Liebert HIROSS

High Performance Air Conditioning

MATRIX S [004-016]

HIGH PERFORMANCE AIR COOLED CHILLER

SERVICE MANUAL

English

Cod. 272491

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EMERSON

Network Power

Caution

It is recommended that:

- the manual is retained for the entire service life of the machine;
- the user reads the manual carefully before carrying out any operations on the machine;
- the machine is used exclusively for the purpose for which it is intended; incorrect use of the machine shall release the manufacturer from any liability.

This manual has been prepared to enable the end–user to carry out only those operations that can be done with the panels closed. Any operations that require the opening of doors or equipment panels must be carried out only by qualified personnel.
Each machine is equipped with an electric isolating device which allows the operator to work in conditions of safety. This device must always be used to eliminate risks during maintenance (electric shocks, scalds, automatic restarting, moving parts and remote control).
The panel key supplied with the unit must be kept by the person responsible for maintenance.
For identification of the unit (model and serial no.) in case of the necessity for assistance or spare parts, read the identification labels affixed to the outside and inside of the unit.

IMPORTANT: This manual may be subject to modification; for complete and up–to–date information the user should always consult the manual supplied with the machine.

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1 – Introduction

1.1 – Foreword

This handbook is aimed at enabling both the installer and the operator to carry out the correct installation, operation and maintenance of the refrigerating machine, without damaging it or causing injuries to the relevant staff.
The handbook is thus an aid for the qualified staff in the arrangement of the specific equipment for the correct installation, operation and maintenance in compliance with the local regulations in force.

The **MATRIX S** water chillers can be identified as follows:

CBH004

Cooling Capacity "kW"
Nominal cooling capacity / 10

Compressor:
H Hermetic Scroll

Version:
B Base
L Low Noise
Q Quiet

Execution:
C Chiller
S Superchiller

1.2 – Responsibility

Liebert Hiross 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 – Inspection

All units are fully assembled and wired in the manufacturing plant. Before shipment they are charged with the necessary quantities of refrigerant and oil and then tested at the operating conditions normally required by the customer. The machine's hydraulic circuit is equipped with drain plugs and open vent valves; the free–cooling coils are supplied dry to avoid possible problems due to 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.

1.4 – General description

MATRIX S 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, in versions with heat recovery for simultaneous heating of thermal circuit water, 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 "MATRIX S" product line has been designed utilising 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 one or two independent refrigerating circuits, each one composed of: an air–cooled condenser, a hermetic Scroll compressor and a braze–welded plate evaporator. The components of the liquid line are the charging valves, filters–dryers, solenoid valve, shut–off valve, moisture indicator and thermostatic expansion valve.
The hydraulic circuit is made up of hydraulic lines both in steel and flexible EPDM rubber, connected by fittings and threaded joints, a flow switch (optional) and, in the freecooling versions, chilled water coils and a three–way valve.

The hermetic scroll compressors are complete with the following protection/safety devices: oil heater (if necessary), 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 "MATRIX S" water chillers are controlled by the "MICROFACE" 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 – Operating limits

The units can operate within the indicated operating ranges (see Tab. 5). These limits apply to new machines, subject to correct installation and maintenance.

- Ambient air minimum temperature: –25°C for Superchiller, +15°C for Chiller without fan speed control (Operation allowed only in summer mode), –10°C for Chiller with continuous fan speed control (Either Triac or EC fan);
- Maximum outdoor air temperature is in relation to each model, as indicated in Tab. 5. In any case outdoor temperatures aver 45°C are not admitted; such limits are determined by electrical and electronic components fitted on units;
- 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;
- 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: 5 bar;
- Voltage range for the electric supply: 400 V +/–10%; max. phase difference: 3%; tolerance on frequency: 1%.

Storage conditions: –20°C – 45°C for all MATRIX S models

Note:
Avoid positioning in areas with strong dominant winds that may impair the operation and effect the indicated limits.

2.2 – Sound pressure levels

The Tab. 6 shows the noise data for the units in standard configuration (without pumps), operating continuously and measured according to the ISO 3744 norm, in free field conditions.
The highest noise levels are detected on the condenser coil side.

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

2.3 – Transport

- 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 sides, see Fig. 2 and Fig. 3).

Note:
Place the lifting tubes in the holes in the base indicated by "LIFT HERE". Lock the ends of the tubes with the locking pins and splits pins as shown in Fig. 2. As an alternative, shackles/hooks (optional) fastened at the base ends can be used as a lifting system: in this case the lifting point must be on the vertical line passing through the machine's centre of gravity (as indicated in Fig. 3) to prevent any load imbalance.
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.

2.4 – 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 that can be supplied as an option (in rubber or spring–type). Refer to the manual "Installation of the spring anti–vibration supports" for their correct positioning.
- When positioned, level the unit.

Note:
For weight distribution see Fig. 4 and Fig. 5.

Note:
The weights and their distribution refer to standard units 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. 8).

2.5 – 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. a)

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

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).
   Matrix S chillers can be equipped, upon request, with pumps having performance as indicated in Tab. 8;
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);
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. 8.4).
Follow the indications in Fig. c 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. b 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:
The water flow switch is a compulsory safety component that must be installed and correctly wired to the Matrix S chillers, otherwise the guarantee will be invalidated.
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, can be installed on the hydraulic circuit by the installer, but it is compulsory that it is wired to the electric panel terminal board, as indicated on the wiring diagram.

3.1.2 – Addition 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.
- 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, °C (*)	0	–4.4	–9.9	–16.6	–25.2	–37.2
Mixture density at 20°C (*), kg/l	–	1.017	1.033	1.048	1.064	1.080

(*) Values are for Shell antifreeze 402. 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.

3.2 – Connection of the safety valve discharge

Safety valves are installed on the high pressure side of the refrigeration circuit(s): 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. a – Ideal chilled water circuit

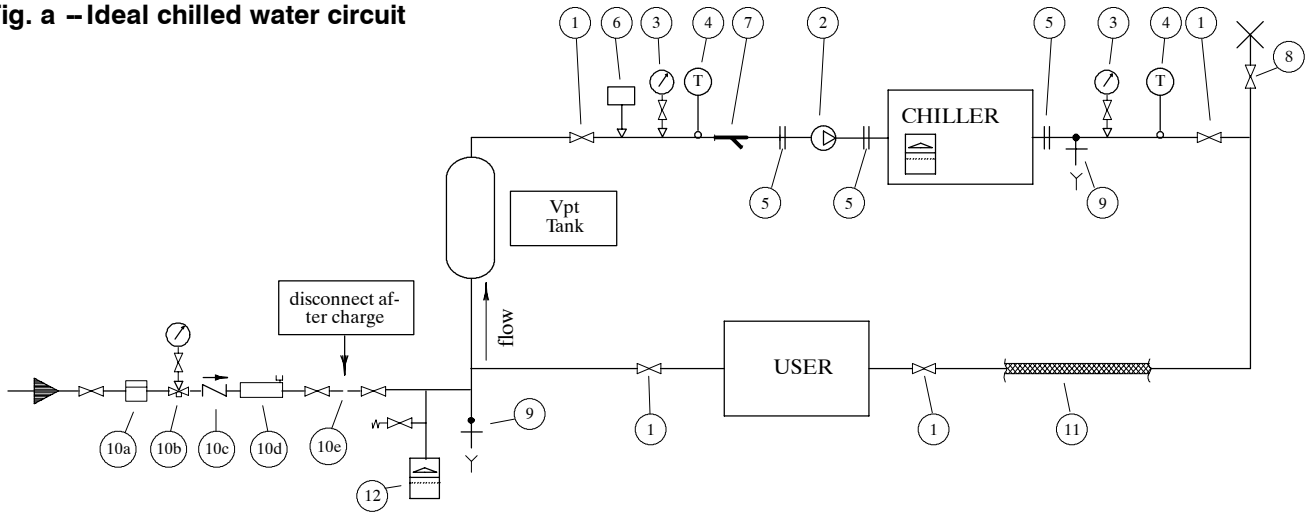


Fig. b – Inertia tank sizing

The total optimum hydraulic volume of the system where the Matrix S chiller is installed can be calculated by the following formula:

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

where:
- V=minimum required total water volume expressed in litres
- Rt=refrigeration capacity expressed in kW
- Xd=differential band set on the control and expressed in degrees centigrade

Please note that the sum of the hydraulic volume of the Matrix S chiller (Vm) plus the volume of the hydraulic circuit connected to it (Vpc) must be greater than, or equal to the minimum required total water volume (V). If this condition is not satisfied, it is necessary to install an inertia tank (Vpt, as indicated in the Fig. a) with a volume at least equal to the following value: Vpt=V–Vm–Vpc

Fig. c – Sizing of the expansion vessel

The total volume of the expansion vessel is calculated with the following formula:

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

where:

- C=quantity of water inside the system expressed in litres
- e=water expansion coefficient, with water at 10°C as a reference
- Pi=absolute pressure of initial charging, equivalent to the vessel pre–charge pressure (typical value 2.5 bara)
- Pf=absolute final tolerated pressure, lower than the operating pressure of the safety valve calibration pressure (typical value 4.0 bara).

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

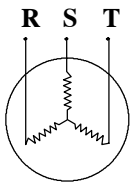
H_2O T [°C]	Density [kg/m^3]	Expansion coefficient "e"
10	999.6	– – –
20	997.9	0.0017
30	995.6	0.0040
40	992.2	0.0075
50	988.1	0.0116

3.3 – Electrical connections

1) Before proceeding with the electrical connections, ensure that:
   - all electrical components are undamaged;
   - all terminal screws are tight;
   - the supply voltage and frequency are in accordance with the rating (with tolerance in accordance with IEC 8–6 norms, March 1990)
   - the allowed phase to phase variability is 3% maximum (see Fig. d). Variability in excess of 3% invalidates the guarantee.
2) Supply cable connections (see Tab. 4):
   - Connect the cable to the supply terminals.
   - Use appropriately sized 3–pole cable. An earth wire must also be connected.
   - After having opened the passage in the framework (pre–punched knock–outs) for the supply line entry, restore the original degree of protection using suitable accessories for the wiring and junction boxes.

Fig. d – Example of calculating phase to phase variability

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:
$$402 - 397 = 5 \text{ V}$$
4) The phase to phase variability is:
$$\frac{5}{397} \times 100 = 1.26 \text{ (acceptable)}$$

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

1) Check all water connections.
2) Open the shut–off valve on the liquid line.
3) Ensure that the intake pressure is higher than 4.0 bar; if this is not the case, prolong pre–heating of the compressor (if possible) and check that the refrigerant shut–off valve is properly sealed, see Fig. 10 and Fig. 11.
4) Open all isolating valves and/or water ball valves.
5) 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.
6) Bleed all air out of the chilled water circuit.
7) Verify the water flow rate and its direction.
8) Ensure that the thermal load is sufficient for start–up.

Caution:
The ambient air temperature probe must be positioned in the shade and protected against the weather.

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

Operate as follows:

1) **At least 8 hours before the start–up, power the crankcase heaters (if any, see point 4) 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. In the units not equipped with crankcase heaters (Chillers for summer operation only, without modulating fan speed control), the start must be carried out in the warm season only (external T > 15°C), and thus oil pre–heating is not necessary.
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 2.1 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 compressor oil level.
11) With the compressor 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 (IF ANY).

- 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 (if any) 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.

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.

4.6 – Microprocessor control

Consult the ”Microface and Hiromatic” 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. 7.

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 R407C cannot be charged with R22 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.
  Flush 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.
- For the units with R407C the refrigerant charge must be made exclusively with liquid refrigerant.
- 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 bulb of the thermostatic 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.
  4) For the units with R407C refer to the pressure gauge scale indicated with the initials D.P. (Dew Point)
- 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.
  4) For the units with R407C refer to the pressure gauge scale indicated with the initials B.P. (Bubble Point)
- 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.

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.

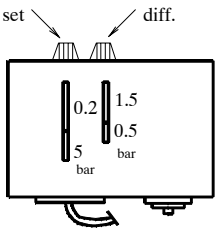
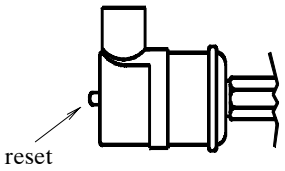
5.2.1 – Procedure for oil topping–up

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 cock 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 cock, 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 cock on the refrigerating circuit and restore the drained refrigerant charge.

6 – Safety Devices Settings

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

COMPONENT	SETTING	NOTES
Low pressure switch (LP)	Operation with R407C/R22 (standard factory setting): START : 3.6 bar DIFF. : 0.8 bar STOP : 2.8 bar	
High pressure switch (HP)	Operation with R407C/R22 (standard factory setting): STOP : 26 bar START : 20 bar DIFF. : 6 bar (fixed)	

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

MODELS	SETTINGS	SAFETY VALVE
004 – 204 – 206 – 207 – 008	28 bar	HP side
006 – 007 – 011 – 014 – 016	29 bar	

6.1 – Setting thermostatic expansion valve

THIS OPERATION MUST BE PERFORMED BY AN EXPERIENCED REFRIGERATION TECHNICIAN.
Before beginning this adjustment be sure that the refrigerant charge is correct, checking the the sub–cooling (3°C – 5°C, as specified in par. 5.1).
The valve has already been factory–set and should be reset when the superheating is not between 5°C – 8°C, as follows:

1) Important:
   Ensure that the instructions in par. 5.1 have been carried out.
2) Allow the compressor to operate for 15 mins.
3) Measure the superheating as follows:
   a) Connect a manometer to the Schraeder connection located on the evaporator outlet tube, and read the manometric temperature on the scale for the refrigerant used (for the units with R407C refer to the pressure gauge scale indicated with the initials D.P. = Dew Point).
   b) Using a contact thermometer, measure the temperature on the tube coming out of the evaporator, next to the socket used for the manometer.
   c) The superheating is the difference between the two readings (b – a).
4) The superheating must be 5°C – 8°C; if not, set the expansion valve as follows:
   a) Remove the protective cover;
   b) Turn the adjustment screw to return to the optimum values, tightening it in a clockwise direction to increase the superheating, or slackening it to reduce the superheating.
   c) Wait about 10 minutes;
   d) Measure the superheating and repeat the operation if necessary.

N.B:
If the superheating is too low, there is a risk of poor lubrication and consequent breakage of the compressor as a result of pressure shock.
If the superheating is too high the output of the system is limited and the compressor overheats.

7 – Maintenance

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

Before any intervention on the unit or accessing the inner components (removing the outer panels), always ensure the machine is switched off. If the rear panels are removed (coil compartment) wait for the fan(s) to come to a complete stop before accessing the compartment; if the front 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. Be very careful when operating close to the finned coils, as the fins are very sharp. Do not remove the fan protection grille before electrically isolating the whole machine. Do not insert foreign matter through the fan protection grille. After the maintenance interventions, always close the unit with the suitable panels, fastened by the tightening system.

7.1 – Spare parts

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

7.2 – 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.
If the unit has to be dismantled, the job must be done by skilled refrigeration technicians.
The refrigerant and the lubricating oil in the circuit must be disposed of in conformity with the laws in force in your country.

