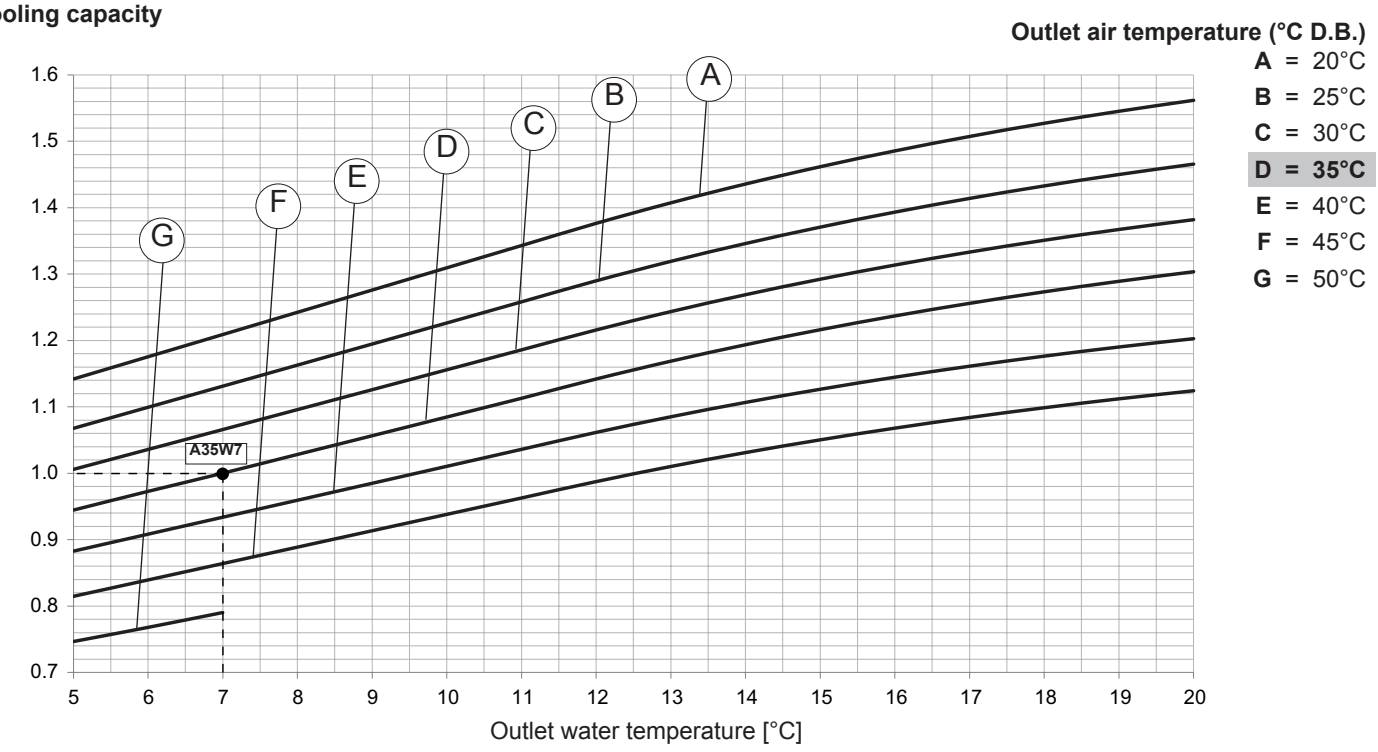
TECHNICAL DATA AND PERFORMANCE - BASE VERSION (VB)

COOLING performances

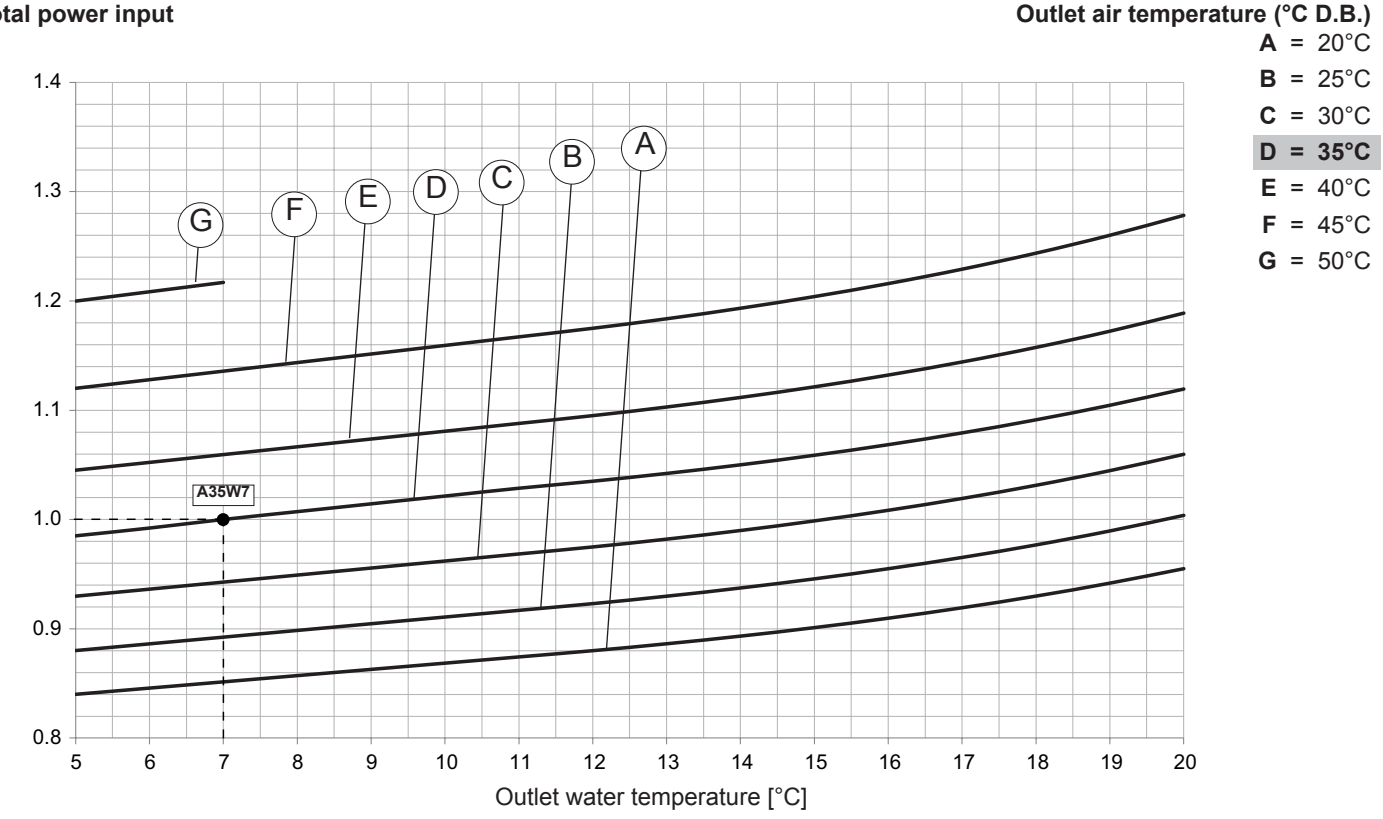
The graphs allow to get the corrective factors to be applied to the nominal performances in order to obtain the real performances in the selected operating conditions. For the "Operation limits" of the unit refer to the section limits.

The reference nominal condition is: **A35W7** (source : air in 35°C d.b. / plant : water in 12°C out 7°C)

Cooling capacity



Total power input



The standard performances refer to a 5°C temperature difference between the water entering and leaving the heat exchanger and to operation of the unit with all fans at nominal or maximum speed. A 0.44 x 10^{-4} m^2 K/W fouling factor has also been considered with the unit installed at zero meters above sea level (Pb = 1013mbar).

TECHNICAL DATA AND PERFORMANCE - BASE VERSION (VB)

HEATING performances

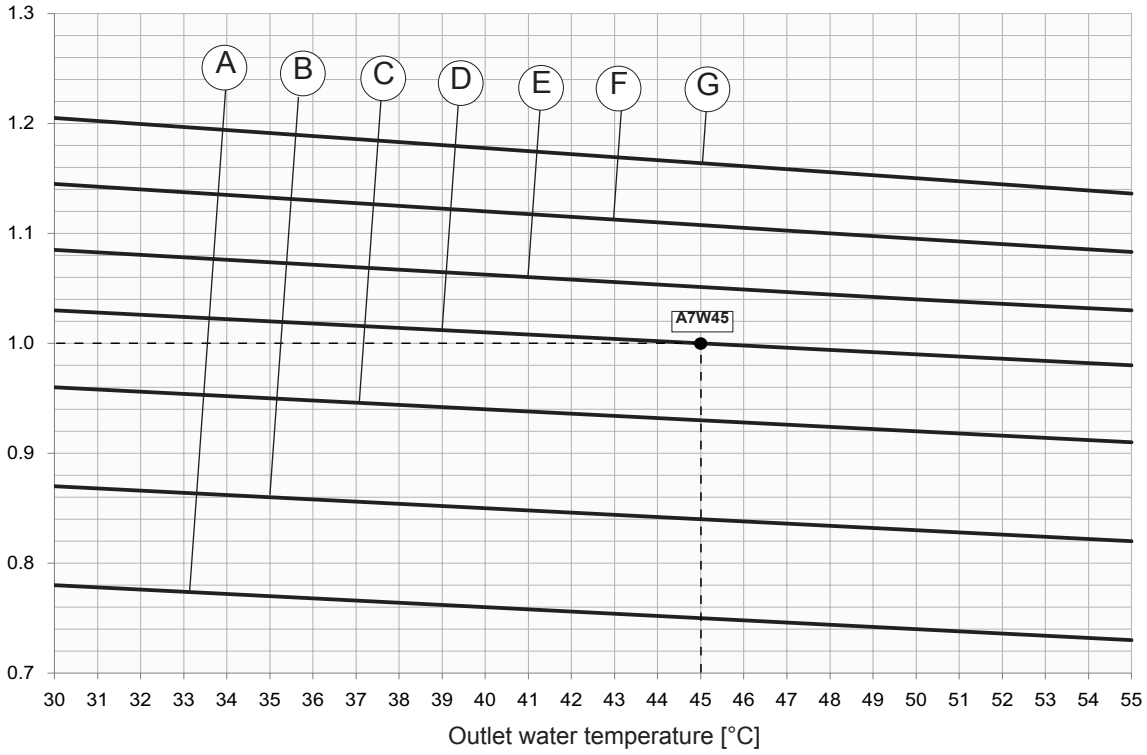
The graphs allow to get the corrective factors to be applied to the nominal performances in order to obtain the real performances in the selected operating conditions. For the "Operation limits" of the unit refer to the section limits.

The reference nominal condition is: **A7W45** (source : air in 7°C d.b. 6°C w.b. / plant : water in 40°C out 45°C)

Heating capacity

Outlet air temperature (°C D.B. / W.B.)

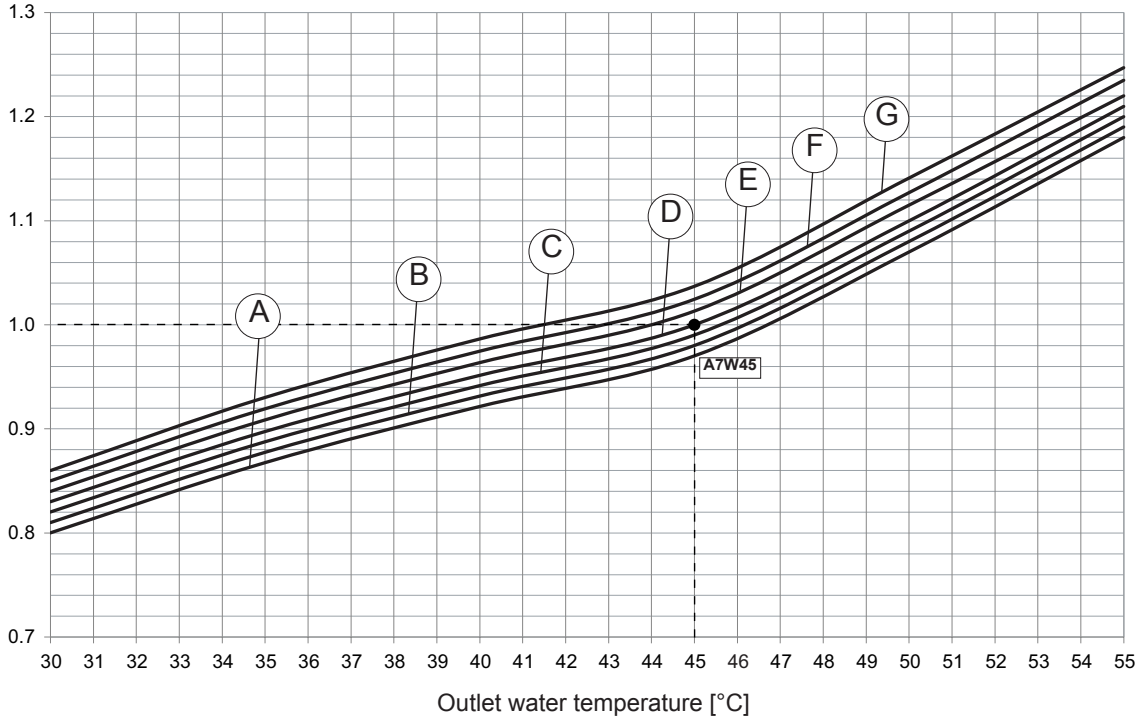
A = -5,5 / -6°C
B = -1,3 / -2°C
C = 2,8 / 2°C
D = 7 / 6°C
E = 10,1 / 9°C
F = 13,2 / 12°C
G = 16,4 /15°C



Total power input

Outlet air temperature (°C D.B. / W.B.)

A = -5,5 / -6°C
B = -1,3 / -2°C
C = 2,8 / 2°C
D = 7 / 6°C
E = 10,1 / 9°C
F = 13,2 / 12°C
G = 16,4 /15°C



The standard performances refer to a 5°C temperature difference between the water entering and leaving the heat exchanger and to operation of the unit with all fans at nominal or maximum speed. A 0.44 x 10^{-4} m^2 K/W fouling factor has also been considered with the unit installed at zero meters above sea level (Pb = 1013mbar).
NOTE For air temperatures of less than 7°C, the heating capacity is declared without considering the effect of the defrosting, strictly correlated with the humidity in the outdoor air.

Corrective factors

Correction factors to apply to the basic version data.

