Liebert® HPC-S Adiabatic

Adiabatic Freecooling Chillers from 170 to 400kW

User Manual

English, 265434MAN_ENG, rev. C - 10.06.2025
This document, written in English, is the original version

1 - Introduction

1.1 - Foreword

The handbook and all the documents supplied with the system are aimed at enabling both the installer and the operator to carry out correctly installation, control and maintenance operations on the chiller unit, without damaging it or harming the relevant staff.
The handbook and the supplied documents are thus an aid for the skilled staff to arrange the special outfit so as to install, operate and maintain the machine correctly according to the local norms in force.
The handbooks, wiring diagrams and documents enclosed to the machine must be read and kept for the whole system life.
The **Liebert® HPC-S Adiabatic** water chillers can be identified as follows:

FGA 017

Cooling Capacity:
Cooling Capacity (x 10 = kW)

Adiabatic:
A = Adiabatic precooler system

Versions:
G = High efficiency class version

Execution:
C = Air cooled Chiller
F = Freecooling Chiller

1.2 - Responsibility

Vertiv™ accepts no present or future responsibility for damage to persons, things or to the machine itself due to operators' negligence, failing to comply with the installation, operation and maintenance instructions of this handbook, failed application of the safety norms in force for the system and the qualified staff charged with the operation and maintenance.

1.3 - General description

Liebert® HPC-S Adiabatic units with air cooled condensers have been designed and manufactured for producing chilled water.

They are also available in versions with a built-in freecooling module, with a pump assembly installed on the machine and/or inertial buffer tank inside the machine; the chilling units can be equipped with several options indicated in the price list.
The **Liebert® HPC-S Adiabatic** product line has been designed considering the state-of-the-art techniques available nowadays in the industry, and includes all the components necessary for automatic and efficient operation.
Each unit is completely factory assembled; after evacuation, the necessary quantity of refrigerant is added to the refrigerant circuit(s) and the unit is tested.
All the units are equipped with two independent refrigerating circuits, each one composed of: an air cooled condenser, a hermetic Scroll compressors and a braze-welded plate evaporator.
The components of the liquid line are the charging valves, filters dryers, shut-off valve, moisture indicator and electronic expansion valve.
The hydraulic circuit - with max. working pressure 6 bar - is made up of carbon steel pipes connected with grooved-end (Victaulic™) fittings and couplings and include also a flow switch and, in the freecooling versions, chilled water coils and a three-way valve.
The hermetic scroll compressors are complete with the followingprotection/safety devices: oil heater, electronic protection monitoring the temperature of the motor windings and the direction of rotation (the latter may be enclosed in the electronics of the compressor or external, depending on the model). The **Liebert® HPC-S Adiabatic** water chillers are controlled by the "iCOM™" microprocessor, managing all the unit operating conditions. The user can change and/or modify the operating parameters through the display keyboard installed on the electrical panel.
The electrical control board is equipped with all the safety and operating devices required for reliable operation. The compressor motors are equipped with protection on all three phases and are started by three-pole contactors.

2 - Preliminary Operations

2.1 - Packing removal

Remove the polythene package caring not to damage the unit.
Dispose of the package materials delivering them to specialized collection or recycling centers (comply with the local norms in force).

2.2 - Inspection

All the units are assembled and wired in the producing factory.
Before shipment they are charged with the necessary quantities of refrigerant and oil and then tested under the operating conditions required by the customer. The freecooling coils are supplied dry to avoid possible problems due to the frost in the storage period.
Immediately inspect the machine carefully on delivery to check for damage during transportation or missing components; possible claims must be made immediately to the carrier and the factory or its representative.

2.3 - Operating range

Refer to the table "*Tab. 3 - Operating range*" showing the limits for each model; contact your dealer for different values.

2.3.1 - Outer air temperature

The units are designed to operate at:
- Min. temperatures:
  -25° C for Freecooling;
- Max. temperatures:
  depending on the model as indicated in the table "*Tab. 3 - Operating range*".
  All working limits refer to steady state operation mode.

Note:
Avoid positioning in areas with strong dominant winds that may impair the operation and effect the indicated limits.
Such limits are considered for new machines or machines that have been correctly installed and maintained.

The units are designed to be stored at:
- Temperatures: +0°C / +45°C Ask your Vertiv™ representative for T < 0°C;
- Humidity: 80% R.H., not condensing.

2.3.2 - Water circuit

- Maximum water flow allowed: depending on the pressure drop corresponding to the required thermal difference (usually not lower than 3.5°C - 4°C);
- Minimum allowed water flow: compatible with a sufficient evaporation temperature, to avoid the intervention of the safety devices (to be evaluated for a thermal difference not higher than 8°C);
- Temperature range of the water exiting the evaporator: 4°C - 15°C;
- Maximum temperature of the water entering the unit: 20°C; higher temperatures are allowed only at the system start-up and not during normal operation;

- allow maximum outlet water temperature of 20° C and maximum water return temperature of 26° C.
- Maximum glycol concentration: 50% (35% with the optional pump assembly installed on the machine);
- Minimum allowed glycol concentration: depending on the minimum temperature of the ambient air expected at the installation site (see *Tab. a*);
- Maximum pressure of the hydraulic circuit: 6 bar; take care that this limit is independent of presence / absence of pumps fitted on the unit, so it's necessary to check the max pump static head (indicated on pump's nameplate) and pressurized the water circuit never more than 6 barg – max. pump static head.

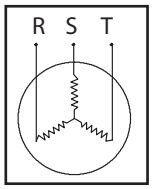
2.3.3 - Power supply

Electrical panel designed according to CEI EN 60204-1 "Safety of machinery - Electrical equipment of machines".

- Voltage: in standard operating conditions, from 0.9 to 1.1 times the rated voltage.
- Frequency: from 0.99 to 1.01 times the rated frequency continuously.
- Voltage unbalance: must be lower than 2%.

The Fig. a shows a calculation example of the voltage unbalance.

1) The 400 V supply has the following variability:
RS = 388 V
ST = 401 V
RT = 402 V



2) The average voltage is:

$$\frac{388 + 401 + 402}{3} = 397$$

3) The maximum deviation from the average is:
402 - 397 = 5 V

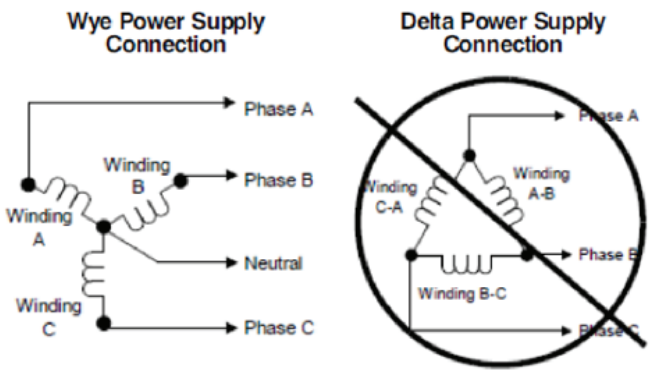
4) The phase to phase variability is:

$$\frac{5}{397 \times 100} = 1.26 \text{ (acceptable)}$$

NOTE:
Three-phase electric power

Requirements:
The **Liebert® HPC-S Adiabatic** units are equipped with electrical devices (EC motors, power supplies module, inverter pumps, control devices, etc.) that are designed to operate properly with Star-connected power (Wye) with earthed neutral (TN or TT system).
Three-phase distribution Delta-connected (Δ) or Star-connected power (Wye) without ground or floating ground (IT) contact **Vertiv™**.

Wye (Y) vs. Delta (Δ) power supply connection diagram.



Acceptable power supply (TT, TN-S, TN-C, TN-C-S systems):
- 400V Wye with solidly grounded neutral (230V line to ground).

Unacceptable power supply:
- 400 V Wye without ground connection or with high-resistance (or impedance) ground (IT).
- 400 V Δ without ground or with high-resistance (or impedance) ground (IT).
- 400 V Δ with corner ground or with grounded center-tapped.

2.4 - Sound pressure levels

Tab. 5 - "Sound pressure levels" shows the noise data for the units in standard configuration (without pumps) with and without PAD, operating continuously and measured according to the ISO 3744 norm, in free field conditions.
The highest noise levels are detected on the coil side.

Note:
Avoid positioning in areas with possible reverberation of the sound waves, which can adversely effect the noise levels.

2.5 - Transport

- If the unit is shipped with a container, for extracting, follow the instructions placed on the front panel;
- Handle the unit by lifting it with a crane from above;
- The lifting holes are positioned in the frame's base (when lifting use spreader bars to protect the side, see *Fig. 3*).

N.B:
Place the lifting tubes (optional) in the holes in the base indicated with "**LIFT HERE**". Lock the ends of the tubes in position with the ring nut, as shown in *Fig. 3*, using 60 mm span. The capacity of the lifting gear must be adequate to lift the load in question. Check the weight of the units, the capacity of the lifting gear and ropes and the condition and suitability of the aforementioned equipment.

2.6 - Foundations

- The unit must be placed on a level surface which will support its weight.
- If necessary, position the unit on suitable anti-vibration supports (see *Fig. 7*) that can be supplied as an option (in rubber or spring- type).

Attention
- Position the anti-vibration supports on the ground, lower the unit on them and at the end fix the anti-vibration supports to the unit itself.
- Refer to the manual "Installation of the spring anti-vibration supports" for their correct positioning.
- When positioned, level the unit and bolt it to the floor.

Note:
For weight distribution see *Fig. 5*.

Note:
The weights and their distribution refer to standard units with/without tank but without options; if the pump assembly, or other options are installed on the machine, add the weights of the installed accessories to those of the standard units (see *Tab. 7 - Application consideration*).

2.7 - Service area

- In order to allow free air flow and maintenance of the unit, a minimum area must be left free of obstructions around the unit (see *Fig. 1*).
- The hot air expelled by the fans must be allowed to rise unimpeded by obstacles for a minimum height of 2.5 m.
- Avoid recirculation of hot air between the suction and discharge, otherwise the unit performance may be impaired or the standard operation can be interrupted.

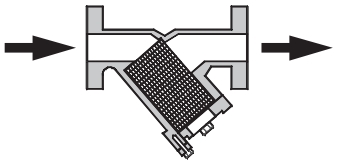
3 - Installation

3.1 - Hydraulic connections

3.1.1 - Hydraulic circuit construction (Fig. b)

The piping must be connected to the chiller. Construct a chilled water circuit as described below, see *Fig. b*:

1. Place shut-off valves within the circuit to allow servicing;
2. Install a pump system suitable for the flow rate required at a pressure head equal to the sum of all the pressure drops (see project data).
   Liebert® HPC-S Adiabatic chillers can be equipped, upon request, with pumps having performance as indicated in *Tab. 4*;
3. Install manometers at the chiller inlet/outlet;
4. Install thermometers at the chiller inlet/outlet;
5. Connect the pipes to the chiller by flexible joints to avoid transmitting vibrations and to balance the thermal expansion; proceed in the same way even if the pump set is outside the chiller;
6. It is useful to include a water pressure switch to give an early warning of low water pressure;



7. Place a mesh filter at the inlets of the pump and water chiller (Can be supplied as an optional accessory - not fitted). If the fluid contains particles larger than1 mm (0,04 inch), we recommend that a strainer with a size of 14-20 mesh (number of openings per inch) is installed before the exchanger. The particles could otherwise block the channels, causing bad performance, increased pressure drop and risk of freezing;
8. Install at the highest points in the circuit, apparatus which allows the bleeding of air and possibly the filling of glycol;
9. Place a drain valve at the lowest point in the circuit and immediately at the outlet of the water chiller;
10. Install a water filling set including the following:
    a. filling water meter;
    b. manometer;
    c. non-return valve;
    d. air separator;
    e. removable supply tube, which must be disconnected after each charge/top-up;
11. For maximum protection ensure that all tubing exposed to low outdoor temperatures is fitted with anti-freeze heaters and insulated using closed cell synthetic rubber (elastomer);
12. The circuit must include an expansion vessel (with safety valve) of suitable capacity;
13. Connect the lines avoiding stresses on the machine inner parts.

Note:
If the water chiller is complete with an expansion vessel (supplied as an option), check if the capacity is enough, and install a second vessel in the circuit, if required (see par. 8.3).
Follow the indications in Fig. d for the correct sizing.
Note:
The whole circuit must contain a water volume suitable for the capacity of the installed chiller. Check if the inertial capacity given by the sum of the hydraulic volume inside the machine (including the volume of the optional interna tank, if fitted) and the system volume is sufficient, or possibly install a tank in the circuit. Follow the indications in Fig. c for the correct sizing.
Note:
The hydraulic circuit must ensure a constant water supply to the evaporator in every operating condition. Otherwise, the compressors may be damaged by repeated returns of liquid refrigerant on their suction.

Note:
If multiple chiller are installed in parallel on hydraulic circuit, it's recommend to install a water check valve (optional kit) on the water delivery of each chiller before the connection to the main hydraulic header.
Note:
In the chiller with pumps and in all freecooling units, water quality has to be in accordance with VDI 2035.

3.1.2 - Additional of water and ethylene glycol

Very important:

Add water and ethylene glycol to the circuit with a % depending on the minimum temperature of the outside air expected at the installation site. Do not exceed the nominal operating pressure of the circuit's components.

Notes:

- To avoid stratification run the circulation pump for at least **30** minutes after adding any glycol. If the pumps are fitted on the chiller, they have to be run all together.
- Water glycol fluid mixture has to be circulated inside the chiller hydraulic parts including freecooling coils and by - pass pipes; in order to do it move the 3-way valve on both positions for the time necessary.
- After adding water to the hydraulic circuit always disconnect the water supply coming from the sanitary supply; this avoids the danger of glycol entering the sanitary water system.
- After any topping-up of the water check the concentration and add glycol if necessary.

3.1.3 - Water-glycol mixture

Water-glycol mixtures are used as the thermal carrier fluid in very cold climates or with temperatures below zero degrees centigrade. Determine the ethylene glycol % which must be added to the water, with the assistance of *Tab. a*.

Tab. a - Ethylene glycol to be added to water (% in weight of total mixture)

Ethylene glycol (% in weight)	0	10	20	30	40	50
Freezing temperature,^{0}C (*)	0	-4.4	-9.9	-16.6	-25.2	-37.2
Mixture density at 20 ^{0}C (*), kg/l	-	1.017	1.033	1.048	1.064	1.080

(*) Values are for Clariant Antifrogen N. For different brands, check manufacturer's data.

For the chiller internal water volume refer to *Tab. 1*. If the optional buffer tank is installed on the machine, add the tank hydraulic volume.

ALWAYS CHARGE THE HYDRAULIC CIRCUIT WITH THE REQUIRED GLYCOL % NECESSARY FOR THE MINIMUM AMBIENT TEMPERATURE AT THE INSTALLATION SITE.
FAILING TO COMPLY WITH THIS INSTRUCTION SHALL INVALIDATE THE UNIT WARRANTY.

3.1.4 - Protection and cleaning of the evaporator and components of hydraulic circuit

It is the user's responsibility to establish the quality of the water and make sure that this is compatible with the materials used in the hydraulic components and exchangers. The quality of water may significantly affect the operation and the life of the exchangers. The first step in the planning the treatment of the water is chemical analysis, which must be performed by qualified personnel from specialist organizations. Exchangers cleaning may be performed only with chemical method, using commercially - available products with a dual action, that is, the removal of the scale and the prevention of corrosion.

In the chiller with pumps and in all freecooling units, water quality

has to be in accordance with VDI 2035.

The oxygen dissolved in water increases the rate of corrosion.

The main factors causing corrosion are sulphur and carbon dioxide acids (see the Langelier and Ryznar indices). A combined effect of fouling due to dust and organic material provides a support for bacteria, fungi and algae; the growth of organisms may produce an oxygen gradient and this results in rather severe pitting of the metallic surface. The phenomenon of corrosion is obviously related to the material used on the liquid side of the heat exchanger. The following table shows the reference values for corrosion on copper, these values must be considered as guidelines to avoid corrosion.

In winter, if the system is stopped, the water inside the exchangers can freeze damaging the system irreparably; thus, it is recommended to use glycol mixtures (see following paragraphs: please consider the different outputs and absorption by the chiller, the pump sizing and the performance of the system terminals/conditioners) or drain the system completely, using the suitable cocks arranged in the exchangers and in the circuit, trying to drain the water residues blowing air in the lines.

Tab. b - Water component for corrosion limit on Copper

pH	-	7.5 ÷ 9.0
SO_4	ppm	< 100
HCO_3 / SO_4	-	> 10
Total hardness	dH	4.5 ÷ 8.5
CJ-	ppm	< 50
PO_4^{3-}	ppm	< 2.0
NH_3	ppm	< 0.5
Free Chlorine	ppm	< 0.5
Fe^{3+}	ppm	< 0.5
Mn^{++}	ppm	< 0.05
CO_2	ppm	< 50
H_2S	ppb	< 50
Temperature	°C	< 65
Oxygen content	ppm	< 0.1

3.2 - Connection of the safety valve discharge

Safety valves are installed on the high pressure side of the refrigeration circuit: the discharge of these valves must be conveyed outside through a suitable pipe, having a diameter of at least that of the valve outlet, without burdening the valve body.
Convey the discharge to areas where the jet cannot harm people and the surrounding environment.

Fig. b - Ideal chilled water circuit

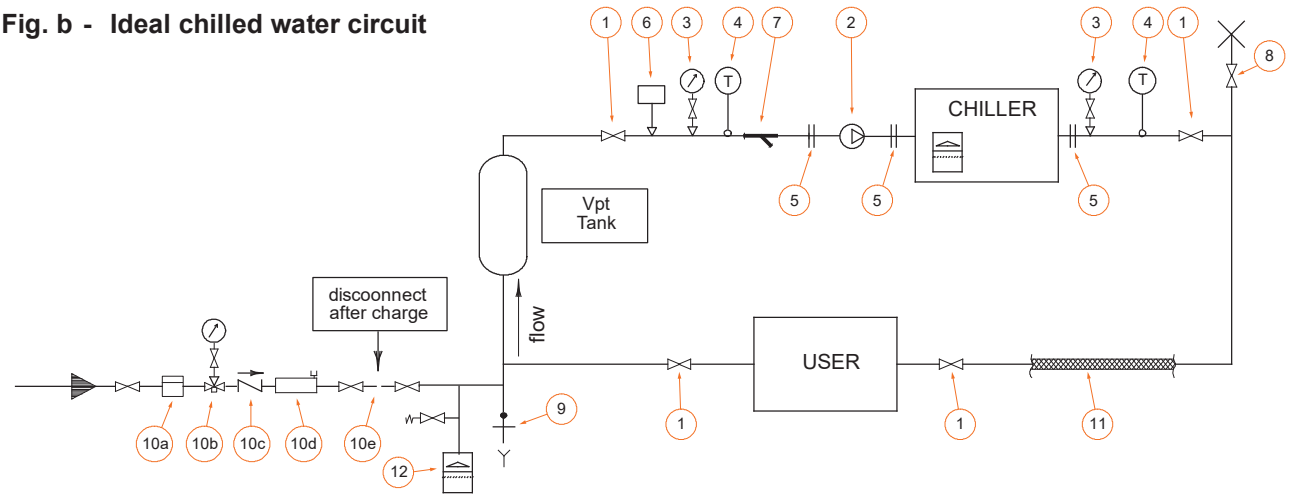


Fig. c - Inertial tank sizig

The total optimal hydraulic value of the system where the **Liebert® HPC-S Adiabatic** chiller is installed can be calculated by the following ratio:

$$V = \frac{43 \times Rt}{Xd}$$

where:
- **V** = min. required total water volume expressed in liters
- **Rt** = refrigerating capacity expressed in kW
- **Xd** = differential band set on the control and expressed in degrees centigrade

Please note that the min. required total water volume (**V**) must be at least equal to the sum of the hydraulic volume of the **Liebert® HPC-S Adiabatic** chiller (**Vm**) plus the volume of the hydraulic circuit connected to it (**Vpc**); if this condition is not complied with, it is necessary to install an inertial tank (**Vpt**, as indicated in the *Fig. b* ideal chilled water circuit) with a volume at least equal to the following value: **Vpt** = **V** - **Vm** - **Vpc**

Fig. d - Sizing of the expansion tank

The total volume of the expansion tank is calculated with the following ratio:

$$V = \frac{C \times e}{1 - \frac{Pi}{Pf}}$$

where:
- **C** = quantity of water inside the system expressed in liters
- **e** = water expansion coefficient, with water at 10^0C as a reference
- **Pi** = absolute pressure of initial charging, equivalent to the tank pre-charge pressure (typical value 2.5 bara)
- **Pf** = absolute final tolerated pressure, lower than the operating pressure or than the safety valve calibration pressure (typical value 4.0 bara).

Use the values of the water expansion coefficient indicated in the table below:

T [°C]	Density [kg/m³]	Expansion coefficient "e" H_2O	"e" 10% glycol	"e" 20% glycol	"e" 30% glycol	"e" 40% glycol	"e" 50% glycol
10	999,6	0,001	0,003	0,005	0,007	0,013	0,015
20	997,9	0,002	0,005	0,008	0,010	0,015	0,018
30	995,6	0,004	0,007	0,011	0,013	0,017	0,020
40	992,2	0,008	0,011	0,014	0,016	0,021	0,024
50	988,1	0,012	0,015	0,018	0,021	0,025	0,028

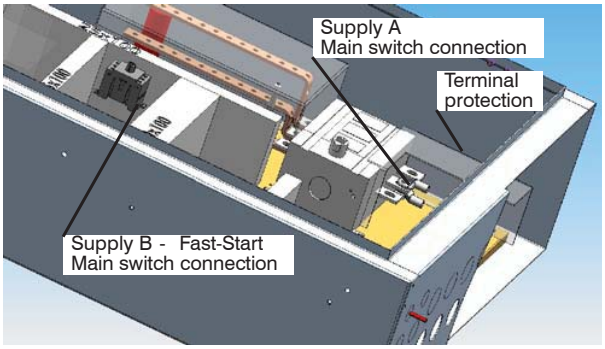
3.3 - Electrical connections

1) Before wiring, check that:
- the electrical components are in good conditions;
- all terminal screws are well tightened;
- the supply voltage and frequency comply with those indicated on the unit and within the tolerances indicated in the paragraph *"Operating limits"*;
- the max. unbalance between the phases does not exceed the value indicated in the paragraph *"Operating limits"*.

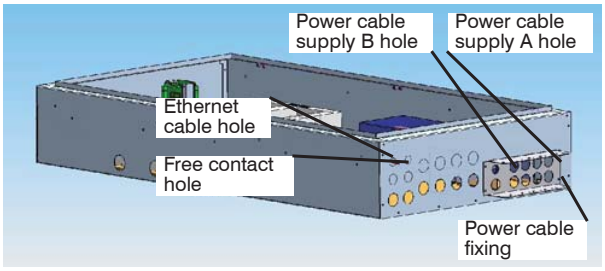
2) Connection of the supply cable:

The units are equipped with electrical panel with one main switch for the power section and one switch (option) for the control section.
- Choose a supply cable (three-pole type with ground) for the power section and a supply cable (two-pole type with ground) for the control section (option):
  - the local norms;
  - the system absorption (FLA unit);
  - the system voltage;
  - installation type;
  - cable length;
  - upstream protection.
- After opening the passage in the structural works (pre-cut), for the supply line inlet, restore the original protection degree with suitable accessories for the wiring and junction boxes.
- Install the cable avoiding carefully to touch the hot parts.
- Connect the cable to the inlet terminal board (disconnecting switch terminals for phases, ground bar for PE conductor).

After having connected the cable, restore the protections against direct contacts.



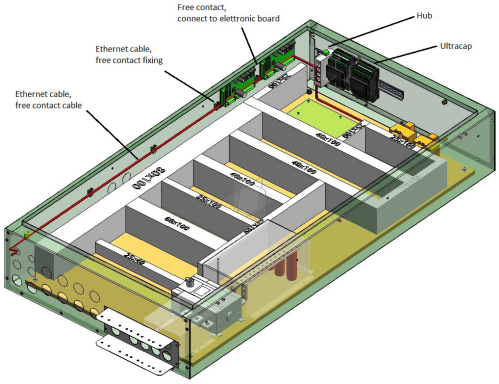
Example of connection with the disconnecting switch with 2 cable terminals.



3. The system/line cable protection is to be arranged by the customer.
   Use a protection with differential switch. If the system is equipped with EC type fans and/or pumps with inverters, use a B type switch.
4. Ethernet cable connection.

The control can be connected with a remote display (ColdFire) through an Ethernet network cable (see HW user handbook).

- Fasten the cable to the clamp - holding plates and make it pass through the first free hole on the panel bottom (arrange a cable clamp).
- After opening the passage in the structural works (pre-cut), opposite the supply line inlet, restore the original protection degree with suitable accessories for the wiring and junction boxes.
- The cable must be protected by a sheath.



5. Connection of the clean contacts for the unit status signals. The clean contacts can be used only with PELV type sources, as described by the norm CEI EN 60204-1 “Safety of machinery - Electrical equipment of machines”. The table below shows the available terminals and their meaning (refer to the wiring diagrams for further information). Use wires 1mm^2. The cable passage must be arranged as described in the previous point 4).

Free contacts available

-XU	400 401 402	General Alarm - Unit off	→ 400-401 NC
-XU	300 301 302	Warning - Unit off	→ 300-301 NC
-XU	450 451	Compressor 1 ON	→ 450-451 NC
-XU	452 453	Compressor 2 ON	→ 452-453 NC
-XU	454 455	Compressor 3 ON	→ 454-455 NC
-XU	456 457	Compressor 4 ON	→ 456-457 NC
-XU	462 463	Configure output	→ 462-461 NC
-XU	476 477	Tank draining	→ 458-459 NC
-K71	8 7	Compressor 1-2 alarm	→ K71:OUT5 NO Alarm - Unit OFF
-K71	6 5	Alarm high water temp.	→ K71:OUT6 NO Alarm - Unit OFF
-K71	2 1	Water flow alarm	→ K71:OUT8 NO Alarm - Unit OFF
-K72	8 7	Compressor 3-4 alarm	→ K72:OUT5 NO Alarm - Unit OFF
-K72	6 5	Compr. Contactor melted	→ K72:OUT6 NC Alarm
-K72	2 1	Condensaer fan failure	→ K72:OUT8 NO Alarm - Unit OFF

Input contact

-XU	470 471	Remote on-off	Supply voltage 24V AC

Dry contact K72: OUT6 NC during alarm state opposite logic to the others) signals compressor’s contactor melted: It has to be managed by the customer switching **OFF** unit power supply. Before switching **ON** the unit, check the compressor and their contactor conditions.