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 with compressed air or soft brushes.
CONTROL	• Check that the control equipment, LEDs and display are operating correctly.
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 thermostatic valve (superheating between 5°C – 8°C). • Check that the oil level indicated by the compressor sight glass is higher than the min. value.
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 free – cooling 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.

8 – Options and Accessories

8.1 – Pump set

The centrifugal pump units are direct driven, with close – coupled motors and a single shaft; the induction motor has 2 poles with IP 54 protection and class F insulation.

The materials used for the pump main components are:

- Pump body in plastic material PA 6.6 (cast iron in all high pressure freecooling versions and on model 016 in the Chiller high head pressure version and Superchiller standard head pressure version);
- Impeller in in plastic material PPO (stainless steel in all high pressure freecooling versions and on model 016 in the Chiller high head pressure version and Superchiller standard head pressure version);
- Stainless steel shaft;
- Graphite impregnated ceramic mechanical seal (EPDM in all high pressure freecooling versions and on model 016 in the Chiller high head pressure version and Superchiller standard head pressure version), suitable for the use of mixtures containing ethylene glycol.

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 hydraulic circuit includes, for each pump, a suction shut – off valve and a delivery check valve if two pumps are installed, or suction and delivery shut – off valves if a single pump is installed.

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.

For the technical features of the pumps and the hydraulic schematic see Tab. 8, Fig. 12, Fig. 13, Fig. 14 and Fig. 15.

8.2 – Water chiller with partial heat recovery (20%)

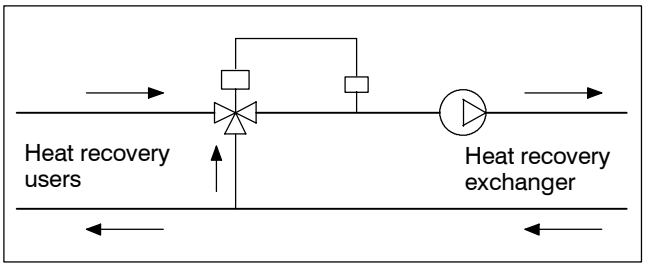
This option enables the recovery of up to 20% of the heat normally rejected by the condensers. The system does not require any adjustment and is made up of plate heat exchangers installed on each circuit before the condenser. The exchangers are protected by a suitable anti – frost heater that operates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

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

8.3 – Water chiller with total heat recovery (100%)

All heat discharged by the unit to the condenser is recovered. The system includes an additional refrigerating circuit made up of a three–way solenoid valve, supplying – in case of hot water demand – a plate exchanger, usually by–passed and sized so as to discharge all condensing heat (also installed before the finned air condenser in series with it); a check valve, a liquid receiver at the exit of the finned air condenser working as storage for the needed additional refrigerant charge (see refrigerating scheme). The recuperator is insulated with closed cell polyurethane and is equipped with heaters activated when the recuperator is deactivated to prevent frost in winter with the system stopped or not perfectly drained.
The operation in total recovery mode is enabled by an external contact. The Microface control will simultaneously suit the fan speed changing the fan speed setpoint differently from the standard operation without recovery (practically slowing the fans down till they switch off); anyway, the operation in recovery mode is enabled also without load at the users. Indeed, if the users do not demand heat, the water flowing to the condenser reaches a temperature that does not enable the total condensation of the compressed gas, and the remaining portion of the phase change can thus take place in finned coil without interrupting the recovery process through the intervention of the machine safety devices.
If the plate exchanger is supplied with too cold water, or if the system is not preset by the installation technician with a three or two–way proportional adjustment valve for the exchanger bypass (indispensable for cold starts, see following "Recommended hydraulic circuit"), the condensing pressure tends to decrease too much; a prolonged condition of low condensing temperature below the safety threshold leads the Microface microprocessor control to disable the heat recovery, protecting the system from any possible malfunctioning.

Fig. e – Recommended hydraulic circuit



8.4 – 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 5 bar. Their position in the hydraulic circuit is illustrated in Fig. 12, Fig. 13, Fig. 14 and Fig. 15.

- Expansion vessel volume: 8 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.

8.5 – Water chiller with inertia tank

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

- it reduces the frequency of the compressor peaks, which is higher the lower the system thermal inertia, improving their performance;
- it naturally eliminates the operational problems caused by sudden load variations (shown by variations of the chilled water temperature).

The buffer tank is supplied insulated, with a drain valve, vent valve and connection for immersion electric heaters; maximum operating pressure 6 bar.

Built in carbon steel and coated with anti–condensation insulation. It can be installed in all MATRIX S versions inside the coil compartment.

Mod. 004–006–007 technical data

- Internal volume: 200 litres
- Net weight: 110 kg
- Working weight: 310 kg

Mod. 008–011–014–016 technical data

- Internal volume: 400 litres
- Net weight: 140 kg
- Working weight: 540 kg

Mod. 204–206–207 technical data

- Internal volume: 160 litres
- Net weight: 100 kg
- Working weight: 260 kg

Tab. 1 – Internal hydraulic volume

Model		Unit volume (*) [l]	Model		Unit volume (*) [l]
CBH	004	8	SBH	004	27
	006	9		006	35
	007	10		007	44
	204	10		204	30
	206	10		206	37
	207	13		207	47
	008	24		008	77
	011	27		011	92
	014	30		014	110
	016	46		016	144
CLH	004	8	SLH	004	27
	006	9		006	43
	007	14		007	55
	204	10		204	30
	206	10		206	45
	207	18		207	59
	008	24		008	77
	011	27		011	107
	014	38		014	134
	016	46		016	144
CQH	004	8	SQH	004	34
	006	13		006	54
	007	14		007	55
	204	10		204	37
	206	15		206	56
	207	18		207	59
	008	24		008	88
	011	35		011	131
	014	38		014	134
	016	46		016	169

(*) Add the tank's volume for the units with optional buffer tank

Tab. 2 – Partial heat recovery (20%)

Model		004 204	006 206	007 207	008	011	014	016
Heating capacity	kW	10,8	14,8	18,2	21,6	29,6	36,4	44,3
Water flow	l/s	0,516	0,707	0,870	1,032	1,414	1,739	2,117
Water pressure drop	kPa	8	11	14	8	11	14	21
Water connections	BSP–T	1"	1"	1"	$1^1/_4$"	$1^1/_4$"	$1^1/_4$"	$1^1/_4$"

Working conditions: outdoor temperature 35°C, water inlet/outlet 12/7°C (Chiller versions), glycol mixture 30% inlet/outlet 15/10°C (SuperChiller versions). Heat recovery conditions: water inlet/outlet 40/45°C.

Tab. 3 – Total heat recovery (100%)

Model		004 204	006 206	007 207	008	011	014	016
Heating capacity	kW	53	74	91	105	144	177	223
Water flow	l/s	2,53	3,54	4,35	5,02	6,88	8,46	10,65
Water pressure drop	kPa	60	70	80	60	70	80	90
Water connections	BSP–T	2"	2"	2"	$2^1/_2$"	$2^1/_2$"	$2^1/_2$"	$2^1/_2$"

Working conditions: water inlet/outlet 12/7°C (Chiller versions). Heat recovery conditions: water inlet/outlet 40/45°C.

Tab. 4 – Electrical characteristics

CBH – R 407C

Size		004	006	007	204	206	207	008	011	014	016
Power supply	–	400 V / 3 Ph / 50 Hz									
OA (1)	A	28	35	43	29	37	48	56	69	85	105
FLA	A	39	54	73	42	62	68	77	107	145	155
LRA	A	179	219	274	121	163	181	217	272	346	403
Compressors power input (1)	kW	13.8	18.6	23.5	13.8	18.3	23.8	27.3	36.7	46.5	56.8
Compressors nominal current (1)	A	24	31	39	25	33	44	48	62	78	94
Compressor max. current	A	35	50	69	19	29	32	35	50	69	72
Fan power input	kW	1.80									
Fan nominal current	A	3.6									
Fan max. current	A	4.0									
SHC std. head pressure pump model (Opt.)	–	12–129						12–136	20–128		20–134
Std. head pressure pump mot. nom. power	kW	0.75						1.10	1.50		1.85
Std. head pressure pump mot. max. power	kW	1.08						1.44	1.92		2.45
Std. head pressure pump max. current	A	1.85						2.67	3.90		4.61
SHC high head pressure pump model (Opt.)	–	12–136						20–128	20–134		–
FHE high head pressure pump model (Opt.)	–	–						–	–		40–160/40
High head pressure pump mot. nom. power	kW	1.10						1.50	1.85		4.0
High head pressure pump mot. max. power	kW	1.44						1.92	2.45		4.0
High head pressure pump max. current	A	2.67						3.90	4.61		8.50
Electrical cable section (min.)	mm^2	16	25	35	16	25	35	35	50	70	70

(1) Outdoor air temperature 35°C; water inlet/outlet temperature 12/7°C

CLH – R 407C

Size		004	006	007	204	206	207	008	011	014	016
Power supply	–	400 V / 3 Ph / 50 Hz									
OA (1)	A	27	34	42	28	36	47	54	66	81	107
FLA	A	37	52	73	40	60	68	74	104	145	151
LRA	A	177	217	274	119	161	181	214	269	346	399
Compressors power input (1)	kW	14.3	18.9	22.5	14.3	18.6	22.8	28.5	37.5	44.2	60.5
Compressors nominal current (1)	A	25	32	38	26	34	43	50	62	74	100
Compressor max. current	A	35	50	69	19	29	32	35	50	69	72
Fan power input	kW	0.95									
Fan nominal current	A	2.2									
Fan max. current	A	2.4									
SHC std. head pressure pump model (Opt.)	–	12–129						12–136	20–128		20–134
Std. head pressure pump mot. nom. power	kW	0.75						1.10	1.50		1.85
Std. head pressure pump mot. max. power	kW	1.08						1.44	1.92		2.45
Std. head pressure pump max. current	A	1.85						2.67	3.90		4.61
SHC high head pressure pump model (Opt.)	–	12–136						20–128	20–134		–
FHE high head pressure pump model (Opt.)	–	–						–	–		40–160/40
High head pressure pump mot. nom. power	kW	1.10						1.50	1.85		4.0
High head pressure pump mot. max. power	kW	1.44						1.92	2.45		4.0
High head pressure pump max. current	A	2.67						3.90	4.61		8.50
Electrical cable section (min.)	mm^2	16	25	35	16	25	35	35	50	70	70

(1) Outdoor air temperature 35°C; water inlet/outlet temperature 12/7°C

CQH – R 407C

Size		004	006	007	204	206	207	008	011	014	016
Power supply	–	400 V / 3 Ph / 50 Hz									
OA (1)	A	25	33	42	26	35	47	50	64	82	102
FLA	A	36	53	72	39	61	67	73	104	142	148
LRA	A	176	218	273	118	162	180	213	269	343	396
Compressors power input (1)	kW	13.6	17.9	23.3	13.6	17.6	23.6	27.0	35.6	46.6	60.0
Compressors nominal current (1)	A	24	30	39	25	33	44	48	60	78	98
Compressor max. current	A	35	50	69	19	29	32	35	50	69	72
Fan power input	kW	0.70									
Fan nominal current	A	1.3									
Fan max. current	A	1.5									
SHC std. head pressure pump model (Opt.)	–	12–129						12–136	20–128		20–134
Std. head pressure pump mot. nom. power	kW	0.75						1.10	1.50		1.85
Std. head pressure pump mot. max. power	kW	1.08						1.44	1.92		2.45
Std. head pressure pump max. current	A	1.85						2.67	3.90		4.61
SHC high head pressure pump model (Opt.)	–	12–136						20–128	20–134		–
FHE high head pressure pump model (Opt.)	–	–						–	–		40–160/40
High head pressure pump mot. nom. power	kW	1.10						1.50	1.85		4.0
High head pressure pump mot. max. power	kW	1.44						1.92	2.45		4.0
High head pressure pump max. current	A	2.67						3.90	4.61		8.50
Electrical cable section (min.)	mm^2	16	25	35	16	25	35	35	50	70	70

(1) Outdoor air temperature 35°C; water inlet/outlet temperature 12/7°C

SBH – R 407C

Size		004	006	007	204	206	207	008	011	014	016
Power supply	–	400 V / 3 Ph / 50 Hz									
OA (1)	A	29	37	44	30	39	49	58	74	88	109
FLA	A	39	54	73	42	62	68	78	108	146	155
LRA	A	179	219	274	121	163	181	218	273	347	403
Compressors power input (1)	kW	14.5	19.7	24.4	14.5	19.4	24.8	28.9	39.2	48.6	59.0
Compressors nominal current (1)	A	25	33	40	26	35	45	50	66	80	98
Compressor max. current	A	35	50	69	19	29	32	35	50	69	72
Fan power input	kW	1.90									
Fan nominal current	A	3.8									
Fan max. current	A	4.0									
SHC std. head pressure pump model (Opt.)	–	12–136	20–128		12–136	20–128			20–134		–
FHE std. head pressure pump model (Opt.)	–	–	–		–	–			–		40–160/40
Std. head pressure pump mot. nom. power	kW	1.10	1.50		1.10	1.50			1.85		4.0
Std. head pressure pump mot. max. power	kW	1.44	1.92		1.44	1.92			2.45		4.0
Std. head pressure pump max. current	A	2.67	3.90		2.67	3.90			4.61		8.50
FHE high head pressure pump model (Opt.)	–	32–160/30	32–160/30		32–160/30	32–160/30			40–160/40		40–200/75
High head pressure pump motor power	kW	3.0	3.0		3.0	3.0			4.0		7.5
High head pressure pump max. current	A	6.50	6.50		6.50	6.50			8.50		15.50
Electrical cable section (min.)	mm^2	16	25	35	16	25	35	35	50	70	70

(1) Outdoor air temperature 35 °C; 30% glycol water mixture; water inlet/outlet temperature 15/10 °C

SLH – R 407C

Size		004	006	007	204	206	207	008	011	014	016
Power supply	–	400 V / 3 Ph / 50 Hz									
OA (1)	A	29	35	45	29	37	49	57	69	85	109
FLA	A	37	52	74	40	60	69	75	105	145	151
LRA	A	177	217	275	119	161	182	215	270	346	399
Compressors power input (1)	kW	15.3	19.6	23.7	15.3	19.3	24.1	30.4	38.9	47.0	63.0
Compressors nominal current (1)	A	26	33	40	27	35	44	52	64	78	102
Compressor max. current	A	35	50	69	19	29	32	35	50	69	72
Fan power input	kW	1.00									
Fan nominal current	A	2.3									
Fan max. current	A	2.4									
SHC std. head pressure pump model (Opt.)	–	12–136	20–128		12–136	20–128			20–134		–
FHE std. head pressure pump model (Opt.)	–	–	–		–	–			–		40–160/40
Std. head pressure pump mot. nom. power	kW	1.10	1.50		1.10	1.50			1.85		4.0
Std. head pressure pump mot. max. power	kW	1.44	1.92		1.44	1.92			2.45		4.0
Std. head pressure pump max. current	A	2.67	3.90		2.67	3.90			4.61		8.50
FHE high head pressure pump model (Opt.)	–	32–160/30	32–160/30		32–160/30	32–160/30			40–160/40		40–200/75
High head pressure pump motor power	kW	3.0	3.0		3.0	3.0			4.0		7.5
High head pressure pump max. current	A	6.50	6.50		6.50	6.50			8.50		15.50
Electrical cable section (min.)	mm^2	16	25	35	16	25	35	35	50	70	70