ETHYLENE GLYCOL

Percentage Of glycol in mass / volume	20 / 18,1								
Freezing point [°C]	-8								
Produced water temperature	4	2	0	-2	-4	-6	-8	-10	-12
CCPF - Cooling capacity	0,912	0,855	0,798	0,738	0,683	-	-	-	-
CCPA - Power input	0,967	0,957	0,947	0,927	0,897	-	-	-	-
CCQA - Water flow rate	1,071	1,072	1,073	1,075	1,076	-	-	-	-
CCDP - Pressure drop	1,090	1,095	1,100	1,110	1,120	-	-	-	-

Percentage Of glycol in mass / volume	30 / 27,7								
Freezing point [°C]	-14								
Produced water temperature	4	2	0	-2	-4	-6	-8	-10	-12
CCPF - Cooling capacity	0,899	0,842	0,785	0,725	0,670	0,613	0,562	-	-
CCPA - Power input	0,960	0,950	0,940	0,920	0,890	0,870	0,840	-	-
CCQA - Water flow rate	1,106	1,107	1,108	1,109	1,110	1,111	1,112	-	-
CCDP - Pressure drop	1,140	1,145	1,150	1,155	1,160	1,175	1,190	-	-

Percentage Of glycol in mass / volume	40 / 37,5								
Freezing point [°C]	-22								
Produced water temperature	4	2	0	-2	-4	-6	-8	-10	-12
CCPF - Cooling capacity	0,884	0,827	0,770	0,710	0,655	0,598	0,547	0,490	0,437
CCPA - Power input	0,880	0,870	0,860	0,840	0,810	0,790	0,760	0,724	0,686
CCQA - Water flow rate	1,150	1,151	1,153	1,154	1,155	1,157	1,158	1,159	1,161
CCDP - Pressure drop	1,190	1,195	1,200	1,210	1,220	1,235	1,250	1,269	1,290

PROPYLENE GLYCOL

Percentage Of glycol in mass / volume	20 / 19,4								
Freezing point [°C]	-7								
Produced water temperature	4	2	0	-2	-4	-6	-8	-10	-12
CCPF - Cooling capacity	0,874	0,807	0,740	0,690	0,641	-	-	-	-
CCPA - Power input	0,945	0,935	0,925	0,900	0,875	-	-	-	-
CCQA - Water flow rate	1,037	1,038	1,039	1,039	1,040	-	-	-	-
CCDP - Pressure drop	1,110	1,115	1,120	1,130	1,140	-	-	-	-

Percentage Of glycol in mass / volume	30 / 29,4								
Freezing point [°C]	-13								
Produced water temperature	4	2	0	-2	-4	-6	-8	-10	-12
CCPF - Cooling capacity	0,869	0,799	0,729	0,680	0,630	0,583	0,536	-	-
CCPA - Power input	0,935	0,923	0,910	0,888	0,865	0,838	0,810	-	-
CCQA - Water flow rate	1,072	1,071	1,070	1,069	1,069	1,068	1,067	-	-
CCDP - Pressure drop	1,160	1,175	1,190	1,200	1,210	1,255	1,300	-	-

Percentage Of glycol in mass / volume	40 / 39,6								
Freezing point [°C]	-21								
Produced water temperature	4	2	0	-2	-4	-6	-8	-10	-12
CCPF - Cooling capacity	0,848	0,784	0,719	0,670	0,620	0,570	0,520	0,478	0,438
CCPA - Power input	0,865	0,855	0,845	0,820	0,795	0,773	0,750	0,714	0,680
CCQA - Water flow rate	1,116	1,114	1,112	1,110	1,108	1,107	1,105	1,103	1,101
CCDP - Pressure drop	1,230	1,275	1,320	1,375	1,430	1,500	1,570	1,642	1,724

Based on leaving water temperature of the evaporator and condensing temperature = 7°C extract Cooling Capacity (kWf) and Compressors Power Input (kWa).
Based on type and percentage of glycol extract CCPF, CCPA, CCQA, CCDP.
Then calculate.

Pf_brine = kWf x CCPF

Pass_CP_brine = kWa x CCPA

Then calculate brine flow rate:

*Q_brine_evap [l/s]=CCQA x (Pf_brine [kW]*0.86/∆T_brine)/3.6*

where ∆T_brine is the difference between inlet-outlet evaporator water temperature:

∆T_brine=Twin_evap_brine-Twout_evap_brine

With this brine flow rate enter in abscissa on the water pressure drop of the evaporator then you have Dp_app.
Finally you can calculate the actual pressure drop of the brine on evaporator side:

Dp_evap_brine =CCDP x Dp_app

BR and BP units must be used with a mixture of water and antifreeze fluid (eg glycol) in a percentage enought to prevent freezing of the mixture under all possible conditions, otherwise it will **VOID THE WARRANTY**.
Please contact our customer service to set the following parameters: →

Parameter to set	Default value	How to calculate the value to set	Example with TWE = 0°C	Example with TWE = -5°C
tr06	7 °C	TWE +5°C	+5 °C	0 °C
tr04	12 °C	TWE +5°C	+5 °C	0 °C
HI 06	5 °C	TWE -2°C	-2 °C	-7 °C
AL 12	4,5 °C	TWE -3°C	-3 °C	-8 °C
TWE= Evaporator outlet desired water temperature				

NOISE LEVELS

Base setting up (AB)

Model	Sound power levels [dB] by octave bands [Hz]								Sound power level		Sound pressure level		
											at 1 metre	at 5 metres	at 10 metres
	63	125	250	500	1000	2000	4000	8000	[dB]	[dB(A)] (E)	[dB(A)]	[dB(A)]	[dB(A)]
19.1	82,4	83,6	80,2	74,8	71,0	65,5	59,4	53,6	87	77	61	51	46
22.1	82,6	83,8	80,4	75,0	71,2	65,7	59,6	53,8	88	77	62	51	46
26.1	83,5	84,7	81,3	75,9	72,1	66,6	60,5	54,7	89	78	62	52	47
30.1	88,2	83,4	80,0	78,2	76,5	72,3	69,5	60,5	90	81	65	55	50
35.1	88,6	83,8	80,4	78,6	76,9	72,7	69,9	60,9	91	82	66	55	50
40.1	88,9	84,1	80,7	78,9	77,2	73,0	70,2	61,2	91	82	66	56	50

Low noise setting up (AS)

Model	Sound power levels [dB] by octave bands [Hz]								Sound power level		Sound pressure level		
											at 1 metre	at 5 metres	at 10 metres
	63	125	250	500	1000	2000	4000	8000	[dB]	[dB(A)] (E)	[dB(A)]	[dB(A)]	[dB(A)]
19.1	80,3	81,5	78,1	71,7	66,9	61,2	54,9	49,1	85	74	58	48	43
22.1	80,5	81,7	78,3	71,9	67,1	61,4	55,1	49,3	85	74	59	48	43
26.1	81,4	82,6	79,2	72,8	68,0	62,3	56,0	50,2	86	75	59	49	44
30.1	86,9	82,1	78,7	75,9	73,2	68,8	65,8	56,8	89	78	62	52	47
35.1	87,5	82,7	79,3	76,5	73,8	69,4	66,4	57,4	90	79	63	53	48
40.1	87,9	83,1	79,7	76,9	74,2	69,8	66,8	57,8	90	79	63	53	48

Reference conditions

Performances referred to units operating in cooling mode at nominal conditions A35W7.
Unit placed in free field on reflecting surface (directional factor equal to 2).
The sound power level is measured according to ISO 3744 standard.
The sound pressure level is calculated according to ISO 3744 and is referred to a distance of 1/5/10 metres from the external surface of the unit.

(E): EUROVENT certifield data

ELECTRICAL DATA

Electrical data

Frame		1			2			
Model		19.1	22.1	26.1	30.1	35.1	40.1	U.M.
Unit								
Power supply		400-3N-50	400-3N-50	400-3N-50	400-3N-50	400-3N-50	400-3N-50	V-ph-Hz
F.L.A.	Maximum total current input	15,8	17,6	19,1	24,4	26,8	30,8	A
F.L.I.	Maximum total power input	9,2	10,7	12,0	14,6	16,1	18,4	kW
M.I.C.	Maximum total start current	106	116	129	156	160	191	A
	Maximum total start current with soft starter (option)	61	67	74	85	87	106	A
Units with pumping module STD								
Power supply		400-3N-50	400-3N-50	400-3N-50	400-3N-50	400-3N-50	400-3N-50	V-ph-Hz
F.L.A.	Maximum total current input	17,3	19,1	20,6	26,0	28,4	32,4	A
F.L.I.	Maximum total power input	9,8	11,3	12,6	15,4	16,9	19,2	kW
M.I.C.	Maximum total start current	107	117	130	158	162	193	A
	Maximum total start current with soft starter (option)	62	68	76	86	89	107	A
Units with pumping module HP1								
Power supply		400-3N-50	400-3N-50	400-3N-50	400-3N-50	400-3N-50	400-3N-50	V-ph-Hz
F.L.A.	Maximum total current input	17,5	19,3	20,8	27,4	29,8	33,8	A
F.L.I.	Maximum total power input	10,1	11,5	12,9	16,2	17,7	20,0	kW
M.I.C.	Maximum total start current	108	118	131	159	163	194	A
	Maximum total start current with soft starter (option)	62	68	76	88	90	109	A
Integrative electrical heaters standard in the tank (option)								
Power supply		400-3-50	400-3-50	400-3-50	400-3-50	400-3-50	400-3-50	V-ph-Hz
F.L.A.	Maximum total current input	9,5	9,5	9,5	9,5	9,5	9,5	A
F.L.I.	Maximum total power input	6,6	6,6	6,6	6,6	6,6	6,6	kW
Compressor								
Power supply		400-3-50	400-3-50	400-3-50	400-3-50	400-3-50	400-3-50	V-ph-Hz
F.L.A.	Maximum total current input	14,6	16,4	17,9	20,3	22,7	26,7	A
F.L.I.	Maximum total power input	8,6	10,1	11,4	12,8	14,3	16,6	kW
L.R.A.	Maximum total start current	101	111	124	141	145	176	A
	Maximum total start current with soft starter (option)	61	67	74	85	87	106	A
Fan								
Power supply		400-3-50	400-3-50	400-3-50	400-3-50	400-3-50	400-3-50	V-ph-Hz
F.L.A.	Maximum total current input	1,20	1,20	1,20	4,10	4,10	4,10	A
F.L.I.	Maximum total power input	0,60	0,60	0,60	1,80	1,80	1,80	kW
L.R.A.	Start current	5,0	5,0	5,0	15,0	15,0	15,0	A
Standard THREE-PHASE pump (option)								
Power supply		400-3-50	400-3-50	400-3-50	400-3-50	400-3-50	400-3-50	V-ph-Hz
F.L.A.	Maximum total current input	1,45	1,45	1,45	1,58	1,58	1,58	A
F.L.I.	Maximum total power input	0,61	0,61	0,61	0,82	0,82	0,82	kW
L.R.A.	Start current	6,3	6,3	6,3	9,4	9,4	9,4	A
High head THREE-PHASE pump (option)								
Power supply		400-3-50	400-3-50	400-3-50	400-3-50	400-3-50	400-3-50	V-ph-Hz
F.L.A.	Maximum total current input	1,65	1,65	1,65	3,00	3,00	3,00	A
F.L.I.	Maximum total power input	0,88	0,88	0,88	1,60	1,60	1,60	kW
L.R.A.	Start current	9,9	9,9	9,9	16,3	16,3	16,3	A

OPERATING LIMITS

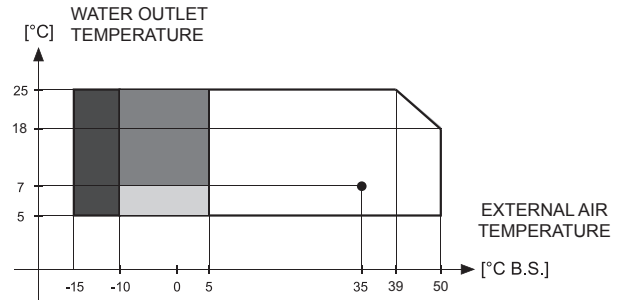
The table below lists the operating limits within which correct operation of the units is guaranteed, depending on the Version and Operating Mode available for each type of unit.
Remember that in Heat Pump units, heat recovery only takes place during operation in the cooling mode.

Thermal gradient of the water		Limit value
Minimum	°C	3
Maximum	°C	8
Verify that water flow rate is inside the admissible limits.		

NOTE: the admissible limits for water flow rate on heat exchangers are indicated under the related pressure drop graph (see section "water pressure drop"). If the unit is equipped with pumping module the admissible limits are indicated under the related working head graph (see section "working head").

STANDARD UNIT IR-IP

IN COOLING MODE



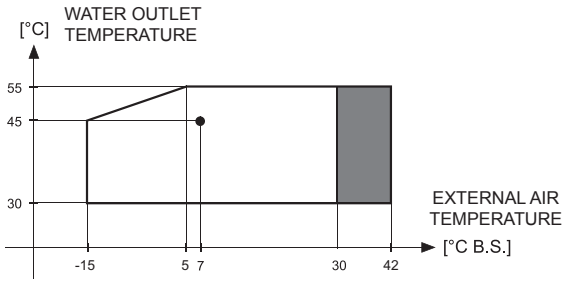
With fans modulating control options

With fans modulating control options and glicole water*

With fans modulating control options, glicole water* and "pressure transducer" accessory.

*: Or other antifreeze solutions

IN HEATING MODE

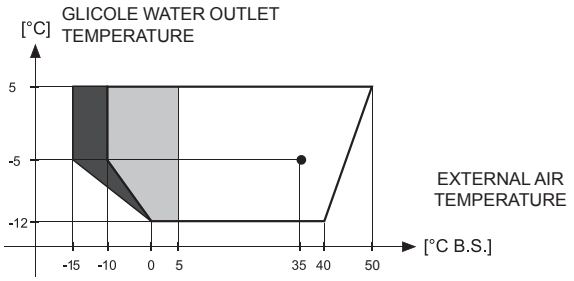


With fans modulating control options

BRINE UNIT BR - BP

For these applications requires the use of brine or other antifreeze solutions.

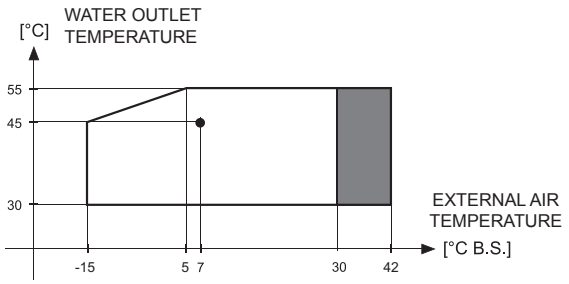
IN COOLING MODE



With fans modulating control options

With fans modulating control options and "pressure transducer" accessory.

