



Installation Operation Maintenance

Indoor air-cooled chillers and heat pumps
Models CGCM/CXCM



July 2015

CG-SVX033A-GB

Original instructions

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General Information

Purpose of this 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.

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 .

The units covered by this manual represent an excellent investment and deserve attention and care both for correct installation is 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.

This manual describes the features and procedures common to the whole number of units. All units are shipped with schematic and dimension drawing, dimensions and weights for the specific unit. **WIRING AND OVERALL DESIGN OF SPECIFIC TO BE CONSIDERED AS AN INTEGRAL PART OF THIS MANUAL.** In case of discrepancy between this manual and the two documents cited prevail as shown on the wiring diagram and outline drawing.

Receiving the unit

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.

Checks

Perform the following checks upon receipt of the unit, for your protection in the event that it is incomplete (missing parts) or has incurred damage during transport: Before accepting the unit, verify every component in the consignment. Check for damage.

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

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

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. In case it is not sent back or delayed, the complaint will not be accepted.

Unit Identification

The unit is identifiable through:

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

Tampering with, removal, lack of identification markings or anything else does not allow reliable identification of the product, makes it hard for any installation and maintenance.

**Label**

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

In case of loss please request for a duplicate from the after sales service. Tampering and/or re-handling the label do not allow the identification of the product, and may complicate any installation and maintenance operation.

Serial number

The serial number identifies the unit unambiguously, it permit to identify the specific characteristic of the unit and the installed components. Without this serial number it is not possible to identify the specific spare parts of the unit. In case of a repair request it is necessary to know the model and serial number.

Operating range

The operating ranges are indicated on the plate placed on the unit

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 authorized 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 TRANE written approvals.

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.



Mechanical Installation

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.

Safety

It is essential to observe the following instructions:

- The unit must be securely fixed to the ground.
- 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 unauthorized 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.

CAUTION! Before carrying out any operation on the unit, please read the instruction 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.

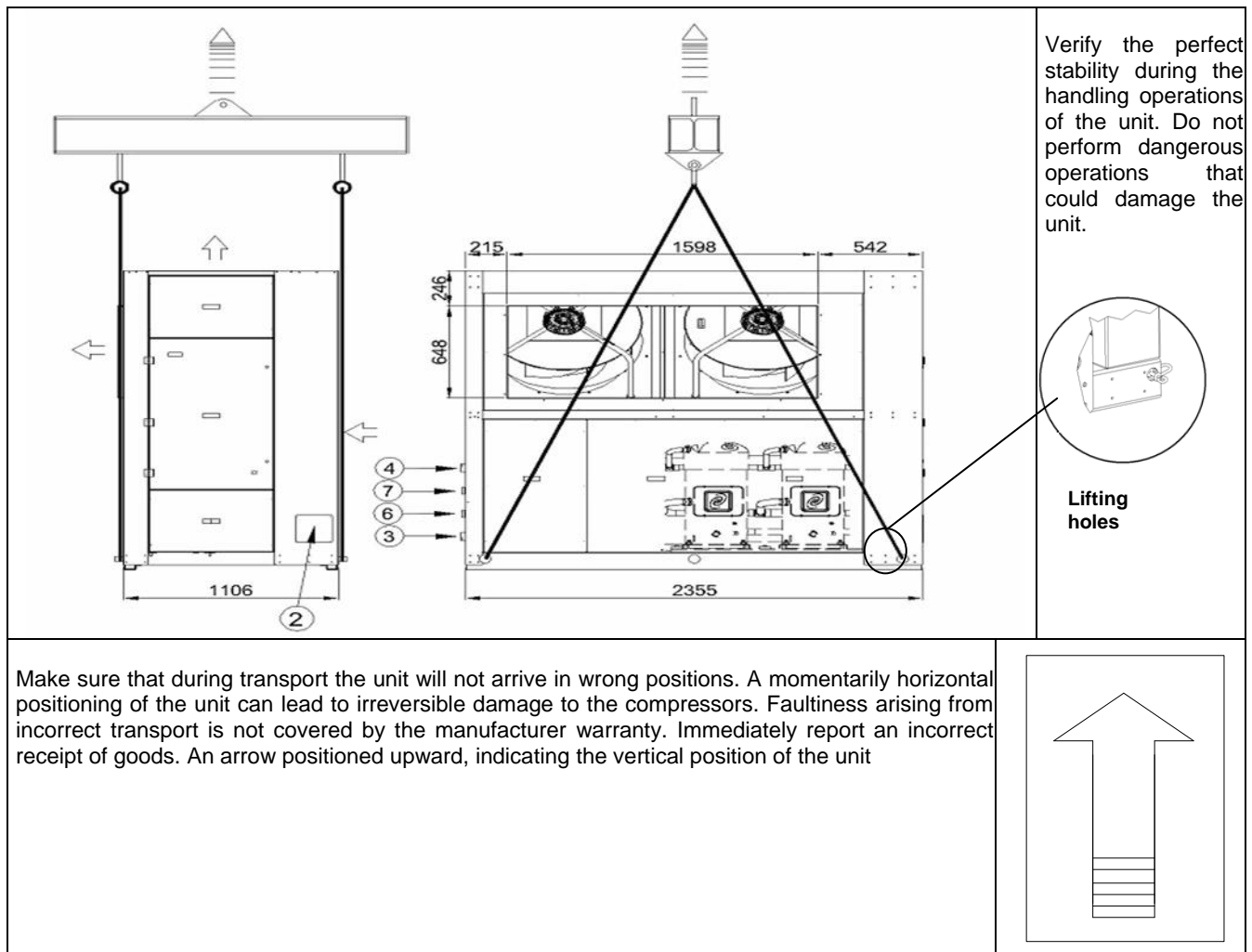
WARNING! The installation of the unit must be avoided in any place that can be considered dangerous during maintenance, such as (but not only) covers without parapets or railings or without proper clearances.

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.

CAUTION! The plates welded at the end of the bases must not be used for handling.

Check the weight of the unit 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.)



WARNING! Both the lifting ropes that 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. Weights given in the tables "Technical data" in the "General Information" refers to standard units, without any additional options. The unit may have specific accessories that increase the overall weight (pumps, copper / copper coils, etc..). The unit must be lifted with the utmost attention and care. Avoid abrupt lifting.

Operating limits

Storage

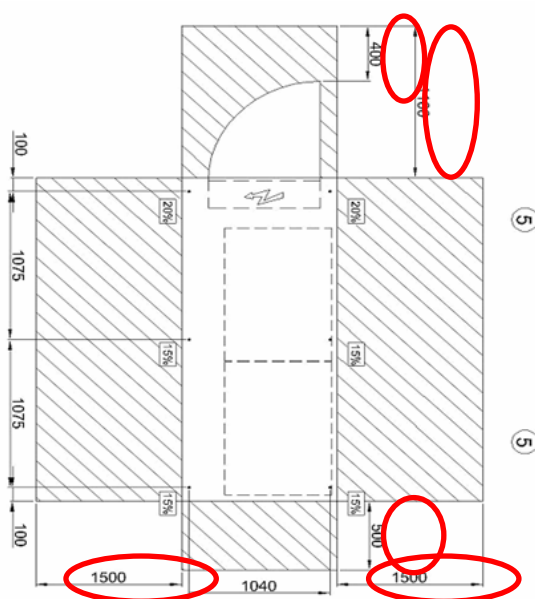
The units can be stored within the following environmental conditions:

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

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

Condensation (too high humidity) can damage electronic components.





Condensate drainage

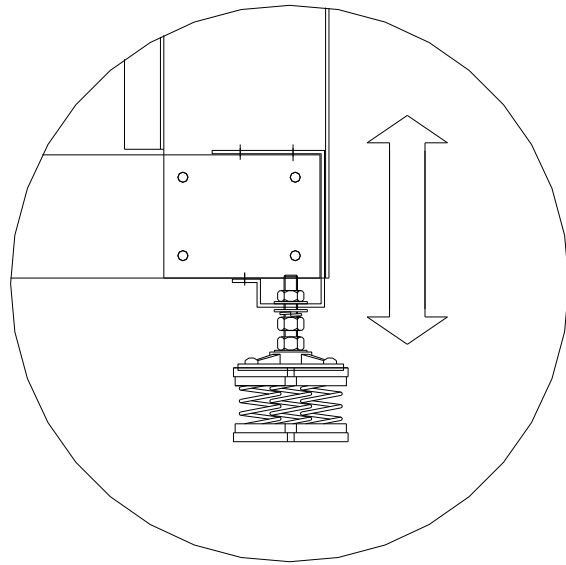
It is critical to easily discharge the condensate caused by the heat pump operation, especially during the defrosting cycle. Avoid placing the condensate drain where people transit.

Anti-vibration

Isolation rubber pads are supplied as standard with the unit, and should be placed between the supporting floor and the unit to isolate the base from the ground.

Secure the bottom part of the anti-vibration to the base unit will support it. (fix the anti-vibration bolts)

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.

