# Installation
# Operation
# Maintenance

## CMAB HSE

Air-cooled multi-pipe units with variable speed driven scroll compressors
Cooling capacity 67-232 kW
Heating capacity (heat pump mode) 74-256 kW

BALANCE™


CMAB HSE model 150-255

CG-SVX037A-GB
**Original instructions**

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# General information

**IMPORTANT!**

**The units covered by this manual deserve attention and care both for correct installation and to keep them in good working order.**

**It is strongly recommended to sign a maintenance contract with an authorized service center to ensure an efficient and trouble-free operation.**

**WARNING!**

**This manual describes the procedures for CMAB HSE multi-pipe units.**

**All units have label applied on the frame of unit and inside electrical panel.**

**WIRING, LABEL AND OVERALL DESIGN OF SPECIFIC TO BE CONSIDERED AS AN INTEGRAL PART OF THIS MANUAL.**

**In case of discrepancy between this manual and the documents cited prevail as shown on the wiring diagram and outline drawing.**

## 1.1.Delivery of the unit

The unit must be inspected for any possible damage immediately upon reaching its final place of installation. All components described in the delivery note must be carefully verified and checked; any damage must be reported to the transporter. Check on the unit nameplate, before connecting it to earth, that the model and power supply voltage are as ordered. Responsibility for any damage after acceptance of the unit cannot be attributed to Trane.

## 1.2.Checks

Please perform the following checks upon receipt of the unit, for your protection in the event that it is incomplete (any missing parts) or has incurred damage during transport:

a) Before accepting the unit, please verify every single component in the consignment. Check for any damage.

b) In the event that the unit has been damaged, do not remove the damaged material. A set of photographs are helpful in ascertaining responsibility.

c) Immediately report the extent of the damage to the transporter and immediately request that they inspect the unit.

d) Immediately report the extent of the damage to the Trane representative, so that arrangements can be made for the required repairs. In no case must the damage be repaired before the unit has been inspected by the representative of the transportation company.

e) On receiving the unit it is up to the customer to check that there is no obvious damage or pieces missing. If this is so, an immediate complaint must be made to the carrier for damage or for not-delivery and the Receiving Card to be found inside the unit electrical panel must be filled in. Photographic evidence must be provided for macroscopic damage. The card must be sent to Trane within 8 days of receiving the goods: if it is not sent back or delayed, the complaint will not be accepted.

## 1.3.Purpose of the Manual

The purpose of this Manual is to allow the installer and the qualified operator to carry out all required operations in order to ensure proper installation and maintenance of the unit, without risking any damage to people, animals and/or objects.

This Manual is an important supporting document for qualified personnel but it is not intended to replace such personnel. All activities must be carried out in compliance with local laws and regulations.

## 1.4.General Warning

This publication has been prepared only as a support and does not constitute a binding offer to Trane. Trane has compiled the content to the best of their knowledge. No express or implied warranty is given for the completeness, accuracy, reliability of the content. All data and specifications in it shown are subject to change without notice. Trane explicitly rejects any liability for any direct or indirect damage, in the broadest sense of the term, arising from or related to the use and / or interpretation of this publication. All content is copyrighted by Trane.

## 1.5.Unit identification

The unit is identifiable through:

- Packaging label: the identification data of the product.
- Technical Label: the technical data of the product.

*TECHNICAL LABEL*

It contains the kind of the unit (serial and size), the serial number, the production year, the electric data, the main technical data, logo and manufacturer address.

Tampering and/or rehandling the label does not allow the identification of the product, and makes difficult any installation and maintenance operation. In case of discrepancy between this manual and the label on the unit in terms of electrical data and refrigerant charge, the data on the label supersedes the data in the manual.

*SERIAL NUMBER*

The serial number identifies specific characteristics of the unit and its components. It allows identification of spare parts for repairs.

**Thermal Performance**

Trane units are tested at the factory, in separate stations, according to an internal procedure. Each performance verification performed on the system is only possible if they are reproduced and maintained in the same conditions (constant load, constancy of temperatures and flow rates of evaporation - condensation and recovery, quality and tolerance of the measuring instruments, etc..) Of the salt test.

The test conditions are those specified by the customer when ordering: in the absence of precise information you should refer to the nominal values specified in the technical bulletin in force on the date of the Order Confirmation.

# General information

## 1.6. Warranty

A. Warranty is based on the general terms and conditions of the manufacturer. The warranty is void if the equipment is repaired or modified without the written approval of the manufacturer, if the operating limits are exceeded or if the control system or the electrical wiring is modified. Damage due to misuse, lack of maintenance or failure to comply with the manufacturer's instructions or recommendations is not covered by the warranty obligation. If the user does not conform to the rules of this manual, it may entail cancellation of warranty and liabilities by the manufacturer.

B. Warranty is twelve (12) months as from the date of first start up at installation place or eighteen (18) months after delivery at the project or other delivery location indicated by the customer.
The date the unit is operated for the first time means the date reported in the "1st start up form" contained into the "unit log book". This form should be filled in and sent, within 8 days from the start up, to Trane.

C. The warranty is valid if all the installation and start-up instructions have been adhered to (both those which may have come from Trane and those coming from current practice), if the "1st start up form" has been filled in and sent to the Trane after sales department.

D. The warranty is subject to any faults or defects being reported within eight days from their discovery.
The warranty will only be applied if and when the purchaser suspends use of the equipment as soon as a defect has been found.

E. The warranty is valid if the first running of the unit is carried out by a Trane authorised assistance center.

F. The warranty is subject to regular maintenance of the unit which is appropriately indicated in the "unit log book" located inside the electrical panel.

G. Warranty automatically ends in case of payments not fulfilled, non-performance of the contract and even if the units show tampering without written approval from Trane.

# Mechanical installation

## 2.1 Shipping

The stability of the unit during shipping must be ensured. If the unit is shipped with a wooden cross-plank on its base, this cross-plank must only be removed after the final destination has been reached.

## 2.2 Responsibility

Trane declines all present and future responsibility for any damage to persons, animals or things caused by negligence of operators failing to follow the installation and maintenance instructions in this Manual.

All safety equipment must be regularly and periodically checked in accordance with this manual and with local laws and regulations regarding safety and environment protection.

## 2.3 Safety

**The unit must be securely fixed to the ground.**

**It is essential to observe the following instructions:**

- **The unit can only be lifted using the hoist points marked in yellow that are fixed to its base. These are the only points that can support the entire weight of the unit.**
- **Do not allow unauthorised and/or unqualified personnel access to the unit.**
- **It is forbidden to access the electrical components without having opened the unit's main switch and switched off the power supply.**
- **It is forbidden to access the electrical components without using an insulating platform. Do not access the electrical components if water and/or moisture are present.**
- **All operations on the refrigerant circuit and on components under pressure must be carried out only by qualified personnel.**
- **Repositioning of a compressor or addition of lubricating oil must be carried out only by qualified personnel.**
- **Sharp edges and the surface of the condenser section could cause injury. Avoid direct contact.**
- **Switch off the unit's power supply, by opening the main switch, before servicing the cooling ventilators and/or compressors. Failure to observe this rule could result in serious personal injury.**
- **Avoid introducing solid objects into the water pipes while the unit is connected to the system.**
- **A mechanical filter must be applied to the water pipe to be connected to the heat exchanger inlet.**
- **The unit is supplied with safety valves, that are installed both on the high-pressure and on the low-pressure sides of the refrigerant gas circuit.**

**WARNING!**

**Before carrying out any operation on the unit, please read the instructions and operating manual.**

**Installation and maintenance must be carried out solely by qualified personnel that is familiar with local rules and regulations and has experience with this type of equipment. Installation of the unit must be avoided in any place that could be considered dangerous during maintenance procedures.**

**WARNING!**

**The installation of the unit must be avoided in any place that can be considered dangerous during maintenance, such as (but not only) covers without parapets or railings or without proper clearances.**

## 2.4 Handling and lifting

Avoid bumping and/or jolting during unloading from the lorry and handling the unit. Do not push or pull the unit from any part other than the base frame. Block the unit from sliding inside the lorry in order to prevent damage to the panels and to the base frame. Avoid any part of the unit falling during unloading and/or handling, as this could cause serious damage.

## 2.5 Operating limits

### 2.5.1 Storage

The units can be stored within the following environmental conditions:

| | | |
|---|---|---|
| Min ambient temperature | : | -10°C |
| Max ambient temperature | : | 53°C |
| Max relative humidity | : | 95% not condensable |

**WARNING!**

**Storage at temperatures below the minimum specified can cause damage to some parts including the electronic controller and its LCD display.**

**WARNING!**

**Storage at temperatures above the maximum indicated causes the opening of the safety valves placed on the suction line of compressors.**

**WARNING!**

**The storage in a very high humidity space (condensation) can damage electronic components.**

### 2.5.2 Operation

CMAB HSE unit operation is permitted within the limits indicated in the diagram provided in 2.5.3.

**WARNING!**

**The operation outside the limits specified may cause the activation of the protections and disrupt the operation of the unit and, in extreme cases, damage the unit.**

**In case of doubt, consult the factory.**

**These operating limits apply to unit operating at full load.**

# Mechanical installation

### 2.5.3 OPERATING RANGE

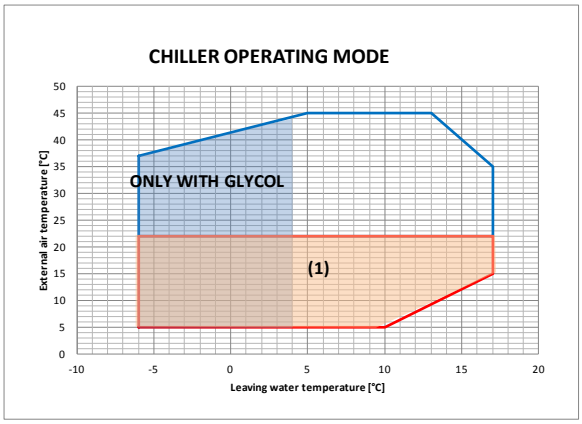
| Operating mode | Ta | | Tw out | |
|---|---|---|---|---|
| | Min | Max | Min | Max |
| Cooling only | 5 (1) | 45 | -6 (2) | 17 |
| Heating only | -12 | 30 (1) | 22 | 60 |

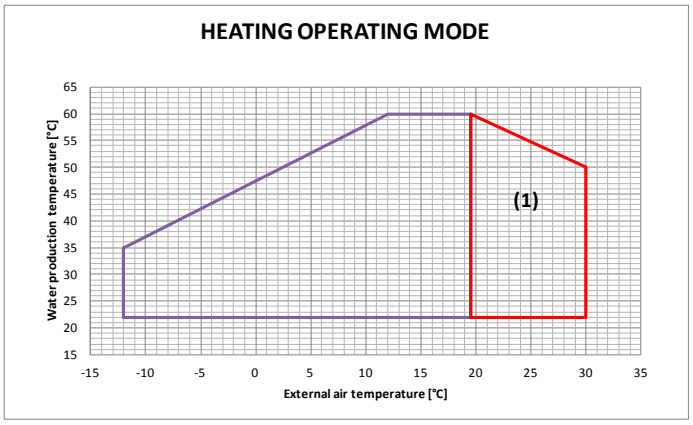
**Ta** = Outdoor air temperature (°C)

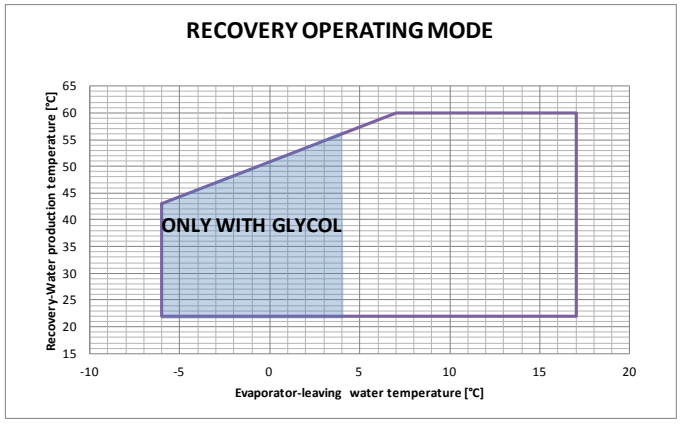
**Tw out** = Outlet water temperature (°C)

(1) In this area the fans modulate in order to control the condensing/evaporating temperature. The performances may be different from the declared ones.

(2) Operation with glycol, see table on next page.




(1) In this area the fans modulate in order to control the condensing/evaporating temperature. The performances may be different from the declared ones.

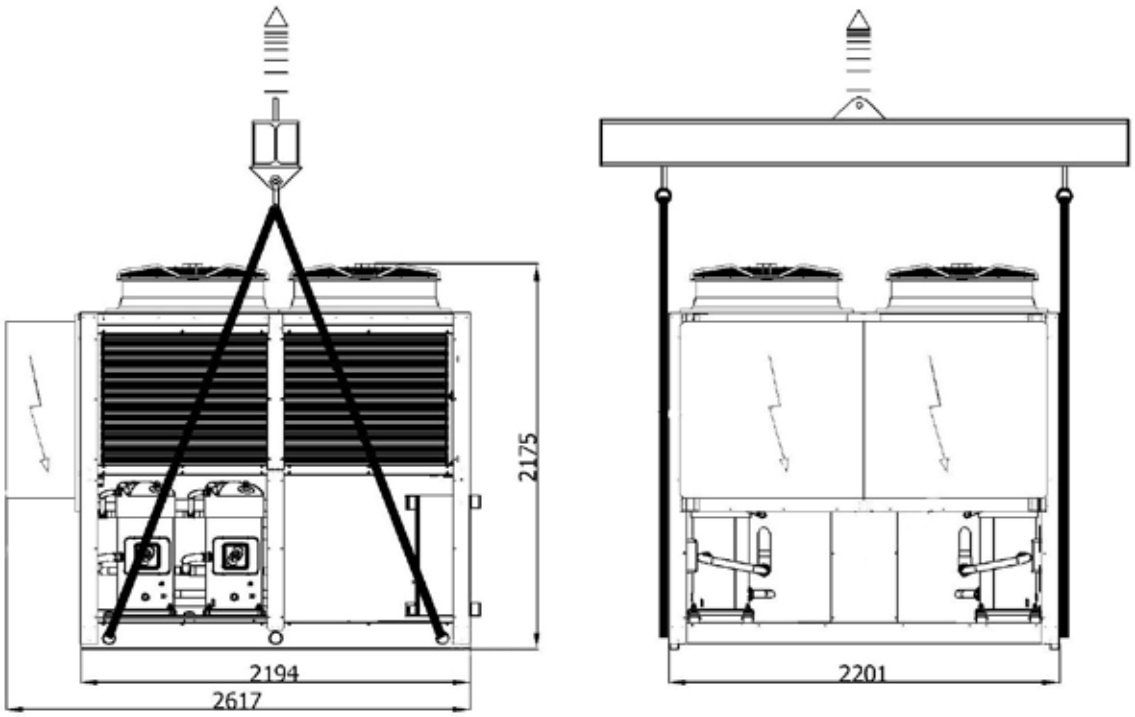
The minimum outdoor air temperature is based on low wind speeds (wind not exceeding 15 km/h). Greater wind speeds will result in a drop in head pressure, therefore increasing the minimum starting and/or operating outdoor air temperature.

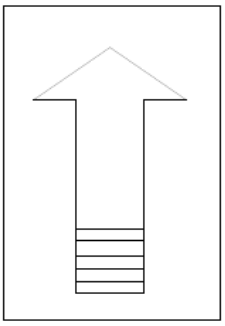
In case of higher wind speeds it may be necessary to install appropriate wind barriers to avoid the operating limit reduction.

## 2.6 Handling

*Handling CMAB HSE*

Check the unit weight and the ability to load the lifting device. Be careful when handling the obstacles placed in the path that may damage the units (bumps, ramps, hills, etc. ..) Verify the perfect stability during the handling operations of the unit. Do not perform dangerous operations that could damage the unit.




| | |
|---|---|
| Make sure that during transport the CMAB unit ALWAYS remains in the correct position! For example horizontal positioning of the unit can lead to irreversible damage to the compressors. Damage arising from incorrect transport will not be under warranty by the manufacturer. **Immediately report an incorrect receipt of goods.** An arrow positioned upward indicates the vertical position of the unit. |  |

**WARNING!**

**The lifting ropes and the spreader bar and/or balance must be sized to hold the weight of the unit safely. Check the weight of the unit on the nameplate of the unit. The weights given in the tables "Technical data" in "General Information" refer to standard units, without any options. The unit may have specific accessories that increase the overall weight (pumps, copper / copper coils, etc..).**

**WARNING!**

**The unit must be lifted with the utmost attention and care. Avoid abrupt lifting.**

**WARNING!**

**Do not use forklift trucks to lift the unit from below.**

**If equipment for lifting from above is not available, using rollers may move the unit.**

# Mechanical installation

## 2.7 Positioning

**Positioning and installation**

All CMAB HSE multi-pipe units are designed for installation outdoors, on balconies or on the ground, provided that the area is free from obstacles that could hamper air flow towards the condenser coils.

The unit must be installed on a robust and perfectly level foundation; should the unit be installed on balconies and/or attics, it could be necessary to use weight distribution beams.

For installation on the ground, a strong cement base that is at least 250 mm wider and longer than the unit must be foreseen. Also, this base must be able to support the weight of the unit as declared in the technical specifications.

If the unit is installed in places that are easily accessible for people and animals, it is advisable to install coil and compressor section protection grates.

To ensure the best possible performance on the installation site, the following precautions and instructions must be followed:

- Avoid air flow recirculation.
- Make sure that there are no obstacles to hamper air flow.
- Air must circulate freely to ensure proper intake and expulsion.
- Ensure strong and solid flooring to reduce noise and vibrations as much as possible.
- Avoid installation in particularly dusty environments, in order to reduce soiling of condenser coils.
- The water in both water circuits must be particularly clean and all traces of oil and rust must be removed. Installation of a mechanical water filter is mandatory for the unit inlet water piping.

## 2.8 Minimum space requirements

Dimensional drawing shall be respected to avoid causing:

- Noise
- Incorrect heat exchange and ventilation
- Difficult maintenance or inaccessibility to components

It is fundamental to respect minimum distances on all CMAB HSE units, in order to ensure optimum ventilation for the condenser coils. Limited installation space could reduce the normal air flow, thus significantly reducing the unit's performance and considerably increasing consumption of electrical energy.

When deciding where to position the unit and to ensure a proper air flow, the following factors must be taken into consideration: avoid any warm air recirculation and insufficient supply to the air-cooled condenser.

Both these conditions can cause an increase of condensing pressure, which leads to a reduction in energy efficiency and refrigerating capacity. Thanks to the geometry of their air-cooled condensers, CMAB HSE units are less affected by bad air circulation situations.

Also, Trane software has a particular ability for calculating the unit's operating conditions and for optimising the load under abnormal operating conditions.

Every side of the unit must be accessible for maintenance operations. Figure 3 shows the minimum space required.

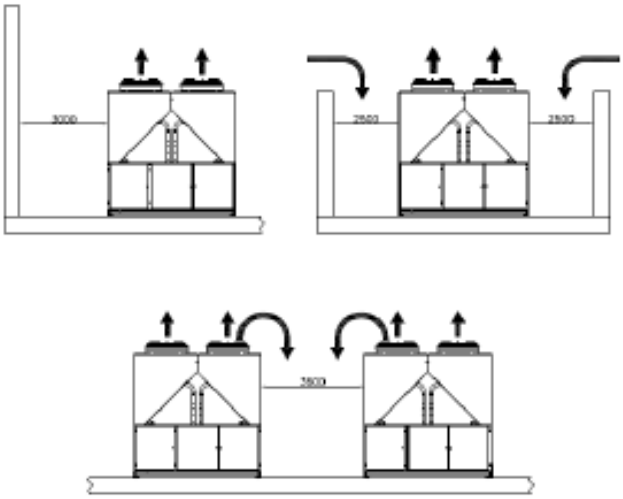
Vertical air expulsion must not be obstructed as this would significantly reduce capacity and efficiency.

If the unit is positioned in such a way as to be surrounded by walls or with obstacles of the same height as the unit, it must be installed at a distance of at least 2500 mm. If these obstacles are higher, the unit must be installed at a distance of at least 3000 mm.

Should the unit be installed without observing the recommended minimum distances from walls and/ or vertical obstacles, there could be a combination of warm air recirculation and/or insufficient supply to the air-cooled condenser which could cause a reduction of capacity and efficiency.

When two or more units are positioned side by side, a distance of at least 3600 mm between condenser coils is recommended.

In any case, the microprocessor will allow the unit to adapt to the new condition producing the maximum available capacity (which would, however, lower than the nominal capacity of the unit) even with a lateral distance less than the recommended. When two or more units are positioned side by side, it is recommended that a minimum distance of 3600 mm of distance between the condenser coils.



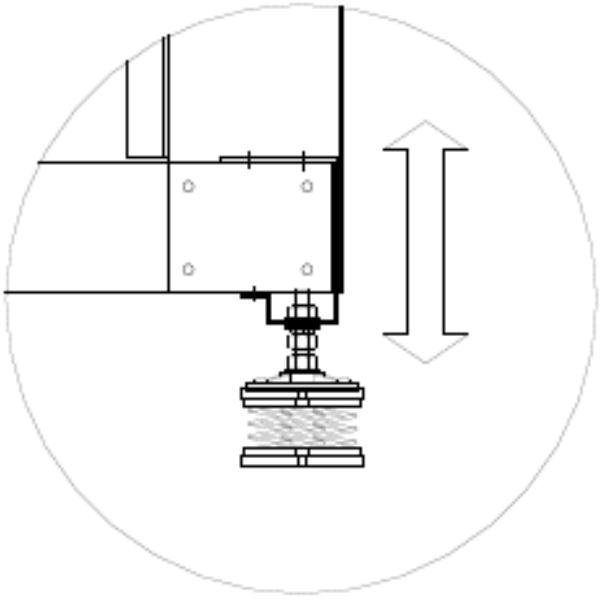
**Condensate**

The unit in order to easily discharge the condensate caused by the heat pump operation, especially during the defrosting cycle. Avoid the condensate drain in location where people transit.

**Anti-vibration**

In order to reduce the transmission of vibrations to the supporting structures, install and mount shock absorbers in every fastening point. Rubber shock absorbers are recommended for units installed on the ground, spring shock absorbers for units installed on roofs.

Screw nut and lock nut to adjust the proper leveling of the unit. The units positioned incorrectly can cause damage to the compressor to incorrect leveling of the oil.

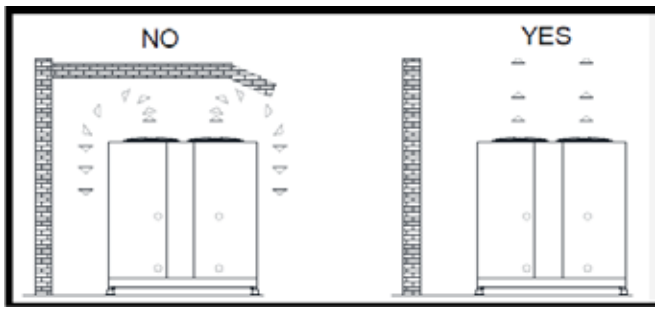


## 2.9 Installation

**Installation side selection**

Before installing the unit, agree with the customer the location where it will be placed, placing WARNING the following points:

- the foundation must be able to support the weight of the unit;
- safety distances between the unit and other equipment or structures to ensure that the air in and out from the fans is free to circulate.




**Positioning**

*Before handling the unit, verify the lifting capacity of the means respecting the information on the packaging. For handling the unit on horizontal base use forklift or other means in an adequate way paying attention on the unit weight. In case of lifting, insert bars in the proper holes of the unit base in order to permit the positioning of the lifting ropes and of the safety cotter pin.*

# Mechanical installation

*In order not to damage the unit structure by the belts, use proper protections to be put between the belts and the unit. Position the unit in the place indicated by the client by interposing between the base and the support, a gum mattress (thickness min. 10 mm.) or antivibration feet (optional). Fix the unit verifying that the base is plan and without inclinations.*

*Verify the easy access to the hydraulic and electric part. In case of installation in places where there could be gust, fixing the unit to the support properly using guy rope if needed.*

**Handling and positioning**

The units have been designed to be lifted from above by means of eyebolts and holes in the base frame.

Use retractor bars to keep the lifting wires or chains away from the unit.

Lifting procedures provided with the unit have to be respected.

**Precautions for dominant winds**

Avoid obstacles on suction and discharge sides of the units. Respect the servicing spaces as shown on the units dimensional drawings.