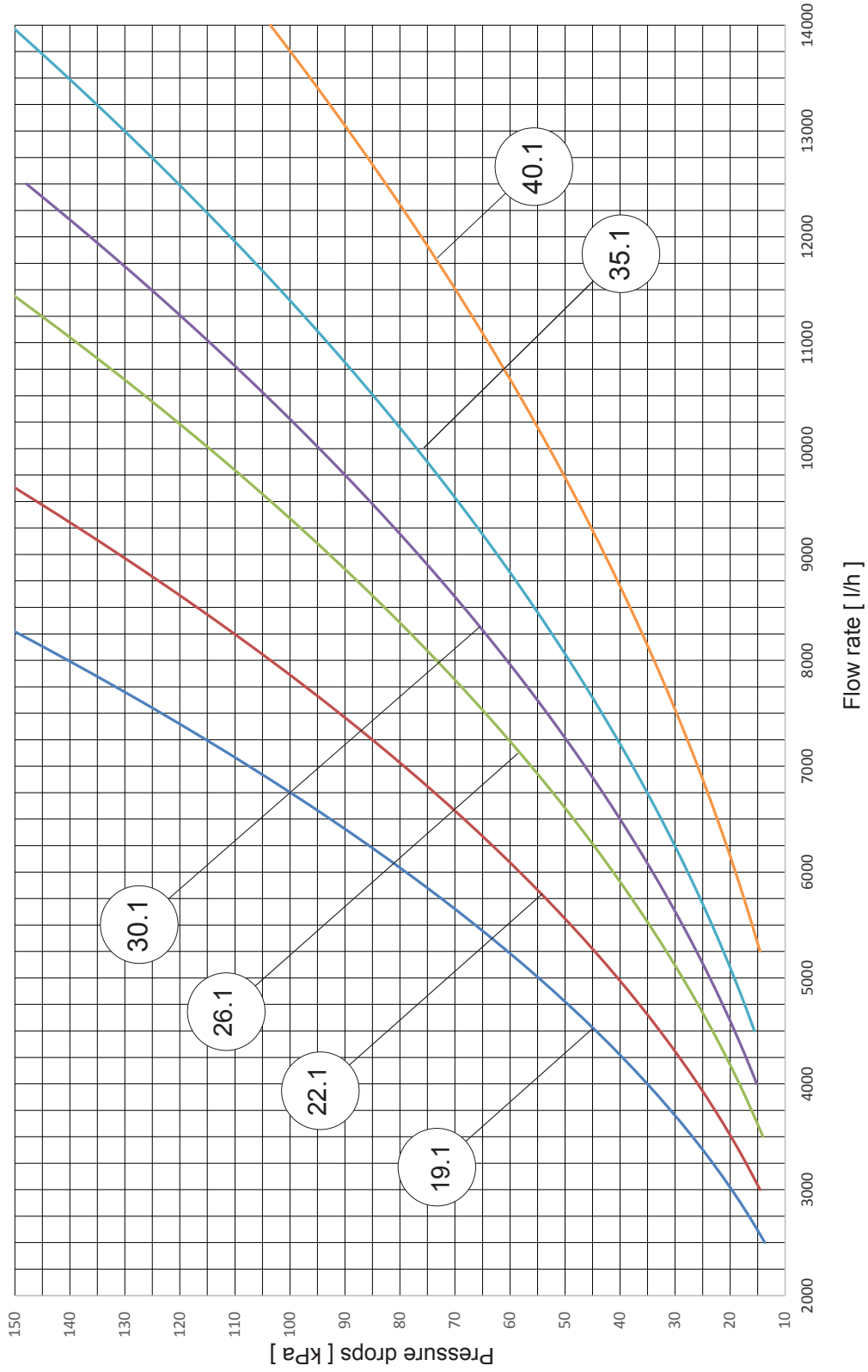
IN HEATING MODE



With fans modulating control options

WATER PRESSURE DROP

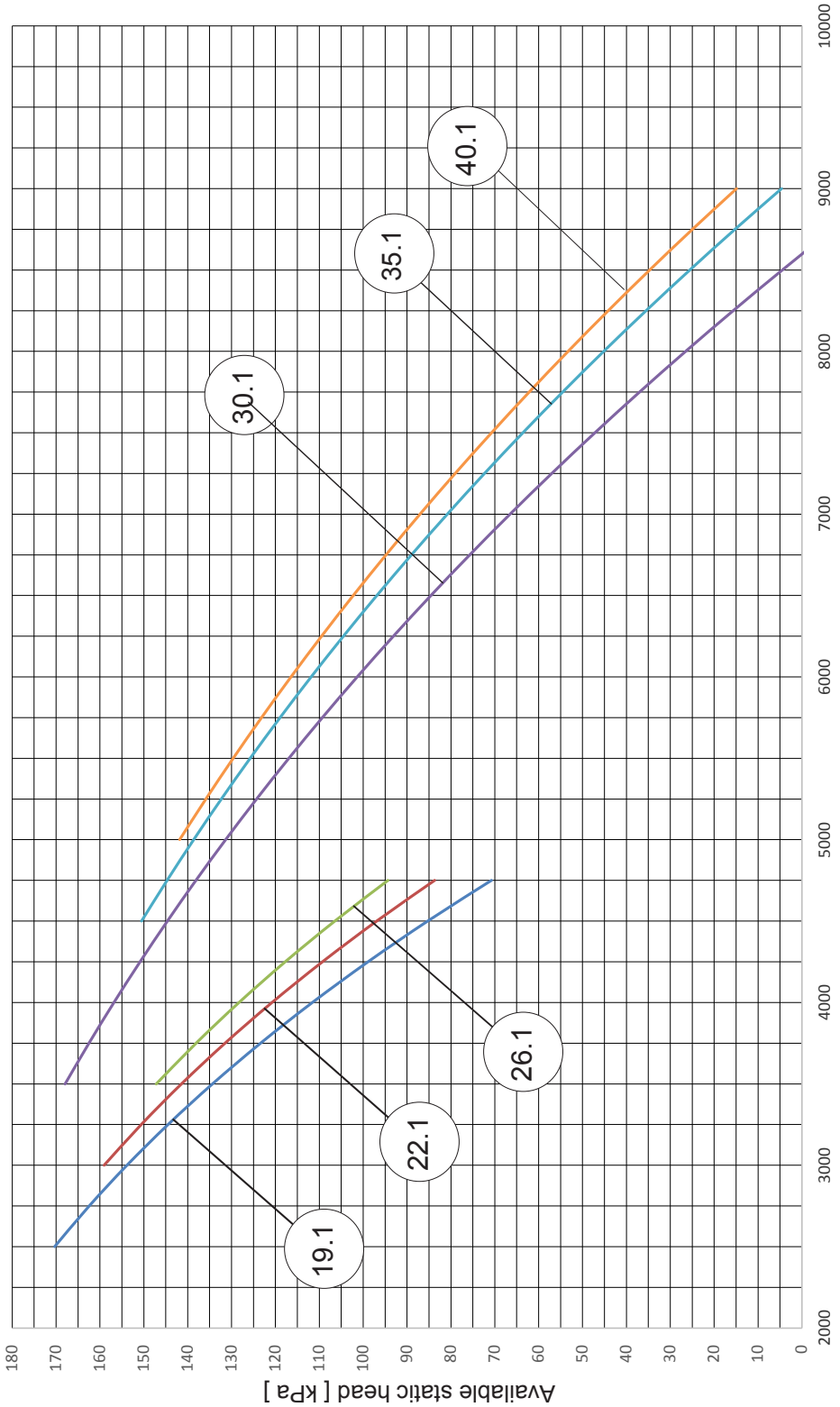
Pressure drops - unit without options



MODELS		19.1	22.1	26.1	30.1	35.1	40.1	UM	NOTE
Lower limit value	Q	2500	3000	3500	4000	4500	5250	l/h	**Q**= Water flow rate
Upper limit value	Q	8500	10000	11500	12500	140000	14000	l/h	

The graphs are referred to units operating with water at the temperature of 10°C (density 1000 kg/m^3).

Available static head - unit with option “Storing and pumping module” :
“Standard pump” or "Tank and standard pump"
“Modulating pump” or "Tank and modulating pump"

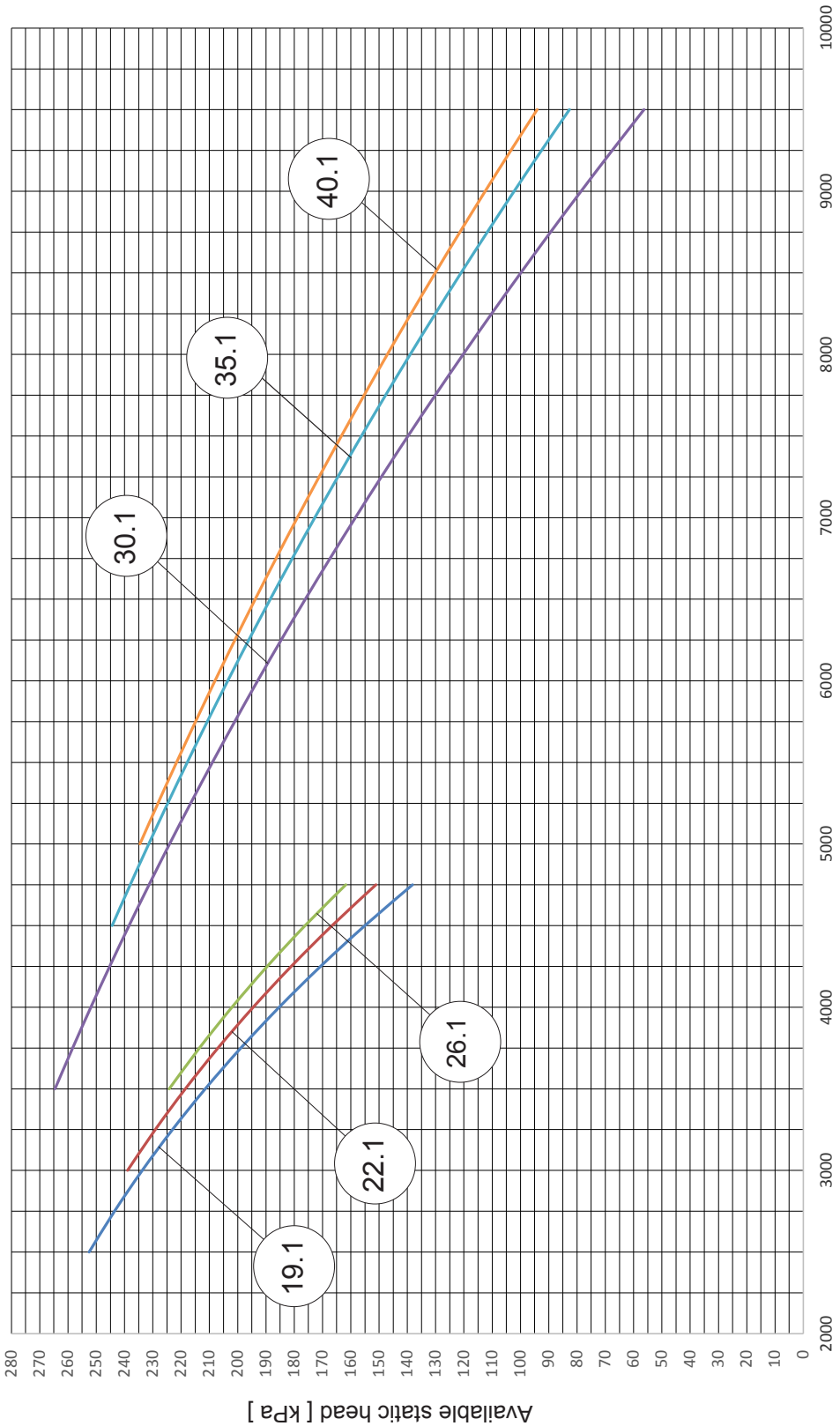


MODELS		19.1	22.1	26.1	30.1	35.1	40.1	UM	NOTE
Lower limit value	Q	2500	3000	3500	4000	4500	5250	l\h	**Q**= Water flow rate
Upper limit value	Q	4750			7800	8500	8900	kPa	

The graphs are referred to units operating with water at the temperature of 10°C (density 1000 kg/m³).

WORKING HEAD

Available static head - unit with option “Storing and pumping module” :
“High head pump” or "Tank and high head pump"

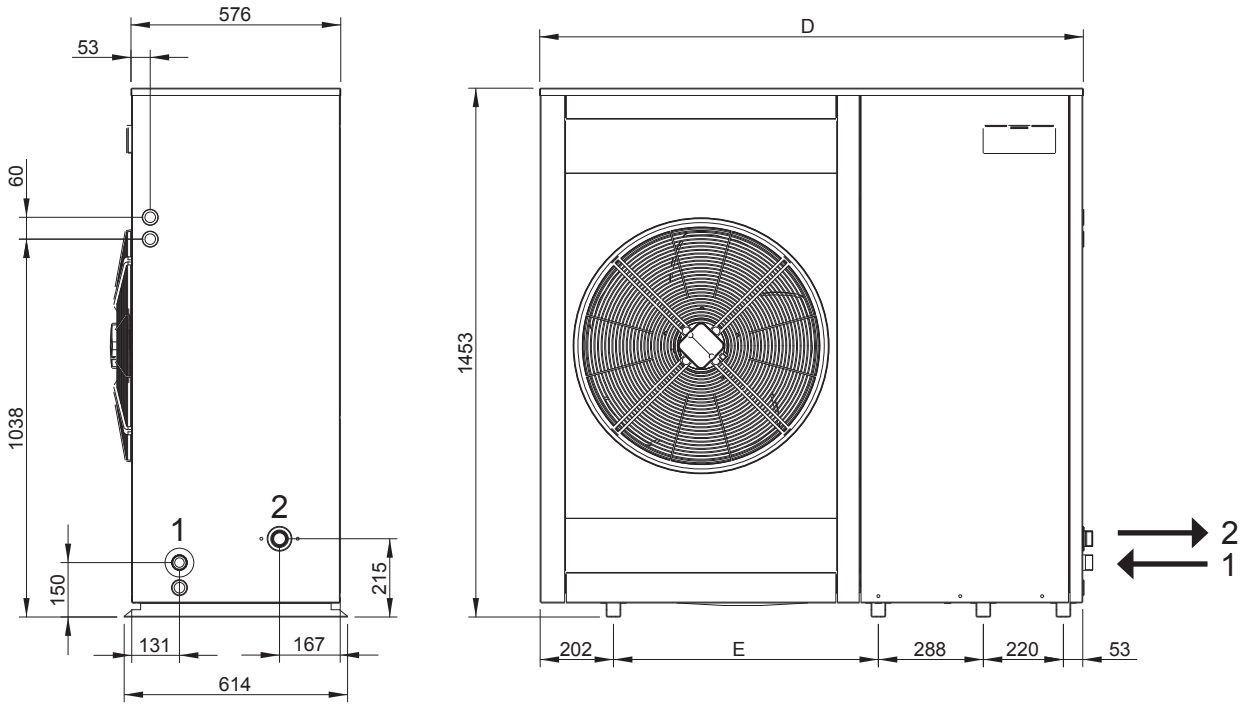


MODELS		19.1	22.1	26.1	30.1	35.1	40.1	UM	NOTE
Lower limit value	Q	2500	3000	3500	4000	4500	5250	l\h	**Q**= Water flow rate
Upper limit value	Q	4750				9500		kPa	

The graphs are referred to units operating with water at the temperature of 10°C (density 1000 kg/m^3).

DIMENSIONAL AND PHYSICAL DATA

Overall dimensions

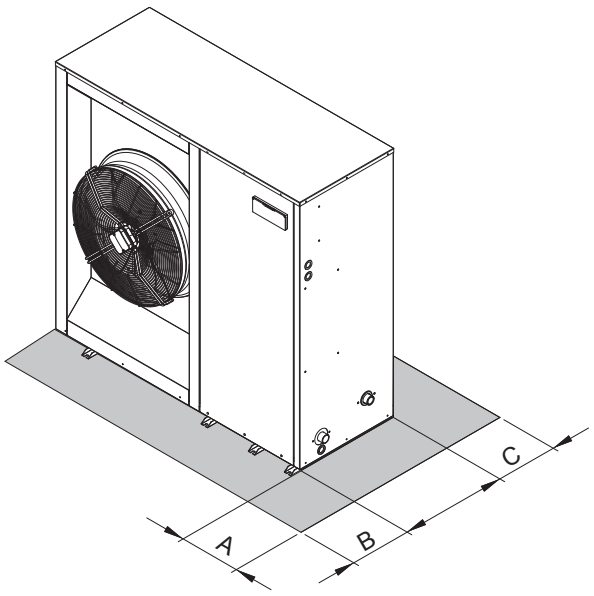


	Frame	1			2			
	Model	19.1	22.1	26.1	30.1	35.1	40.1	
Plant return	1	1"1/4 F	1"1/4 F	1"1/4 F	1"1/4 F	1"1/4 F	1"1/4 F	-
Plant flow	2	1"1/4 M	1"1/4 M	1"1/4 M	1"1/4 M	1"1/4 M	1"1/4 M	-
	D	1494			1704			mm
	E	728			938			mm

Minimum operating area

Respect the free area around the unit as shown in the figure in order to guarantee a good accessibility and facilitate maintenance and control operations.

A	400 mm
B	600 mm
C	200 mm



DIMENSIONAL AND PHYSICAL DATA

Weights

Frame			1			2			
Model			19.1	22.1	26.1	30.1	35.1	40.1	U.M.