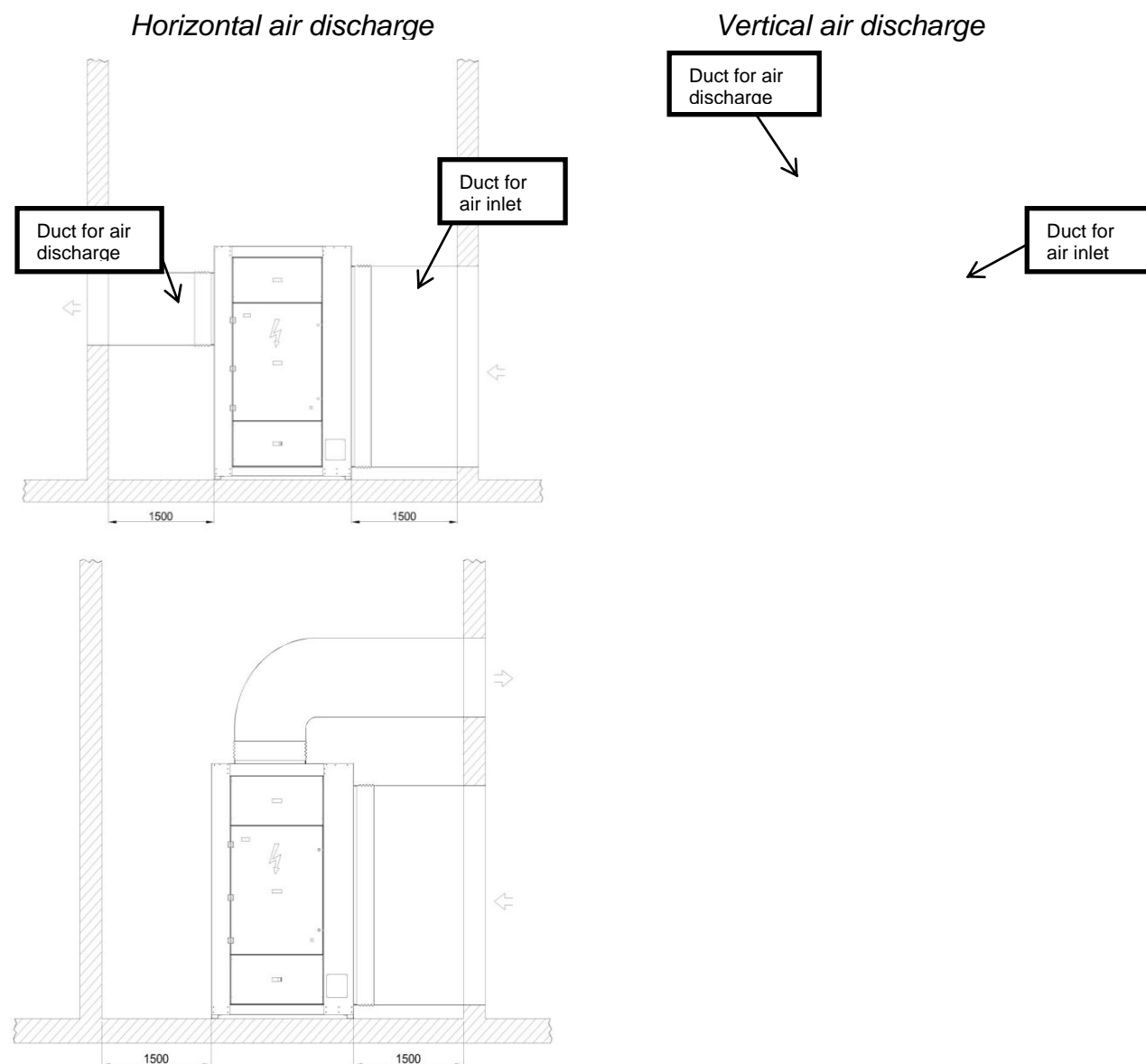




Installation

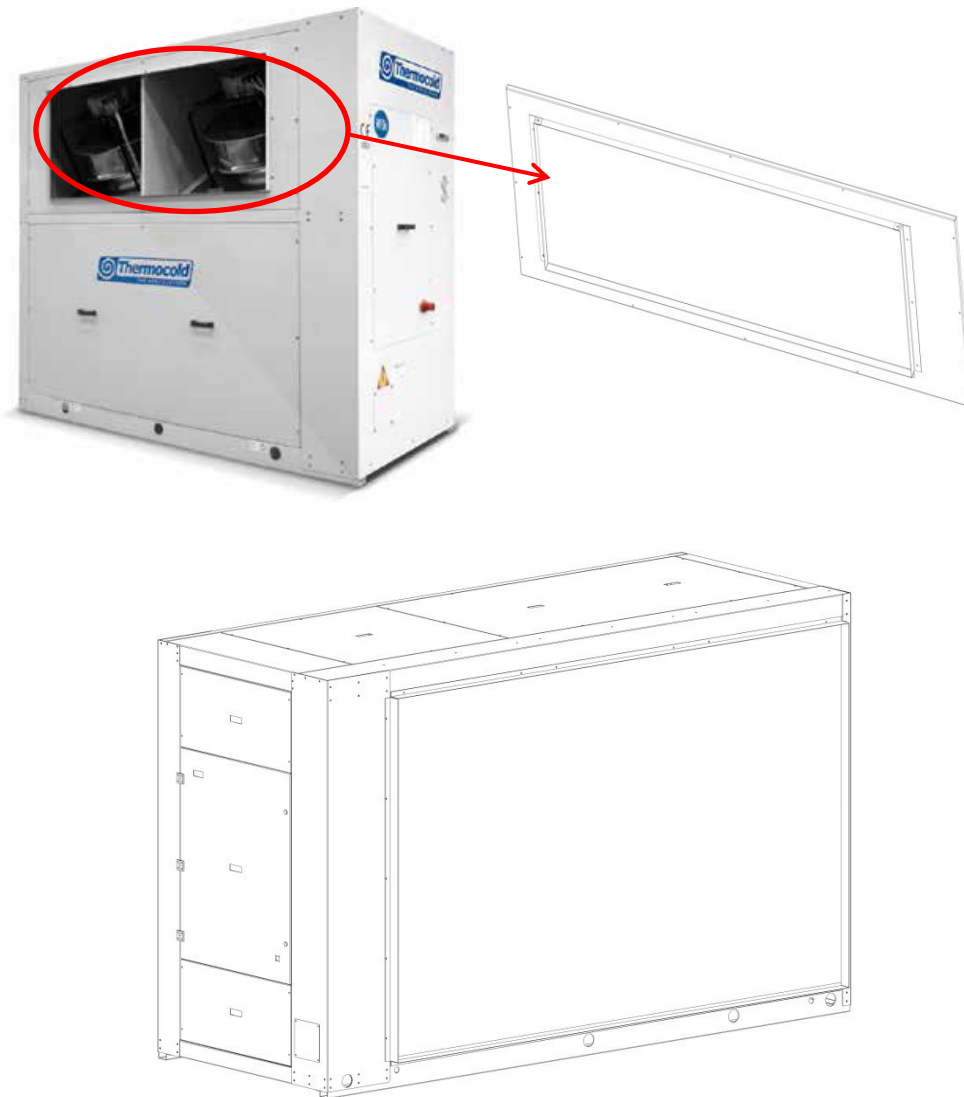
Duct connections

Duct connections of suction and discharge of the unit and accessories must be made of flexible hose. The duct connection must be flexible enough to prevent transmitting vibrations to the tube network. On all units, a straight duct section connected to a fan must have at least the same cross sectional area as the output panel orifice, and its minimum length must be one and a half times the fan diameter, before any bend or deviation.



For all units, insert a flexible joint waterproof to avoid any vibrations. The air intake of the coil and exhaust air fan must absolutely be as short and straight as possible. The cross section area of the duct should be at least as large as the group of intake and exhaust. There are installed grilles on external air intake. The discharge opening must always be above the air intake, and should be at least oriented upward. When sizing ductwork the external static pressure of the fans should be considered.

It is essential for the installation that the flange which ensures the connection with the duct in the inlet and discharge air be drilled to determine the correct installation of the duct on the suction side to fix ducts to avoid vibrations. It is possible to drill flange to ensure attachment and coupling ducts, as shown below.



CAUTION! Unit operation is function of the air temperature. Any recycling of the air fed out by the fans will increase the air intake temperature over the condenser fins and can result in high pressure cutout. In this case the standard operating conditions are modified. Operation of the unit may be affected by an increase in air temperature on the condenser. When fixing the duct to the condenser inlet, make sure the fixing screws do not pierce the coil. To prevent a reduction in fan efficiency, which would reduce the air flow and the unit's cooling capacity, the duct connections must be designed and connected according to normal trade practice. If the duct network does not provide the external static pressure stipulated on selection, it will have repercussions on the air flow and therefore on the unit's performance.



Plug Fans

Plug fans are simple suction, constructed of sheet steel treated with polyester paint against corrosion, centrifugal fan with curved blades backward sheet galvanized steel, dynamically balanced. Three phase motor with a PTC for fail-safe operation, IP54, class F. Equipped with hub (taper lock hub or fixed hub) and inlet ring. Figure below shows dimensions and wiring.

Dimensions and wiring - Plug fan on unit size 010 to 020

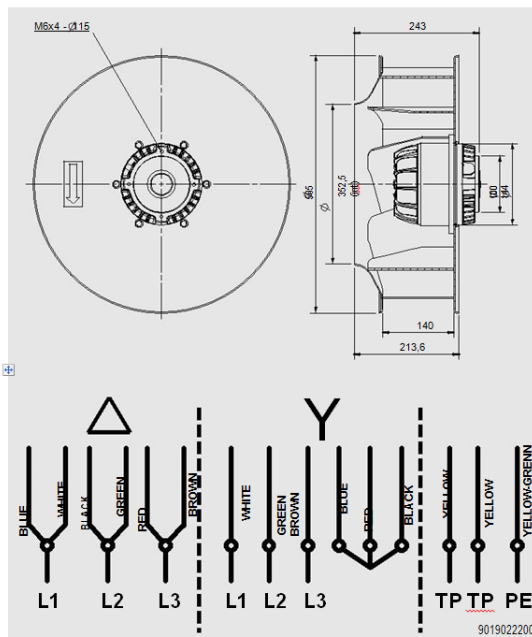
IP54

Caratteristiche Characteristics

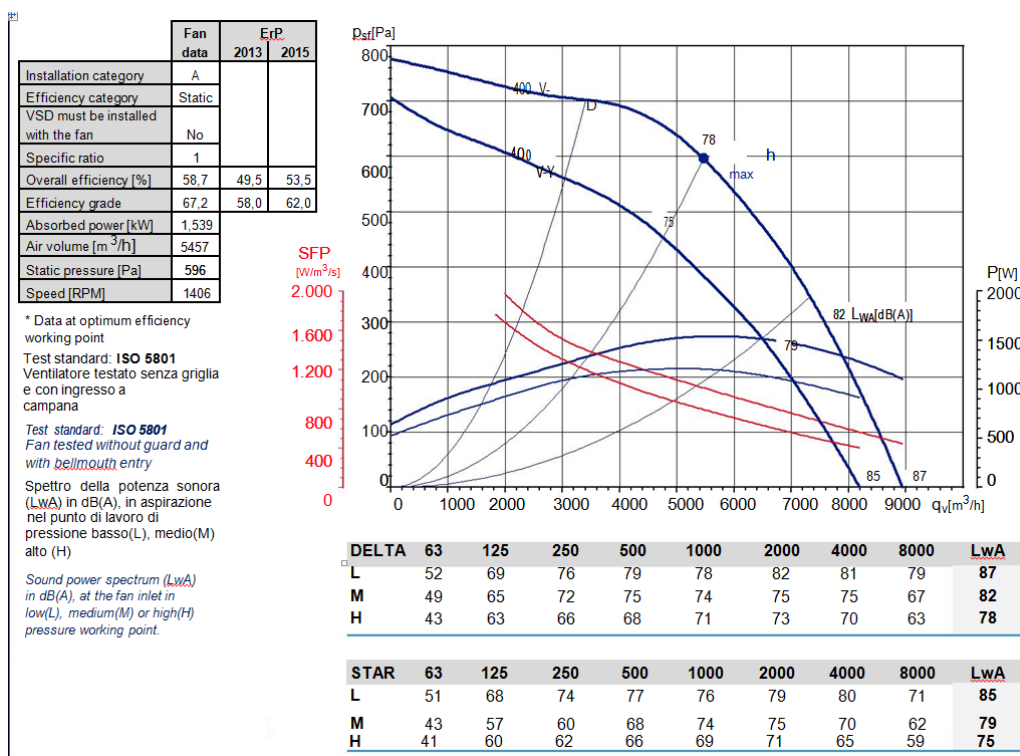
Tensione Voltage	3 ~400V 50Hz
Tipo motore Motor type	1V IP54 dLE
Velocità Speed	4 poli 4 poles
Potenza motore Motor power	1,54/1,21 kW
Corrente massima assorbita Maximum absorbed current	3,2/2,0 A
Ia/In Is/In	-,-
Temperatura dell'aria Air temperature	-40°C<T<+70°C
Peso Weight	29,0 kg



Dimensioni e Connessioni Dimensions and wiring



Performance curves - Plug fan on unit size 010 to 020



Dimensions and wiring - Plug fan on unit size 025 to 060

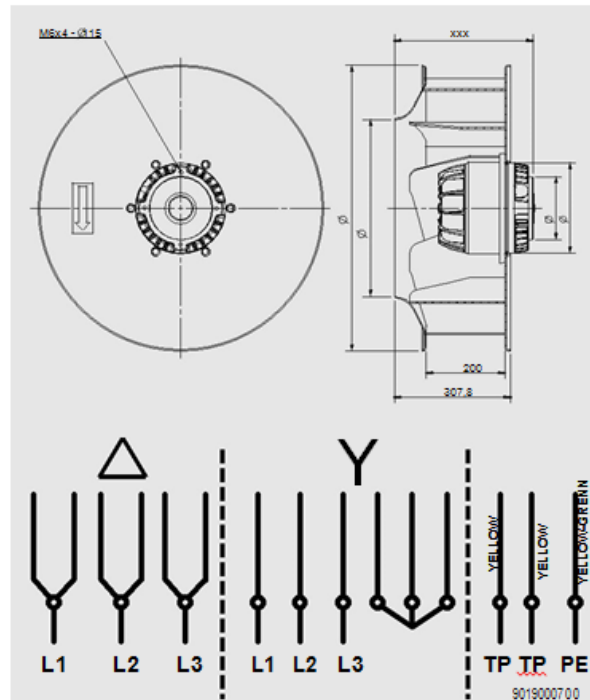
IP54



Caratteristiche Characteristics

Tensione Voltage	3 ~400V 50Hz
Tipo motore Motor type	1V 1S <small>IP54 CLZ</small>
Velocità Speed	6 poli 6 poles
Potenza motore Motor power	2,82 kW
Corrente massima assorbita Maximum absorbed current	5,2 A
Ia/I _n Is/I _n	-
Temperatura dell'aria Air temperature	-40°C<T<+60°C
Peso Weight	54,0 kg

