Installation
Operation
Maintenance

Condensing units
Models RAUS/RAUX

July 2015

CG-SVX032A-GB
Original instructions

Contents

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.

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.

Factory inspection

RAUS/RAUX units are inspected in the factory, in appropriate areas, in accordance with internal procedures. Each performance test carried out on the unit is possible only if the same conditions are reproduced and maintained (charge consistency, constant temperature and evaporation - condensation and recovery capacity, quality and tolerance of the measuring instruments etc.) in the test rooms.

The inspection conditions are those indicated by the customer in the ordering phase: if not otherwise specified, reference should be made to the nominal performance indicated in the product catalog in force at the date of the Confirmation of the Order.

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 annul

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.

Installation

Handling and lifting

Units have been designed to be lifted from above by means of eyebolts and holes in the base members.
Use retractor bars to keep the lifting wires or chains away from the unit.
Lifting procedures provided with the unit have to be respected.

CAUTION!
Do not use forklift trucks to lift the unit from below. If equipment for lifting from above is not available, using rollers may move the unit.

Foundations

No special foundations are required, provided that the supporting surface is flat and level, and can withstand the weight of the unit.

Clearances

Open spaces around the unit must be provided for in order to allow for the passage of necessary airflow and in order to allow normal maintenance to be carried out (as shown product catalogs).
In the case where two units have to be installed side by side, the distance must be doubled.

Precautions for dominant winds
Avoid obstacles on suction and discharge sides of the units. Respect the safety distances as shown on the units dimensional drawings.
In case of presence of dominant winds in the installation area it is strictly necessary to avoid (for units with horizontal flow fans) that such winds blow in front of the unit (fans discharge side). In case of unit with vertical flow fans it is strictly necessary to avoid installations where the dominant winds could cause rejected hot air to come back to the condensing coils.

Precautions against the direct sunshine
Direct solar radiation can raise the temperature of condensation until it causes the unit shutdown or failure start-up of the same by action of the high pressure switch.

Precautions against the presence of fireplaces and exhaust heat
Avoid installation of the machines downwind of chimneys, smokestacks and effluent discharges different.

Precautions against the presence of foliage and foreign bodies
Avoid installing the unit in the immediate vicinity of plants that can prevent proper intake and discharge air.

Control of compressor fastening

The compressors are fitted on shock absorbers. To fix spring antivibration mounts, it is necessary to remove blockages to fasten the compressors, as indicated on the label on compressors body.

After the unit has reached the final position, fix the antivibration bolts.
In order to reduce the transmission of vibrations to the supporting structures, fit shock absorbers in every fastening point.
Rubber shock absorbers are recommended for units installed on the ground, spring shock absorbers for units installed on roofs.

Electrical connections

Electrical power supply
The mains power supply characteristics have to match the unit's absorption. The mains power supply tension must correspond to the nominal value ± 10%, with a maximum difference between the phases of 3%.

Power connections
Protect the unit electric box power supply circuit with protection devices (not included in the supplied equipment)
Connect the line terminals with a three-core cable of a section, which is appropriate to the machine absorption.
The switch and the fuses like all the power connections must comply with the regulations in force.

Unbalance between the supply tension phases
Do not run the electrical motors when the voltage unbalance between the phases is more than 3%.

Use the following formula to check:

% voltage unbalance = Max voltage deviation from average *100
Average voltage

$$\%\ \text{voltage unbalance} = \frac{\text{Max voltage deviation from average}}{\text{Average voltage}} \cdot 100$$

Important! If the mains voltage has an unbalance of above 3%, contact the company, which distributes the electrical energy. If the unit functions with **a unit voltage unbalance between the phases of above 3% the guarantee is invalid.**

Evaluation of harmonic components and total harmonic distortion THD value

The bridge rectifier of an inverter requires from the mains a current that is not purely sinusoidal. In fact, due to the presence of the diodes (non-linear components), the current absorbed by a bridge rectifier presents frequency components higher than the mains frequency. These components are called harmonics; in case of power supply at 50 Hz is called the fundamental harmonic component at 50 Hz, the second harmonic is the component to 100 Hz, the third harmonic is the component at 150 Hz and so on (in the case of power 60Hz to the fundamental component is at 60Hz, the second harmonic is 120Hz, 180Hz in the third and so on).