Empty weight

Unit without options			235	238	261	280	303	305	kg
Options	Storing and pumping module	Standard pump	9	9	9	9	11	11	kg
		High head pump	12	12	12	12	13	13	kg
		Modulating pump	12	12	12	14	16	16	kg
		Tank and standard pump	31	31	31	31	33	33	kg
		Tank and high head pump	34	34	34	34	35	35	kg
		Tank and modulating pump	34	34	34	36	38	38	kg
	Integrative electrical heaters	Standard in the tank	5	5	5	5	5	5	kg

Transport weights

Unità senza opzioni			251	254	277	300	323	325	kg
Options	Storing and pumping module	Standard pump	9	9	9	9	11	11	kg
		High head pump	12	12	12	12	13	13	kg
		Modulating pump	12	12	12	14	16	16	kg
		Tank and standard pump	31	31	31	31	33	33	kg
		Tank and high head pump	34	34	34	34	35	35	kg
		Tank and modulating pump	34	34	34	36	38	38	kg
	Integrative electrical heaters	Standard in the tank	5	5	5	5	5	5	kg

Operating weights

Unità senza opzioni			239	242	266	285	309	311	kg
Options	Storing and pumping module	Standard pump	10	10	10	10	12	12	kg
		High head pump	13	13	13	13	14	14	kg
		Modulating pump	13	13	13	15	17	17	kg
		Tank and standard pump	117	117	117	117	119	119	kg
		Tank and high head pump	120	120	120	120	121	121	kg
		Tank and modulating pump	120	120	120	122	124	124	kg
	Integrative electrical heaters	Standard in the tank	5	5	5	5	5	5	kg

RECEPTION AND POSITIONING

Receiving

Check on receiving
As soon as the unit is received verify accurately the correspondance of the load to what was ordered to make sure that all the material has been delivered. Check carefully that the load has not been damaged. In case of goods with visible damages inform promptly the haulage contractor reporting on the delivery note the phrase **"Collected with reserves owing to evident damage"**. Delivery ex works implies reimbursement of any damage on charge of the insurance company as established by law.

Safety instructions
Observe the safety regulations in force concerning the equipment to use for unit handling or the operating formalities to follow.

Handling
Before handling the unit, check the weight of the unit, reported both on the dataplate and on the technical documentation. Make sure the unit to be handled with care avoiding any kind of collision that could damage the operating parts of the unit.
On the packaging of the unit are reported all the instructions necessary for a corect handling during storing and installation.
The unit is supplied on a pallet suitable for the transport. It is advisable to place protective material between the truck and the unit to avoid damages to the unit. Prevent the unit or parts of it from falling down.

Storing
The units must be stored in a dry place, repaired from sun, rain, sand or wind.
Do not stack the units.

Maximum temperature	=	60 °C
Minimum temperature	=	-10 °C
Humidity	=	90 %

Packaging removal
Remove the packaging taking care not to damage the unit.
Check for any visible damage.
Get rid of the packaging material sending them to specialized recycling centres (observe the regulations in force).

Positioning

The units are suitable for outdoor installation.
Verify that the support surface can bear the weight of the selected unit and is perfectly horizontal. In order to limit the vibrations transmitted by the unit it is possible to place, between the unit base and the support surface, a strip of hard rubber or, if a higher level of insulation is required, vibration dampers.
In any case it is not advisable to place the unit near private offices, bedrooms or zones where very low noise levels are required.

Protect the finned coil against direct sunlight and prevailing winds and do not place the unit on dark ground (for example tarred surfaces) to avoid the risk of overheating during operation.
Do not place the unit under roofs or near plants (even if the unit is only partly covered) in order not to reduce the possibility of air recirculation.
Respect the minimum operating area and verify that the installation place is not subject to flooding.

HYDRAULIC CONNECTIONS

General rules

A mesh filter (hole Ø<0,5mm for plates heat exchanger) must be installed on the unit's water inlet otherwise warranty is immediately forfeited. The filter performs the function of blocking any foreign matter in the system's plumbing circuit (shavings, machining debris, etc.) limiting or avoiding possible problems of fouling (that decreases the heat exchange coefficient), erosion, and clogging
The clogging and fouling of the exchanger can lead to a reduction of the water flow rate and. In the case that the exchanger works as evaporator- of the evaporation temperature: these 2 factors can cause the icing of the exchanger
The icing event leads to the bursting of the exchanger, the inlet of water into the refrigerant circuit and so the necessity of a replacement of the main components (compressors, filters, expansion valves,. Etc.) and an accurate washing of components as refrigerant pipes, coils, etc., practically the rebuilding nearly complete of the refrigerant circuit.

The filter must be maintained clean: this is so necessary verify the cleanness after the unit installation and checking periodically the state.

Protection devices

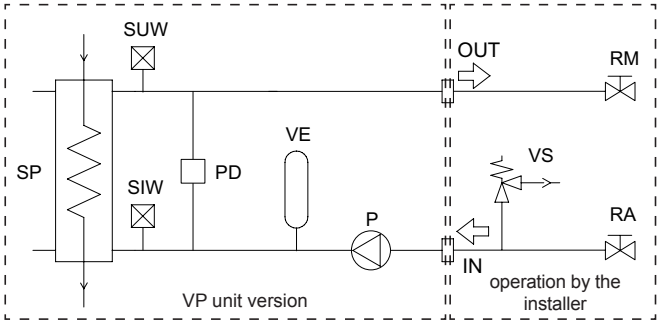
Standard supply includes a differential pressure switch situated between the water inlet and outlet of the heat exchanger to avoid freezing if the water flow stops for any reason.
• Standard supply includes an antifreeze heater placed between the external thermal insulation and the shell of the exchanger and controlled by the main electronic controller of the unit in order to protect the evaporator full of water (but not the pipes) from the winter icing when the unit is in stand-by mode. The exchanger is protected down to an outdoor air temperature of -20°C.
NOTE the antifreeze protection only worlk if the unit is electrically connected the standby period.
It is recommended to install a water paddle flow switch at the water inlet of the unit: the water paddle flow switch has to be electrically wired in series with the differential pressure switch.
It is mandatory to calibrate the trip out of the water paddle flow switch at a water flow rate value higher than the minimum water flow rate admissible for the exchanger (re. section Pressure Drop).

Tips for a successful installation

For a correct design and installation of the hydraulic plant comply the local laws governing safety matters and sound…
The following information is suggestion for a correct installation of the unit:
• Before connecting the unit to the system wash adequately the pipes using clean water, filling and emptying and cleaning the filters.
Only after that proceed connecting the unit to the system; this operation is crucial to ensure proper start-up without the need to have repeated stops to clean the filter, with the possible risk of damage to heat exchangers and other components.
• Check by qualified personnel the quality of the water or of the mixture used; avoid the presence of inorganic salts, biological load (seaweeds, etc.) suspended solids, dissolved oxygen and the pH. Water with inadequate characteristics can cause a pressure drop increase due to a rapid fouling of the filter, energy efficiency decrease and corrosive symptom increase that can damage the unit.
• The pipes must have the least possible number of bends to minimize load losses and must be adequately supported in order to prevent the connections of the unit from being excessively stressed.
• Install on-off valves near components that need to be serviced to isolate them when maintenance work needs to be done and to allow them to be replaced without having to discharge the system.
• Before isolating the pipes and charging the system, carry out preliminary inspections to make sure that there are no leaks.
• Isolate all the chilled water pipes to prevent condensation from forming along the pipes themselves. Make sure that the material used is the steam barrier type, failing this, cover the insulation with an appropriate protection. Also make sure that the air venting valves can be accessed through the insulation.
• Do not forget to install or at least allow for the installation of pressure and temperature reading instruments on the inlet and outlet parts of the hydraulic circuit. These instruments will allow you to monitor the operation of the system.
• The circuit can be kept under pressure by means of an expansion tank and a pressure reducer. A plant filling unit can also be used in order to automatically charge the system and keep it at the desired pressure if it drops below a certain pressure value. Install manual or automatic values in the highest point of the system to eliminate air from the circuit.
Fit manual or automatic valves at the highest point in the circuit in order to vent air from the circuit.
• the water connections are Victaulic-type joints for hooking up to the unit.
The joints allow the pipes to expand due to changes in temperature and in addition the elastomer gasket and the specified play help insulate and absorb noise and vibration.
• If vibrations dampers are installed under the unit, it is recommended to use flexible couplings before and after the water circulation pump and near the unit.
• Install on the outlet of the unit a suitable valve able to regulate the water flow.
• Avoid that the weight of the connection pipes pushes on the hydraulic connections of the unit using approved supports.

Check that plant components are suitable to bear the maximum static pressure (it depends on the height of the building).

ATTENTION
For units in VP version equipped with expansion vessel is required to install a safety valve (SET = 3 bar) on the hydraulic circuit. If the unit is disconnected from the rest of the hydraulic system with shut-off valve or other equivalent device (eg during maintenance), check that the safety valve is always connected with the expansion vessel. See diagram:



ITEM	DESCRIPTION
P	PUMP
PD	DIFFERENTIAL PRESSURE WATER
RA	SUCTION BALL VALVE
RM	DISCHARGE BALL VALVE
SIW	PROBE WATER INLET
SP	HEAT EXCHANGER
SUW	PROBE WATER OUTLET
VS	SAFETY VALVE
VE	EXPANSION TANK

HYDRAULIC CONNECTIONS

Water component for corrosion limit

To avoid corrosion problems in water exchangers make sure that the water used in the plant meets the requirements listed in the table.

pH	7.5 ÷ 9.0	-
SO4 --	< 100	ppm
HCO3 -/ SO4 --	>1.0	
Total hardness	8.0 ÷ 15.2	°F
Cl-	< 50	ppm
PO4 3-	< 2.0	ppm
NH3	< 0.5	ppm

Free Chlorine	< 0.5	ppm
Fe3+	< 0.5	ppm
Mn++	< 0.05	ppm
CO2	< 50	ppm
H2S	< 50	ppb
Temperature	< 65	°C
Oxygen content	< 0.1	ppm

Precautions for the Winter

The water could freeze and damage the exchanger of the unit and other parts of the system during the winter period, if the system was to remain at a standstill. This problem can be obviated in 3 different ways:
1. Drain the system completely, taking care to drain the plate exchanger (in order to drain the unit's piping system completely, open the water drain ball valves and the air vent valves, open any valves closed).
2. Operate with glycol water taking account, depending on the % of glycol, of the factor of correction of the refrigerating capacity, power input, water flow rate and losses of head (see table on following page)
3. If it is certain that the unit will always be powered throughout the winter, the unit is able to protect itself from freezing, down to a temperature of -20°C: this is possible thanks to an antifreeze electric heating element installed on the plate exchanger and intelligent control of the water pump that must be governed by the microprocessor board (see the "Electric Connections" section).
If the unit is fitted with a Storage tank, solution no. 3 requires installing the tank antifreeze heating element accessor.

Air vent and water drain

On the plumbing circuit feeding the unit, the installer must fit an appropriate number of valves (manual or automatic) at the top of the circuit in order to vent any air in the plumbing system. In the same way, he must install a water drain valve in order, when necessary, to drain the unit's plate exchanger completely (especially during the winter in order to prevent freezing that would seriously jeopardize the operation of the unit).

Maximum volume of water in the system with wet module

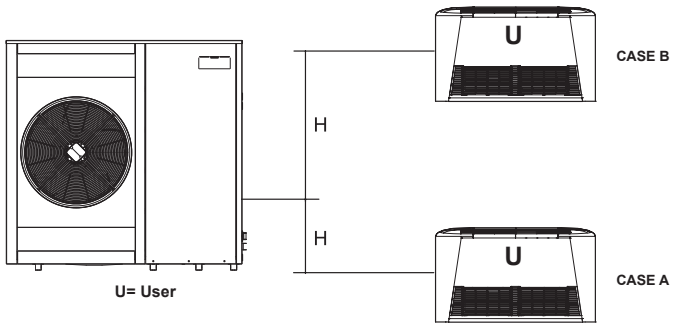
Before filling the water system, it is advisable to consider the type of installation in question, i.e. check the difference in level between the wet module and user. The following table gives the maximum water content of the water supply system in liters, depending on the capacity of the standard expansion vessel supplied and the pressure at which it should be charged. The expansion vessel setting must be regulated to suit the maximum positive difference in level of the user.
Maximum setting value 600 kPa.
With a positive H of more than 12.25 meters, calculate the expansion vessel precharge value in kPa using the formula below:

Expansion vessel precharge= [H/10.2+0.3] x100 = [kPa]

NOTE. In case A, make sure that the user's lowest point is able to withstand the global pressure.

Tab.1

Expansion vessel volume (liters)			10	
Safety valve set (bar)			3	
Thermal expansion of water (10-40°C)			0.0074	
Thermal expansion of water (10-60°C)			0.0167	
H (metri)		Expansion vessel pressure (bar)	IR	IP
Case A	H <0	1	667	299
Case B	0 < H < 17	1	667	299
	12	1,5	500	225
	15	1,8	400	180
	20	2,3	233	105



NOTE: If the unit operates with brine, calculate the real volume of the system by taking into account the corrective factors for the volume of the system given in the table below.

Corrective factors per total maximum volume of the system with brine

% of brine	0%	10%	20%	30%	40%
Cooling Mode	1,000	0,738	0,693	0,652	0,615
Heating Mode	1,000	0,855	0,811	0,769	0,731

ELECTRICAL CONNECTIONS

Electrical connections

The electrical wirings must be carried out by qualified personnel according to the regulations in force at the installation time in the country of installation. Before starting any work on the electrical circuit make sure that the unit power supply line is disconnected at the start.

N.B. Refer to the electrical diagram enclosed in the unit.

Power supply system

The power cables of the heat pump power supply line must be connected to :

- for single phase power supply : from a single phase voltage system provided with neutral conductor and separated earth wire :

  V = 230 V ± 10 %

  f = 50 Hz

- for three phase power supply : from a symmetrical three phase voltage system provided with neutral conductor and separated earth wire :

  V = 380÷420 V

  f = 50 Hz

The units are shipped completely factory wired and arranged for the connection to the power supply.

The power cables must enter the unit through the holes on the lateral panel and must be connected to the power supply terminals of the unit.

The integrative electrical heaters (option) must be supplied by a dedicated power supply line to be connected to the power supply terminals inside the electrical board of the unit.

Unit power supply

The power supply cables must have an adequate section for the power absorbed by the unit and must be chosen in conformity with the regulations in force. Design the power supply line, always referring to the total FLI and FLA values of the unit, taking into account the selected options (except the integrative electrical heaters) and the installed accessories.

Alimentazione delle resistenze elettriche integrative

The power supply cables must have an adequate section for the power absorbed by the only integrative electrical heaters and must be chosen in conformity with the regulations in force.

The electrical heaters must be connected to a single phase power supply if the unit power supply is single phase or to a three phase power supply if the unit power supply is three phase.

Upstream protection

An automatic switch suitable for ensuring protection against overcurrents and indirect contacts must be installed upstream each power supply line.

Coordination between line switch must be carried out observing the regulations in force on electrical safety, regarding the type of installation and the installation ambient conditions.

Connections available for the user

The wiring board inside the electrical panel contains dedicated terminals for the following connections.

General alarm

Voltage output (230V - max 2A) to be used to notify the presence of an active alarm.

Output active : active alarms

Output not active : no active alarms

Remote stand by

To turn on and off the unit, a remote device (selector, programmer clock, centralised supervision device ...) with a voltage free contact suitable for switching loads of very low power, can be connected.

This function must be enabled by parameter (see the section “Adjustment and control”) and prevails the settings made on the user interface.

Remote Cooling-Heating

It is possible to switch between cooling mode and heating mode from remote by connecting a device equipped with a voltage free contact suitable for switching loads of very low power.

This function must be enabled by parameter (see the section “Adjustment and control”) and prevails the settings made on the user interface.

Remote control

It is possible to connect a remote control that has all the control and display functions available on the user interface on the unit and therefore enables the complete remote control of the unit.

Pump control

The controller of the unit can directly activate the circulating pump by means of a voltage free contact (maximum absorbed current 4A).

ATTENTION

Carry out all the connections outside the unit avoiding the power cables and the probe cables to be coupled.