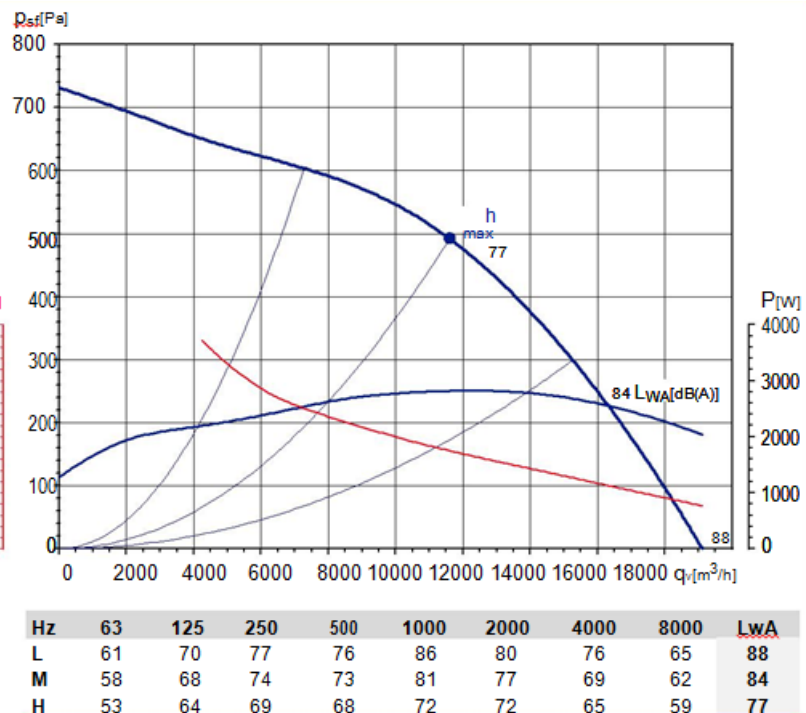
Dimensioni e Connessioni Dimensions and wiring



Performance curves -- Plug fan on unit size 025 to 060

	Fan data	ErP 2013	ErP 2015
Installation category	A		
Efficiency category	Static		
VSD must be installed with the fan	No		
Specific ratio	1		
Overall efficiency [%]	56,3	52,2	56,2
Efficiency grade	62,1	58,0	62,0
Absorbed power [kW]	2,819		
Air volume [m ³ /h]	11601		
Static pressure [Pa]	492		
Speed [RPM]	910		

* Data at optimum efficiency working point
Test standard: ISO 5801
Ventilatore testato senza griglia e con ingresso a campana
Test standard: ISO 5801
Fan tested without guard and with bellmouth entry
Spettro della potenza sonora (L_{WA}) in dB(A), in aspirazione nel punto di lavoro di pressione basso (L), medio (M) alto (H)
Sound powers spectrum (L_{WA}) in dB(A), at the fan inlet in low (L), medium (M) or high (H) pressure working point



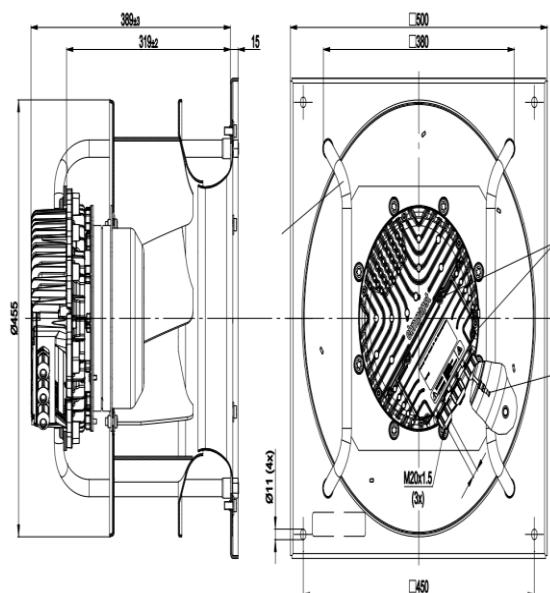


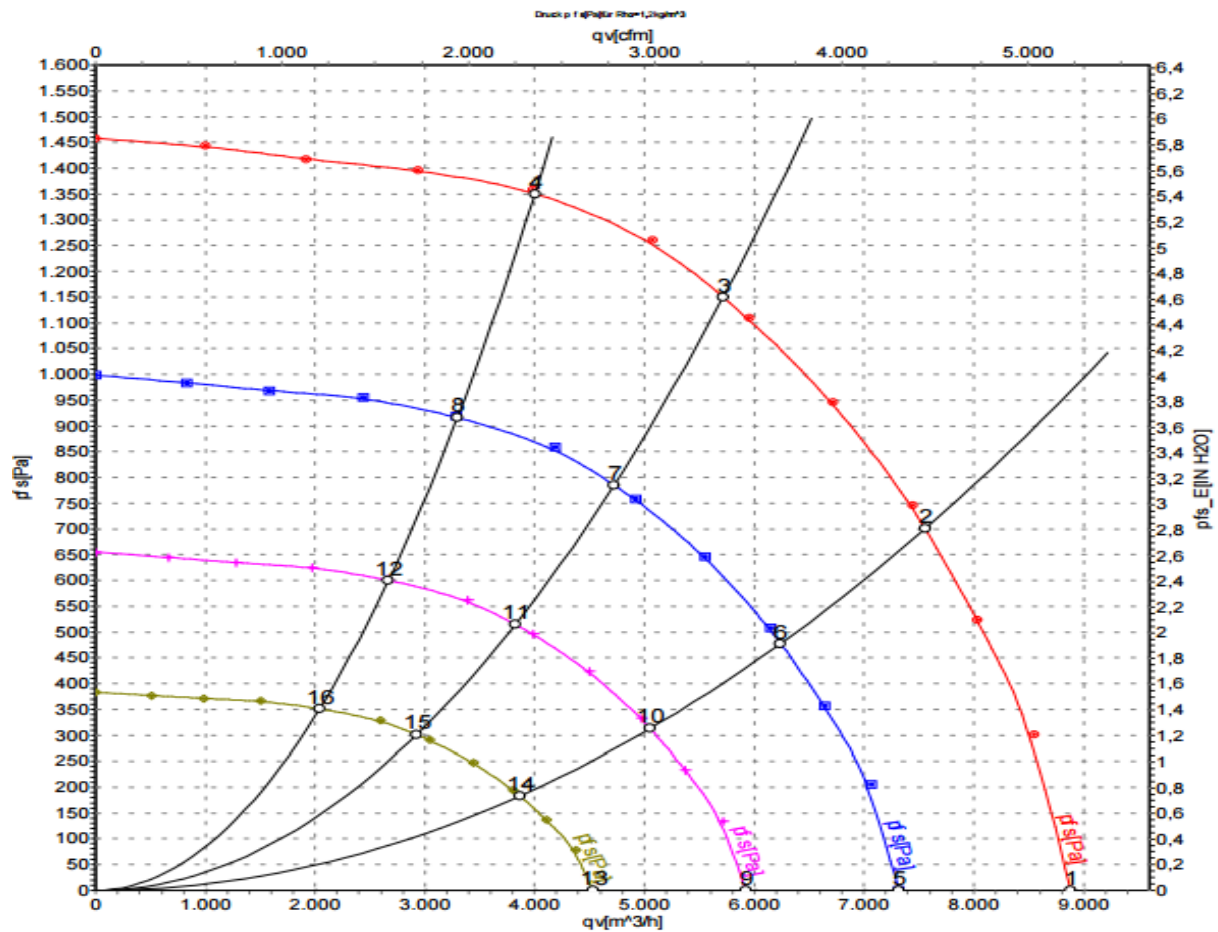
Optional EC Plug fan on unit size 010 to 020

Nominal data

Type	K3G400-AQ23-01	
Motor	M3G150-FF	
Phase		3~
Nominal voltage	VAC	400
Nominal voltage range	VAC	380 .. 480
Frequency	Hz	50/60
Type of data definition		ml
Speed	min ⁻¹	2550
Power input	W	3000
Current draw	A	4.6
Min. ambient temperature	°C	-25
Max. ambient temperature	°C	+60

ml = Max. load · me = Max. efficiency · fa = Running at free air · cs = Customer specs · cu = Customer unit
Subject to alterations



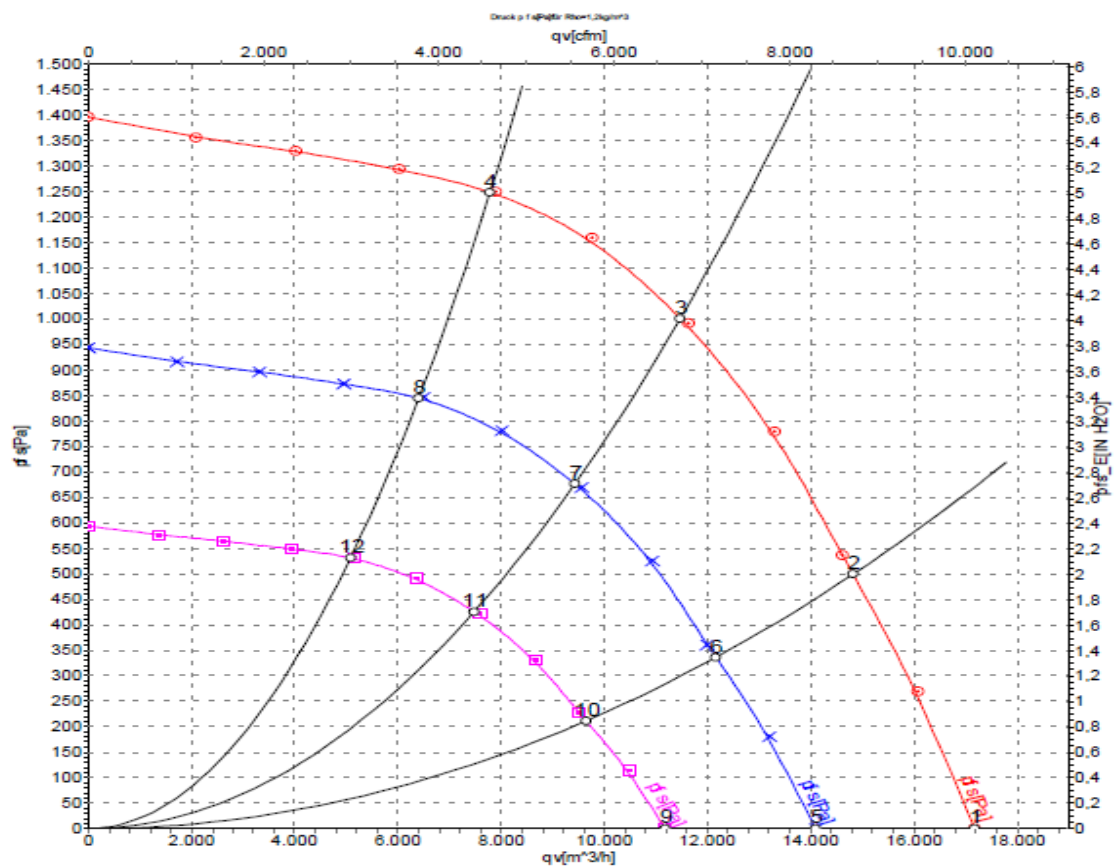
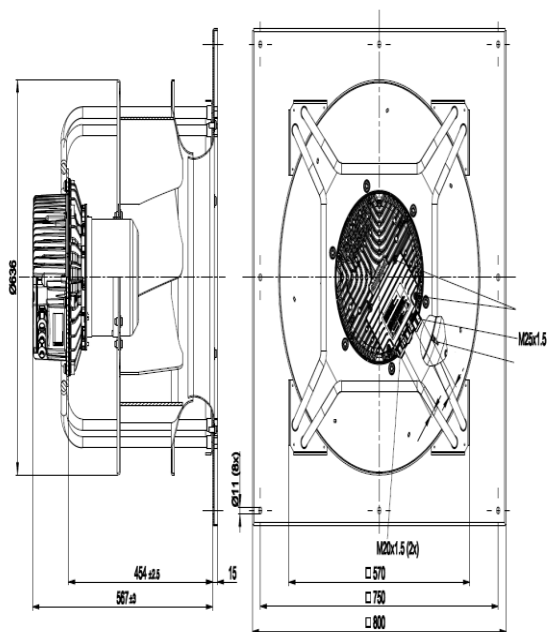