In case of presence of dominant winds in the installation area it is strictly necessary to avoid (for units with horizontal flow fans) that such winds blow in front of the unit (fans discharge side). In case of unit with vertical flow fans it is strictly necessary to avoid installations where the dominant winds could cause rejected hot air to come back to the condensing coils.

If needed, install windbreak barriers (in this case contact our offices).

**Precautions against direct sunshine**

The direct sunshine can raise the condensation temperature and it causes the unit stopping or the missing set-up because of the high-pressure switch intervention.

**Precautions against chimney and hot air discharge**

Avoid the unit installation lee side near chimney and liquid and gas discharge.

## 2.10 Safety regulations

**Preamble.**

All Trane units are designed, built and inspected in compliance with the European Community Directives n° 98/37/CE (three phase power supply), EN 60335 Part 1 and 2 , low voltage directive 73/23CEE, electromagnetic compatibility directive EMC 89/336CEE, Pressure Equipment Directive 97/23/CEE. Before using the unit read carefully the recommendations reported in the following manual.

**Definition**

Owner:

The legal representative of the company, body or natural person who owns the plant in which the Trane unit is installed: he or she is responsible for the control and respect of all the safety regulations indicated in this manual as well as the national ones in force. :

Installer:

The legal representative of the company appointed by the owner to position and hydraulically, electrically etc. connect the Trane unit to the plant: he or she is responsible for handling and the correct installation of the unit in accordance with the indications in this manual and with the national regulations in force. :

Operator:

A person authorised by the owner to carry out all the operations of regulation and control on the Trane unit which are specifically mentioned in this manual. He or she should keep to actions described in the manual and limit his or her action to what is explicitly allowed.

Technician:

A person who is directly authorised by Trane or, secondarily, for all EU countries except for Italy, by the distributor of the Trane product, under their own responsibility, to carry out all ordinary or extraordinary maintenance operations, as well as regulations, controls, repairs and parts repositioning which may be necessary during the lifetime of the unit.

**Access to dangerous areas**

The access to the unit dangerous areas is usually obstructed through protection panels, which are removable, by using a tool. Axial fans are protected with accident prevention grilles. Centrifugal fans are not protected on the discharge, as they have to be connected to ducts. In case they have to run without ducts, it is the installer duty to provide protection grilles.

Finned coil, for units not equipped with coil protection grilles, is completely accessible with danger for cuts and abrasions. In these cases technicians and operators must be aware about this risk.

For all the units which allow access to the cooling piping or to the packaged condensing coils with fins, without security gratings (optional) or closing panelling, the following precautions must be taken:

- mark the areas with contact risks;
- apply warning signs.

The danger zone must be of a suitable size to avoid any contact, even accidental contact.

In the presence of safety valves without relevant remote controls, the operating area must be of a size which considers a range of action of the discharge flow of 3 metres.

Trane declines any responsibility for damage to things and unauthorised personnel in case of absence of clear and static limiting systems of the risk areas and of the relevant warning and danger signs.

## 2.11 General precautions

The operator must only intervene on the unit commands; he or she must not open any panels except for the one which gives access to the command module.

The installer must only intervene on the connections between the plant and the unit; he or she must not open any unit panels nor carry out any commands.

The following precautions should be made when approaching or working on the unit:

- do not wear jewellery, baggy clothes or any other accessory which can get caught up;
- use appropriate protection (gloves, glasses etc.) when using an open flame (welding) or compressed air;
- if the unit is located in a closed environment, wear hearing protection;
- before disconnecting, rehandling tubes, filters, joints or other line parts intercept the connection tubes, empty them until the pressure reaches that of the atmosphere;
- do not use your hands to check for possible pressure losses;
- always use tools which are in good condition; make sure the instructions have been fully understood before using them;
- make sure that any tools, electrical cables or other loose objects have been removed before closing the unit and starting it up again.

***Precautions against risks due to the refrigerant***

| **Safety data** | |
|---|---|
| **Toxicity** | Not important |
| **Risks for skin touching** | Splashes or sprinkles can cause chill burns. The risk of absorptions through the skin is not relevant. |
| | Those refrigerants could take some lightly irritating effects and in liquid stage they have a strong skinning effect. In this case it is necessary to rinse with fresh water the contaminated parts of the skin. |
| | The refrigerant in liquid stage in contact with wet clothes cause freezing and adherence to the skin. In this case it is necessary to put off the contaminated clothes to avoid freezing. Please contact a doctor in case of irritation of the contaminated parts. |
| **Risks for contact with the eyes** | Vapors don't take any effect. Splashes or sprinklers can cause chill burns. In those cases it is necessary to rinse the eyes with water or with solution for ocular washings for 10 minutes. The intervention of a doctor is needed. |
| **Risks for ingestion** | Should it happen, it causes chill burns. It does not cause vomiting. The person must be kept awake. It is needed to rinse the mouth with fresch water and to drink almosto 0,25 liters. The intervent of a doctor is needed. |
| **Risks for inhalation** | High concentration of vapours in air can lead to anaesthetic effects up to a loss of conscience. Long exposures could give rise to cardiac arrhythmia and sometimes even to death. |
| | High concentrations can create a reduction of oxygen in air, with consequent possibility of suffocation. Should it happen the person must be taken to the open air and let him to take a rest. |
| | Administer oxygen if needed. In case the breathing has interrupted or become irregular, it is necessary to apply the artificial breathing. In case of cardiac arrest a heart massage must be applied. Contact a doctor immediately. |
| **Conditions to avoid** | Use in presence of exposed flames, and of elevates levels of humidity. |
| **Dangerous reactions** | Possibility of violent reactions with the sodium, the potassium, the barium and with other alkaline substances, incompatible materials and all the alloys containing more than 2% of magnesium. |
| **Protection wearing - Behavior in case of losses or escapes** | Wear protection apparel and self respirators. Insulate the source of the loss, if this operation can be done in safety conditions. Small quantitative of refrigerant escaped at liquid state can be allowed to evaporate only if the room is well ventilated. In case of great losses ventilate the room immediately. Plug the loss with sand, soil or other absorbent material; avoid that the liquid refrigerant can enter in water-drainages or losing pools. |
| **Disassambly** | The best procedure is the recovery and the recycle. If this is not possible the refrigerant must be conferred to an accredited system for its destruction in order to neutralize acid and toxic by-products. |

# Mechanical installation

***Precautions against residual risks***

Prevention from risks due to the command system

- make sure the instructions for use have been understood before carrying out any work on the control panel;
- always keep the instruction manual close at hand when working on the control panel;
- start up the unit only after having certified that it is correctly connected to the plant;
- inform the technician promptly of any alarms which appear on the unit;
- do not reset the alarms to manual restart without having first identified the cause and removed it.

***Prevention against residual mechanical risks***

- install the unit in accordance with the provisions of the following manual;
- carry out all the maintenance operations provided for by this manual regularly;
- wear a protective helmet before entering inside the unit;
- before opening a unit panel make sure that it is firmly connected by means of a hinge;
- do not touch the air condensation coils without having first put on protective gloves;
- do not remove the protections to the handling parts while the unit is running;
- before restarting the unit make sure that the handling part protections are in the correct position.

***Prevention against residual electrical risks***

- connect the unit to the mains in accordance with the provisions of this manual;
- carry out all maintenance operations regularly;
- before opening the control panel disconnect the unit from the mains by means of the external knife switch;
- check that the unit has been earthen correctly before starting it up;
- control all the electrical connections, the connection cables paying particular attention to the state of isolation; replace the cables which are clearly worn or damaged;
- carry out periodic checks of the wiring inside the panel;
- do not use cables with an inappropriate section or flying connections not even for a limited period or in an emergency.

***Prevention against residual risks of a different nature***

- the residual risk due to pressure are mainly coming from non funtioning of the safety devices. To prevent them it is necessary to follow the checks and repositionings as following indicated (§12.1 and 13);
- to protect from safety devices exhausting it is not allowed to remove the protections while the unit is in operation and to approach the unit without wearing the right protections. In case of accidental contact with refrigerant due to the safety valves exhaust it is necessary to follow the above indicated (§2.5);
- carry out the plant connections to the unit by following the indications reported on the following manual and on the panels of the unit itself;
- if a part is disassembled, make sure that it is correctly reassembled before restarting the unit;
- do not touch the discharge line of the compressor, the compressor itself or any other tube or component which is inside the unit without putting on protective gloves;
- keep a fire extinguisher which is able to put out fires on electrical equipment near the unit;
- on units installed inside, connect the refrigerant circuit shut off valve to a network of tubes which are able to lead the possible spillage of refrigerating fluid outside;
- eliminate any fluid loss inside or outside the unit;
- collect the discharge liquid and clean up any possible oil leakage;
- periodically clean the compressor casing of the accumulated dirt deposits;
- do not keep inflammable liquids near the unit;
- do not dispose of the refrigerant fluid and the lubricating oil in the environment;
- welding should only be carried out on empty tubes; do not approach the tubes containing refrigerant fluid with flames or other sources of heat;
- do not bend or strike tubes containing pressurised fluids.

Also always take the following precautions:

***Precautions to be observed during maintenance operations***

Authorised technicians may only carry out maintenance operations.

Before carrying out any maintenance the following must be performed:

- isolate the unit from the mains electricity by using the external knife switch;
- place a notice on the external knife switch which says “do not use - maintenance in progress”;
- make sure that any possible on-off commands are disabled;
- use appropriate safety equipment (helmet, isolating gloves, protective glasses, safety shoes etc.).

If measurements or controls must be carried out which require the unit to be running the following observations must be followed:

- operate with the electrical panel open for as short a time as is possible;
- close the electrical panel as soon as the individual measurement or control has been carried out;
- for units which are located outside, do not carry out interventions in dangerous atmospheric conditions such as rain, snow, fog etc.

The following precautions should also be taken at all times:

- never dispose of fluids contained in the refrigerant circuit into the environment;
- when replacing an EPROM or electronic card always use appropriate equipment (extractor, anti static bracelet, etc.);
- if a compressor, the evaporator, the condensation coils or any other heavy part is to be replaced, make sure that the lifting equipment matches the weight to be lifted;
- in the air cooled units with an independent compressor compartment, do not open the ventilator compartment without having first isolated the unit using the knife switch on the side of the panel and only after having placed a sign which says “do not use - maintenance in progress”;
- if modifications must be carried out to the cooling, hydraulic or electrical circuit of the unit, as well as to its command logic, contact Trane;
- if particularly complicated assembly or disassembly operations are to be carried out contact Trane;
- always use original spare parts bought directly from Trane or from official dealers of the companies reported in the list of recommended spare parts;
- if the unit is to be moved after a year of being in the site or if it has to be dismantled contact Trane.

***Precautions against foliage and external body***

Avoid the unit installation nearby plants which could obstacle the correct air charge and discharge.

**Warning**

Do not use forklift trucks to lift the unit from below.

If equipment for lifting from above is not available, using rollers may move the unit.

The surface on which the unit is placed must be flat and strong enough to withstand the weight of the unit while running.

In order to reduce the transmission of vibrations to the supporting structures, fit shock absorbers in every fastening point. Rubber shock absorbers are recommended for units installed on the ground, spring shock absorbers for units installed on roofs. Open spaces around the unit must be provided for in order to allow for the passage of necessary airflow and in order to allow normal maintenance to be carried out (as shown on general catalogues).

ATTENTION: in case two units have to be installed side by side, the distance of respect must be doubled.

# Mechanical installation

***Precaution against frost risk of the hydraulic pipes***

It is necessary to insulate pipes in the plant to avoid extreme heat loss and to protect them from weather conditions. The problem of wather pipes freezing could appear in two different situations:

- Unit standby, with mode on, but electrically connected: in this case, the unit has frost resistances, which protect the wather locally contained in the exchangers and in the pipes from ice formation. These resistances do not guarantee the protection against the frost in the outdoor connection pipes, to be prevent by frost protection systems. Trane suggest to insert frost thermostatic resistances on every outdoor pipes. In the following table there are the indicative electric power per pipe linear meter:

| dn | inch | W/mt |
|---|---|---|
| 8 | 1/4" | 5 |
| 10 | 3/8" | 5 |
| 15 | 1/2" | 5 |
| 20 | 3/4" | 10 |
| 25 | 1" | 13 |
| 40 | 1" 1/2 | 30 |
| 50 | 2" | 50 |
| 65 | 2" 1/2 | 80 |
| 80 | 3" | 120 |
| 100 | 4" | 200 |
| 125 | 5" | 300 |
| 150 | 6" | 450 |
| 200 | 8" | 750 |

- Electrically unconnected unit: in this case the frost resistances of the unit could not guarantee the protection. So it is absolutely necessary unload the unit content for A.C.S., instead for air conditioning it is necessary to add the correct glycol quantity indicated in the chapter: “ethylene glycol correction table”.

***Precaution for very low outdoor temperature***

In case of installation conditions with a lower temperature:

6. If there are storages, insert electric resistances to be calculated by :

$$Pr_{Watt} = V \times (10 - tmin) / 860$$

where: PrWatt is the resistance power (Watt) and tmin is the lower temperature (°C)

7. If there are not storages, maintain the temperature higher than 10°C the water temperature by inserting thermostatic resistance with power calculated as in case 1.

**Control of compressor fastening**

The compressors are fitted on shock absorbers. After receiving the unit check if there are blockages to fasten the compressors during the transportation. If there are, it is necessary to remove blockages put to fasten the compressors feets before the start-up otherwise the warranty is not valid.

**Acoustic Protections**

When the sound level must be checked in particular, it is necessary to pay maximum WARNING in isolation from the base of the unit properly applying the anti-vibration mounts (provided optionally). Also, install flexible joints on water connections.

## 2.12 Water piping

Piping must be designed with the lowest number of curves and the lowest number of vertical changes of direction. In this way, installation costs are reduced considerably and system performance is improved.

The hydraulic system should have:

1. Anti-vibration supports in order to reduce transmission of vibrations to the underlying structure.
2. Sectioning valves to isolate the unit from the hydraulic system during servicing.
3. Manual or automatic air bleeding device at the system’s highest point. Drainage device at the system’s lowest point. Both the evaporator and the heat recovery device must not be positioned at the system’s highest point.
4. A device that can maintain the hydraulic system under pressure (expansion tank, etc.)
5. Water temperature and pressure indicators on the unit to aid servicing and maintenance operations.
6. A filter or device that can remove extraneous particles from the water before it enters the pump (Please consult the pump manufacturer’s recommendations for an appropriate filter to prevent cavitation). Use of a filter prolongs the life of the pump and helps keep the hydraulic system in best condition.
7. Another filter must be installed on the pipe conveying inlet water to the unit, near the evaporator and heat recovery heat exchanger (if installed). The filter avoids solid particles entering the heat exchanger, as this could damage it or reduce its heat exchanging capacity.
8. All the other hydraulic piping outside the unit must be sufficiently protected against freezing.

9. If the unit is installed in order to replace another, the entire hydraulic system must be emptied and cleaned before the new unit is installed. Regular tests and proper chemical treatment of water are recommended before starting up the new unit.
10. In the event that glycol is added to the hydraulic system as anti-freeze protection, pay attention to the fact that intake pressure will be lower, the unit's performance will be lower and water pressure drops will be greater. All unit-protection methods, such as anti-freeze, and low-pressure protection will need to be reset. Before insulating water piping, check that there are no leaks.

**WARNING!**

Install a mechanical water filter at the water inlet of each heat exchanger. Failure to install the filter allows access of solid particles and / or welding slag inside the heat exchanger. We recommend the installation of a filter having a filtering net with holes not exceeding 0.5 mm in diameter.

Trane can not be held responsible for any damage to heat exchangers due to the lack of good quality water filters.

## 2.13 Water treatment

Before putting the unit into operation, clean the hydraulic circuit. Dirt, scales, corrosion residue and other extraneous material can accumulate inside the heat exchanger and reduce its heat exchanging capacity. Pressure drops can increase, as well, thus reducing water flow. Proper water treatment therefore reduces the risk of corrosion, erosion, scaling, etc. The most appropriate water treatment must be determined locally, according to the type of system and to the local characteristics of the process water.

Trane is not responsible for damage to or malfunctioning of equipment caused by failure to treat water or by improperly treated water.

***Table - Acceptable water quality limits***

| | | | |
|---|---|---|---|
| PH (25°C) | 6,8÷8,0 | Total Hardness (mg $CaCO_3$ / l) | < 200 |
| Electrical conductivity S/cm (25°C) | < 800 | Iron (mg Fe / l) | < 1.0 |
| Chloride ion (mg Cl - / l) | < 200 | Sulfur ion (mg $S_{2-}$ / l) | None |
| Sulphate ion (mg $SO_{24-}$ / l) | < 200 | Ammonium ion (mg $NH_{4+}$ / l) | < 1.0 |
| Alkalinity (mg $CaCO_3$ / l) | < 100 | Silica (mg $SiO_2$ / l) | < 50 |

## 2.14 Antifreeze protection on the heat exchangers

**Evaporator and recovery exchangers anti-freeze protection**

Two or more protection methods should be foreseen when designing the system as whole:

1. Continuous water flow circulation inside piping and exchangers.
2. Addition of an appropriate amount of glycol inside the water circuits.
3. Additional heat insulation and sufficient heating of exposed piping.
4. Emptying and cleaning of the heat exchangers during the winter season.

It is the responsibility of the installer and/or of local maintenance personnel to ensure two or more of the described antifreeze methods. Continuously verify, through routine checks, that appropriate anti-freeze protection is maintained.

Failure to follow the instructions above could result in damage to some of the unit's components. Damage from freezing is not covered by the warranty.

**CAUTION:** The unit water pipes are not protected against the risk of water freeze-up when the unit is not electrically powered and when the power and control of the external water pumps is not managed by the CMAB unit controller. The owner or local maintenance personnel must provide appropriate solutions to prevent freezing.

The desuperheater hot water side on 6-pipe units is not protected from freezing.

# Mechanical installation

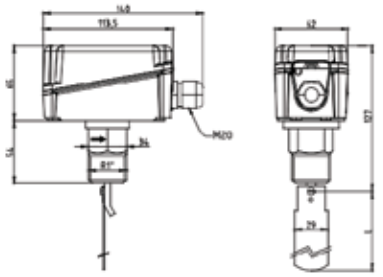
## 2.15 Flow switch installation

To ensure adequate water flow through the evaporator, it is essential to install a flow switch on the water circuit. The flow switch may be either installed on both the inlet pipe of the water on that output. The purpose of the flow switch is to stop the unit in case of an interruption of the water flow while protecting the evaporator from freezing. Install a flow switch on the heating water circuit to ensure adequate water flow through the recovery heat exchanger. The flow on recovery circuit prevents shutting down the unit for high pressure.

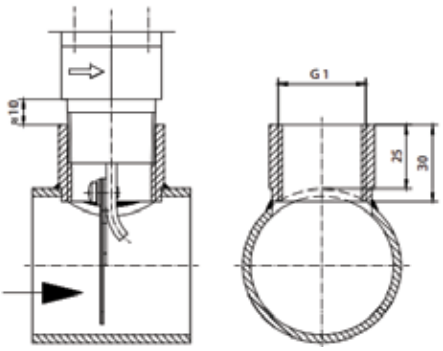
The flow switches can be mounted in any position far from elbows or bottlenecks and with the arrow in the direction of flow. For installations on vertical piping is necessary to calibrate the device to compensate for the weight of the headstock. If the unit is mounted to the bottom, we must make WARNING deposits that can form. The appliance must be installed in a straight pipe with no filters, valves, etc.., Have at least 5 times its diameter, both upstream and downstream.

Blade type flow switches are available as loose accessories and are suitable for harsh environments and for pipes with diameters from 1" to 8". The flow switch has a contact which must be wired, by the contractor, on the jobsite. Check the unit wiring diagram for more information. See the instruction sheet inside the flow switch box for information about positioning and settings.

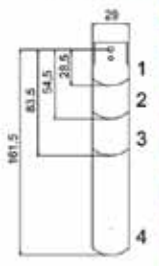
Dimensions (mm)



Mounting instructions




Paddle (model without "T" piece)




| TUBAZIONE | PALETTE |
|---|---|
| 1" | 1 |
| 11/4" | 1 |
| 11/2" | 1 |
| 2" | 1,2 |
| 21/2" | 1,2 |
| 3" | 1,2,3 |
| 4" | 1,2,3 |
| 4" Z | 1,2,3,4 |
| 5" | 1,2,3 |
| 5" Z | 1,2,3,4 |
| 6" | 1,2,3 |
| 6" Z | 1,2,3,4 |
| 8" | 1,2,3 |
| 8" Z | 1,2,3,4 |

Electrical connection

Connect to the contact to the white and red of the microswitch (fig. 1). The red-white contact opens when the flow drops below the set value. In the absence of flow the contact red-blue closes and can be used as a contact signal or alarm.

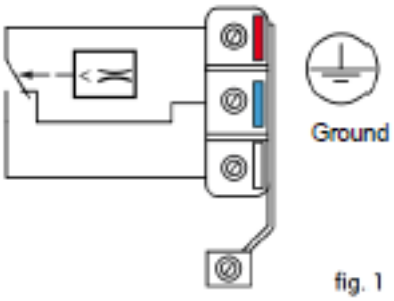



fig. 1

Screw for load control

Note

The flow switch is available as loose accessory. It must be calibrated in accordance to the water pipe diameter of the system. The cut-out value must be >= the minimum flow necessary to ensure the protection of the system.

**WARNING!**

In case the unit is used as a minimum flow controller must be placed downstream of a further control device for the activation of the alarm condition.

**Installing the filter**

To ensure proper operation of the heat exchanger, it is mandatory to install a water filter on the input of the evaporator near the unit (max 2 meters). The component is required and must be mounted before making circular adequate flow of water through.

# Mechanical installation

## 2.16 Hydraulic data

### MINIMUM AND MAXIMUM WATER FLOW AND RECOMMENDED WATER CONTENT

| Model | Chilled water heat exchanger | | | | Hot water heat exchanger | | | |
|---|---|---|---|---|---|---|---|---|
| | V [$m^3$] | K | Q min [$m^3/h$] | Q max [$m^3/h$] | V [$m^3$] | K | Q min [$m^3/h$] | Q max [$m^3/h$] |
| **75** | 0.6 | 142.2 | 7.2 | 19.2 | 1.8 | 137.9 | 8.1 | 21.5 |
| **100** | 0.8 | 44.5 | 10.0 | 26.7 | 2.5 | 43.3 | 11.0 | 29.3 |
| **120** | 0.9 | 44.4 | 11.6 | 30.8 | 3.0 | 42.7 | 12.9 | 34.5 |
| **135** | 1.1 | 24.2 | 13.5 | 36.0 | 3.4 | 23.4 | 14.9 | 39.7 |
| **150** | 1.2 | 24.1 | 14.6 | 38.8 | 3.7 | 23.2 | 16.1 | 42.8 |
| **165** | 1.3 | 23.8 | 16.3 | 43.3 | 4.1 | 22.9 | 18.0 | 48.0 |
| **185** | 1.4 | 23.6 | 17.9 | 47.7 | 4.6 | 22.7 | 20.0 | 53.3 |
| **225** | 1.7 | 23.3 | 21.3 | 56.8 | 5.5 | 22.3 | 24.1 | 64.2 |
| **255** | 2.0 | 17.4 | 24.9 | 66.3 | 6.4 | 16.7 | 27.9 | 74.3 |
| **75 S** | 0.6 | 143.0 | 6.9 | 18.4 | 1.8 | 137.3 | 7.8 | 20.9 |
| **100 S** | 0.8 | 44.8 | 9.7 | 25.8 | 2.5 | 43.1 | 10.7 | 28.6 |
| **120 S** | 0.9 | 44.3 | 11.1 | 29.6 | 2.9 | 42.6 | 12.5 | 33.4 |
| **135 S** | 1.0 | 24.2 | 13.1 | 34.9 | 3.3 | 23.4 | 14.5 | 38.7 |
| **150 S** | 1.1 | 24.1 | 14.2 | 37.8 | 3.6 | 23.2 | 15.6 | 41.7 |
| **165 S** | 1.3 | 23.8 | 15.8 | 42.1 | 4.0 | 22.9 | 17.6 | 46.8 |
| **185 S** | 1.4 | 23.6 | 17.2 | 45.9 | 4.4 | 22.7 | 19.4 | 51.9 |
| **225 S** | 1.6 | 23.2 | 20.5 | 54.8 | 5.4 | 22.3 | 23.4 | 62.5 |
| **255 S** | 1.9 | 17.4 | 23.8 | 63.6 | 6.2 | 16.7 | 27.1 | 72.2 |

**V:** **recommended water content of the plant (chilled water side and hot water side) with dT 5°C on the heat exchanger**

**Q min:** **minimum water flow to the heat exchanger**

**Q max:** **maximum water flow to the heat exchanger**

**$dpw = K \cdot Q^2 / 1000$**

$Q = 0{,}86\ P/\Delta T$

P: Heating or cooling capacity [kW]

$\Delta t$: $\Delta T$ at the heat exchanger (min = 3, max = 8) [°C]

Dpw: Pressure drop [kPa]

**Important:** In every working condition the variation of the water flow rate must be as low as possible. Variation must be less than 1% of the nominal flow rate per minute (see tables/curves in section 2.17)

## 2.17 HYDRAULIC VERSIONS

CMAB HSE units are also available in multiple hydraulic versions, characterized by complete kits of all major hydraulic components for an easier installation, with reduced time, cost and space.