Note:
The power supply should never be disconnected, except when performing maintenance.
Operate (open) the main switch before carrying out any maintenance work on electrical components.
Note:
It is forbidden to work on the electrical components without using insulating platforms, and in the presence of water or fog or mist.
Note:
The supply to the external pump assembly must be made before starting the chiller and must be kept on as long as the chiller is in use. Incorrect operation will cause the unit to lock-out because of the internal protections (flow switch intervention).
Note:
The compressors are equipped with an electronic protection device blocking their start if the phase sequence is not correct, or stopping their operation if a thermal relay intervenes. This device is essential for the integrity of the mechanical and electrical components of the compressors. Reset the standard functions by isolating this device and removing the causes of the lock-out.
Note:
The chillers are equipped with their own microprocessor control adjustment. The use of the remote ON-OFF input (located in the electric panel terminal board) as a system temperature control element is forbidden.

4 - Start-Up and Operation

4.1 - Initial check

Caution:

The operation has to be done by a qualified technician with an experience and know-how on chiller units, iCOM™ control board and software.

Before the checks below make sure the unit power supply line is disconnected at the start. Make sure the disconnection device is locked and the suitable warning plate for no operation is applied on the start handle. Before operating on the electrical connections, make sure there is no voltage through a voltmeter or a phase detector.

Some components (electronic pumps, EC fans, compressor's capacitors, soft-start, inverter) may remain high voltage for a short period after power supply removal. Wait at least **5** minutes to remove their electrical box panels and access to their parts under tension.

1. Check all the cable connections particularly the main power connections on the power fuses, contactors and MCB.
2. Check that all thermal protections are calibrated according the electrical data tables reported on wiring diagram.
3. Check all water connections.
4. Open the shut-off valve on the liquid line.
5. Ensure that the low pressure is higher than 7.0 bar for R410A: if this is not the case, prolong pre-heating of the compressor (see *Fig. 9 - Refrigerant circuits*) and check that the refrigerant EEV (shut-off valve) is properly sealed.
6. Open all isolating valves and/or water ball valve
7. In case of climates with temperatures below zero degrees C, make sure the chilled water circuit is filled with the correct concentration of water/glycol.
8. Bleed all air out of the chilled water circuit.
9. Verify the water flow rate and its direction.
10. Ensure that the thermal load is sufficient for start-up.
11. Record the functional data on the Start-Up certificate.

Caution:

The outer air temperature probe must be positioned in the shade and protected against the weather.

Caution:

Now set the handle of the door - lock general knife switch to the position "**I**"; it is now possible to supply the unit electrically closing the disconnection device upstream the power supply line.

4.2 - First start-up (or after a long stop)

Caution:

Before the following operations, make sure all protections on the units have been reset; set the handle of the door - lock general knife switch to the position "**I**", check the display LED is switched on and check again by a voltmeter or tester if the voltage and phase difference fall within the indicated limits.

Operate as follows:

1. At least **8** hours before the start-up, power the crankcase heaters by setting the main isolator switch **ON**. Make sure the auxiliary circuit has been powered and check the operation (a fault due to an incorrect procedure will invalidate the compressor guarantee).
2. Open the valves of the refrigeration circuit that had been closed before the initial check.
3. Check the machinery supplying the thermal load connected with the unit and start the system pump(s).
4. **MAKE SURE THE COMPRESSOR OIL HAS BEEN HEATED FOR AT LEAST 8 HOURS**; start the unit only then.
5. Make sure the fans rotate in the correct direction (anticlockwise): check the electrical connections, if necessary.
6. Make sure the pumps rotate in the correct direction.
7. During the unit start-up an inlet water temperature higher than 20°C is allowed. Under standard operating conditions check that the limits indicated in *paragraph 2.3* are not exceeded.
8. Check the correct operation of the control and safety devices.
9. Check the outlet temperature of the chilled water (check if the set-point set on the controller is reached).
10. Check the oil level when both compressors are running.
11. With the compressors at full load, check there are no bubbles visible in the frefrigerant sight glass. If there are any, charge the unit according to *par. 5*.

4.3 - Starting and stopping

ALWAYS ENSURE THAT THE COMPRESSOR OIL HAS BEEN PREHEATED.

FOR BRIEF STOPPAGES MAINTAIN THE SUPPLY TO THE CRANKCASE HEATER.

- Start the unit setting the Microprocessor switch **ON**.
- Stop the unit setting the Microprocessor switch **OFF**.
- In case of long stops, turn the machine **OFF** using the Microprocessor switch **OFF**.

In this case the compressor crankcase heaters remain powered.

- For seasonal shutdown of the unit operate the main switch located on the main electrical power supply. This will disconnect the compressor crankcase heaters. Machine restart must be managed as in *§ 4.2 "Initial startup (or following a long interruption)"*.
- The unit can tolerate short periods without power due to a blackout without the fast start function (up to four hours), with automatic restart without the need to repeat the procedure described in *§ 4.2 "Initial startup (or following a long interruption)"*.
- The unit can tolerate short periods without power due to a blackout with the fast start function (up to one hour), with automatic restart without the need to repeat the procedure described in *§ 4.2 "Initial startup (or following a long interruption)"*.

4.4 - Chillers serving special plants

The units are capable of cooling a water-glycol mixture to temperatures close to 0° C without the need for significant modifications. In the case of modification, the set values of the safety and control components must also be changed. This can be carried out in the factory (at the time of testing) or at the time of installation, only by qualified and authorised personnel.

4.5 - Freecooling

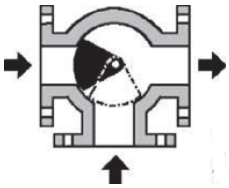
The "freecooling" is a system of pre-cooling and/or cooling the water/glycol mixture using ambient air when the latter is at a temperature below the return mixture temperature. If the outside temperature is sufficiently low to dissipate the entire heat load, the refrigeration compressors automatically switch **OFF**, and the mixture's temperature is controlled by the fan speed adjustment.

If the mixture temperature is too high for freecooling, the compressors will operate as long as necessary to ensure the correct water/glycol mixture temperature.

4.5.1 - Freecooling versions: Three-way valve

Water quality has to be in accordance with VDI 2035 in order to assure valve functionality; max. working pressure is 6 Bar.
Shutter valve position is shown by cutting reference on the valve end of the valve shaft (when the servo is disassembled) and by pin indicator mounted on the motor body.

Actuator running time (90° angle rotation) is 90 seconds.
In the following pictures it is shown manual unlocking instruction (it is necessary to follow this instruction when the hydraulic circuit is filled with glycol).



UNLOCK
To unlock the actuator open the top cover and push the activation button.

4.6 - Microprocessor control

Consult the “iCOM™” Service Manual.

5 - Refrigerant and Oil Charge

All work on pipes or components of the refrigerating circuit under pressure must be exclusively carried out by qualified staff, competent in such works.

5.1 - Refrigerant charge

WHILST REPAIRING THE REFRIGERATING CIRCUIT RECOVER ALL THE REFRIGERANT IN A CONTAINER: DO NOT ALLOW IT TO ESCAPE. NEVER USE THE COMPRESSOR FOR THE SYSTEM VACUUM (THIS INVALIDATES THE WARRANTY).

- The unit is delivered charged according to the *Tab. 2*.

Warning for the refrigerant charge:

- Ensure there are no refrigerant leaks.
- Check the refrigerant type in the refrigeration circuit: a unit originally charged by the manufacturer with R410A cannot be charged with other gas and vice versa; possibly apply to the Technical Support Department.
- Charge with the compressor in operation, connecting the cylinder with the charge connector after the thermostatic expansion valve.
- Drain the connection pipe between the cylinder and the charging point; tighten the seal joint and then start charging the unit. It is imperative that the cylinder is weighed both before and after the operation.
- Charge the unit until the bubbles in the sight glass have disappeared and the working conditions of the entire refrigeration circuit have returned to normal (sub-cooling and superheating within the limits indicated below).
- Measure the superheating as follows:

1. Detect the temperature on the suction line, close to the temperature sensosor of the electronic expansion valve, using a contact thermometer.
2. Connect a pressure gauge (by max. a 30 cm pipe) with the Schraeder connection and read the corresponding saturated evaporating temperature.
3. The superheating is the difference between the two readings.
   - Verify that the superheating is 5° C - 8° C.
   - Measure the sub-cooling as follows:
1. Detect the temperature on the liquid line using a contact thermometer.
2. Connect a pressure gauge (by max. a 30 cm pipe) with the Schraeder connection on the liquid line and read the corresponding saturated condensing temperature.
3. The sub-cooling is the difference between the two readings.
   - Verify that at the condenser outlet, sub - cooling is 3° C - 5° C.

IT IS IMPORTANT TO CARRY OUT CHARGING CORRECTLY.
An excess of refrigerant causes an increase in sub-cooling and consequent operating difficulties in the hot season; a shortage of charge generates an increase in superheating and possible compressor stoppages. Whenever work is carried out on the unit, ensure afterwards that the working conditions are correct, checking sub-cooling and superheating.
Check the oil level (3/4 of max) in sight glass (fitted on oil and gas equalization tube of each tandem compressor) after a short operating time of both compressors (installed in the same refrigerant circuit).

Note: *Check the oil level moving in sight glass (fitted on oil and gas equalization tube of each tandem compressor) from the stopped compressor to the running one.*

Note: *if only one compressor is running it’s possible that the oil level in sight glass (fitted on oil and gas equalization tube of each tandem compressor) reach the min level or lower: it’s a normal operating mode and it doesn’t affect the reliability of the unit.*

5.2 - Oil charge

Contact the Technical Support Department for the specifications of the oil to be used for topping up; the oil changes according to the type of used refrigerant.

NEVER MIX DIFFERENT OILS TOGETHER. CLEAN THE PIPING COMPLETELY BEFORE CHANGING THE TYPE OF OIL USED.

TOP- UPS OF UP TO 20-30% OF THE TOTAL AMOUNT OF OIL CONTAINED IN THE COMPRESSOR CRANKCASE ARE PERMITTED; FOR LARGER PERCENTAGES CONTACT THE TECHNICAL SUPPORT DEPARTMENT.

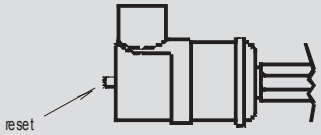
5.2.1 - Procedure for oil topping-up

If there has been any loss of oil then this must be topped up as follows:

1. Take a clean, dry, transparent container (with volume calibrations) and fill it with at least twice the amount of oil required.
2. Isolate the compressor by closing the valve on the liquid line.
3. Connect to the fittings on the compressor body (Schraeder valves) and empty it of refrigerant until atmospheric pressure (1 bar) is reached.
4. Using a pipe, connect the oil container to the oil service fitting on the lower part of the compressor.
5. Open the oil service valve, lifting the container, so that the oil flows by gravity.
6. Charge the required quantity of oil (make sure the tube always remains below the oil level in the container).
7. Stop the oil flow by closing the oil service fitting, open the shut-off valve on the refrigerating circuit and restore the drained refrigerant charge.

6 - Safety Devices Settings

The water chiller has been already tested and calibrated by the manufacturer. The following setting values are suggested in the field.

COMPONENT	SETTING	NOTES
Low pressure switch (LP) (managed by electronic control iCOM)	Operation with R410A (standard factory setting): START : 5.5 bar DIFF. : 0.5 bar STOP : 5.0 bar	
High pressure switch (HP)	Operation with R410A (standard factory setting): STOP : 42.0 bar START : 33.0 bar DIFF. : 9.0 bar (fixed)	

The settings for the safety valves installed on the machine are indicated below:

MODELS	SETTING	SAFETY VALVE
FGA 017- 020- 023- 025- 028- 030	45.0 bar	High Pressure side (HP)

6.1 - Electronic expansion valve

The electronic expansion valve used in the **Liebert® HPC-S Adiabatic** range enables accurate and min. possible control of the overheating of the gas sucked by the compressor under all load conditions, together with the operation at low condensation and high compressor choking. Under such application conditions a mechanical expansion valve can never reach the performance ensured by an electronic expansion valve (with energy benefits) nor the functional stability, above all during the transients of the load variations (with benefits as for reliability).
The final result of the application of the electronic expansion valve on **Liebert® HPC-S Adiabatic** is therefore an improved energy operating costs and a higher reliability, thanks to its special adjustment features above all on partial loads, conditions under which every chiller operates for most of the time. The operating parameters and their programming in the microprocessor dedicated to the EEV control are described in the suitable iCOM™ manual available on the machine
The valve has already been factory - set and superheat should be reset only when it's not between 5 and 8° C or it's present oil foam (visible on compressor's oil sight glass),

THIS OPERATION MUST BE PERFORMED BY AN EXPERIENCED REFRIGERATION TECHNICIAN.

Before beginning this calibration be sure that the refrigerant charge is correct: this is obtained through the sub-cooling (4-8°C, as specified in *para. 5.1*).
Compressor's suction pressure, temperature and superheat could be read on iCOM™ control display as described in the suitable iCOM manual available on the machine.
PLEASE CHANGE SUPERHEAT SETPOINT ONLY WHEN RELEVANT COMPRESSOR IS **OFF**; IT'S NOT ALLOWED TO CHANGE EEV SUPERHEAT SETPOINT WHEN THE RELEVANT COMPRESSOR IS RUNNING.
If the superheat is too low, there is a risk of poor lubrication and consequent breakage of the compressor as a result of pressure shock.
If the superheat is too high the output of the system is limited and the compressor overheats.

6.2 - Environment protection

A misuse or an incorrect calibration of the unit leads to increased energy consumption, resulting in an economic and environmental damage. Use the freecooling function, if available.

7 - Maintenance

The Maintenance Programme below must be carried out by a qualified technician, preferably working under a maintenance contract.

Caution:

Before the checks below make sure the unit power supply line is disconnected at the start. Make sure the disconnection device is locked and the suitable warning plate for no operation is applied on the start handle.
Before operating on the electrical connections, make sure there is no voltage through a voltmeter or a phase detector.
Some components (electronic pumps, EC fans, compressor's capacitors, soft-start, inverter) may remain high voltage for a short period after power supply removal. Wait at least **5** minutes to remove their electrical box panels and access to their parts under tension.
Before any intervention on the unit or accessing the inner components, always ensure the machine is turned **OFF**. The front part of the compressor and the delivery pipe are very hot: be careful when operating nearby. Be very careful when operating close to the finned coils, as the fins are very sharp. Do not remove the fan protection grille before having shut the whole machine **OFF**; do not insert foreign objects through the fan protection grille.
After the maintenance interventions, always close the unit by refitting the relevant panels, fastened by the fixing screws.
If the front upper panels are removed (coil compartment) wait for the fan(s) to come to a complete stop before accessing the compartment; if the front lower panels are removed, pay special attention when working near the compressor upper part and the discharge line: they are very hot; possibly wait for them to cool.

7.1 - Coil cleaning procedures

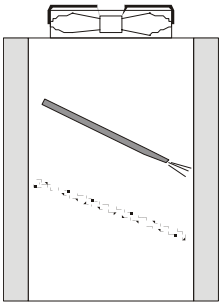
The obstructions provided by powder, pollution etc. accumulated between the coils fins can be removed by means of a pressure washer.
This operation shall be periodically executed.

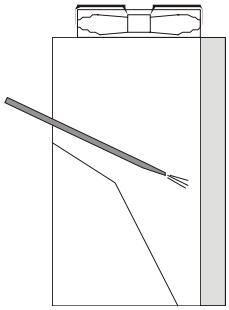
Before operating:

1. disconnect the unit from the electrical power supply;
2. remove the air filters;
3. wait until the fans are completely stopped;
4. ensure that the fans impellers cannot move for any reason (e.g.: wind). Block them mechanically to avoid accidental contacts with the rotating blades.

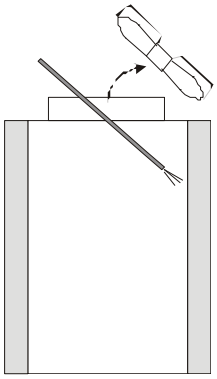
The high pressure water flow shall be the contrary of the air flow direction and parallel to the coil fins.
In order to achieve this result, introduce the water nozzle in the internal space of the unit, following these possible strategies:

Remove the back panel(s) and insert the nozzle inside the internal space.





Remove the side panels (in case of single coil units) and insert the nozzle inside the internal space.



Remove one or more fans.
Insert the water nozzle through the fan opening / nozzle.

In case of greasy obstructions, a specific neutral degreasing product can be used to ease the process.
After the cleaning operation, re-assemble the parts previously removed and unblock the blocked fans before reconnecting to the electrical power supply.

7.2 - Lubrication - pump

The bearings of motors up to 11 kW are greased for life and require no lubrication.
The bearings of motors of 11 kW and up must be greased in accordance with the indications on the motor nameplate.
The motor should be lubricated with a lithium - based grease meeting the following specifications:

- NLGI grade 2 or 3.
- Viscosity of basic oil: 70 to 150 cSt at 40° C (aprox. +104° F).
- Temperature range: - 30°C (aprox. - 22°F) to 140°C (aprox. +284°F) during continuous operation.

7.3 - Spare parts

The use of original spare parts is recommended.
When placing an order refer to “Component List” enclosed with the machine and quote the unit model no. and serial no.

NOTE: *if one or more compressors must be replaced, you must contact “Vertiv™” Service.*

7.4 - Dismantling the unit

The machine has been designed and built to ensure continuous operation. The working life of some of the main components, such as the fans and the compressors, depends on the maintenance that they receive.

The unit contains substances and components hazardous for the environment (electronic components, lead battery, refrigerating gases and oils). At the end of the useful life, when the unit is dismantled, the operation must be carried out by specialized technicians. The unit must be delivered to suitable centers specialized for the collection and disposal of equipment containing hazardous substances. Lead battery, refrigerating fluid and the lubricating oil inside the circuit must be recovered according to the laws in force in the relevant country.

7.5 - Regulation (EC) no. 517/2014 (F-gas)

7.5.1 Introduction

Stationary air conditioners placed into the European Community market and operating with fluorinated greenhouse gases (F-gas, such as R407C, R134a, R410A), have to comply with the F- gas Regulation (EU) No. 517/2014.
This Regulation is in force since Jan 1, 2015 an it replaces the Re. (EU) no. 342/2006.
This document summarizes the obligations for the operators that are responsible for the equipment during all its operative life until its disposal.

7.5.2 Normative References

F-gas	517/2014	Regulation (EU) No 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006
Certified personnel and Companies	2015/2067	Commission Implementing Regulation (EU) 2015/2067 of 17 November 2015 establishing, pursuant to Regulation (EU) No 517/2014 of the European Parliament and of the Council, minimum requirements and the conditions for mutual recognition for the certification of natural persons as regards stationary refrigeration, air conditioning and heat pump equipment, and refrigeration units of refrigerated trucks and trailers, containing fluorinated greenhouse gases and for the certification of companies as regards stationary refrigeration, air conditioning and heat pump equipment, containing fluorinated greenhouse gases
Leak check air conditioning	1516/2007	Commission Regulation No 1516/2007 of 19 December 2007 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, standard leakage checking requirements for stationary refrigeration, air conditioning and heat pump equipment containing certain fluorinated greenhouse gases
Leak check fire protection systems	1497/2007	Commission Regulation No 1497/2007 of 18 December 2007 establishing, pursuant to Regulation (EC) No 842/2006 of the European Parliament and of the Council, standard leakage checking requirements for stationary fire protection systems containing certain fluorinated greenhouse gases From 01/01/2017 to be replaced by: Commission Implementing Regulation (EU) 2015/2068 of 17 November 2015 establishing, pursuant to Regulation (EU) No 517/2014 of the European Parliament and of the Council, the format of labels for products and equipment containing fluorinated greenhouse gases

7.5.3 Fluorinated Greenhouse Gases

Following notes have to be considered when operating with the above mentioned equipments:

- Fluorinated greenhouse gases are covered by the Kyoto Protocol.
- The fluorinated greenhouse gases in this equipment should not be vented to the atmosphere.
- Referring to the value noted in Annex I and Annex IV of Regulation (EU) No 517/2014 here below the global warming potential (GWP) of some major F-gases or mixtures:
  - R-134a GWP 1430
  - R-407C GWP 1774
  - R-410A GWP 2088

NOTE: the refrigerants as R22 are not F-gas and their relevant regulation is Reg. (EU) no. 1005/2009.

7.5.4 Operators

7.5.4.1 Definitions

- Operator, according to Regulation 517/2014 Article 2, point 8, means the natural or legal person exercising actual power over the technical functioning of products and equipment covered by this Regulation.
- The State may, in defined, specific situations, designate the owner as being responsible for the operator's obligations.
- Where large installations are involved, service companies are contracted to carry out maintenance or servicing. In these cases the determination of the operator depends on the contractual and practical arrangements between the parties.

7.5.4.2 Obligations

Operators of stationary air conditioners, which contain fluorinated greenhouse gases, shall, using all measures which are technically feasible and do not entail disproportionate cost:

a Prevent leakage of these gases and as soon as possible repair any detected leakage.

b Ensure that they are checked for leakage by certified personnel.

c Ensure for putting in place arrangements for the proper recovery by certified personnel.

d According to Regulation 517/2014 the operators shall ensure that the equipment is checked for leaks as following:
Case 1 - Non-sealed equipment contains less than 5 tonnes of CO_2 equivalent of fluorinated greenhouse gases.
► Leakage test not required
Case 2 - Hermetically sealed equipment contains less than 10 tonnes of CO_2 equivalent of fluorinated greenhouse gases.
► Leakage test not required
Case 3
► **Leakage test required:** check the equipment for leaks with the minimum frequency given in the following table:

X = Tonnes of CO_2 Equivalent	Y = equivalent amount of refrigerant [kg]			Minimum frequency for leak check	
	R134a	R410A	R407C	with leakage detection	without leakage detection
5 ≤ X < 50	3,5 ≤ Y < 35	2,4 ≤ Y < 24	2,8 ≤ Y < 28	12 Months	24 Months
50 ≤ X < 500	35 ≤ Y < 350	24 ≤ Y < 240	28 ≤ Y < 282	6 Months	12 Months
X ≥ 500	Y ≥ 350	Y ≥ 240	Y ≥ 282	3 Months	12 Months

e Recovery for the purpose of recycling, reclamation or destruction of the fluorinated greenhouse gases, pursuant to Art. 8 of the Regulation 517/2014 shall take place before the final disposal of that equipment and, when appropriate, during its servicing and maintenance.

7.5.5 Leakage Detection

The manufacturer approves the following leakage check methods according to Reg. 1516/2007 and Reg. 1497/2007:

	Method	Specifications
a	Check of circuits and components representing a risk of leakage with gas detection devices adapted to the refrigerant in the system	Gas detection devices shall be checked every 12 months to ensure their proper functioning. The sensitivity of portable gas detection devices shall be at least five grams per year.
b	Application of ultraviolet (UV) detection fluid or suitable dye in the circuit	The method shall only be undertaken by personnel certified to undertake activities which entail breaking into the refrigeration circuit containing fluorinated greenhouse gases.
c	Proprietary bubble solutions/soapsuds	---

7.5.6 Labelling

The label applied on the unit (see *Onboard Label*) is designed to fill-in the relevant amounts of refrigerant according to Regulation 1494/2007 (2015/2068):

a Where fluorinated greenhouse gas is foreseen to be added to the equipment outside of the manufacturing site at the point of installation, a dedicated label accommodates notation of both the quantity [kg] pre-charged in the manufacturing plant and of the quantity charged at the installation site as well as the resulting total quantity of F-gas as a combination of the above mentioned quantities, in a manner which conforms to the legibility and indelibility.
Our split units are usually not pre-charged on factory, in this case the total quantity of refrigerant charged in the unit has to be written in the relevant label, during the commissioning operation at the installation site.
All of the quantities of must be given both as mass of refrigerant [kg] and as Tonnes of CO_2 Equivalent.
Use the following rule for computation:

$$\text{Tonnes of } CO_2 = \frac{\text{kg of refrigerant x GWP of refrigerant}}{1000}$$

where:

Refrigerant	GWP
R-134a	1430
R-407C	1774
R-410A	2088

b Our packaged units (not split) operating with f-gas are usually full charged on factory and the total amount of refrigerant charge is already reported on the label. In this case, the label has no need of further written information.

c In general, the above mentioned information has been located in the main nameplate of relevant unit.

d For equipment with double refrigeration circuits, in regards to differentiates requirements on the basis of the quantity of F-gas contained, the required information about refrigerant charge quantities has to be listed separately for each individual circuit

e For equipments with separate indoor and outdoor sections connected by refrigerant piping, the label information will be on that part of the equipment which is initially charged with the refrigerant. In case of a split system (separate indoor and outdoor sections) without a factory pre-charge of refrigerant, the mandatory label information will be on that part of the product or equipment which contains the most suitable service points for charging or recovering the fluorinated greenhouse gas(es).