Optional EC Plug fan on unit size 010 to 020

Nominal data

Type	K3G560-AQ04-01	
Motor	M3G150-NA	
Phase		3~
Nominal voltage	VAC	400
Nominal voltage range	VAC	380 ... 480
Frequency	Hz	50/60
Type of data definition		ml
Speed	min ⁻¹	1750
Power input	W	4700
Current draw	A	7.3
Min. ambient temperature	°C	-25
Max. ambient temperature	°C	40

ml = Max. load · me = Max. efficiency · fa = Running at free air · cs = Customer specs · cu = Customer unit
Subject to alterations





Safety regulations and Certifications

Reference standards

- THE PRESSURE EQUIPMENT DIRECTIVE (97/23/EC).
- UNI EN ISO 3744 ACOUSTIC REGULATION.
- UNI-EN-ISO 9001:2008: QUALITY MANAGEMENT SYSTEMS
- LOW VOLTAGE DIRECTIVE (LVD) 2006/95/EC
- MACHINERY DIRECTIVE 2006/42/EC
- DIRECTIVE FOR ELECTROMAGNETIC COMPATIBILITY 2004/108/CE.
- CEI-EN 60204-1 DIRECTIVE (CEI44-5; CEI EN 62061) MACHINERY SAFETY – ELECTRIC MACHINERY – EQUIPMENTS
- ERP DIRECTIVE (ENERGY-RELATED-PRODUCTS ECODESIGN 2009/125/CE)
- UNI EN 14511-1-2-3-4 TESTING CONDITIONS

Certifications

PED RELEASED FROM IMQ SPA - NOTIFIED BODY FOR REGULATION 97/23/EC (NO. 0051) ACCORDING TO THE FOLLOWING STATEMENTS:

- DECLARATION OF QUALITY SYSTEM APPROVAL - FORM H1 (QUALITY ASSURANCE WITH DESIGN CONTROL AND MONITORING OF FINAL CHECK DETAIL): CERTIFICATE N. PEC-0051-1105003.
- CERTIFICATES OF EXAMINATION OF THE PROJECT N. 0051-PEC-1105004/05/06/07/08.
- QUALITY CERTIFICATION ACCORDING TO THE STANDARD UNI EN ISO 9001:2008 ISSUED BY CSQ (ACCREDITED BY ACCREDIA).
- PERFORMANCE CERTIFICATION OF THE UNIT WITH THE PRESENCE OF RINA SPA DURING THE TESTING PROCESS (OPTIONAL).
- GOST CERTIFICATION - (OPTIONAL) FOR PRESSURE RECIPIENTS OF THE RUSSIAN FEDERATION.

Definitions

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 moving 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 replacement 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.

General safety precautions

The operator must only intervene on the unit controls; 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 machine; he or she must not open any machine 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, removing 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	R410a
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	Vapours 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 fresh water and to drink almost 0,25 litres. The intervention of a doctor is useful.
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 - Behaviour 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.
Disassembly	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.

Precautions against residual risks due to the control 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 machine 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 moving parts while the unit is running.
- before restarting the unit make sure that the moving 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 is mainly coming from non-functioning of the safety devices.
To prevent them it is necessary to follow the checks and replacements as following:

- 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
- 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 machine without putting on protective gloves.
- keep a fire extinguisher which is able to put out fires on electrical equipment near the machine.
- 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.

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 machine 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 machine 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.

Manual alarm reset

If there is an alarm, the unit must not be manually reset before having located and eliminated the cause of the fault. Repeated manual resets may cause the warranty to be annulled.

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 water 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 water 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 prevented by frost protection systems. Trane suggest to insert frost thermostatic resistances on every outdoor pipes.

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: "Ethylenic glycol correction table".



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 compressor feet before the start-up otherwise the warranty is not valid.

Acoustic Protection

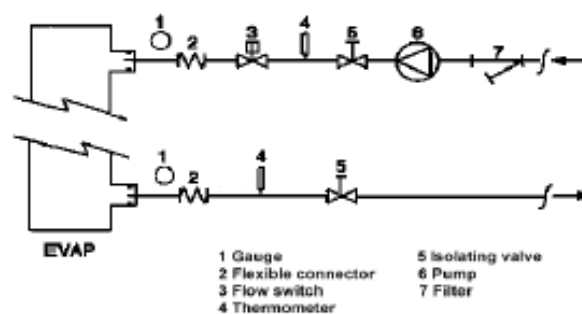
When the sound level must be checked in particular, it is necessary to pay maximum WARNING in isolation from the base of the unit properly applying the anti-vibration mounts (provided optionally). Also, install flexible joints on water connections.

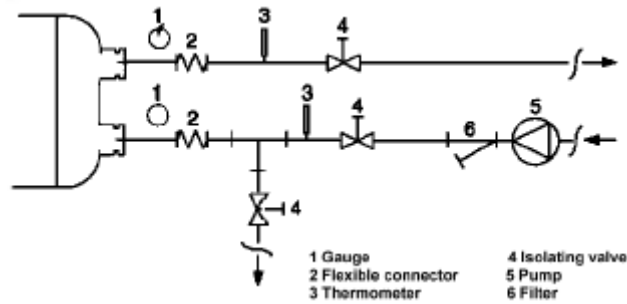
Water piping

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 ingoing water to the unit, near the evaporator and heat recovery (if installed). The filter avoids solid particles entering the heat exchanger, as they could damage it or reduce its heat exchanging capacity.
 8. The shell and tube heat exchanger has an electrical resistance with a thermostat that ensures protection against water freezing up to an outdoor temperature of -25°C . All the other hydraulic piping outside the unit must therefore be protected against freezing.
 9. The heat recovery device must be emptied of water during the winter season, unless an ethylene glycol mixture in appropriate percentage is added to the water circuit.
 10. 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.
 11. 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.





Hydraulic connection heat recovery

WARNING! Install a mechanical filter at the entrance of each heat exchanger. Failure to install the mechanical 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. The manufacturer can not be held responsible for any damage to heat exchangers due to the lack of a mechanical filter.

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.

For units equipped with plate heat exchangers the filter should guarantee a filtration of particles until 0,8 mm. Trane is not responsible for damages to or malfunctioning of the equipment caused by failure to treat water or by improperly treated water.

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	Fe (mg Fe / l)	1.0
Chloride ion (mg Cl ⁻ / l)	200	Sulphide ion (mg S ₂ ⁻ / l)	Absent
Sulphate ion (mg SO ₄ ²⁻ / l)	200	Ammunium ion (mg NH ₄ ⁺ / l)	1.0
Alkalinity (mg CaCO ₃ / l)	100	Silica (mg SiO ₂ / l)	50

Antifreeze protection on the heat exchangers

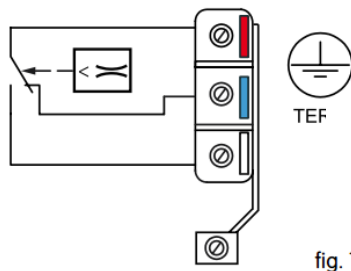
Evaporator and recovery exchangers anti-freeze protection

All evaporators are supplied with a thermostatically controlled anti-freeze electrical resistance, which provides adequate anti-freeze protection up to -25°C. However, this method is not the only protection system against freezing, unless the heat exchangers are completely emptied and cleaned with anti-freeze solution.

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

- Continuous water flow circulation inside piping and exchangers.
- Addition of an appropriate amount of glycol inside the water circuit
- Additional heat insulation and heating of exposed piping
- Emptying and cleaning of the heat exchanger 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.



Screw for load control

Note: The flow switch is factory-calibrated with reference to the minimum cut-out value. To increase this value, turn the adjustment screw clockwise. The cut-out value must be \geq the minimum flow necessary to ensure the protection of the system. The units without fittings will be supplied with 4 paddles (see drawing palette), which must be cut according to the pipe. On request they can be supplied to all devices with the T-piece.

CAUTION! 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 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.



Hydraulic Data

Water Flow and Pressure Drop

The units have to work with the flow of inertia and tanks provided in the product catalog.

Hydronic Group

The 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.

Hydraulic Versions

Hydraulic versions are available in according with dates provided in the product catalog.

Hydronic Kit

Centrifugal pumps with 2 or 4 poles, axial suction bowls and radial delivery, available in low, medium or high head pressure. Pumps with cast iron body and impeller entirely welded using laser technology. Mechanical seal with ceramic components, coal and EPDM elastomers. Three phase electric motor with IP55 protection and insulation class F, suitable for continuous service.

Series motors with higher efficiency IE2 technology.

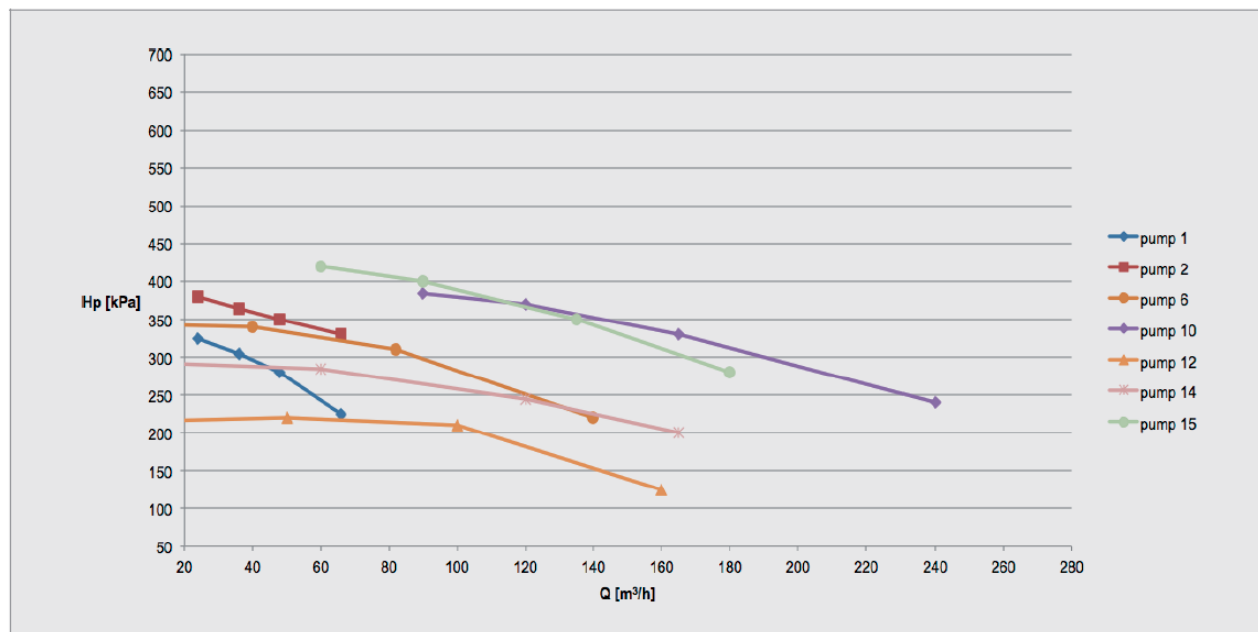
- Differential pressure switch on exchanger
- Discharge taps
- Taps on pumps suction / delivery which allow the replacement of a damaged pump eliminating the plant shutdown differently from other types of common use.
- Check valve
- Relief valve
- Discharge valve
- Minimum / maximum pressure switch

The stand by pump accessory is also available, including an additional pump in stand-by mode to the first, equipped with manual changeover or automatic changeover (optional) including. With the automatic changeover option 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.