(1) Outdoor air temperature 35 °C; 30% glycol water mixture; water inlet/outlet temperature 15/10 °C

SQH – R 407C

Size		004	006	007	204	206	207	008	011	014	016
Power supply	–	400 V / 3 Ph / 50 Hz									
OA (1)	A	27	35	44	27	36	49	53	68	86	106
FLA	A	36	53	72	39	61	67	73	104	142	148
LRA	A	176	218	273	118	162	180	213	269	343	396
Compressors power input (1)	kW	14.4	18.8	24.8	14.4	18.5	25.1	28.7	37.8	49.9	62.3
Compressors nominal current (1)	A	25	32	41	26	34	46	50	64	82	102
Compressor max. current	A	35	50	69	19	29	32	35	50	69	72
Fan power input	kW	0.75									
Fan nominal current	A	1.4									
Fan max. current	A	1.5									
SHC std. head pressure pump model (Opt.)	–	12–136	20–128		12–136	20–128			20–134		–
FHE std. head pressure pump model (Opt.)	–	–	–		–	–			–		40–160/40
Std. head pressure pump mot. nom. power	kW	1.10	1.50		1.10	1.50			1.85		4.0
Std. head pressure pump mot. max. power	kW	1.44	1.92		1.44	1.92			2.45		4.0
Std. head pressure pump max. current	A	2.67	3.90		2.67	3.90			4.61		8.50
FHE high head pressure pump model (Opt.)	–	32–160/30	32–160/30		32–160/30	32–160/30			40–160/40		40–200/75
High head pressure pump motor power	kW	3.0	3.0		3.0	3.0			4.0		7.5
High head pressure pump max. current	A	6.50	6.50		6.50	6.50			8.50		15.50
Electrical cable section (min.)	mm^2	16	25	35	16	25	35	35	50	70	70

(1) Outdoor air temperature 35 °C; 30% glycol water mixture; water inlet/outlet temperature 15/10 °C

- *Nominal power supply = 400 V; 3 Ph; 50 Hz*
- *Nominal power supply tolerance = 400 V ±10 %*
- *Max. voltage unbalance = 3 %*
- *The cables have to be sized in compliance with local standards and according to the type and characteristics of installation. Suggested cables section are referred to PVC insulation with a max. working temperature of 70 °C and an ambient temperature of 30 °C.*

Tab. 5 – Operating limits

CBH – R 407C

Size		004	006	007	204	206	207	008	011	014	016
Working Range											
Max. outdoor air temperature (1)	°C	43.5	44.0	42.5	43.5	44.0	42.5	44.0	44.5	43.0	44.0
Safety Device Settings											
High pressure switch (1)	Barg	26.0									
High pressure safety valve	Barg	28.0 / 29.0									
Low pressure switch	Barg	2.8									

(1) With nominal air flow; water flow outlet at 7°C; full load

CLH – R 407C

Size		004	006	007	204	206	207	008	011	014	016
Working Range											
Max. outdoor air temperature (1)	°C	42.0	43.5	44.5	42.0	43.5	44.5	42.5	43.5	45.0	41.0
Safety Device Settings											
High pressure switch (1)	Barg	26.0									
High pressure safety valve	Barg	28.0 / 29.0									
Low pressure switch	Barg	2.8									

(1) With nominal air flow; water flow outlet at 7°C; full load

CQH – R 407C

Size		004	006	007	204	206	207	008	011	014	016
Working Range											
Max. outdoor air temperature (1)	°C	44.0	45.0	43.0	44.0	45.0	43.0	44.5	45.0	43.0	41.5
Safety Device Settings											
High pressure switch (1)	Barg	26.0									
High pressure safety valve	Barg	28.0 / 29.0									
Low pressure switch	Barg	2.8									

(1) With nominal air flow; water flow outlet at 7°C; full load

SBH – R 407C

Size		004	006	007	204	206	207	008	011	014	016
Working Range											
Max. outdoor air temperature (1)	°C	41.5	41.5	41.0	41.5	41.5	41.0	41.5	41.5	41.0	42.5
Safety Device Settings											
High pressure switch (1)	Barg	26.0									
High pressure safety valve	Barg	28.0 / 29.0									
Low pressure switch	Barg	2.8									

(1) With nominal air flow; 30% mixture flow outlet at 10°C; full load

SLH – R 407C

Size		004	006	007	204	206	207	008	011	014	016
Working Range											
Max. outdoor air temperature (1)	°C	40.0	42.0	42.5	40.0	42.0	42.5	40.0	42.0	42.5	39.5
Safety Device Settings											
High pressure switch (1)	Barg	26.0									
High pressure safety valve	Barg	28.0 / 29.0									
Low pressure switch	Barg	2.8									

(1) – With nominal air flow; 30% mixture flow outlet at 10°C; full load

SQH – R 407C

Size		004	006	007	204	206	207	008	011	014	016
Working Range											
Max. outdoor air temperature (1)	°C	41.5	43.5	40.5	41.5	43.5	40.5	42.0	43.5	40.0	40.0
Safety Device Settings											
High pressure switch (1)	Barg	26.0									
High pressure safety valve	Barg	28.0 / 29.0									
Low pressure switch	Barg	2.8									

(1) With nominal air flow; 30% mixture flow outlet at 10°C; full load

Tab. 6 – Noise levels

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.

Models	Total sound level [dB(A)]	Models	Total sound level [dB(A)]	Models	Total sound level [dB(A)]
CBH / SBH 004	70	**CLH / SLH 004**	63	**CQH / SQH 004**	58
CBH / SBH 006		**CLH / SLH 006**		**CQH / SQH 006**	59
CBH / SBH 007		**CLH / SLH 007**	64	**CQH / SQH 007**	
CBH / SBH 204		**CLH / SLH 204**	63	**CQH / SQH 204**	58
CBH / SBH 206		**CLH / SLH 206**		**CQH / SQH 206**	59
CBH / SBH 207		**CLH / SLH 207**	64	**CQH / SQH 207**	
CBH / SBH 008	72	**CLH / SLH 008**	65	**CQH / SQH 008**	60
CBH / SBH 011		**CLH / SLH 011**		**CQH / SQH 011**	61
CBH / SBH 014		**CLH / SLH 014**	66	**CQH / SQH 014**	
CBH / SBH 016	73	**CLH / SLH 016**		**CQH / SQH 016**	

Tab. 7 – R 407C refrigerant and oil charge

Models: CBH		**004**	**006**	**007**	**204**	**206**	**207**	**008**	**011**	**014**	**016**
Refrigerant charge (each circuit)	[kg]	7.8	12.2	15.3	5.0	6.7	8.5	8.7	12.8	16.2	18.3
Oil charge (each circuit)	[lt]	6.20	8.00		3.25		3.30	6.20	8.00		

Models: CLH		**004**	**006**	**007**	**204**	**206**	**207**	**008**	**011**	**014**	**016**
Refrigerant charge (each circuit)	[kg]	7.8	14.8	15.2	5.0	7.9	8.4	8.7	15.4	17.4	18.3
Oil charge (each circuit)	[lt]	6.20	8.00		3.25		3.30	6.20	8.00		

Models: CQH		**004**	**006**	**007**	**204**	**206**	**207**	**008**	**011**	**014**	**016**
Refrigerant charge (each circuit)	[kg]	10.9	14.6	15.2	6.6	7.8	8.4	11.2	16.6	17.4	23.7
Oil charge (each circuit)	[lt]	6.20	8.00		3.25		3.30	6.20	8.00		

Models: SBH		**004**	**006**	**007**	**204**	**206**	**207**	**008**	**011**	**014**	**016**
Refrigerant charge (each circuit)	[kg]	7.8	12.2	16.3	5.0	6.7	9.0	8.7	12.8	17.2	18.3
Oil charge (each circuit)	[lt]	6.20	8.00		3.25		3.30	6.20	8.00		

Models: SLH		**004**	**006**	**007**	**204**	**206**	**207**	**008**	**011**	**014**	**016**
Refrigerant charge (each circuit)	[kg]	7.8	15.8	15.2	5.0	8.4	8.4	8.7	16.4	17.4	18.3
Oil charge (each circuit)	[lt]	6.20	8.00		3.25		3.30	6.20	8.00		

Models: SQH		**004**	**006**	**007**	**204**	**206**	**207**	**008**	**011**	**014**	**016**
Refrigerant charge (each circuit)	[kg]	10.9	14.6	15.2	6.6	7.8	8.4	11.2	16.6	17.4	23.7
Oil charge (each circuit)	[lt]	6.20	8.00		3.25		3.30	6.20	8.00		

Tab. 8 – Pump set characteristics (opt.)

2 pole pump set, standard head pressure (data refers to each pump)

Models			004	006	007	204	206	207	008	011	014	016
CBH	Water flow	m^3/h	6.83	9.42	11.36	6.83	9.27	11.53	13.35	18.39	22.20	28.36
	Available head pressure	kPa	127	116	99	156	142	125	142	134	96	73
CLH	Water flow	m^3/h	6.66	9.32	11.67	6.66	9.16	11.85	12.95	18.19	22.90	27.23
	Available head pressure	kPa	129	116	96	157	142	124	143	135	94	90
CQH	Water flow	m^3/h	6.89	9.65	11.41	6.89	9.49	11.57	13.45	18.72	22.16	27.40
	Available head pressure	kPa	127	114	98	156	141	125	140	132	96	87
Pump quantity		Nr.	1						2			
Pump rotor model		–	12–129						12–136	20–128		20–134
Nominal motor power		kW	0.75						1.1	1.5		1.85
Noise level (*)		dB(A)	58							63		65
Pump weight		kg	10.4						12.7	13.8		15.4

2 pole pump set, high head pressure (data refers to each pump)

Models			004	006	007	204	206	207	008	011	014	016
CBH	Water flow	m^3/h	6.83	9.42	11.36	6.83	9.27	11.53	13.35	18.39	22.20	28.36
	Available head pressure	kPa	169	156	140	198	182	166	167	184	151	170
CLH	Water flow	m^3/h	6.66	9.32	11.67	6.66	9.16	11.85	12.95	18.19	22.90	27.23
	Available head pressure	kPa	171	156	137	199	182	165	168	185	149	182
CQH	Water flow	m^3/h	6.89	9.65	11.41	6.89	9.49	11.57	13.45	18.72	22.16	27.40
	Available head pressure	kPa	169	154	139	198	181	166	165	182	151	180
Pump quantity		Nr.	1						2			
Pump rotor model		–	12–136						20–128	20–134		40–160/40
Nominal motor power		kW	1.1						1.5	1.85		4.0
Noise level (*)		dB(A)	58						63	65		70
Pump weight		kg	12.7						13.8	15.4		42.0

2 pole pump set, standard head pressure (data refers to each pump)

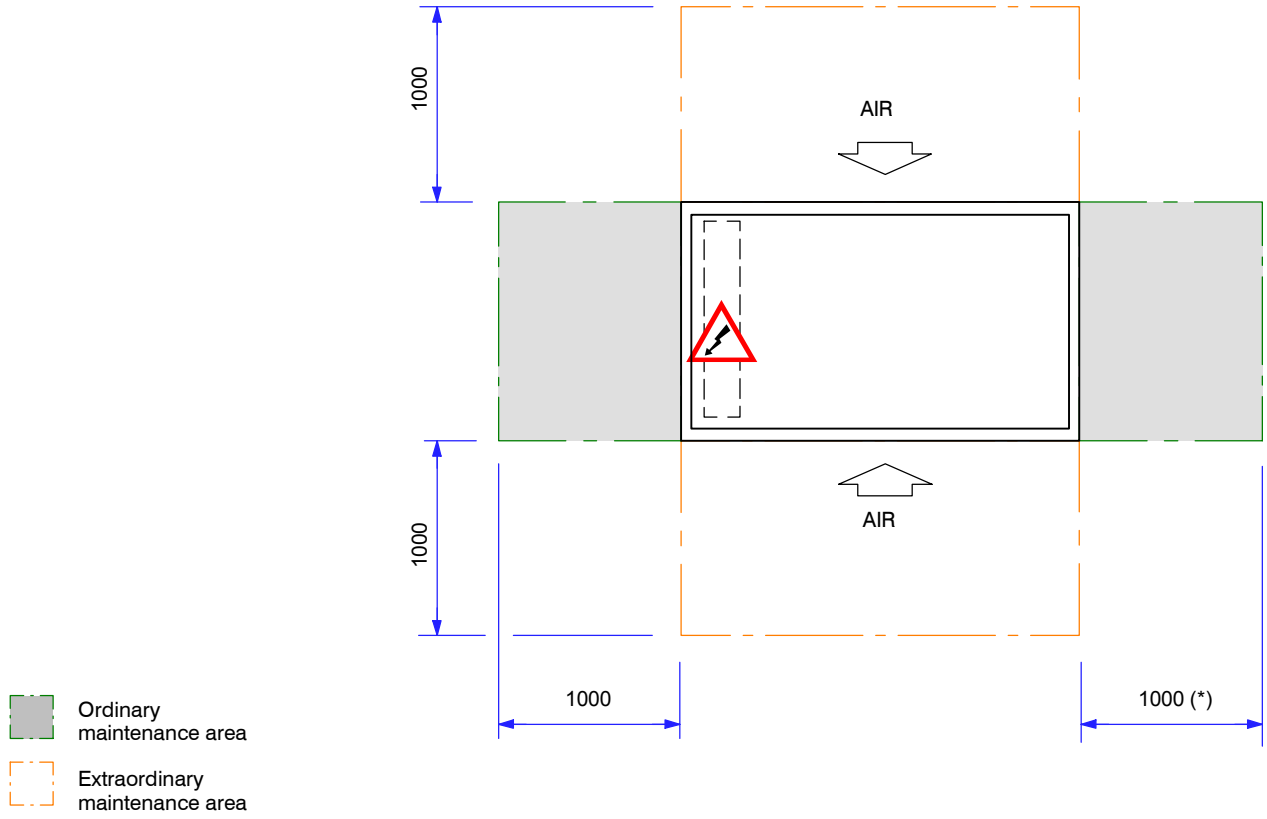
Models			004	006	007	204	206	207	008	011	014	016
SBH	30% glycol/water mixture flow	m^3/h	7.90	10.86	13.26	7.90	10.68	13.45	15.68	21.53	26.27	33.58
	Available head pressure	kPa	93	93	63	135	130	101	64	90	17	16
SLH	30% glycol/water mixture flow	m^3/h	7.64	10.93	13.51	7.64	10.77	13.71	15.12	21.67	26.83	32.09
	Available head pressure	kPa	101	98	76	141	136	115	72	96	20	42
SQH	30% glycol/water mixture flow	m^3/h	7.93	11.20	13.11	7.93	11.01	13.29	15.75	22.07	25.75	32.48
	Available head pressure	kPa	124	104	82	166	143	120	103	95	29	66
Pump quantity		Nr.	1						2			
Pump rotor model		–	12–136	20–128		12-136	20–128			20–134		40–160/40
Nominal motor power		kW	1.1	1.5		1.1	1.5			1.85		4.0
Noise level (*)		dB(A)	58	63		58	63			65		70
Pump weight		kg	12.7	13.8		12.7	13.8			15.4		42.0