NOTE: *Safety data sheets of F-gases used in the products are available on demand.*

7.5.7 Record Keeping

Operators of equipment which is required to be checked for leaks (see 7.5.5 Leakage Detection), shall establish and maintain records for each piece of such equipment specifying the following information:

a the quantity and type of fluorinated greenhouse gases installed

b the quantities of fluorinated greenhouse gases added during installation, maintenance or servicing or due to leakage

c whether the quantities of installed fluorinated greenhouse gases have been recycled or reclaimed, including the name and address of the recycling or reclamation facility and, where applicable, the certificate number

d the quantity of fluorinated greenhouse gases recovered

e the identity of the undertaking which installed, serviced, maintained and where applicable repaired or decommissioned the equipment, including, where applicable, the number of its certificate

f the dates and results of the leak checks carried out (see *7.5.5 Leakage Detection*)

g if the equipment was decommissioned, the measures taken to recover and dispose of the fluorinated greenhouse gases

Unless the records are stored in a database set up by the competent authorities of the Member States the following rules apply:

a the operators shall keep the records for at least five years

b undertakings carrying out activities for operators shall keep copies of the records for at least five years

Maintenance programme - Monthly check

FANS	• Check that the fan motor rotates freely without any abnormal noise, and ensure that the bearings are not running hot. • Also check the current absorption.
CONDENSER AND AIR FILTER	• Check the conditions of the filters (if they are supplied); if necessary clean them (including the electrical panel ventilation filter). • Check the condenser coils and clean if necessary (see coil cleaning procedures).
CONTROL	• Check that the control equipment, LEDs and display are operating correctly. • Check the supply voltage. • Check the operation of the compressor's oil heaters. • Check the conditions of the remote control switch contacts. • Check the operation of the evaporator resistance (if present). • Check the operation of the electrical panel fan and heaters (if present).
ELECTRICAL CIRCUIT	• Check the electrical supply on all phases. • Ensure that all electrical connections are tight.
REFRIGERATION CIRCUIT	• Check the condensing and the evaporating pressures (to be done by a refrigeration technician). • Check the compressor's current absorption, the delivery temperature and possible unusual noises. • Check the refrigerant charge by means of the sight glass. • Check that the safety devices operate correctly. • Check the correct operation of the EEV (superheating between 5° C - 8° C). • Check that the oil level is approx 3/4 indicated by the sight glass (fitted on oil and gas equalization tube of each tandem compressor) after a short operating time of both compressors.
CHILLED WATER CIRCUIT	• Ensure that there are no water leaks. • Bleed any air out of the hydraulic circuit using the bleed valves. • Verify that the water flow rate is correct. • Check the inlet-outlet liquid temperature and pressure. • Check the correct operation of the three-way valve (Versions with freecooling only). • Check if the system is charged with the specified glycol percentage and that no ice has formed in the hydraulic circuit. • Check the evaporator cleanliness. • Check the motor pump current. • Check the motor pump noise. • Ensure the motor pump is periodically lubricated.
ADIABATIC SYSTEM	• See Chapter *10 "ADIABATIC SYSTEM"*

8 - Options and Accessories

8.1 - Pump set

It is possible to select the pump type (low or high head) on each unit, both in the standard version and in the one with inverter and integrated electronic adjustment. The centrifugal pump units are direct driven, with close - coupled motors and a single shaft; the induction motor has 2 poles with IP 55 protection and class F insulation.
Pumps are primarily fitted with motors that meet the legislative requirements of the EuP IE3 grade.
The pumps are of the top-pull-out design, i.e. the power head (motor, pump head and impeller) can be removed for maintenance or service while the pump housingremains in the pipework.
The electronic pump adjustment algorithm enables to modulate the pump speed to keep the delivery steady through the evaporator even if the hydraulic load changes; in this way, a significant energy saving is achieved and varies depending on the applications. In particular, in the Freecooling units this benefit is obtained above all in summer, when the Freecooling coil is short-circuited. The programming of the adjustment set of the electronic pump can be made in factory or in the installation site thanks to a simple user panel interface CU351 fitted on chiller electrical panel; in case of doubt, contact your dealer.

Pump casings and impellers are in cast iron EN - GJL 200, shafts are in stainless steel, the shaft seal is a unbalanced, mechanical shaft seal with dimensions according to DIN 24 960 and assembly length according to EN 12 756, brass neck ring permits ideal conditions for the use of water mixtures containing ethylene glycol. The BQQE mechanical shaft seal is a rubber bellow seal with silicon carbide/silicon carbide seal faces and secondary seals of EPDM. The pump housing, the motor stool and the motor stator housing are electrocoated.

The pump units have been chosen and sized to operate within specific limits, namely:

- Water / ethylene glycol mixtures up to 65% / 35% by weight;
- Temperatures of the standard pumped fluid not lower than 4°C.

The motor stool forms connection between the pump housing and the motor, and is equipped with a manual air vent screw for venting of the pump housing and the shaft seal chamber. It is very important to carry out this operation as the circulation of liquid through the duct of the air vent screw ensures lubrication and cooling of the shaft seal.

Between the outlets of the two chambers and the discharge flange, twin-head pumps have a non - return flap valve in EPDM rubber. The flap is opened by the flow of the pumped liquid and cuts off the port of the idle pump chamber.

In the electrical panel there are automatic circuit breakers for each pump; the microprocessor control manages the operating rotation between the two pumps and start-up of the stand-by pump if the primary pump fails.

In case of electronic inverter pump replacement it's necessary to set all deep parameters (user panel is not feasible for this operation); this operation must be performed by an experienced **Vertiv**™ technician.

For the technical features of the pumps and the hydraulic schematic see *Tab. 4*, *Fig. 11* and *Fig. 12*.

8.2 - Water chiller with partial heat recovery (20%) - Special option

This option enables the recovery of up to 20% of the heat normally rejected by the condensers. The system does not require any adjustment and is made up of plate heat exchangers installed on each circuit before the condenser. The exchangers are protected by a suitable anti-frost heater that operates when the system is stopped. It is recommended to install a safety valve in the hydraulic circuit to avoid hazards due to overpressures, if there is no water flow in the recuperator.

The water temperature at the recuperator inlet (in stable operating conditions) must be in the range of 25° to 45°C, with a differential of between 3.5° and 8°C.

WARNING: you must exclude the use of heat recovery for the direct heating of sanitary hot water.

8.3 - Hydraulic circuit accessories

Made up of an expansion vessel (pre - charged at 1.5 bar, max. operating pressure 10 bar) and a safety valve, set at 6 bar. Their position in the hydraulic circuit is illustrated in *Fig. 11*, *Fig. 12*.

- Expansion vessel volume: 12 litres for all units.

It is recommended that the total required expansion vessel capacity is always checked, depending on the unit's internal hydraulic volume (with the volume of the buffer tank, if installed), the user circuit volume, the glycol percentage in the mixture, and the expected maximum temperature variation of the mixture.

The water flow switch is a compulsory device protecting the unit.

It is installed, as standard, on units with the optional on-board pump set, and is available as a option for units without pumps on board: in the latter case the flow switch, if not installed on the machine, must be installed on the hydraulic circuit by the installer and wired to the electric panel terminal board, as indicated on the wiring diagram.

8.4 - Water chiller with inertial tank

The machine can be supplied complete with a buffer tank; it performs the inertial stabilizer function, for a better compressor operation, summed up in the following two points:

- it reduces the frequency of the compressor start up and consequent high current peaks, which is higher when the system thermal inertia is lower, improving their performance.
- it naturally eliminates the operation troubles caused by sudden load variations (shown by variations of the chilled water temperature).

The buffer tank is supplied complete with manometer and temperature sensor well, air purge valve, discharge valve and sinking connection for electric heaters (to be installed as option, managed by the iCOM™ control); max operating pressure: 6 bar.

Built in carbon steel and coated with anti-condensate insulation with PVC film proper for outdoor installation. It is installed inside a cabinet which can be supplied either already connected to the unit (mechanically and hydraulically jointed to it) or loose (completely separate from the unit).

Technical data:

- Internal volume: 1000 litres
- Net weight: 400 kg
- Working weight: 1400 kg

9 - Electrical Panel and Chiller Control

The electrical panel is designed, constructed and tested in compliance with IEC standards (EN60204- 1).
It is installed on the compressor compartment side and can be accessed through the unit right side panel; it has a degree of protection equivalent to IP54. It is possible to access the “iCOM™” control display without switching the unit off, so as to aid maintenance operations.
The cooling of the electrical panel is achieved through forced ventilation controlled by the microprocessors board. For low ambient temperatures (below -5°C) it is possible to have an electric heater fitted inside (optional) and controlled as well by the microprocessor board.

Main features:

- Power supply: 400V±10% / 3Ph + PE / 50Hz.
- Auxiliary power supply circuit: 230V / 1Ph / 50Hz and 24V / 1Ph / 50Hz.
- Main switch.
- Main switch for auxiliary circuit and fast start feature (optional).
- Protection MCBs for compressors, fans and pumps.
- Contactors for compressors and pumps.
- Relay for checking phase sequence, minimum voltage, loss one or more phase.
- Manual operation through “iCOM™” controller.
- PFC(Power Factor Correction) for compressors (option).
- Compressors electronic soft start (option).
- Volt-free contacts for remote indication of:
  - compressors in operation;
  - pump(s) in operation;
  - general alarm;
  - warning alarm;
  - tandem compressor alarm 1/2;
  - high temperature inlet/outlet water alarm;
  - water flow alarm;
  - condenserfanfailure:
  - configurable free contact;
  - external input for remote ON/OFF.

10 - Adiabatic System

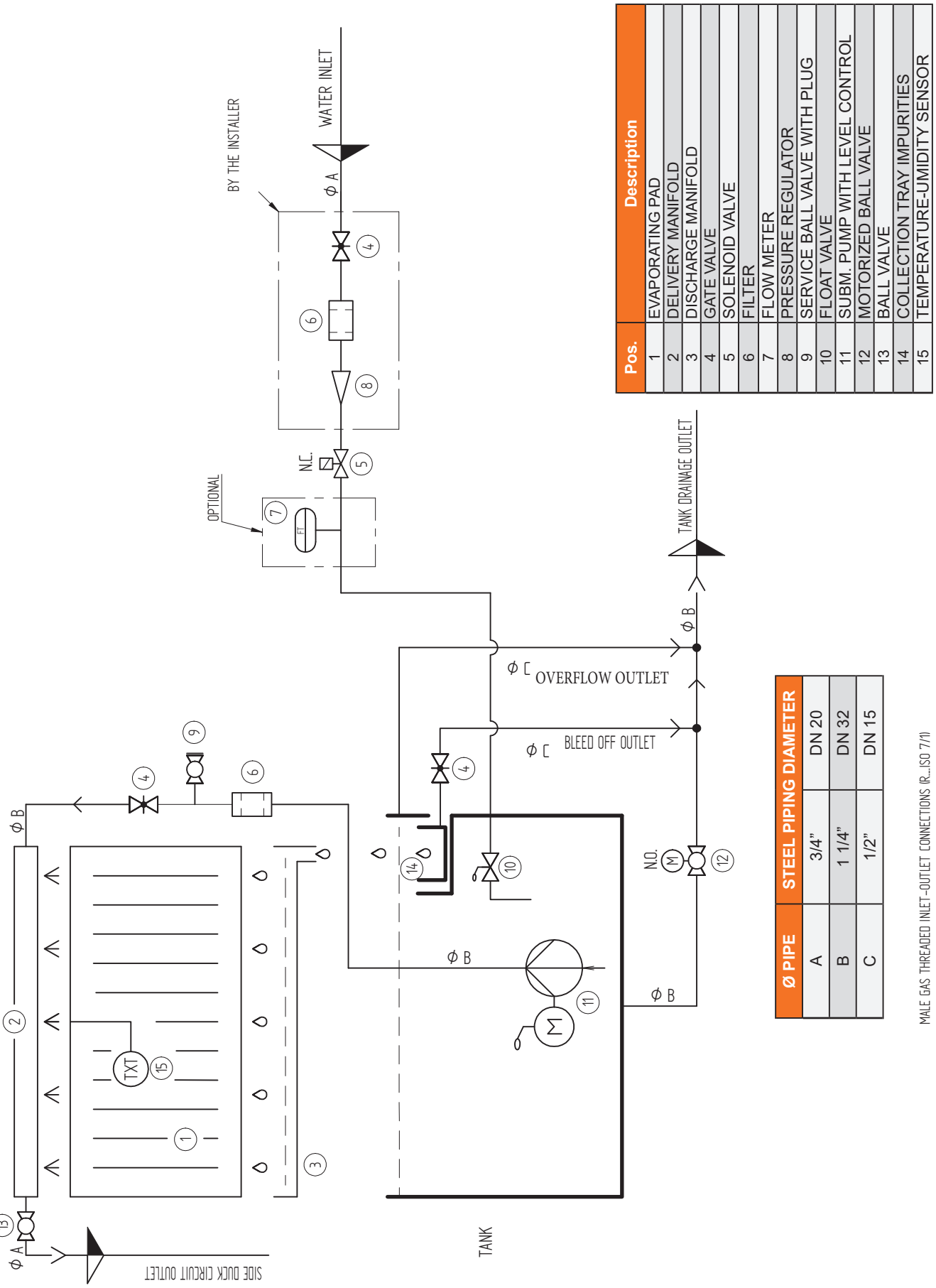
10.1 - Description of the hydraulic section of the adiabatic system with built-in tanks

The adiabatic system includes:

- Water collection modules size and volume as *Tab. 1* complete with pump support, overflow, predisposition to various hydraulic connections.
- Circulation pump
- Pump safety switch (level control)
- Water supply cock float-operated

The components of the hydraulic diagram below are also present:

- Motorized ball valves
- Hydraulic section including inspectable metal mesh filter, flow rate adjusting manual shutters, press intakes, pipes and connectors.



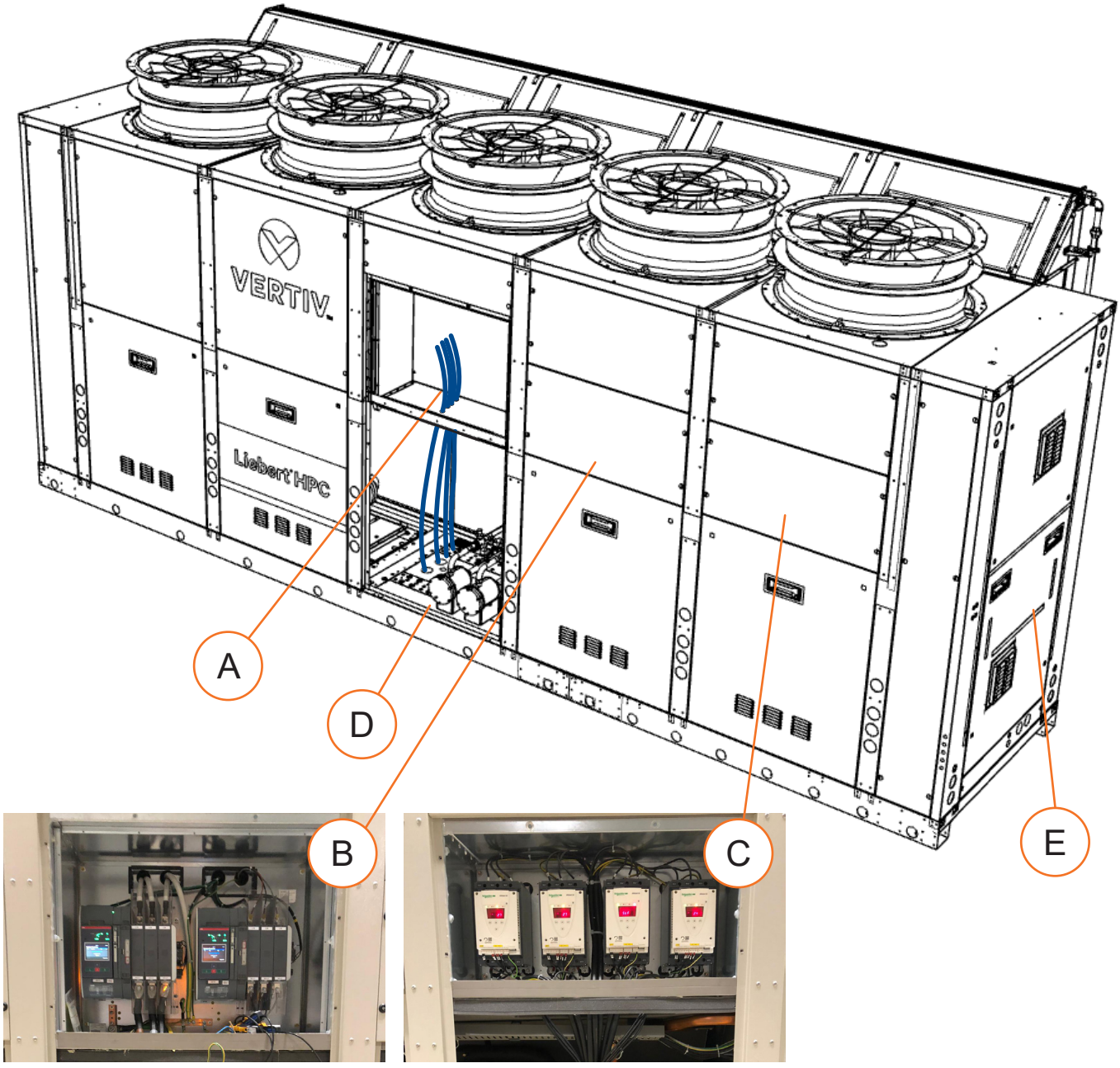
Pos.	Description
1	EVAPORATING PAD
2	DELIVERY MANIFOLD
3	DISCHARGE MANIFOLD
4	GATE VALVE
5	SOLENOID VALVE
6	FILTER
7	FLOW METER
8	PRESSURE REGULATOR
9	SERVICE BALL VALVE WITH PLUG
10	FLOAT VALVE
11	SUBM. PUMP WITH LEVEL CONTROL
12	MOTORIZED BALL VALVE
13	BALL VALVE
14	COLLECTION TRAY IMPURITIES
15	TEMPERATURE-UMIDITY SENSOR

Ø PIPE	STEEL PIPING DIAMETER
A	3/4" DN 20
B	1 1/4" DN 32
C	1/2" DN 15

MALE GAS THREADED INLET-OUTLET CONNECTIONS (R...ISO 7/1)

Fig. 10.1 - ADIABATIC SYSTEM HYDRAULIC DIAGRAM - 3 FANS

Cable entry into the chiller

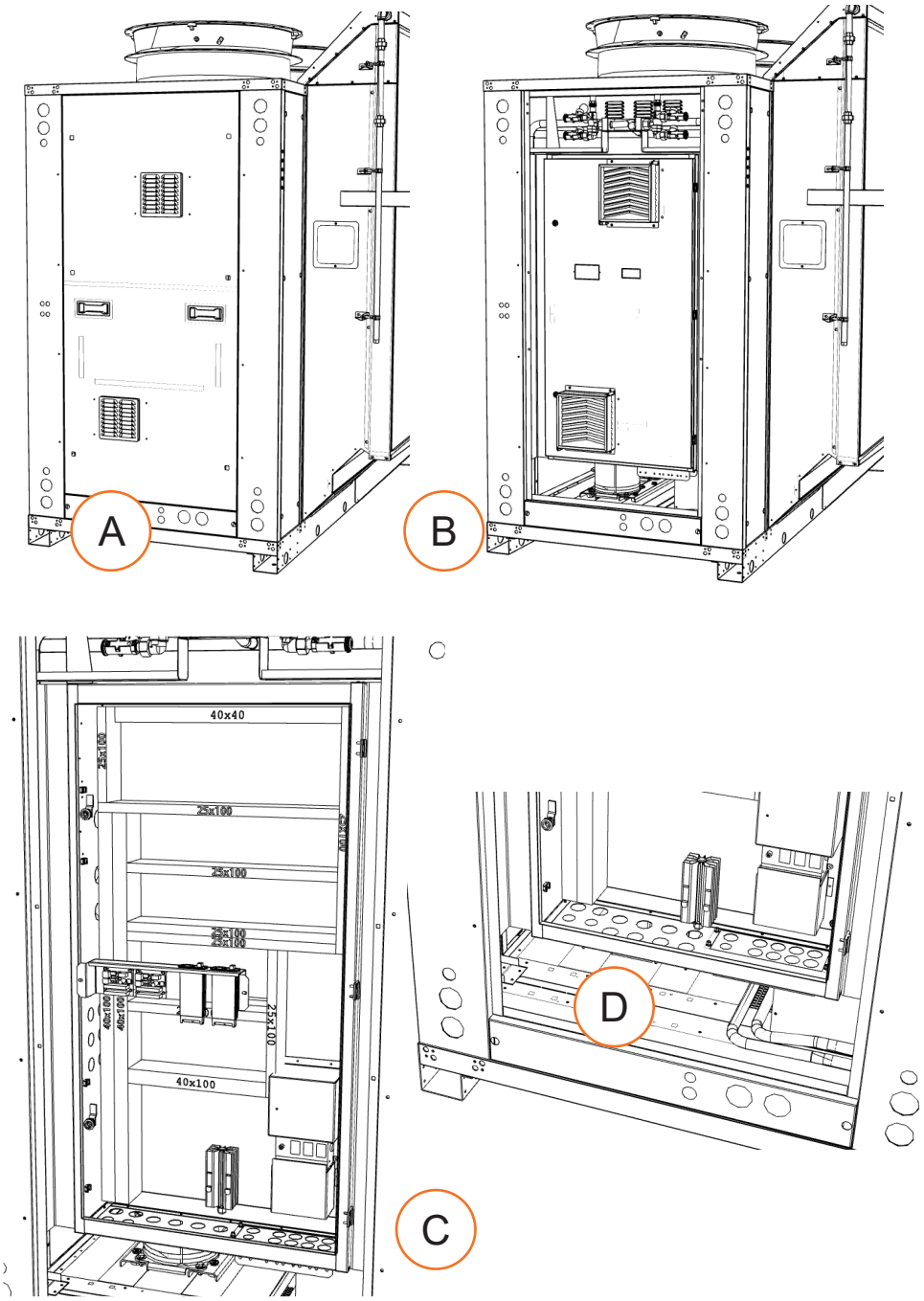


	Description
A	ATS box
B	Auxiliaries box
C	Soft-Starters box
D	Cable Path from the basement to the ATS box (Max Length 2m)
E	Electric Panel

Cable entry into the chiller: Detail in ATS cassette

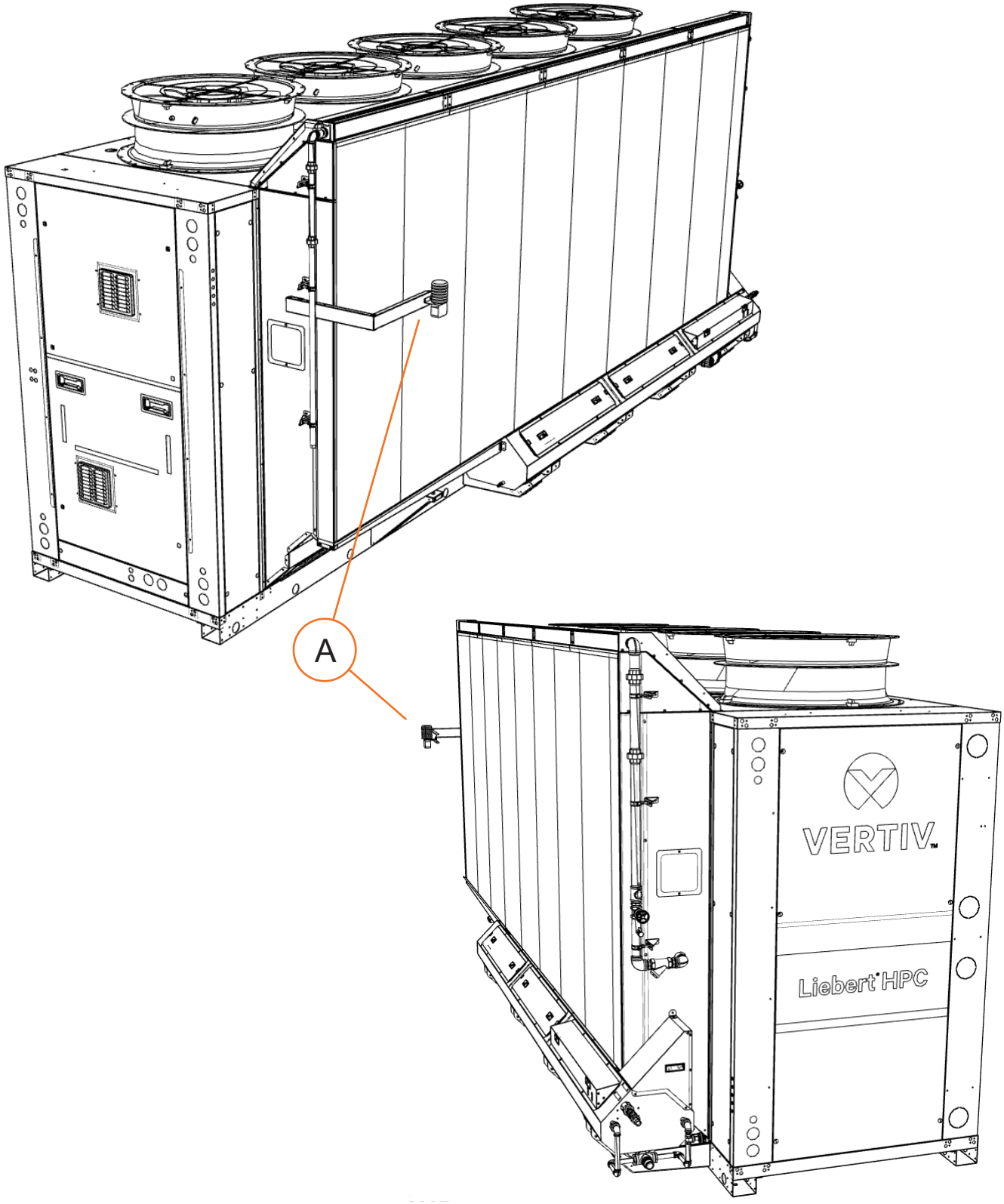
	Description
A	ATS box

Cable entry into the electric panel



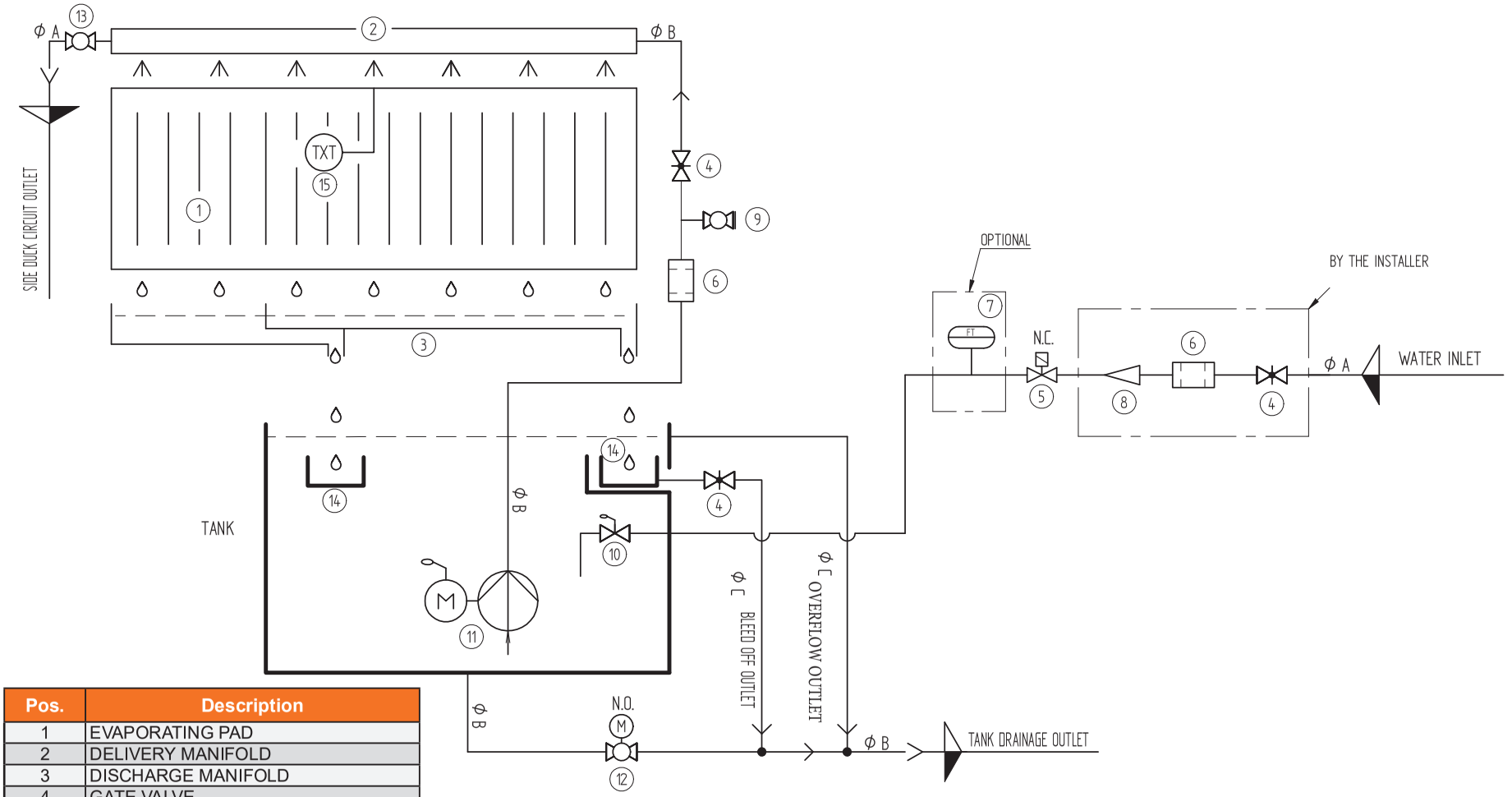
	Description
A	Main Electric Panel front cover is removable with screws
B	Electric Panel door with safety interlock handle
C	Detail: Main Electric Panel
D	Detail: Cable entries

Adiabatic kit



	Description
A	Bracket and Air Temp./Humidity probe

Fig. 10.2 - ADIABATIC SYSTEM HYDRAULIC DIAGRAM - 4-5 FANS



Pos.	Description
1	EVAPORATING PAD
2	DELIVERY MANIFOLD
3	DISCHARGE MANIFOLD
4	GATE VALVE
5	SOLENOID VALVE
6	FILTER
7	FLOW METER
8	PRESSURE REGULATOR
9	SERVICE BALL VALVE WITH PLUG
10	FLOAT VALVE
11	SUBM. PUMP WITH LEVEL CONTROL
12	MOTORIZED BALL VALVE
13	BALL VALVE
14	COLLECTION TRAY IMPURITIES
15	TEMPERATURE-UMIDITY SENSOR

Ø PIPE	STEEL PIPING DIAMETER	
A	3/4”	DN 20
B	1 1/4”	DN 32
C	1/2”	DN 15

MALE GAS THREADED INLET-OUTLET CONNECTIONS (R...ISO 7/1)

Tab. 10.1 - Water built-in tanks

"HPC-S" fan no.	PAD no.	Nominal volume of tank [l]	Max volume of tank [l]	Total system volume [l]
3	5	125	215	268
4	7			285
5	9			303

*. PAD section already cut to fill the whole length

Legend

Nominal volume of tank: water volume contained in all tanks for side, from the bottom to the level of the float cock. This is the water volume usually present in the tank while the adiabatic system is operating.