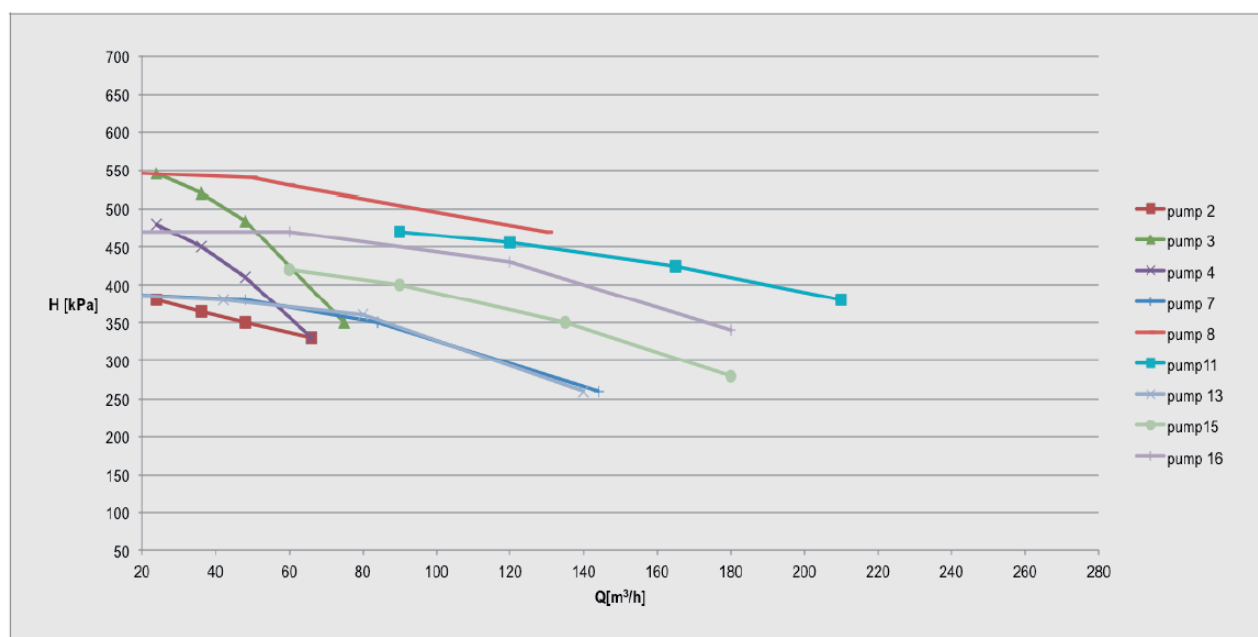
Hydronic Accessories On Request

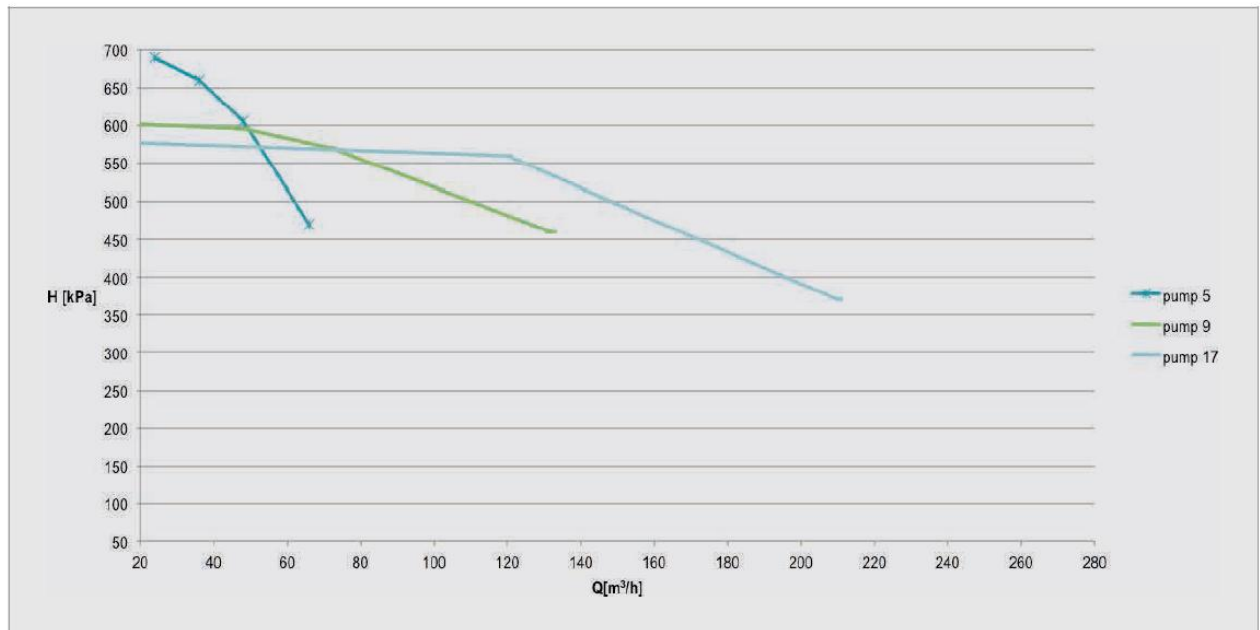
- "Y" water strainer (sold separately), consists of body and stainless steel mesh, with replaceable filter through the inspection cap.
- Automatic water filling (sold separately).
- B1 one pump and expansion vessel, low available pressure 150 kPa
- M1 one pump and expansion vessel, medium available pressure 250 kPa
- A1 one pump and expansion vessel, high available pressure 450 kPa
- B2 two pumps and expansion vessel, low available pressure 150 kPa
- M2 two pumps and expansion vessel, medium available pressure 250 kPa
- A2 two pumps and expansion vessel, high available pressure 450 kPa

LOW HEAD PRESSURE PUMP (150 kPa)



MEDIUM HEAD PRESSURE PUMP (250 kPa)

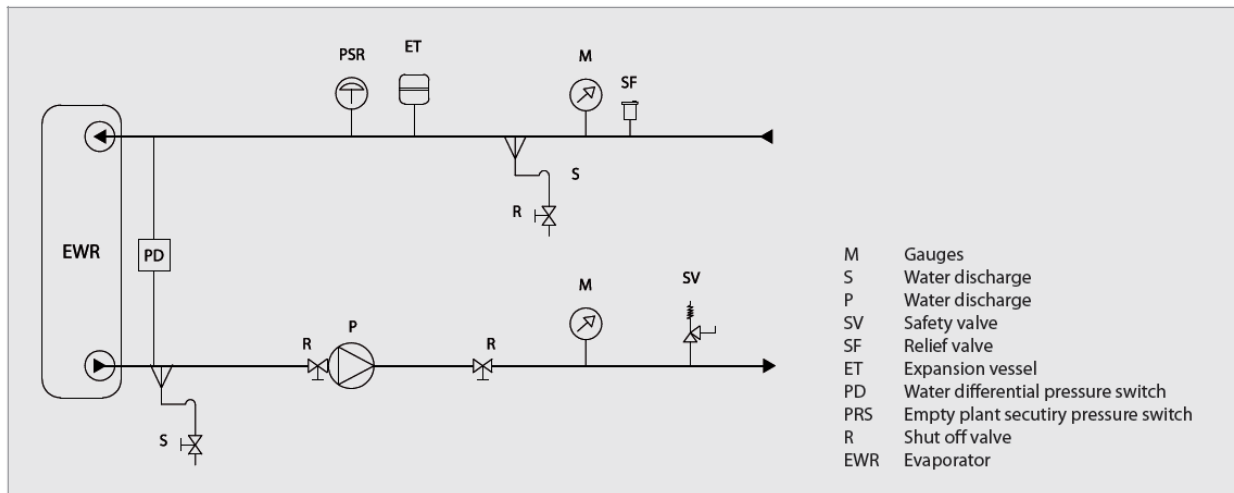


HIGH HEAD PRESSURE PUMP (450 kPa)

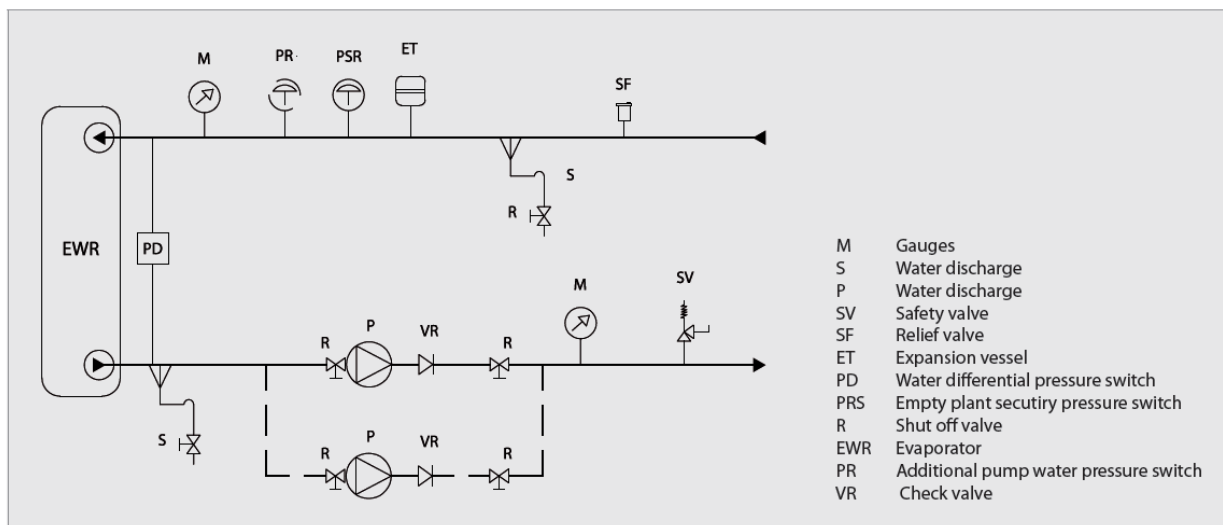


CONNECTION SCHEME - STANDARD VERSION

Hydronic kit with 1 pump - B1/M1/A1 versions



Hydronic kit with 2 pumps - B2/M2/A2 versions



Refrigerant safety valves

Each system comes with safety valves that are installed on each circuit, both on the high pressure & low pressure pipes. The purpose of the valves is to discharge the refrigerant inside the refrigerating circuit in the event of any malfunction.

WARNING! This unit is designed for installation indoors. 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.

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 unit with thermal jumps too high, since very low water flow may cause coil freezing with automatic exclusion of warranty, or vice versa, too low, since very 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.

Control and safety calibrations

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.

	RELIEF VALVE	HIGH PRESSURE SWITCH	ANTIFREEZE
SCROLL	45 BAR	41 BAR	4°C

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

Ethylene glycol correction table

% 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	0.947	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		1.039	1.06	1.09	1.118	1.149	1.182	1.211	1.243

Glycol percentage depending on freezing temperature

Freezing temperature (°C)	0	-5	-10	-15	-20	-25
% Ethylene glycol	5%	12%	20%	28%	35%	40%
Flow rate coefficient	1.02	1.033	1.05	1.072	1.095	1.124

Fouling factor correction table

Fouling Factor	Plant side cold heat-exchanger			Plant side hot heat-exchanger		
F.F.	A1	B1	Tmin	A2	B2	Tmax
[m ² °C*W]						
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

B factor

T min

T max

Capacity correction factor

Compressor power input correction factor

Minimum evaporator outlet water temperature increase

Maximum condenser outlet water temperature decrease



Electrical installation

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. 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.

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).

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. Can also be used a flexible pipe containing the three supply phases plus ground. In every way to ensure total protection against the possible penetration of water into the connection point.

Control circuit

The control circuit is powered with 24V d.c. Each unit of the series is provided with auxiliary transformer control circuit 230/24V. It is not therefore requires no additional power cable to the control equipment.