The wide range of hydraulic versions available make the unit suitable for any type of installation

– 1 pump for chilled water circuit + 1 pump for hot water circuit, low head pressure

– 1 pump for chilled water circuit + 1 pump for hot water circuit, medium head pressure

– 1 pump for chilled water circuit + 1 pump for hot water circuit, high head pressure

– 2 pumps for chilled water circuit + 2 pumps for hot water circuit, low head pressure

– 2 pumps for chilled water circuit + 2 pumps for hot water circuit, medium head pressure

– 2 pumps for chilled water circuit + 2 pumps for hot water circuit, high head pressure

## Hydronic kit

Centrifugal pumps with 2 poles, available in low, medium or high head pressure.

Pumps with cast iron body and impeller entirely welded using laser technology. Three phase electric motor with IP55 protection and insulation class F, suitable for continuous service.

Series motors with higher efficiency IE3 technology.

- Differential pressure switch on exchanger
- Water discharge and shut-off valve
- Taps on pumps suction / delivery which allow the replacement of a damaged pump eliminating the plant shutdown differently from other types of common use
- Check valve (only for double pump versions)
- Relief valve
- Safety valve (operating pressure 6 bars for low/medium head pressure pump versions and 9 bars for high head pressure pump version).
- Water gauges
- Expansion vessel

The stand-by pump accessory is also available, including 2 additional pumps (one for the cold circuit and the other for the hot circuit) in standby mode to the first, equipped with the automatic changeover including also the pressure switch for the intervention of the second pump.

The pumps operate with the balance of the related working hours. In case of failure of one pump the controller in automatic switches on the additional pump. The control panel is equipped with fuses and contactor with thermal protection.

**HYDRONIC ACCESSORIES ON REQUEST**

- “Y” water strainer (sold separately), consists of body and stainless steel mesh, with replaceable filter through the inspection cap.
- Automatic water filling (sold separately).

# Mechanical installation

### LOW HEAD PRESSURE PUMP

### COOLING ONLY MODE

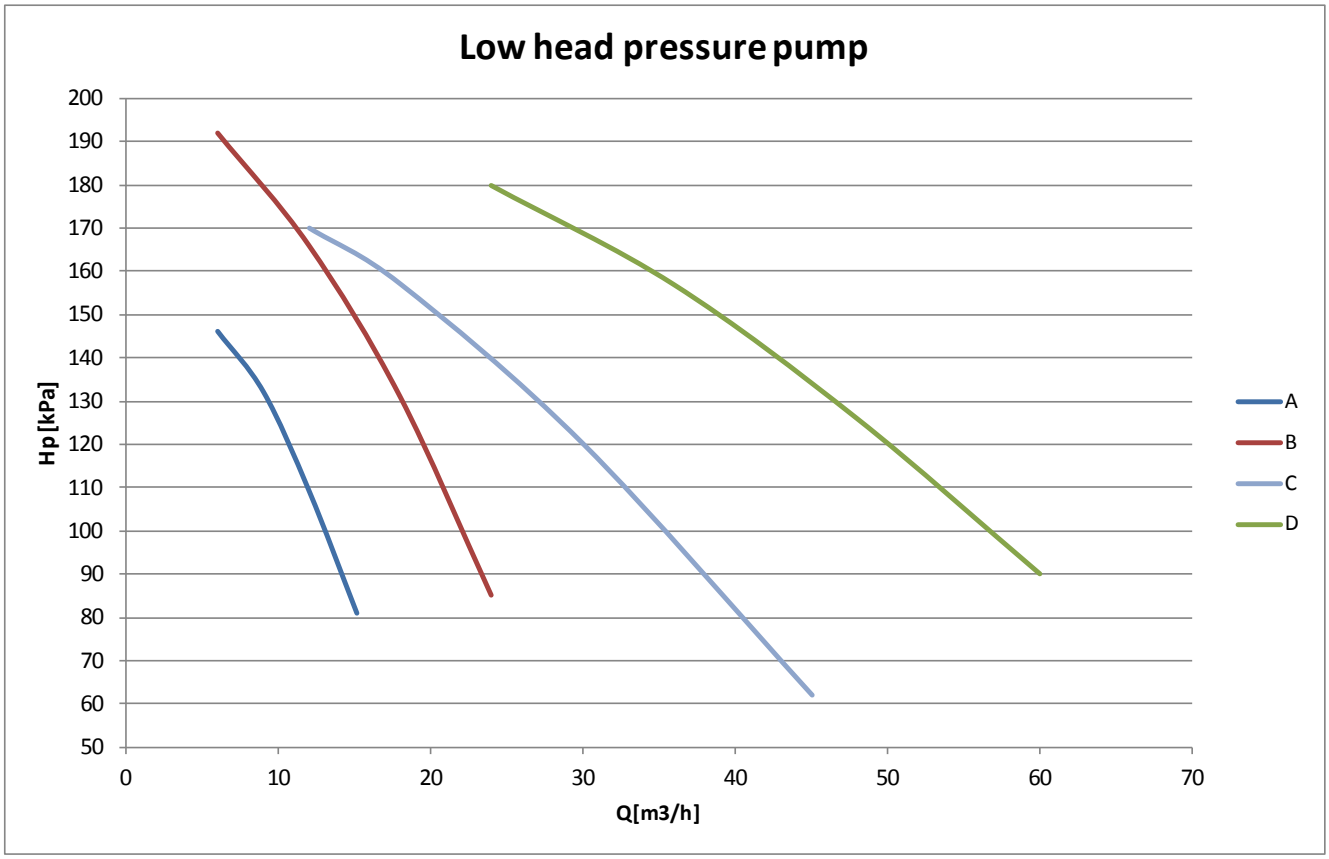
| Mod. | Pf | qw | dpw | Ref. Curve | Expansion vessel | F.L.I. | F.L.A. | Hp | Hu |
|---|---|---|---|---|---|---|---|---|---|
| | [kW] | [$m^3/h$] | [kPa] | | [l] | [kW] | [A] | [kPa] | [kPa] |
| **75** | 66.8 | 11.5 | 18.8 | A | 24 | 0.95 | 1.7 | 113 | 94 |
| **100** | 93.0 | 16.0 | 11.4 | B | 24 | 1.8 | 3.3 | 144 | 133 |
| **120** | 108 | 18.5 | 15.2 | B | 24 | 1.8 | 3.3 | 128 | 113 |
| **135** | 126 | 21.6 | 11.3 | C | 24 | 1.7 | 3.8 | 148 | 136 |
| **150** | 136 | 23.3 | 13.1 | C | 24 | 1.7 | 3.8 | 143 | 130 |
| **165** | 152 | 26.0 | 16.1 | C | 24 | 1.7 | 3.8 | 134 | 118 |
| **185** | 167 | 28.6 | 19.3 | C | 24 | 1.7 | 3.8 | 126 | 106 |
| **225** | 199 | 34.1 | 27.1 | D | 24 | 2.6 | 4.7 | 162 | 135 |
| **255** | 232 | 39.8 | 27.5 | D | 2 x 24 | 2.6 | 4.7 | 149 | 121 |

### HEATING ONLY MODE

| Mod. | Pt | qw | dpw | Ref. Curve | Expansion vessel | F.L.I. | F.L.A. | Hp | Hu |
|---|---|---|---|---|---|---|---|---|---|
| | [kW] | [$m^3/h$] | [kPa] | | [l] | [kW] | [A] | [kPa] | [kPa] |
| **75** | 74.2 | 12.9 | 23.0 | A | 24 | 0.95 | 1.7 | 101 | 78 |
| **100** | 101.2 | 17.6 | 13.4 | B | 24 | 1.8 | 3.3 | 134 | 121 |
| **120** | 119 | 20.7 | 18.3 | B | 24 | 1.8 | 3.3 | 112 | 94 |
| **135** | 137 | 23.8 | 13.2 | C | 24 | 1.7 | 3.8 | 141 | 128 |
| **150** | 148 | 25.7 | 15.3 | C | 24 | 1.7 | 3.8 | 135 | 120 |
| **165** | 166 | 28.8 | 19.0 | C | 24 | 1.7 | 3.8 | 125 | 106 |
| **185** | 184 | 32.0 | 23.2 | C | 24 | 1.7 | 3.8 | 114 | 91 |
| **225** | 221 | 38.5 | 33.0 | D | 24 | 2.6 | 4.7 | 152 | 119 |
| **255** | 256 | 44.6 | 33.1 | D | 2 x 24 | 2.6 | 4.7 | 136 | 103 |

Pf = Cooling capacity (kW)
Pt = Heating capacity (kW)
qw = Water flow ($m^3/h$)
dpw = Pressure drop (kPa)
F.L.I. = Full load electrical power
F.L.A. = Full load operating current
Hp = Pump head pressure
Hu = Available pump pressure

**LOW HEAD PRESSURE PUMP**



# Mechanical installation

### MEDIUM HEAD PRESSURE PUMP

### COOLING ONLY MODE

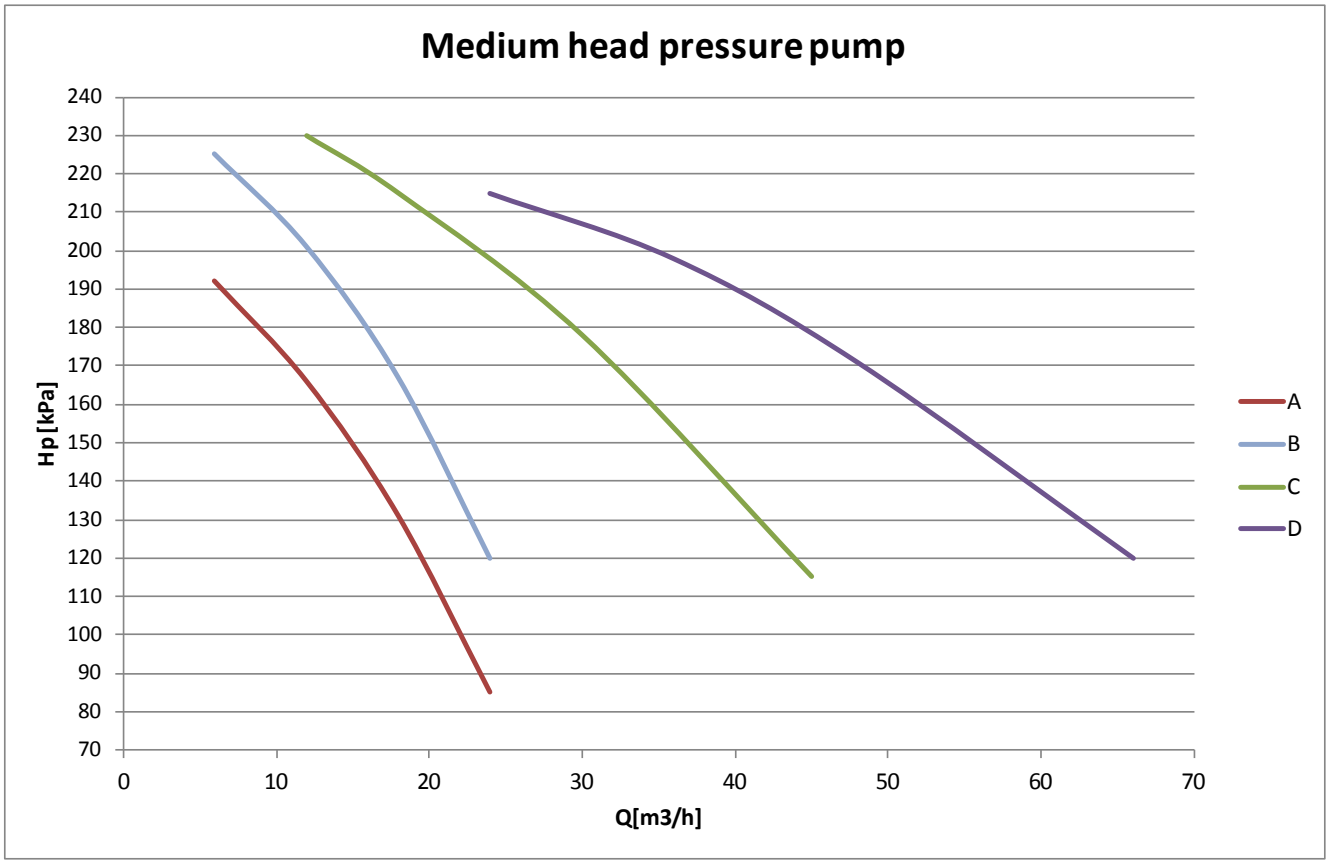
| Mod. | Pf | qw | dpw | Ref. Curve | Expansion vessel | F.L.I. | F.L.A. | Hp | Hu |
|---|---|---|---|---|---|---|---|---|---|
| | [kW] | [$m^3$/h] | [kPa] | | [l] | [kW] | [A] | [kPa] | [kPa] |
| **75** | 66.8 | 11.5 | 18.8 | A | 24 | 1.77 | 3.3 | 169 | 150 |
| **100** | 93.0 | 16.0 | 11.4 | B | 24 | 1.7 | 3.8 | 180 | 168 |
| **120** | 108 | 18.5 | 15.2 | C | 24 | 2.6 | 4.7 | 213 | 198 |
| **135** | 126 | 21.6 | 11.3 | C | 24 | 2.6 | 4.7 | 205 | 193 |
| **150** | 136 | 23.3 | 13.1 | C | 24 | 2.6 | 4.7 | 200 | 186 |
| **165** | 152 | 26.0 | 16.1 | C | 24 | 2.6 | 4.7 | 191 | 175 |
| **185** | 167 | 28.6 | 19.3 | C | 24 | 2.6 | 4.7 | 182 | 163 |
| **225** | 199 | 34.1 | 27.1 | D | 24 | 3.4 | 6.4 | 203 | 176 |
| **255** | 232 | 39.8 | 27.5 | D | 2 x 24 | 3.4 | 6.4 | 193 | 165 |

### HEATING ONLY MODE

| Mod. | Pt | qw | dpw | Ref. Curve | Expansion vessel | F.L.I. | F.L.A. | Hp | Hu |
|---|---|---|---|---|---|---|---|---|---|
| | [kW] | [m3/h] | [kPa] | | [l] | [kW] | [A] | [kPa] | [kPa] |
| **75** | 74.2 | 12.9 | 23.0 | A | 24 | 1.77 | 3.3 | 161 | 139 |
| **100** | 101.2 | 17.6 | 13.4 | B | 24 | 1.7 | 3.8 | 170 | 156 |
| **120** | 119 | 20.7 | 18.3 | C | 24 | 2.6 | 4.7 | 207 | 189 |
| **135** | 137 | 23.8 | 13.2 | C | 24 | 2.6 | 4.7 | 198 | 185 |
| **150** | 148 | 25.7 | 15.3 | C | 24 | 2.6 | 4.7 | 192 | 177 |
| **165** | 166 | 28.8 | 19.0 | C | 24 | 2.6 | 4.7 | 182 | 162 |
| **185** | 184 | 32.0 | 23.2 | C | 24 | 2.6 | 4.7 | 170 | 147 |
| **225** | 221 | 38.5 | 33.0 | D | 24 | 3.4 | 6.4 | 195 | 162 |
| **255** | 256 | 44.6 | 33.1 | D | 2 x 24 | 3.4 | 6.4 | 183 | 150 |

Pf = Cooling capacity (kW)
Pt = Heating capacity (kW)
qw = Water flow ($m^3$/h)
dpw = Pressure drop (kPa)
F.L.I. = Full load electrical power
F.L.A. = Full load operating current
Hp = Pump head pressure
Hu = Available pressure

**MEDIUM HEAD PRESSURE PUMP**



# Mechanical installation

### HIGH HEAD PRESSURE PUMP

### COOLING ONLY MODE

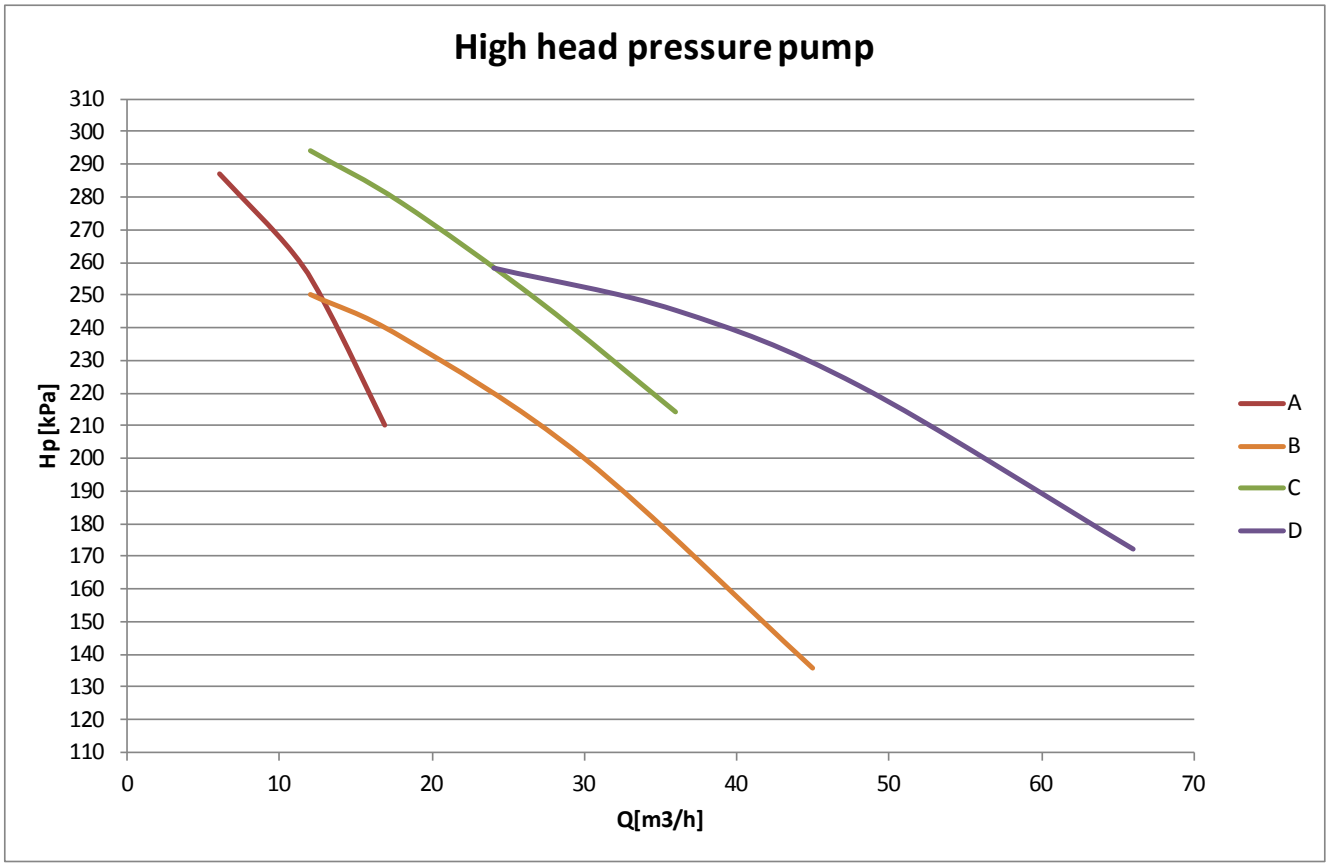
| Mod. | Pf | qw | dpw | Ref. Curve | Expansion vessel | F.L.I. | F.L.A. | Hp | Hu |
|---|---|---|---|---|---|---|---|---|---|
| | [kW] | [$m^3/h$] | [kPa] | | [l] | [kW] | [A] | [kPa] | [kPa] |
| **75** | 66.8 | 11.5 | 18.8 | A | 24 | 2.20 | 4.3 | 194 | 176 |
| **100** | 93.0 | 16.0 | 11.4 | A | 24 | 2.2 | 4.3 | 219 | 208 |
| **120** | 108 | 18.5 | 15.2 | B | 24 | 3.4 | 6.4 | 236 | 220 |
| **135** | 126 | 21.6 | 11.3 | B | 24 | 3.4 | 6.4 | 227 | 216 |
| **150** | 136 | 23.3 | 13.1 | B | 24 | 3.4 | 6.4 | 222 | 209 |
| **165** | 152 | 26.0 | 16.1 | C | 24 | 3.4 | 6.4 | 251 | 235 |
| **185** | 167 | 28.6 | 19.3 | C | 24 | 3.4 | 6.4 | 242 | 222 |
| **225** | 199 | 34.1 | 27.1 | C | 24 | 3.4 | 6.4 | 220 | 193 |
| **255** | 232 | 39.8 | 27.5 | D | 2 x 24 | 4.5 | 8.7 | 236 | 208 |

### HEATING ONLY MODE

| Mod. | Pt | qw | dpw | Ref. Curve | Expansion vessel | F.L.I. | F.L.A. | Hp | Hu |
|---|---|---|---|---|---|---|---|---|---|
| | [kW] | [$m^3/h$] | [kPa] | | [l] | [kW] | [A] | [kPa] | [kPa] |
| **75** | 74.2 | 12.9 | 23.0 | A | 24 | 2.20 | 4.3 | 187 | 164 |
| **100** | 101.2 | 17.6 | 13.4 | A | 24 | 2.2 | 4.3 | 203 | 189 |
| **120** | 119 | 20.7 | 18.3 | B | 24 | 3.4 | 6.4 | 230 | 211 |
| **135** | 137 | 23.8 | 13.2 | B | 24 | 3.4 | 6.4 | 221 | 207 |
| **150** | 148 | 25.7 | 15.3 | B | 24 | 3.4 | 6.4 | 215 | 199 |
| **165** | 166 | 28.8 | 19.0 | C | 24 | 3.4 | 6.4 | 241 | 222 |
| **185** | 184 | 32.0 | 23.2 | C | 24 | 3.4 | 6.4 | 229 | 205 |
| **225** | 221 | 38.5 | 33.0 | C | 24 | 3.4 | 6.4 | 203 | 170 |
| **255** | 256 | 44.6 | 33.1 | D | 2 x 24 | 4.5 | 8.7 | 226 | 192 |

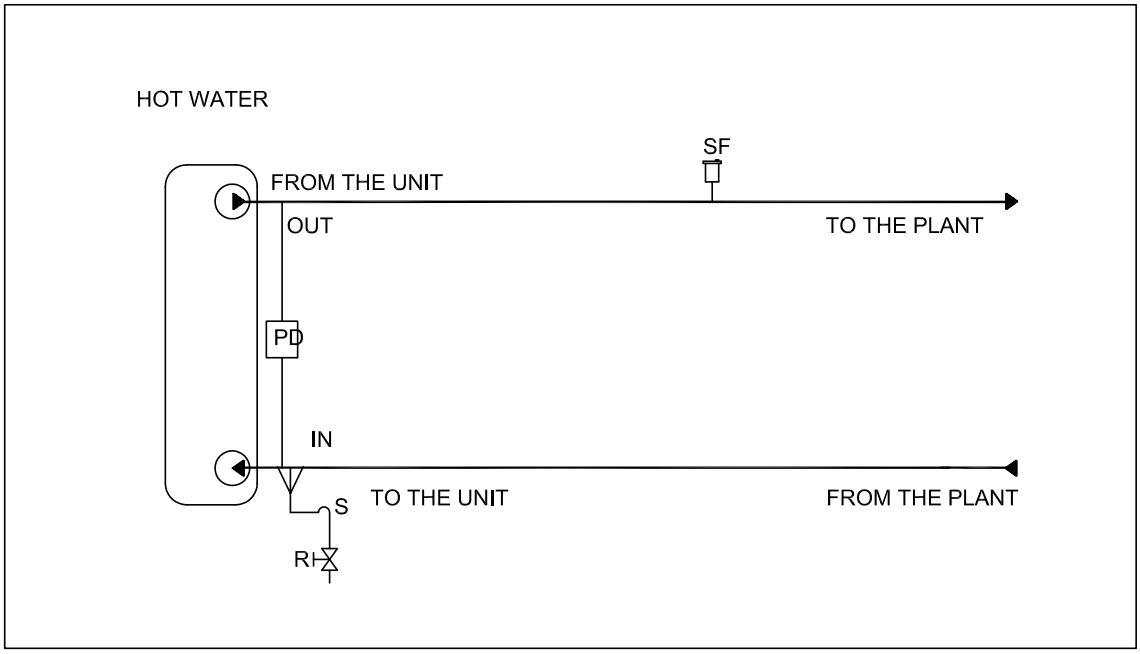
Pf = Cooling capacity (kW)
Pt = Heating capacity (kW)
qw = Water flow ($m^3/h$)
dpw = Pressure drop (kPa)
F.L.I. = Full load electrical power
F.L.A. = Full load operating current
Hp = Pump head pressure
Hu = Available pressure