Max. volume of tank: water amount contained in all tanks for each side, from the bottom to the overflow level. This is the max. volume that can be contained in the entire adiabatic system (tanks, hydraulic circuit, lower channel, water in the pads…)

Total system volume: water volume contained in the entire adiabatic system (tanks, hydraulic circuit, lower channel, water in the pad…)

Caution:
To ensure the healthiness of the adiabatic system, the hydraulic system must be installed by the customer in a way preventing any stagnant water inside the whole system, nor even after emptying the circuit.

Caution:
Plug on the drain: it is compulsorily forbidden to place any kind of plug or restriction that might prevent or limit (even momentarily) the tank drain. The customer is responsible for ensuring a correct routing of the adiabatic system drain ducts, for a fast drain of the system and the tank, without any water stagnation.

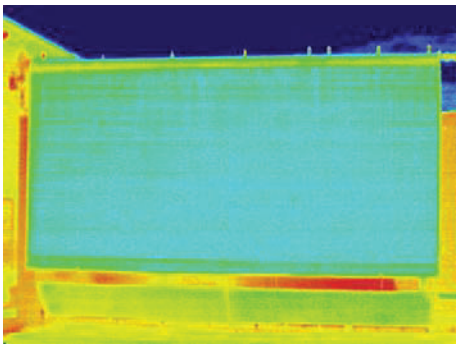
10.2 - Calibration of the hydraulic circuit

The PAD must be wetted with a water flow rate not lower than a certain value to ensure the best operation and increase the PAD's life. The min. flow rate for wetting the PAD depends on the total length of the installed PAD type and of the pack. For standard PADs, the min.

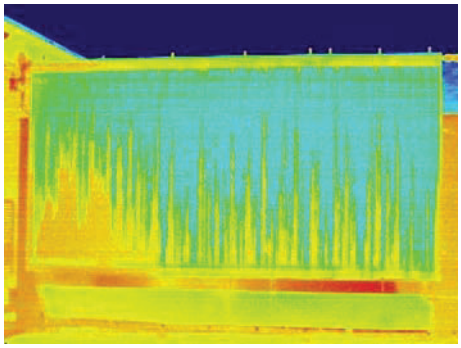
$$Q\ [^{l}/_{min}] = 6 \times n$$

flow rate is:
(n is the number of fans)

If this flow rate is guaranteed the distribution of the water fall is uniform in the whole PAD, as the picture taken by a thermo-camera shows.



If the flow rate is lower than the minimum value, a few parts of the PAD are not wetted and remain dry, as the following picture shows.



Too high flow rates are not acceptable as too much water to the PAD may cause drops from the same, and the bottom channel may overflow. As a result, water is wasted unacceptably.

Therefore, the flow rate for the PAD supply must be balanced by the suitable adjustment valve (shutter) so that there is no drop formation and water does not overflow.

The system equipped with tank, to aid flow rate calibration, has a pressure intake just after the pump; in this way, as the characteristic curve of the pump is known; the working point and thus the PAD supply flow rate can be determined.

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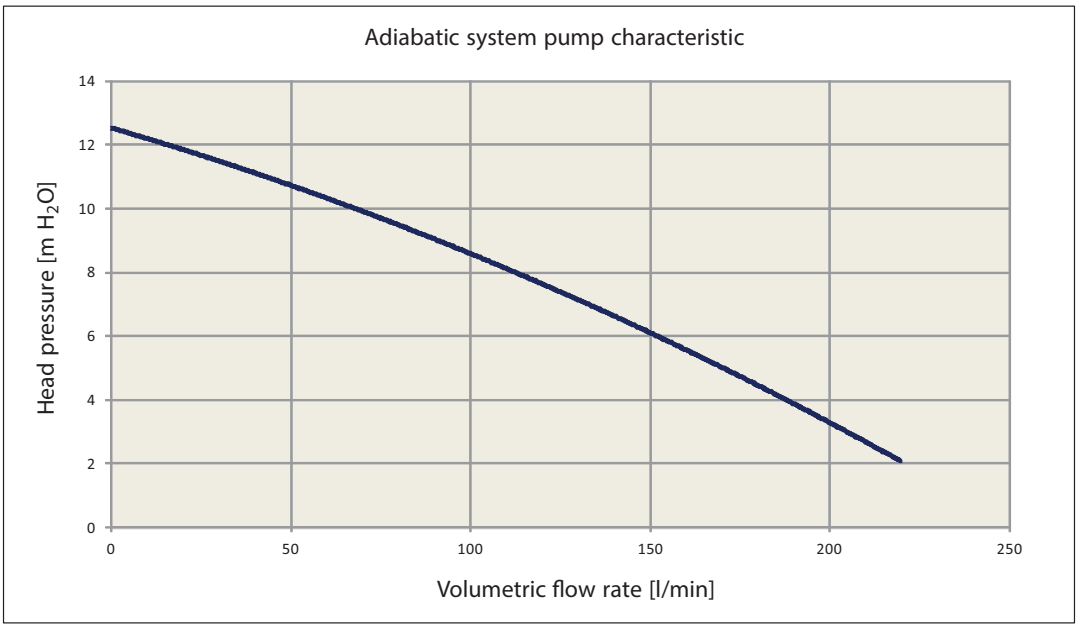


Tab. 10.2 - Electric data for submersible pump on each tank

Power supply	I [A]	Nominal power
400 V +/- 10 % / 3 Ph / 50 Hz	1.6	0.45 kW / 0.6 HP

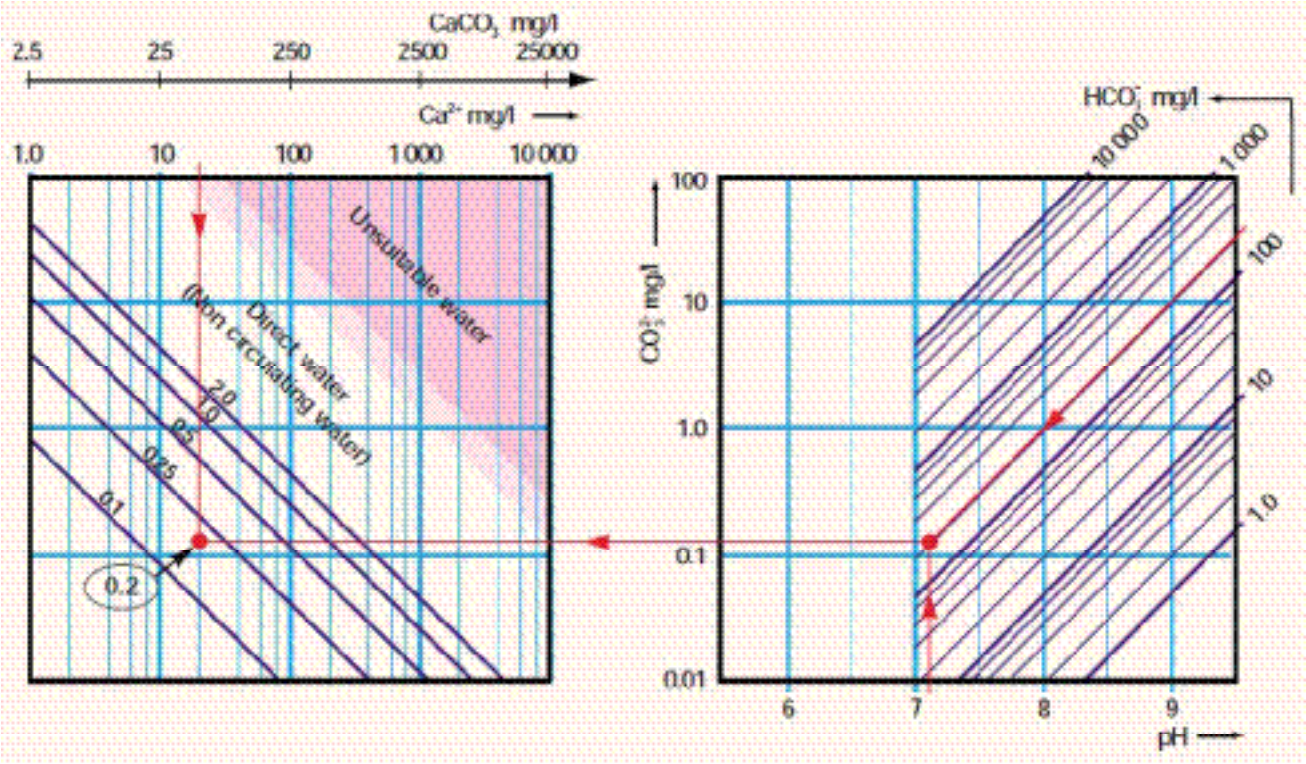
A leak of a few drops is normal if the PAD is started when perfectly dry. When the PAD is completely wet, leaks of water drops naturally decrease and then stop completely. Otherwise, adjust the shutter till eliminating the drop leaks. If the water leaks continue, check the following:

- Make sure the PAD are not damaged during the installation. Check if there are bumps. If the PAD is damaged replace it.
- Check if there are leaks from the lower channel. If so, seal the leak points with silicone.
- Check for the correct installation of the upper channel.

In the same way, adjust also the bleed-off flow rate which is available for the system with tank only, so as to control the mineralization degree of the water in the tank. The bleed-off flow rate depends on the flow rate evaporated in the PADs and on the chemical features of the refill water. The bleed-off flow rate is very important, as a too low value would increase the limescale concentration in the tank water, with problems of deposit in the various components and a subsequent reduction of the system life (PAD included). On the other hand, a too high value would cause an excessive water consumption.
The bleed-off flow rate can be calculated as:

$$B\left[{}^{l}\!/_{min}\right] = \frac{c_B \times E}{2}$$

(c_B coefficient that can be determined from the diagram below, according to the water chemical features, and **E**: evaporated flow rate that can be taken as equal to **1 l/min** for each fan arranged on a machine side)



In order to calculate the water flow consumption, it is necessary to sum evaporated and bleed-off flow.

Example

Chiller with 5 fans, the water has the following chemical features:

- pH = 7.1
- HCO_3^- ion concentration = 200 mg/l
- Ca_2^+ ion concentration = 20 mg/l

$$B\left[{}^{l}/_{min}\right] = \frac{c_B \times E}{2} = \frac{0{,}2 \times (1 \times 5)}{2} = 0{,}5\,\frac{l}{min}$$

The diagram shows that the coefficient c_B = 0.2. The bleed-off flow rate will therefore be:

After adjusting the flow rates, seal the valve to prevent unauthorized staff from tampering with the adjustment.

10.3 - Microprocessor Control and Adjustment

The microprocessor controls adiabatic pre-cooling systems for each chiller.

The microprocessor offers the possibility of manually controlling each component of the hydraulic circuit for maintenance needs. Using this mode, the operator can make special washing cycles if necessary and/or check the functions of the single components.

For more information, see *Chap. 12*.

Adiabatic Cooling - Rev. S.W. 1.6.3								
Configuration Mask	**Parameter Name**	**Description**	**Values**	**Default (Set to Default = YES)**	**Visibility**	**Min. Admitted Value**	**Max. Admitted Value**	**Unit of Measure**
System Configuration	System type	System type with tank or without according to hydraulic circuit	With tank Without tank	Without tank	Always	N.A	N.A	N.A
	Working mode	Adiabatic Kit working mode	Stand Alone Integrated Manual	Stand Alone	Always	N.A	N.A	N.A
	Pump mode	Pump working mode: set to always on as default	On/Off Always On (PAD Type = Cellulose)	Always On	Always	N.A	N.A	N.A
	Regulation type	Regulation type: On/Off according to Psycrometric diagram, otherwise Psycrometric diagram + Setpoint thresold	On/Off Setpoint	On/Off	Always	N.A	N.A	N.A
	Setpoint	If Regulation type = Setpoint, the value of desired setpoint		0	If Regulation type=Setpoint	0	60	°C
	Differential	Differential used for regulation type = Setpoint		0	If Regulation type=Setpoint	0	20	°C
	Side number	Number of active side of PAD		1	If Regulation type=Setpoint	1	2	N.A
	Valves presence - BleedOff	Bleed Off valve presence (optional)	Yes No	No	Always	N.A	N.A	N.A
	Valves presence - Distribution	Distribution valve presence (optional)	Yes No	No	Always	N.A	N.A	N.A
	Valves presence - FlowMeter	Flow meter presence (optional)	Yes No	No	Always	N.A	N.A	N.A

Adiabatic Cooling - Rev. S.W. 1.6.3								
Configuration Mask	**Parameter Name**	**Description**	**Values**	**Default (Set to Default = YES)**	**Visibility**	**Min. Admitted Value**	**Max. Admitted Value**	**Unit of Measure**
Probe Configuration	Flow meter Side 1/2	Type of flow meter	NTC PTC 0...20mA 4...20mA 0...10V 0...1V 0...5V Digital CPC/ ERS	4...20mA	If FlowMeter = Yes	N.A	N.A	N.A
	Lower limit	Flow meter manufacturer parameter for lower read value		0	If FlowMeter = Yes			L/H
	Upper limit	Flow meter manufacturer parameter for upper read value		500	If FlowMeter = Yes	0	10000	L/H
	Offset	Flow meter calibration		0	If FlowMeter = Yes			N.A
	Humidity Side 1/2	Type of humidity probe	NTC PTC 0...20mA 4...20mA 0...10V 0...1V 0...5V Digital CPC/ ERS	0...10V	Always	N.A	N.A	N.A
PAD Configuration	Number of PAD Side 1/2	Numeber of PAD installed		0	Always	0	12	N.A
	Air Flow for PAD	m^3/h of air flow		10000	Always	0	32767	mc/h
	PAD efficiency	Efficiency of PAD		70	Always	0	100	%
	PAD type	Type of used PAD: only Cellulose available	Cellulose Other	Cellulose	Always	N.A	N.A	N.A
Pump Configuration	Nominal pump Flow Side 1/2	Nominal pump flow (lt/min)		140	Always	0	240	lt/min
	Time period Side 1/2	Time period		360	Always	60	540	sec
Water Param-eter	Bleed Off constant	Bleed Off constant		0.25	Always	10	200	
Antifreeze Parameter	Cold temperature	Thresold for Cold Temperature-antifreeze alarm		10	Always	- 200	200	°C
	Differential	Differential for Cold Temperature alarm activation		1	Always	0	20	°C
	Time delay	Delay for cold temperature alarm activation		0	Always	0	60	sec
	Intensive cold temperature	Thresold for Intensive cold Temperature-antifreeze alarm		5	Always	- 200	200	°C
	Differential	Differential for Intensive cold Temperature alarm activation		1	Always	0	20	°C
	Time delay	Delay for intensive cold temperature alarm activation		0	Always	0	60	sec

Adiabatic Cooling - Rev. S.W. 1.6.3								
Configuration Mask	Parameter Name	Description	Values	Default (Set to Default = YES)	Visibility	Min. Admitted Value	Max. Admitted Value	Unit of Measure
Antilegionella Parameter	Pipes	Time to empty pipes during antilegionella procedure		300	Always	0	3600	sec
	Tank	Time to empty tank during antilegionella procedure		1200	Always	0	3600	sec
	Days between 2 cycles	Days between two antilegionella cycles		3	Always	1	7	day
	Starting hour	Starting hour for antilegionella cycle		0	Always			
Date - Time Settings	DD/MM/GG - HH:MM	Date - time for the controller			Always	N.A	N.A	N.A
Set to Default	YES / NO	If YES starts the default settings install procedure		No	Always			

The change of the controller parameters by non-authorized staff may result in an incorrect device operation, with oscillation, too early pre-cooling activation (and therefore higher water consumption) or too late pre-cooling activation (and therefore higher electricity consumption). Refer to the appendix at the end of this manual for the Guide to the programming with Display for the adiabatic system, refer to Appendix of *Chapter 12*, reported at the end of this manual.

10.4 - Control Logic

The control types of the adiabatic system is:

- The outputs of EEV can be activated by condensing pressure as usual or, when the freecooling valve is at 100%.
- If activated by freecooling valve then the outputs are deactivated when the freecooling valve position is lower than 5%.
- The minimum adiabatic working time is defined with the “A527 HP Fan Override Duration” parameter.

10.5 - Adiabatic System Operation and Adjustment

10.5.1 - Pump management

In systems with tank, the operating logic of the water distribution pump for each section is the following:

- The pump steadily supplies the PAD with a flow rate that prevents drops from being carried by the PAD.
- The bleed-off flow rate is discharged simultaneously with the PAD supplying. It is anyway necessary to calibrate the shutters to guarantee the correct supply and bleed-off flow rates.

The minimum flow rate that must be guaranteed with the pump will be:

$$Q\ [^{l}/_{min}] = 6 \times n$$

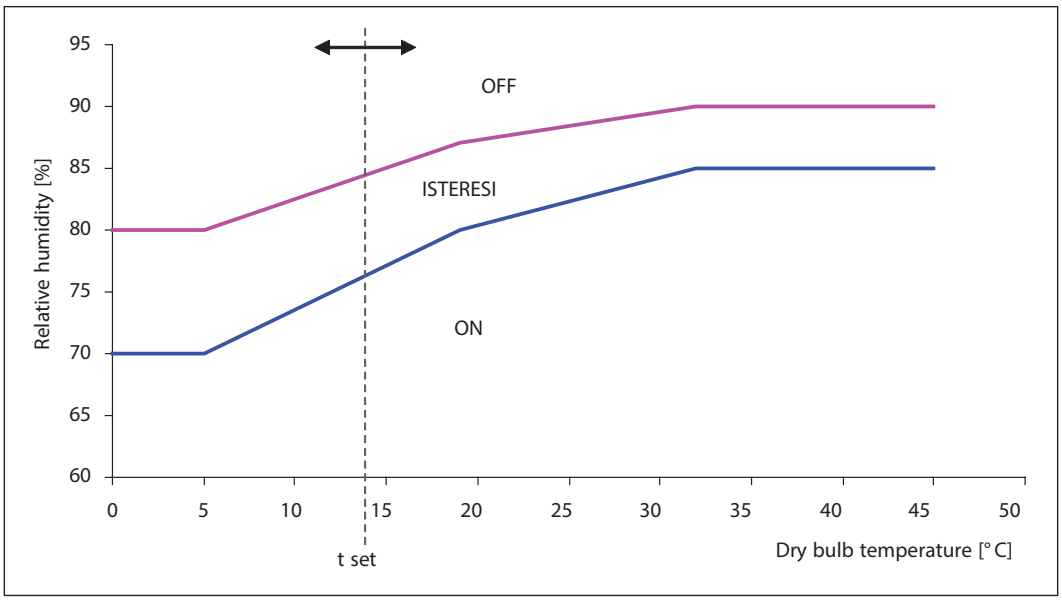
10.5.2 - On-off automatic system

Independently of the adjustment logic, inside the control board, the ON/OFF limits of the adiabatic system are enclosed by a broken line in the psychometric diagram. The points are summed up in the table below:

ON		OFF	
t_{BS} [° C]	U.R. [%]	t_{BS} [° C]	U.R. [%]
5	80	5	87
70	32	80	32
19	85	19	90

The points in the table are by default and other values can thus be set directly in the control. They reflect high humidity environmental conditions (rain and/or fog) where the adiabatic cooling is useless.

Fig. 10.3 - Principle of operation adiabatic system



10.5.3 - PAD daily drying

In any adjustment type the PAD must be dried completely every **24** hours to lengthen its life and reduce the growth of algae, moss, etc. There are two drying methods:

1. If the fans are on, there are **30** minutes during which the PADs are not wetted. In this way, the PADs dry completely.
2. If the fans are stopped there is no PAD wetting for at least **10** hours, for example from 11 p.m. until 9 a.m., to allow the PADs to dry completely.

10.5.4 - Anti-legionella draining system

The draining is necessary to prevent all risks of legionella formation.
It is necessary to empty the pipes every **24** hours for cleaning reasons, at the same time as the PAD daily drying.

The tank drying occurs by default every **3** days. This parameter can be changed on the display.

Allowed values range between 1 and 7 days, anyway the default value is strongly recommended, or lower values can be possibly used.

IT IS RECOMMENDED NOT TO SET TANK EMPTYING INTERVALS LONGER THAN THE DEFAULT VALUES, AS THE LAW SPECIFIES THAT TANKS MUST BE EMPTIED AT LEAST EVERY **3** DAYS IN SOME COUNTRIES.

The next filling will occur only when the adiabatic system is activated. Draining occurs at the same time as the PAD daily drying (at night).

The customer is responsible for maintaining the safety and healthiness of the adiabatic system in every part. The customer is responsible for cleaning the adiabatic system from limescale, biofilm or other residues and to sanitize it if necessary.

Using mains water with a temperature near to 20°C or lower reduces all health issues, due to Legionella bacterium.

In fact it is dormant in this temperature range.

The risk of airborne transmission of the bacterium is reduced by the use of the adiabatic pre-cooling with PAD, as this involves a flow of air without aerosols.

10.5.5 - Water quality

The temperature of the water must not be higher than 20° C, to reduce microbiologic proliferation.

The mains water distributed to the PADs must have the required min. features.

The quality of the water must be periodically checked in compliance with the table below:

Tab.10.3 - Water quality

Constituent	Limits	Constituent	Limits
Calcium Hardness (as $CaCO_3$)	20 – 150 mg/l	Conductivity	< 750 µmhos
Total Alkalinity (as $CaCO_3$)	20 – 150 mg/l	Suspended solids	< 5 mg/l
Chlorides (as Cl)	< 50 mg/l	pH	6.0 – 8.5
Silica (as SiO_2)	< 25 mg/l	Chlorine	0 – 1.5 mg/l
Iron (as Fe)	< 0.2 mg/l	Bromine	0 – 1.5 mg/l

10.5.6 - Anti-freeze protection

In every adjustment type, the ice protection includes two alarm levels:

1. Moderate cold: the adiabatic system pipes only are protected. All valves are open to drain the water from the pipes.
2. Severe cold: the tank must be protected draining the water; the automatic control drains the whole system (pipes and tank).

CAUTION: To avoid continuous emptying at night and filling in the day of the tanks, starting from season conditions often included in the “Freezing risk” range of the diagram in *Table 1*, it is strongly recommended to empty the system completely and, for particularly cold climate, to remove the pump.

CAUTION: The customer must ensure the anti-freeze protection for the hydraulic circuit section he is responsible for. During the winter stop, the installer is responsible for correctly emptying all system parts, carefully avoiding any water accumulation in every component.

10.6 - Maintenance

To ensure a correct operation of the adiabatic system and the longest possible PAD’s life, it is necessary to consider the following aspects:

- **Water quantity:** the PAD must be wetted uniformly, and there must be no non-wet area (see indication on the flow rate calibration). The water flow rate can be adjusted by the cock valve (shutter). Check that the holes in the PVC pipe are not clogged with limescale or dirt. In this case, clear them with a punch.
- **Check of the water quality:** the water must be clean and have the min. chemical features already indicated in table 1. Clean the tank (if any), the mechanical filter and the hydraulic system every month or more frequently, depending on the environmental use conditions.
- **Check of the leaks:** if water leaks are observed from the PAD, check if the water flow rate is too high (in this case adjust the shutter valve), if the PAD is damaged or if the connections are damaged. If there is a leak from the PAD the adiabatic system must be switched off and the leaking point must be sealed with silicone. A light dripping at the start with completely dry PAD is normal, but must stop when the PAD is completely wetted.
- **Daily maintenance:** dry the PAD (automatically by the control) every day; remove the coarsest dirt from the PAD surface.
- **Monthly maintenance:** clean regularly the distribution circuit and the PVC pipe, particularly if there are areas with incorrect distribution, removing the dirt and pumping clean water. Open the clogged holes of the PVC pipe with a punch; dry the PAD completely. Brush the PAD downwards. It is recommended to try brushing on a small section of PAD. When you are sure the PAD cannot be damaged by the brush, clean completely.