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 inside the unit. Obviously the operation of the electrical resistors is guaranteed only if this constant power supply. In case of the unit during winter is electrically disconnected, 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 BMS to monitor the unit. Follow the wiring diagram for correct wires connection of the unit.

Remote On / Off unit - Electrical connection

The unit has a dry contact that allows on/off command 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. Opening the contact, the microprocessor starts the shutdown sequence of the unit, turning off the compressor and after few minutes the water pump.

External set point of the water - Electrical connection (Optional)

The local set point of the unit can be varied via an external analog signal 4-20ma.

The signal cable should be connected directly to the terminal "X" as per the wiring diagram in broths unit. The signal cable should be shielded and not the type to be passed close to the power supply cables.

Remote keypad connection

Please refer to the wiring diagram provided with the unit.

Unit operation

Operator responsibilities

It is important that the operator is properly trained and become 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. Moreover, another record should be maintained for all maintenance activities and periodic service. If the operator checks abnormal or unusual operating conditions, it is recommended to consult the authorized technician.

Oil compressor load

Checking the oil charge

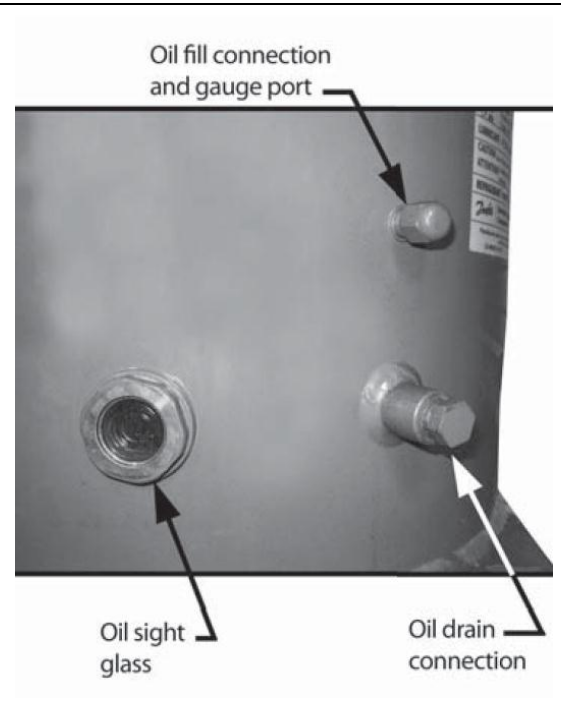
All Trane units compressors are charged with oil at the factory. The scroll compressors are equipped with an oil sight glass from which you can control the level. The precise level should be between two marks that indicate the minimum and maximum allowable levels. In tandem or trio performances, pay 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 1/4" 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

General

Once the unit has been installed, use the following procedure to check that it 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

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 fans.

WARNING! 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.

Maximum allowed tolerance • $\pm 10\%$.

Voltage unbalance between the three phases must not exceed • $\pm 3\%$.

Follow the same phase sequence refers into the wiring diagram. It is available an optional that prevents compressors from starting in the event of a reverse phase sequence; in the event that, after the unit has been powered on, the phase monitor should set off an alarm, only invert two phases of the power supply at the main switch. The monitor is in phase with the electrical motors of the unit, so not invert the phases directly on it.

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 (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 water side of the evaporator is 10,0 bar.

Never

exceed this pressure at any time during the life of the unit.



WARNING! Before placing the unit into operation, clean the hydraulic circuit. Dirty, 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 to 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

Electrical supply

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

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:

Unbalance %: $((V_{\text{max}} - V_{\text{average}}) / V_{\text{average}}) \times 100 = \underline{\hspace{2cm}}\%$

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::

$\% \text{ Voltage unbalance} = (\text{Max voltage deviation from average}) / (\text{medium voltage}) \times 100$

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.



Start-Up preliminary procedures

Initial controls

Before starting the unit, even only momentarily, all the units 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.

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 (vapors) into it until pressure is reached and look for leakage.

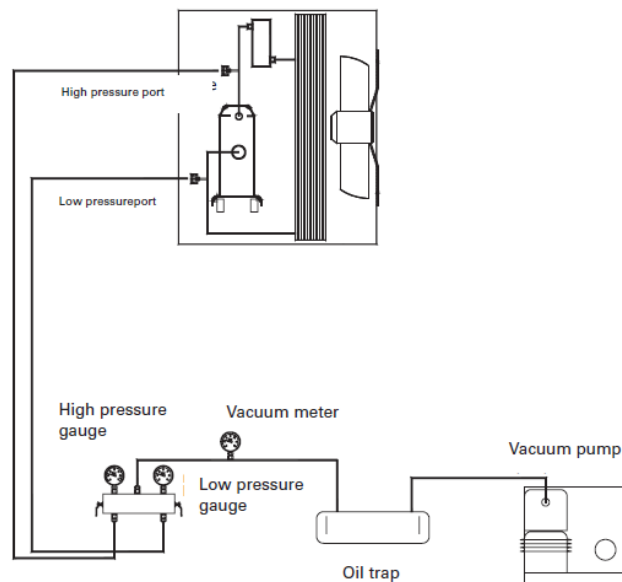
After having eliminated the leakage, the system has to be dehydrated with a vacuum pump up to at least 1mm Hg - absolute pressure (1 Torr o 133.3 Pa). This is the minimum recommended value to dehydrate the plant.

WARNING! 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 peephole with the compressor running with a full charge and steadily, it means that the refrigerant charge is insufficient.

WARNING! 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-commissioning Check list – mandatory operation control before start up

DATE		N.	
UNIT			

CUSTOMER:	SITE: ADDRESS: POSTCODE: COUNTRY:
-----------	--

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

GENERAL

		COMPLIANCE	
		YES	NO
	THE HYDRAULIC CIRCUIT IS COMPLETE AND READY TO BE USED AND THE THERMAL LOAD IS AVAILABLE. PLEASE NOTE THAT THE FIRST START-UP SHALL NOT BE CARRIED OUT UNLESS THE PLANT IS READY AND THE WATER LOAD IS AVAILABLE.		
	THE UNIT DISPLAYS DAMAGES ON THE EXTERNAL CASING OCCURRED DURING THE TRANSPORTATION OR POSITIONING. IF ANY, SPECIFY BELOW: WARNING: PLEASE BE AWARE THAT RELEVANT DAMAGES CAUSED BY THE QUOTED CIRCUMSTANCES MAY RESULT IN THE CALL-OFF OF THE WARRANTY.		
	THE UNIT HAS BEEN INSTALLED IN ACCORDANCE WITH THE MINIMUM DISTANCE PROVIDED IN THE DIMENSIONAL DRAWING AND TECHNICAL DOCUMENTATION PROVIDED.		
	THE UNIT IS INSTALLED NEXT TO THE: PHOTOVOLTAIC SYSTEM, ELECTRONIC TRANSMITTERS, ANTENNAS OR SIMILAR DEVICES.		
	THE UNIT IS POSITIONED ON A PERFECTLY FLAT (NOT INCLINED) SURFACE.		
	ANTI-VIBRATIONS DAMPERS HAVE BEEN INSTALLED BETWEEN THE UNIT AND THE FLOOR.		
	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. WARNING: PLEASE BE AWARE THAT RELEVANT DAMAGES CAUSED BY THE QUOTED CIRCUMSTANCES MAY RESULT IN THE CALL-OFF OF THE WARRANTY.		
	THE UNIT HAS BEEN INSTALLED VERY CLOSE TO A MARINE ENVIRONMENT OR AN AGGRESSIVE INSTALLATION ENVIRONMENT (HIGHLY CORROSIVE CHEMICAL AGENT). WARNING: PLEASE BE AWARE THAT RELEVANT DAMAGES CAUSED BY THE QUOTED CIRCUMSTANCES MAY RESULT IN THE CALL-OFF OF THE WARRANTY.		



	SPOTTED PRESENCE OF MOLD, MUSHROOMS, BACTERIA, MICROBIAL OF ANY TYPE.		
	THE UNIT DISPLAYS DAMAGES CAUSED BY: FLOODS, LIGHTNING, FIRE, ANY ACCIDENT BEYOND TRANE'S CONTROL.		

ELECTRIC AND ELECTRONIC

	THE UNIT IS ELECTRICALLY POWERED AND ALL THE RELEVANT ELECTRICAL WIRES ARE PROPERLY CONNECTED.		
	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)		
	PHASES ARE CONNECTED IN THE PROPER SEQUENCE.		
	ELECTRICAL CABLES SIZE CONFORMS TO FLA MAX VALUE.		
	BOTH EXTERNAL AND INTERNAL ELECTRICAL WIRES ARE WELL TIGHTENED.		
	THE COMPRESSOR CRANKCASE HEATERS HAVE BEEN POWERED AND HEATED AT LEAST 8 HOURS BEFORE THE START-UP.		
	AN ELECTRONIC SUPERVISOR (OR ANY ADDITIONAL CONTROLLER) HAS BEEN INSTALLED.		
	CONNECTION WIRES ARE SHIELDED.		
	REMOTE CONTROL DEVICES OR INTERFACES ARE CONNECTED TO THE ELECTRICAL PANEL IN CONFORMITY WITH TRANE WIRING DIAGRAMS.		
	ELECTRIC DEVICES ARE INTACT AND DON'T DISPLAY ANY DAMAGE.		
	ELECTRONIC DEVICES ARE INTACT AND DON'T DISPLAY ANY DAMAGE.		
	WATER PUMPS ARE ELECTRICALLY CONNECTED TO THE ELECTRICAL PANEL IN ACCORDANCE WITH THE WIRING DIAGRAMS PROVIDED BY TRANE.		
	THE ELECTRICAL ABSORPTION AND THE WATER PUMPS OVERHEATING ARE STANDARD.		

REFRIGERANT CIRCUIT

	ALL CONNECTIONS ON THE REFRIGERANT CIRCUITS ARE WELL TIGHTENED.		
	THE ELECTRONIC LEAKAGE DETECTOR OR THE PRESSURE GAUGE LEVEL INSTALLED ON THE REFRIGERANT CIRCUIT HAVE DETECTED ANY LEAKAGE. IF ANY, SPECIFY BELOW:		



	THE COMPRESSOR OIL INDICATOR LIGHT POINTS THE MAXIMUM LEVEL.		
	<p>THE INDICATOR SIGHT GLASS ON THE LIQUID LINE IS GREEN.</p> <p>WARNING: THE YELLOW LIGHT INDICATES PRESENCE OF MOISTURE IN THE CIRCUIT. IN THIS CASE PLEASE CONTACT TRANE.</p>		

WATER CIRCUIT

	<p>THE FILTER IS INSTALLED ON ALL THE HEAT EXCHANGERS INLET PIPES, AT A MAXIMUM DISTANCE OF 2 METERS FROM THE UNIT.</p> <p>PLEASE NOTE THAT THE FILTER INSTALLATION IS MANDATORY. FOR FURTHER TECHICAL INFORMATION RELATING THE FILTER PLEASE REFER TO THE TECHNICAL DOCUMENTATIONS.</p>		
	THE FLOW SWITCH HAS BEEN INSTALLED AND ELECTRICALLY CONNECTED. PLEASE NOTE THAT FLOW SWITCH INSTALLATION IS MANDATORY .		
	THE VALVES ON THE WATER PLANT MUST BE OPENED. PLEASE BE AWARE THAT IF THE UNIT 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.		
	DRAINAGE VALVES ARE INSTALLED. THE DRAINAGE VALVES ARE INSTALLED ON THE LOWEST POINT. THE UTILIZATION OF AUTOMATIC DRAINAGE VALVES IS RECOMMENDED.		
	<p>AUTOMATIC OR MANUAL PURGE VALVES ARE INSTALLED.</p> <p>AUTOMATIC OR MANUAL PURGE VALVES ARE INSTALLED ON THE HIGHEST POINT.</p>		
	<p>THE HYDRAULIC CIRCUIT HAS BEEN FILLED AND PURGED.</p> <p>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. FOR FURTHER TECHICAL INFORMATIONS PLEASE REFER TO TRANE DOCUMENTATIONS AND PROCEDURE FOR THE FIRST START UP.</p>		
	HYDRAULIC CONNECTIONS TO THE UNIT ARE COMPLIANT WITH THE UNIT NAME PLATE AND DIMENSIONAL DRAWINGS.		
	RUBBER JOINTS ARE INSTALLED ON THE HYDRAULIC CONNECTIONS, IN ORDER TO MINIMIZE VIBRATIONS BETWEEN THE UNIT AND WATER PIPES.		
	SHUTOFF VALVES ARE INSTALLED ON THE HYDRAULIC CIRCUIT.		
	THE EXPANSION TANK IS INSTALLED ON THE HYDRAULIC CIRCUIT. EXPANSION TANK CAPACITY CONCURS WITH THE WATER PLANT CAPACITY.		
	TEMPERATURE PROBES AND PRESSURE GAUGES ARE INSTALLED ON THE HYDRAULIC CIRCUIT, BOTH INLET AND OUTLET SIDE.		
	THE HYDRAULIC CIRCUIT IS FREE FROM OBSTRUCTION OR ANY KIND OF CONSTRAINT.		