2 pole pump set, high head pressure (data refers to each pump)

Models			004	006	007	204	206	207	008	011	014	016
SBH	30% glycol/water mixture flow	m^3/h	7.90	10.86	13.26	7.90	10.68	13.45	15.68	21.53	26.27	33.58
	Available head pressure	kPa	228	210	165	270	247	203	162	174	108	158
SLH	30% glycol/water mixture flow	m^3/h	7.64	10.93	13.51	7.64	10.77	13.71	15.12	21.67	26.83	32.09
	Available head pressure	kPa	236	214	178	276	252	217	171	180	111	185
SQH	30% glycol/water mixture flow	m^3/h	7.93	11.20	13.11	7.93	11.01	13.29	15.75	22.07	25.75	32.48
	Available head pressure	kPa	259	220	184	301	259	222	202	180	120	209
Pump quantity		Nr.	1						2			
Pump rotor model		–	32–160/30							40–160/40		40–200/75
Nominal motor power		kW	3.0							4.0		7.5
Noise level (*)		dB(A)	66							70		74
Pump weight		kg	35							42		64

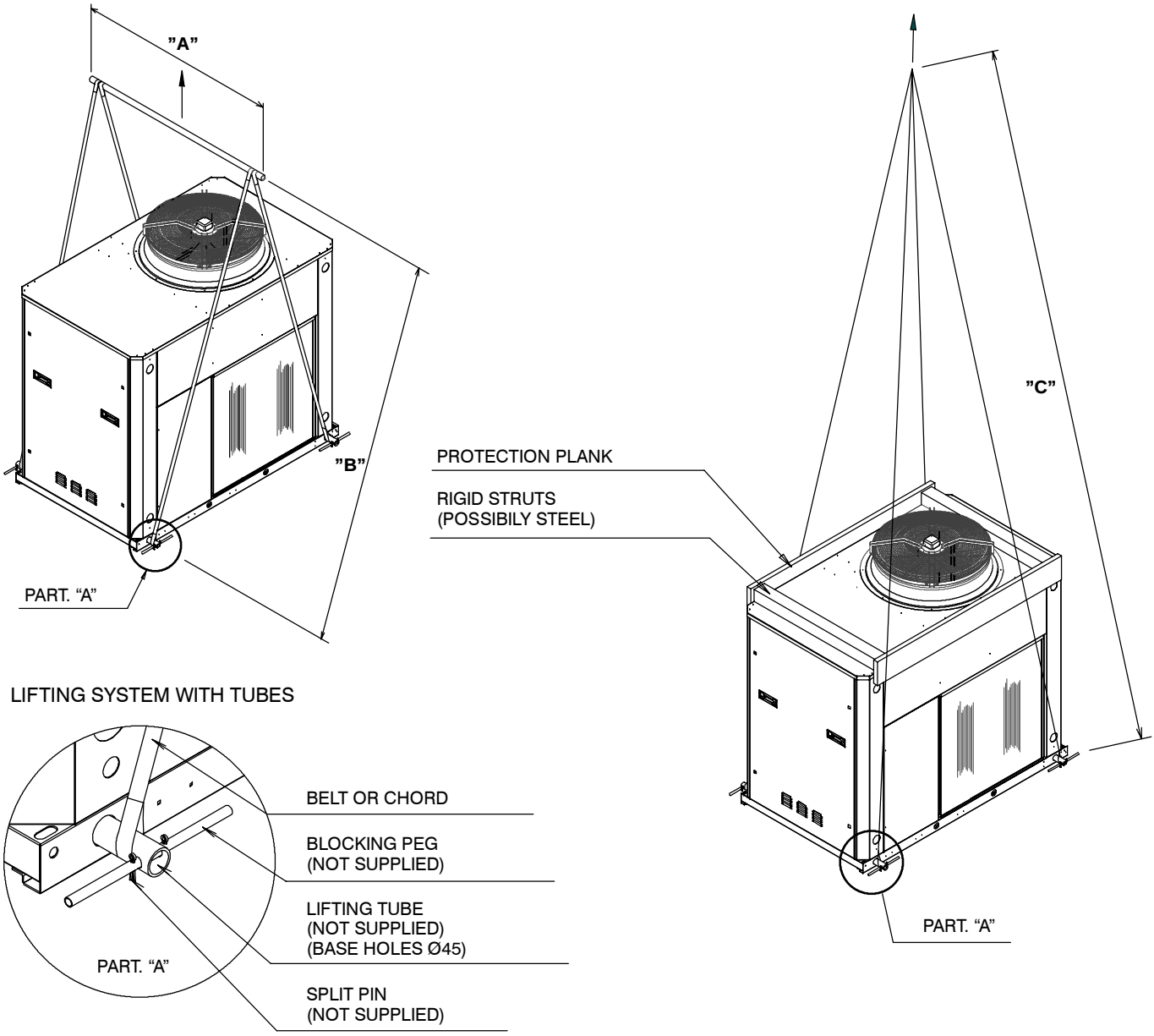
(*) According to ISO 3744

Fig. 1 – Service areas (top view)



Notes:
Minimum distance between 2 units from condensing coil side = 2m
Do not obstruct the air exiting the fans for a minimum distance of 2.5m
(*) 1500 mm (with 160 – 200 Lt Tank); 2500 mm (with 400 Lt Tank)

Fig. 2 – Lifting instructions with tubes

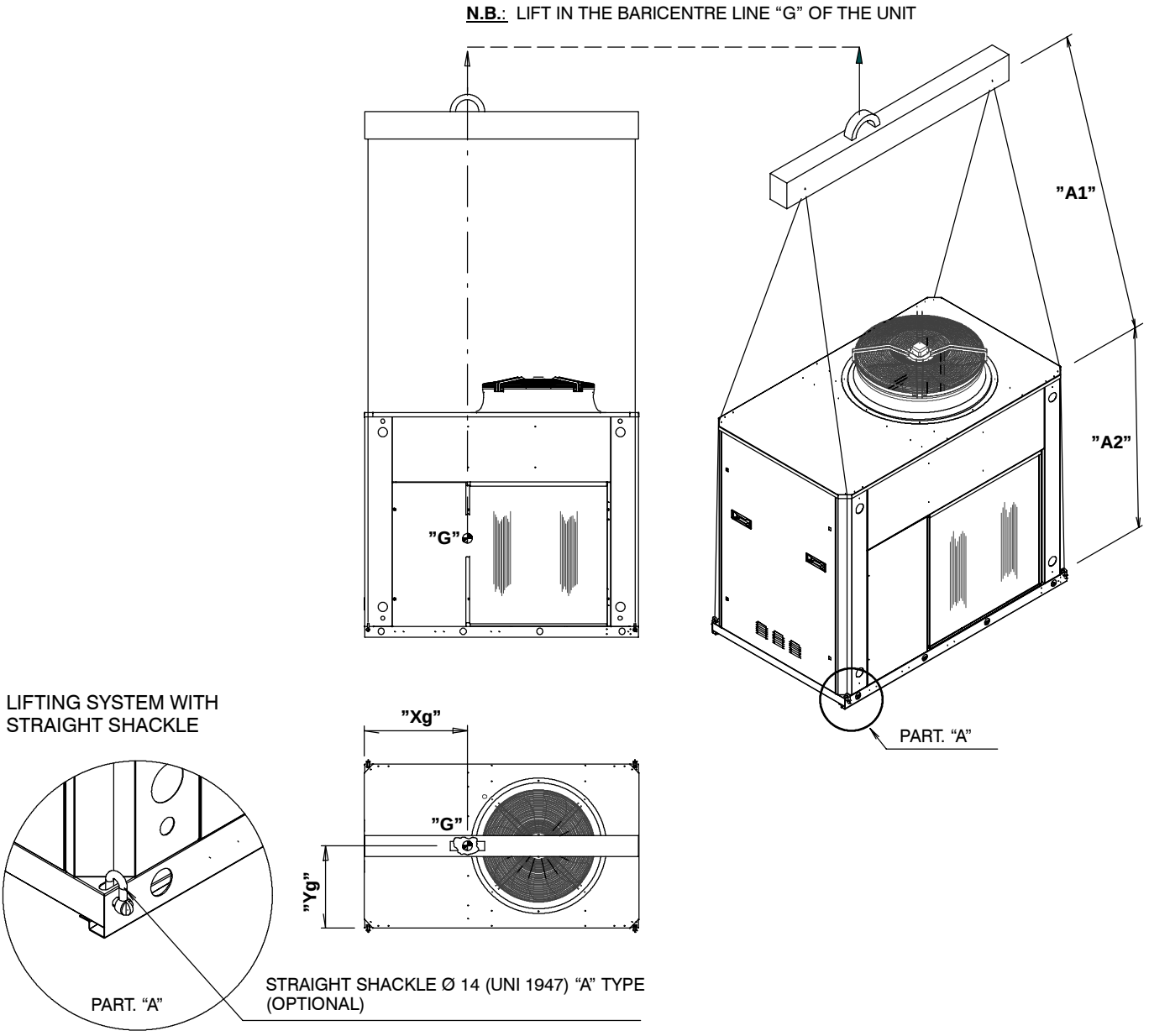


N.B: Place the lifting tubes in the holes in the base indicated by the words "LIFT HERE". Lock the ends of the tubes in position with the locking pins and split pins as shown above "A".
The capacity of the lifting gear must be adequate to lift the load in question. Check the weight of the unit, the capacity 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 structure.

Lifting

Models	Fans number	"A" (m)	"B" (m)	"C" (m)
CBH / SBH 004–006–007–204–206–207 **CLH / SLH 004–006–204–206** **CQH / SQH 004–204**	1	1.7	≃ 3	≃ 8
CBH / SBH 008–011–014 **CLH / SLH 007–207–008–011** **CQH / SQH 006–007–206–207–008**	2	1.7	≃ 4	≃ 8
CBH / SBH 016 **CLH / SLH 014–016** **CQH / SQH 011–014–016**	3	1.7	≃ 4	≃ 8

Fig. 3 – Lifting instructions with straight shackle



N.B: The capacity of the lifting gear must be adequate to lift the load in question. Check the weight of the unit, 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 structure.

Lifting

Models	Fans number	"A1 + A2" (m)
CBH / SBH 004–006–007–204–206–207 **CLH / SLH 004–006–204–206** **CQH / SQH 004–204**	1	≃ 5
CBH / SBH 008–011–014 **CLH / SLH 007–207–008–011** **CQH / SQH 006–007–206–207–008**	2	≃ 6
CBH / SBH 016 **CLH / SLH 014–016** **CQH / SQH 011–014–016**	3	≃ 6

Baricentre "G" – CBH – CLH – CQH

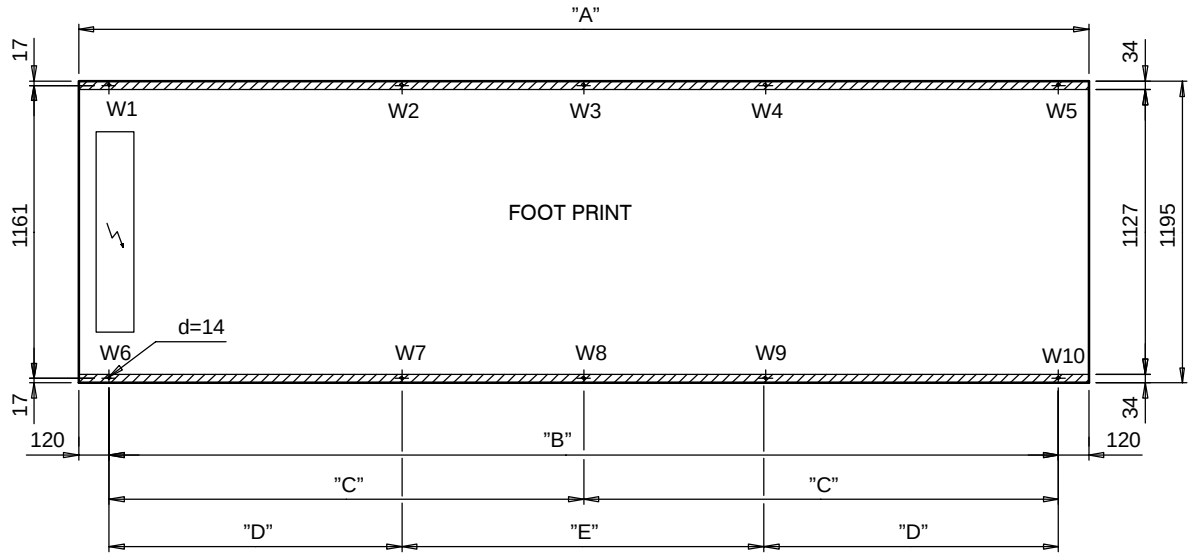
Models	Unit baricentre position "G" – (without water)			
	Without tank		With tank	
	"Xg" (m)	"Yg" (m)	"Xg" (m)	"Yg" (m)
CBH 004	0.80	0.55	0.88	0.55
CBH 006	0.77	0.52	0.85	0.54
CBH 007	0.78	0.53	0.86	0.54
CBH 204	0.77	0.60	Not available	
CBH 206	0.77	0.60	Not available	
CBH 207	0.78	0.60	Not available	
CBH 008	1.10	0.60	1.22	0.60
CBH 011	1.04	0.60	1.15	0.60
CBH 014	1.06	0.60	1.16	0.60
CBH 016	1.37	0.60	1.52	0.60
CLH 004	0.79	0.54	0.88	0.55
CLH 006	0.78	0.52	0.86	0.53
CLH 007	1.15	0.54	1.29	0.55
CLH 204	0.76	0.60	Not available	
CLH 206	0.77	0.60	Not available	
CLH 207	1.12	0.60	Not available	
CLH 008	1.09	0.60	1.21	0.60
CLH 011	1.05	0.60	1.16	0.60
CLH 014	1.41	0.60	1.56	0.60
CLH 016	1.36	0.60	1.51	0.60
CQH 004	0.80	0.54	0.89	0.55
CQH 006	1.16	0.54	1.29	0.54
CQH 007	1.15	0.54	1.29	0.55
CQH 204	0.77	0.60	Not available	
CQH 206	1.13	0.60	Not available	
CQH 207	1.12	0.60	Not available	
CQH 008	1.11	0.60	1.22	0.60
CQH 011	1.41	0.60	1.57	0.60
CQH 014	1.41	0.60	1.56	0.60
CQH 016	1.36	0.60	1.51	0.60