After brushing, rinse the PAD with a low pressure jet.

DO NOT USE HIGH PRESSURE OR STEAM NOZZLES TO WASH THE PAD!

After brushing and then rinsing, switch the adiabatic system on so that the PAD wetting removes all residual dirt traces.

After the final PAD wetting, remember to empty the tank so that the dirt accumulated inside does not circulate again in the system.

If present, clean also the tank, emptying it and removing organic and inorganic residues from the walls, the bottom and any other part. After that, wash the tank by clean water.

These interventions may be required more often in the case of harsh environmental conditions.

- Winter arrangement: the PAD can remain installed outdoors. In any case, it is necessary to make sure that under frozen rain the PADis not clogged. In order to avoid it, in very cold climates, remove 10% of PAD surface during the maintenance of winterization.

If a correct maintenance is not performed, the adiabatic system can become a breeding ground for bacteria, fungi, moulds, etc. The expected PAD life is therefore significantly decreased, with a deterioration shown in the pictures below.

PADS MUST BE REPLACED IN THESE CONDITIONS!

10.6.1 - PAD removal and replacement

The expected operating life of the pre-cooling PADs is 3 to 5 years, depending on the application and maintenance conditions. If low efficiency in the pre-cooling is experienced together with a significant decrease of the air flow, the PADs need to the replaced.

PAD removal/replacement procedure

1. Remove the panel of the upper channel
2. Remove the water distribution PADs
3. Remove the pre-cooling PADs

To re-install the PADs, reverse steps 1-2-3.

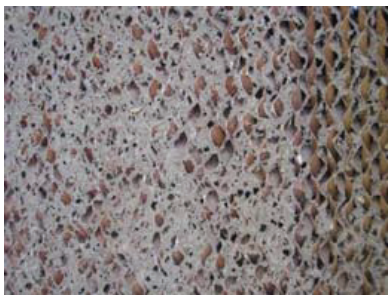
Important:

The used PADs are non- hazardous waste and must to be disposed according with the local norms in force.

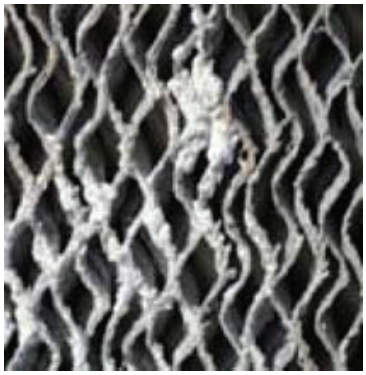
Important:

The pre-cooling PADs have a front and a back; they must be re-installed in the correct position to ensure their full operation in the whole section and their full efficiency. The black section must be positioned from the outer side; be careful with the sloping angle of the channels inside the PAD as shown here below.

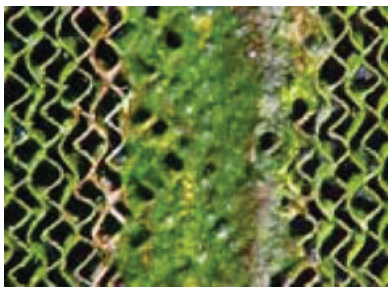
Dirt and incorrect distribution



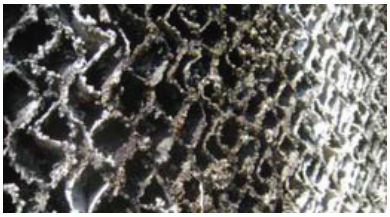
Limescale



Alga growth



Limescale and mould



10.7 - FAQ-Answers to Frequently Asked Questions

How long is the PADs' life ?

The design life is 3-5 years, with a typical use of 5-6 months/year, if the maintenance and supply specifications for the PADs are complied with.

Can vinegar be used to sanitize the system ?

Vinegar is an organic substance and can cause bacteria and alga growth on the PAD. Moreover, it can decrease the pH too much.

When are the PADs to be replaced ?

PADs are to be replaced when their efficiency (cooling capacity, as indicated in Tab. 1) decreases. This occurs practically when the PAD is worn, when it crumbles, or with dirt or clogging that cannot be removed with the previously described cleaning operation. The best time to replace them is at the end of the usage season.

The water in the storage tank is now greenish-yellow. Does this indicate problems ?

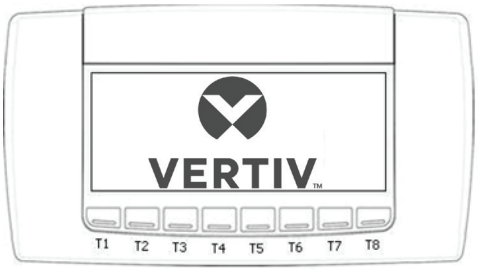
This is normal indeed with completely new PADs. It is a temporary condition that disappears after approximately fifteen days of continuous operation of the adiabatic system.

10.8 - Adiabatic Cooling Controller

10.8.1 - Display Documentation

Home Page

Press any key to move to main unit page;control switches back to home if any key is pressed for a time of 5 minutes.



Main Unit Page:
it shows the general overview status of unit

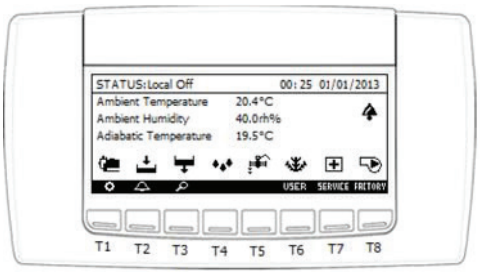
HEADER LINE:
Shows the status of unit and the current local time.

BODY:
Shows the main unit information which sensors value and status of devices.

BOTTOM LINE:
Shows the meaning of T keys:

T1 = On/Off key: switches On / Off the unit.
T2 = Events Log: display moves to Main Event Log page.
T3 = Display moves to first Overview page.
T4 = Not used.
T5 = Not used.
T6 = Display moves into USER area (level 0).
T7 = Display moves into SERVICE area (level 1).
T8 = Display moves into FACTORY area (level 3).

Note: Display does not move to User, Service or Factory area if the right Pin is not entered.



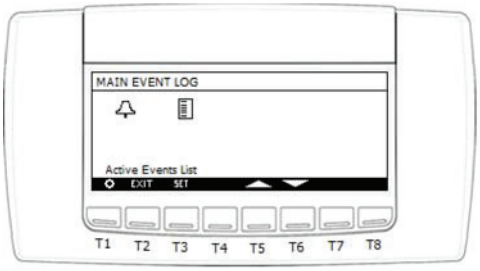
Event Log Page:
It shows the list of icons used to enter into event overview

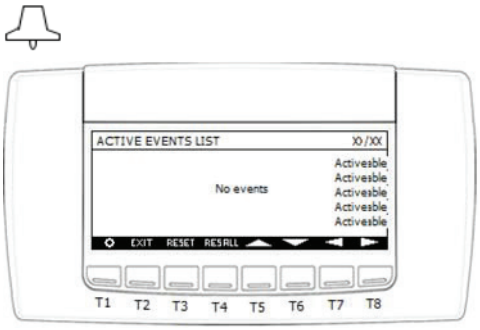
HEADER LINE:
Describes the meaning of page.

BODY:
Shows the selectable icons and the description of the selected icon.

BOTTOM LINE:
Shows the meaning of T keys:

T1 = On/Off key: switches On / Off the unit.
T2 = Display moves to Main Unit page or deselects the icon.
T3 = Allows entering into the area of the selected icon.
T4 = Not used.
T5 = Up key used to move between lines or pages.
T6 = Down key used to select the first icon and to move between lines or pages.
T7 = Left key used to move between icons of the same line.
T8 = Right key used to move between icons of the same line.





HEADER LINE:
Describes the meaning and the number of page.

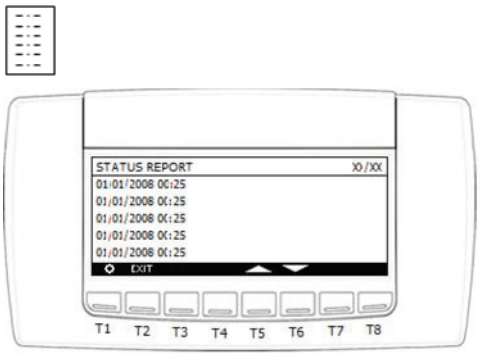
BODY:
Shows the active events list (ID and description).

BOTTOM LINE:
Shows the meaning of T keys:

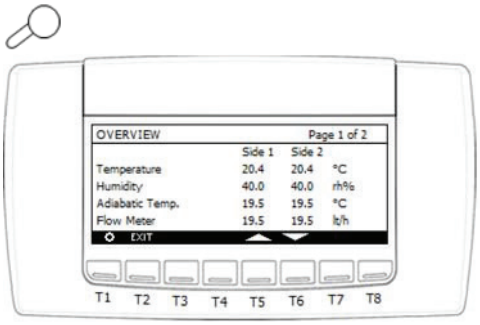
T1 = On/Off key: switches On / Off the unit.
T2 = Display moves to Main Event Log page.
T3 = Resets the single resettable events.

T4 = Resets all resettable events.
T5 = Up key used to move between pages.
T6 = Down key used to move between pages.
T7 = Moves between events.
T8 = Moves between events.

HEADER LINE:
Describes the meaning and the number of page.
BODY:
Shows the event list which includes data, time, number code and description of the activated event.
BOTTOM LINE:
Shows the meaning of T keys:
T1 = On/Off key: switches On / Off the unit.
T2 = Display moves to Main Event Log page.
T3 = Not used.
T4 = Not used.
T5 = Up key used to move between pages.
T6 = Down key used to move between pages.
T7 = Not used.
T8 = Not used.



Unit Overview Page:
HEADER LINE:
Describes the meaning and the number of page.
BODY:
Shows the status of devices.
BOTTOM LINE:
Shows the meaning of T keys:
T1 = On/Off key: switches On / Off the unit.
T2 = Display moves to Main Unit page.
T3 = Not used.
T4 = Not used.
T5 = Up key used to move between pages.
T6 = Down key used to move between pages.
T7 = Not used.
T8 = Not used.



HEADER LINE:
Describes the meaning and the number of page.
BODY:
Shows the status of devices.
BOTTOM LINE:
Shows the meaning of T keys:
T1 = On/Off key: switches On / Off the unit.
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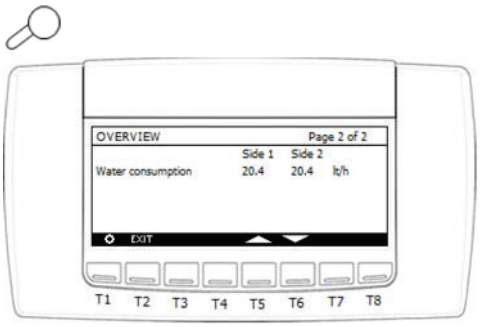
T8 = Not used.



Main User Page:
Shows the list of selectable icons
HEADER LINE:
Describes the meaning of page.
BODY:
Shows the selectable icons and the description of the selected icon.
BOTTOM LINE:
Shows the meaning of T keys:
T1 = Not used.
T2 = Display moves to Main Unit page or deselects the icon.
T3 = Allows entering into the area of the select icon.
T4 = Not used.
T5 = Up key used to move between lines or pages.
T6 = Down key used to select the first icon and to move between lines or pages.
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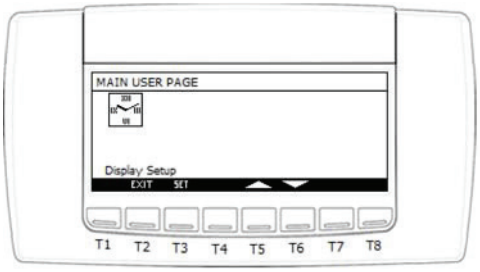
T8 = Right key used to move between icons of the same line.



HEADER LINE:
Describes the meaning and the number of page.
BODY:
Shows the event list which includes data, time, number code and description of the activated event.
BOTTOM LINE:
Shows the meaning of T keys:
T1 = On/Off key: switches On / Off the unit.
T2 = Display moves to Main Event Log page.
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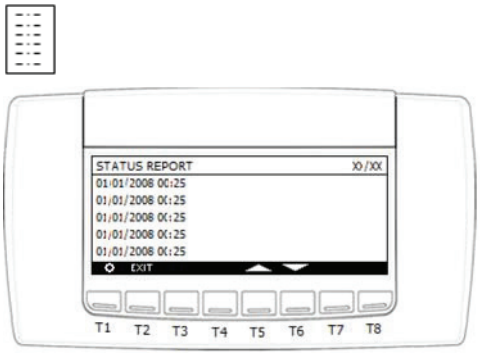
T4 = Not used.
T5 = Up key used to move between pages.
T6 = Down key used to move between pages.
T7 = Not used.
T8 = Not used.



Unit Overview Page:

HEADER LINE:
Describes the meaning and the number of page.
BODY:
Shows the status of devices.
BOTTOM LINE:
Shows the meaning of T keys:
T1 = On/Off key: switches On / Off the unit.
T2 = Display moves to Main Unit page.
T3 = Not used.
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T6 = Down key used to move between pages.
T7 = Not used.
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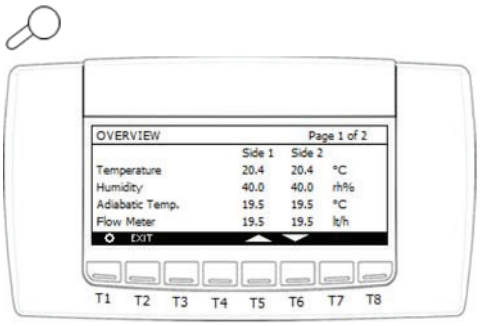

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T6 = Down key used to move between pages.
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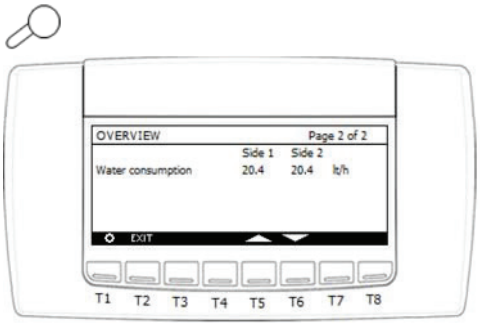

Main User Page:

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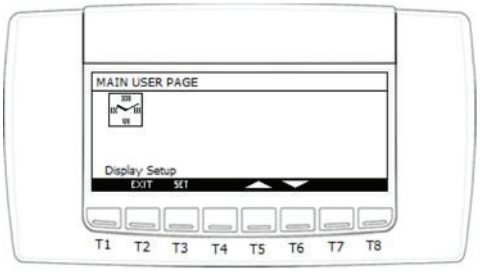

HEADER LINE:
Describes the meaning and the number of page.
BODY:
Contains the list of parameters.
BOTTOM LINE:
Shows the meaning of T keys:
T1 = Not used.
T2 = Display moves to Main Service page or deselect the parameter.
T3 = Enables the configuration of parameter.
T4 = Not used.
T5 = Up key used to move between parameters or pages.
T6 = Down key used to select the first parameter and to move between parameters or pages.
T7 = Decreases the value of selected parameter.
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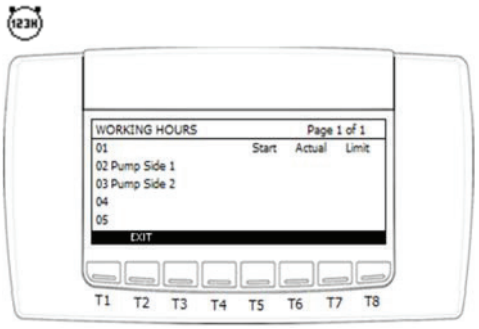

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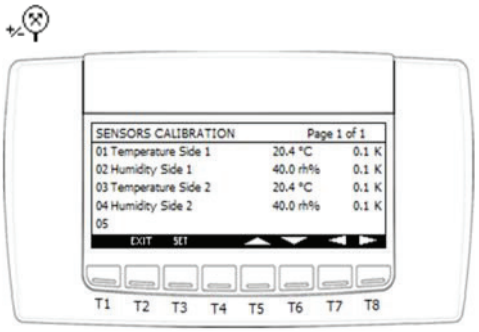

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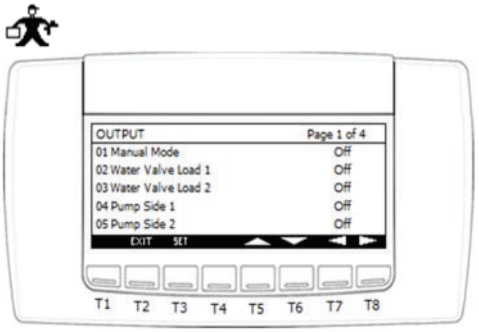

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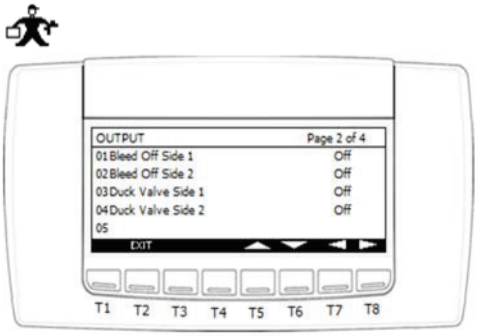

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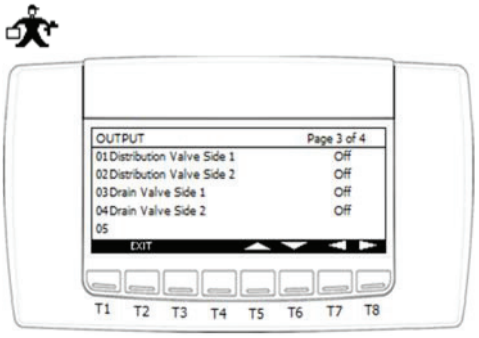

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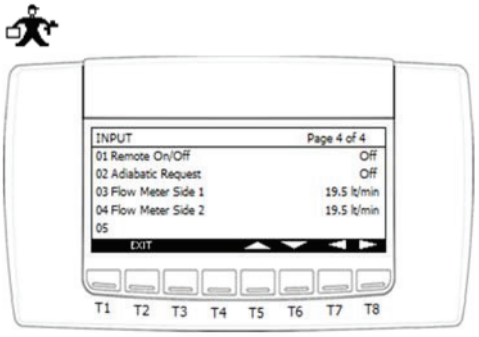

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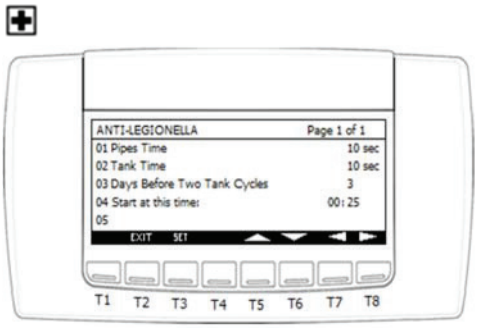

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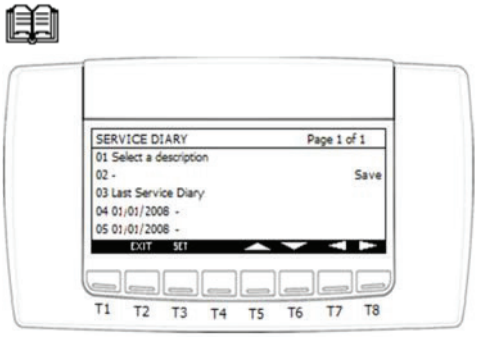

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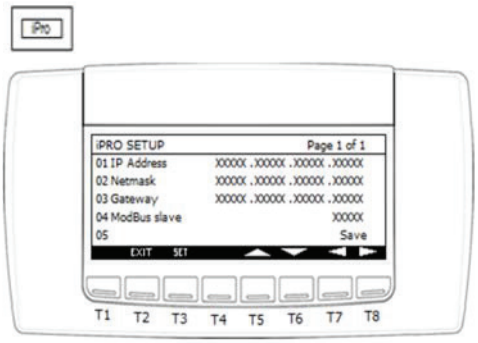
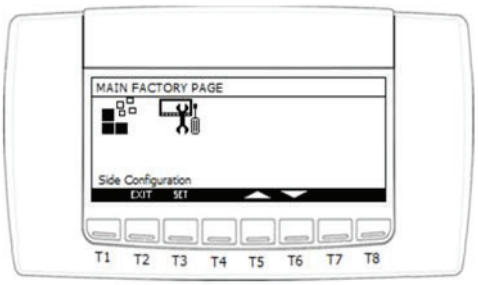


Main Factory Page:
Shows the list of selectable icons
HEADER LINE:
Describes the meaning of page.
BODY:
Shows the selectable icons and the description of the selected icon.
BOTTOM LINE:
Shows the meaning of T keys:
T1 = Not used.
T2 = Display moves to Main Unit page or deselects the icon.
T3 = Allows entering into the area of the select icon.
T4 = Not used.
T5 = Up key used to move between icons.
T6 = Down key used to select the first icon and.
T7 = Not used.
T8 = Not used.



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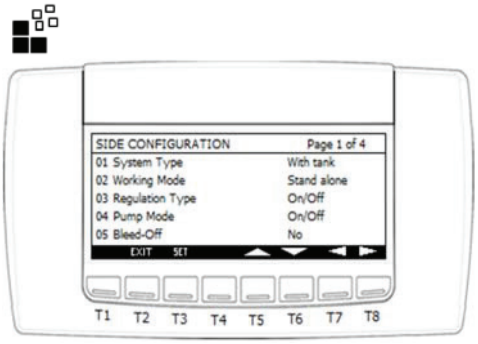

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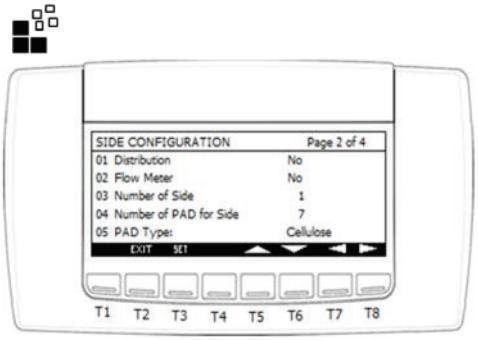

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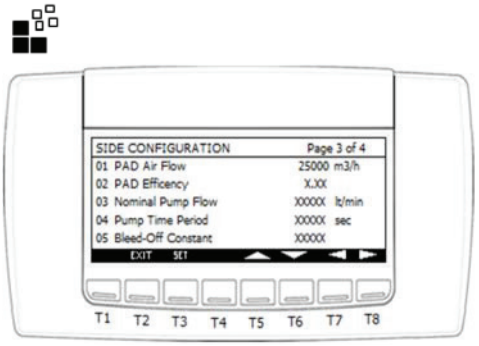

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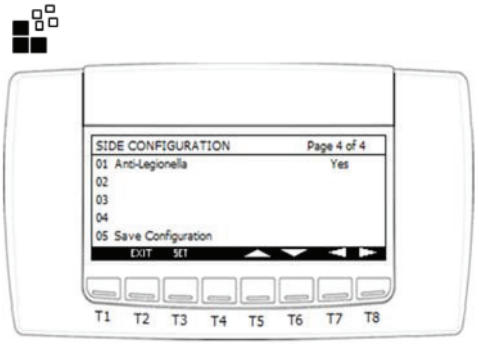

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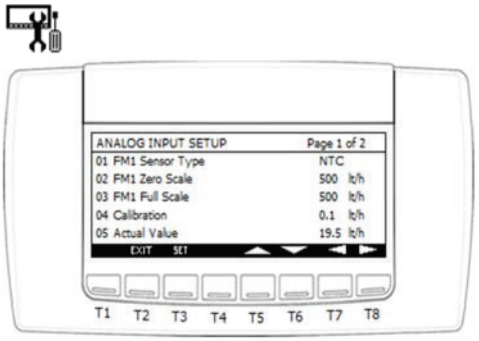
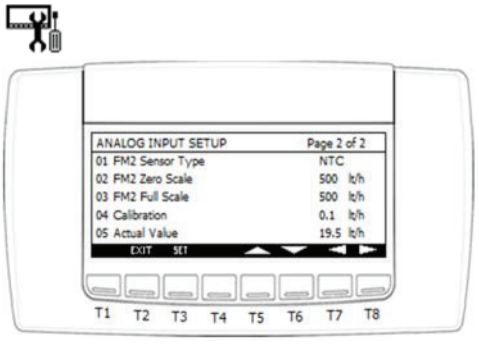
T7 = Decreases the value of selected parameter.
T8 = Increases the value of the selected parameter.

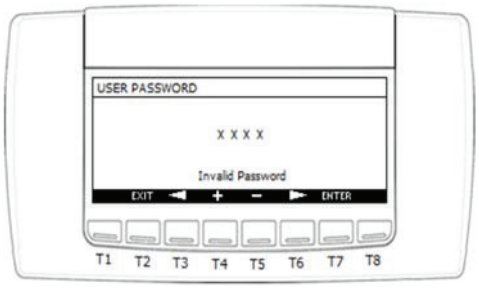


HEADER LINE:
Describes the meaning and the number of page.
BODY:
Contains the list of parameters.
BOTTOM LINE:
Shows the meaning of T keys:
T1 = Not used.
T2 = Display moves to Main Factory page or deselect the parameter.
T3 = Enables the configuration of parameter.
T4 = Not used.
T5 = Up key used to move between parameters or pages.
T6 = Down key used to select the first parameter and to move between parameters or pages.
T7 = Decreases the value of selected parameter.
T8 = Increases the value of the selected parameter.



Password Page:

HEADER LINE:
Shows the meaning of page.
BODY:
Contains the 4 digit for password AND shows the text ”Invalid Password” in case of wrong password.
BOTTOM LINE:
Shows the meaning of T keys:
T1 = Not used.
T2 = Display moves to Main Unit page.
T3 = Moves between digits.
T4 = Increases the value.
T5 = Decreases the value.
T6 = Moves between digits.
T7 = Confirms the entered PIN.
T8 = Not used.