R410A PROTECTION DEVICES

Protection devices HIGH PRESSURE

LEVEL	1
Device	High pressure automatic switch
Trip out (barg)	41.0
Trip in (barg)	29.5
connected to	electronic controller
effect	stop the compressors and the fans of that circuit
reset *	YES by keyboard if the high pressure switch has trip-in and after the solution of the problem that generates the alarm

*: For more details refers to section monitoring basic system.

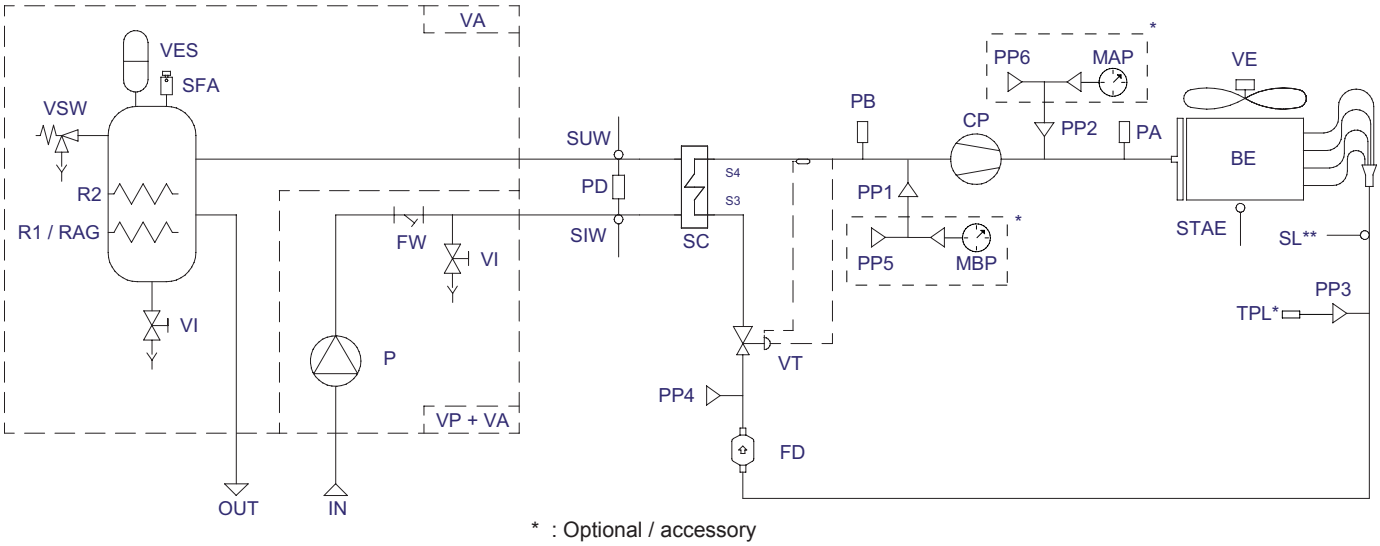
Protection devices LOW PRESSURE

LEVEL	1
Device	Low pressure automatic switch
Trip out (barg)	4 bar (IR, IP unit in cooling mode) 2 bar (BR,BP, IP unit in heating mode)
Trip in (barg)	6 bar (IR, IP unit in cooling mode) 4 bar (BR,BP, IP unit in heating mode)
connected to	electronic controller
effect	stop the compressors of that circuit
reset *	YES by keyboard if the low pressure switch has trip-in and after the solution of the problem that generates the alarm

*: For more details refers to section monitoring basic system.

REFRIGERANT FLOW DIAGRAM

IR unit

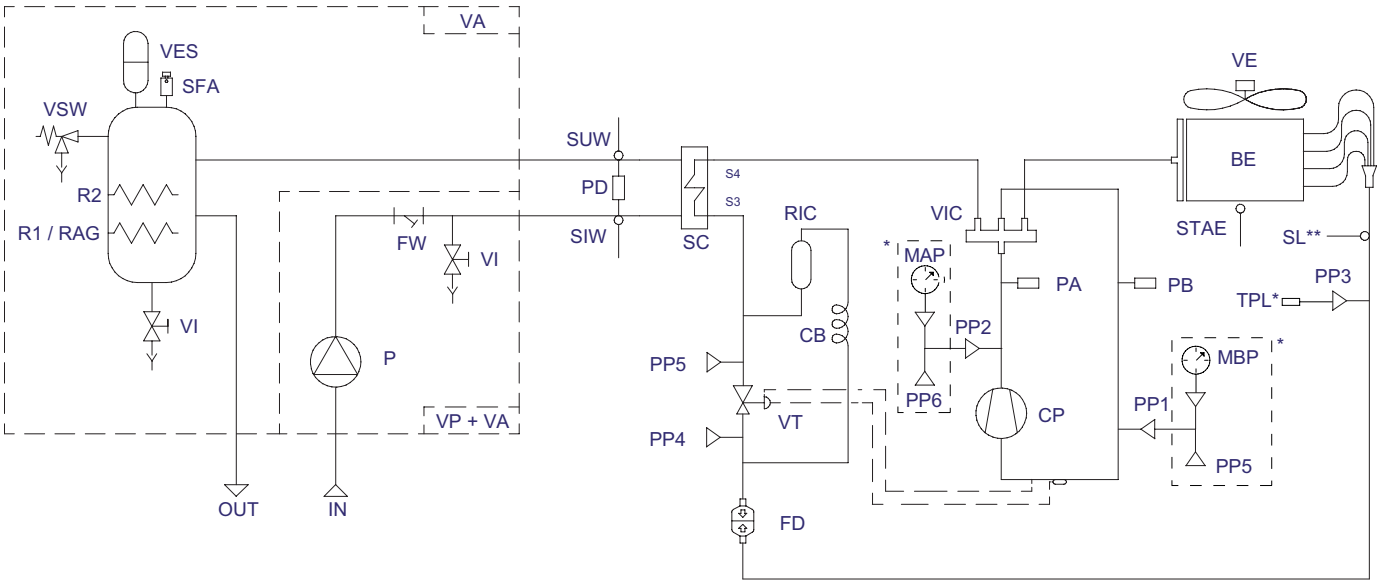


* : Optional / accessory
** : Do not installed if present TPL accessory

ID	DESCRIPTION
BE	finned coil
CB	Capillary by-pass
CP	compressor
FD	filter dryer
MAP	High pressure gauge
MBP	Low pressure gauge
PA	High pressure
PB	Low pressure
PD	differential pressure

ID	DESCRIPTION
PP	Outlet pressure
SC	Plate heat exchanger
SIW	Probe inlet water
SL	probe liquid
STAE	Outside air sensor
SUW	Water outlet probe
TPL	Liquid pressure transducer
VE	fan
VT	thermostatic valve

IP unit



* : Optional / accessory
** : Do not installed if present TPL accessory

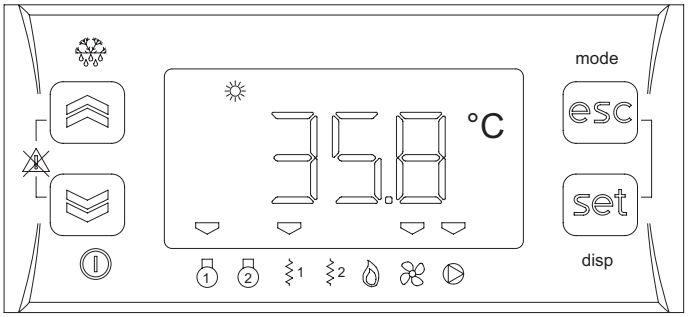
ID	DESCRIPTION
BE	finned coil
CB	Capillary by-pass
CP	compressor
FD	filter dryer
MAP	High pressure gauge
MBP	Low pressure gauge
PA	High pressure
PB	Low pressure
PD	differential pressure
PP	Outlet pressure

ID	DESCRIPTION
RIC	Liquid receiver
SC	Plate heat exchanger
SIW	Probe inlet water
SL	probe liquid
STAE	Outside air sensor
SUW	Water outlet probe
TPL	Liquid pressure transducer
VE	fan
VT	thermostatic valve

CONTROL SYSTEM

Control system

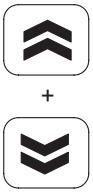
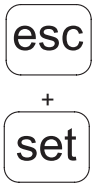
The unit is managed by a **microprocessor controller** to which, through a wiring board, all the electrical loads and the control devices are connected. The user interface is realized by a display and four buttons that allow to view and, if necessary, modify all the operating parameters of the unit. It's available, as an accessory, a remote control that reports all the functionalities of the user interface placed on the unit. The interface, placed on the frontal panel of the unit, is accessible from the outside and is protected by a transparent plastic door.
It's available, as an accessory, a remote control that reports all the functionalities of the user interface placed on the unit.



To each button are associated :

- a **direct function** : indicated on the button itself and activated pressing the button
- an **associated function** : indicated on the front of the instrument at the corresponding button and activated pressing the button for long (3 seconds)
- a **combined function** : activated pressing 2 buttons at the same time

Button		Direct function	Associated function	
	UP	To increase the value of the selected parameter To scroll up the menu	-	-
	DOWN	To decrease the value of the selected parameter To scroll down the menu	-	-
	ESC	To go to the higher level of the menu without saving	mode	To access the “Operating mode” menu
	SET	To go to the higher level of the menu saving To go to the lower level of the menu Access the "Status" menu	-	-
-	ALL	Alarm deactivation	-	-

Button		Combined function	
	UP + DOWN		Manual reset
	ESC + SET		To access the “Programming” menu

CONTROL SYSTEM

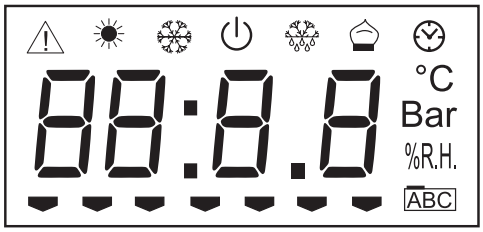
Display

Normally are shown :

• the setting temperature that is the water inlet temperature (in tenths of Celsius degree with decimal dot)

• alarm code, if at least one alarm is active (if more alarms are active, the first one according to the order of the Alarm Table, is shown)

In menu mode the informations on the display change according to the position inside the menu (see the structure of the menu).

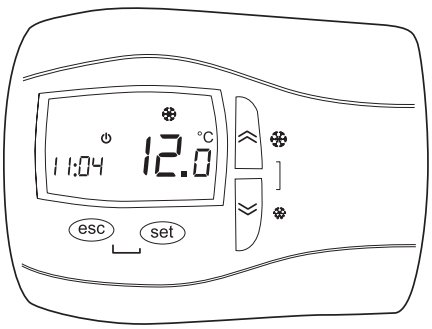


	Icon	Description	Colour	Steady on	Flashing on
Status and operating modes		Alarm	Red	Active alarm	Deactivated alarm
		Heating	Green	Heating mode from keyboard	Heating mode from remote
		Cooling	Green	Cooling mode from keyboard	Cooling mode from remote
		Stand by	Green	Stand by from keyboard	Stand by from remote
		Defrost	Green	Defrost in progress	-
		Economy	Green	not used	-
Measure units		Clock	Red	Time display format 24.00	Time setting format 24.00
	°C	Celsius degrees	Red	Unit of measure of the selected parameter	-
	Bar	Bar	Red	not used	-
	%R.H.	Relative humidity	Red	not used	-
	ABC	Menu	Red	Menu browsing	-
Loads		Compressor	Amber	Active load	Safety time in progress
		not used	-	-	-
		Antifreeze heater Integrative heater 1st step	Amber	Active load	Safety time in progress
		Integrative heater 2nd step	Amber	Active load	Safety time in progress
		not used	-	-	
		Fans	Amber	Active load	Safety time in progress
		Pump	Amber	Active load	Safety time in progress

Remoto control

Suitable for wall mounting, it reports all the functions available on the user interface placed on the unit.
The buttons, functions associated with the buttons and the display indications are the same as those provided for the standard interface.
All configuration and control operations are further facilitated by the double display which allows the name and value of the selected parameter to be shown at the same time.

Refer to the enclosed manual for the installation and connection procedures and operating instructions.



CONTROL SYSTEM

Menu structure

The control system provides for three menus with tree structure.

Menu	Access procedure	Sub menu	Parameters	Available functions
Operating mode	Press **ESC** button for long (ESC button associated function)	StbY	-	Operating mode change
		HEAt		
		COOL		
Status	Press **SET** button (SET button direct function)	AI	AI01	Display input AI1
			AI02	Display input AI2
			AI03	Display input AI3
			AI04	Display input AI4
		dI	dI01	Display input ID1
			dI02	Display input ID2
			dI03	Display input ID3
			dI04	Display input ID4
			dI05	Display input ID5
		AO	AO1	Display output AO1
			AO2	Display output AO2
			AO3	Display output AO3
		dO	dO01	Display output DO1
			dO02	Display output DO2
			dO03	Display output DO3
			dO04	Display output DO4
			dO05	Display output DO5
		CL	HOUr	Clock adjustment : time
			dAtE	Clock adjustment : date
			YEAr	Clock adjustment : year
		AL	-	Display active alarms
		SP	HEAt	Set point display and setting : heating
			COOL	Set point display and setting : cooling
		Sr	HEAt	Display real set point : heating
			COOL	Display real set point : cooling
		Hr	CPO1	Display compressor operating hours
			PUO1	Display pump operating hours
Programming	Press **ESC + SET** buttons at the same time (combined functioni ESC + SET buttons)	PAr / CF	CF19	Remote stand by enable
			CF20	Remote Cooling-Heating enable
			CF63	Device address (Modbus protocol)
			CF66	Display parameter map code
			CF67	Display parameter map revision
		PAr / tr	trO1	Heat pump enable
			tr17	Heat pump lock set point
		PAr / PI	PI05	Modulating pump speed : cooling
			PI11	Modulating pump speed : heating
		PAr / HI	HI02	Integrative electrical heaters enable
		FnC	EUr	Alarm memory reset
		EU	-	Alarm memory display

To go from one level to the level below press the SET button. To return to the upper level press the ESC button.
To scroll the menu up and down inside the same level, press respectively the UP and DOWN buttons.

To modify the value of the selected parameter press the UP and DOWN buttons. Press the SET button to confirm the new value. Press the ESC button not to confirm the new value.

CONTROL SYSTEM

Inputs and outputs

In order to control the unit, the controller is equipped with the following inputs and outputs :
- Analogue inputs : 4
- Digital inputs : 5
- Analogue outputs : 2
- Digital outputs : 6

DESCRIPTION			CHARACTERISTICS
Analogue inputs			
AI1	SIW	water inlet probe	NTC (-30°C ÷ 90°C)
AI2	SUW	water outlet probe	NTC (-30°C ÷ 90°C)
AI3	SL	liquid line probe / Liquid pressure transducer	NTC (-30°C ÷ 90°C) / (4-20mA / 0-50 BAR)
AI4	STAE	outdoor air probe	NTC (-30°C ÷ 90°C)
Digital inputs			
ID1	PA	High pressure switch	voltage free digital input
	TVE	Fan thermal protection	
	SS	Soft starter alarm	
ID2	PB	Low pressure switch	voltage free digital input
	SEQ	Phase presence and sequence controller	
ID3	PD	Differential pressure switch	voltage free digital input
ID4	ON-OFF	Remote stand by	voltage free digital input
ID5	E-I	Remote Cooling-Heating	voltage free digital input
Analogue outputs			
AO1	VE	Fan	PWM output for relay or inverter control
AO3	PM	Modulating pump	10V voltage output
Digital outputs			
DO1	ALL	Alarm	relay 2 A resistive - 250 Vac
DO2	CP	Compressor	relay 2 A resistive - 250 Vac
DO3	VIC	Reverse cycle valve	relay 2 A resistive - 250 Vac
DO4	RSC	Plate heat exchanger antifreeze heater	relay 2 A resistive - 250 Vac
	RAG RE1	Tank antifreeze heater Integrative heater 1st step	
DO5	P	Pump	500mA - 12Vdc voltage output for control of relay K1 (4 A resistive - 250 Vac)
AO2	RE2	Integrative heater 2nd step	10V voltage output for control of relay KA2 (12 A resistive - 250 Vac)

All the inputs and outputs are connected to the wiring board except for output AO2 which directly controls a relay inside the electrical panel of the unit and output AO3 which directly control the modulating pump.