Baricentre "G" – SBH – SLH – SQH

Models	Unit baricentre position "G" – (without water)			
	Without tank		With tank	
	"Xg" (m)	"Yg" (m)	"Xg" (m)	"Yg" (m)
SBH 004	0.84	0.55	0.91	0.56
SBH 006	0.81	0.53	0.88	0.54
SBH 007	0.83	0.53	0.89	0.54
SBH 204	0.81	0.60	Not available	
SBH 206	0.81	0.60	Not available	
SBH 207	0.82	0.60	Not available	
SBH 008	1.17	0.60	1.27	0.60
SBH 011	1.12	0.60	1.21	0.60
SBH 014	1.13	0.60	1.22	0.60
SBH 016	1.47	0.60	1.60	0.60
SLH 004	0.83	0.55	0.91	0.55
SLH 006	0.82	0.53	0.89	0.54
SLH 007	1.21	0.54	1.33	0.55
SLH 204	0.80	0.60	Not available	
SLH 206	0.82	0.60	Not available	
SLH 207	1.18	0.60	Not available	
SLH 008	1.16	0.60	1.26	0.60
SLH 011	1.13	0.60	1.21	0.60
SLH 014	1.51	0.60	1.64	0.60
SLH 016	1.46	0.60	1.59	0.60
SQH 004	0.85	0.55	0.92	0.56
SQH 006	1.22	0.54	1.34	0.55
SQH 007	1.21	0.54	1.33	0.55
SQH 204	0.81	0.60	Not available	
SQH 206	1.19	0.60	Not available	
SQH 207	1.18	0.60	Not available	
SQH 008	1.19	0.60	1.28	0.60
SQH 011	1.52	0.60	1.65	0.60
SQH 014	1.51	0.60	1.64	0.60
SQH 016	1.49	0.60	1.61	0.60

Fig. 4 – Support positions and loads (Note: weights refer to standard units)

CBH - CLH - CQH



Dimensions – CBH – CLH – CQH

Dimensions (mm)		**A**	**B**	**C**	**D**	**E**
Model	**Size**					
CBH **CLH** **CQH**	**004–006–007–204–206–207** **004–006–204–206** **004–204**	2000	1760	–	–	–
CBH **CLH** **CQH**	**008–011–014** **007–207–008–011** **006–007–206–207–008**	3000	–	1380	–	–
CLH **CLH** **CQH**	**016** **014–016** **011–014–016**	4000	–	–	1160	1440

Weight distribution – CBH – CLH – CQH

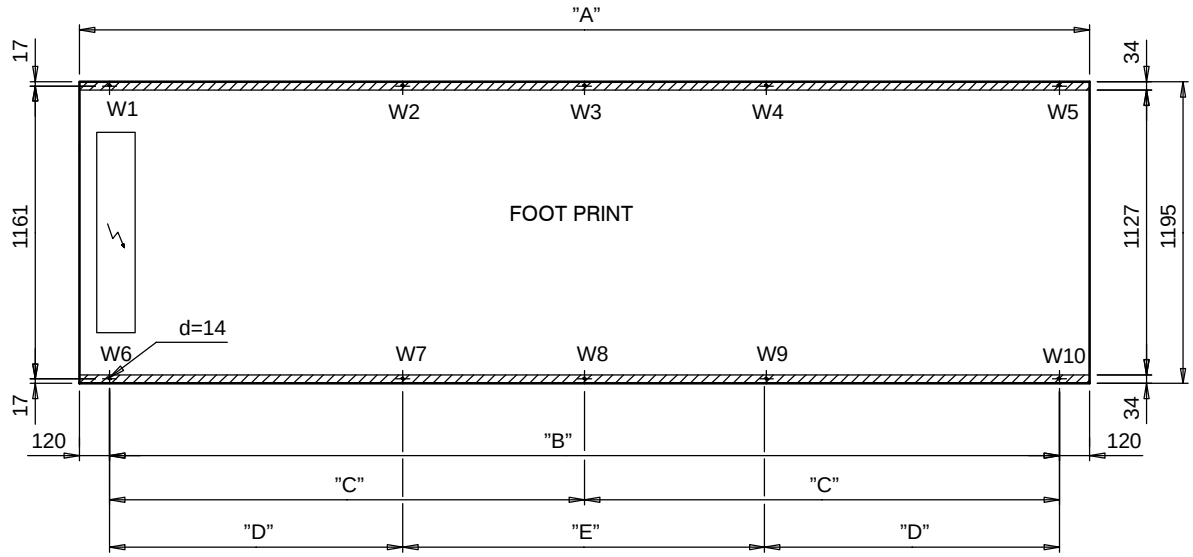
Weight distribution (kg)		**W 1**	**W 2**	**W 3**	**W 4**	**W 5**	**W 6**	**W 7**	**W 8**	**W 9**	**W 10**
Model	**Size**										
CBH	**004**	161	–	–	–	103	195	–	–	–	124
	006	181	–	–	–	108	234	–	–	–	140
	007	187	–	–	–	115	240	–	–	–	147
	204	206	–	–	–	123	206	–	–	–	123
	206	217	–	–	–	129	217	–	–	–	129
	207	229	–	–	–	138	229	–	–	–	138
	008	245	–	114	–	114	245	–	114	–	114
	011	305	–	127	–	127	305	–	127	–	127
	014	314	–	135	–	135	314	–	135	–	135
	016	260	260	–	95	95	260	260	–	95	95
CLH	**004**	163	–	–	–	103	199	–	–	–	126
	006	187	–	–	–	114	243	–	–	–	148
	007	186	–	95	–	95	230	–	117	–	117
	204	212	–	–	–	124	212	–	–	–	124
	206	228	–	–	–	136	228	–	–	–	136
	207	228	–	109	–	109	228	–	109	–	109
	008	251	–	114	–	114	251	–	114	–	114
	011	316	–	133	–	133	316	–	133	–	133
	014	243	243	–	95	95	243	243	–	95	95
	016	264	264	–	95	95	264	264	–	95	95
CQH	**004**	167	–	–	–	108	203	–	–	–	131
	006	185	–	94	–	94	229	–	117	–	117
	007	186	–	95	–	95	230	–	117	–	117
	204	216	–	–	–	129	216	–	–	–	129
	206	220	–	108	–	108	220	–	108	–	108
	207	228	–	109	–	109	228	–	109	–	109
	008	257	–	122	–	122	257	–	122	–	122
	011	240	240	–	95	95	240	240	–	95	95
	014	243	243	–	95	95	243	243	–	95	95
	016	270	270	–	97	97	270	270	–	97	97

Weight distribution with tank – CBH – CLH – CQH

Weight distribution (kg)		W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10
Model	**Size**										
CBH	**004**	213	–	–	–	207	241	–	–	–	234
	006	233	–	–	–	210	279	–	–	–	251
	007	239	–	–	–	217	284	–	–	–	258
	204	Not available									
	206	Not available									
	207	Not available									
	008	269	–	237	–	237	269	–	237	–	237
	011	329	–	250	–	250	329	–	250	–	250
	014	338	–	258	–	258	338	–	258	–	258
	016	275	275	–	215	215	275	275	–	215	215
CLH	**004**	215	–	–	–	206	245	–	–	–	235
	006	240	–	–	–	216	287	–	–	–	258
	007	182	–	174	–	174	213	–	203	–	203
	204	Not available									
	206	Not available									
	207	Not available									
	008	275	–	238	–	238	275	–	238	–	238
	011	339	–	257	–	257	339	–	257	–	257
	014	258	258	–	215	215	258	258	–	215	215
	016	279	279	–	215	215	279	279	–	215	215
CQH	**004**	218	–	–	–	211	248	–	–	–	240
	006	181	–	173	–	173	212	–	203	–	203
	007	182	–	174	–	174	213	–	203	–	203
	204	Not available									
	206	Not available									
	207	Not available									
	008	280	–	245	–	245	280	–	245	–	245
	011	255	255	–	215	215	255	255	–	215	215
	014	258	258	–	215	215	258	258	–	215	215
	016	285	285	–	217	217	285	285	–	217	217

Fig. 5 – Support positions and loads (Note: weights refer to standard units)

SBH - SLH - SQH



Dimensions – SBH – SLH – SQH

Dimensions (mm)		A	B	C	D	E
Model	**Size**					
SBH **SLH** **SQH**	**004–006–007–204–206–207** **004–006–204–206** **004–204**	2000	1760	–	–	–
SBH **SLH** **SQH**	**008–011–014** **007–207–008–011** **006–007–206–207–008**	3000	–	1380	–	–
SBH **SLH** **SQH**	**016** **014–016** **011–014–016**	4000	–	–	1160	1440

Weight distribution – SBH – SLH – SQH

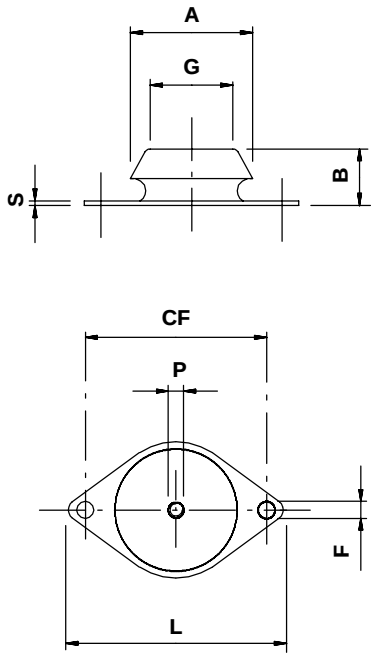
Weight distribution (kg)		W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10
Model	**Size**										
SBH	**004**	174	–	–	–	125	206	–	–	–	148
	006	197	–	–	–	135	248	–	–	–	170
	007	201	–	–	–	143	251	–	–	–	179
	204	219	–	–	–	145	219	–	–	–	145
	206	232	–	–	–	158	232	–	–	–	158
	207	242	–	–	–	169	242	–	–	–	169
	008	261	–	145	–	145	261	–	145	–	145
	011	325	–	165	–	165	325	–	165	–	165
	014	332	–	175	–	175	332	–	175	–	175
	016	287	287	–	137	137	287	287	–	137	137
SLH	**004**	176	–	–	–	125	211	–	–	–	149
	006	201	–	–	–	142	254	–	–	–	179
	007	201	–	120	–	120	242	–	144	–	144
	204	224	–	–	–	147	224	–	–	–	147
	206	240	–	–	–	167	240	–	–	–	167
	207	241	–	135	–	135	241	–	135	–	135
	008	267	–	145	–	145	267	–	145	–	145
	011	333	–	174	–	174	333	–	174	–	174
	014	270	270	–	137	137	270	270	–	137	137
	016	291	291	–	137	137	291	291	–	137	137
SQH	**004**	183	–	–	–	135	217	–	–	–	160
	006	199	–	119	–	119	240	–	143	–	143
	007	201	–	120	–	120	242	–	144	–	144
	204	231	–	–	–	157	231	–	–	–	157
	206	234	–	134	–	134	234	–	134	–	134
	207	241	–	135	–	135	241	–	135	–	135
	008	276	–	160	–	160	276	–	160	–	160
	011	267	267	–	136	136	267	267	–	136	136
	014	270	270	–	137	137	270	270	–	137	137
	016	306	306	–	153	153	306	306	–	153	153

Weight distribution with tank – SBH – SLH – SQH

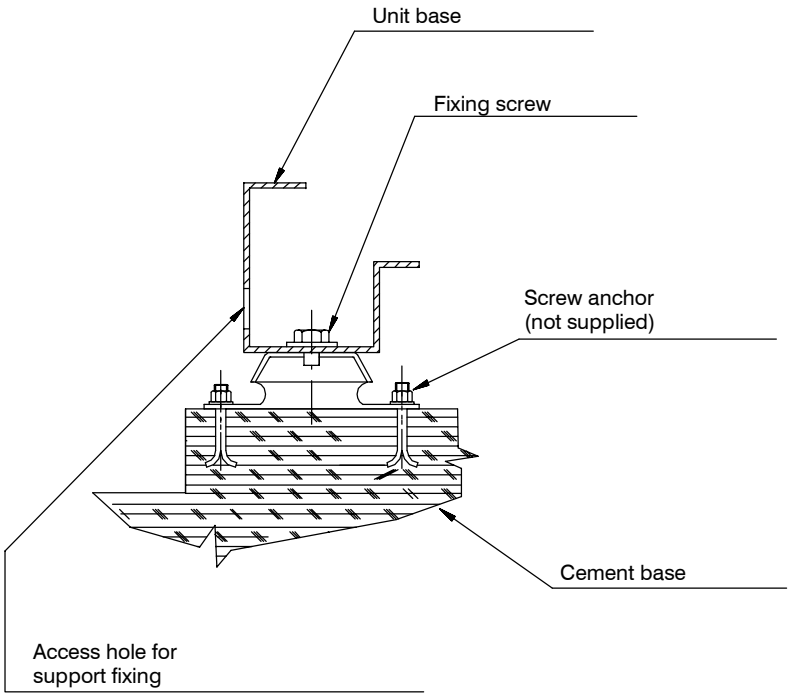
Weight distribution (kg)		W 1	W 2	W 3	W 4	W 5	W 6	W 7	W 8	W 9	W 10
Model	**Size**										
SBH	**004**	225	–	–	–	229	252	–	–	–	257
	006	249	–	–	–	238	293	–	–	–	280
	007	253	–	–	–	246	296	–	–	–	289
	204	Not available									
	206	Not available									
	207	Not available									
	008	284	–	268	–	268	284	–	268	–	268
	011	348	–	288	–	288	348	–	288	–	288
	014	355	–	298	–	298	355	–	298	–	298
	016	302	302	–	257	257	302	302	–	257	257
SLH	**004**	227	–	–	–	229	256	–	–	–	259
	006	253	–	–	–	245	299	–	–	–	289
	007	196	–	199	–	199	225	–	229	–	229
	204	Not available									
	206	Not available									
	207	Not available									
	008	290	–	269	–	269	290	–	269	–	269
	011	357	–	297	–	297	357	–	297	–	297
	014	285	285	–	257	257	285	285	–	257	257
	016	306	306	–	257	257	306	306	–	257	257
SQH	**004**	234	–	–	–	239	263	–	–	–	269
	006	195	–	199	–	199	224	–	229	–	229
	007	196	–	199	–	199	225	–	229	–	229
	204	Not available									
	206	Not available									
	207	Not available									
	008	299	–	283	–	283	299	–	283	–	283
	011	282	282	–	256	256	282	282	–	256	256
	014	285	285	–	257	257	285	285	–	257	257
	016	321	321	–	273	273	321	321	–	273	273

Fig. 6 – Rubber anti–vibration support

Rubber support dimensions



Rubber support installation



Single support code

Code	A (mm)	B (mm)	P (mm)	F (mm)	CF (mm)	G (mm)	L (mm)	S (mm)
270327	82	35	M10	11.0	110	60	128	2

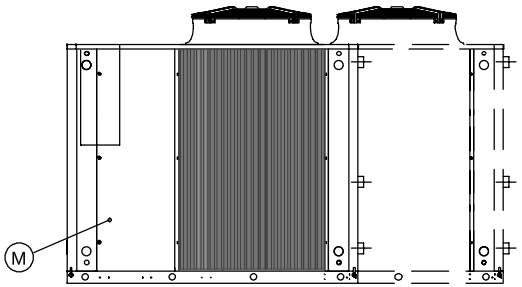
Rubber supports

Unit	Configuration	Support kit code	Single support code	Kit support pieces
CBH 204–206–207–004–006–007 CLH 204–206–004–006 CQH 204–004 SBH 204–206–207–004–006–007 SLH 204–206–004–006 SQH 204–004	With or without tank	485620	270327	4
CBH 008–011–014 CLH 207–007–008–011 CQH 206–207–006–007–008 SBH 008–011–014 SLH 207–007–008–011 SQH 206–207–006–007–008		485621		6
CBH 016 CLH 014–016 CQH 011–014–016 SBH 016 SLH 014–016 SQH 011–014–016		485622		8

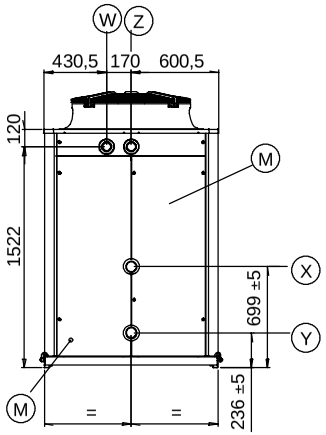
Each kit is complete with stainless steel fixing screws and plain washers for unit assembly.