Symbols Description:

ON/OFF symbol

Event symbol

Overview symbol

Symbol appears when Pump/s is/are ON

Symbol appears when Inlet Valve/s is/are ON

Symbol appears when Drain Valve/s is/are ON

Symbol appears when Distribution is active

Symbol appears when Duck Valve/s is/are activate

Symbol appears when Freeze Protection is active

Symbol appears when the Anti- Legionella function is active

Symbol appears when the PAD function is active

Symbol appears when an Event is active

ID	Event Description	Type	Delay	Reset	Notes / Effect
001	Local OFF	Message	No	-	-
002	Remote OFF	Message	No	-	-
003	Alarm Off	Message	No	-	-
004	Standby	Message	No	-	-
005	Working	Message	No	-	-
006	Temperature Sensor Side 1 Failure	Warning	10 sec	AUTO	Activated when sensor is not available. Adiabatic is kept ON using the sensor of side 2
007	Temperature Sensor Side 2 Failure	Warning	10 sec	AUTO	Activated when sensor is not available. Adiabatic is kept ON using the sensor of side 1
008	Humidity Sensor Failure Side 1	Warning	10 sec	AUTO	Activated when sensor is not available. Adiabatic is kept ON using the sensor of side 2
009	Humidity Sensor Failure Side 2	Warning	10 sec	AUTO	Activated when sensor is not available. Adiabatic is kept ON using the sensor of side 1
010	Temperature Sensor Failure	Alarm	10 sec	AUTO	Activated when any sensor is available. Adiabatic is switched OFF
011	Humidity Sensor Failure	Alarm	10 sec	AUTO	Activated when any sensor is available. Adiabatic is switched OFF
012	Flow Meter Side 1 Failure	Alarm	1 min	AUTO	Activated when sensor is not available. Adiabatic is switched OFF
013	Flow Meter Side 2 Failure	Alarm	1 min	AUTO	Activated when sensor is not available. Adiabatic is switched OFF
014	Future Use	-	-	-	-
015	Future Use	-	-	-	-
016	Emergency Drain 1	Alarm	5 sec	MAN	Drain flow switch 1 active Adiabatic is switched OFF
017	Emergency Drain 2	Alarm	5 sec	MAN	Drain flow switch 2 active Adiabatic is switched OFF
018	Pump 1 Failure	Alarm	1 sec	MAN	Activated when pump is not working Adiabatic is switched OFF
019	Pump 2 Failure	Alarm	1 sec	MAN	Activated when pump is not working Adiabatic is switched OFF
020	Future Use	-	-	-	-
021	Future Use	-	-	-	-
022	Future Use	-	-	-	-
023	Working Hours Pump Side 1	Alarm	No	AUTO	Activated when the limit is exceeded Adiabatic continues to run
024	Working Hours Pump Side 2	Alarm	No	AUTO	Activated when the limit is exceeded Adiabatic continues to run
025	Missing AFC Adiabatic	Warning	1 min	AUTO	Activated when the AFC is not sending data Adiabatic is forced to be in stand-by

Tab. 1 - Internal hydraulic volume

MODEL		UNIT VOLUME (l)	ADIABATIC VOLUME (l)
FGA	**030**	147	303

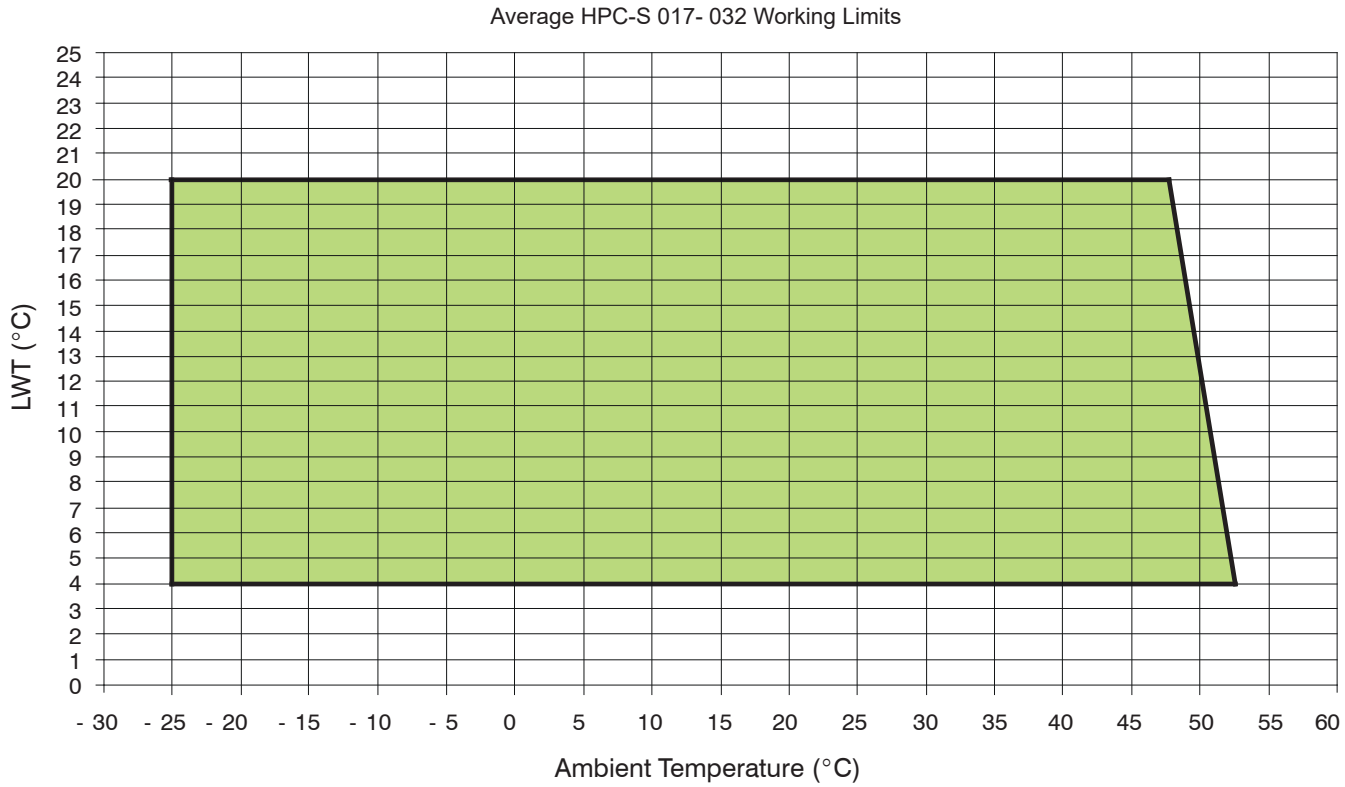
Note:
Add the tank's volume for the units with optional buffer tank.

Tab. 2 - Refrigerant and oil charge

FGA	
MODEL	**030**
Refrigerant charge (each circuit) [kg]	26
Oil charge (each circuit) [lt]	6,8+6,3

Note:
Refrigerant type: R410A; Oil type: ICI Emkarate RL 32 3MAF.

Tab. 3 - Operating range



Tab. 3a - Operating range - Freecooling

Models: FGA 017-030		017	020	023	025	028	030
Operating range							
Max. outdoor temperature (1)	°C	49,5	49,0	50,0	49,5	49,5	49,0
Max. outdoor temperature (2)	°C	46,0	45,0	46,5	46,0	46,0	45,5
Safety devices settings							
High pressure switch	barg	42					
High pressure safety valve	barg	45					
HP safety valve (each circuit)	No	1					
High pressure safety valve connection	inch	3/4" G					
Low pressure switch	barg	5					

(1) - Nominal air flow; outlet water temperature 10°C; full load; refrigerant R410A
(1) - Nominal air flow; outlet water temperature 20°C; full load; refrigerant R410A
(*) - Outdoor temperature for adiabatic versions = Dry bulb air temperature after PAD

Tab. 3b - Operating range - Freecooling Low noise

Models: FGA 017-030 + LN		017	020	023	025	028	030
Operating range							
Max. outdoor temperature (1)	°C	46,5	45,5	47,0	46,5	47,0	46,0
Max. outdoor temperature (2)	°C	42,5	41,5	43,0	42,0	42,5	41,5
Safety devices settings							
High pressure switch	barg	42					
High pressure safety valve	barg	45					
HP safety valve (each circuit)	No	1					
High pressure safety valve connection	inch	3/4" G					
Low pressure switch	barg	5					

(1) - Nominal air flow; outlet water temperature 10°C; full load; refrigerant R410A
(1) - Nominal air flow; outlet water temperature 20°C; full load; refrigerant R410A
(*) - Outdoor temperature for adiabatic versions = Dry bulb air temperature after PAD

Tab. 4 - Pump group characteristics

Tab. 4a - 2 Pole, standard head pressure (data referred to each pump)

Models			017	020	023	025	028	030
FGA	30% glycol- water Mixture Flow	m3/h	32,26	35,89	42,12	45,96	52,85	59,31
	Available Pressure Head	kPa	93	55	146	111	52	76
Pump/s number		Nr.	1/2	1/2	1/2	1/2	1/2	1/2
Pump Rotor Model		-	65-260/2	65-260/2	65-340/2	65-340/2	65-340/2	65-410/2
Nominal Motor Power		kW	4,0	4,0	5,5	5,5	5,5	7,5
Noise Level (*)		dB(A)	63	63	63	63	63	60

(*) - According to ISO 3744

Tab. 4b - 2 Pole, high head pressure (data referred to each pump)

Models			017	020	023	025	028	030
FGA	30% glycol- water Mixture Flow	m3/h	32,26	35,89	42,12	45,96	52,85	59,31
	Available Pressure Head	kPa	169	134	235	204	150	148
Pump/s number		Nr.	1/2	1/2	1/2	1/2	1/2	1/2
Pump Rotor Model		-	65-340/2	65-340/2	65-410/2	65-410/2	65-410/2	65-460/2
Nominal Motor Power		kW	5,5	6,0	7,5	7,5	7,5	11,0
Noise Level (*)		dB(A)	63	63	60	60	60	60

(*) - According to ISO 3744

Tab. 5 - Sound pressure/power level

The following table indicates the overall sound pressure level at full load conditions, measured 1m from the unit, according to ISO 3774, with an outdoor temperature of 35°C and referred to free field conditions.

Tab. 5a - SPL FGA

Models	Octave band frequency [Hz]								TOTALE [dB(A)]
	63	125	250	500	1000	2000	4000	8000	
FGA	"SPL" Sound pressure levels [dB]								
030	84.7	77.7	72.7	74.7	69.7	66.7	58.7	51.7	75.5

Tab. 5b - PWL FGA

Models	Octave band frequency [Hz]								TOTALE [dB(A)]
	63	125	250	500	1000	2000	4000	8000	
FGA	"PWL" Sound power levels [dB]								
030	105.3	98.3	93.3	95.3	90.3	87.3	79.3	72.3	96.1

Note:
Sound power levels tolerance for each octave band: - 0/+2 dB

Tab. 5c - SPL FGA + LN

Models	Octave band frequency [Hz]								TOTALE [dB(A)]
	63	125	250	500	1000	2000	4000	8000	
FGA + LN	"SPL" Sound pressure levels [dB]								
030	79.4	72.4	68.4	67.4	64.4	59.4	52.4	58.4	69.5

Tab. 5d - PWL FGA +LN

Models	Octave band frequency [Hz]								TOTALE [dB(A)]
	63	125	250	500	1000	2000	4000	8000	
FGA + LN	"PWL" Sound power levels [dB]								
030	100	93	89	88	85	80	73	79	90.1

Tab. 6 - Electrical characteristics

Tab. 6a - Electrical data - FGA 017-030

Models FGA		017	020	023	025	028	030
Power supply	V/Ph/Hz	400V / 3Ph + PE / 50Hz					
Total power input (1)	kW	60	68	78	85	96	108
OA (1) (without PFC)	A	110	120	136	144	162	182
cosφ (1) (without PFC)		0.79	0.81	0.83	0.85	0.86	0.86
OA (1) (with PFC)	A	95	108	124	136	154	171
cosφ (1) (with PFC)		0.91	0.90	0.90	0.90	0.90	0.91
Total power input (2)	kW	65	74	84	92	103	118
OA (2) (without PFC)	A	118	128	144	152	174	196
cosφ (2) (without PFC)		0.79	0.83	0.84	0.87	0.86	0.87
OA (2) (with PFC)	A	118	128	144	152	175	196
cosφ (2) (with PFC)		0.79	0.83	0.84	0.87	0.86	0.87
Max. power input	kW	84	96	110	122	136	155
FLA	A	150	162	184	196	219	251
cosφ (without PFC)		0.80	0.85	0.86	0.90	0.90	0.89
FLA (with PFC)	A	135	151	173	189	211	241
cosφ (with PFC)		0.90	0.92	0.92	0.93	0.93	0.93
LRA	A	292	349	409	421	443	497
LRA (with compr. soft-start)	A	213	247	287	299	321	358
Min. cable section	mm²	70	70	95	95	120	150
Max. fuse (gG/aM)	A	315/315	315/315	315/315	500/450	500/450	500/450
Ring terminals with hole	mm	8	8	8	10	10	10
Line screw fixing	Nm	15-22	15-22	15-22	30-44	30-44	30-44
Control power supply (only for option Fast-Start)	V/Ph/Hz	230 (400)V / 2Ph + PE / 50Hz					
Pmax	kW	0.35					
Imax	A	1,5 (0,88)					
Cable section min./max.	mm²	1,5 / 10					
Max. fuse (gG/aM)	A	40					
Line screw fixing	Nm	2					
Compressor - Power input (1)	kW	51	59	66	73	82	94
Compressor - Nominal current (1)	A	96	106	118	126	140	160
Compressor - Power input (2)	kW	56	65	72	80	89	103
Compressor - Nominal current (2)	A	104	114	126	134	152	174
Single compressor 1/3 - Max. current	A	34	40	49	49	49	65
Single compressor 1/3 - LRA	A	174	225	272	272	272	310
Single compressor 1/3 - LRA Soft-start	A	96	124	150	150	150	171
Single compressor 2/4 - Max. current	A	34	34	34	40	49	49
Single compressor 2/4 - LRA	A	174	174	174	225	272	272
Single compressor 2/4 - LRA Soft-start	A	96	96	96	124	150	150
Fans number	-	3	3	4	4	5	5
EC fans 900 - Power input	kW	2.7					
EC fans 900 - Nominal current	A	4.1					
EC fans 900 - Max. current	A	4.2					
EC fans 800 - Power input (option)	kW	0.8					
EC fans 800 - Nominal current (option)	A	1.3					
EC fans 800 - Max. current (option)	A	4.2					
Std. head pressure pump model (option)	-	65-260/2	65-260/2	65-340/2	65-340/2	65-340/2	65-410/2
Std. head pressure pump - Nominal power	kW	4	4	5.5	5.5	5.5	7.5
Std. head pressure pump - Motor power	kW	4.7	4.7	6.5	6.5	6.5	8.4
Std. head pressure pump - Max. current	A	8.0	8.0	11.2	11.2	11.2	15.2
Std. head pressure pump - LRA	A	98	98	131	131	131	169
High head pressure pump model (option)	-	65-340/2	65-340/2	65-410/2	65-410/2	65-410/2	65-460/2
High head pressure pump - Nominal power	kW	5.5	5.5	7.5	7.5	7.5	11
High head pressure pump - Motor power	kW	6.5	6.5	8.4	8.4	8.4	13.3

Models FGA		017	020	023	025	028	030
High head pressure pump - Max. current	A	11.2	11.2	15.2	15.2	15.2	21.4
Std. head pressure pump - LRA	A	131	131	169	169	169	171
Adiabatic pump model	-	GXR 13					
Adiabatic pump - Number	-	1					
Adiabatic pump - Nominal power	kW	0.45					
Adiabatic pump - Motor power	kW	0.95					
Adiabatic pump - Max current	A	1.6					
Adiabatic pump - LRA	A	-					

(1) - Outdoor temperature 35° C; fluid inlet/outlet temperature 15/10° C; 70-30% water-glycol mixture; R410A refrigerant; dry pad
(2) - Outdoor temperature 35° C; fluid inlet/outlet temperature 26/20° C; 70-30% water-glycol mixture; R410A refrigerant, dry pad

The cable have to be sized compliance with local standards and according to the type and characteristics of installation. Suggested cables section are reffered to PVC insulation with max. working temperature at 70° C and ambient temperature at 30° C.

OA, FLA, LRA are calculated for unit without pumps and with fans as standard configuration.

If the unit with EC-FAN or inverter pump is connected to an electric installation where an earth leakage circuit breaker (ELCB) is used as additional protection, the circuit breaker must be of a type marked with the following symbols (This circuit breaker is type B.) :

Note: EC fans electrical data are provided with max. operating current (fans at max. speed).

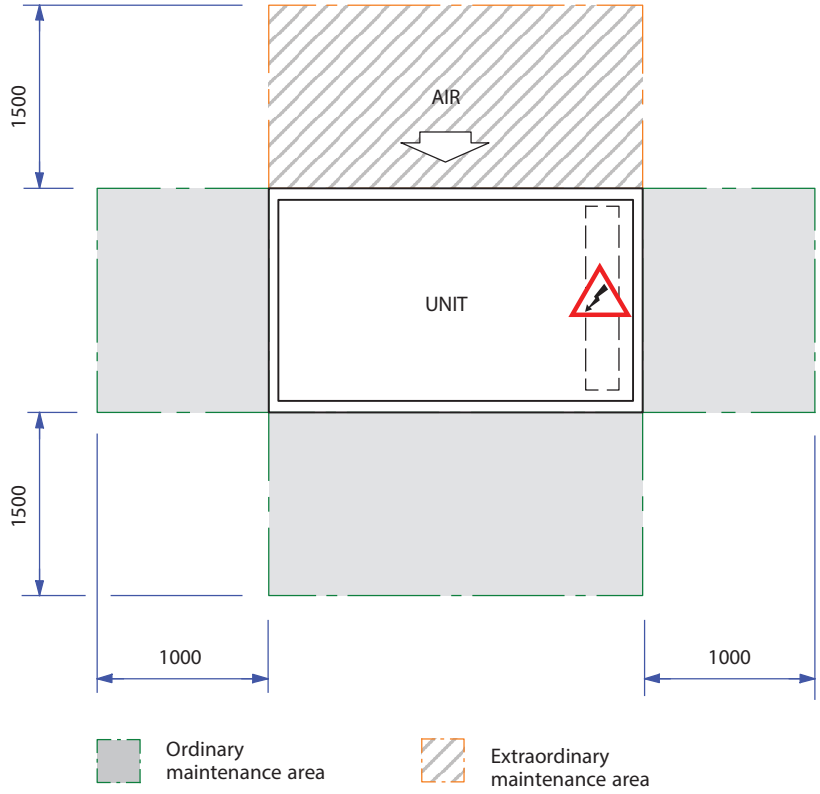
- Nominal power supply: 400V / 3Ph + PE / 50Hz;
- Nominal power supply tollerance: 400V ±10%;
- Max. phase difference: 2%.

Tab. 7 - Application consideration

Options	Model FG0	Weight [kg]					
		017	020	023	025	028	030
	Base unit	2199	2349	2785	2935	3378	3416
Acoustic option	digit 11 = D	80	80	100	100	115	115
Soft starter	digit 8 = 1	30	30	30	30	30	30
Buffer tank	digit 10 ≠ 0	440	440	440	440	440	440
Pumps group / Hydraulic kit	digit 12 = 1	10	10	10	10	10	10
	digit 12 = 2	95	95	110	110	110	112
	digit 12 = 3	110	110	112	112	112	170
	digit 12 = 4	170	170	200	200	200	204
	digit 12 = 5	200	200	204	204	204	327
	digit 12 = 6	114	114	125	125	125	203

N.B.: Special versions are not included in these tables.
N.B.: With copper-copper coil shipping, weight have big increase. It's mandatory to check all lifting devices.

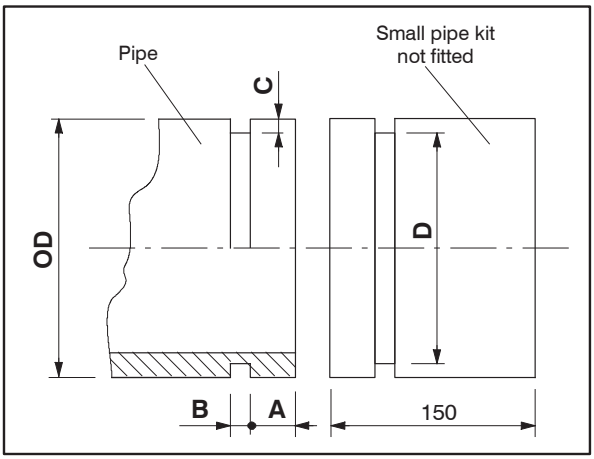
Fig. 1 - Service areas (top view)



Notes:
Minimum distance between 2 units from condensing coil side = 3 m
Do not obstruct the air exiting the fans for a minimum distance of 2.5 m

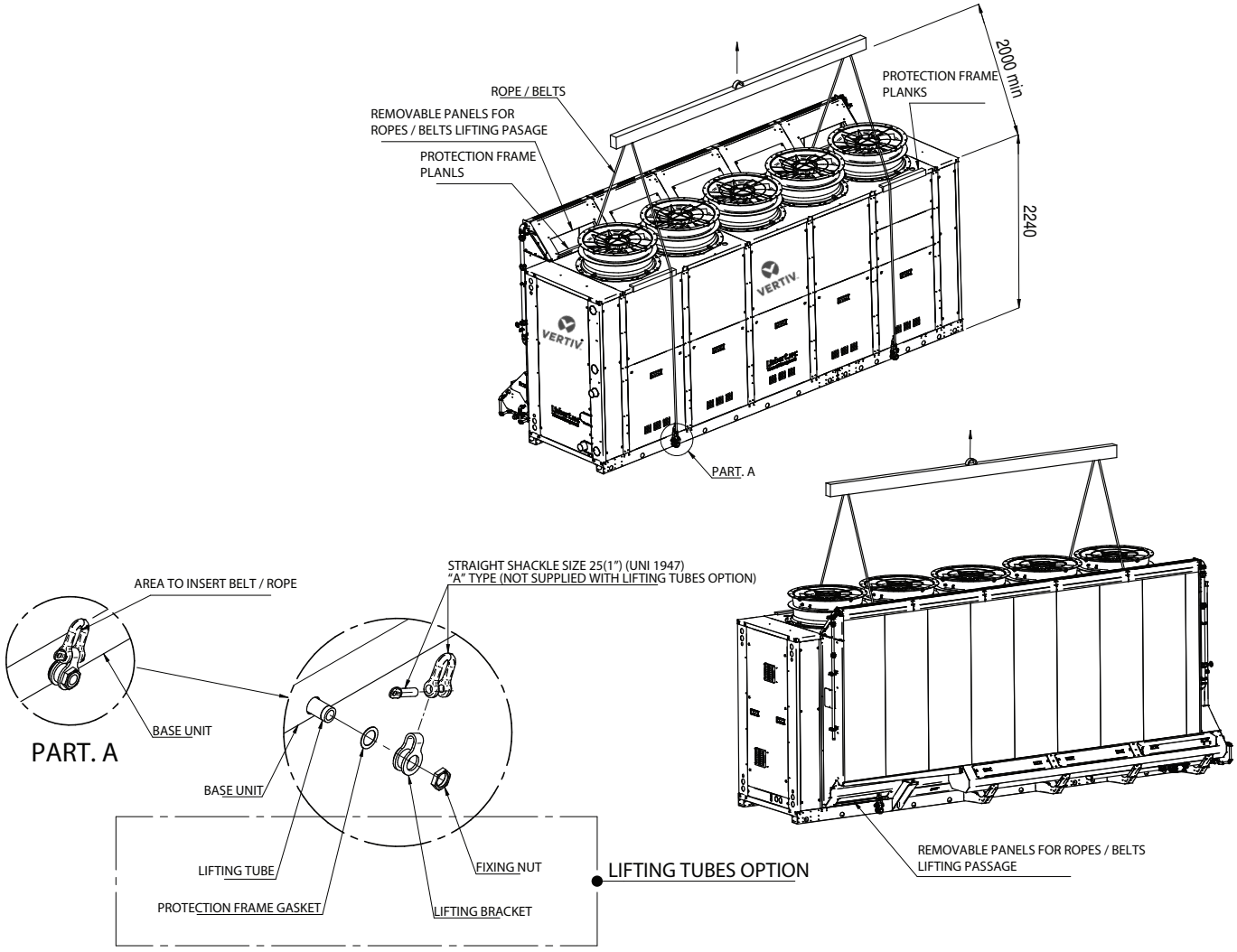
Fig. 2 - Victaulic connection system

DIMENSIONS						
OD	Ø inch	3”	4”	5”	6”	8”
	DN	80	100	125	150	200
	Ø mm	889	1,143	1,397	1,683	2,191
A	mm	1,588	1,588	1,588	1,588	1,905
Tolerance	mm	±0,77	±0,77	±0,77	±0,77	±0,77
B	mm	795	953	953	953	1,113
Tolerance	mm	±0,77	±0,77	±0,77	±0,77	±0,77
C	mm	198	211	213	216	234
D Tolerance	Ø mm mm mm	84,94 - 0,51 +0,00	110,08 - 0,51 +0,00	135,50 - 0,56 +0,00	163,96 - 0,56 +0,00	214,4 - 0,64 +0,00



For welded hydraulic connection use the “line sections” supplied, otherwise directly connect grooved lines with the Victaulic- type joints of the unit, taking care to suitably grease the joint gaskets.