$$P_{act} = \sqrt{3} \cdot V \cdot I \cdot \cos\varphi \qquad \text{NO}$$

Since the bridge rectifier sees in front of him one stage direct current, the current drawn is practically, in phase with the voltage. However it is no longer true the relationship between the classical electrical quantities: because the higher harmonics to the fundamental components do not contribute to the active power.
We must therefore define different sizes:
Displacement Power Factor (power factor lag)

$$DPF = \cos\varphi$$

Power Factor (total power factor)

$$PF = \frac{I_1}{I} \cdot DPF$$

The Power Factor takes into account both the phase shift that the harmonic content, expressed as the ratio between the fundamental component of the current I1, and the overall RMS value. It expresses how much of braids of the input current is converted into active power. It is worth noting that, in the absence of inverters or devices electronics in general, DPF and PF are the same. Moreover, the majority of entities in the electric energy distribution take account only of the DPF, as the harmonic content is not measured, but only the absorption of active and reactive energy.
Another index of measurement of harmonics fed into the grid is given by THDi THD (Total Harmonic Distortion) so defined:

$$THD_i = \sqrt{\frac{I^2 - I_1^2}{I_1^2}}$$

In an inverter without expedients harmonic distortion can reach values higher than 100% (ie the components Harmonics can, on the whole have a width greater than the fundamental component). In order to reduce the harmonic content of the current (and therefore the THD) units object of this manual are equipped with appropriate limitation systems. Since the harmonic content depends on the ratio between the current required by the inverter and the short-circuit current at the point of connection, the THD for a given plant varies depending on the absorption of the machine.
It should also be said that the harmonic distortion is reduced in value if the connection point (CCP) are also connected other loads: the greater the weight of these utilities, the lower the current distortion. The total harmonic distortion at the point where the unit is connected to the network is a function of the ratio between short-circuit current circuit at the point of connection (ISC) and the current drawn by the unit (IL) and the percentage of power drawn the unit compared to the total power supplied by the network at the connection point. The harmonic distortion in the connection point can 'assume values very low (less than 5%) if the short circuit current is less than 20 times the current of unity and this constitutes a

percentage not more than 20% of the total load of the network. In any case, the harmonic distortion introduced by the unit must be determined by reference to the specific application. After a detailed analysis of the entire network of power and loads supplied.

How to size refrigerant lines

In the dimensioning of refrigerant lines of air conditioning systems equipped two sections, the designer has to take into account that, due to the pressure loss of the refrigerant circuits, cooling capacity decrease and compressors power input increase may occur. It is also necessary to consider that the fluid changes its state when There is also to consider that the fluid changes state when circulating within the plant. Another common problem is related to the oil: this, in fact, is highly miscible to the refrigerant and consequently it is easily dragged into the circuit; obviously, it is necessary to make sure that this lubricant is able to entirely come back to the compressor.
Finally, the following basic conditions, typical of each refrigerant circuit, must be respected: cleaning of the pipes and total absence of liquid to the compressor's inlet.
In order to avoid all the above mentioned problems, the connection lines must be properly sized.

Sizing refrigerant lines

Diameter
The pipes diameter is one of the most critical feature in sizing the refrigerant lines. The refrigerant speed inside the pipes and the pressure drop depend on the diameter. Although it is advisable to limit as much as possible the pressure drop (to reduce the loss of cooling capacity) is important to ensure a velocity in the pipe to allow the oil carryover. Generally the dimensioning of the suction line is made in order to maintain a speed higher than 4 m / s to the minimum load (minimum step of capacity) and lower than 20 m / s at full load.
The tables in the appendix show the standard diameters for machines ACDX.
These diameters shall be considered approximate and must be verified for each installation.

Length
The length of the suction line produces pressure losses higher than those found in the circuit of a machine with a single section. Obviously consequently there is a lower pressure in the intake to the compressor. This may cause, as already mentioned, a decrease of the output power and increase of that absorbed, with consequent reduction of the COP. A similar phenomenon occurs in the discharge line: loss of load force the compressor to work at a pressure that is higher than the actual condensation, with effects equal to those previously analyzed. In the following table the pressure drops effects on the cooling capacity are shown, expressed in terms of temperature drops [°C] on the suction and discharge lines:

The high pressure drops, caused by the considerable lengths, create another type of problem on the liquid line: known as "*gas flashing*". It consists in the evaporation of part of the refrigerant, due to the heat developed by friction along the line and due to the pressure drops. This may cause a malfunction of the thermostatic valve. A proper sizing of the refrigerant lines will avoid these problems. A simple and rather accurate method has been suggested by ASHRAE and will be explained below.