Fig. 7 – Overall dimensions

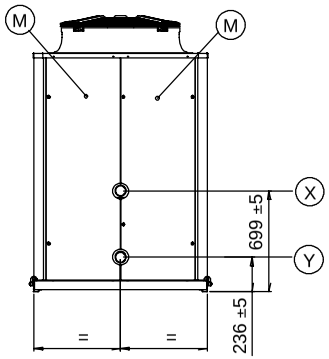
			CBH/CLH/CQH 004-006-007 204-206-207	SBH/SLH/SQH 004-006-007 204-206-207	CBH/CLH/CQH 008-011-014-016	SBH/SLH/SQH 008-011-014-016
W	HEAT RECOVERY WATER CONNECTION (OPTIONAL)	PARTIAL HEAT RECOVERY INLET	1" GAS MALE	1" GAS MALE	$1^1/_4$" GAS MALE	$1^1/_4$" GAS MALE
		TOTAL HEAT RECOVERY INLET	2" GAS MALE	NOT AVAILABLE	$2^1/_2$" GAS MALE	NOT AVAILABLE
Z		PARTIAL HEAT RECOVERY OUTLET	1" GAS MALE	1" GAS MALE	$1^1/_4$" GAS MALE	$1^1/_4$" GAS MALE
		TOTAL HEAT RECOVERY OUTLET	2" GAS MALE	NOT AVAILABLE	$2^1/_2$" GAS MALE	NOT AVAILABLE



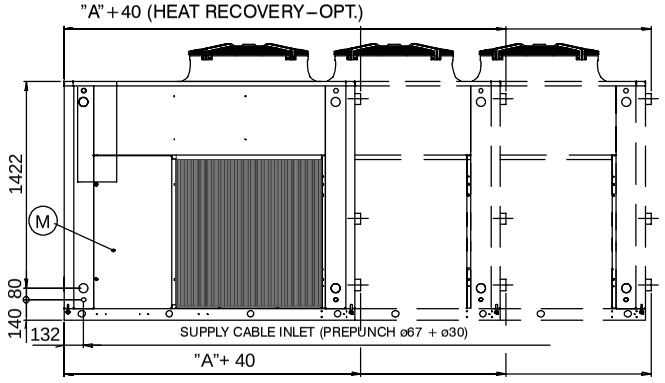
LATERAL VIEW (ONLY FOR:
CQH 016
SBH 007 AND SBH 014
SLH 006 AND SLH 011
SQH 016)



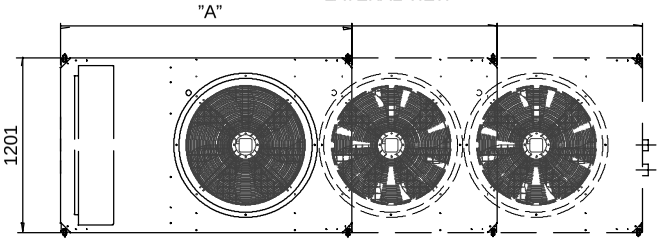
REAR VIEW
(WITH HEAT RECOVERY)



REAR VIEW
(STD. UNIT)

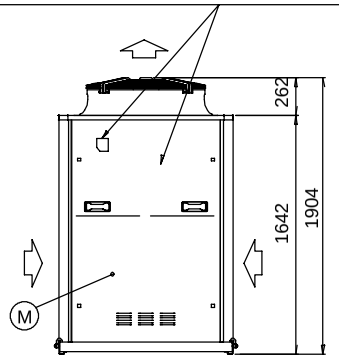


LATERAL VIEW



TOP VIEW

ELECTRICAL PANEL AND CONTROL UNIT
(REAR FRONT REMOVABLE PANEL)



FRONT VIEW

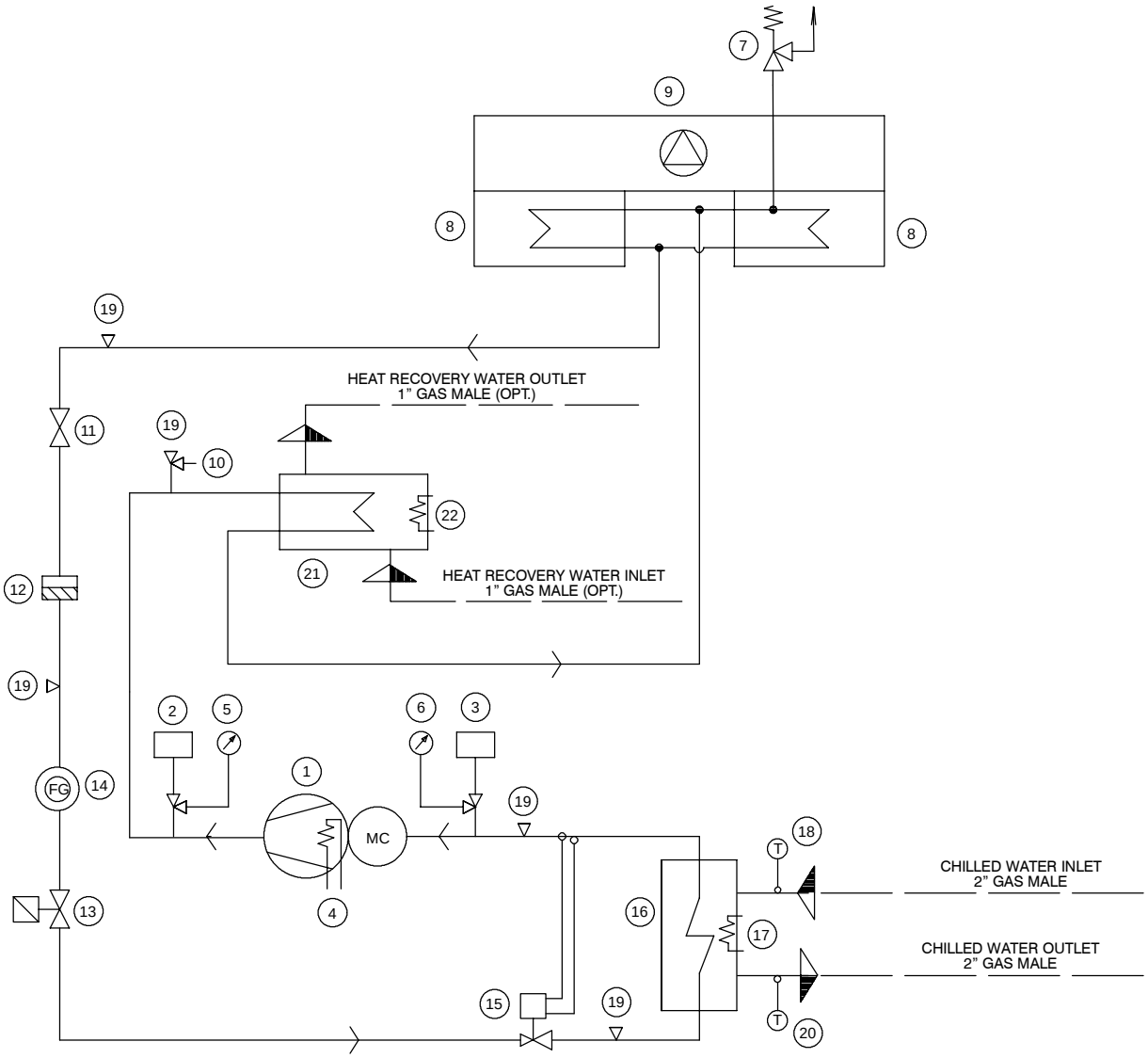
M REMOVABLE PANEL

AIR FLOW

(*) ON 204 – 206 – 207 MODELS, TANK VERSION WITH/WITHOUT PUMP IS NOT AVAILABLE

□ = Std., with tank, with tank+pump/s ■ = With pump/s (without tank)		CBH/SBH004–006–007–204(*)–206(*)–207(*) CLH / SLH 004–006–204(*)–206(*) CQH / SQH 004–204(*)		CBH / SBH 008 – 011 – 014 CLH / SLH 007 – 207(*) – 008 – 011 CQH / SQH 006 – 007 – 206(*) – 207(*) – 008		CBH / SBH 016 CLH / SLH 014 – 016 CQH / SQH 011–014–016	
		□	■	□	■	□	■
"A"	mm	2006		3006		4006	
Chilled water connection	" X "	INLET 2" Gas Male	OUTLET 2" Gas Male	INLET 2" Gas Male (Mod. 006–007–206–207) $2^1/_2$" Gas Male (Mod. 008 ÷ 014)	OUTLET 2" Gas Male (Mod. 006–007–206–207) $2^1/_2$" Gas Male (Mod. 008 ÷ 014)	INLET $2^1/_2$" Gas Male	OUTLET $2^1/_2$" Gas Male
	" Y "	OUTLET 2" Gas Male	INLET 2" Gas Male	OUTLET 2" Gas Male (Mod. 006–007–206–207) $2^1/_2$" Gas Male (Mod. 008 ÷ 014)	INLET 2" Gas Male (Mod. 006–007–206–207) $2^1/_2$" Gas Male (Mod. 008 ÷ 014)	OUTLET $2^1/_2$" Gas Male	INLET $2^1/_2$" Gas Male

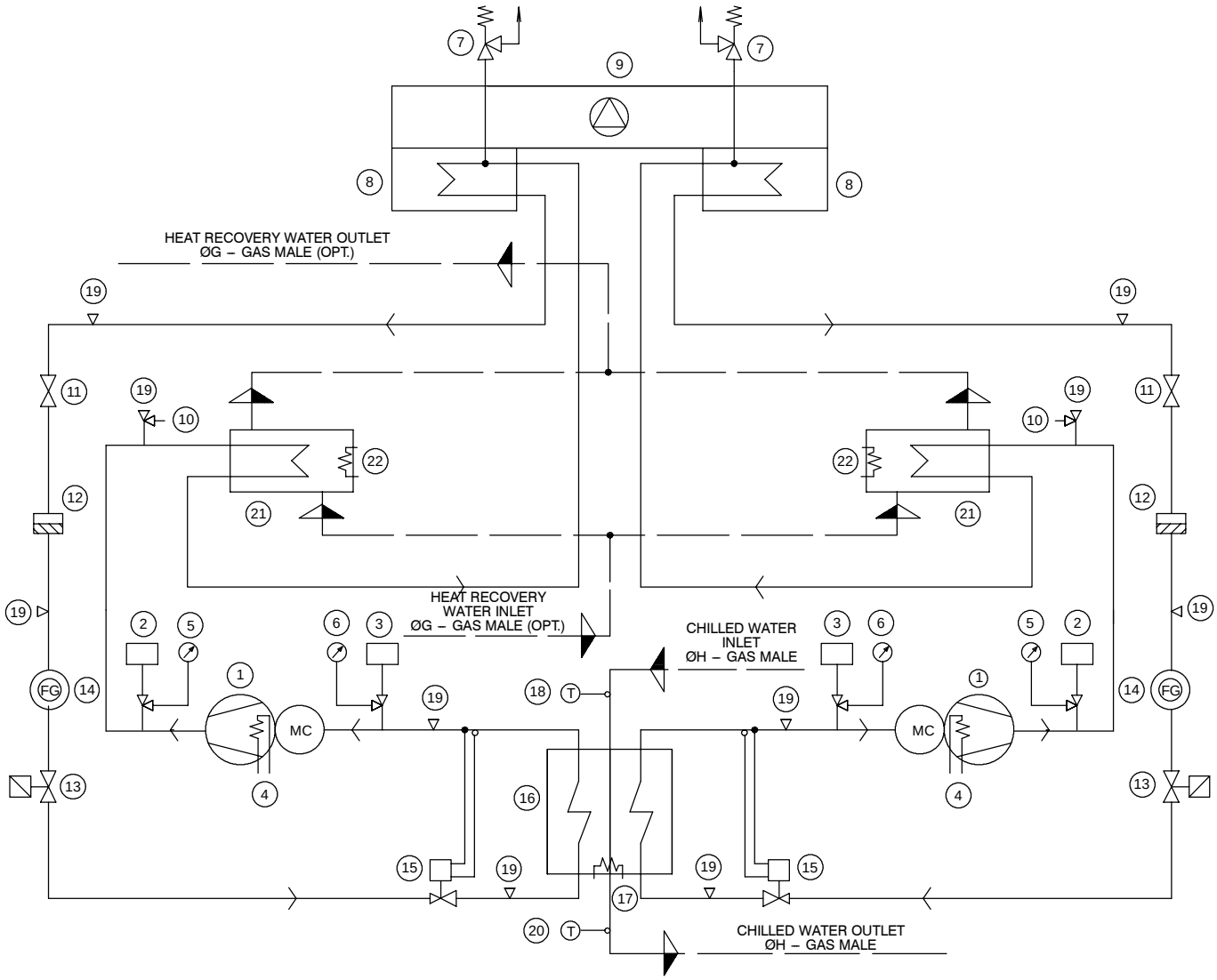
Fig. 8 – Refrigerant circuit (std.) with partial recovery (opt.) CBH/CLH/CQH / SBH/SLH/SQH 004–006–007