Fig. 3 - Lifting instructions with tubes

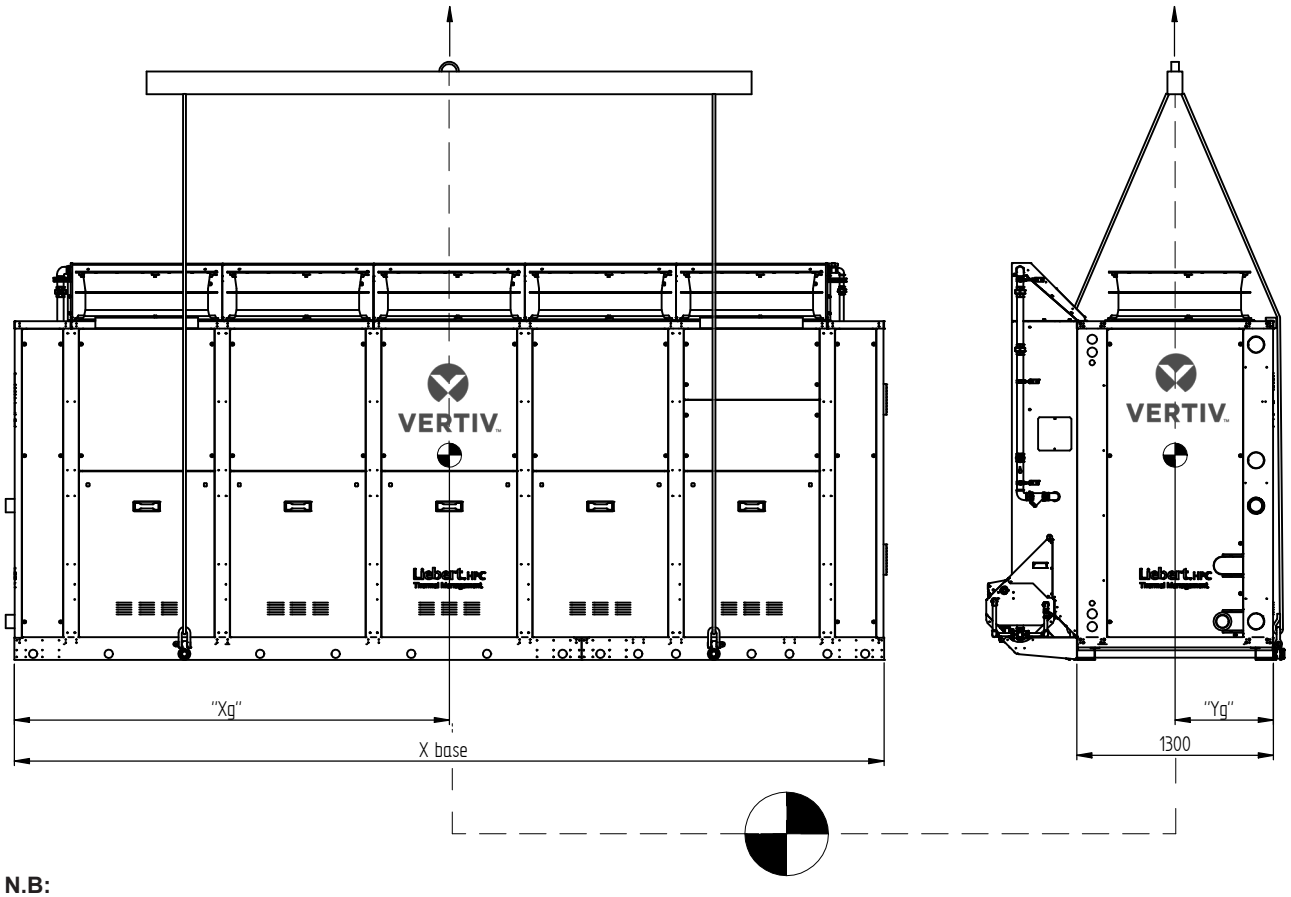


N.B: Place the lifting tubes in the holes in the base indicated by the word '**LIFT HERE**'. Lock the ends of the tubes in position with the ring nut as shown above, using 60 mm span.
The capacity of the lifting gear must be adequate to lift the load in question. Check the weight of the units, the capacity of the lifting gear and ropes and the condition and suitability of the aforementioned equipment.
Lift the unit with a speed suitable for the load to be moved, so as not to damage the **Liebert® HPC-S Adiabatic** structure.
After lifting and positioning the unit, remove lifting accessories (ropes, slings, chains, hooks, brackets and tubes).
Lifting tools as: hooks, lifting gear, ropes, chords, belts, rigid struts, protection plank are not provided with the unit.

Lifting

Models	A (mm)	B (mm)	C (mm)
FGA 017 - 020 - 023 - 025 - 028 - 030	1,800	≈5.000	≈9.000

Fig. 4 - Lifting baricentric axis



N.B:
The lifting point has to be on the vertical baricentric axis, which is individualized by symbols indicated on the base.

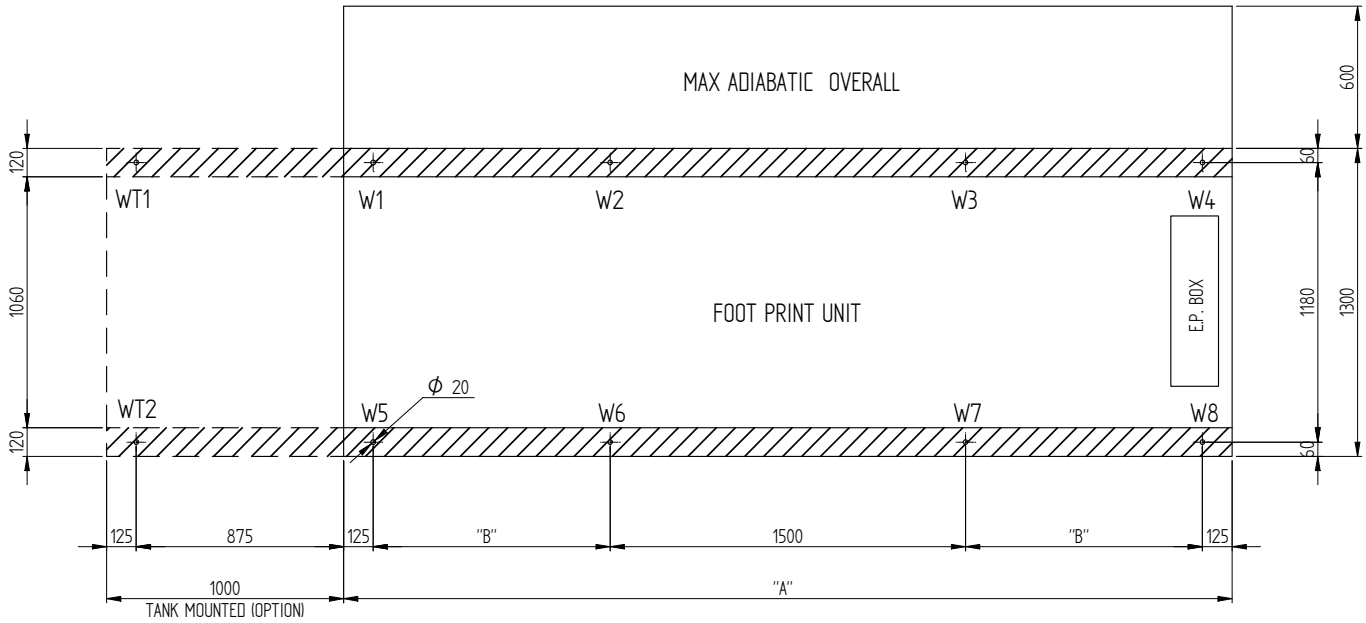
Shipping weight and unit baricentre position - Unit without tank

MODEL	SIZE	X base	Unit without pumps		
		(mm)	Xg (mm)	Yg (mm)	Shipping weight (kg)

Shipping weight and unit baricentre position - Unit with tank

MODEL	SIZE	X base	Unit without pumps		
		(mm)	Xg (mm)	Yg (mm)	Shipping weight (kg)

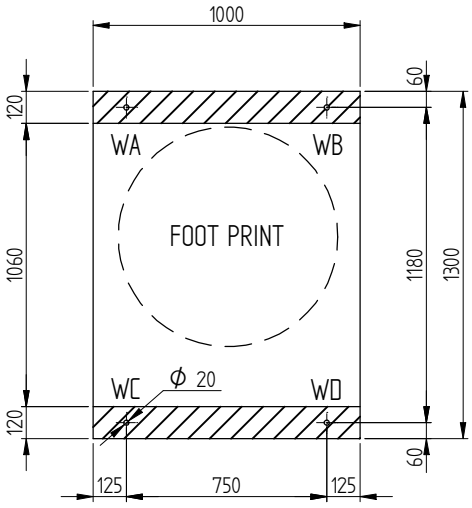
Fig. 5 - Support positions and loads



Tank (supply not mounted on unit)

Dimensions

MODELS	SIZE	DIMENSIONS (mm)	
		"A"	"B"



WA=WB= 406 Kg
WC=WD= 299 Kg

Operating weight distribution - Unit without tank

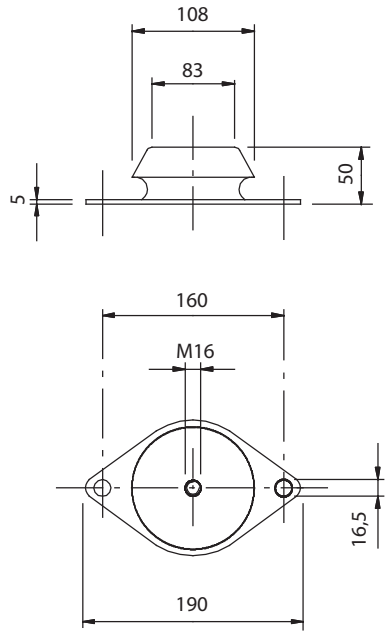
MODEL	SIZE	Weight distribution (kg)								TOT. (kg)
		W1	W2	W3	W4	W5	W6	W7	W8	

Operating weight distribution - Unit with tank

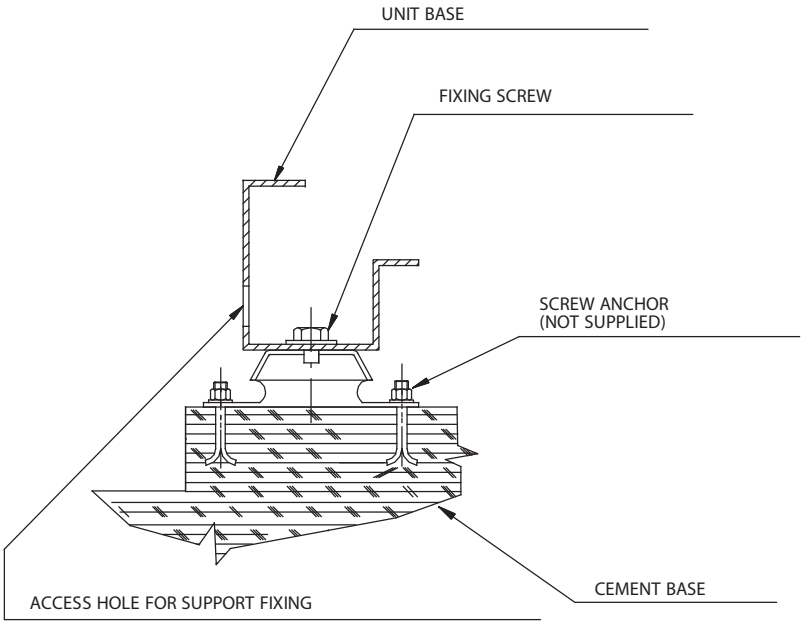
MODEL	SIZE	Weight distribution (kg)										TOT. (kg)
		WT1	W1	W2	W3	W4	WT2	W5	W6	W7	W8	

Fig. 6 - Rubber anti- vibration support + 1000 liters tank

Rubber support dimensions
(Single rubber support code: 270326)



Rubber support installation

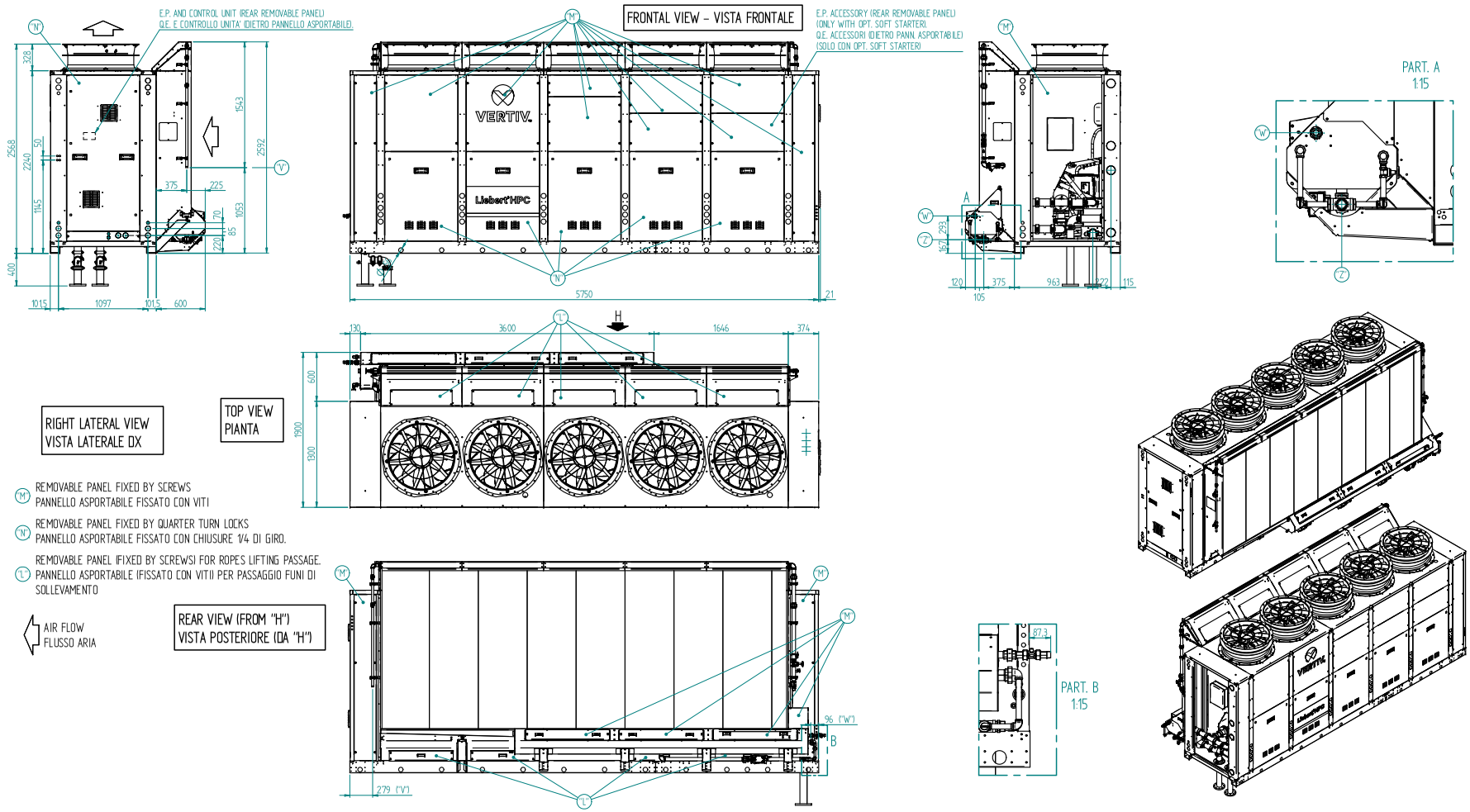


Rubber supports + 1000 liters tank

Unit	Configuration	Support kit code	Single support code	Kit support pieces
FGA 017 - 020 - 023 - 025 - 028 - 030	Without tank	485625	270326	8
	With tank	485626	270326	10
1000 liters tank	Loose supplied	485649	270326	4

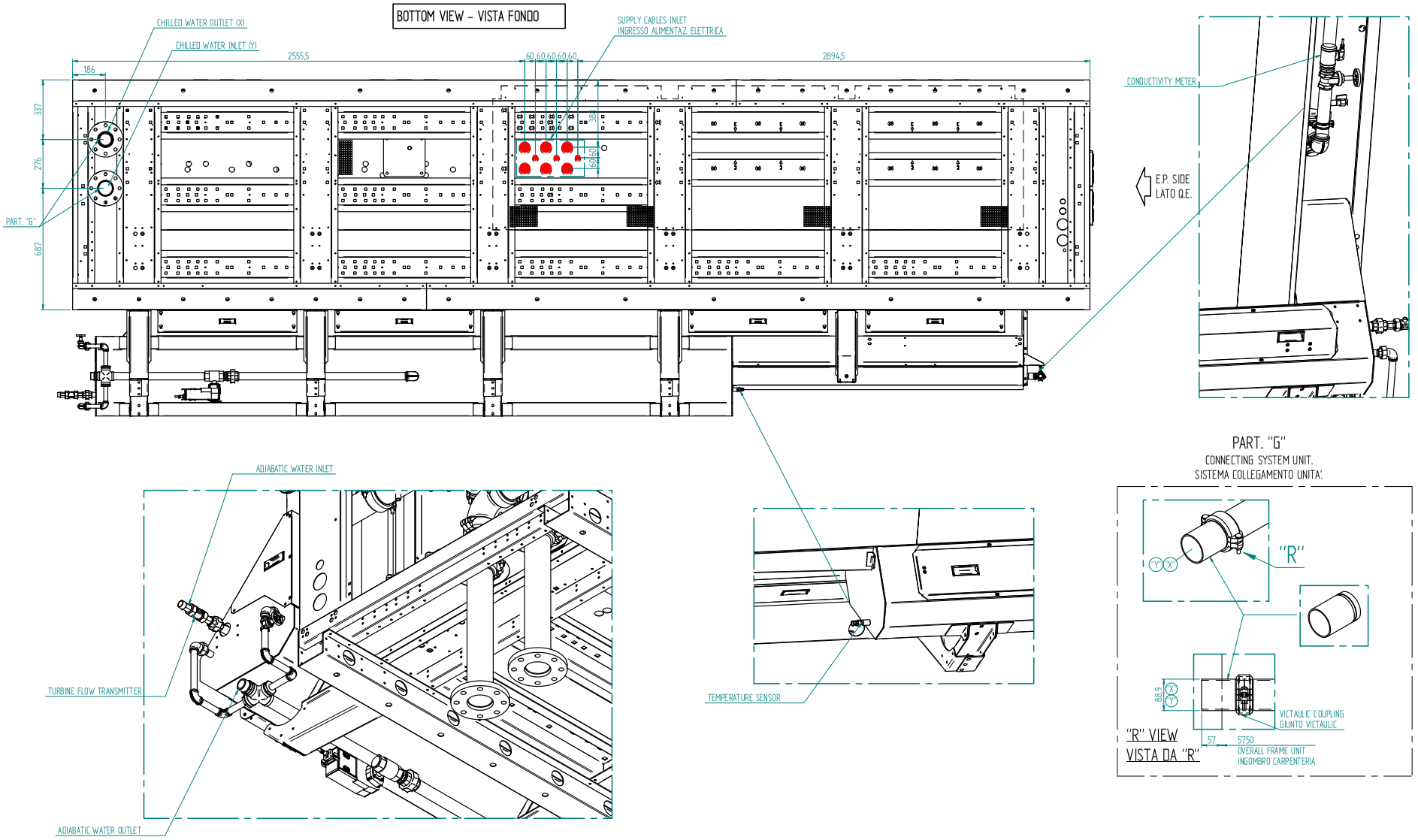
Each kit is complete with stainless steel fixing screws and plain washers for unit assembly.

fig. 7e - HPC-S 5 FANS WITHOUT TANK



MODELS MODELLI	X	Y	W	Z	V
	CHILLED WATER CONNECTION CONNESSIONE ACQUA REFRIGERATA	CHILLED WATER CONNECTION CONNESSIONE ACQUA REFRIGERATA	ADIABATIC WATER CONNECTION CONNESSIONE ACQUA SISTEMA ADIABATICO	ADIABATIC WATER CONNECTION CONNESSIONE ACQUA SISTEMA ADIABATICO	ADIABATIC WATER SERVICE CONNECTION CONNESSIONE DI SERVIZIO ACQUA SISTEMA ADIABATICO
FGA 028-030	INLET -INGRESSO DN80 – 3"- 88,9mm	OUTLET – USCITA DN80 – 3"- 88,9mm	INLET -INGRESSO R 3/4 (ISO 7/1)	OUTLET – USCITA R 1 1/4 (ISO 7/1)	OUTLET – USCITA R 3/4 (ISO 7/1)

MODELS	"X"	"Y"	"W"	"Z"	"V"
	CHILLED WATER CONNECTION	CHILLED WATER CONNECTION	ADIABATIC WATER CONNECTION	ADIABATIC WATER CONNECTION	ADIABATIC WATER SERVICE CONNECTION
FGA 030	INLET DN80 - 3"- 88,9mm	OUTLET - DN80 - 3"- 88,9mm	INLET -R 3/4 (ISO 7/1)	OUTLET - R 1 1/4 (ISO 7/1)	OUTLET - R 3/4 (ISO 7/1)



MODELS	"X"	"Y"	"W"	"Z"	"V"
	CHILLED WATER CONNECTION	CHILLED WATER CONNECTION	ADIABATIC WATER CONNECTION	ADIABATIC WATER CONNECTION	ADIABATIC WATER SERVICE CONNECTION
FGA 030	INLET DN80 - 3"-88,9mm	OUTLET - DN80 - 3"-88,9mm	INLET -R 3/4 (ISO 7/1)	OUTLET - R 1 1/4 (ISO 7/1)	OUTLET - R 3/4 (ISO 7/1)