	<p>BUFFER TANKS ARE INSTALLED IN THE HYDRAULIC CIRCUIT. THE BUFFER TANKS INSTALLATION IS STRONGLY RECOMMENDED IN ORDER TO GUARANTEE THE OPTIMAL UNIT OPERATION.</p> <p>SPECIFY BUFFER TANK CAPACITY: _____ LT</p>		
	<p>THE PRESSURE RELIEF VALVE IS INSTALLED BETWEEN DELIVERY AND RETURN PIPES.</p> <p>WARNING: IN ORDER TO AVOID <u>WATER-HAMMER</u>, THE RELIEF VALVE PRESSURE SHALL BE SET UP IN ACCORDANCE WITH THE STANDARD OPERATING PRESSURE OF THE WATER CIRCUIT.</p>		
	<p>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.</p> <p>WARNING: THE UNIT SHALL NEVER WORK (NOT EVEN FOR SHORT PERIODS) WITH AN INLET WATER TEMPERATURE LOWER THAN 18°C.</p>		
	<p>ANTIFREEZE PROTECTIONS ARE INSTALLED IN THE WATER CIRCUIT (ELECTRICAL HEATERS ARE INSTALLED ON WATER PIPES AND TANKS).</p> <p>FOR FURTHER TECHNICAL INFORMATION PLEASE REFER TO TECHNICAL DOCUMENTATION PROVIDED. PLEASE NOTE THAT ANTIFREEZE PROTECTIONS ARE MANDATORY FOR OUTDOOR AIR TEMPERATURES LOWER THAN 3°C.</p>		
	<p>THE WATER CIRCUIT IS FILLED WITH ETHYLENE GLYCOL. ETHYLENE GLYCOL "%" SHALL CONFORM TO THE DATA PROVIDED IN THE TECHNICAL DOCUMENTATION.</p>		
	<p>ALL WATER PIPES ARE GROUND CONNECTED (IN ORDER TO AVOID ABNORMAL VOLTAGES THAT CAN CAUSE DANGEROUS CORROSIONS).</p>		
	<p>THE EVAPORATOR WATER FLOW IS COMPLIANT TO THE TECHNICAL DOCUMENTATION PROVIDED BY TRANE.</p>		
	<p>THE WATER PUMPS ARE CORRECTLY SET UP IN ACCORDANCE WITH THE PLANT WATER FLOW, AVAILABLE HEAD PRESSURE AND PRESSURE DROP.</p>		
	<p>THE PUMP IMPELLERS ARE MECHANICALLY UNBLOCKED AND UNCLOGGED (FREE FROM ANY KIND OF CONSTRAINT).</p>		

DATE:	AUTHORIZED SERVICE: <u>NAME AND SIGNATURE</u>	CUSTOMER: <u>NAME AND SIGNATURE</u>
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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 under cooler 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 economizer. 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

Pressure/Temperature HFC-410					
°C	Bar	°C	Bar	°C	Bar
-20	4,04	6	9,61	32	19,68
-18	4,35	8	10,20	34	20,69
-16	4,67	10	10,82	36	21,75
-14	5,02	12	11,46	38	22,84
-12	5,38	14	12,14	40	23,98
-10	5,76	16	12,85	42	25,16
-8	6,16	18	13,58	44	26,39
-6	6,58	20	14,35	46	27,65
-4	7,03	22	15,15	48	28,97
-2	7,50	24	15,99	50	30,33
0	7,99	26	16,85	52	31,75
2	8,50	28	17,76	54	33,21
4	9,04	30	18,70	56	34,72



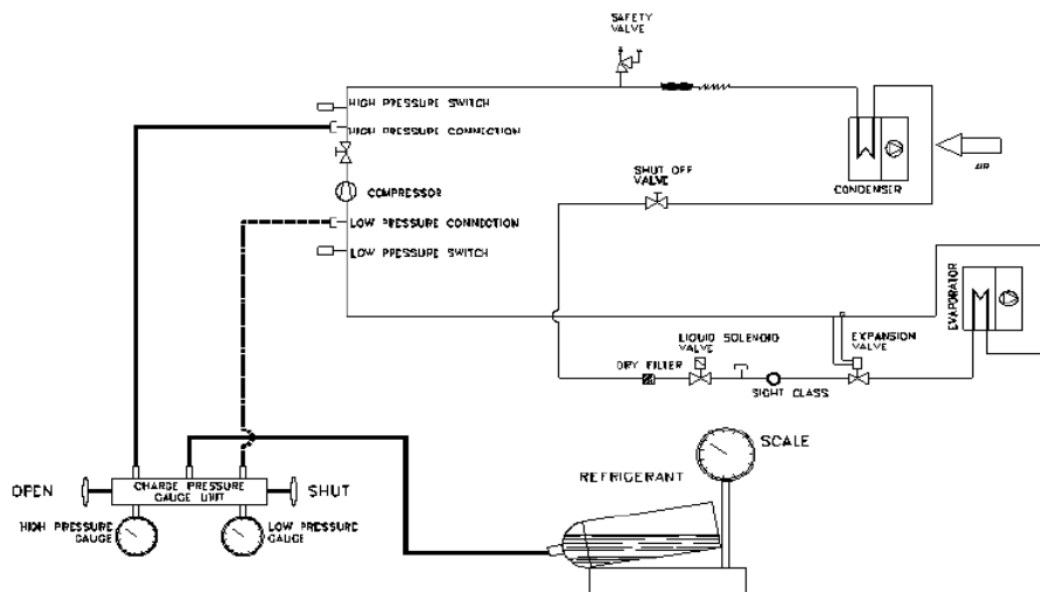
Refrigerant charge

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.

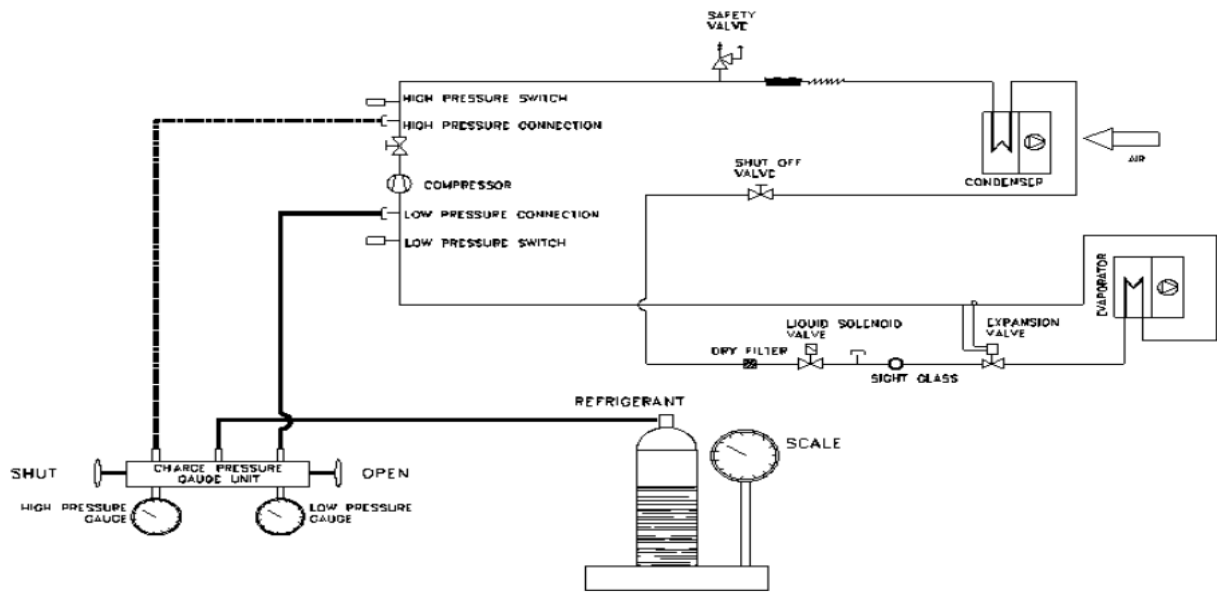
Overheating is equal to the difference between the measured temperatures. Measure then the temperature of the pipe of liquid leaving the condenser and detect on the high-pressure gauge the equilibrium pressure on the condenser and the corresponding saturation temperature. Subcooling is the difference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



Refrigerant charge addition with the unit running (refrigerant charge in the vapor 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.



Charge in vapour phase



WARNING! 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 normal operation.

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

WARNING! If the unit has not been provided with integrated pump on board, do not turn off the external pump before

3 minutes have elapsed after turning off the last compressor. The early shutdown of the pump causes a water flow alarm failure.

Seasonal shutdown

1. Turn switches Q1 and Q2 to Off (or 0) position to shut down the compressors, using the normal pump-down procedure.
2. After the compressors have been shut down, turn switch Q0 to Off (or 0) and wait for the built-in water pump to shut down. If the water pump is managed externally, wait for 3 minutes after the compressors have shut down before turning off the pump.
3. Open the Q12 (Off position) thermal magnetic switch inside the control section of the electrical board then open the general backflow switch Q10 to cut off the unit's power supply entirely.
4. Close the compressor intake taps (if any) and delivery taps and also the taps located on the liquid and injection line.
5. Place a warning sign on every switch that has been opened, advising to open all the taps before starting the compressors.
6. If no water and glycol mixture has been introduced into the system, discharge all the water from the evaporator and from the connected piping if the unit is to remain inactive during the winter season. One must remember that once the unit's power supply has been cut off, the antifreeze electrical resistance cannot function. Do not leave the evaporator and piping exposed to the atmosphere during the entire period of inactivity.

Starting up after seasonal shutdown

1. With the general backflow switch open, make sure that all the electrical connections, cables, terminals and screws are well tightened to ensure good electrical contact.
2. Verify that the power supply voltage applied to the unit is within • +/- 10% of the nominal nameplate voltage and that the voltage unbalance between phases is between • +/- 3%.
3. Verify that all control apparatus is in good condition and functioning and that there is a suitable thermal load for startup.
4. Verify that all the connection valves are well tightened and that there are no refrigerant leaks. Always reposition the valve caps.
5. Verify that switches are in the open position (Off). Turn the general backflow switch to the On position. Doing this will allow to turn on the electrical resistances of the compressors. Wait at least 12 hours for them to start up.
6. Open all intake, delivery, liquid and liquid injection taps. Always reposition tap covers.
7. Open the water valves to fill the system and bleed air from the evaporator through the air valve installed on its shell.
8. Verify that there are is no water leakage from piping.



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 find the root cause of the refrigerant loss. If necessary, repair the system before proceeding with recharging.

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 stabilization of the steps of the fans, and then the pressure of condensation.

About 15% of the condensing coils are dedicated for subcooling the 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 increasing the efficiency of the system. However a small amount of additional refrigerant (1 ÷ 2 kg) makes the system less sensitive.