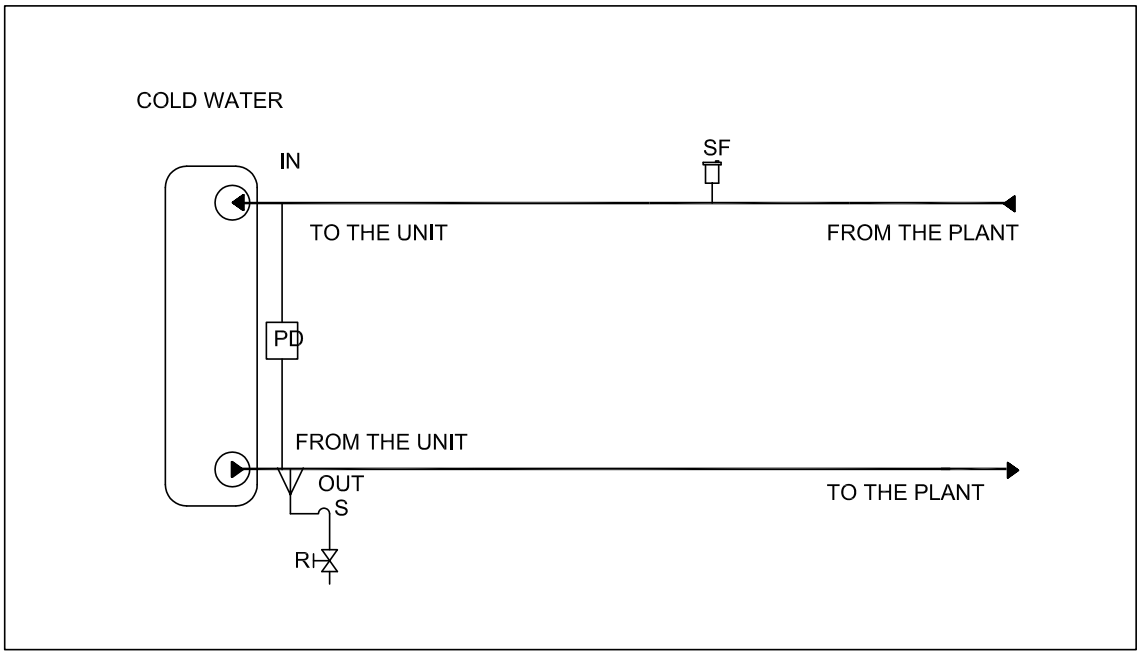
**HIGH HEAD PRESSURE PUMP**



# Mechanical installation

**UNIT HYDRAULIC CIRCUIT - NO PUMP VERSION**

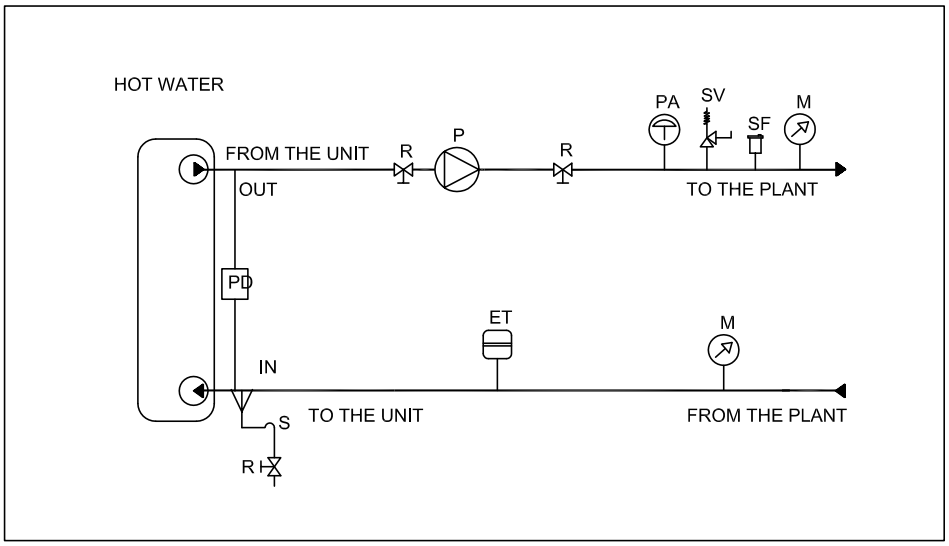


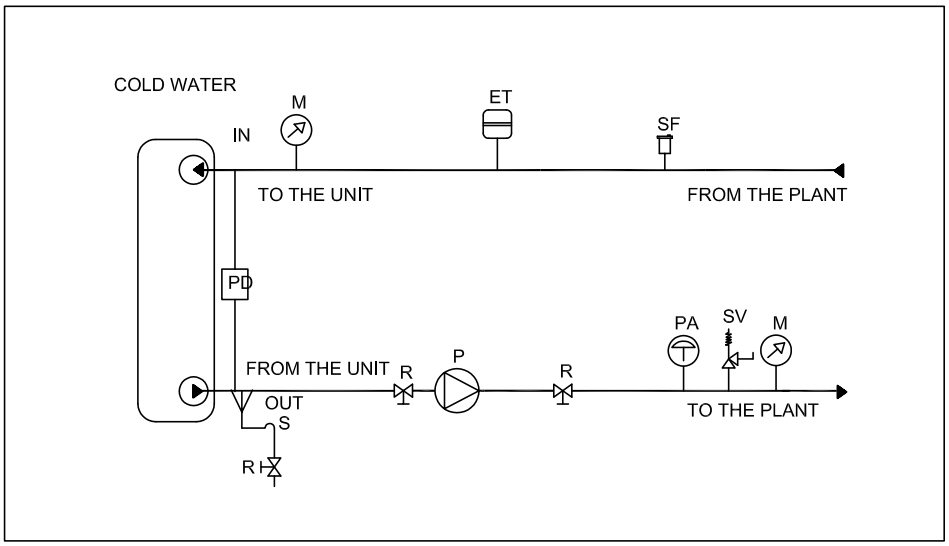




| | |
|---|---|
| S | Water discharge |
| SF | Relief valve |
| PD | Water differential pressure switch |
| R | Shut off valve |

**WARNING: Please check the installation sketches available in this manual showing the mandatory hydraulic accessories to be installed on the HVAC system and under customer responsibility.**

**UNIT HYDRAULIC CIRCUIT - 1 PUMP HOT WATER SIDE + 1 PUMP COLD WATER SIDE**



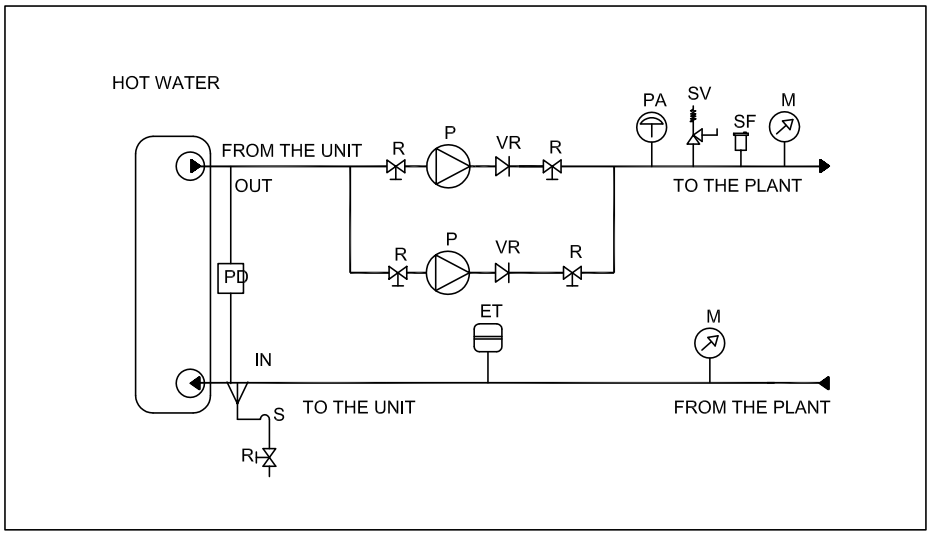



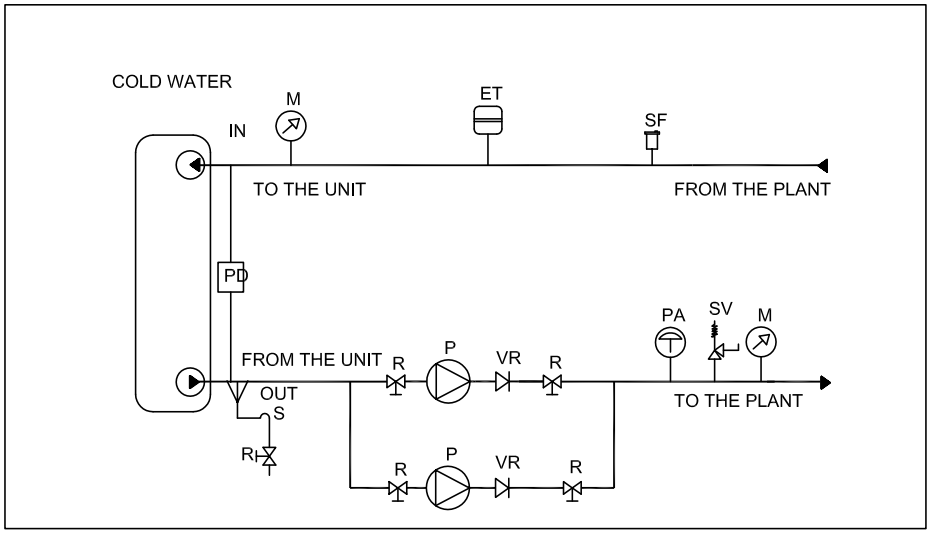

| | |
|---|---|
| M | Gauges |
| S | Water discharge |
| P | Pump |
| SV | Safety valve |
| SF | Relief valve |
| ET | Expansion vessel |
| PD | Water differential pressure switch |
| R | Shut off valve |
| PA | High pressure switch (optional)* |
| | * 4,6 bar - Low Head pressure |
| | * 5,4 bar - Medium Head pressure |
| | * 5,4 bar - High Head pressure |

**WARNING: Please check the installation sketches available in this manual showing the mandatory hydraulic accessories to be installed on the HVAC system and under customer responsibility.**

# Mechanical installation

**UNIT HYDRAULIC CIRCUIT - 2 PUMPS HOT WATER SIDE + 2 PUMPS COLD WATER SIDE**




| | |
|---|---|
| M | Gauges |
| S | Water discharge |
| P | Pump |
| SV | Safety valve |
| SF | Relief valve |
| ET | Expansion vessel |
| PD | Water differential pressure switch |
| R | Shut off valve |
| VR | Check valve |
| PA | High pressure switch (optional)* |
| | * 4,6 bar - Low Head pressure |
| | * 5,4 bar - Medium Head pressure |
| | * 5,4 bar - High Head pressure |

**WARNING: Please check the installation sketches available in this manual showing the mandatory hydraulic accessories to be installed on the HVAC system and under customer responsibility.**

## 2.18 Refrigerant circuit safety valves

Each system comes with safety valves that are installed on each circuit on the high pressure and low pressure side.

The purpose of the valves is to discharge the refrigerant inside the refrigerant circuit in the event of any malfunction.

**WARNING!**

This unit is designed for installation outdoors. However, check that there is sufficient air circulation around the unit.

If the unit is installed in closed or partly covered areas, possible damage from inhalation of refrigerant gases must be avoided. Avoid releasing the refrigerant in the environment.

The safety valves must be connected externally. The installer is responsible for connecting the safety valves to the discharge piping and for establishing their size.

## 2.19 Heat exchanger pressure drop

It is possible to use units with different flow rates from the nominal ones and consequently with different temperature differences from nominal. It is not recommended to operate the unit with thermal jumps too high, since very low water flow may cause the heat exchanger freezing with automatic exclusion of warranty. Too high water flow rates result in excessive water velocity and possible erosion / corrosion. In the first case low speed can lead to underperformance and easy scaling, and in the second case must install pumps with high prevalence energetically little valid.

## 2.20 Control and safety calibration

SCALING CORRECTION SCHEDULES

The following table provides information on the organs of action and safety of the unit. Always verify that the unit is within the limits imposed by pressure switches or pressure transducers and periodically check the calibration.

| | UM | open | close | value |
|---|---|---|---|---|
| **High pressure switch** | barg | 41 | 33 | - |
| **Low pressure switch** | barg | 2,2 | 3,4 | - |
| **Anrifreeze settings** | barg | - | - | 1 |
| **Low pressure safety valve** | barg | - | - | 24,5 |
| **High pressure safety valve** | barg | | | 45 |
| **N° start compressor max per hour** | N | | | 10 |

UM = measurement unit

**ETHYLENE GLYCOL CORRECTION SCHEDULE**

| % Ethylene glycol weight | | 5% | 10% | 15% | 20% | 25% | 30% | 35% | 40% |
|---|---|---|---|---|---|---|---|---|---|
| **Freezing temperature** | °C | -2 | -3,9 | -6,5 | -8,9 | -11,8 | -15,6 | -19 | -23,4 |
| **Suggested security limit** | °C | 3 | 1 | -1 | -4 | -6 | -10 | -14 | -19 |
| **Cooling capacity coefficient** | - | 0,995 | 0,99 | 0,985 | 0,981 | 0,977 | 0,974 | 0,971 | 0,968 |
| **Power input coefficient** | - | 0,997 | 0,993 | 0,99 | 0,988 | 0,986 | 0,984 | 0,982 | 0,981 |
| **Flow rate coefficient** | - | 1,003 | 1,01 | 1,02 | 1,033 | 1,05 | 1,072 | 1,095 | 1,124 |
| **Pressure drop coefficient** | - | 1,029 | 1,06 | 1,09 | 1,118 | 1,149 | 1,182 | 1,211 | 1,243 |

In order to calculate performance with glycoled solutions multiply main sizes by respective coefficients.

# Mechanical installation

## GLYCOL PERCENTAGE DEPENDING ON FREEZING TEMPERATURE

| % glycol according to the freezing temperature | | | | | | |
|---|---|---|---|---|---|---|
| **Freezing temperature** | **0°C** | **-5°C** | **-10°C** | **-15°C** | **-20°C** | **-25°C** |
| **% Ethylene glycol** | 5% | 12% | 20% | 28% | 35% | 40% |
| **Flow rate coefficient** | 1,02 | 1,033 | 1,05 | 1,072 | 1,095 | 1,124 |

In order to calculate performance with glycoled solutions multiply main sizes by respective coefficients.

## FOULING FACTOR CORRECTION TABLE

| **Fouling Factor** | **Plant side cold heat exchanger** | | | **Plant side hot heat exchanger** | | |
|---|---|---|---|---|---|---|
| **F.F. [m^2°C*W]** | **A1** | **B1** | **Tmin** | **A2** | **B2** | **Tmax** |
| 0 | 1,00 | 1,00 | 0,00 | 1,00 | 1,00 | 0,00 |
| 1,80E-05 | 1,00 | 1,00 | 0,00 | 1,00 | 1,00 | 0,00 |
| 4,40E-05 | 1,00 | 1,00 | 0,00 | 0,99 | 1,03 | 1,00 |
| 8,80E-05 | 0,96 | 0,99 | 0,70 | 0,98 | 1,04 | 1,50 |
| 1,32E-04 | 0,94 | 0,99 | 1,00 | 0,96 | 1,05 | 2,30 |
| 1,72E-04 | 0,93 | 0,98 | 1,50 | 0,95 | 1,06 | 3,00 |

A factor Capacity correction factor

B factor Compressor power input correction factor

Tmin Minimum evaporator outlet water temperature increase

T max Maximum condenser outlet water temperature decrease

# Electrical installation

**WARNING!**

All electrical connections to the unit must be carried out in compliance with laws and regulations in force.

All installation, management and maintenance activities must be carried out by qualified personnel.

Refer to the specific wiring diagram for the unit that you have purchased and which was sent with the unit. Should the wiring diagram not appear on the unit or should it have been lost, please contact your nearest Trane office, who will send you a copy.

**WARNING!**

Only use copper conductors. Failure to use copper conductors could result in overheating or corrosion at connection points and could damage the unit.

To avoid interference, all control wires must be connected separately from the power cables. Use different electrical passage ducts for this purpose.

**WARNING!**

Before servicing the unit in any way, open the general disconnecting switch on the unit's main power supply.

When the unit is off but the disconnecting switch is in the closed position, unused circuits are live, as well.

Never open the terminal board box of the compressors before having opened the unit's general disconnecting switch.

**WARNING!**

The units are equipped with electrical components non-linear high power (VFD power of the compressors, such as I, introduces higher order harmonics can cause a significant leakage ground (of the order of 2 A)

The protectors of the power supply system must take into account the value of the above mentioned.

# Electrical installation

## 3.1 Electrical data

**CMAB HSE**

| | NOMINAL VALUES Outdoor air temperature 35°C, evaporator water temperature in/out 12/7°C | | | | | | | | MAXIMUM VALUES (1) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Compressors | | | Fans | | TOTAL | | | TOTAL | | |
| Unit size | F.L.I. | F.L.A. | L.R.A. | E.P. | O.C. | F.L.I. | F.L.A. | S.A. | F.L.I. | F.L.A. | S.A. |
| | kW | A | A | kW | A | kW | A | A | kW | A | A |
| **75** | 22.2 | 34.6 | 46.9 | 2.94 | 14.2 | 25.1 | 48.8 | 78.4 | 45.8 | 89.2 | 98.6 |
| **100** | 28.2 | 44.5 | 55 | 4.9 | 23.6 | 33.1 | 68.1 | 100.8 | 55.2 | 111.6 | 122.6 |
| **120** | 35.3 | 57.4 | 98 | 4.9 | 23.6 | 40.2 | 81.0 | 161.7 | 72.9 | 142.6 | 203.1 |
| **135** | 38.2 | 62.9 | 142 | 6.0 | 12.0 | 44.2 | 74.9 | 200.1 | 82 | 145 | 249.5 |
| **150** | 41.0 | 55.8 | 76.3 | 6.0 | 12.0 | 47.0 | 67.8 | 116.2 | 75.7 | 134 | 149.3 |
| **165** | 49.2 | 79.7 | 147 | 9.0 | 18.0 | 58.2 | 97.7 | 222 | 93.6 | 166 | 269 |
| **185** | 56.3 | 90.6 | 197 | 9.0 | 18.0 | 65.3 | 108.6 | 282.3 | 103.4 | 183.2 | 336.2 |
| **225** | 67.4 | 102.6 | 215 | 9.0 | 18.0 | 76.4 | 120.6 | 306.6 | 120.2 | 212.6 | 376.6 |
| **255** | 77.8 | 114.4 | 260 | 9.0 | 18.0 | 86.8 | 132.4 | 359 | 135.9 | 240 | 438 |

**CMAB HSE Super Low Noise**

| | NOMINAL VALUES Outdoor air temperature 35°C, evaporator water temperature in/out 12/7°C | | | | | | | | MAXIMUM VALUES (1) | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Compressors | | | Fans | | TOTAL | | | TOTAL | | |
| Unit size | F.L.I. | F.L.A. | L.R.A. | E.P. | O.C. | F.L.I. | F.L.A. | S.A. | F.L.I. | F.L.A. | S.A. |
| | kW | A | A | kW | A | kW | A | A | kW | A | A |
| **75** | 23.5 | 34.9 | 46.9 | 2.1 | 9.9 | 25.6 | 44.8 | 74.3 | 45.8 | 89.2 | 98.6 |
| **100** | 29.5 | 44.9 | 55 | 3.4 | 16.5 | 32.9 | 61.4 | 93.9 | 55.2 | 111.6 | 122.6 |
| **120** | 37.5 | 57.8 | 98 | 3.4 | 16.5 | 40.9 | 74.3 | 154.8 | 72.9 | 142.6 | 203.1 |
| **135** | 39.8 | 63.3 | 142 | 4.2 | 8.4 | 44.0 | 71.7 | 196.8 | 82 | 145 | 249.5 |
| **150** | 43.0 | 56.3 | 76.3 | 4.2 | 8.4 | 47.2 | 64.7 | 112.8 | 75.7 | 134 | 149.3 |
| **165** | 51.4 | 80.3 | 147 | 6.3 | 12.6 | 57.7 | 92.9 | 217 | 93.6 | 166 | 269 |
| **185** | 59.3 | 91.2 | 197 | 6.3 | 12.6 | 65.6 | 103.8 | 277.3 | 103.4 | 183.2 | 336.2 |
| **225** | 71.2 | 103.4 | 215 | 6.3 | 12.6 | 77.5 | 116 | 301.8 | 120.2 | 212.6 | 376.6 |
| **255** | 82.7 | 115.3 | 260 | 6.3 | 12.6 | 89.0 | 127.9 | 354.3 | 135.9 | 240 | 438 |

**Electrical data referred to 400V - 3PH+N-50Hz**
Maximum operating admitted conditions: 10%
Maximum phase unbalance: 3%
F.L.I. full load electrical power with max thermal load
F.L.A. full load operating current with max thermal load
L.R.A. compressor motor locked rotor current (direct starting)
S.A. sum of LRA of the most powerful compressor, FLA of other compressor and fans current
E.P. electrical power
O.C. operating current

(1) Values to be considered in the sizing of the power cables and line protection

(2) Data referred to the biggest compressor for units with different compressors

## 3.2 Electrical components

All power and interface electrical connections are specified in the wiring diagram that is shipped with the unit.

The installer must supply the following components:

- Power supply cables (dedicated duct).
- Interconnection and interface cables (dedicated duct).
- Thermal-magnetic circuit breaker of suitable size (please see electrical data).

## 3.3 Electrical connections

**Power circuit:**

Connect the power supply wires directly to the terminals of the overall place in the framework of the unit. The access panel must be drilled depending on the section of the cable used and its gland. A flexible pipe containing the three supply phases plus ground can also be used.

Ensure total protection against the possible penetration of water into the connection point.

**Control circuit:**

The control circuit is powered with 24 VAC. Each unit is provided with auxiliary transformer control circuit 230/24V. It requires no additional power cable for the control equipment.

Only in the case where it is required to install a separate optional storage tank is necessary to feed separately antifreeze heater.

**Electric heaters**

The unit has an antifreeze heater installed directly into the evaporator. Each circuit also has an electric resistance installed in the compressor in order to keep warm the oil and thus avoid the transmigration of the refrigerant in its interior. Obviously the operation of the electrical resistors is guaranteed only if this constant power supply. If you can not leave the fed unit during the winter stop, apply at least two of the procedures described in the section "Installation - Mechanics" in "Frost protection of the evaporator and heat recovery exchangers."

**Alarm Relay – Electrical connections**

The unit is equipped with an alarm relay, which changes state every time an alarm occurs in one of the cooling circuits. Connect the terminals as per the wiring diagram on the unit - terminal "X" - a visual or audible alarm or any external supervision system.

**BMS to monitor its operation.** See the wiring of the unit for wiring.

**Remote On / Off unit - Electrical connection.**

The unit has a digital input that allows remote control of the unit as per the wiring diagram on the unit - terminal "X" -. This input can be connected to a clock start-up, a switch or a BMS. Once closed, the microprocessor starts the boot sequence before turning on the water pump and then the compressors. On opening the contact, the microprocessor starts the shutdown sequence of the unit. The contact must be clean.

**External reset of the setpoint of the water - Electrical connection (Optional)**

The setpoint of the unit can be varied via an external analog signal 4-20 mA.

The signal cable should be connected directly to the terminal strip "X" as per the wiring diagram. The signal cable should be shielded and not in the vicinity of the power cables to the electronic controller.

**End user electrical board connection - "X"**

Please refer to the wiring diagram provided with the unit.

## 3.4 Electrical Recommendations

**WARNING! Hazardous Voltage with Capacitor!**

Disconnect all electric power, including remote. Disconnect and discharge all motor start/run and capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized.

For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharges capacitors. Verify with an appropriate voltmeter that all capacitors have discharged.