Calculation of the equivalent pressure drops
For a correct and quick dimensioning of refrigerant lines refer to the following table, developed for R410a refrigerant.

Cu Tubo - *Pipe* Dext (mm)	Linea aspirazione - *Suction line* ΔT=0,04 k/m			Linea di mandata - *Discharge line* ΔT=0,02 k/m ΔP=0,749 kPa/m		Linea del liquido - *Liquid line*	
	Temp. di aspirazione satura - *Saturated suction temp.*					Velocità *Speed* 0,5 m/s	ΔT=0,02 k/m ΔP=0,749 kPa/m
	-20°C	-5°C	+5°C				
	Caduta di pressione corrispondente (kPa/m) *Corresponding pressure drop (kPa/m)*			Temperatura di aspirazione satura *Saturated suction temperature*			
	0,378	0,572	0,731	-20°C	+5°C		
10	-	-	-	-	-	4,14	4,37
12	0,75	1,28	1,76	2,44	2,6	7,08	11,24
14	1,2	2,06	2,83	3,91	4,16	10,02	18,1
16	1,78	3,05	4,19	5,71	6,15	13,46	26,8
18	2,49	4,26	5,85	8,06	8,59	17,41	37,49
22	4,39	7,51	10,31	14,15	15,07	26,66	66,1
28	8,71	14,83	20,34	27,89	29,7	44,57	131
35	15,99	27,22	37,31	51,05	54,37	70,52	240,7
42	26,56	45,17	61,84	84,52	90	103,4	399,3
54	52,81	89,69	122,7	167,2	178,1	174,1	794,2
63	81,38	138,02	188,9	257,1	273,8	240,4	1223,9

Table 1: Cooling capacity corresponding to different tubes diameter referred to different pressure drops or speed values.

This table refers to the pressure drop values or speed values (for the liquid line) indicated in the column heading.

If different pressure drops are needed, the cooling capacity shall be corrected with the following formula:

$$P_f = P \times \left[\frac{L_e}{L_{eff}} \times \frac{\Delta T}{\Delta T_{tab}} \right]^{0,55} \qquad [1]$$

Where:

Pf: cooling capacity
P : cooling capacity shown into table 1
Le : equivalent length of table 1
Leff : actual equivalent length
ΔT : required pressure drop
ΔTtab: pressure drop shown into table 1

The equivalent length can be calculated as follows: A fictitious length for each curve or branch or concentrated drop shall be added to the real lengths, corresponding to the linear tube length that would give the same pressure drop caused by the curve or by the branch.

Those fictitious lengths are shown in table 2 and shall be considered effective for fully open valves.

Table 2: Equivalent lengths (in meters) for concentrated drops.