Note: By varying the load and the number of active fans, subcooling varied and requires some time to re-stabilize. 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:

- 1 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.
2. If the unit is moderately gas discharge, the corresponding circuit could have stops low pressure. Prime the circuit as described in the corresponding charge.



Start up

Preliminary checks

Before starting the appliance 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 start.

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.

Unit 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.

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.



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 set point is set to the required value by pressing the Set button
 10. Turn the main switch to "OFF". Open the cabinet. Reactivate the compressors. Push in the picture. 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. Verify the start of the cooling fans in function of raising the condensing pressure chiller mode, with decreasing evaporation pressure in Recovery, fans still in recovery chiller mode more.
 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.
 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 points 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 on board 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.



System maintenance

General

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.

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.

WARNING! 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 is 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

Although the single-screw compressor is of the semi-hermetic type and therefore does not need scheduled maintenance in order to keep the compressor at optimum levels of performance and efficiency and prevent incipient failures, it is recommended every 10,000 hours of operation, a check visual state of wear of the satellites and measuring the tolerances of satellite-lives. 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. The compressor load will be similar to the previous load measurement for a reliability of measure.

Sight check of the under pressure vessels state

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 at least once per year the under pressure vessels state.

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 vessel mechanical resistance.

Use antioxidant paint or products to protect.



Standard Controls

<i>Operations description</i>	<i>Recommended frequency</i>
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 by the microprocessor to control the unit's load according to the system's thermal load. It also performs the evaporator's 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.

External air temperature sensor

Optional. This sensor allows to monitor the external air temperature on the microprocessor display. It is also used to carry out the "OAT set point override".

Compressor delivery pressure transducer

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

Oil pressure transducer

This is installed on every compressor and allows to monitor the oil pressure. Using this sensor, the microprocessor informs the operator on the conditions of the oil filter and on how the lubrication system is functioning. By working together with the high- and low-pressure transducers, it protects the compressor from problems deriving from poor lubrication.

Low-pressure transducer

This is installed on every compressor and allow to monitor the compressor intake 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 compressor, 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 compressor and allows to monitor compressor discharge temperature and oil temperature. The microprocessor controls liquid injection by means of this sensor and shuts down the compressor in case of alarm in the event that the discharge temperature reaches 110°C. It also protects the compressor from possible startups with liquid.

Unit test sheet

Recommended spare parts

Following is a list of the recommended parts for several years of operation. 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

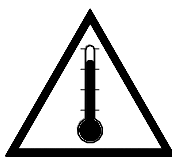
Improper uses

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



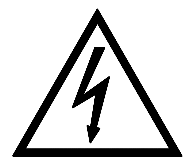
DANGER:
General danger



DANGER:
Temperature



DANGER:
Handling parts



DANGER:
Cut off voltage



Ordinary Maintenance - Programmed maintenance

Activities list	Week	Month (1)	Year (2)
General			
Data collection operation (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 (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 (4)			X
Check that the fans are tightened			X
Check the fins of coils - Control if necessary of regular intervals			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



Dehydration filter repositioning

It is recommended to reposition 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 is recommended to reposition 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

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 the 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.



Oil Filter repositioning

WARNING! The lubrication system is designed to maintain the majority of the charge of oil inside the compressor. However, during operation, a limited amount of oil circulates freely within the system, transported from the refrigerant. Therefore, the amount of oil to enter into the compressor will have to be equal to that removed and not the total amount of plaque to prevent excessive amount of oil start next.

The measurement of the amount of oil removed from the compressor, must be carried out after leaving evaporate the refrigerant contained in the oil itself for a period of time adequate. To minimize the content of refrigerant in the oil, it is recommended to leave the heating elements on and to remove the oil when the latter has reached a temperature of $35 \div 45^{\circ} \text{C}$.

WARNING! The repositioning of the oil filter requires special care in the preservation of the oil; being extremely hygroscopic, it must not be exposed to air for a period exceeding 30 minutes. If in doubt, check the acidity of the oil or, where such a measure to change the oil with another taken from sealed container or stored according to manufacturer's specifications.

The compressor oil filter is located under the oil separator pressure side. It is recommended to reposition when its pressure drop exceeds 2.0 bar. The pressure drop through the oil filter is given by difference between the discharge pressure of the compressor less the oil pressure. Both of these pressures can be controlled by the microprocessor for both compressors.

For more information about filter repositioning please contact the manufacturer.

Repositioning Procedure

- 1) Turn off both compressors turning the switches in the off position
- 2) Turn the main switch OFF wait until the circulation pump and open the switch general to remove the power supply to the unit.
- 3) Put a plate on the handle of the main switch to prevent accidental starting.
- 4) Close the valves of suction, discharge and liquid injection
- 5) Connect the recovery unit to recover the refrigerant compressor and within an adequate and clean storage container.
- 6) Evacuate the refrigerant until the pressure inside has achieved a negative pressure (compared atmospheric pressure). With this reduces to a minimum the amount of refrigerant dissolved in the oil.
- 7) Remove the oil contained in the compressor by opening the drain cock located below the engine
- 8) Remove the oil filter cover and remove the filter element inside
- 9) Replace the O-ring of the lid and the inner sleeve. Do not lubricate the O-ring with mineral oil to non-pollute the system.
- 10) Insert the new filter element
- 11) Replace the lid of the filter and tighten the screws. The screws should be tightened alternately progressively tightening torque 60Nm.
- 12) Load the oil from the top cap placed on the oil separator. Given the high hygroscopicity foreign oil, the oil filling must be done in the shortest possible time. Do not leave the ester oil exposed to the atmosphere for a time greater than 10 minutes.
- 13) Close the oil filler cap.
- 14) Connect the vacuum pump and evacuate the compressor up to a vacuum of 230 Pa.
- 15) On reaching the vacuum level predicted close the valve on the vacuum pump.
- 16) Open the valves, suction and liquid injection system
- 17) Disconnect the vacuum pump from the compressor.
- 18) Remove the plate WARNING located on the switch.
- 19) Close the main switch to power the unit
- 20) Start the unit according to the starting procedure described above.



Disposal

Unit backflow

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.

Decommissioning and disposal

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.



Maintenance contract

These units have been developed and constructed according to high quality standards ensuring years of failure-free operation. It is important, however, to ensure proper and periodical maintenance in accordance with all the procedures listed in this manual.

We strongly advise stipulating a maintenance contract with Trane Service in order to ensure efficient and problem-free operation, thanks to the expertise and experience of our personnel.

It must also be taken into consideration that the warranty period requires maintenance, as well, as do the warranty terms.

It must be borne in mind that operating the unit in an inappropriate manner, beyond its operating limits or not performing proper maintenance according to this manual can void the warranty.

Observe the following points in particular, in order to conform to warranty limits:

1. The unit cannot function beyond the catalog limits
2. The electrical power supply must fall within the voltage limits and without voltage harmonics or sudden changes.
3. The three-phase power supply must not have an unbalance between phases exceeding 3%. The unit must stay turned off until the electrical problem has been solved.
4. No safety device, either mechanical, electrical or electronic must be disabled or bypassed.
5. The water used for filling the hydraulic circuit must be clean and suitably treated. A mechanical filter must be installed at the point closest to the evaporator entrance.
6. Unless there is a specific agreement at the time of ordering, the evaporator water flow rate must never be above 120% and below 80% of the nominal flow rate.



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

The refrigerant charge is indicated on the name plate of the unit.

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 CO₂ equivalent contained in the refrigerant circuit.

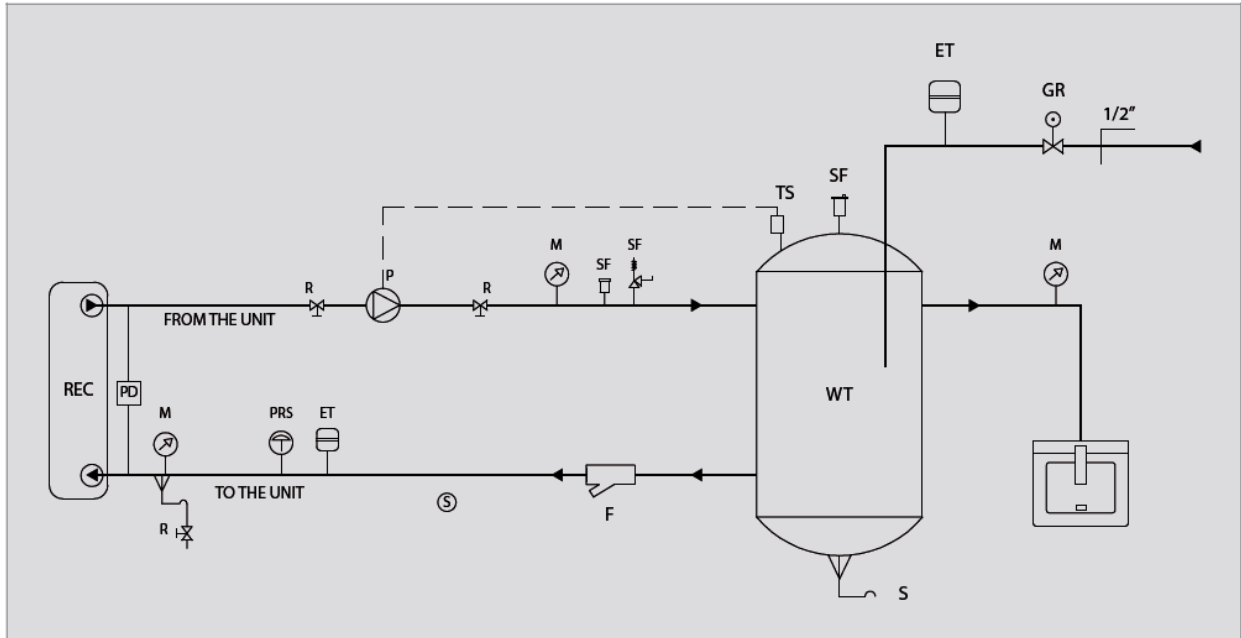
This is calculated by multiplying the refrigerant charge (in kg) and the GWP value of the used refrigerant.

For more detailed information, contact your local dealer.



Plant sketches STANDARD SKETCH

INSTALLATION SKETCH PARTIAL RECOVERY (CUSTOMER CARE)



- M Gauges
- S Water discharge
- P Pump
- SV Safety valve
- SF Relief valve
- ET Expansion vessel
- PD Water differential pressure switch
- PRS Empty plant security pressure switch
- R Shut-off valve
- REC Total or partial recovery
- PR Additional pump water pressure switch
- VR Check valve
- WT Water tank
- GR Automatic water filling
- TS Thermostat for pump

NOTES:

The installation of pump thermostat and control has to be provided by the customer.



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 warranty. Trane is at your disposal to examine any differing needs, which still must be approved prior to the operation of the unit. The water flow of the group must be compatible with that of the evaporator. It is also necessary maintain a constant water flow 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). Refer to the chapter on data general. 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 operation of the unit, it is absolutely necessary to ensure a constant flow rate to the unit: especially in case of lack of accumulations is recommended to mount between the delivery branch and return pump valve a by-pass or automatic or manual appropriately set in phase 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 Or mono-block centrifugal electric pump

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

Automatic filling unit

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

Safety valve

Undertakes to open atmosphere in the system if the pressure exceeds 6 bar.

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.



Dimensional drawing and weight

Refer to product catalogs.



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 inexperienced individuals. Operations marked with the letter "U" can be performed directly by the user, who must carefully follow the instructions provided in this manual.

U = User

S = Specialized personnel only

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

SYMPTOM	Cooling	Heating	Who can take corrective action	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	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 incorrect differential	Modify them as reported in the tables.
	X	X	S	Lack of coolant	See point G



SYMPTOM	Cooling	Heating	Who can take corrective action	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 refrigerating 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	Unit 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 eventually 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 pressuring 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
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



SYMPTOM	Cooling	Heating	Who can take corrective action	Probable cause	Possible remedy
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 Unit does not start	X	X	s	phases of the supply network reversed	Invert phases



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