DC bus capacitors retain hazardous voltages after input power has been disconnected. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized.

After disconnecting input power, wait 5 minutes for units which are equipped with EC fans and wait 20 minutes for units which are equipped with variable frequency drive (0V DC) before touching any internal components. Failure to follow these instructions could result in death or serious injury.

# Unit operation

**THE INTENDED PURPOSE OF MULTI-PIPE UNITS IS ONLY FOR COMFORT COOLING AND HEATING.**
**FOR ANY DIFFERENT REQUEST, PLEASE CONTACT TRANE TECHNICAL SUPPORT.**
**The regulation of the multi-pipe unit is ONLY made through proportional step according to the inlet water temperature. For technical reasons, the leaving water temperature control is not available.**

## 4.1 Operator responsibilities

It is important that the operator is properly trained and familiar with the equipment before working on the unit. In addition to reading this manual, the operator must study the manual operation of the microprocessor and the wiring diagram to understand the sequence of start-up, operation, shutdown sequences, and the criterion of operation of all safety devices. During the initial start-up of the unit an authorized technician is available to answer any questions and educate on the proper functioning. We recommend the operator to maintain a record of the operating data for each unit installed and all maintenance activities and periodic service. If the operator observes abnormal or unusual operating conditions, consult the authorized service technician.

## 4.2 Unit description

**CASING**

Casing made with heavy gauge galvanized steel. The powder paint anti-corrosive treatment on the entire frame provides long lasting resistance in outdoor installations, even in challenging air quality environments. Its design allows these units to be manufactured as modular units, ensures a constant air flow through the finned coils and makes for easy maintenance and service.

**COMPRESSORS**

Hermetic scroll compressors, characterized by high performances, reduced vibrations and low sound emissions. During operation, compression and pulsation are uniform, without alternative movements of pistons accompanied by masses or vibration forces to ensure low noise.

High COP values are guaranteed by high volumetric efficiency. During operation the compressor maintains a supply of power output with limited variations, guaranteeing continuous operation of the compressor with limited number of starts and stops compared to other types of compressors.

The inverter technology allows control and adapts the speed of the compressor to the set-point. Once the required temperature is reached, it is kept constant modulating the power delivered to a minimum, ensuring higher energy savings.

For this reason, it is possible to save energy while achieving the desired set-point faster. The temperature of the gas flow is significantly lower thanks to the limited internal heat of the gas aspirated. It allows you to work with reduced condensation pressures with more comfort and longer life cycle of the compressor.

The electric inverter motor, cooled by the refrigerant inlet, is equipped with internal thermal protection.

**FANS**

The technology of propeller fans, has blades statically and dynamically balanced, driven directly by the electric motors, closed type, external rotor and thermal protection for outdoor installation. Class F windings, internal protection according to VDE 0730. Ecoprofile are characterized by low speed and “owlet” profile to reduce the effect of vo rtices, thereby reducing the energy consumed for operation and noise, reducing it by an average of 6dB (A) compared with standard fans. The units are equipped with the continuous control and therefore the continuous variation of the fans speed.

This type of regulation on the fan motor is made using a system able to modify the supply voltage of the fans while limiting the number of rotations per minute of the fans rotor. A precise and reactive regulation is always obtained in this way, ensuring the maximum efficiency of the circuit.

**PLATE HEAT EXCHANGER – COLD SIDE**

Direct expansion, stainless steel AISI 316 brazed plate type with double circuit, externally insulated with closed cell anti-condensation material and equipped with water differential pressure switch and antifreeze protection electric heater.

**HIGH EFFICIENCY PLATE HEAT EXCHANGER – HOT SIDE**

Direct expansion, stainless steel AISI 316 brazed plate type with double circuit, externally insulated with closed cell anti-condensation material and equipped with water differential pressure switch and antifreeze protection electric heater.

**SOURCE HEAT EXCHANGER**

Condenser coils with seamless copper tubes expanded into aluminum corrugated fins. The coils are high efficiency coils, complete with subcooling circuit which allows an increase of cooling capacity without an increase of the power input.

**REFRIGERANT CIRCUIT**

The refrigerant circuit is specific and optimized for the use of a reduced number of solenoids valve and for the use of hot side heat exchanger during defrost, in order to avoid ice formation in the evaporator on cold side.

The units are equipped with two independent refrigerant circuits, entirely constructed with copper tubes, each supplied by its own compressor, including:

- Refrigerant charge R410a;
- Electronic expansion valve;
- Filter drier with interchangeable cartridge suitable for the use of ecological fluids and polyesters oils;
- Indicator lamp for liquid flow and humidity presence;
- Shut off valve on the liquid line complete of balancing pressure system making easier the opening and closing operations;
- Solenoid valve on the liquid line;
- High pressure switch;
- Low pressure switch;
- Safety valve on the discharge line;
- Safety valve on the suction line;
- High pressure transducers;
- Low pressure transducers;
- Liquid receiver;
- Liquid accumulator on the suction line;
- 4 way reverse valve;
- Cycle configuration valve.

**ELECTRICAL PANEL**

The electrical panel made in accordance with CEI-EN 60204-1 (CEI44-5; CEI EN 62061) standards, is housed in watertight box, the opening system of the box needs the use of a retractable handle or dedicated tools, in each case the opening is allowed only after disconnection of the power supply through the main switch with door lock handle lockable in OFF position.

The electrical panel includes:

- Protection fuses for the supply line of each compressor;
- Protection fuses for the supply line of fans for each refrigerant circuit;
- Protection fuses of auxiliary circuit;
- Start up contactors for compressors On/Off (size with tandem Inverter+On/Off) dimensioned according to the maximum stress;
- Variable Speed Drive for scroll compressor(s);
- Start up contactors for fans;
- Adjustable thermal magnetic circuit breaker for the protection of the pump (only in case of units equipped with hydraulic kit);
- Start up contactors for pump (only in case of units equipped with hydraulic kit);
- Single-phase transformer for the power supply of the auxiliary circuits;
- Numbered wires (optional);
- Microprocessor control.

In case of phase failure an automatic system protects fans and compressors.

The wiring of the electric panel and the connection with the components of the units are made using cables appropriately calculated for operation at 55°C and according to the maximum electrical stress of the components.

In order to reduce the electromagnetic interference, the connection between the VSD compressors and the electrical panel consists out of shielded cables.

All the cables and the terminals are univocally numbered according to the electrical scheme in order to avoid possible misinterpretation. The identification system of the cables connected to the components allow also an easy and intuitive recognition of the component.

Each component of the electrical panel is provided with an identification plate according to what is shown on the electrical scheme. All the connection to the electrical panel are made from the bottom and are equipped with cover preventing from break.

The electrical panel supply is 400V/3ph+n/50Hz and no additional power supply is necessary. The entrance for the power cables is provided on the bottom of the box where a dismountable flange suitable for the purpose is provided.

The electrical power supply without neutral 400V/3ph/50Hz is available as option.

**WARNING! Hazardous Voltage with Capacitor!**

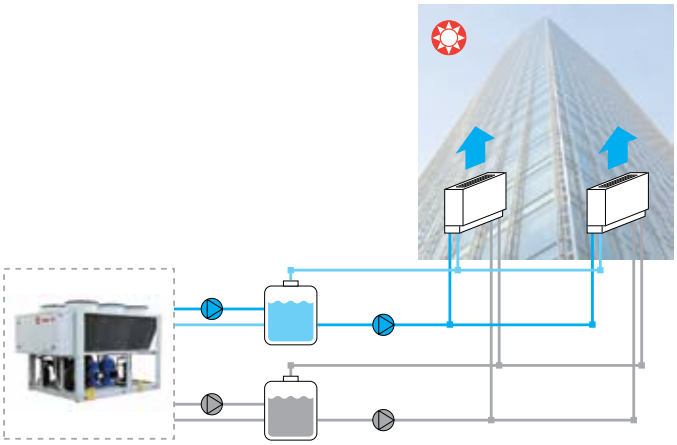
Disconnect all electric power, including remote disconnects and discharge all motor start/run and capacitors before servicing. Follow proper lockout/tagout procedures to ensure the power cannot be inadvertently energized.

- For variable frequency drives or other energy storing components provided by Trane or others, refer to the appropriate manufacturer's literature for allowable waiting periods for discharges capacitors. Verify with an appropriate voltmeter that all capacitors have discharged.
- DC bus capacitors retain hazardous voltages after input power has been disconnected. Follow proper lockout/ tagout procedures to ensure the power cannot be inadvertently energized. After disconnecting input power, wait five (5) minutes for units which are equipped with EC fans and wait twenty (20) minutes for units which are equipped with variable frequency drive (0V DC) before touching any internal components. Failure to follow these instructions could result death or serious injury.

## 4.3 Operating modes

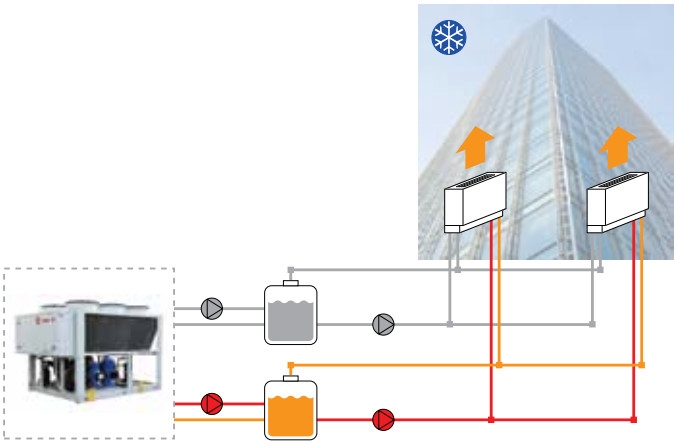
Multi-pipe units are made of 2 distinct sections, one for heating (condenser side) and one for cooling (evaporator side). The simultaneous production of hot and chilled water allows the unit to adapt its operation to any requirement of the HVAC system, in a totally autonomous and self-managed way.

Multi-pipe units automatically switch their operating cycle according to the load demands during the whole year, without doing the manual switch from summer to winter mode needed for traditional heat pumps. There are three basic operating modes which are automatically selected in order to minimize the power input and satisfy the thermal load of the plant.



**ONLY CHILLER MODE**

The unit works in chiller mode dissipating the condensation heat through a finned coil heat exchanger (condenser). The water is chilled in a water-refrigerant plate heat exchanger (evaporator).



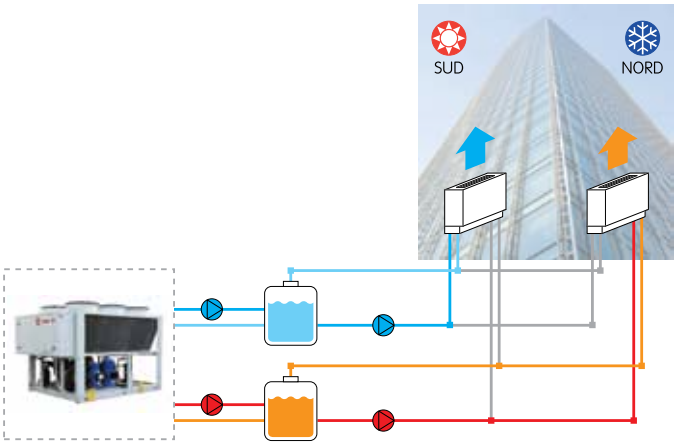
**ONLY HEAT PUMP MODE**

The unit works in heat pump mode only, exploiting the outdoor air energy to heat the water through a water-refrigerant plate heat exchanger (condenser).

Different from traditional reversible heat pumps the hot water is produced in a different heat exchanger from the one used to produce chilled water.

Therefore according to the operating mode, whether the unit works in heat pump mode or in chiller mode, there are dedicated heat exchangers for the chilled or hot water production (evaporator or condenser).

This is required in order to keep the cooling and heating side separated, as needed in a 4-pipe system.




**CHILLER + TOTAL OR PARTIAL RECOVERY MODE**

The unit works as a water-water heat pump in case there is simultaneous demand of hot and chilled water, by controlling the condensation and the evaporation through two different plate heat exchangers each for its own hydraulic circuit of the 4 pipe plant.

## 4.4 Compressor oil load

**Checking the oil charge**

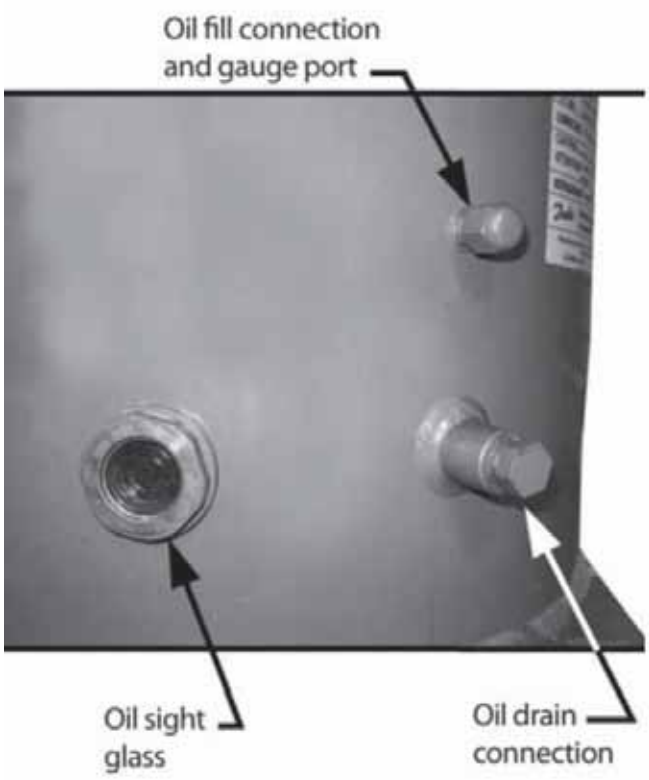
For all Trane units compressors are charged with oil at the factory. The scroll compressors are equipped with an oil sight glass from which you can control the level. In tandem or trio performances, pay particular attention to oil level. Not perfectly leveled sight glasses between compressors in parallel, but falling in the upper and lower limits, are considered normal.

Next to the lamp there is a connection on every compressor for draining the oil and a connection for refilling.

To refill oil, there is a ¼" Schrader connection.

To refill oil, it is necessary to discharge the refrigerant in the unit, recovering it in adequate cylinders. Then vacuum until you reach a pressure of about 6 Pa to remove any trace of humidity from the circuit. Then load the unit with a small amount of refrigerant and fill oil from the proper connection for refilling.

Add oil until the oil sight glass is flat within the upper and lower limits indicated by the corresponding notches. At this point refill the previously discharged amount of refrigerant as in the indications above. Restart the compressor. Run for 20 minutes at full load and check the oil level.



# Pre-startup checks

## 5.1 General

Once the unit has been installed, use the following procedure to check that is has been done properly:

**WARNING!**
Remove the power supply from the unit before performing any checks.

Failure to open the power switches at this stage can result in serious injury to the operator or even death.

Inspect all the electrical connections to the power circuits and to the compressors including the contactors, fuse carriers and electrical terminals and check that they are clean and well secured. Even though this is done at the factory to every unit that is shipped, vibrations from transport could have loosened some electrical connections.

**WARNING!**
Check that the electrical terminals of cables are well tightened. A loose cable can overheat and give rise to problems with the compressors.

Open discharge, liquid, liquid injection and intake (if installed) taps.

**WARNING!**
Do not start up the compressors if the exhaust, liquid, liquid injection and intake taps are closed. Failure to open these taps/ valves can cause serious damage to the compressor.

Place all the thermal-magnetic switches of the ventilators.

**IMPORTANT!**
If the thermal-magnetic switches of the ventilators are forgotten open, both compressors will block due to high pressure when the unit is started up for the first time. Resetting the high-pressure alarm requires opening the compressor compartment and resetting the high-pressure mechanical pressure switch.

be the same as that on the nameplate. Maximum allowed tolerance +/- 10%.

Voltage unbalance between the three phases must not exceed +/- 3%.

The unit comes with a factory-supplied phase monitor that prevents compressors from starting in the event of an erroneous phase sequence. Properly connect the electrical terminals to the disconnector switch so as to ensure alarmfree operation. In the even that, after the unit has been powered on, the phase monitor should set off an alarm, only invert two phases at the general disconnector switch input (Unit input). Never invert the electrical wiring on the monitor.

**WARNING!**
Starting up with the wrong sequence of phases irreparably compromises operation of the compressor. Ensure that phases L1, L2 and L3 correspond in sequence to R, S and T.

Fill the water circuit and remove air from the system's highest point and open the air valve above the evaporator skirt.

Remember to close it again after filling. The design pressure on the wter side of the evaporator is 10.0 bars. Never exceed this pressure at any time during the life of the unit.

**IMPORTANT!**
Before placing the unit into operation, clean the hydraulic circuit. Dirt, incrustation, corrosion residue and other extraneous material can accumulate in the heat exchanger and reduce its thermal exchange capacity. Pressure drops can also increase, consequently reducing water flow. Thus, correct water treatment reduces the risk of corrosion, erosion, scaling, etc. The most appropriate water treatment must be established locally, according to the type of installation and to the characteristics of the process water locally.

Trane is not responsible for damage or bad operation of the apparatus resulting from failure to treat water or from incorrectly treated water.

Close the door lock main switch placed on the door of the main electrical panel and move the switch

On position Make sure that the display shows: "Unit in stand-by."

**WARNING!**
From this moment on, the unit will be electrically powered. Use extreme caution in operations later.

Failure WARNING, in subsequent activities, can cause serious harm to people.

## 5.2 Electrical supply

The supply voltage of the unit must be equal to that specified on the rating plate ± 10%, while in voltage unbalance between phases must not exceed ± 3%. Measure the voltage between phases and whether the measured value is not within the limits, provide for its correction before the unitry.

**WARNING!**
Provide an adequate supply voltage. Inadequate supply voltage may cause malfunction of control components and unwanted interventions thermal protection as well as a substantial reduction of the life of the contactors and electric motors.

**Unbalance in power supply voltage**

In a three phase system the excessive unbalance between the phases is the cause of the overheating of the engine. The maximum allowed voltage unbalance is 3%, calculated as follows:

$$\%\ Phase\ unbalance = \frac{V\max - Vaverage}{Vaverage} * 100$$

***Unbalance between phases in the power supply***

**Do not operate the electric motors when the unbalance voltage between the phases is greater than 3%.**

**Use the following formula for the control:**

$$\%\ Phase\ unbalance = \frac{Max\ deviation\ \ from\ the\ average\ voltage}{Average\ voltage} * 100$$

**Important**

**If the grid voltage has an imbalance greater than 3%, contact the company for distribution of electricity. Operating the unit with a bias voltage between phases over 3% is inhibited or lose the warranty.**

**Electrical resistances power supply**

Each compressor comes with an electrical resistance located in the compressor's lower area. Its purpose is to warm the lubricating oil and thus avoid the transmigration of refrigerant fluid within.

It is therefore necessary to ensure that the resistances are powered at least 24 hours before the planned startup time.

To ensure that they are activated, it is sufficient to keep the unit on by closing the general disconnecting switch Q10.

The microprocessor, however, has a series of sensors that prevent the compressor being started up when the oil temperature is not at least 5°C above the intake-pressure equivalent saturation temperature.

Keep the Q0, Q1, Q2 and Q12 switches in the Off (or 0) position until the unit is to be started up.

## 5.3 Startup preliminary procedures

**Initial controls**

Before starting the unit, even only momentarily, all the unitry supplied by the chilled water, like the air handling units, pumps, etc. have to be checked. The pump auxiliary contacts and the flow switch have to be connected to the control panel as indicated in the electrical diagram. Before carrying out interventions on the valve regulations, loosen the relevant valve gland. Open the discharge valve of the compressor. Open the liquid shutoff valve placed on the liquid line. Measure the suction pressure. If it is lower than 0.42 MPa jumper and strain the solenoid valve on the liquid line. Bring the suction pressure to 0.45 MPa, then remove the jumper. Charge all the water circuit progressively. Starts up the water pump of the evaporator with the calibration valve shut and then slowly open it.

Discharge the air from the high points of the water circuit and check the direction of the water flow. Carry out calibration of the flow by using a measurer (if present or available) or by means of a combination of the readings of the manometers and the thermometers. In the starting phase calibrate the valve on the pressure difference read on the manometers, carry out drainage of the tubes and then carry out fine calibration on the temperature difference between the water in and the water out. The regulation is calibrated in the factory for water in to the evaporator at 12°C and water out at 7°C. With the general switch open, check that the electrical connections are tightly clamped. Check for any possible refrigerant leaks. Check that the electrical data on the label correspond to those of the mains supply. Check that the thermal charge available is appropriate for starting.

***Refrigerant seals control***

Trane units are sent with the complete charge of refrigerant and are at a sufficient pressure to check the seal after installing. If the system were not under pressure, blow refrigerants (vapour) into it until pressure is reached and look for leakage.

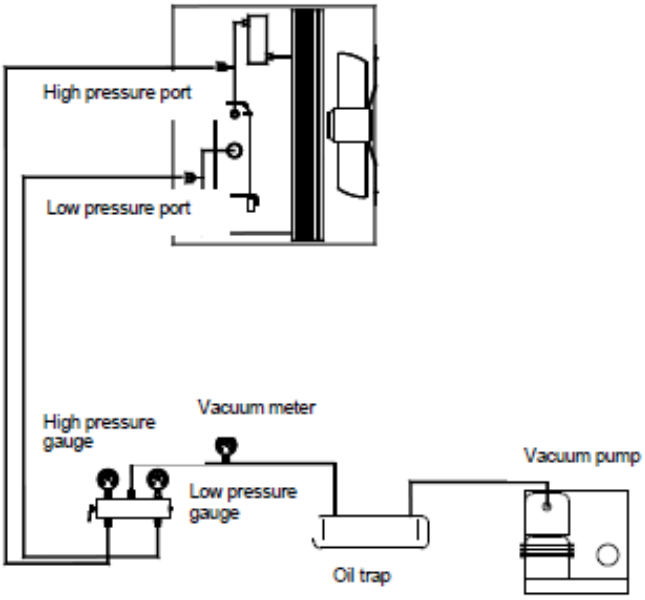
After having eliminated the leakage, the system has to be dehydrated with a vacuum pump up to at least 1mm Hg - absolute pressure (1 Torr o 133.3 Pa). This is the minimum recommended value to dehydrate the plant.

Dangers do not use the compressor to vacuum the system.

***Refrigerant charge check***

Trane units are supplied with a complete charge of refrigerant. If bubbles can be seen through the sight glass with the compressor running with a full charge and steadily, it means that the refrigerant charge is insufficient.

Danger While refrigerant is being added do not exclude any control system and let the water circulate in the evaporator to avoid the formation of ice.



# Pre-startup checks

## 5.4 Check list – mandatory operation control before start up

| | | | |
|---|---|---|---|
| **DATE** | | N. | |
| **UNIT** | | | |

| | |
|---|---|
| **CUSTOMER:** | SITE:<br>ADDRESS:<br>POSTCODE:<br>COUNTRY: |

THE INTENDED PURPOSE OF CMAA UNITS IS NOT FOR INDUSTRIAL APPLICATION. PLEASE CONTACT TRANE TECHNICAL DEPARTMENT IN CASE OF INDUSTRIAL APPLICATION.