Cu Pipe Dext [mm]	10	12	14	16	18	22	28	35	42	54	68
Standard 90° curve	0,38	0,4	0,46	0,48	0,5	0,6	0,8	1	1,2	1,5	1,7
Large radius 90° curve	0,26	0,3	0,29	0,3	0,3	0,4	0,5	0,7	0,8	1	1,2
90° elbow	0,66	0,7	0,73	0,76	0,8	1	1,2	1,7	1,9	2,5	2,9
45° curve	0,2	0,2	0,22	0,24	0,2	0,3	0,4	0,5	0,6	0,8	0,97
45° elbow	0,3	0,3	0,36	0,4	0,4	0,5	0,6	0,9	1	1,4	1,6
180° curve	0,67	0,7	0,73	0,76	0,8	1	1,2	1,7	1,9	2,5	2,9
Direction change connectors	0,77	0,8	0,87	0,91	0,9	1,2	1,5	2,1	2,4	3	3,5
Direct pass. of flow without reduc.	0,26	0,3	0,29	0,3	0,3	0,4	0,5	0,7	0,8	1	1,2
Direct passage of reduction flow 1/4	0,33	0,4	0,39	0,43	0,4	0,6	0,7	0,9	1,1	1,4	1,7
Direct passage of reduction flow 1/2	0,38	0,4	0,46	0,48	0,5	0,6	0,8	1	1,2	1,5	1,8
Sudden expansion d/D= 1/4	0,36	0,4	0,48	0,54	0,64	0,8	0,1	1,4	1,8	2,4	3
Sudden expansion d/D= 1/2	0,2	0,2	0,28	0,33	0,36	0,5	0,6	0,9	1,1	1,5	1,9
Sudden expansion d/D= 3/4	0,07	0,04	0,1	0,12	0,13	0,2	0,2	0,3	0,4	0,5	0,61
Sudden restriction d/D= 4/1	0,18	0,2	0,24	0,27	0,3	0,4	0,5	0,7	0,9	1,2	1,5
Sudden restriction d/D= 2/1	0,12	0,2	0,18	0,21	0,3	0,3	0,4	0,5	0,7	0,9	1,2
Sudden restriction d/D= 4/3	0,07	0,1	0,1	0,12	0,13	0,2	0,2	0,3	0,4	0,5	0,61
Sudden inlet stop	0,41	0,5	0,5	0,54	0,68	0,9	1,1	1,6	2	2,7	3,6
Sudden outlet stop	0,21	0,2	0,27	0,3	0,34	0,4	0,5	0,8	1	1,3	1,7
Inlet pipe protection	0,4	0,5	0,5	0,54	0,68	0,9	1,1	1,6	2	2,7	3,6
Outlet pipe protection	0,28	0,3	0,4	0,46	0,53	0,7	0,82	1,3	1,5	2,1	2,6
Straight cock/check valve	4,8	5,1	5,3	5,4	5,8	6,6	8,7	11,4	12,6	16,5	20,7
Cock at 60° inclination	2,2	2,4	2,5	2,7	2,9	2,3	4,6	6,1	7,3	9,1	10,7
Cock at 45° inclination	1,6	1,8	2	2,1	2,3	2,7	3,6	4,6	5,4	7,3	8,7
Right angled cock/check valve	1,6	1,8	2	2,1	2,3	2,7	3,6	4,6	5,4	7,3	8,7
Gate valve	0,16	0,18	0,2	0,21	0,23	0,27	0,3	0,46	0,54	0,7	0,85
Straight ball valve	1,3	1,5	1,7	1,8	2	2,4	3,6	4,2	4,8	6,1	7,6

Table 1 is referred to a condensation temperature of 40°C. In case of different condensation temperatures the following correcting values shall be applied to the cooling capacity.

Temp. cond. (°C) - *Cond. Temp. (°C)*	20	30	40	50
K linea aspirazione - *K suction line*	1,18	1,1	1	0,91
K linea mandata - *K discharge line*	0,8	0,88	1	1,11

Table 2.a: Cooling capacity of the correction factors in function of the condensing temperature.

Using table 1 and the suggested correction factors it is possible to choose the proper diameter in accordance to the requested cooling capacity and the evaluated pressure drops.

Once the choice is taken a check shall be made by calculating the real pressure drop using the following formula.

$$\Delta T = \Delta T_{tab} \times \frac{L_{eff}}{L_e} \times \left[\frac{P_f}{P}\right]^{1,8} \qquad [2]$$

In order to verify if the selected diameter could be correct the following maximum pressure drops shall be considered according to ASHRAE:

Liquid line: ΔPmax = 0,5÷1 K
Suction line: ΔPmax = 1 K
Discharge line: ΔPmax = 1 K

Example:

How to choose the proper tube diameter.

Input data:

Equivalent length calculated: Leq=60 m
Saturated suction temperature: Tas=5°C
Condensing temperature: Tc=50°C
Cooling capacity at the evaporator: Pf=30 kW

Since the values of cooling capacity indicated in Table 1 are relative to pressure drop values equal to 0.02 K / m , first check the pressure drops that would occur on the line using the diameter corresponding to the cooling capacity of the unit. The equivalent length is about 60 meters , then with a pressure drops of 0.02 K / m the total pressure drops are equal to: T = 60x0 , 02 = 1.2 K

These pressure drops are higher than the maximum specified by ASHRAE. To comply with the recommended value (K 1) it is necessary to reduce the pressure drops length down to 0.016 K / m , using the formula [1]. Refer to Table 1 and to search in the discharge line column (with suction temperature equal to 5 ° C) a cooling capacity close to the unit one.