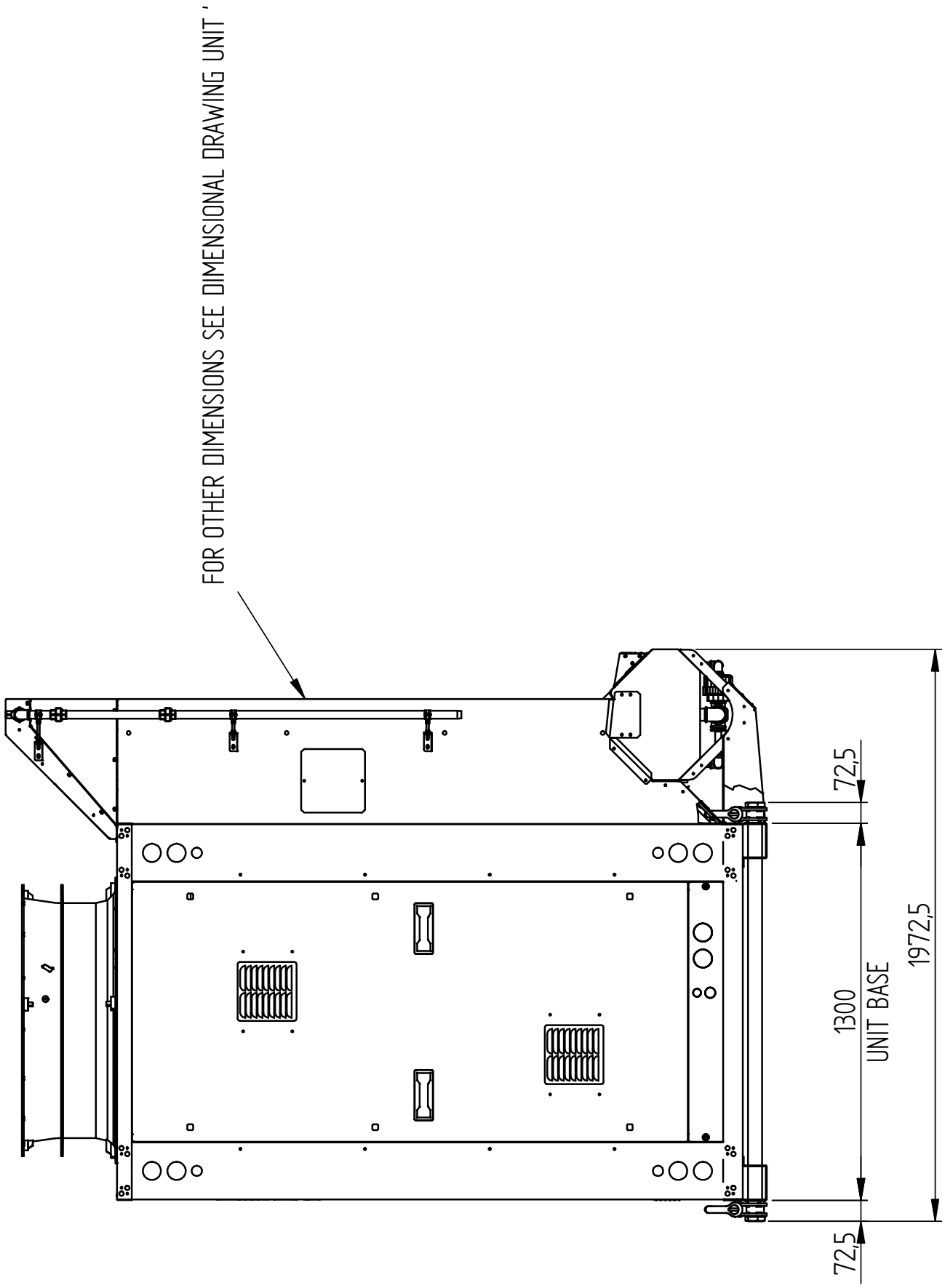


Fig. 8 - Overall unit dimensions with lifting tubes option

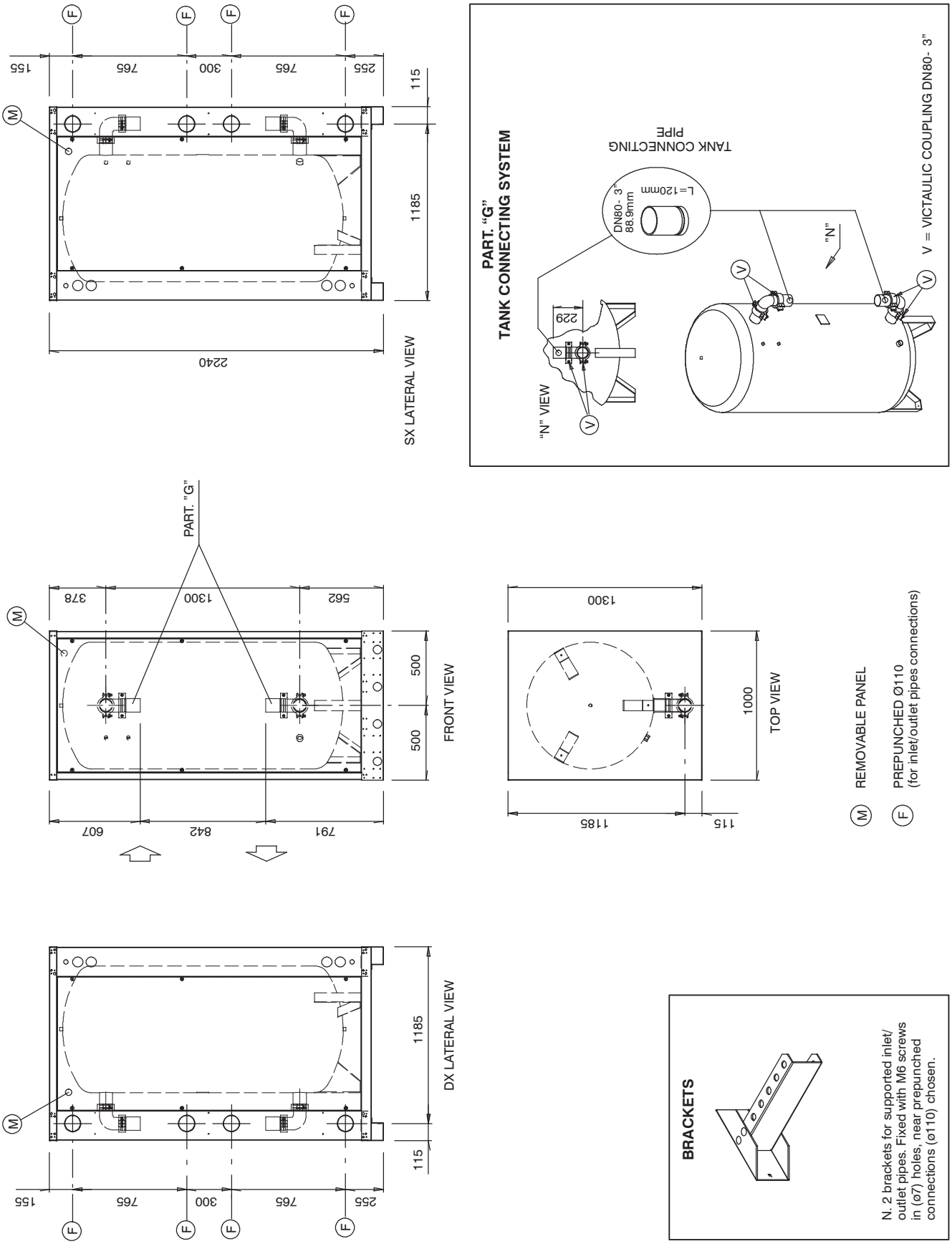
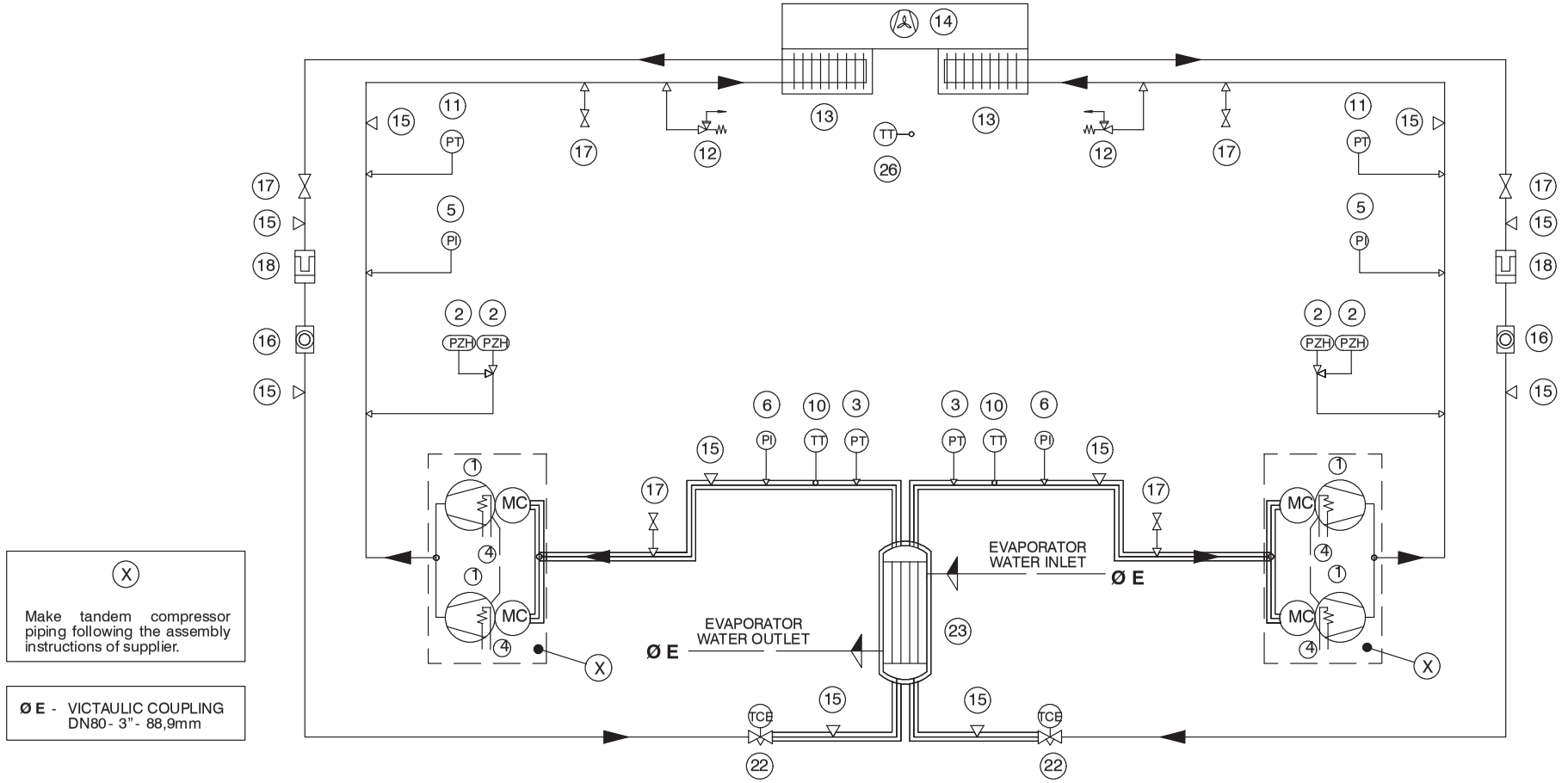


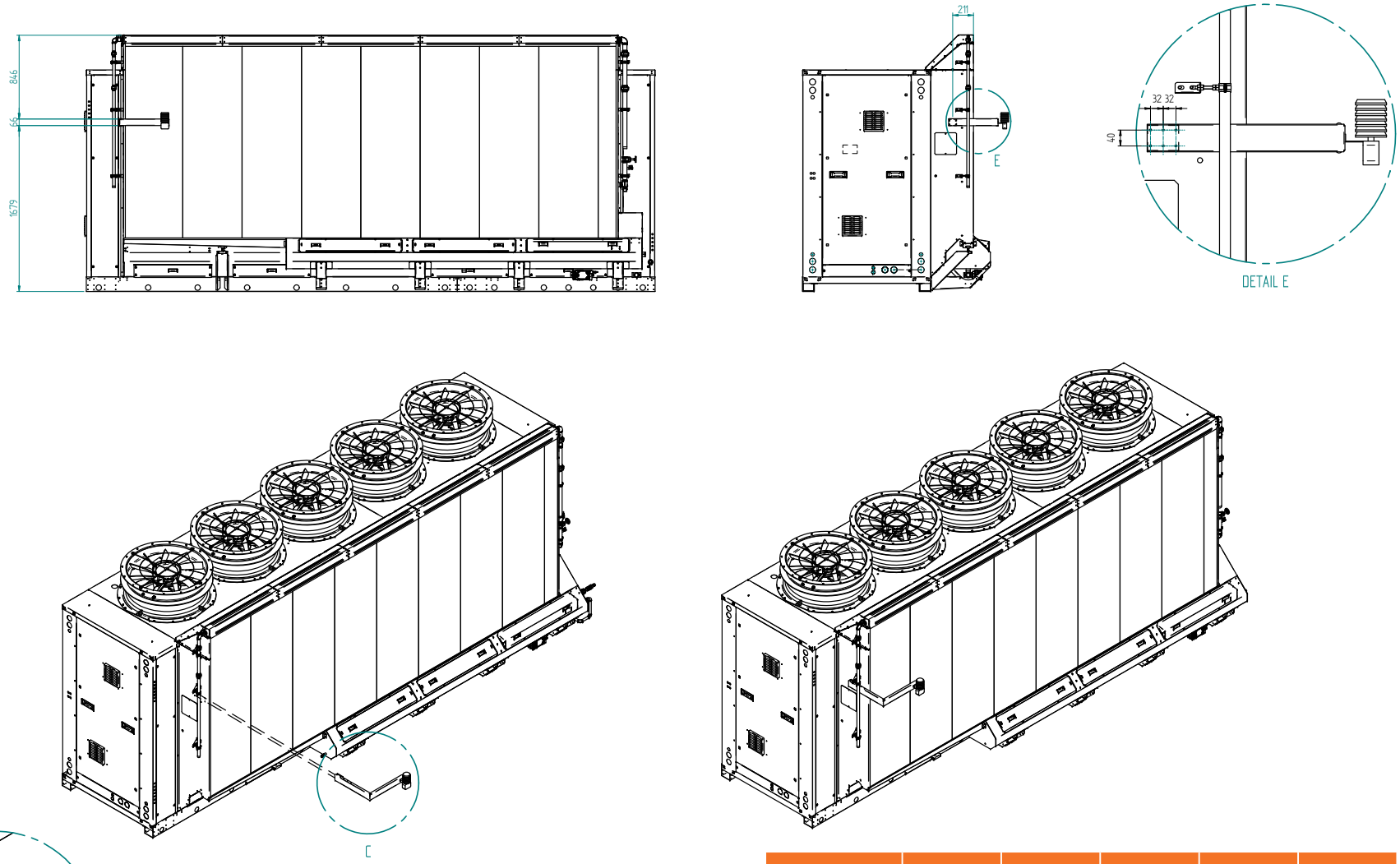
Fig. 9 - Tank overall dimensions (supply not mounted on unit)

Fig. 10 - REFRIGERANT CIRCUIT



Pos.	Description	Pos.	Description	Pos.	Description
1	Compressor	10	Thermostatic temperature sensor	19	-
2	High pressure switch	11	Transducer pressure sensor (High pressure control)	20	-
3	Transducer pressure sensor (Low pressure control)	12	Safety valve	21	-
4	Crankcase heater	13	Condenser	22	Electronic expansion valve
5	High pressure manometer	14	Condenser fans	23	Evaporator
6	Low pressure manometer	15	Service connection	24	-
7	-	16	Sight glass	25	-
8	-	17	Shut- Off valve	26	External air temperature sensor
9	-	18	Filter dryer	27	-

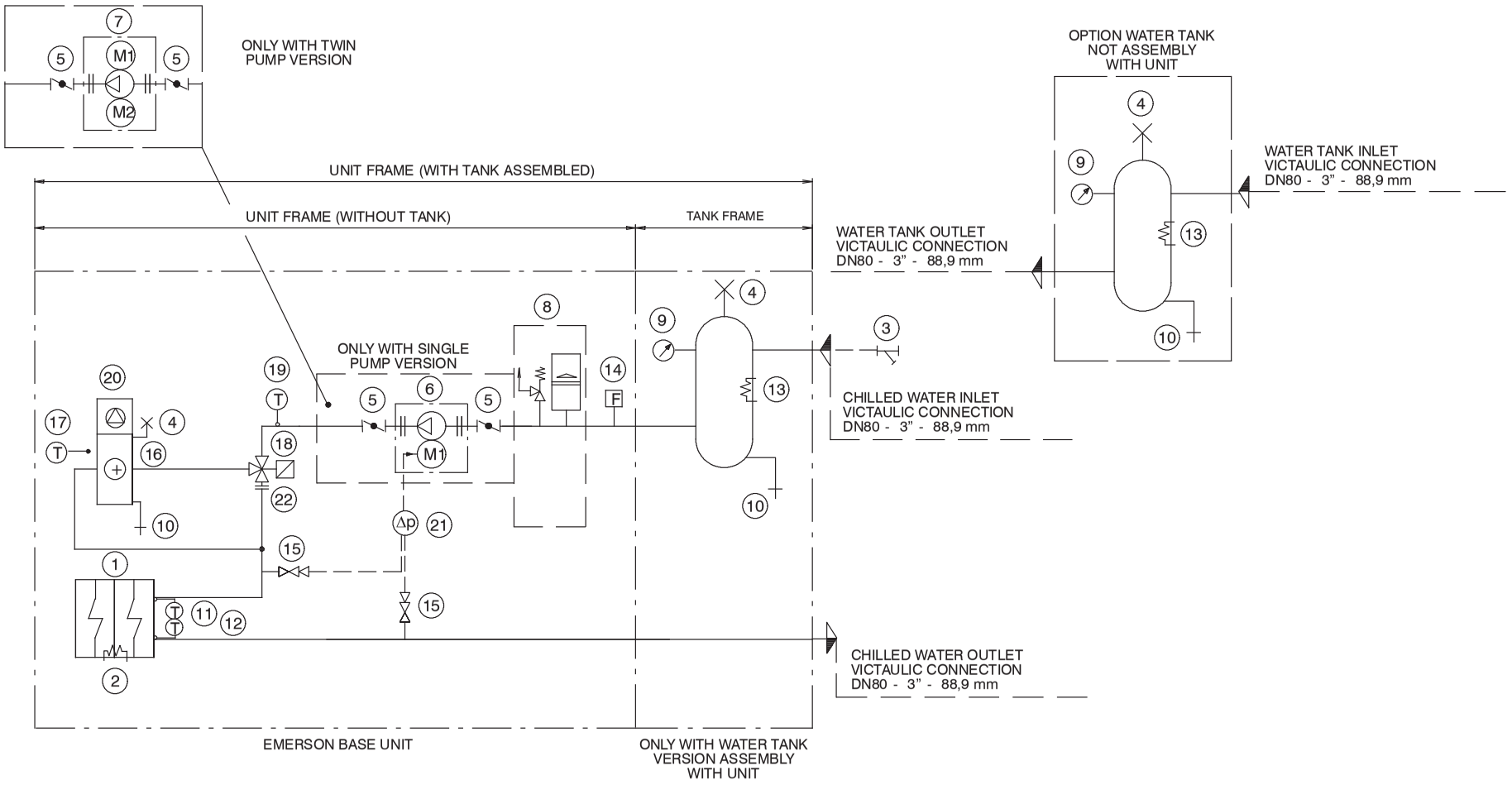
Fig. 11 - POSITIONING TEMPERATURE- HUMIDITY SENSOR ON ADIABATIC SYSTEM



MODEL	N. FANS	L (mm)	C (mm)	D (mm)	E (mm)
FGA 030	5	5750	2466	2466	5002

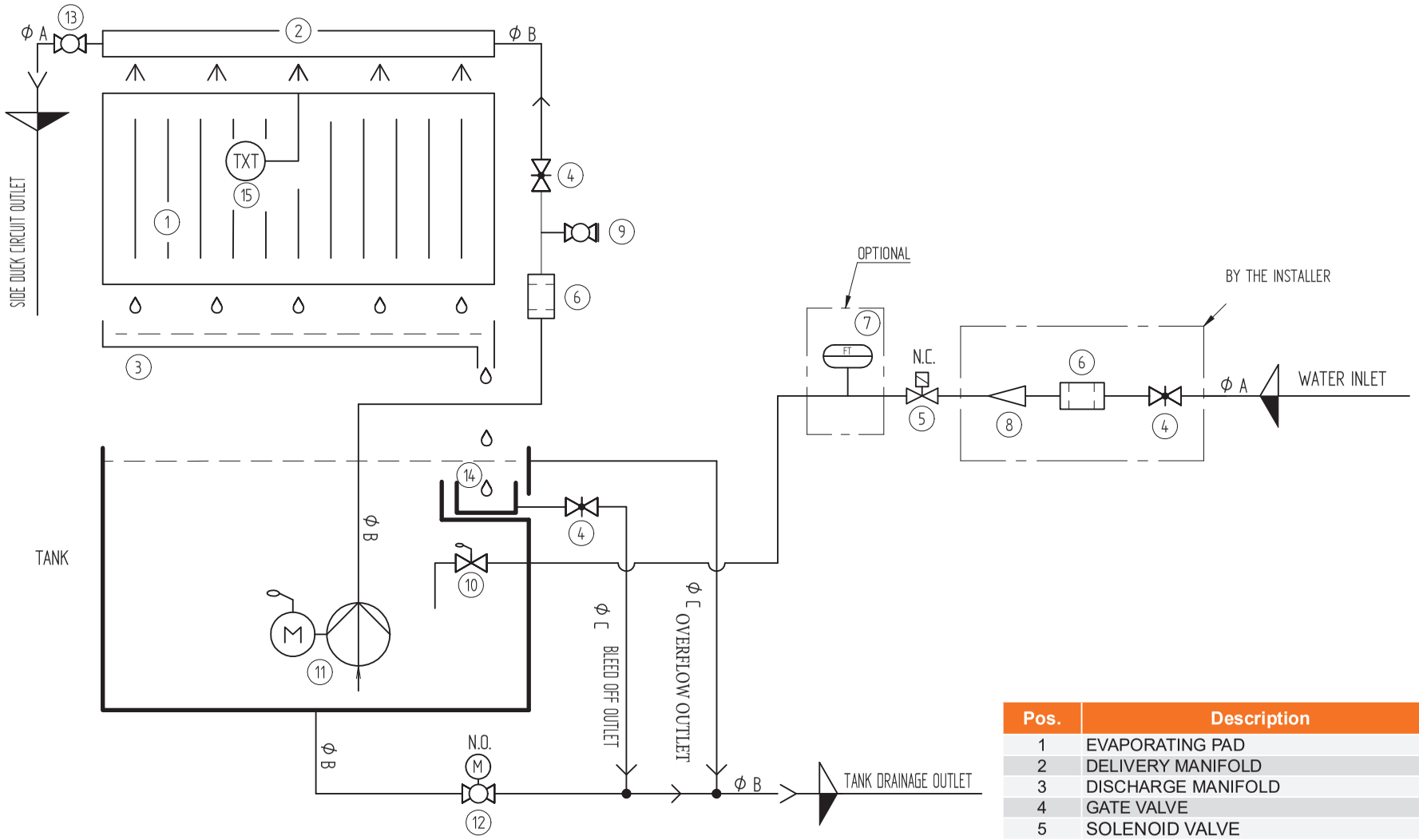
Pos.	Draw.	Cod.	Description	Quant.
1	EF1000C130	139249	BRACKET SUPPORT SENSOR QFA3171	1
2	EK1000C135	137454	SENSOR BRACKET QFA3171	1
3		276985	SENSOR QFA3171 4.20 mA	1

Fig. 12 - FREECOOLING HYDRAULIC CIRCUIT



Pos.	Description	Pos.	Description
1	Evaporator	12	Water outlet evaporator probe
2	Evaporator antifreeze heater (optional)	13	Tank antifreeze heater (optional)
3	Water filter (option)	14	Flow switch
4	Manual air valve	15	Service valve with cap
5	Butterfly valve	16	Freecooling coil
6	Single pump	17	Air temperature sensor
7	Twin pump	18	3 way valve
8	Expansion tank + Safety valve (optional)	19	Control freecooling thermostat sensor
9	Manometer	20	Fans
10	Discharge valve	21	Differential transducer (only with electronic pumps)
11	Water inlet evaporator probe	22	Caslibrated bafle

Fig. 13a - ADIABATIC SYSTEM HYDRAULIC DIAGRAM - 3 FANS

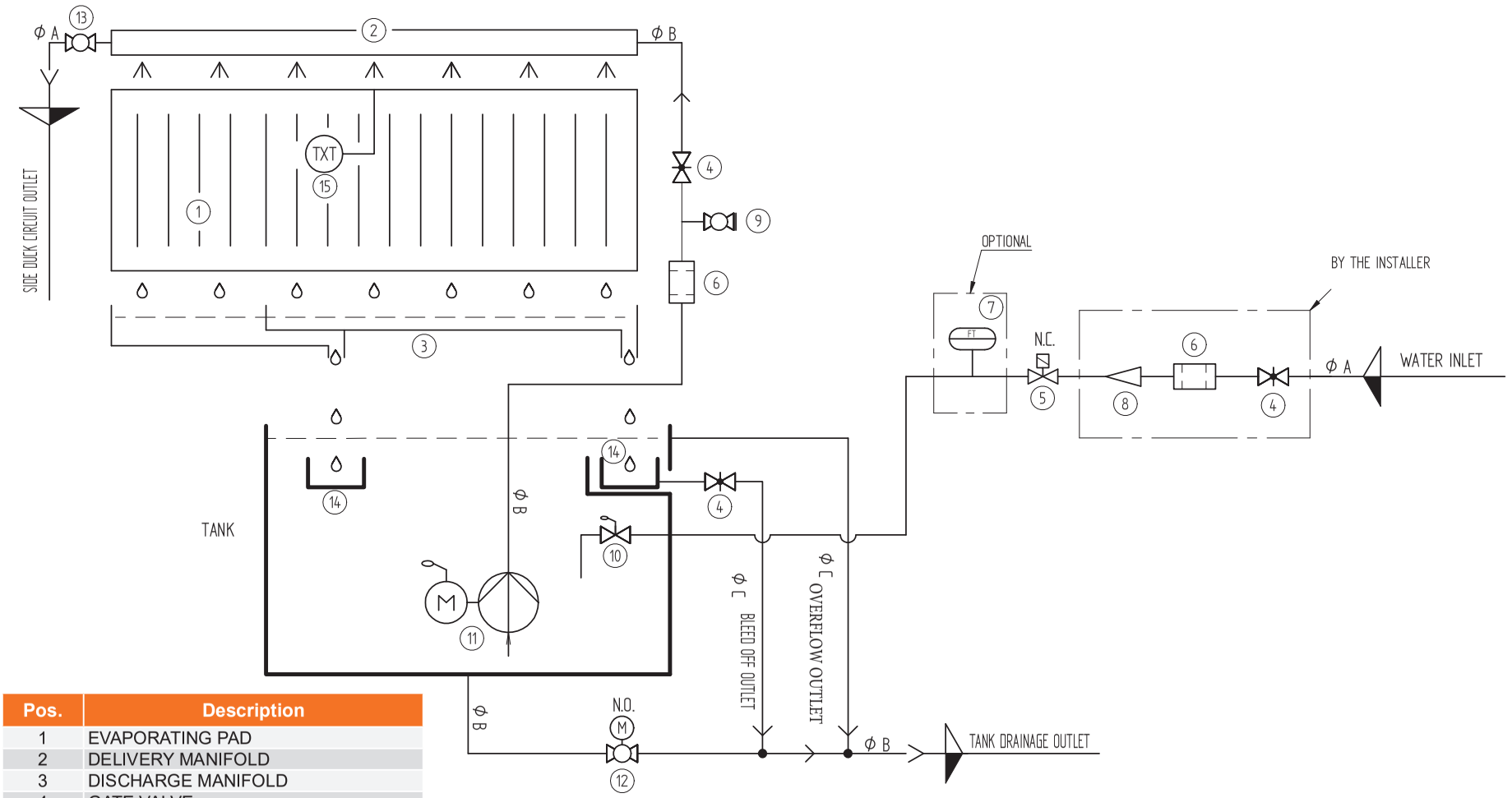


Ø PIPE	STEEL PIPING DIAMETER	
A	3/4”	DN 20
B	1 1/4”	DN 32
C	1/2”	DN 15

MALE GAS THREADED INLET-OUTLET CONNECTIONS (R...ISO 7/1)

Pos.	Description
1	EVAPORATING PAD
2	DELIVERY MANIFOLD
3	DISCHARGE MANIFOLD
4	GATE VALVE
5	SOLENOID VALVE
6	FILTER
7	FLOW METER
8	PRESSURE REGULATOR
9	SERVICE BALL VALVE WITH PLUG
10	FLOAT VALVE
11	SUBM. PUMP WITH LEVEL CONTROL
12	MOTORIZED BALL VALVE
13	BALL VALVE
14	COLLECTION TRAY IMPURITIES
15	TEMPERATURE-UMIDITY SENSOR

Fig. 13b - ADIABATIC SYSTEM HYDRAULIC DIAGRAM - 4-5 FANS



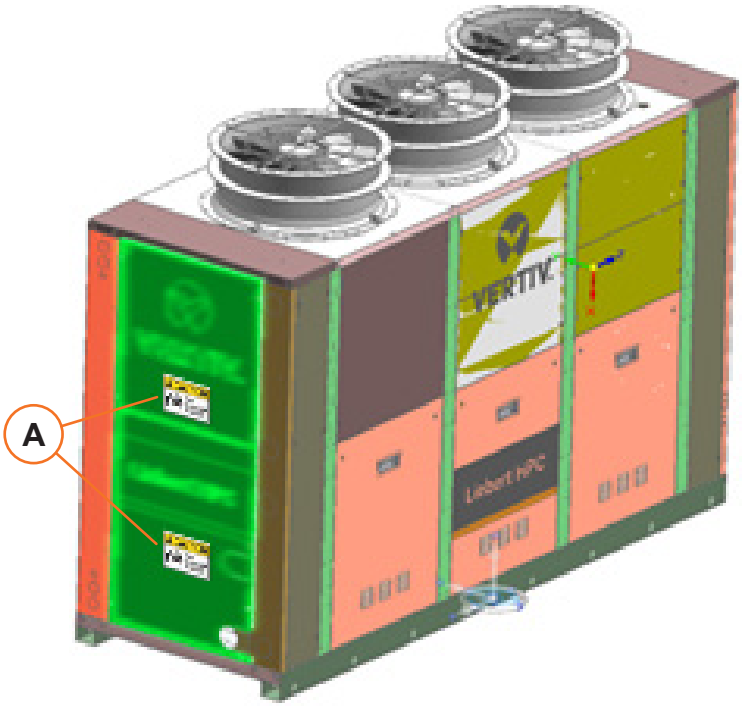
Pos.	Description
1	EVAPORATING PAD
2	DELIVERY MANIFOLD
3	DISCHARGE MANIFOLD
4	GATE VALVE
5	SOLENOID VALVE
6	FILTER
7	FLOW METER
8	PRESSURE REGULATOR
9	SERVICE BALL VALVE WITH PLUG
10	FLOAT VALVE
11	SUBM. PUMP WITH LEVEL CONTROL
12	MOTORIZED BALL VALVE
13	BALL VALVE
14	COLLECTION TRAY IMPURITIES
15	TEMPERATURE-UMIDITY SENSOR

Ø PIPE	STEEL PIPING DIAMETER	
A	3/4”	DN 20
B	1 1/4”	DN 32
C	1/2”	DN 15

MALE GAS THREADED INLET-OUTLET CONNECTIONS (R...ISO 7/1)

WARNING
Use this label (**A**) to identify removable components subject to regular maintenance that, due to their weight, require handling by **two** operators.

If it is damaged or no longer legible, apply a new label (**A**) on the panels highlighted in green in the image below.



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Il Fabbricante dichiara che questo prodotto è conforme alle direttive Europee:
The Manufacturer hereby declares that this product conforms to the European Union directives:
Der Hersteller erklärt hiermit, dass dieses Produkt den Anforderungen der Europäischen Richtlinien gerecht wird: Le Fabricant déclare que ce produit est conforme aux directives Européennes:
El Fabricante declara que este producto es conforme a las directivas Europeas:
O Fabricante declara que este produto está em conformidade com as directivas Europeias: Tillverkare försäkrar härmed att denna produkt överensstämmer med Europeiska Uniones direktiv: De Fabrikant verklaart dat dit produkt conform de Europese richtlijnen is:
Vaimistaja vakuuttaa täten, että tämä tuote täyättää seuraavien EU-direktiivien vaatimukset: Produsent erklærer herved at dette produktet er i samsvar med EU-direktiver:
Fabrikant erklærer herved, at dette produkt opfylder kravene i EU direktiverne:
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