Controller technical data

Description	Typical	Minimum	Maximum
Power supply voltage *	12,0 V~	10,8 V~	13,2 V~
Power supply frequency	50 Hz / 60 Hz	-	-
Power	5 VA	-	-
Insulation class	2	-	-
Protection degree	Frontale IP0	-	-
Ambient operating temperature	25 °C	-10 °C	60 °C
Ambient operating humidity (not condensing)	30 %	10 %	90 %
Ambient storage temperature	25 °C	-20 °C	85 °C
Ambient storage humidity (not condensing)	30 %	10 %	90 %

* The controller is powered by a proper insulated transformer mounted on the wiring board.

Alarms

Alarm activation and reset
The controller can perform a complete diagnosis of the unit, detecting all the operating faults and reporting a set of alarms.
Activation of an alarm involves :
• locking of the loads concerned
• reporting of the alarm code on the display (in case of simultaneous alarms the one with the lowest index is displayed whereas the complete list of active alarms can be shown by accessing the “Status \ AL” menu)
• recording of the event in the alarms memory

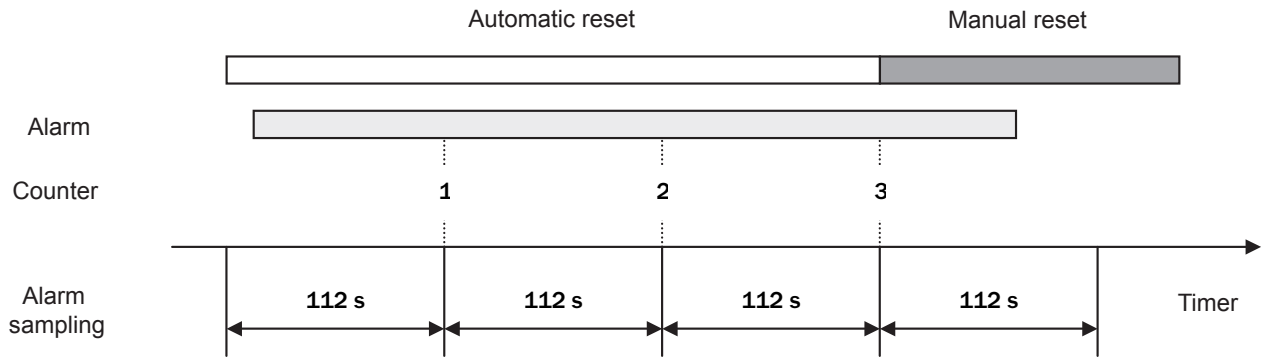
Alarms that can damage the unit or the plant require a **manual reset** that implies an action by the operator to reset the controller (pressing the UP and DOWN buttons at the same time). It is reccomended to carefully check the cause of the alarm and make sure the problem is eliminated before restarting the unit. In any case the unit restarts only if the cause of the alarm has disappeared.

Less critical alarms are **automatically reset**. As soon as the cause of the alarm is eliminated the unit starts working again and the alarm code disappears from the display. Some of these alarms require a manual reset if the number of events per hour exceeds a fixed limit.

Pressing any button it's possible to **deactivate the alarm** : alarm report disappears from the display, the alarm LED starts flashing and the Alarm digital output is disabled. The deactivation of the alarm does not affect the alarm in progress.

Number of events per hour
For some alarms the number of events per hour is recorded : if, in the last hour, the number of events reaches a fixed limit, the alarm reset change from automatic to manual.
Sampling of alarms occurs every 112 seconds. If an alarm is activated several times in a sampling period (112 seconds) it is counted only once.

*Esempio. If the fixed limit of events per hour is 3, in order to change from automatic to manual reset, tha alarm has to remain active for a period of time between 2*112 seconds and 3*112 seconds.*



Alarms memory
The controller enables the recording of the alarms occurred during the unit operation (up to a maximum 99 events). The following informations are recorded for each event :
- alarm code
- activation time
- activation date
- deactivation time
- deactivation date
- type of alarm (automatic or manual reset)

Such informations can be shown by accessing the “Programming \ EU” menu.
When the number of events recorded is higher than 99 the following events are recorded overwriting the oldest alarms.
The alarms memory can be cancelled by means of the Eur function available inside the “Programming \ FnC” menu, keeping pressed the SET button till YES appears on the display.

Alarms table

				Locked loads				
				Compressor	Antifreeze heater Integrative heaters 1st step	Pump	Integrative heaters 2nd step	Fans
CODE	ALARM	RESEt (1)	INPUT	DO2	DO4	DO5	AO3	AO1
Er05	Low pressure Phase presence and sequence controller Soft starter alarm	A / M	ID2	X				X
Er20	Differential pressure switch	A / M	ID3	X	X	X (2)	X	X
Er30	Antifreeze	M	AI2	X				X
Er41	High pressure / Fan thermal protection	A / M	ID1	X				X
Er45	Clock fault	A	-					
Er46	Clock to be adjusted	A	-					
Er47	Communication error with remote control	A	-					
Er60	Water inlet probe fault	A	AI1	X	X	X	X	X
Er61	Water outlet probe fault	A	AI2	X	X	X	X	X
Er62	Liquid line probe fault	A	AI3					
Er68	Outdoor air probe fault	A	AI4					
Er75	Liquid pressure transducer fault	A	AI3					
Er80	Configuration error	A	-	X	X	X	X	X

Notes:
(1) A = automatic reset , M = manual reset
(2) Only when the alarm change to manual reset

Er05 Low pressure – Phase presence and sequence controller - Soft starter alarm
The alarm becomes manual reset when the number of operations per hour is higher than the set value of the parameter AL01.
The alarm is bypassed for the time equal to the value defined by parameter AL02 starting from the activation of the compressor or of the reversing valve.
The alarm is disabled during defrost.

Er20 Differential pressure switch
The alarm is activated if the associated digital input remains activated for at least 2 seconds and automatically resets if the digital input remains not activated for at least 2 seconds. The alarm change to manual reset if the digital input remains activated for more than 10 seconds.
The start-up from stand-by mode of operation to cool or heat provides the by-pass of 'alarm for 30 seconds after the activation of the pump with the compressor off.

Er30 Antifreeze
The alarm is bypassed for 3 minutes from switching on of the unit (in heating mode only).

Er41 High pressure / Fan thermal protection
The alarm change to manual reset when the number of events per hour is more than the value set in parameter AL03.

Er62 Liquid line probe fault
When the alarm is activated the fans work with on-off logic according to compressor request. The defrost cycle inlet and outlet are managed according to the operating time of the compressor.

Er68 Outdoor air probe fault
When the alarm is activated, neither climate control nor dynamic defrost are available.

Er75 Liquid pressure transducer fault
When the alarm is activated the fans work with on-off logic according to compressor request. The defrost cycle inlet and outlet are managed according to the operating time of the compressor.

Functions available for the user

Operating mode selection
It's possible to select the operating mode by accessing the “Operating mode” menu :
- Cooling COOL
- Heating HEAt
- STAND BY * StdbY

* The antifreeze function is still active.

Remote STAND BY
This function allows remote selection of the STANDBY mode. If the input is activated (open contact) the controller is in STANDBY mode and the operating mode can not be modified from the user interface.
The digital input used is DI4. Set the parameter CF 19 = -27 to enable this function.

Remote Cooling-Heating
This function allows remote selection of Cooling or Heating mode. If the input is activated (open contact) the unit is in heating mode. If the input is not activated (closed contact) the unit is in cooling mode. The operating mode can not be modified from the user interface (but STAND BY mode can be selected).
The digital input used is DI5. To enable this function set the parameter CF20 = 14.

Set point
The set point value in cooling (COOL) and heating (HEAt) can be set by accessing the “StAtUS \ SP” menu. These values must be between a fixed maximum and minimum value. The purpose of the controller is to keep the water temperature at the unit inlet as close as possible to the set value, by activating the compressor according to an on-off logic.

Operating in heat pump mode
For all the heat pump units the parameter trO1 enables operation in heat pump mode when its value is 1. It is possible to set an outdoor air temperature value (parameter tr 17) below which heat pump mode is locked (in any case the integrative electrical heaters, if present, remain activated).

Antifreeze
The plate heat exchanger is protected by the activation of an electrical antifreeze heater and the activation of the antifreeze alarm, occurring in sequence when the temperature of the water at the exchanger outlet reaches dangerous values. The buffer tank is protected by the antifreeze heater (accessory) activated together with the plate heat exchanger heater.
When the outdoor air temperature approaches 0°C, if the unit is not working, the pump is activated in any case to prevent excessive cooling of the water in the pipes.

Integrative electrical heaters
The parameter H 02 enables the electrical heaters, as integration of the heat pump, when its value is 1. The heaters are activated according to a two step logic depending on the unit inlet water temperature. When present, the heaters also carry out the storage tank antifreeze function .

Dynamic defrost
The activation limit is modified in a dynamic way according to the outdoor air temperature.

Serial communication
The device is configured to communicate on a serial line using the MODBUS protocol. When the device is connected, it must be assigned an address univocally identifying it among all the devices connected to the same serial line (“Modbus individual address”). This address must be between 1 and 247 and is configurable by means of the parameter CF63 (see section on serial communication).

Operating hours recording
The controller can record the operating hours of compressor and pump. Access the “StAtUS \ Hr” menu to see the values. The hours are reset by pressing the SET button for long, while the hours of operation are displayed.

Power failure
In case of a power failure, when the power is restored the controller will return to the status before the power failure. If a defost cycle was in progress the procedure is cancelled. All safety timing in progress are cancelled and reinitialized.

Clock
The controller is equipped with an internal clock to record date and time of each alarm occurred during unit operation (see “Alarms memory”). The clock can be set by accessing the “StAtUS \ CL” menu.

Modulating pump management
Modifying the parameters PI 05 (for cooling mode) and PI 11 (for heating mode). It is possible to set the rotational speed of the modulating pump in order to get the water flow rate required to mantain the desired temperature difference between the water inlet and outlet. Verify that the value set ensures a flow of water within the operating limits specified in the installation manual and use.

Serial communication

The unit can communicate on a serial line using the **Modbus** communication protocol with **RTU** coding.
The unit can be connected to an RS485 network by means of the serial interface supplied as an accessory, and reply to the requests of any master device connected to the network.

Serial line settings

The serial line must be set as follows :

- baud rate : **9600**
- data bits : **8**
- stop bits : **1**
- parity : **even**

All the devices connected to the same serial line MUST use the same settings.

Device address

To communicate properly, each device connected to the serial network must have an univocal address (*"Modbus individual address"*) contained between 1 and 247. This address can be set by modifying the parameter CF63.

Modbus commands

The Modbus commands implemented by the controller are :

- parameter reading **3** *(Hex 03 : Read Holding Registers)*
- parameter writing **16** *(Hex 10 : Write Multiple Registers)*

Addresses table

All the available resources are stored in the controller as WORD (2 byte) and therefore require the reading or writing of an entire Modbus register. According to the Modbus protocol, to identify a register of address X the address X-1 must appear in the message. Some registers contain more than one piece of information : in this case the bits representing the resource value are identified by means of the number of bits used ("Bit number") and by the least significant bit ("Lsb"). In the writing operation for these registers it is necessary to read the current register value, modify the bits representing the resource concerned and rewrite the entire register.

Example.

Bit number = 4
Lsb = 7
Resource value = 3

15	14	13	12	11	**10**	**9**	**8**	**7**	6	5	4	3	2	1	0
0	1	1	0	1	**0**	**0**	**1**	**1**	1	0	1	1	0	1	0

The resources can be only read (R), only written (W) or read and written (RW).

To interpret the value written in the register it is necessary to consider the value of CPL, EXP and UM :

CPL : if the register represents a number with sign (CPL = Y) carry out the following conversion :

0 = register value < 32767 : resource value = register value
32768 = register value < 65535 : resource value = register value – 65536

EXP : indicates the exponent of the power of 10 to be multiplied by the register value to obtain the resource value.

EXP	Moltiplicatore	
-2	10^{-2}	0,01
-1	10^{-1}	0,1
0	100	1
1	10^{1}	10
2	10^{2}	100

MU : indicates the unit of measure of the resource

IMPORTANT. DO NOT modify any parameter not indicated in the table provided or indicated as a read only parameter (R), otherwise the warranty will be invalidated.

Label	Description	RW	Register address		Bit number	Lsb	CPL	EXP	UM
			Dec	Hex					
COOL	Set point cooling	RW	16900	4204	16	0	Y	-1	°C
HEAt	Set point heating	RW	16902	4206	16	0	Y	-1	°C
CF 19	Remote stand by enable	RW	49303	C097	8	0	Y	0	-
CF20	Remote Cooling-Heating enable	RW	49304	C098	8	0	Y	0	-
CF63	Device serial address	RW	49178	C01A	8	0	N	0	-
tr01	Heat pump enable	RW	49665	C201	8	0	N	0	-
tr 17	Heat pump lock set point	RW	16930	4222	16	0	Y	-1	°C
PI 05	Modulating pump speed : cooling	RW	49749	C255	8	0	N	0	%
PI 11	Modulating pump speed : heating	RW	49757	C25D	8	0	N	0	%
H i02	Integrative electrical heaters enable	RW	49858	C2C2	8	0	N	0	-
CP01	Compressor operating hours	R	753	02F1	16	0	N	0	ore
PU01	Pump operating hours	R	763	02FB	16	0	N	0	ore
AI 01	Water inlet probe	R	344	0158	16	0	Y	-1	°C
AI 02	Water outlet probe	R	346	015A	16	0	Y	-1	°C
AI 03	Liquid line probe	R	348	015C	16	0	Y	-1	°C/BAR
AI 04	Outdoor air probe	R	350	015E	16	0	Y	-1	°C
-	Unit operating in COOLING	R	33028	8104	1	4	N	0	-
-	Unit operating in HEATING	R	33028	8104	1	6	N	0	-
-	Unit in STAND BY (user interface or serial communication)	R	33028	8104	1	2	N	0	-
-	Unit in STAND BY (digital input)	R	33028	8104	1	3	N	0	-
-	Unit in OFF	R	33028	8104	1	0	N	0	-
-	COOLING mode enable *	W	33471	82BF	1	3	N	0	-
-	HEATING mode enable *	W	33471	82BF	1	4	N	0	-
-	STAND BY enable *	W	33471	82BF	1	5	N	0	-
-	Unit switching on (1 = ON ; 0 = OFF)	W	33471	82BF	1	7	N	0	-
-	Alarm Er05	R	33037	810D	1	5	N	0	-
-	Alarm Er20	R	33039	810F	1	4	N	0	-
-	Alarm Er30	R	33040	8110	1	6	N	0	-
-	Alarm Er41	R	33042	8112	1	1	N	0	-
-	Alarm Er45	R	33042	8112	1	5	N	0	-
-	Alarm Er46	R	33042	8112	1	6	N	0	-
-	Alarm Er60	R	33044	8114	1	4	N	0	-
-	Alarm Er61	R	33044	8114	1	5	N	0	-
-	Alarm Er62	R	33044	8114	1	6	N	0	-
-	Alarm Er68	R	33045	8115	1	4	N	0	-
-	Alarm Er75	R	33046	8116	1	3	N	0	-

** If several operation modes are enabled by mistake :*
- *OFF has priority over STAND BY, HEATING, COOLING*
- *STAND BY has priority over HEATING, COOLING*
- *HEATING has priority over COOLING*

Probes characteristics

The temperature probes used are NTC 10K (10 kΩ at 25°C).
When the probe bulb is at the temperature of 25°C the electrical resistance measurable at the probe ends is 10 kΩ.
The thermistor of these probes has a negative temperature coefficient: the electrical resistance value decreases as the temperature increases.