Refrigerant components

Item	Description	Item	Description
1	Compressor	15	Thermostatic expansion valve
2	High pressure switch *(HP)*	16	Evaporator
3	Low pressure switch *(LP)*	17	Antifreeze heater *(Opt.)*
4	Crankcase heater *(Std. with pressure transducer)*	18	Control temperature sensor
5	High pressure manometer *(Opt.)*	19	Charge connection
6	Low pressure manometer *(Opt.)*	20	Antifreeze sensor
7	Safety valve	21	Partial recovery heat exchanger *(Opt.)*
8	Condenser	22	Antifreeze heater *(Std. with heat recovery)*
9	Fan(s)		
10	Pressure transducer *(Opt. on CBH/CLH/CQH without heat recovery)*		
11	Shut–off valve		
12	Filter dryer		
13	Shut–off solenoid valve		
14	Sight glass		

Fig. 9 – Refrigerant circuit (std.) with partial recovery (opt.) CBH/CLH/CQH / SBH/SLH/SQH 204–206–207–008–011–014–016

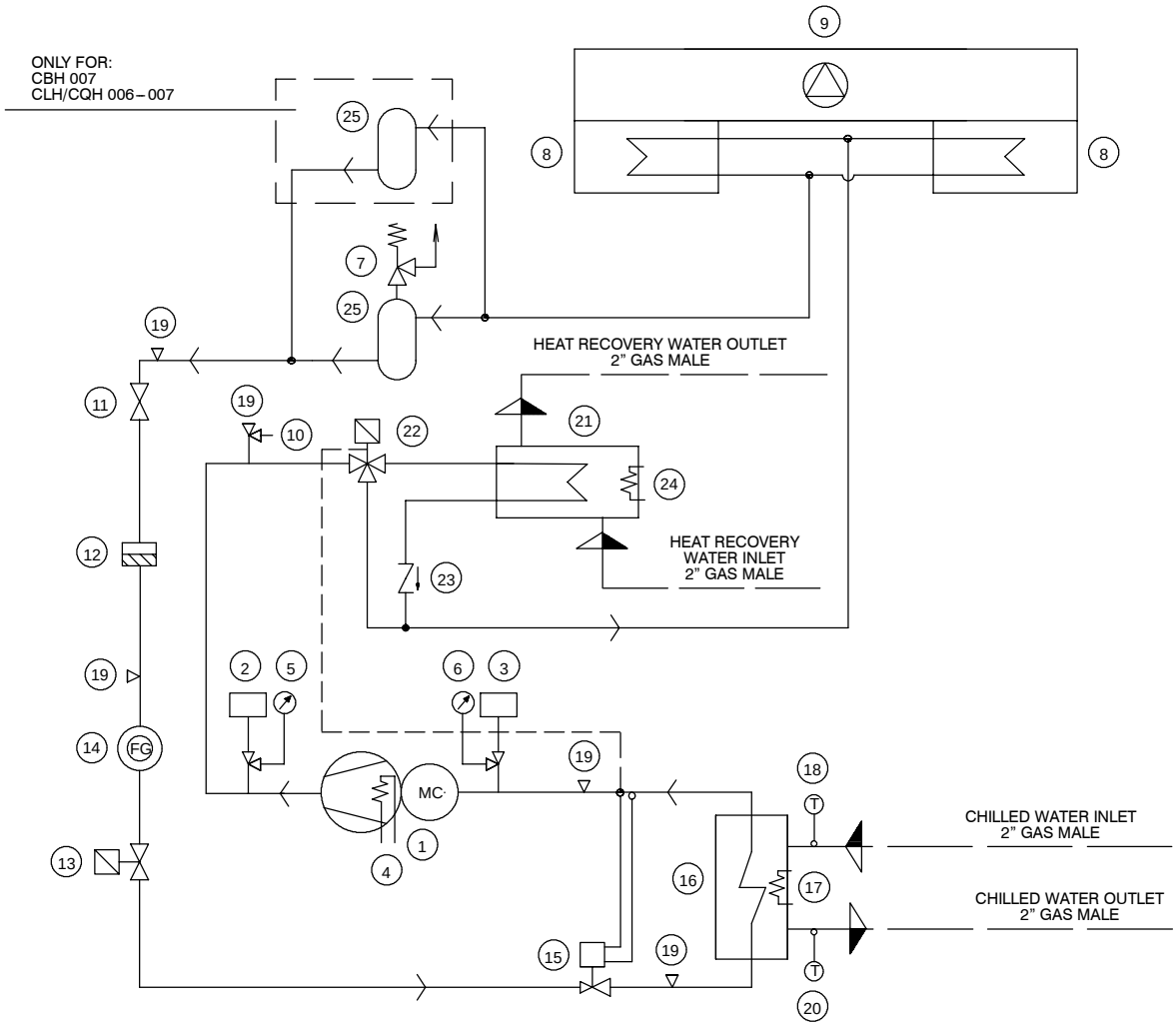


	CBH / CLH / CQH / SBH / SLH / SQH						
	204	206	207	008	011	014	016
Ø G	1”	1”	1”	$1^1/_4$”	$1^1/_4$”	$1^1/_4$”	$1^1/_4$”
Ø H	2”	2”	2”	$2^1/_2$”	$2^1/_2$”	$2^1/_2$”	$2^1/_2$”

Refrigerant components

Item	Description	Item	Description
1	Compressor	15	Thermostatic expansion valve
2	High pressure switch *(HP)*	16	Evaporator
3	Low pressure switch *(LP)*	17	Antifreeze heater *(Opt.)*
4	Crankcase heater *(Std. with pressure transducer)*	18	Control temperature sensor
5	High pressure manometer *(Opt.)*	19	Charge connection
6	Low pressure manometer *(Opt.)*	20	Antifreeze sensor
7	Safety valve	21	Partial recovery heat exchanger *(Opt.)*
8	Condenser	22	Antifreeze heater *(Std. with heat recovery)*
9	Fan(s)		
10	Pressure transducer *(Opt. on CBH/CLH/CQH without heat recovery)*		
11	Shut–off valve		
12	Filter dryer		
13	Shut–off solenoid valve		
14	Sight glass		

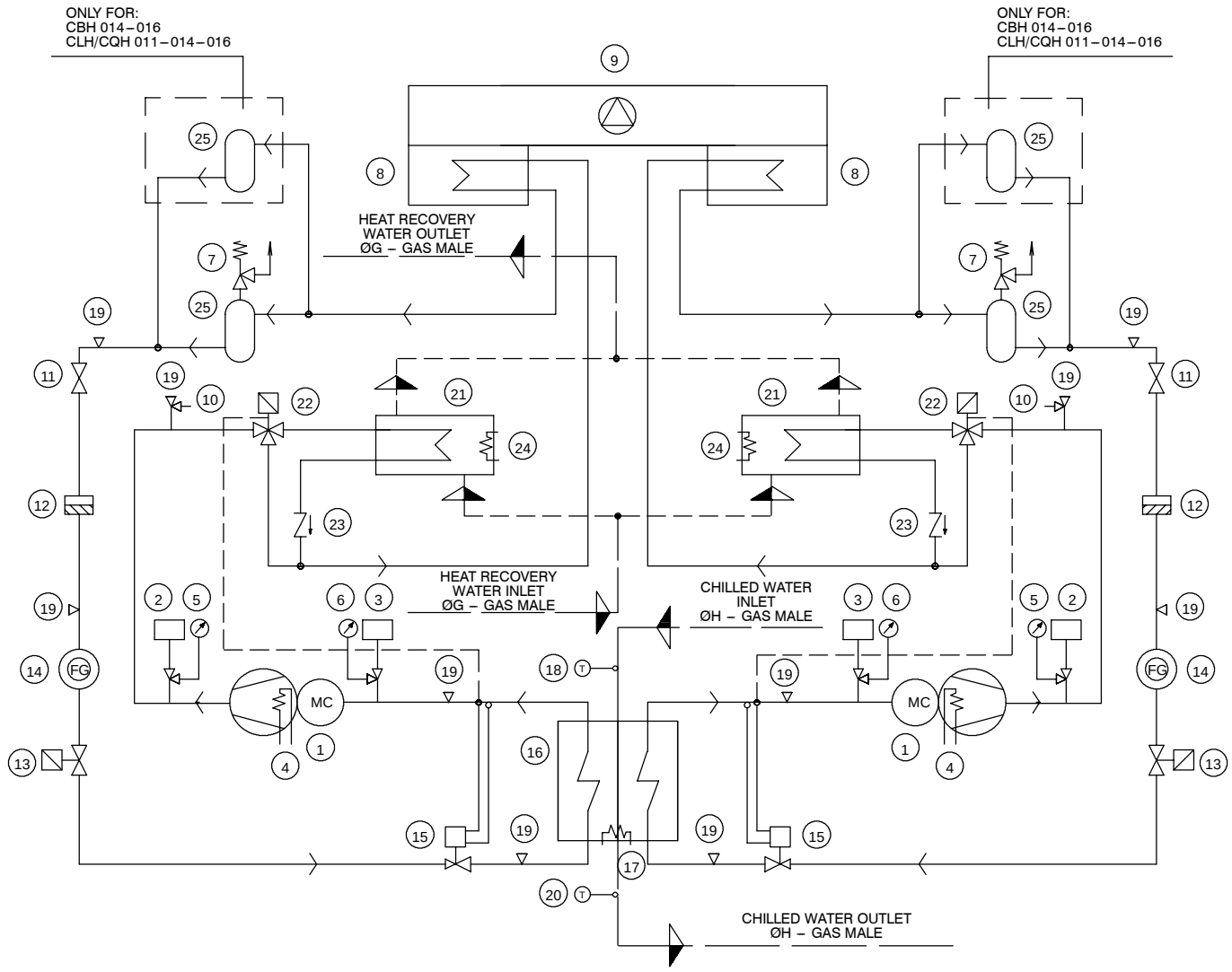
Fig. 10 – Refrigerant circuit with total recovery (opt.) CBH/CLH/CQH 004–006–007



Refrigerant components

Item	Description	Item	Description
1	Compressor	15	Thermostatic expansion valve
2	High pressure switch *(HP)*	16	Evaporator
3	Low pressure switch *(LP)*	17	Antifreeze heater *(Opt.)*
4	Crankcase heater	18	Control temperature sensor
5	High pressure manometer *(Opt.)*	19	Charge connection
6	Low pressure manometer *(Opt.)*	20	Antifreeze sensor
7	Safety valve	21	Total recovery heat exchanger
8	Condenser	22	Three way valve
9	Fan(s)	23	Non return valve
10	Pressure transducer	24	Antifreeze heater
11	Shut–off valve	25	Liquid receiver
12	Filter dryer		
13	Shut–off solenoid valve		
14	Sight glass		

Fig. 11 – Refrigerant circuit with total recovery (opt.)
CBH/CLH/CQH 204–206–207–008–011–014–016

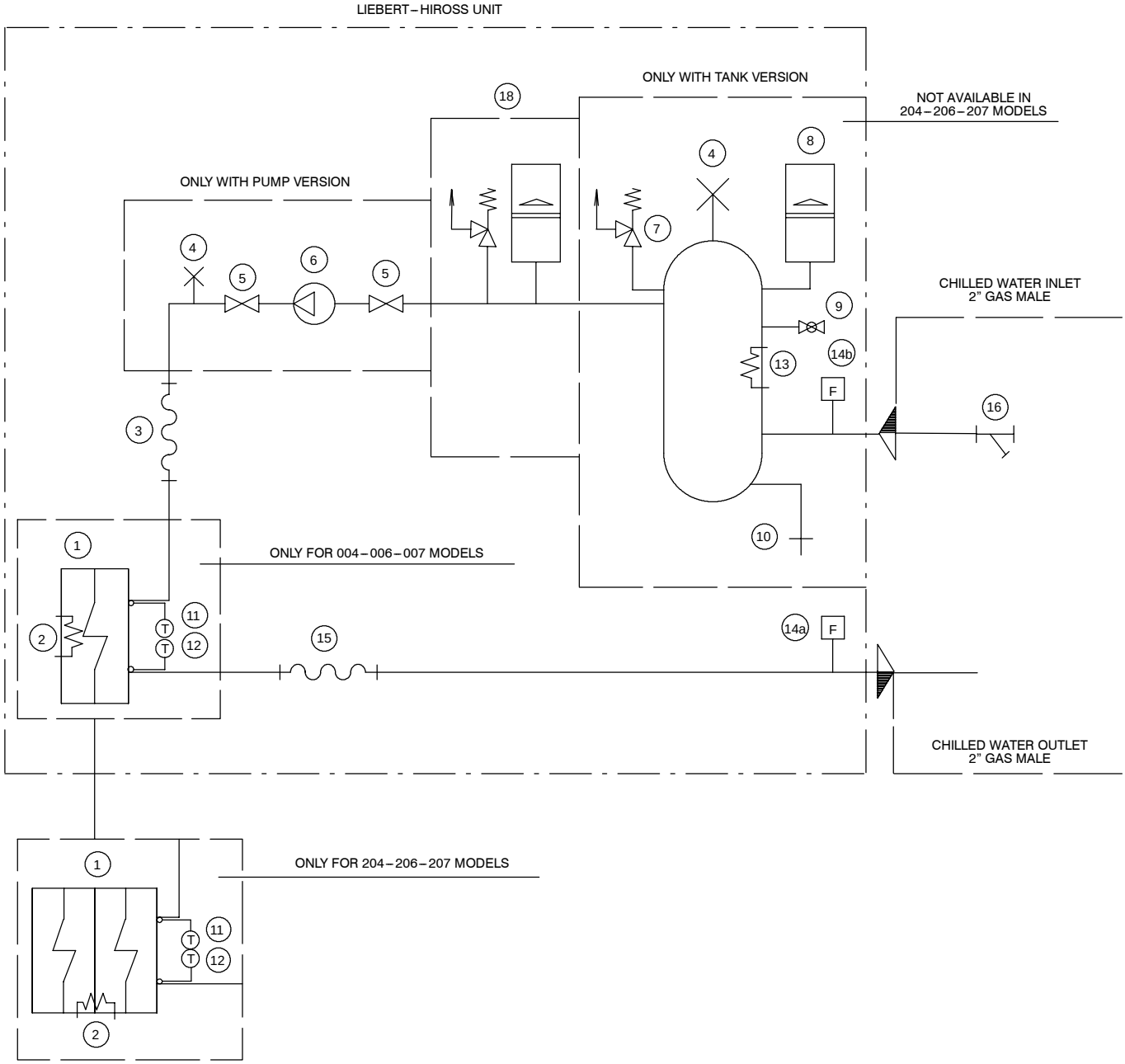


	CBH / CLH / CQH / SBH / SLH / SQH						
	204	206	207	008	011	014	016
Ø G	2”	2”	2”	$2^1/_2$”	$2^1/_2$”	$2^1/_2$”	$2^1/_2$”
Ø H	2”	2”	2”	$2^1/_2$”	$2^1/_2$”	$2^1/_2$”	$2^1/_2$”

Refrigerant components

Item	Description	Item	Description
1	Compressor	15	Thermostatic expansion valve
2	High pressure switch *(HP)*	16	Evaporator
3	Low pressure switch *(LP)*	17	Antifreeze heater *(Opt.)*
4	Crankcase heater	18	Control temperature sensor
5	High pressure manometer *(Opt.)*	19	Charge connection
6	Low pressure manometer *(Opt.)*	20	Antifreeze sensor
7	Safety valve	21	Total recovery heat exchanger
8	Condenser	22	Three way valve
9	Fan(s)	23	Non return valve
10	Pressure transducer	24	Antifreeze heater
11	Shut–off valve	25	Liquid receiver
12	Filter dryer		
13	Shut–off solenoid valve		
14	Sight glass		