### GENERAL

| | | COMPLIANCE | |
|---|---|---|---|
| | | YES | NO |
| 1 | THE HYDRAULIC CIRCUIT IS COMPLETE AND READY TO BE USED AND THE THERMAL LOAD IS AVAILABLE.<br><br>PLEASE NOTE THAT **THE FIRST START-UP SHALL NOT BE CARRIED OUT UNLESS THE PLANT IS READY AND THE WATER LOAD IS AVAILABLE**. | | |
| 2 | THE UNIT DISPLAYS DENTS OR DAMAGES ON THE EXTERNAL CASING OCCURRED DURING THE TRANSPORTATION OR POSITIONING.<br><br>IF ANY, SPECIFY BELOW:<br><br>**WARNING:** PLEASE BE AWARE THAT RELEVANT DAMAGES CAUSED BY THE QUOTED CIRCUMSTANCES MAY RESULT IN THE CALL-OFF OF THE WARRANTY. | | |
| 3 | THE UNIT HAS BEEN INSTALLED IN ACCORDANCE WITH THE MINIMUM DISTANCE PROVIDED IN THE DIMENSIONAL DRAWING AND TECHNICAL DOCUMENTATION PROVIDED. | | |
| 4 | THE UNIT IS INSTALLED NEXT TO THE: PHOTOVOLTAIC SYSTEM, ELECTRONIC TRANSMITTERS,ANTENNAS OR SIMILAR DEVICES. | | |
| 5 | THE UNIT IS POSITIONED ON A PERFECTLY FLAT (NOT INCLINED) SURFACE. | | |
| 6 | ANTI-VIBRATIONS DAMPERS HAVE BEEN INSTALLED BETWEEN THE UNIT AND THE FLOOR. | | |
| 7 | THE UNIT DISPLAYS DEFECTS OR DAMAGES RESULTING FROM MODIFICATIONS OR CHANGES (UNIT TAMPERING / UNAUTHORIZED MODIFICATIONS TO THE REFRIGERANT CIRCUIT OR THE HYDRAULIC CIRCUIT OR THE ELECTRICAL PANEL OR CHANGES TO THE UNIT OPERATING PARAMETERS) MADE BY A THIRD PERSON WITHOUT A WRITTEN AUTHORIZATION ISSUED BY TRANE. THE UNIT SHALL BE CONFORM TO TRANE WIRING DIAGRAMS AND TECHNICAL DOCUMENTATION) IN CASE OF RELEVANT DIFFERENCE BETWEEN THE UNIT AND TRANE STANDARD CONFIGURATION PLEASE CONTACT TRANE.<br><br>**WARNING:** PLEASE BE AWARE THAT RELEVANT DAMAGES CAUSED BY THE QUOTED CIRCUMSTANCES MAY RESULT IN THE CALL-OFF OF THE WARRANTY. | | |
| 8 | THE UNIT HAS BEEN INSTALLED VERY CLOSE TO **A MARINE ENVIRONMENT** OR AN **AGGRESSIVE INSTALLATION ENVIRONMENT** (HIGHLY CORROSIVE CHEMICAL AGENT).<br><br>**WARNING:** PLEASE BE AWARE THAT RELEVANT DAMAGES CAUSED BY THE QUOTED CIRCUMSTANCES MAY RESULT IN THE CALL-OFF OF THE WARRANTY. | | |
| 9 | SPOTTED PRESENCE OF MOLD, MUSHROOMS, BACTERIA, MICROBIAL OF ANY TYPE. | | |
| 10 | THE UNIT DISPLAYS DAMAGES CAUSED BY: FLOODS, LIGHTNING, FIRE, ANY ACCIDENT BEYOND TRANE'S CONTROL. | | |

## ELECTRIC AND ELECTRONIC

| | | | |
|---|---|---|---|
| 11 | THE UNIT IS ELECTRICALLY POWERED AND ALL THE RELEVANT ELECTRICAL WIRES ARE PROPERLY CONNECTED. | | |
| 12 | ELECTRICAL SUPPLY HAS BEEN INSTALLED IN ACCORDANCE WITH THE INSTRUCTIONS PROVIDED IN THE NAME PLATE AND IN THE TECHNICAL DOCUMENTATION. (ELECTRICAL POWER SUPPLY: 230V/400V +/- 10% - MAXIMUM "%" OF PHASE IMBALANCE: +/- 3% ) . IT IS RECOMMENDABLE TO CHECK BY USING A TESTER THE VOLTAGE VALUE ( BETWEEN PHASES AND BETWEEN PHASE AND NEUTRAL) | | |
| 13 | PHASES ARE CONNECTED IN THE PROPER SEQUENCE. | | |
| 14 | ELECTRICAL CABLES SIZE ARE CONFORM TO FLA MAX VALUE. | | |
| 15 | BOTH EXTERNAL AND INTERNAL ELECTRICAL WIRES ARE WELL TIGHTENED. | | |
| 16 | THE COMPRESSOR CRANCKCASE HEATERS HAVE BEEN POWERED AND HEATED AT LEAST 8 HOURS BEFORE THE START-UP. | | |
| 17 | AN ELECTRONIC SUPERVISOR (OR ANY ADDITIONAL CONTROLLER) HAS BEEN INSTALLED. | | |
| 18 | THE CONNECTION WIRES ARE SHIELDED. | | |
| 19 | REMOTE CONTROL DEVICES OR INTERFACES ARE CONNECTED TO THE ELECTRICAL PANEL IN CONFORMITY WITH TRANE WIRING DIAGRAMS. | | |
| 20 | ELECTRIC DEVICES ARE INTACT AND DON'T DISPLAY ANY DAMAGE. | | |
| 21 | ELECTRONIC DEVICES ARE INTACT AND DON'T DISPLAY ANY DAMAGE. | | |
| 22 | WATER PUMPS ARE ELECTRICALLY CONNECTED TO THE ELECTRICAL PANEL IN ACCORDANCE WITH THE WIRING DIAGRAMS PROVIDED BY TRANE. | | |
| 23 | THE ELECTRICAL ABSORBTION AND THE WATER PUMPS OVERHEATING ARE STANDARD. | | |

## REFRIGERANT CIRCUIT

| | | | |
|---|---|---|---|
| 24 | ALL CONNECTIONS ON THE REFRIGERANT CIRCUITS ARE WELL TIGHTENED. | | |
| 25 | THE ELECTRONIC LEAKAGE DETECTOR OR THE PRESSURE GAUGE LEVEL INSTALLED ON THE REFRIGERANT CIRCUIT HAVE DETECTED ANY LEAKAGE.<br><br>IF ANY, SPECIFY BELOW: | | |
| 26 | THE COMPRESSOR OIL INDICATOR LIGHT POINTS THE MAXIMUM LEVEL. | | |
| 27 | THE FILTER INDICATOR LIGHT ON THE LIQUID LINE IS GREEN.<br><br>**WARNING:** THE YELLOW INDICATOR LIGHT INDICATES PRESENCE OF MOISTURE IN THE CIRCUIT. IN THIS CASE PLEASE CONTACT TRANE. | | |

# Pre-startup checks

## WATER CIRCUIT

| | | | |
|---|---|---|---|
| 28 | THE FILTER IS INSTALLED ON BOTH HEAT EXCHANGERS INLET PIPES,AT A MAXIMUM DISTANCE OF 2 METERS FROM THE UNIT.<br><br>PLEASE NOTE THAT THE FILTER INSTALLATION IS **MANDATORY**. FOR FURTHER TECHNICAL INFORMATION RELATING THE FILTER PLEASE REFER TO THE TECHNICAL DOCUMENTATIONS. | | |
| 29 | THE FLOW SWITCH HAS BEEN INSTALLED AND ELECTRICALLY CONNECTED. PLEASE NOTE THAT FLOW SWITCH INSTALLATION IS **MANDATORY**. | | |
| 30 | THE VALVES ON THE WATER PLANT MUST BE OPENED. PLEASE BE AWARE THAT IF THE MACHINE IS POWERED (OR IN STAND-BY MODE) PUMPS WILL START IF THE WATER TEMPERATURE IS EQUAL OR BELOW 4°C. CLOSING THE VALVES MAY THEREFORE CAUSE SEVERE DAMAGES. | | |
| 31 | DRAINAGE VALVES ARE INSTALLED. THE DRAINAGE VALVES ARE INSTALLED ON THE LOWEST POINT. THE UTILIZATION OF AUTOMATIC DRAINAGE VALVES IS RECOMMENDED. | | |
| 32 | AUTOMATIC OR MANUAL PURGE VALVES ARE INSTALLED.<br><br>AUTOMATIC OR MANUAL PURGE VALVES ARE INSTALLED ON THE HIGHEST POINT. | | |
| 33 | THE HYDRAULIC CIRCUIT HAS BEEN FILLED AND PURGED.<br><br>THE PLANT SHALL BE PURGED SEVERAL TIMES BEFORE STARTING UP THE UNIT. THE FILTER INSTALLED NEXT TO THE HEAT EXCHANGER SHALL BE CLEANED SEVERAL TIMES BEFORE STARTING UP THE UNIT, UNTIL THE CORRECT DELTA T IS ASSURED AND THE HYDRAULIC PRESSURE IS CONFORM TO THE PLANT AND TO THE WATER PRESSURE DROPS.<br>FOR FURTHER TECHICAL INFORMATIONS PLEASE REFER TO TRANE DOCUMENTATIONS AND PROCEDURE FOR THE FIRST START UP. | | |
| 34 | HYDRAULIC CONNECTIONS TO THE UNIT ARE COMPLIANT WITH THE UNIT NAME PLATE AND DIMENSIONAL DRAWINGS (HOT WATER INLET, HOT WATER OUTLET, COLD WATER INLET, COLD WATER OUTLET, EXT.). | | |
| 35 | RUBBER JOINTS ARE INSTALLED ON THE HYDRAULIC CONNECTIONS, IN ORDER TO MINIMIZE VIBRATIONS BETWEEN THE UNIT AND WATER PIPES. | | |
| 36 | SHUTOFF VALVES ARE INSTALLED ON THE HYDRAULIC CIRCUIT. | | |
| 37 | THE EXPANSION TANK IS INSTALLED ON THE HYDRAULIC CIRCUIT. EXPANSION TANK CAPACITY CONCURS WITH THE WATER PLANT CAPACITY. | | |
| 38 | TEMPERATURE PROBES AND PRESSURE GAUGES ARE INSTALLED ON THE HYDRAULIC CIRCUIT, BOTH INLET AND OUTLET SIDE. | | |
| 39 | THE HYDRAULIC CIRCUIT IS FREE FROM OBSTRUCTION OR ANY KIND OF CONSTRAINT. | | |
| 40 | BUFFER TANKS ARE INSTALLED IN THE HYDRAULIC CIRCUIT. THE BUFFER TANKS INSTALLATION IS STRONGLY RECOMMENDED IN ORDER TO GUARANTEE THE OPTIMAL UNIT OPERATION.<br><br>SPECIFY HOT BUFFER TANK CAPACITY: LT<br><br>SPECIFY COLD BUFFER TANK CAPACITY: LT | | |
| 41 | THE PRESSURE RELIEF VALVE IS INSTALLED BETWEEN DELIVERY AND RETURN PIPES.<br><br>**WARNING:** IN ORDER TO AVOID WATER-HAMMER, THE RELIEF VALVE PRESSURE SHALL BE SET UP IN ACCORDANCE WITH THE STANDARD OPERATING PRESSURE OF THE WATER CIRCUIT. | | |

| | | | |
|---|---|---|---|
| 42 | THE AUXILIARY HEATING SYSTEM IS INSTALLED IN THE WATER CIRCUIT IN ORDER TO AVOID THE START-UP OF THE UNIT WITH WATER TEMPERATURE BELOW 18°C. BEFORE STARTING UP THE UNIT THE INLET WATER TEMPERATURE MUST BE EQUAL OR HIGHER THAN 18°C.<br><br>**WARNING:** THE UNIT SHALL NEVER WORK (NOT EVEN FOR SHORT PERIODS) WITH AN INLET WATER TEMPERATURE LOWER THAN 18°C. | | |
| 43 | ANTIFREEZE PROTECTIONS ARE INSTALLED IN THE WATER CIRCUIT (ELECTRICAL HEATERS ARE INSTALLED ON WATER PIPES AND TANKS).<br><br>FOR FURTHER TECHNICAL INFORMATION PLEASE REFER TO TECHNICAL DOCUMENTATION PROVIDED. PLEASE NOTE THAT ANTIFREEZE PROTECTIONS ARE **MANDATORY** FOR OUTDOOR AIR TEMPERATURE LOWER THAN 3°C. | | |
| 44 | THE WATER CIRCUIT IS FILLED WITH ETHYLENE GLYCOL. ETHYLENE GLYCOL "%" SHALL CONFORM WITH THE DATA PROVIDED IN THE TECHNICAL DOCUMENTATION. | | |
| 45 | ALL WATER PIPES ARE GROUND CONNECTED (IN ORDER TO AVOID ABNORMAL VOLTAGES THAT CAN CAUSE DANGEROUS CORROSIONS). | | |
| 46 | THE EVAPORATOR WATER FLOW IS COMPLIANT TO THE TECHNICAL DOCUMENTATION PROVIDED BY TRANE. | | |
| 47 | THE WATER PUMPS ARE CORRECTLY SET UP IN ACCORDANCE WITH THE PLANT WATER FLOW, AVAILABLE HEAD PRESSURE AND PRESSURE DROP. | | |
| 48 | THE PUMP IMPELLERS ARE MECHANICALLY UNBLOCKED AND UNCLOGGED (FREE FROM ANY KIND OF CONSTRAINTS.) | | |

| **DATE:** | **AUTHORIZED SERVICE:**<br>**NAME AND SIGNATURE** | **CUSTOMER:**<br>**NAME AND SIGNATURE** |
|---|---|---|
| | | |

## 5.5 Refrigerant replacement procedure

1. If the unit has exhausted the refrigerant, it is necessary first of all to establish the causes, before carrying out any replenishment operation. The leak must be looked for and repaired. Oil stains are a good indicator, as they can appear in the vicinity of a leak. However, this is not necessarily always a good search criterion. Searching with soap and water can be a good method for medium to large leaks, while an electronic leak searching device is required to find the position of small leaks.
2. Add refrigerant to the system through the service valve located on the intake pipe or through the Schrader valve located on the evaporator entry pipe.
3. The refrigerant can be added under any load condition between 25 and 100% of the circuit. Intake overheating must be between 4 and 6°C.
4. Add enough refrigerant to fill the liquid pilot lamp entirely, until the passage of bubbles inside stops. Add an extra 2 ÷ 3 kg of refrigerant as a reserve, to fill the undercooler if the compressor is operating at 50 – 100% load.
5. Check the undercooling value by taking the liquid pressure and the liquid's temperature near the expansion valve. The undercooling value must be between 4 and 8 °C and between 10 and 15°C units with an economiser. The undercooling value will be lower 75 to 100% of the load and above 50% of the load.
6. With ambient temperature above 16°C, all ventilators should be on.
7. A system overcharge will entail a rise in the compressor's discharge pressure, owing to excessive filling of the condenser section pipes.

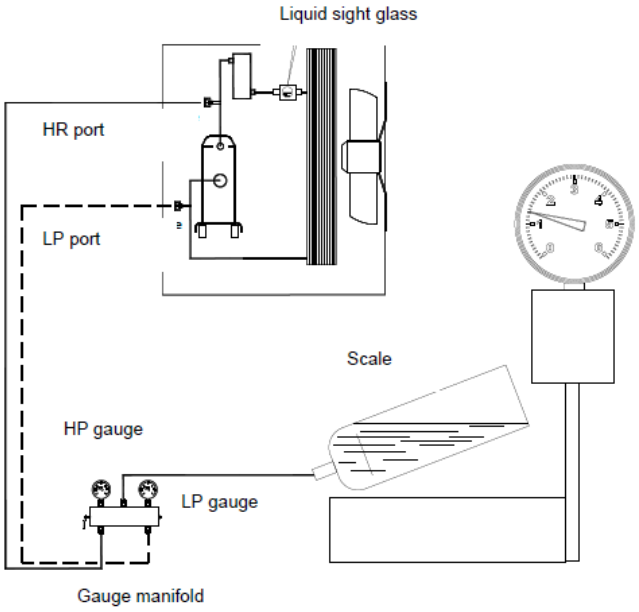
**Refrigerant charge**

*Charge with unit stopped and in vacuum (refrigerant charge in the liquid phase)*

Completely open the valve for it to close the service connection. Connect the refrigerant cylinder to the service connection without tightening the connection. Half close the liquid shut off valve. If the circuit has been dehydrated and vacuum, load liquid with the cylinder upside down. Weigh and charge the appropriate amount. Open the valve completely. Start the unit and let it run at full load for several minutes. Check that the indicator is clear and without bubbles. Be sure that the transparency condition without bubbles is due to the liquid and not to the vapor. For correct unit operation overheating must be at 4 to 7 ° C and subcooling at 4 - 8 ° C. Too high values of overheating can be caused by a lack of refrigerant, while high values of subcooling may indicate excess charge.

After changing the charge, you should check that the unit works within the declared values: in full load operation , by measuring the temperature of the intake pipe downstream of the bulb of the thermostatic valve; read the equilibrium pressure on the evaporator on the low pressure gauge and the corresponding saturation temperature.

Overheating is equal to the difference between the measured temperatures. Measure then the temperature of the pipe of liquid leaving the condenser and detect on the high-pressure gauge the equilibrium pressure on the condenser and the corresponding saturation temperature. Subcooling is the difference between these temperatures. Charge is in the liquid phase.

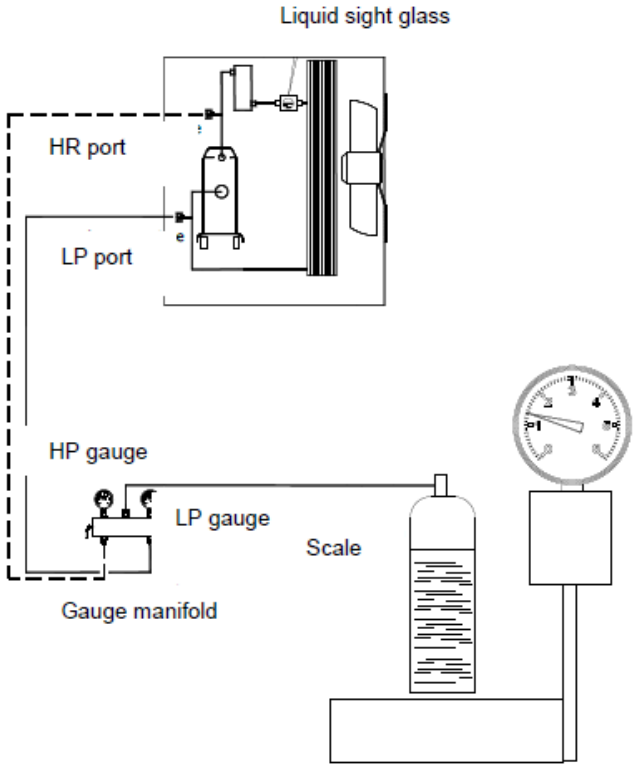


*Refrigerant charge addition with the unit running (refrigerant charge in the vapour phase)*

Caution: Charge only vapor. Do not charge liquid because it may damage the compressor.

Connect the cylinder to the service connection without tightening the connection. Drain the connecting pipe and tighten the connection. Charge each circuit until the indicator shows liquid without bubbles. The unit now has an adequate charge. Be careful not to overload the circuit. Loading more than necessary leads to higher outlet pressure, higher power consumption and possible damage to the compressor.

Charge is in the vapor phase.




**IMPORTANT!**

The symptoms of a low refrigerant charge are:

- Low evaporation pressure.
- High superheat the intake and exhaust (outside the above limits).
- Low value of subcooling.

In this case, add refrigerant R410A in the corresponding circuit. The system is planned charging port between the expansion valve and the evaporator. Charge refrigerant until conditions return to work normal.

Remember to replace the cap closing the valve at the end.

**IMPORTANT!**

If the unit has not been provided with integrated pump on board, do not turn off the external pump before You do not 3 minutes have elapsed after turning off the last compressor. The early shutdown of the pump causes a water flow alarm failure.

## 5.6 Refrigerant loading

**WARNING!**

The units are designed to work with R410A refrigerant. DO NOT USE therefore different refrigerants from 'R410A'.

**WARNING!**

The addition or removal of refrigerant gas must be done in accordance with the laws and regulations in force.

**WARNING!**

When you add or remove the refrigerant from the system, ensure the proper flow of water through the evaporator for the entire period of charge / discharge. The interruption of the flow of water during this procedure would result in the freezing of the evaporator resulting in rupture of its internal pipes.

Damage due to freezing will void the warranty.

**WARNING!**

The removal of refrigerant and charging the coil should be made by qualified technicians in the use of material appropriate for the unit. Improper maintenance can lead to uncontrolled pressure loss and fluid. Also does not disperse the refrigerant and the lubricating oil in the environment. Always wear a special system of recovery.

Units are shipped with the total refrigerant charge, but there might be cases where it is necessary recharge the vehicle on the ground.

**WARNING!**

Always check the causes that have led to a loss of refrigerant. If necessary, repair the system and then proceed to its charging.

The charging of the unit can be made in any load condition stable (preferably between 70 and 100%) and in every condition of temperature (preferably higher than 20°C). The unit should be maintained turned on for at least 5 minutes to allow the stabilization of the steps of the fans, and then the pressure of condensation.

The units have about 15% of the condensing coils dedicated to the subcooled liquid refrigerant. the value of subcooling is equal to about 5-6°C (10-15°C for units economized).

Once the section subcooling has been completely filled. a further quantity of refrigerant is not increases the efficiency of the system. However a small amount of additional refrigerant (1 ÷ 2 kg) makes the system less sensitive.

## Pre-startup checks

Note: By varying the load and the number of active fans, subcooling varied and requires some time to restabilize. However it should never drop below 3°C in all conditions. Furthermore, the value of subcooling may change slightly with changes in temperature of the water and the superheat of suction.

One of the following two scenarios may occur in a unit discharge of refrigerant:

5. If the unit is slightly discharge of refrigerant through the sight glass you can see the passage of bubbles. The circuit as described in the charging process.
6. If the unit is moderately gas discharge, the corresponding circuit could have stops low pressure. Prime the circuit as described in the corresponding charge.6.1 Preliminary checks

Before starting the appliance it is very important verify that you have correctly performed all the operations described in the section "PREPARATION OF STARTING."

Also check that all mechanical and electrical equipment are tightened properly. WARNING particular should be paid to the fundamental components (compressor, heat exchangers, fans, electric motors, pumps, terminal blocks) are detected in the case fixing screws loose, proceed to their tightness before first start up.

The oil heaters should be placed at least 8 hours before starting. Make sure that the compressor crankcase is warm. Check that all valves in the refrigerant circuit are open. Check all equipment connected to the unit.

## 6.1 Start up

Start the unit by pressing the ON / OFF button. From the moment you give the request for unit start up, the moment at which you start the (first) compressor, will spend a fixed time. After switching off at the next start of the same compressor will spend a configured time set by the unit controller.

Check the direction of rotation of the fans and compressors. If wrong, reverse two phases of power. Make sure that all safety devices are working properly and control. Check the temperature of the water leaving the evaporator and adjust the settings of control. Check the oil level.

## 6.2 Start up of the plant per unit

During the operation of the system, in order to preserve each component of the unit and to optimize the use of the same, you need to get heat into the circuit before giving cooling energy to utilities.

To this end, it must operate in the following way:

- start the unit;
- wait until the temperature of the inlet water to the unit is that of regime;
- start utilities.

Follow the above procedure at each stop of the plant, of such duration as to raise the temperature of the water contained in it.

## 6.3 Start up procedure

Unit start up (only authorized person)

1. With the switch closed, open the electrical panel and exclude compressor (refer to the wiring diagram on the unit). Close the panel, set switch to “ON” (to give power to the unit).
2. Wait for the start of the microprocessor and control. Make sure that the temperature of the oil is hot enough. The oil temperature must be at least 5°C higher than the saturation temperature of the refrigerant inside the compressor.
3. Place the unit in the “ON” and wait until the unit is indicated on the display-On.
4. Turn the pumps (if with inverter) at max speed.
5. Verify that the loss of load of the evaporator is equal to that of the project and correct if necessary. The loss must be recorded attacks on the charge placed on the evaporator piping and supplied as standard. Do not measure the load losses in points where they are interposed any valves and / or filters.
6. Check for air in cleaning Filters, and then draining the system.
7. Return the pump to the factory setting.
8. Turn off the power (into standby mode) and make sure the pumps stop after about 2 minutes.
9. Verify that the local temperature setpoint is set to the required value by pressing the Set button.
10. Turn the main switch to “OFF”. Open the cabinet. Reactivate the compressors. Close the cabinet. Turn the main switch to “ON” (to give power to the unit).
11. Wait for the start of the microprocessor and control. Just put in “ON” circuit # 1
12. When the compressor is started, wait about 1 minute for the system begins to stabilize.
13. Check the pressure of evaporation and condensation of refrigerant.
14. Check the fans start depending on the condensing pressure increase in chiller mode, on the evaporation pressure decrease in Recovery mode. In Chiller + Recovery mode fans are stopped.
15. Verify that, after a period of time necessary for the stabilization of the refrigerant circuit, the liquid indicator placed on the inlet pipe to the expansion valve is completely filled (no bubbles), and that the moisture indicator signs ‘Dry’. The passage of bubbles within the liquid indicator, it may indicate a low amount of refrigerant, or an excessive pressure drop through the filter drier, or an expansion valve blocked at the maximum opening position.

# Start up

16. In addition to checking the sight glass, check the operating parameters of the circuit controlling:
    a. Overheating compressor suction
    b. Overheating compressor discharge
    c. Subcooling of the liquid exiting the condenser coils
    d. Evaporation pressure
    e. Condensing pressure

Measure the values of pressure and temperature instrumentation suitable vehicle with various pti indicated and make comparison by reading the corresponding values directly on the display of the microprocessor on board.