To find out if a temperature probe is faulty or disconnected, check the correspondence between the resistance value in kΩ and the bulb temperature in °C according to the table.

For a reliable verify it is not necessary to check all the single values but is enough to check some random values. If the instrument indicates neverending resistance then the probe is interrupted.

Temperature	Resistance
[°C]	[kΩ]
0	25,7950
5	21,3963
10	17,7477
15	14,7213
20	12,2110
25	10,1287
30	8,4015
35	6,9688
40	5,7805
45	4,7948
50	3,9771
55	3,2989

INVERTER

The display is accessible from the external of the unit dismounting the frontal panel of the electrical box. (ref. fig.1).
The unit can be equipped with n° 1 for each pump (part. 1-fig.2) and/or with n° 1 for each fan (part. 2-fig.2).

Fig.1

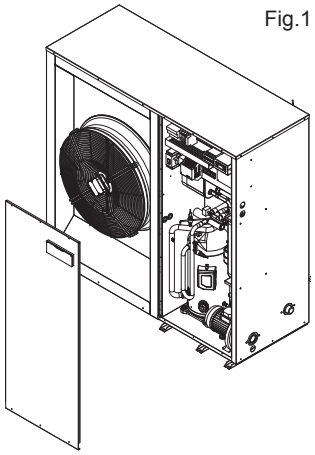
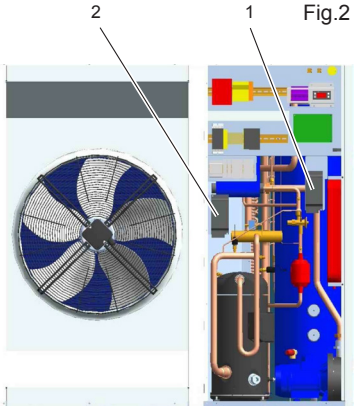


Fig.2



Operating setting procedure

To access the Delta VFD-EL settings:

- Ensure the inverter is in STOP mode by pressing STOP RESET
- Press MODE until the message appears Frd
- To enter int the Frd menu press ENTER
- At this point, we are in the main parameters menu.

-To access and modify the parameters, choose the parameter, press ENTER, change value with the arrows keys and confirm with

- The modified parameter will be confirmed with the label End

- At the end of the parameters settings, turn OFF and turn ON power supply, then check that the RUN light is on and the STOP light is flashing.

Fig.3

Alarm

Note that the intervention of the inverter alarm stops the inverter and so stops the device controlled by the inverter with the result of generating alarms on the main electronic controller: i.e. the alarm of the water pump inverter generates the water pump thermal switch alarm.

Code	Input on inverter	Alarm	Cause	Troubleshooting
oc	U-V-W	Over current	Abnormal increase in current	1. Check if motor power corresponds with the AC motor drive output power 2. Check the wiring connections to U/T1, V/T2, W/T3 for possible short circuits 3. Check the wiring connections between the AC motor drive and motor for possible short circuits, also to ground 4. Check for loose contacts between AC motor drive and motor 5. Increase the Acceleration Time 6. Check for possible excessive loading conditions at the motor 7. If there are still any abnormal conditions when operating the AC motor drive after a shortcircuit is removed and the other points above are checked, it should be sent back to manufacturer
ou	-	Over voltage	The DC bus voltage has exceeded its maximum allowable value	1. Check if the input voltage falls within the rated AC motor drive input voltage range 2. Check for possible voltage transients 3. DC-bus over-voltage may also be caused by motor regeneration. Either increase the Decel. Time or add an optional brake resistor (and brake unit) 4. Check whether the required braking power is within the specified limits

Code	Input on inverter	Alarm	Cause	Troubleshooting
oH1	-	Overheating	Heat sink temperature too high	1. Ensure that the ambient temperature falls within the specified temperature range 2. Make sure that the ventilation holes are not obstructed 3. Remove any foreign objects from the heatsinks and check for possible dirty heat sink fins 4. Check the fan and clean it 5. Provide enough spacing for adequate ventilation
oH2	-	Overheating	Heat sink temperature too high	1. Ensure that the ambient temperature falls within the specified temperature range 2. Make sure that the ventilation holes are not obstructed 3. Remove any foreign objects from the heatsinks and check for possible dirty heat sink fins 4. Check the fan and clean it 5. Provide enough spacing for adequate ventilation
LU	-	Low voltage	The AC motor drive detects the the DC bus voltage has fallen below its minimum value	1. Check whether the input voltage falls within the AC motor drive rated input voltage range 2. Check for abnormal load in motor 3. Check for correct wiring of input power to R-ST (for 3-phase models) without phase loss
oL	-	Overload	The AC motor drive detects excessive drive output current	1. Check whether the motor is overloaded 2. Reduce torque compensation setting in Pr.07.02 3. Use the next higher power AC motor drive model
oL1	-	Overload 1	Internal electronic overload trip	1. Check for possible motor overload 2. Check electronic thermal overload setting 3. Use a higher power motor 4. Reduce the current level so that the drive output current does not exceed the value set by the Motor Rated Current Pr.07.00
oL2	-	Overload 2	Motor overload	1. Reduce the motor load 2. Adjust the over-torque detection setting to an appropriate setting (Pr.06.03 to Pr.06.05)
HPF1	-	CC (Current clamp)	Internal error	Return to factory
HPF2	-	OV hardware error	Internal error	Return to factory
HPF3	-	GFF hardware error	Internal error	Return to factory
HPF4	-	OC hardware error	Internal error	Return to factory
bb	-	External base block	External base block	1. When the external input terminal (B.B) is active, the AC motor drive output will be turned off 2. Deactivate the external input terminal (B.B) to operate the AC motor drive again
ocA	-	Over-current during acceleration	Over-current during acceleration	1. Short-circuit at motor output: Check for possible poor insulation at the output lines 2. Torque boost too high: Decrease the torque compensation setting in Pr.07.02 3. Acceleration Time too short: Increase the Acceleration Time 4. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model
ocd	-	Over-current during deceleration	Over-current during deceleration	1. Short-circuit at motor output: Check for possible poor insulation at the output line 2. Deceleration Time too short: Increase the Deceleration Time 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model
ocn	-	Over-current during constant speed operation	Over-current during constant speed operation	1. Short-circuit at motor output: Check for possible poor insulation at the output line 2. Sudden increase in motor loading: Check for possible motor stall 3. AC motor drive output power is too small: Replace the AC motor drive with the next higher power model
EF	-	External fault	External fault	1. When multi-function input terminals (MI3-MI9) are set to external fault, the AC motor drive stops output U, V and W 2. Give RESET command after fault has been cleared

Code	Input on inverter	Alarm	Cause	Troubleshooting
cF1.0	-	Internal EEPROM can not be programmed	Internal error	Return to factory
cF1.1	-	Internal EEPROM can not be programmed	Internal error	Return to factory
cF2.0	-	Internal EEPROM can not be read	Internal error	1. Press RESET key to set all parameters to factory setting 2. Return to the factory
cF2.1	-	Internal EEPROM can not be read	Internal error	1. Press RESET key to set all parameters to factory setting 2. Return to the factory
cF3.0	-	U-phase error	Internal error	Return to factory
cF3.1	-	V-phase error	Internal error	Return to factory
cF3.2	-	W-phase error	Internal error	Return to factory
cF3.3	-	OV or LV	Internal error	Return to factory
cF3.4	-	Temperature sensor error	Internal error	Return to factory
cF3.5	-	Temperature sensor error	Internal error	Return to factory
OFF	-	Ground fault	Ground fault	When (one of) the output terminal(s) is grounded, short circuit current is more than 50% of AC motor drive rated current, the AC motor drive power module may be damaged NOTE: The short circuit protection is provided for AC motor drive protection, not for protection of the user 1. Check whether the IGBT power module is damaged 2. Check for possible poor insulation at the output line
cFA	-	Auto accel/decel failure	Auto accel/ decel failure	1. Check if the motor is suitable for operation by AC motor drive 2. Check if the regenerative energy is too large 3. Load may have changed suddenly
cE--	-	Communication error	No communication	1. Check the RS485 connection between the AC motor drive and RS485 master for loose wires and wiring to correct pins 2. Check if the communication protocol, address, transmission speed, etc. are properly set 3. Use the correct checksum calculation 4. Please refer to group 9 in the chapter 5 for detail information
codE	-	Software protection failure	Internal error	Return to factory
AErr	AVI-ACM	Analog signal error	No signal on ACI	Check the wiring of ACI
FbE	AVI-ACM	PID feedback signal error	No signal on ACI	1. Check parameter settings (Pr.10.01) and AVI/ACI wiring 2. Check for possible fault between system response time and the PID feedback signal detection time (Pr.10.08)
PHL	-	Phase loss	Loss of a input phase	Check input phase wiring for loose contacts
AUE	-	Auto tuning error	Auto tuning feature failure	1. Check cabling between drive and motor 2. Retry again
CP10	-	Communication time-out error on the control board or power board	Communication time-out	1. Press RESET key to set all parameters to factory setting 2. Return to the factory
PtC1	-	Motor overheat protection	Possible motor overheat	1. Check if the motor is overheat 2. Check Pr.07.12 to Pr.07.17 settings
PtC2	-	Motor overheat protection	Possible motor overheat	1. Check if the motor is overheat 2. Check Pr.07.12 to Pr.07.17 settings

START UP

Start up

The following operations must be carried out only by properly trained personnel. To make the **contractual warranty** effective, start up **must be carried out by authorized service centres**.
Before calling the service centre it is advisable to make sure that all the installation steps have been completed (positioning, electrical connections, hydraulic connections).

Preliminary operation

WARNING - Before you perform the checks listed below, please read carefully the section "Safety and Maintenance"
Verify that :
- the unit has not suffered visible damages due to transport or positioning
- the unit is placed on an horizontal surface able to bear its weight
- the minimum operating area are respected
- the ambient conditions comply with the provided operating limits
- the hydraulic and electrical connections has been carried out correctly

Electrical cheks
Verify that the unit power supply line complies with the regulations in force. Check that the section of power cables are suitable to withstand the overall absorption of the unit (see electrical data), and that the unit has been properly grounded.

Check that all electrical connections are well fixed and all terminals properly tightened.
Switch on the unit by turning the switch in position ON . The display will light a few seconds after power up , check the operating status of both Std -by or off (via keyboard). A wrong sequence of the power supply phases is immediately detected by the phase sequence controller (standard on all the three phase power supply units) and reported on the display of the unit. To eliminate the error switch each other two phases of the power supply line.
Verify that:
- the voltage of the power supply line complies with the the nominal one of the unit
- for three phase power supply units, the unbalance between the phases is lower than 3% (a higher value produces an excesive current input on one or more phases causing possible damages to the electrical components of the unit)

NOTE. *Example of phase unbalance calculation*

- Read the value of the three line voltages using a voltmeter :
  line voltage between phases L_1 and L_2 : V_{1-2} = 390 V
  line voltage between phases L_2 and L_3 : V_{2-3} = 397 V
  line voltage between phases L_3 and L_1 : V_{3-1} = 395 V
- Calculate the difference between the maximum and minimum value of the measured line voltages :
  $\Delta V_{max} = \max(V_{1-2}; V_{2-3}; V_{3-1}) - \min(V_{1-2}; V_{2-3}; V_{3-1}) = V_{2-3} - V_{1-2} = 397 - 390 = 7$ V
- Calculate the average line voltage value :
  $\Delta_{average} = (V_{1-2} + V_{2-3} + V_{3-1}) / 3 = (390 + 397 + 395) / 3 = 394$ V
- Calculate the percentage unbalance value :
  $\Delta V_{max} / V_{average}$ x 100 = 7 / 394 x 100 = 1,78 % < 2 %

Check that the connections made by the installer comply with the data reported here .
If present, check that the resistance of the compressors oil crankase are operating, by measuring the temperature rise of the oil crankase. The resistance / s must be in operation for at least 24 hours before starting the compressor , and in each case the temperature of the oil crankase must be 10 - 15 ° C higher than the ambient temperature .
WARNING - At least 24 hours prior to the operation of the unit (or at the end of each period of prolonged pause) the unit must be powered in such a way as to allow the heating elements of the compressor crankcases to evaporate the refrigerant present in the oil. Failure to do so may cause serious damage to the compressor and will void the warranty.

Hydraulic circuit checks
Check that all hydraulic connections are executed correctly: Refer to the installation manual.
Check that the hydraulic system is filled, under pressure and air free (possibly vent it).
Make sure that any shutoff valves present in the system are properly open.
Make sure that the circulation pump is running and that the water flow is sufficient to close the contact of the differential pressure and / or flow switches .
Check the correct operation of the differential pressure and / or flow switches: close the shutoff valve at the outlet of the heat exchanger, the unit display must show the alarm message, eventually reopen the valve and reset the alarm.

Turning on
ATTENTION . The operation must be agreed in advance depending on the timing of construction of the plant . Before the intervention of Service Department all works (electrical and plumbing connections , water filling and air vent of the plant) will have been completed.
Start all the plant components necessary to guarantee an adequate water flow rate on the plant hydraulic circuit.
Activate the unit in cooling or in heating mode operating on the user interface and setting a set point suitable to require the unit to work.

Refrigerant circuit checks
The vibrations during transport , may have loose connections : check for leaks of refrigerant gas especially at the refrigerant pressure taps , pressure transducers and pressure switches.
After a short period of operation, check the oil level of the compressor (if present siight oil) and the absence of bubbles in the glass of liquid indicator (if present) . The continuous passage of vapor bubbles may mean that the refrigerant charge is low or that the expansion valve is not properly adjusted. The presence of bubbles in the running for short periods , however, is possible.

Evaporation and condensation temperature
Verify that:
- the saturation temperature (dew point) corresponding to the condensing pressure is about 10-15°C higher than the outdoor air temperature in cooling and about 5°C higher than the water outlet temperature in heating
- the saturation temperature (dew point) corresponding to the evaporating pressure is about 5°C lower than the water outlet temperature in cooling and about 5-10°C lower than the outdoor air temperature in heating

Superheat
Check the superheat comparing the temperature measured with a contact thermostat fitted to the compressor suction pipe , with the temperature shown on the low pressure gauge (saturation temperature corresponding to the evaporation pressure) . The difference between these two temperatures gives the value of the superheta. The optimal values are between 4 and 8 ° C.

Subcooling
Check the subcooling comparing the temperature measured with a contact thermostat on the pipe outlet of the condenser , with the temperature shown on the pressure gauge of high pressure (saturation temperature corresponding to the condensation pressure) . The difference between these two temperatures gives the value of subcooling . The optimal values are between 4 and 5 ° C, for reversible units with subcooler in the coil the optimal values are between 10 and 20 ° C depending on the external air temperature .

Discharge temperature
If the values of subcooling and superheat are regular, the temperature measured at the outlet of the compressor discharge pipe must be:
- Units charged with R410A of 30/40 ° C higher than the condensing temperature
- Units charged with R134a of 15/20 ° C higher than the condensing temperature .

Hydraulic circuit check
- the difference between the water inlet and outlet temperature from the plate heat exchanger of the unit is inside the limits provided.

Electrical setting check
- the current absorbed by the compresor and the fans is lower than the maximum value admitted (FLA), as indicated in the section "Technical data and performances"

SAFETY AND MAINTENANCE

Basic safety rules

Recall that the use of products that use electricity and water entails the observance of some basic safety rules , such as: This appliance is not intended for use by persons (including children) with reduced physical , sensory or mental capabilities or lack of experience and knowledge, unless supervised or instructed on the use of the appliance by a person responsible for their safety . Children should be supervised to ensure that they do not play with the appliance.