P = 29.7 kW at line with Δext = 28 mm .

This capacity is relative to a condensing temperature of 40 ° C. To obtain the corresponding 50 ° C capacity, this value shall be multiplied to a factor shown in the table 2a: (discharge line , Tc = 50 ° C) → factor = 1.11. The cooling capacity delivered by the line with Δext = 28 mm (corresponding to pressure drops of 0.02 k / m) is therefore:

P = 29,7 x1, 11 = 32.97 kW.

In conclusion, the data we need to use the formula [1] are the following:

ΔT=0,016x60=0,96 K
ΔTtab=0,02 K
Le=1m
Leff=60m
P=32,97 kW

As a consequence:

$$P_f = 32,97 \times \left[\frac{1}{60} \times \frac{0,96}{0,02}\right]^{0,55} = 29,16kW < 30kW$$

The above value represents the cooling capacity for a line with Δext=28mm, at Tas=5°C e Tc=50°C and with a corresponding pressure drop equal to 0,016 K/m.Since this capacity is lower than the cooling capacity supplied by the unit (30 kW), the pipe diameter will be undersized. The Δext=35 mm will then be chosen. In order to verify if the choice is correct, the total pressure drop must be calculated again by using the formula [2]. Consequently, having chosen Δext=35 mm only the P value will change, as follows:

P=54,37x1,11=60,35 kW

And then:

$$\Delta T = 0{,}02 \times \frac{60}{1} \times \left[\frac{30}{60{,}35} \right]^{1{,}8} = 0{,}34K$$

As shown, the new total pressure drop is much more smaller than the maximum value suggested by the ASHRAE.

It should be noted that it’s important to verify that the compressor oil return on the suction line is ensured.

A small oil amount tend to escape towards the refrigerant circuit, and therefore it’s fundamental that even this small oil amount could flow through the pipes reaching the compressor through the suction line. In this section, the oil can flow by gravity if the pipe is oriented downward otherwise it is carried by the refrigerant if the pipe is perfectly horizontal or even upward oriented.

To ensure a correct oil flowing the refrigerant speed shall not be lower than the minimum allowed value. This, however, shall also be possible if the is working at partial load due to a reduced power demand from the plant.

In such cases, very common for unit of big capacity, it is necessary to size the plant according to the minimum compressor capacity, and not in accordance to the full load capacity.

In Tables 3 and 4, the allowed capacities at partial load condition are shown, both for the suction and discharge lines.

Temperatura satura di evaporazione (°C) *Saturated evaporation temperature (°C)*	Temperatura di aspirazione del gas (°C) *Gas suction temperature (°C)*	Tubo rame, diametro esterno (mm) - *Copper pipe, External diameter (mm)*									
		12	14	16	18	22	28	35	42	54	68
-20	-15	0,287	0,447	0,646	0,885	1.508	2,867	5,087	8,213	15,748	23,703
	-5	0,273	0,425	0,614	0,841	1,433	2,724	4,834	7,804	14,963	22,522
	5	0,264	0,411	0,595	0,815	1,388	2,638	4,68	7,555	14,487	21,805
-5	0	0,389	0,605	0,874	1,198	2,041	3,879	6,883	11,112	21,306	32,070
	10	0,369	0,574	0,829	1,136	1,935	3,678	6,526	10,535	20,2	30,405
	20	0,354	0,559	0,797	1,092	1,861	3,537	6,275	10,131	19,425	28,238
5	10	0,47	0,731	1,057	1,449	2,468	4,692	8,325	13,441	25,771	28,791
	20	0,440	0,684	0,99	1,356	2,311	4,393	7,794	12,582	24,126	36,314
	30	0,422	0,666	0,949	1,301	2,217	4,213	7,467	12,069	23,414	34,831

Table 3: Minimum capacity (kW) ensuring the oil flowing in vertical sections of the suction line (R410a refrigerant).

The cooling capacity shown in table 3 refer to 40°C of condensing temperature: in case of different temperature values of the liquid line, the capacities must be adjusted according to the following factors:

Temperatura del liquido (°C) - *Liquid temperature (°C)*	30	40	50
Fattore correttivo - *Corrective factor*	1,08	0,91	0,82

Table 3.a: Correction factors for different liquid temperature.