17. Repeat steps 11 to 16 for the second circuit.
18. To temporarily turn off the unit (turn off daily or weekend) put on standby the unit key, or open the remote contact (terminals shown in the wiring diagram provided with the unit) of the terminal X (Installing a remote switch by the customer ), or set time zones. The microprocessor will activate the shutdown procedure that will take a few seconds. Two minutes after switching off the compressor will turn off the microprocessor / pump and / e. Do not remove the main power to not turn off the electrical resistances of the compressor and the evaporator.

Typical operating conditions with 100 working of compressors

| ECONOMIZED CYCLE | SUCTION SUPERHEATING | DISCHARGE SUPERHEATING | LIQUID SUBCOOLING |
|---|---|---|---|
| NO | 5 – 7°C | 20-25°C | 5-6°C |
| SI | 5 – 7°C | 18-23°C | 15-20°C |

**WARNING!**

All activities of ordinary and extraordinary maintenance on the unit must be carried out by qualified personnel who have been properly trained and familiar staff has the equipment, their operation, the correct procedures of assistance and knowing all the safety requirements as well as both aware of the dangers.

**WARNING!**

The causes of repeated shutdowns due to the intervention of the safety devices must be investigated and corrected.

The simple reset of alarm occurrences can lead to serious damage to the unit.

**WARNING!**

A proper charge of refrigerant and oil is essential for an optimal functioning of the unit and for the protection of the environment.

The recovery of oil and any refrigerant discharged from the unit must be carried out in accordance with current regulations.

## 7.1 General

**IMPORTANT!**

Beyond the cadences of checks recommended in the following, in order to keep the unit at optimum levels of performance and efficiency and prevent incipient failures, we recommend periodic visits of inspection and control of the unit by qualified personnel.

In particular, we recommend:

4 annual visits to units that operate about 365 days / year (quarterly)

2 visits per year for units with seasonal operation about 180 days / year (one start seasonal and a mid-season)

1 annual visit for units with seasonal operation of about 90 days / year (starting seasonal)

It's important that during the initial start-up and periodically during operation, carry out the checks and routine checks. Among them we must also check the suction and condensation as well as the sight glass located on the liquid line. Check through the microprocessor installed on the unit, the unit is working within normal parameters of superheating and subcooling. A routine maintenance program recommended is shown at the end of this chapter while a card collection of operating data is at the end of this manual. It is suggested to record on a weekly basis all the operating parameters of the unit. The collection of these data will be very useful to technicians, in case it is requested technical assistance.

**Compressor Maintenance**

**IMPORTANT!**

This inspection must be performed by qualified and trained personnel.

The analysis of vibration is a great tool for checking the mechanical conditions of the compressor.

It is recommended to check the value of the vibration immediately after starting and periodically on an annual basis.

**Compressor Electrical Connections**

It is very important that all the compressors are wired correctly for proper rotation. These compressors will not tolerate reverse rotation. Verify correct rotation/phasing using a rotation meter.

If wired incorrectly the compressor will make excessive noise, will not pump and will draw about half the normal current. It will also become very hot if allowed to run for an extended period.

**NOTICE: Do not "bump" the compressor to check rotation as incorrect rotation could cause compressor motor failure in as little as 4 to 5 seconds!**

Improper rotation of the compressors is indicated by a compressor module trip, noisy operation, no pressure difference on manifold gauges and low amp draw.

**Tandem and Triple Compressor Suction Restrictors**

Since most tandem and triple compressor sets use unequal size compressors, these combinations require the use of a restrictor in the suction line of one or more compressors in order to provide correct oil level balance between compressors when they are operating.

**Compressor Replacement**

If the chiller suffers a failed compressor, use these steps for replacement:

Each compressor has lifting eyes. Both lifting eyes must be used to lift the failed compressor.

After a mechanical failure of a compressor, it is necessary to change the oil in the remaining compressor and also replace the liquid line filter drier. After an electrical failure of a compressor, it will also be necessary to change the oil in the remaining compressor, replace the filters driers and add a suction filter drier with clean-up cores.

Make sure that a heater is correctly installed on the compressor. The heater helps prevent dry starts.

***Note: Do not alter the refrigerant piping in any way as this can affect compressor lubrication.***

# System maintenance

**Refrigerant System Open Time**

The chillers use POE oil and therefore refrigerant system open time must be kept to a minimum. The following procedure is recommended:

Leave a new compressor sealed until it is ready to be installed in the unit. Maximum system open time is dependent upon ambient conditions, but do not exceed one hour open time.

Plug the open refrigerant line to minimize moisture absorption. Always change the liquid line filter drier. Do not leave POE oil containers open to the atmosphere. Always keep them sealed.

**Electrical Compressor Failure**

Replace the failed compressor and change the oil in the other compressor(s). Also add a suction filter with cleanup cores and change the liquid line filter drier. Change filters and oil until the oil no longer test acidic. See “Oil Testing.”

## 7.2 Maintenance

The maintenance operations are essential to maintain the efficiency of the refrigeration unit, both from a purely functional and energy consumption. Each unit is equipped with a booklet on the unit, which will be provided by the user, or the person who is authorized on his behalf to the maintenance of the unit, return all records required in order to keep a historical record of the operation of the unit. The lack of records in the booklet will serve as evidence of poor maintenance.

## 7.3 Sight check of the liquid receivers

The risks due to the pressure inside the circuit have been eliminated or (when it is not possible) reduced by means of safety devices. It is important to check periodically the status of these devices and to carry out the components inspections and repositioning as follows.

Check the liquid receivers state at least once a year.

It is important to check that the surface does not get rusty and that neither corrosion nor deformations are visible.

In case the superficial oxidation and the corrosion are not properly controlled and stopped in time, cause a thickness reduction with a consequent reduction of the receivers mechanical resistance.

Use antioxidant paint or products to protect.

## 7.4 Standard controls

| Operations description | Recommended basis |
|---|---|
| Compressors oil level check | monthly |
| Inlet temperature check (overheating) | monthly |
| Water circuits filling check | monthly |
| Fans and compressors motors electrical input check | monthly |
| Power supply and auxiliary power voltage check | monthly |
| Refrigerant charge check through sight glass | monthly |
| Compressors carter heaters operation check | monthly |
| Tightening all electrical connections | monthly |
| Coils cleanliness | monthly |
| Compressors and liquid circuit solenoid valve check | semiannual |
| Adjusting and safety thermostat calibration check | Quarterly |
| Fans (if present) and compressors contactors state check | Quarterly |
| Evaporator heater operation check | Quarterly |
| Motor and fan (if present) bearing noise check | semiannual |
| Pressure vessels conditions check | yearly |

**Temperature and pressure probes**

The unit comes factory-equipped with all the sensors listed below. Periodically check that their measurements are correct by means of sample instruments (manometers, thermometers); correct readings if necessary using the microprocessor keyboard. Well-calibrated sensors ensure better efficiency for the unit and a longer lifetime.

Note: refer to the microprocessor use and maintenance manual for a complete description of applications, setting and adjustments.

All sensors are preassembled and connected to the microprocessor. The descriptions of each sensor are listed below:

**Outgoing water temperature sensor** – This sensor is located on the evaporator outgoing water connection and is used for antifreeze protection.

**Ingoing water temperature sensor** – This sensor is located on the evaporator ingoing water connection and is used for monitoring the return water temperature. It is used by the microprocessor to control the unit load according to the system thermal load.

**External air temperature sensor** – This sensor allows to monitor the external air temperature on the microprocessor display.

**High pressure transducer** – This is installed on every circuit and allows to monitor the delivery pressure and to control the ventilators. Should a increase in condensation pressure arise, the microprocessor will control the circuit load in order to allow it to function even if choked. It contributes to complementing the oil control logic.

**Low-pressure transducer** – This is installed on every circuit and allow to monitor the compressor suction pressure along with low pressure alarms. It contributes to complementing the oil control logic.

**Intake sensor** – This is installed optionally (if the electronic expansion valve has been requested) on each circuit, and allows to monitor the intake temperature. The microprocessor manages the electronic expansion valve control by means of this sensor.

**Compressor discharge temperature sensor** – This is installed on each circuit and allows to monitor compressor discharge temperature and oil temperature. The microprocessor shuts down the compressor in case of alarm in the event that the discharge temperature reaches 120°C.

## 7.5 Unit test sheet

It is advisable to periodically detect the following operating data to verify the correct functionality of the unit in time. These data will also be of great benefit to the technicians who carry out routine maintenance and / or extraordinary unit.

**Water side measurements**

Chilled water setpoint °C _____

Evaporator outgoing water temperature °C _____

Evaporator ingoing water temperature °C _____

Evaporator pressure drop kPa _____

Evaporator water flow rate $m^3/h$ _____

**Refrigerant side measurements**

**Circuit #1:**

Compressor Load _____ %

N°of active Ventilators _____

N°of expansion valve cycles (electronic only) _____

Refrigerant/ Oils pressure

Evaporation pressure _____ Bar

Condensation pressure _____ Bar

Oil pressure _____ Bar

Refrigerant temperature Saturated evaporation temperature _____ °C

Intake gas pressure _____ °C

Intake overheating _____ °C

Saturated condensation temperature _____ °C

Delivery overheating _____ °C

Liquid temperature _____ °C

Undercooling _____ °C

**Circuit #2**

Compressor Load _____ %

N°of active fans _____

N°of expansion valve cycles (electronic only) _____

Refrigerant/ Oils pressure

Evaporation pressure _____ Bar

Condensation pressure _____ Bar

Oil pressure _____ Bar

Refrigerant temperature Saturated evaporation temperature _____ °C

Intake gas pressure _____ °C

Intake overheating _____ °C

Saturated condensation temperature _____ °C

Delivery overheating _____ °C

Liquid temperature _____ °C

Undercooling _____ °C

External air temperature _____ °C

**Electrical measurements**

**Analysis of the unit's voltage unbalance:**

**Phases:** ***RS*** ***ST*** ***RT***

_____**V** _____**V** _____**V**

**Unbalanced** $\frac{V\,\max - Vmedio}{Vmedio} x100 = \_\_\_\_\_\,\%$

Compressors current – Phases: R S T

Compressor #1 _____ A _____ A _____ A

Compressor #2 _____ A _____ A _____ A

Fans Current i: #1 _____ A #2 _____ A

#3 _____ A #4 _____ A

#5 _____ A #6 _____ A

#7 _____ A #8 _____ A

## 7.6 Recommended spare parts

Below is a list of the recommended parts for several years' running. Trane is at your disposal to recommend a personalised list of accessories according to the commissioned order, including the part number of the equipment

| 1 YEAR | |
|---|---|
| **COMPONENTS** | **QUANTITY** |
| Fuses | all |
| Drier filters | all |
| Solenoid valves | 1 per type |
| Thermostatic or electronic valves | 1 per type |
| Pressure switches | 1 per type |
| Gas gauge | 1 per type |
| Contactors and relays | 1 per type |
| Thermal protectors | 1 per type |
| Crankcase heaters | 1 per type |
| Reversing valves | 1 per type |
| Check valves | 1 per type |
| Safety valves | 1 per type |
| Sight glasses | 1 per type |
| Fans | 1 per type |

| 2 YEARS | |
|---|---|
| **COMPONENTS** | **QUANTITY** |
| Fuses | all |
| Drier filters | all |
| Solenoid valves | all |
| Thermostatic or electronic valves | all |
| Pressure switches | all |
| Gas gauge | all |
| Contactors and relays | all |
| Thermal protectors | all |
| Crankcase heaters | all |
| Reversing valves | 1 per type |
| Check valves | 1 per type |
| Safety valves | 1 per type |
| Sight glasses | 1 per type |
| Fans and motors | 1 per type |
| Electronic components | all |
| Compressors | 1 per type |

| 5 YEARS | |
|---|---|
| **COMPONENTS** | **QUANTITY** |
| Fuses | all |
| Drier filters | all |
| Solenoid valves | all |
| Thermostatic or electronic valves | all |
| Pressure switches | all |
| Gas gauge | all |
| Contactors and relays | all |
| Thermal protectors | all |
| Crankcase heaters | all |
| Reversing valves | all |
| Check valves | all |
| Safety valves | all |
| Sight glasses | all |
| Fans and motors | all |
| Electronic components | all |
| Compressors | all |
| Heat exchangers | 1 per type |

## 7.7 Improper use

The unit is projected and built up to grant the maximum safety in its proximity, as well as to resist to the aggressive environmental conditions. The fans are protected by grilles.

Residual risks are indicated with warning labels.

SAFETY SYMBOLS

DANGER:
General danger

DANGER:
Temperature

DANGER:
Handling parts

DANGER:
Cut off voltage

# System maintenance

## 7.8 Ordinary maintenance

**Programmed maintenance**

| Activities list | week | Month (note 1) | Year (note 2) |
|---|---|---|---|
| **General:** | | | |
| Data collection operation (Note 3) | X | | |
| Visually inspect the unit for any damage and / or looseness | | X | |
| Verifying the integrity of the thermal insulation | | | X |
| Clean and paint where needed | | | X |
| Water Analysis (6) | | | X |
| | | | |
| **Electric:** | | | |
| Check the correct operation of the equipment on the unit | | | X |
| Check the wear of contactors - Replace if necessary | | | X |
| Check tightness of all electrical terminals - Tighten if necessary | | | X |
| Clean the inside of the electrical panel | | | X |
| Visual inspection of the components for signs of overheating | | X | |
| Check the operation of the compressor and the electric resistance | | X | |
| Measurement using a Megger insulation of the compressor motor | | | X |
| | | | |
| **Refrigerant circuit:** | | | |
| Perform a test of refrigerant leaks | | X | |
| Check through the sight glass coolant flow - Full Indicator | X | | |
| Check the pressure drop of the filter drier | | X | |
| Check the pressure drop of the oil filter (Note 5) | | X | |
| Carry out the analysis of the vibrations of the compressor | | | X |
| Carry out the analysis of the acidity of the oil of the compressor (7) | | | X |
| | | | |
| **Condensing section:** | | | |
| Cleaning the condenser coils (Note 4) | | | X |
| Check that the fans are tightened | | | X |
| Check the fins of coils – comb it if necessary | | | X |

Notes:

1) The monthly activities include all those weekly.

2) The annual activity (or earlier in the season), include all activities weekly and monthly.

3) The values of the unit should be recorded each day for a high level of observation.

4) The coil cleaning may be required more frequently in areas with a high percentage of particles in the air.

5) Replace the oil filter when its pressure drop reaches 2.0 bar.

6) Check for dissolved metals.

7) TAN (Total Acid Number):

| | |
|---|---|
| ≤ 0.10: | No action |
| From 0.10 to 0.19: | Repositioning filters antacid and occurs after 1000 hours of operation. Continue to replace the filters until the TAN not falls below 0.10. |
| > 12:19: | Changing the oil, oil filter and the filter drier, Refer to regular intervals. |

## 7.9 Dehydration filter repositioning

It is recommended the repositioning of filter cartridges Dryer in the case of high pressure drop across the filter same or in case with the value of the subcooling within the limits of acceptability, occurs the passage of bubbles through the sight glass.

It suggests the repositioning of the cartridges when the pressure drop across the filter reaches 50 kPa with the compressor at full load.

The cartridges must also be replaced when the humidity indicator inside the sight glass changes color and highlight excessive humidity, or the periodic oil analysis indicates the presence of acidity (TAN excessive).

**Repositioning Procedure**

**WARNING!**

Ensure proper water flow through the evaporator throughout the intervention period. The interruption of the flow water during this procedure would result in the freezing of the evaporator resulting in rupture of its internal pipes.

1. Switch off the compressor by turning the corresponding switch in the Off.
2. Wait until the compressor has stopped and close the valve located on the liquid line.
3. Start the compressor by turning the corresponding switch to On.
4. Verify on the display of the microprocessor, the evaporation pressure corresponding.
5. When the vapor pressure reaches 100 kPa rotate the switch again to switch off the compressor.
6. Once the compressor is stopped by putting a label on the switch for starting the compressor maintenance to prevent unwanted ignitions.
7. Close the suction valve of the compressor (if any).
8. With a recovery unit to remove the remaining refrigerant from the filter of the liquid, until the atmospheric pressure. The refrigerant must be stored in a suitable container and clean.

**WARNING!**

To protect the environment, do not release the refrigerant into the atmosphere removed. Always use a device recovery and storage.

9. Balance the internal pressure with the outside by pressing the vacuum valve installed on the filter cover.
10. Remove the cover from the filter drier.
11. Remove the filter elements.
12. Install the new filter elements within the filter.
13. Replace the cover gasket. Do not oil the filter gasket with mineral oil to non-contamination in the circuit. Use for this purpose only compatible oil (POE).
14. Close the filter cover.
15. Connect the vacuum pump to the filter and evacuate up to 230 Pa.
16. Close the valve on the vacuum pump.
17. Recharge the refrigerant recovered in the filter during its emptying.
18. Open the valve on the liquid line.
19. Open the suction valve (if any).
20. Start the compressor by turning the switch.

## 7.10 Disposal

The unit disposal must be performed by qualified personnel.

Pay attention not to disperse harmful liquid or gases.

Recover as much refrigerant gas as possible from the unit and any freezing solution in the water circuits.

At disposal, heat exchangers, finned coils, fans or motors may be recovered if working.

All non-recoverable materials are to be disposed of in accordance with current standards and regulatory requirements.

# Important information regarding the refrigerant used

This product contains fluorinated greenhouse gases covered by the Kyoto Protocol.

Do not vent refrigerants into the atmosphere.

Type of refrigerant: R410A

GWP (1) 2088

(1) GWP = global warming potential

Refrigerant charge values are not binding. Refer to the quantity of refrigerant shown on the unit nameplate.

| CMAB HSE | Refrigerant charge (kg) |
|---|---|
| **75** | 25 |
| **100** | 38 |
| **120** | 38 |
| **135** | 51 |
| **150** | 51 |
| **165** | 40 |
| **185** | 40 |
| **225** | 58 |
| **255** | 77 |

Mandatory refrigerant leakage inspections apply to stationary equipment (refrigeration, air conditioning and heat pump equipment) in accordance with the EU F-gas Regulation (EU) N 517/2014.

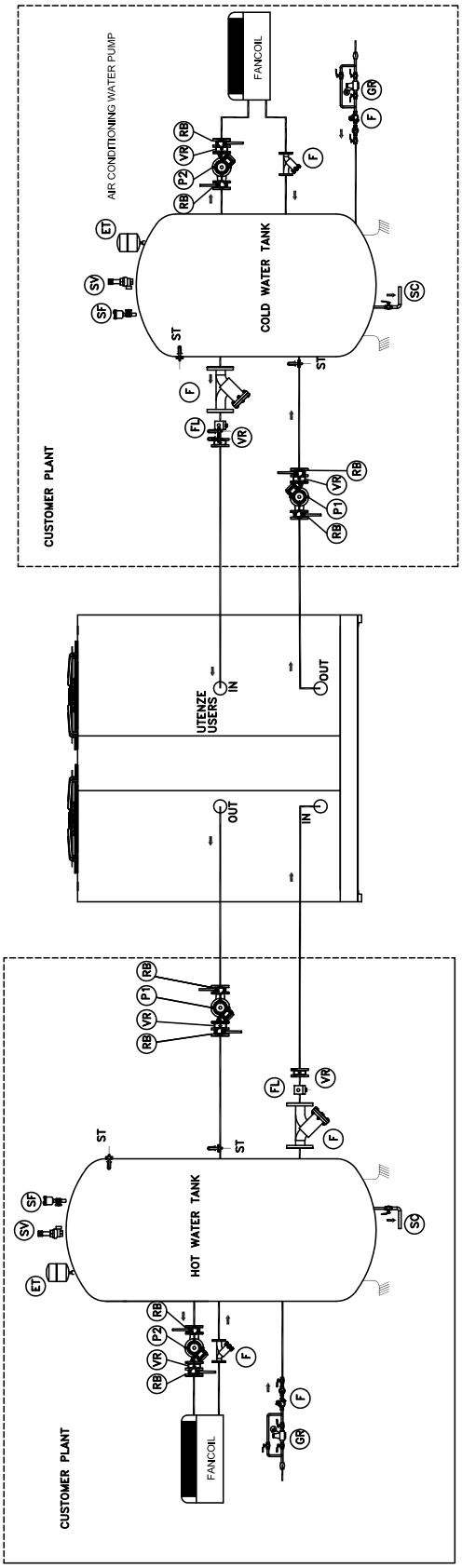
This Regulation does not prevent Member States from introducing more stringent measures at national level. This may apply as well.

The frequency of leakage inspections depends on the amount of tonnes of $CO_2$ equivalent contained in the refrigerant circuit.

This is calculated by multiplying the refrigerant charge (in kg) and the GWP value of the used refrigerant.

For more detailed information, contact your local dealer.

## 9.1 Plant sketch standard version




| | | |
|---|---|---|
| P1 | POMPA PRIMARIO | - PRIMARY PUMP |
| P2 | POMPA SECONDARIO | - SECONDARY PUMP |
| ST | SONDA TEMPERATURA | - TEMPERATURE PROBE |
| FL | FLUSSOSTATO | - FLOW SWITCH |
| SC | SCARICO | - DRAINAGE |
| SF | VALVOLA DI SFIATO | - VENT VALVE |
| ET | VASO DI ESPANSIONE | - EXPANSION VESSEL |
| GR | GRUPPO DI RIEMPIMENTO | - FILLING GROUP |
| F | RACCOGLITORE IMPURITA' | - STEEL MESH STRAINER |
| VR | VALVOLA DI NON RITORNO | - CHECK VALVE |
| SV | VALVOLA DI SICUREZZA | - SAFETY VALVE |
| RB | VALVOLA INTERCETTAZIONE | - INTERCEPTION VALVE |

Flow switches and water strainers are separate and mandatory accessories which must be installed by the contractor/building owner, close to the unit, in both the hot and chilled inlet water pipes.

The flow switch signal prevails the build-in delta P switch signal to prevent unit failure in case of lack of water flow.

**Important for flow switches:**

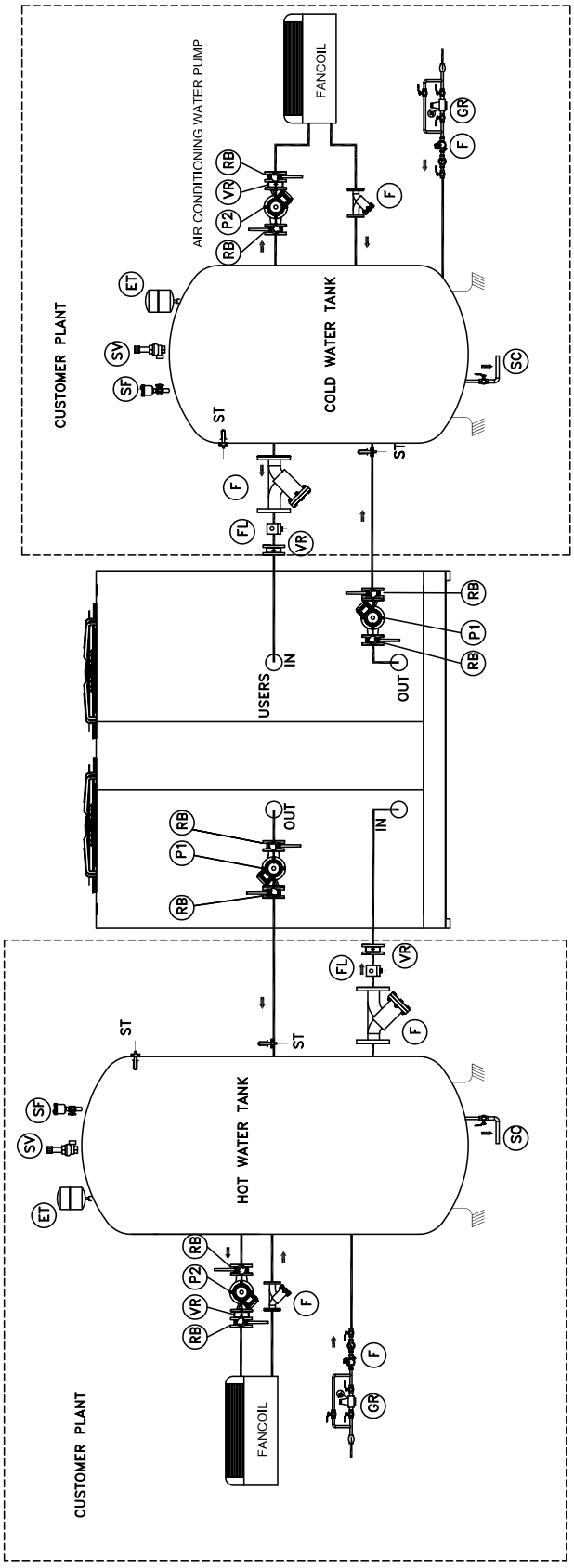
Install the flow switch upright, with a minimum of 5 pipe diameters of straight horizontal run on each side.