It is forbidden to any technical intervention or maintenance without first disconnecting the unit from the mains supply by moving the master switch and the main control panel to “Off” .
You may not modify safety equipment or settings.
Do not pull, detach or twist the electrical cables coming from the unit even if it is disconnected from the mains supply.
It is forbidden to leave containers of flammable substances near the unit.
Do not touch the appliance when barefoot or with wet or damp parts of the body .
It is forbidden to open the doors of access to the internal parts of the unit without first ensuring that the system switch to “Off”.
Not dispose of, abandon or leave within reach of children packaging materials as it can be a potential source of danger.

IMPORTANT SAFETY INFORMATION
There is no guarantee proper operation as a result of a fire, before restarting the machine, contact an authorized service center. If equipped with safety valves refrigerant, in case of excessive pressure the safety valves can discharge high temperature refrigerant gas to the atmosphere. Wind, earthquakes and other natural phenomena of exceptional intensity were not considered. When using the unit in an aggressive atmosphere and or with aggressive water consult the factory.

Residual Risks

The machine has been designed with a view to reducing the risks to persons and the environment in which it is installed, to the minimum. To eliminate residual risks, it is therefore advisable to become as familiar as possible with the machine in order to avoid accidents that could cause injuries to persons and/or damage to property.

a. Access to the unit
Only qualified persons who are familiar with this type of machine and who are equipped with the necessary safety protections (footwear, gloves, helmet, etc.) may be allowed to access the machine. Moreover, in order to operate, these persons must have been authorized by the owner of the machine and be recognized by the actual Manufacturer.

b. Elements of risk
The machine has been designed and built so as not to create any condition of risk. However, residual risks are impossible to eliminate during the designing phase and are therefore listed in the following table along with the instructions about how to neutralize them.

Part in question	Residue hazard	Mode	Precautions
Compressor and delivery pipe	Burns	Contact with the pipes and/or compressor	Avoid contact by wearing protective gloves
Delivery pipes, heat recovery exchanger and coils	Explosion	Excessive pressure	Turn off the machine, check the high pressure switch and safety valve, the fans and condenser
Pipes in general	Ice burns	Leaking refrigerant	Do not pull on the pipes
Electrical cables, metal parts	Electrocution, serious burns	Defective cable insulation, live metal parts	Adequate electrical protection (correctly ground the unit)
Heat exchange coils	Cuts	Contact	Wear protective gloves
Fans	Cuts	Contact with the skin	Do not push the hands or objects through the fan grille

Disconnection and disposal

The machine contains lubricating oil and refrigerant gas for which, during the destruction of the unit, these fluids will be recovered and disposed of in accordance with the rules in force in the country where it is installed.
During the disconnection thus avoid spills or leaks of refrigerant gas and of the plant water if treated with additives or antifreeze substances.
The machine must not be abandoned in the process of destruction, but it can also be stored outdoors with gas, water and electrical circuits intact and closed.
For dismissing and disposal, deliver the units to specialized centres according to your national laws.

General recommendations about the R410A refrigerant used

1 SUPPLIER COMPANY AND PRODUCT IDENTIFICATION

Card No.	FRIG 8
Product	R-410A
Supplier company identification	RIVOIRA SpA

2 COMPOSITION / INFORMATION ON INGREDIENTS

Substance / Preparation	Preparation
Components / Impurities	Contains the following components : Difluoromethane (R32) 50 % in weight Pentafluoroethane (R125) 50 % in weight
EEC No.	Non-applicable for mixtures
Trade-name	/ /

3 IDENTIFICATION OF HAZARDS

Identification of hazards	Liquefied gas. The vapours are heavier than air and can cause suffocation, reducing the oxygen available for breathing. Rapid evaporation of the fluid can cause freezing. Can cause cardiac arrhythmia.

4 FIRST-AID MEASURES

Inhalation	Do not administer anything if the person has fainted. Take the person outdoors. Use oxygen or artificial respiration if necessary. Do not administer adrenaline or similar substances.
Contact with eyes	Rinse thoroughly with plenty of water for at least 15 minutes and see a doctor.
Contact with skin	Wash immediately with plenty of water. Immediately remove all contaminated garments.
Swallowing	

5 FIRE-PREVENTION MEASURES

Specific hazards	Increase in pressure.
Dangerous fumes	Halogen acids, traces of carbonyl halides.
Fire-extinguishing means usable	All the known fire-extinguishing means can be used.
Specific methods	Cool the containers/tanks with water sprays.
Special protection equipment	Use self-contained breathing apparatus in confined spaces.

6 MEASURES AGAINST ACCIDENTAL SPILLING OF THE PRODUCT

Personal protection	Evacuate personnel to safe areas. Provide for adequate ventilation. Use personal protection equipment
Protection for the environment	It evaporates.
Product removal methods	It evaporates.

7 HANDLING AND STORAGE

Handling and storage	Ensure an adequate air change and/or extraction in the workplaces. Only use well-ventilated rooms. Do not breathe vapours or aerosols. Carefully close the containers and keep them in a cool, dry and well-ventilated place. Keep in the original containers.
Incompatible products	Explosives, flammable materials, organic peroxides.

8 CONTROL OF EXPOSURE / PERSONAL PROTECTION

Personal protection	Ensure adequate ventilation, especially in closed areas.
Control parameters	Difluoromethane (R32): Recommended exposure limits: AEL (8h and 12h TWA) = 1000 ml/m3 Pentafluoroethane (R125): Recommended exposure limits: AEL (8h and 12h TWA) = 1000 ml/m3
Respiratory tract protection	For rescue and for maintenance works in tanks, use self-contained breathing apparatus. The vapours are heavier than air and can cause suffocation, reducing the oxygen available for breathing.
Eye protection	Total protection glasses.
Hand protection	Rubber gloves.
Hygiene measures	Do not smoke.

9 CHEMICAL-PHYSICAL PROPERTIES

Relative density, gas (air=1)	Heavier than air.
Solubility in water (mg/l)	Not known, but deemed very low.
Appearance	Colourless liquefied gas.
Odour	Similar to ether.
Fire point	Does not ignite.

10 STABILITY AND REACTIVITY

Stability and reactivity	No decomposition if used according to the special instructions.
Materials to be avoided	Alkali metals, alkali-earth metals, granulated metal salts, Al, Zn, Be, etc. in powder.
Hazardous products of decomposition	Halogen acids, traces of carbonyl halides.

11 TOXICOLOGICAL INFORMATION

Local effects	Concentrations substantially above the value TLV (1000 ppm) can cause narcotic effects. Inhalation of highly concentrated products of decomposition can cause respiratory insufficiency (pulmonary oedema).
Long-term toxicity	No carcinogenic, teratogenic or mutagenic effects have been recorded in experiments on animals.
Specific effects	Rapid evaporation of the fluid can cause freezing. Can cause cardiac arrhythmia.

12 ECOLOGICAL INFORMATION

Effects linked to ecotoxicity	Pentafluoroethane (R125) Potential global warming with halocarbides; HGWP (R-11 = 1) = 0.84 Potential impoverishment of the ozone; ODP (R-11 = 1) = 0

13 CONSIDERATIONS ON DISPOSAL

General	Do not dispose of where accumulation can be hazardous.
	Usable with reconditioning.
	The depressurised containers must be returned to the supplier.
	Contact the supplier if instructions for use are deemed necessary.

14 INFORMATION FOR TRANSPORT

Designation for transport	LIQUEFIED GAS N.A.S. (DIFLUOROMETHANE, PENTAFLUOROETHANE)
UN No.	3163
Class/Div	2.2
ADR /RID No.	2, 2nd A
ADR/RID hazard no.	20
ADR label	Label 2 : non-toxic non-flammable gas.
CEFIC Groupcard	20g39 - A
Other information for transport	Avoid transport on vehicles where the loading zone is not separate from the cab. Make sure the driver is informed about the potential risk of the load and knows what to do in case of accident or emergency. Before starting transport, make sure the load is properly secured and : make sure the valve of the container is closed and does not leak; make sure the blind cap of the valve (when provided) is correctly fitted; make sure the cap (when provided) is correctly fitted and that there is an adequate ventilation passage; ensure compliance with the current provisions.

15 INFORMATION ON REGULATIONS

The product must not be labelled according to Directive 1999/45/EC.
Comply with the regulations given below, and the relevant applicable updates and amendments.
Circulars no. 46/79 and 61/81 of the Ministry of Labour : Risks related to the use of products containing aromatic amines
Leg. Decree no. 133/92 : Regulations on the discharge of hazardous substances in waters
Leg. Decree no. 277/91 : Protection of workers against noise, lead and asbestos
Law 256/74, Decree 28/1/92, Leg. Decree no. 52 dated 3/2/97, Decree dated 28/4/97 as amended : Classification, packing and labelling of hazardous substances and preparations
Decree no. 175/88, as amended : Activities with significant accident risks (Seveso Law)
Decree no. 203/88 : Emissions into the atmosphere
Decree no. 303/56 : Work hygiene
Decree no. 547/55 : Regulations on accident prevention
Leg. Decree no.152 dated 11/5/99 : Protection of waters

16 OTHER INFORMATION

Recommended uses Refrigerant
Can cause suffocation in high concentration.
Keep in a well-ventilated place.
Do not breathe the gas.
The risk of suffocation is often underestimated and must be clearly explained during the training of operators.
Ensure compliance with all the national and regional regulations.
Before using this product in any new process or trial, an in-depth study on safety and compatibility of the product with the materials must be carried out.
The above information is based on our current know-how and describes the product according to the safety requirements. It does not however represent a guarantee and assurance of the qualities in a legal sense. Each person responds personally for compliance with such regulations.

First aid

• Move the victim away from the toxic source, keep him warm and allow him to rest.
• Administer oxygen if necessary.
• Proceed with artificial respiration if necessary.
• Give heart massage in the case of heart failure.
• Immediately seek medical help.

Contact with the skin:
• Immediately thaw the affected parts under running lukewarm water.
• Remove contaminated clothing (garments may stick to the skin in the case of ice burns) if they have not adhered to the skin.
• Seek medical assistance if necessary.

Contact with the eyes:
• Immediately rinse the eyes with physiologic eyewash or clean water for at least 10 minutes with the eyelids pulled open.
• Seek medical assistance if necessary.

Swallowing:
• Do not make the victim vomit. If the victim is conscious, have him rinse his mouth out with clean water and then drink 200, 300 ml of water.
• Immediately seek medical help.
• Do not administer adrenaline or sympathomimetic drugs after exposure owing to the risk of cardiac arrhythmia.
For further information about the characteristics of the refrigerant, consult the technical briefs that can be obtained from manufacturers of refrigerant products.

General Rules for Maintanance

The maintenance is extremely important for the functioning of the system and the regular working of the unit over time.
In accordance with the European Regulation EC 303/2008 , it should be noted that companies and engineers in maintenance , repair, leak testing and recovery / recycle refrigerant gases should be CERTIFIED in accordance with local regulations.
Maintenance must be performed in compliance with the safety rules and tips given in the manual supplied with the unit.
Routine maintenance helps maintain unit efficiency, reduce the rate of deterioration which each device is subject in time and gather information and data to understand the efficiency of the unit and prevent failures.
For extraordinary maintenance or in case you need service , contact only to a specialized service center approved by the manufacturer and use original spare parts.
In accordance with the European Regulation EC 1516/2007 it is necessary to prepare a “equipment record”.
Provide anyway a databook (not supplied) that allows you to keep track of interventions made on the unit; in this way it will be easier to properly program the various interventions and will facilitate a possible troubleshooting.
Bring on the databook : date, type of intervention made, description of the intervention , measurements , reported anomalies , alarms recorded in the alarm history , etc. ...

Routine maintenance

The inspections described below, to which the unit must be subjected, do not require specific technical know-how.
They merely include a few simple inspections involving certain parts of the unit.
The table below gives a recommended list of inspections which should be carried out at the indicated intervals.
Provide controls and interventions more frequently in case of heavy (continuous or intermittent high, close to operating limits, etc ...) or critical (essential service such as data centres, hospital etc ...) use.

DESCRIPTION	WEEKLY	MONTHLY	EVERY SIX MONTHS
Visual inspection of the unit			•
Inspection of hydraulic circuit		•	
Inspection of electrical system		•	
Inspection of condensing system		•	
Inspection of the water heat exchanger			•
Inspection of the water filter		•	
Inspection of the water pumps (if present)			•
Reading and adjustment of the operating parameters	•		

• Visual inspection of the structure of the unit
When checking the condition of the parts that form the structure of the unit, pay particular attention to the parts liable to rust.
If traces of rust are noted, they must be treated with rust-inhibitor paint in order to eliminate or reduce the problem.
Check to make sure that the external panels of the unit are well fixed.
Bad fixing gives rise to noise and abnormal vibrations.

• Inspection of hydraulic circuit
Check visually to make sure that there are no leaks in the hydraulic circuit. Check that water filters are clean.

• Inspection of electrical system
Make sure that power cables that supply the unit are not torn, cracked or damaged in a way that could impair its insulation.

• Inspection of the ventilated condensing/evaporating section
WARNING: The finned pack exchanger has fins made of aluminium or some other thin material, thus even accidental contact could cause cuts.

Condensing/Evaporating coils
In view of the function of this component, it is very important for the surface of the exchanger to be as free as possible from clogging caused by items that could reduce the fan’s air flow rate and, thus, the performances of the unit itself.
The following operations may be required:
- Remove all impurities (such as paper scraps, leaves, etc.) that could be clogging the surface of the bank either by hand or using a brush (comply with the above mentioned safety prescriptions).
- If the dirt has deposited on the fins and is difficult to remove by hand, use a flow of compressed air or pressurized water on the aluminium surface of the coils, remembering to direct the flow in a vertical and opposite to the standard flow direction to prevent the fins from being damaged.
- “Comb” the coils with the relative tool, using the appropriate comb spacing for the fins if some parts of them are bent or squashed.

Axial fans
Visually inspect these parts to make sure that the fans are well fixed to the bearing grille and that this latter is fixed to the structure of the unit. Check the fan bearings, and close the terminal box and cable glands. Bearings damaged and bad fixing are the source of abnormal noise and vibrations,

• Inspection of the water heat exchangers
The exchangers must ensure the maximum heat transfer possible so keep them clean and free from dirt that may reduce efficiency; make sure that the temperature difference between water outlet temperature and evaporation/condensation does not increase over time, if the difference exceeds 8 -10 ° C it is necessary to proceed cleaning the water side of the exchanger, keeping in mind the following: water circulation must be in the opposite direction than normal, the fluid velocity does not exceed 1.5 times the nominal velocity and use just water or moderately acid products but only water for final washing.

• Inspection of the water filters
Make sure to clean the filter and remove any impurities that block the proper flow of water, contributing to increase pressure drop and therefore energy consumption of the pumps. Refer to the section “Hydraulic Connections” too.

• Inspection of the water pumps
Check water leakages, the state of the bearings, the closing of the terminal box and integrity of the cable. Bearings damaged and bad fixing are the source of abnormal noise and vibrations,

• Reading and adjustment of the operating parameters
This control can be done using the pressure gauges (if installed) of the refrigerant circuits and using the pressure and temperature gauges (if installed) of the hydraulic circuits of the unit (evaporator + heat recovery - if present)

NOTE:
FOR THE PLANT WATER FILL AND DRAIN REFER TO THE SECTION HYDRAULIC CONNECTIONS

CAUTION
As a result of extraordinary maintenance on the cooling circuit with component replacement, before restarting the machine, perform the following steps:
- Pay attention to restore the refrigerant charge indicated on the name plate of the machine.
- Open all the ball valves in the refrigerant circuit.
- Correctly connect the power supply and grounding.
- Check the hydraulic connections.
- Check that the water pump is working properly.
- Clean water filters.
- Check that the finned coils are not dirty or clogged.
- Check the proper rotation of fans.

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