Temperatura satura di mandata *(°C)* *Saturated discharge* temperature *(°C)*	Temperatura di mandata del gas (°C) *Discharge temperature of the gas (°C)*	Tubo rame, diametro esterno (mm) - *Copper pipe, External diameter (mm)*									
		12	14	16	18	22	28	35	42	54	68
30	70	0,596	0,927	1,34	1,836	3,127	5,945	10,547	17,028	32,649	49,143
	80	0,579	0,901	1,303	1,785	3,040	5,779	10,254	16,554	31,74	47,775
	90	0,565	0,878	1,27	1,74	2,964	5,635	9,998	16,14	30,948	46,582
40	80	0,618	0,96	1,389	1,903	3,242	6,163	10,934	17,653	33,847	50,946
	90	0,601	0,935	1,353	1,853	3,157	6,001	10,647	17,189	32,959	49,609
	100	0,584	0,908	1,314	1,8	3,067	5,83	10,343	16,690	32,018	48,193
50	90	0,63	0,981	1,418	1,943	3,31	6,291	11,162	18,020	34,552	52
	100	0,611	0,951	1,375	1,884	3,209	6,1	10,823	17,473	33,503	50,428
	110	0,595	0,926	1,339	1,834	3,125	5,941	10,54	17,016	32,627	49,019

Table 4: Minimum capacity (kW) ensuring the oil flowing in vertical sections of the discharge line (R410a).

In this case also, the cooling capacity shown in table 4 refers to a saturated evaporating temperature equal to -5°C: for different temperature values the capacity the capacities must be adjusted according to the following factors:

Temperatura di aspirazione satura (°C) - *Saturated suction temperature (°C)*	-20	+5
Fattore correttivo - *Corrective factor*	0,96	1,02

Table 4.a: Correction factors for different suction temperature

It might be guessed that in order to guarantee the proper speed ensuring the correct oil flow, if the compressor is working at partial loads, the diameter shall be reduced, therefore a too much high speed is obtained when the compressor is working at full load.

This is due to excessive pressure drops.

Thus, the refrigerant line sizing, results often in a problem of balance between two opposite needs. In some cases (especially when the suction line is upward oriented), this balance cannot be easily reached, and therefore it is necessary to use a precaution on the plant, known as a "dual inclination".

The dual inclination consist in installing two parallel lines, one of each (marked as “A” in fig. 1) is sized in order to allow the oil return at the minimum capacity, the other one (marked as “B”) is sized to ensure that the sum of the two sections is at least equal to that of a single line dimensioned in accordance to the maximum cooling capacity.

Between the two vertical sections a sump is realized. The sump is sized in order to guarantee that at minimum loads, it will be filled with oil closing the entrance to the line "B".

The sump, however, must not contain excessive amounts of oil, but it must have a minimum volumetric capacity. When the cooling capacity grows, the greater flow creates a higher pressure allowing to overcome the oil cap and therefore also the line “B” works.

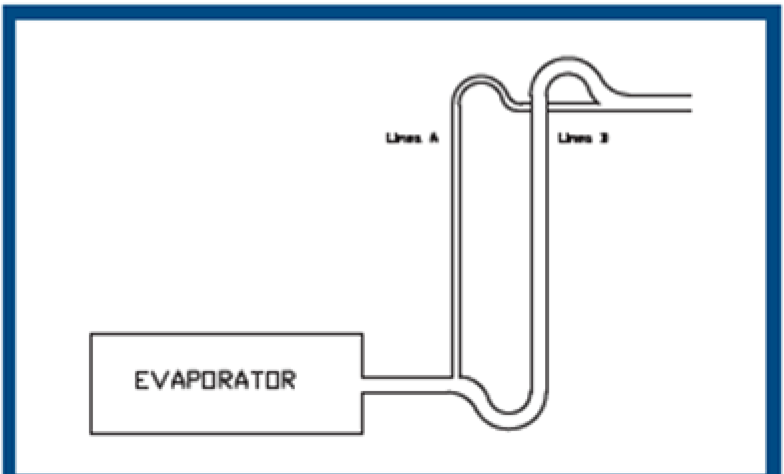


Figura 1: schema impiantistico della doppia risalita
Figure 1: system diagram of the dual inclination

There are two other important precautions to be taken in account in making sunction lines an oil trap 6 meters shall be created or a small downward line inclination shall be installed in case of horizontal sections, to ensure a better oil flow.