Do not install close to elbows, orifices, or other valves.

**Important for water strainers:**

Install the water strainer in the inlet water pipes. Failure to do so can result in heat exchanger tube damage.

## 9.2 Plant sketches for single pump version

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The flow switch signal prevails the build-in delta P switch signal to prevent unit failure in case of lack of water flow.

**Important for flow switches:**

Install the flow switch upright, with a minimum of 5 pipe diameters of straight horizontal run on each side.

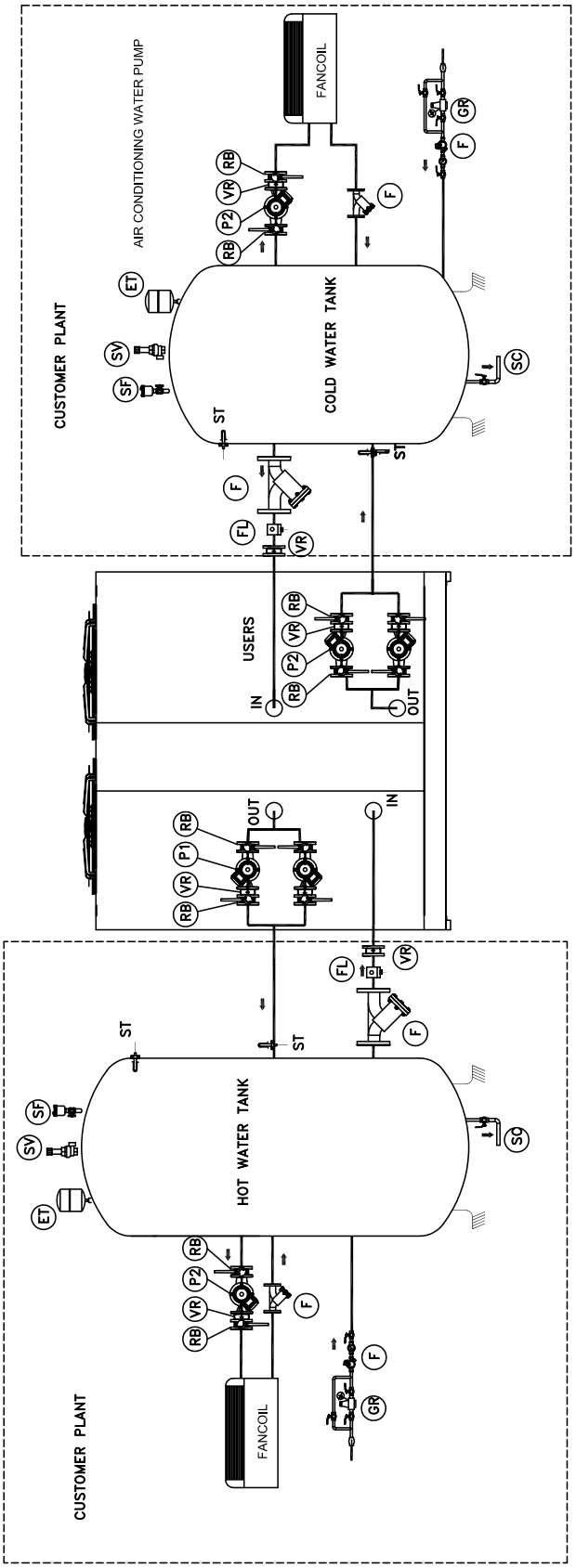
Do not install close to elbows, orifices, or other valves.

**Important for water strainers:**

Install the water strainer in the inlet water pipes. Failure to do so can result in heat exchanger tube damage.

| | | |
|---|---|---|
| P1 | POMPA PRIMARIO | - PRIMARY PUMP |
| P2 | POMPA SECONDARIO | - SECONDARY PUMP |
| ST | SONDA TEMPERATURA | - TEMPERATURE PROBE |
| FL | FLUSSOSTATO | - FLOW SWITCH |
| SC | SCARICO | - DRAINAGE |
| SF | VALVOLA DI SFIATO | - VENT VALVE |
| ET | VASO DI ESPANSIONE | - EXPANSION VESSEL |
| GR | GRUPPO DI RIEMPIMENTO | - FILLING GROUP |
| F | RACCOGLITORE IMPURITA' | - STEEL MESH STRAINER |
| VR | VALVOLA DI NON RITORNO | - CHECK VALVE |
| SV | VALVOLA DI SICUREZZA | - SAFETY VALVE |
| RB | VALVOLA INTERCETTAZIONE | - INTERCEPTION VALVE |

## 9.3 Plant sketches for single pump + stands by pumps version




Flow switches and water strainers are separate and mandatory accessories which must be installed by the contractor/building owner, close to the unit, in both the hot and chilled inlet water pipes.

The flow switch signal prevails the build-in delta P switch signal to prevent unit failure in case of lack of water flow.

**Important for flow switches:**

Install the flow switch upright, with a minimum of 5 pipe diameters of straight horizontal run on each side.

Do not install close to elbows, orifices, or other valves.

**Important for water strainers:**

Install the water strainer in the inlet water pipes. Failure to do so can result in heat exchanger tube damage.

| | |
|---|---|
| P1 | POMPA PRIMARIO - PRIMARY PUMP |
| P2 | POMPA SECONDARIO - SECONDARY PUMP |
| ST | SONDA TEMPERATURA - TEMPERATURE PROBE |
| FL | FLUSSOSTATO - FLOW SWITCH |
| SC | SCARICO - DRAINAGE |
| SF | VALVOLA DI SFIATO - VENT VALVE |
| ET | VASO DI ESPANSIONE - EXPANSION VESSEL |
| GR | GRUPPO DI RIEMPIMENTO - FILLING GROUP |
| F | RACCOGLITORE IMPURITA' - STEEL MESH STRAINER |
| VR | VALVOLA DI NON RITORNO - CHECK VALVE |
| SV | VALVOLA DI SICUREZZA - SAFETY VALVE |
| RB | VALVOLA INTERCETTAZIONE - INTERCEPTION VALVE |

# Plant sketches

Check for hot and cold accumulation, and their proper installation according to the diagrams above.

Before a stationary unit with temperatures close to 0 °C, to provide compressed air to evacuate the contents of the exchanger in order to prevent breakage caused by ice formation.

## 9.4 Hydraulic connections

The connecting pipes should be adequately supported so as not to burden with their weight on the system.

The installation instructions included in the statements to follow, represent a necessary condition for the validity of the guarantee.

Trane is at your disposal to examine any differing needs, which still must be approved prior to the operation of the unit.

It is necessary that the water flow to the group is compatible with that of the evaporator. It is also necessary that the water flow is maintained constant during operation.

***Dimensioning of the minimum water content and flow***

*To function properly, the unit needs a water content sufficient to avoid continuous changes of the cycle or shutdown and restart the compressor too frequently (refer to the contents in this manual page 20) tab p. Refer to the general technical data chapter The content can be reduced by the quantity declared 'contained in the piping distribution system as regards the only air conditioning system. Accumulations undersized reduce the useful life of the unit design.*

*For a correct unit operation, it is absolutely necessary to ensure a constant flow rate to the unit, especially in case of absence storage tanks. It is recommended to mount an automatic or manual valve by-pass between the delivery branch and the return pump and to set it during the commissioning of the unit.*

WARNING: it is recommended to mount on the side water overflow valves to prevent dangerous overpressure and / or water hammer.

**Apparatus for adjusting the water circuit**

Monoblock centrifugal electric pump

Ensures the scope and prevalence needed to power the evaporator shell and tube or plate, storage and utilities.

Automatic water filling

Ensures the maintenance of water pressure in the system at least 1.5 bar.

Safety valve

The safety valve is opened when the pressure of the hydraulic circuit reaches 6 bars.

Expansion vessel

Compensates for small water hammer and volume changes for different temperatures.

Shut-off valves

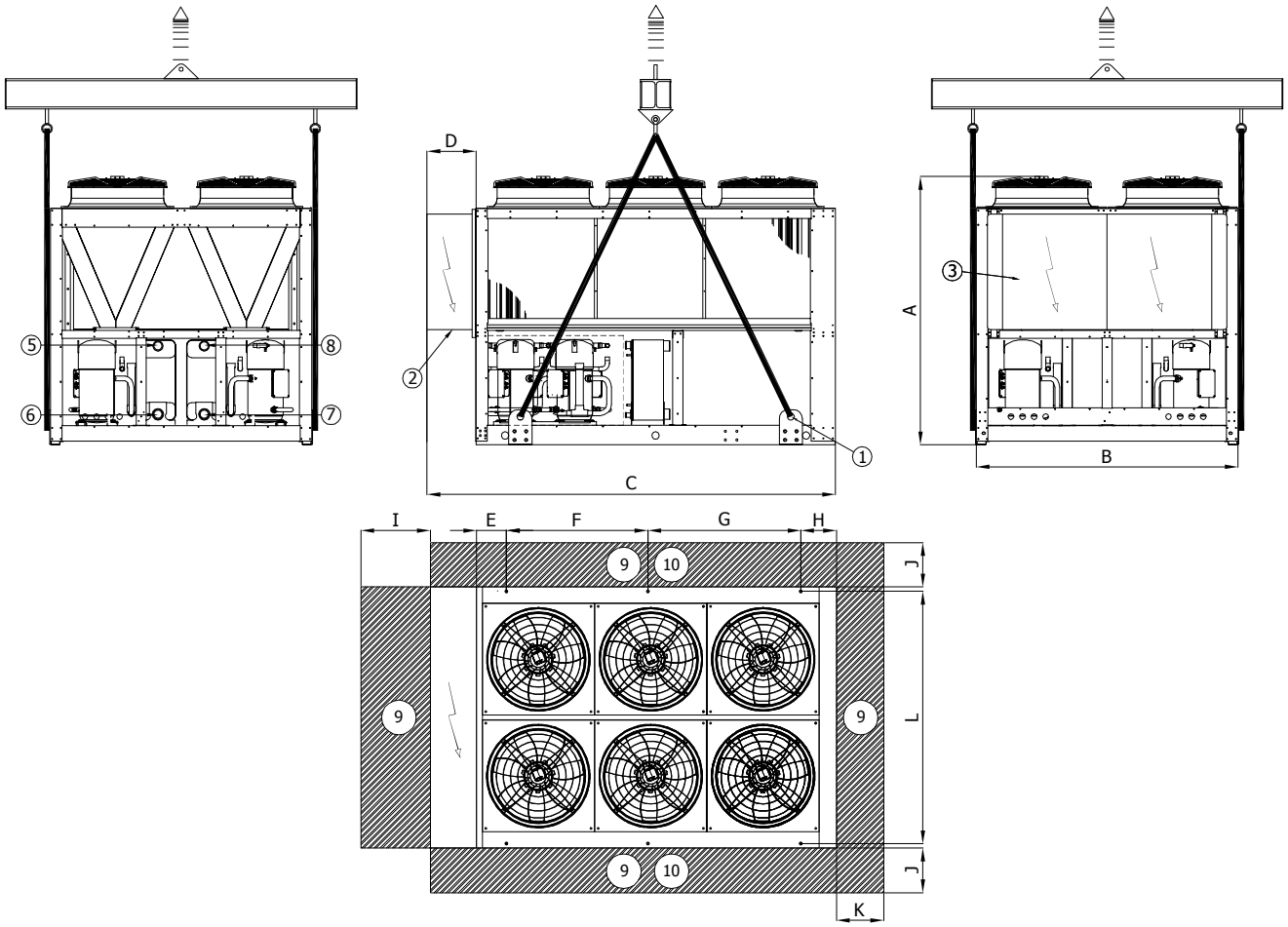
Provide to intercept the pump or other components for maintenance.

Non-return valves

Take steps to ensure the direction of water flow and also have the function of preventing the propagation of heat downstream of the plant when its pump is switched off.The drawing below represents an example of a schematic for lifting and installing a unit. For specific drawings and clearances, contact your local Trane sales office.

# Dimensional drawing and weight

The drawing below represents an example of a schematic for lifting and installing a unit. For specific drawings and clearances, contact your local Trane sales office.




| CMAB HSE | | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **75** | mm | 2111 | 1100 | 2560 | 362 | 152 | 872 | 1022 | 152 | 1000 | 1500 | 600 | 1046 |
| **100** | mm | 2159 | 1100 | 3559 | 360 | 159.5 | 1440 | 1440 | 159.5 | 1000 | 1500 | 600 | 1044 |
| **120** | mm | 2159 | 1100 | 3559 | 360 | 159.5 | 1440 | 1440 | 159.5 | 1000 | 1500 | 600 | 1044 |
| **135** | mm | 2175 | 2201 | 2617 | 423 | 157 | 940 | 940 | 157 | 1000 | 1500 | 600 | 2146 |
| **150** | mm | 2175 | 2201 | 2617 | 423 | 157 | 940 | 940 | 157 | 1000 | 1500 | 600 | 2146 |
| **165** | mm | 2400 | 2260 | 3565 | 455 | 255 | 1300 | 1300 | 255 | 1500 | 1500 | 500 | 2170 |
| **185** | mm | 2400 | 2260 | 3565 | 455 | 255 | 1300 | 1300 | 255 | 1500 | 1500 | 500 | 2170 |
| **225** | mm | 2400 | 2260 | 3565 | 455 | 255 | 1300 | 1300 | 255 | 1500 | 1500 | 500 | 2170 |
| **255** | mm | 2400 | 2260 | 3565 | 455 | 255 | 1300 | 1300 | 255 | 1500 | 1500 | 500 | 2170 |

1 = Lifting holes
2 = Electric power supply
3 = Electric box
4 = A/V mounting position
5 = Chilled water inlet
6 = Chilled water outlet
7 = Hot water inlet
8 = Hot water outlet
9 = Minimum clearance for maintenance
10 = Minimum clearance for air entering

# Dimensional drawing and weight

### Weights

| Operating Weights | | 75 | 100 | 120 | 135 | 150 | 165 | 185 | 225 | 255 |
|---|---|---|---|---|---|---|---|---|---|---|
| Basic Version | kg | 1126 | 1357 | 1471 | 1653 | 1680 | 2128 | 2149 | 2402 | 2766 |
| 2 Pumps - Low head pressure | kg | 1200 | 1399 | 1513 | 1701 | 1728 | 2176 | 2197 | 2500 | 2864 |
| 2+2 Pumps - Low head pressure | kg | 1232 | 1441 | 1555 | 1749 | 1776 | 2224 | 2245 | 2598 | 2962 |
| 2 Pumps - Medium Head pressure | kg | 1210 | 1401 | 1569 | 1751 | 1778 | 2226 | 2247 | 2506 | 2870 |
| 2+2 Pumps - Medium head pressure | kg | 1252 | 1445 | 1667 | 1849 | 1876 | 2324 | 2345 | 2610 | 2974 |
| 2 Pumps - High head pressure | kg | 1228 | 1417 | 1529 | 1711 | 1738 | 2230 | 2251 | 2504 | 2892 |
| 2+2 Pumps - High head pressure | kg | 1288 | 1477 | 1587 | 1769 | 1796 | 2332 | 2353 | 2606 | 3018 |
| **Additional weight** | | | | | | | | | | |
| Super low Noise | kg | 90 | 90 | 181 | 181 | 90 | 181 | 181 | 181 | 181 |

| Shipping weights | | 75 | 100 | 120 | 135 | 150 | 165 | 185 | 225 | 255 |
|---|---|---|---|---|---|---|---|---|---|---|
| Basic Version | kg | 1116 | 1331 | 1445 | 1617 | 1644 | 2092 | 2113 | 2366 | 2714 |
| 2 Pumps - Low head pressure | kg | 1190 | 1373 | 1487 | 1665 | 1692 | 2140 | 2161 | 2464 | 2812 |
| 2+2 Pumps - Low head pressure | kg | 1222 | 1415 | 1529 | 1713 | 1740 | 2188 | 2209 | 2562 | 2910 |
| 2 Pumps - Medium Head pressure | kg | 1200 | 1375 | 1543 | 1715 | 1742 | 2190 | 2211 | 2470 | 2818 |
| 2+2 Pumps - Medium head pressure | kg | 1242 | 1419 | 1641 | 1813 | 1840 | 2288 | 2309 | 2574 | 2922 |
| 2 Pumps - High head pressure | kg | 1218 | 1391 | 1503 | 1675 | 1702 | 2194 | 2215 | 2468 | 2840 |
| 2+2 Pumps - High head pressure | kg | 1278 | 1451 | 1561 | 1733 | 1760 | 2296 | 2317 | 2570 | 2966 |
| **Additional weight** | | | | | | | | | | |
| Super low Noise | kg | 90 | 90 | 181 | 181 | 90 | 181 | 181 | 181 | 181 |

# Water connection diameters

| Tubes diameter | | 75 | 100 | 120 | 135 | 150 | 165 | 185 | 225 | 255 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Basic Version** | | | | | | | | | | |
| ⑤ - ⑥ | Ø | 3″ | 3″ | 3″ | 3″ | 3″ | 3″ | 3″ | 3″ | 3″ |
| | | | | | | GM | | | | |
| ⑦ - ⑧ | Ø | 3″ | 3″ | 3″ | 3″ | 3″ | 3″ | 3″ | 3″ | 3″ |
| | | | | | | GM | | | | |
| **Hydraulic version** | | | | | | | | | | |
| ⑤ - ⑥ | Ø | 2″ | 2″½ | 2″½ | 2″½ | 2″½ | 3″ | 3″ | 3″ | 3″ |
| | | | | | | VICTAULIC | | | | |
| ⑦ - ⑧ | Ø | 2″ | 2″½ | 2″½ | 2″½ | 2″½ | 3″ | 3″ | 3″ | 3″ |
| | | | | | | | | | | |

GM Gas male

# Troubleshooting

In this section you will find a list of the most common problems that may cause the chiller unit to stop or malfunction. Possible remedies are shown alongside a description of easily identifiable remedies.

Warning! Extreme care should be taken when performing work or repairs on the unit: overconfidence can result in injuries, even serious ones, to inexpert individuals. Operations marked with the letter “U” can be performed directly by the user, who must carefully follow the instructions provided in this manual. Operations marked with the letter “S” may be performed exclusively by specialised personnel.

Once the cause has been identified, you are advised to contact authorized service centre or a qualified technician for help.

| Symptom | Cooling | Heating | Who can take corrective action U = User S = specialised personnel | Probable cause | Possible remedy |
|---|---|---|---|---|---|
| **A** The unit does not start | X | X | S | Faulty connection or open contacts | Check the voltage and close contacts. |
| | X | X | S | Lack of external consents | Check the operation of the water pump, the pressure switch, vent the system. |
| | X | X | U | Anti-recycle timer active | Wait 5 minutes for the timer gives consent. |
| | X | X | S | Probe faulty service | Check and replace if necessary. |
| | X | X | U | Lack of consent of the service thermostat | Plant in temperature, lack of demand; verify calibration. |
| | X | X | U | Lack of consent of the frost protection thermostat | Check water temperature Check the calibration of the anti-. |
| | X | X | S | Frost sensor defective | Check the operation. |
| | X | X | S | Tripped breaker general | Check if there are any short circuits in the wiring or in the windings of the motors of pump, fan, compressor, and the transformer. |
| | X | X | S | Lack of consent of the high or low pressure | See points D-E. |
| | X | X | S | Defective compressor | See point B. |
| **B** The compressor does not start | X | X | S | Compressor burnt or seized | Replace the compressor. |
| | X | X | S | Compressor contactor de- energized | Check the voltage across the coil of the compressor contactor and the continuity of the coil. |
| | X | X | S | Power circuit open | Investigate the cause of the protection, and check if there are any short circuits in the wiring or in the windings of the motors of pump, fan, compressor and transformer. |
| | | X | S | Motor thermal protection open | The compressor has operated in critical condition or there is a lack of charge in the circuit: Make sure that working conditions are within the limits of operation. Loss of coolant: see section G. |
| **C** The compressor starts up and stops repeatedly | X | X | S | Intervention of the minimum | See point E. |
| | X | X | S | Compressor contactor defective | Check and replace if necessary. |
| | X | X | U | Calibration values of the set- point or differential | Modify them as reported in the tables. |
| | X | X | S | Lack of coolant | See point G. |

# Troubleshooting

| Symptom | Cooling | Heating | Who can take corrective action U = User S = specialised personnel | Probable cause | Possible remedy |
|---|---|---|---|---|---|
| **D** The compressor does not start because the maximum pressure switch has tripped | X | X | S | Pressure switch out of order | Check and replace. |
| | X | X | S | Overcharge of refrigerant | Download the excess gas. |
| | X | | U | Finned coil clogged, air flow rate is too low | Remove dirt from the coil and obstructions to the airflow. |
| | X | | S | Fan not working | See point F. |
| | | X | U | Water circulation pump blocked | Unlock the pump. |
| | | X | S | Water circulation pump defective | Check the pump and replace if necessary. |
| | X | X | S | Presence of non-condensable gases in the refrigerant circuit | Prime the circuit after it has been downloaded and put under vacuum. |
| | X | X | S | Refrigerant filter clogged | Check and replace. |
| **E** The compressor does not start because the minimum pressure switch has tripped | X | X | S | Pressure switch out of order | Check and replace. |
| | X | X | S | Machine completely download | See point G. |
| | | X | U | Finned coil clogged, air flow rate is too low | Remove dirt from the coil. |
| | X | | U | Water circulation pump blocked | Unlock the pump. |
| | X | | S | Water circulation pump blocked defective | Check the pump and replace if necessary. |
| | | X | S | Presence of frost on evaporator coil | See point O. |
| | | X | S | Evaporator fan not working | See point F. |
| | X | X | S | Refrigerant filter clogged | Check and replace. |
| | X | X | S | Expansion device that is not working properly | Check and if necessary replace. |
| | X | X | S | The presence of moisture in the refrigerant circuit | Replace the filter and dry eventualmentem and recharge. |
| **F** The fans do not start | X | X | S | Fan contactor de-energized | Check the voltage across the coil of the contactor and the continuity of the coil. |
| | X | X | S | Lack of output voltage from the control fan speed | Check the contacts, replace if necessary. |
| | X | X | S | Thermal protection inside the fan | Check the condition of the fan and the air temperature during operation of the unit. |
| | X | X | S | Fan motor faulty | Check and replace. |
| | X | X | S | Loose electrical connections | Check and secure. |
| **G** Lack of gas | X | X | S | Loss in the refrigerant circuit | Check the cooling circuit using a leak detector after pressurising the circuit to approximately 4 bars. Repair, evacuate and refill. |
| **I** Frost in liquid pipe downstream from a filter | X | X | S | The liquid filter is clogged | Replace the filter. |

# Troubleshooting

| Symptom | Cooling | Heating | Who can take corrective action U = User S = specialised personnel | Probable cause | Possible remedy |
|---|---|---|---|---|---|
| **L** The unit works continuously without ever stopping | X | X | S | Lack of refrigerant gas | See item G. |
| | X | X | U | Incorrect tuning of the operating thermostat | Check the setting. |
| | X | X | S | Excessive thermal load | Reduce the thermal load. |
| | X | X | S | Compressor does not give the thermal output | Check, change or revise. |
| | X | X | S | The liquid filter is clogged | Replace. |
| **M** The unit works regularly but with an insufficient capacity | X | X | S | Low refrigerant charge | See point G. |
| | X | X | S | 4-way reversing valve defective | Check the power supply and the coils of the valve and replace the valve. |
| **N** Frost in the compressor intake pipe | X | X | S | Expansion device that is not working properly | Verify replace. |
| | X | | S | Water circulation pump blocked | Unlock the pump. |
| | X | X | S | Water circulation pump defective | Check the pump and replace if necessary. |
| | X | X | S | Low refrigerant charge | See point G. |
| | X | X | S | The liquid filter is clogged | Replace. |
| **O** The defrosting cycle is never activated | | X | S | 4-way reversing valve defective | Check the power supply and the coil of the valve and replace the valve. |
| | | X | S | The defrost thermostat is worn out or has an incorrect calibration value | Check and replace if defective or change the calibration value. |
| **P** Abnormal noises detected in the system | X | X | S | Compressor noisy | Check and replace if necessary. |
| | X | X | S | The panels vibrate | Fasten properly. |
| **Q** THE UNIT DOES NOT START | X | X | s | phases of the supply network reversed | Invert phases. |

# Notes

## Notes

## Notes

Trane optimizes the performance of homes and buildings around the world. A business of Ingersoll Rand, the leader in creating and sustaining safe, comfortable and energy efficient environments, Trane offers a broad portfolio of advanced controls and HVAC systems, comprehensive building services and parts. For more information visit www.Trane.com

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