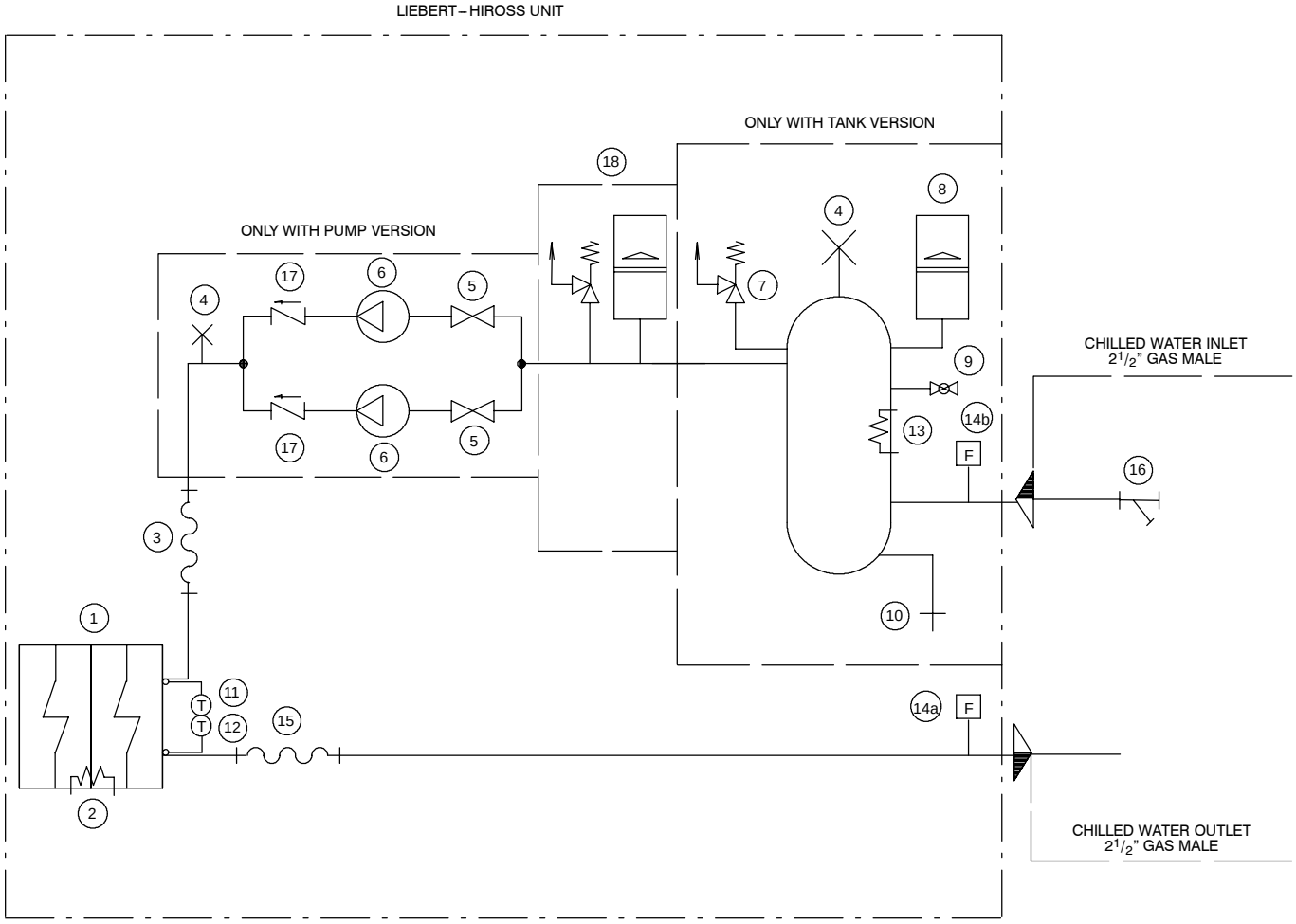
Fig. 12 – Hydraulic circuit – CBH/CLH/CQH 004–006–007–204–206–207



Hydraulic components

Item	Description	Item	Description
1	Evaporator	11	Control temperature sensor
2	Evaporator antifreeze heater *(Opt.)*	12	Antifreeze temperature sensor
3	Rubber flexible pipe *(only with pumps and/or tank))*	13	Tank antifreeze heater *(Opt.)*
4	Manual air valve	14a	Flow switch *(unit without tank, Opt. without pumps)*
5	Gate valve	14b	Flow switch *(unit with tank, Opt. without pumps)*
6	Pump	15	Rubber flexible pipe *(only with pumps, without tank)*
7	Safety valve	16	Filter *(Opt.)*
8	Expansion tank	17	Non return valve
9	Service ball valve	18	Expansion tank + Safety valve *(Opt. without tank)*
10	Drain valve		

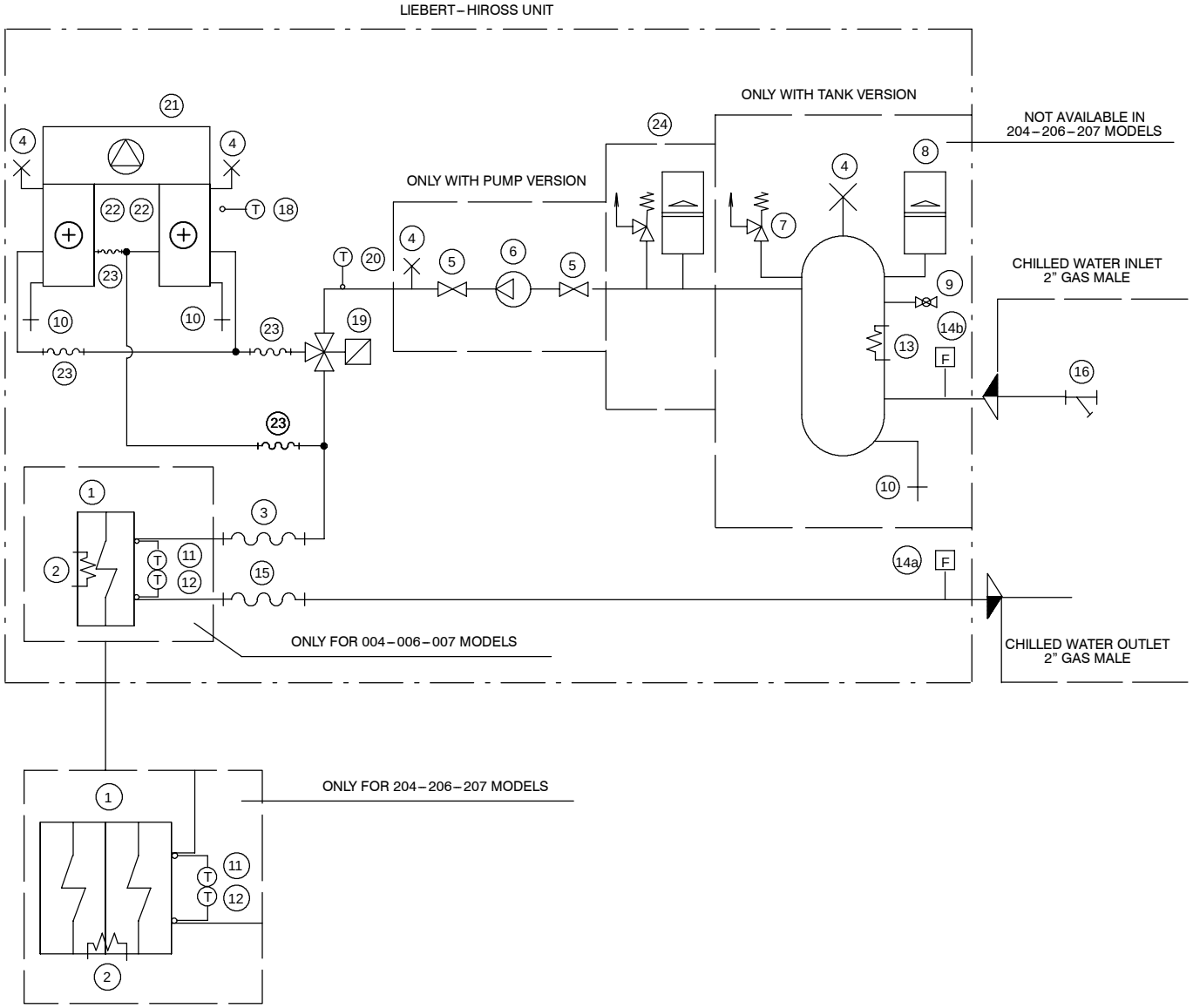
Fig. 13 – Hydraulic circuit – CBH/CLH/CQH 008–011–014–016



Hydraulic components

Item	Description	Item	Description
1	Evaporator	11	Control temperature sensor
2	Evaporator antifreeze heater *(Opt.)*	12	Antifreeze temperature sensor
3	Rubber flexible pipe *(only with pumps and/or tank))*	13	Tank antifreeze heater *(Opt.)*
4	Manual air valve	14a	Flow switch *(unit without tank, Opt. without pumps)*
5	Gate valve	14b	Flow switch *(unit with tank, Opt. without pumps)*
6	Pump	15	Rubber flexible pipe *(only with pumps, without tank)*
7	Safety valve	16	Filter *(Opt.)*
8	Expansion tank	17	Non–return valve
9	Service ball valve	18	Expansion tank + Safety valve *(Opt. without tank)*
10	Drain valve		

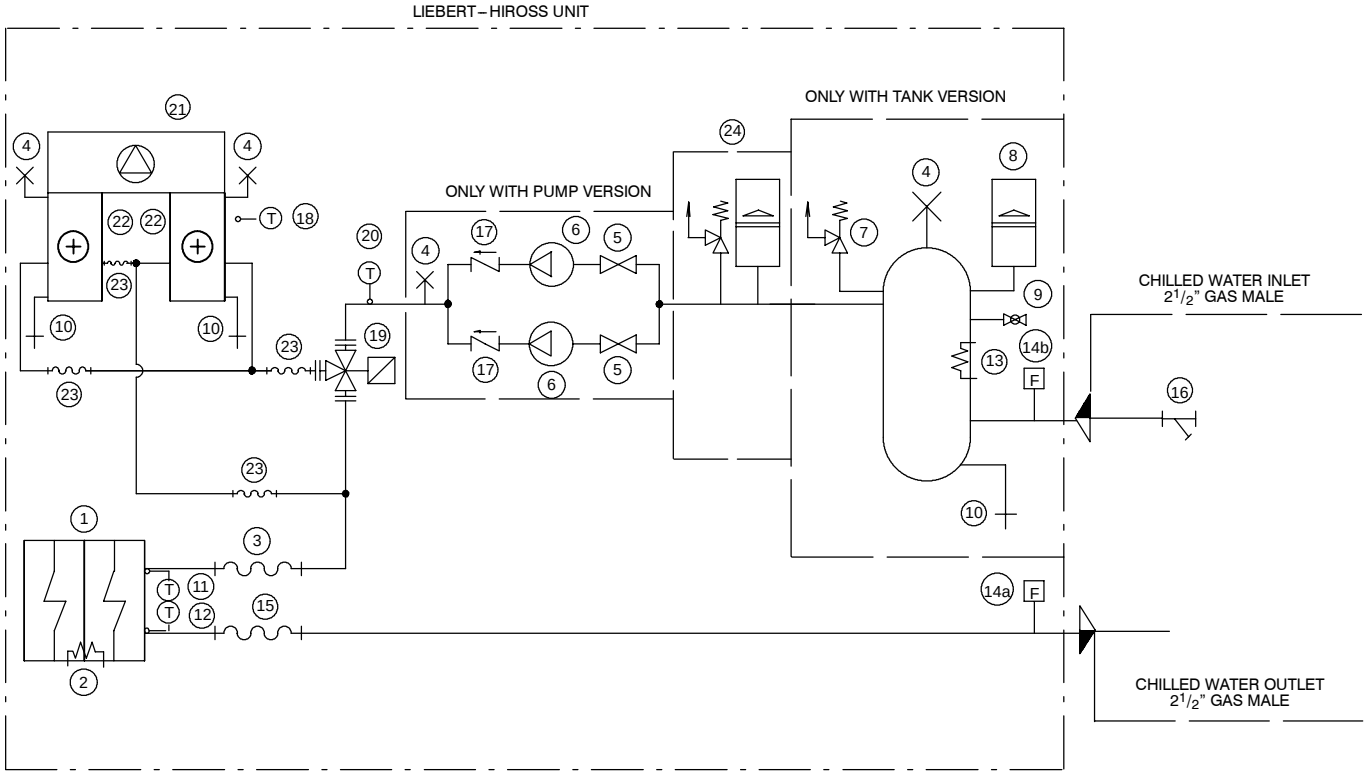
Fig. 14 – Hydraulic circuit – SBH/SLH/SQH 004–006–007–204–206–207



Hydraulic components

Item	Description	Item	Description
1	Evaporator	14a	Flow switch *(unit without tank, Opt. without pumps)*
2	Evaporator antifreeze heater *(Opt.)*	14b	Flow switch *(unit with tank, Opt. without pumps)*
3	Rubber flexible pipe *(only with pumps and/or tank))*	15	Rubber flexible pipe *(only with pumps, without tank)*
4	Manual air valve	16	Filter *(Opt.)*
5	Gate valve	17	Non return valve
6	Pump	18	Air temperature sensor
7	Safety valve	19	3–way valve
8	Expansion tank	20	Freecooling control temperature sensor
9	Service ball valve	21	Fan(s)
10	Drain valve	22	Freecooling coil
11	Control temperature sensor	23	Rubber flexible pipe
12	Antifreeze temperature sensor	24	Expansion tank + Safety valve *(Opt. without tank)*
13	Tank antifreeze heater *(Opt.)*		

Fig. 15 – Hydraulic circuit – SBH/SLH/SQH 008–011–014–016



Hydraulic components

Item	Description	Item	Description
1	Evaporator	14a	Flow switch *(unit without tank, Opt. without pumps)*
2	Evaporator antifreeze heater *(Opt.)*	14b	Flow switch *(unit with tank, Opt. without pumps)*
3	Rubber flexible pipe *(only with pumps and/or tank))*	15	Rubber flexible pipe *(only with pumps, without tank)*
4	Manual air valve	16	Filter *(Opt.)*
5	Gate valve	17	Non–return valve
6	Pump	18	Air temperature sensor
7	Safety valve	19	3–way valve
8	Expansion tank	20	Freecooling control temperature sensor
9	Service ball valve	21	Fans
10	Drain valve	22	Freecooling coil
11	Control temperature sensor	23	Rubber flexible pipe
12	Antifreeze temperature sensor	24	Expansion tank + Safety valve *(Opt. without tank)*
13	Tank antifreeze heater *(Opt.)*		

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