If the circuit is equipped with two evaporator in parallel, one independent from each other, and one of the two evaporator is not working, oil accumulation must be avoided anyway. If the two evaporators are installed at the same level a downward line on both evaporators outlet shall be created, before joining the common section. If the two evaporators are installed at different levels there are two possible solutions shown in figure 2.

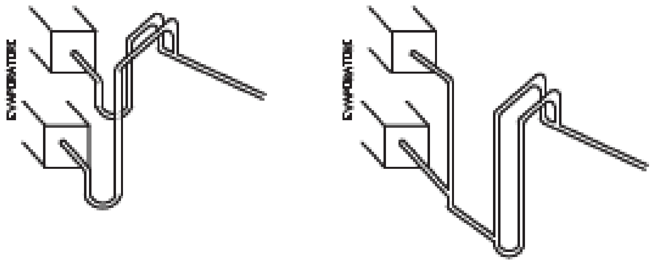


Figura 2: soluzioni impiantistiche per la linea di aspirazione collegata a due evaporatori indipendenti

Figure 2: design solutions for the suction line connected to two independent evaporators

On the discharge line, there is the same problem due to the oil flow on the suction line. The solution to the problem is the same. In this case, the most important issue could be the oil drop towards the compressor. This issue can be solved using check valves and making oil taps if the condenser is mounted at a higher level than the compressor.

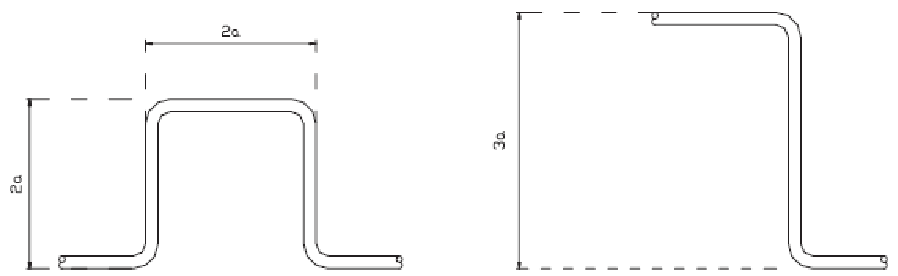
On the liquid line, it is important to avoid that non liquid refrigerant reaches the thermostatic valve. This purpose is achieved by giving to the fluid a high subcooling in the condenser, but a proper sized liquid receiver shall be installed upstream from the line in the case of high lengths (over 20 meters). If the liquid temperature is lower than the outdoor temperature (it may happen for water cooled units) the line shall be properly insulated.

Precautions for refrigerant line sizing

Suction line must always be insulated to avoid condensate formation.

- The liquid line must be insulated if the outdoor temperature is higher than the liquid temperature. (approximately 5°C less than the condensing temperature)
- The discharge line must be insulated only to prevent from burning danger (the temperature can reach up to 100°C)
- Special couplings or U-shaped or L-shaped sections can be used to compensate the copper pipe expansions. The expansion of the pipe can be estimated using the following table:

These special couplings or U-shaped or L-shaped sections used to compensate the pipe expansion can be sized according to the following sketch:



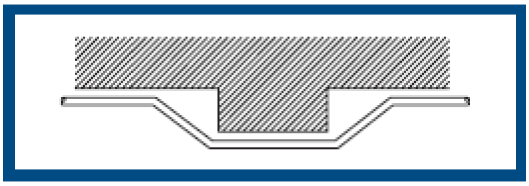
Diametro tubo rame (mm) *Copper pipe diameter (mm)*	Lunghezza tratto a (mm) riferita a dilatazione lineare (mm) - *Length of section a (mm) referred to linear expansion (mm)*							
	10	20	30	40	50	60	80	100
16	25	29	36	45	50	58	66	74
18	25	30	38	46	52	60	68	75
22	26	32	41	48	56	62	71	79
28	28	37	45	52	61	65	76	86
36	30	40	48	56	65	70	85	95
42	32	42	51	60	69	77	91	103
54	36	45	57	66	77	87	101	114
68	39	49	59	69	79	89	107	121

Since this type of components may cause significant pressure drops, their use must be carefully eveluated.

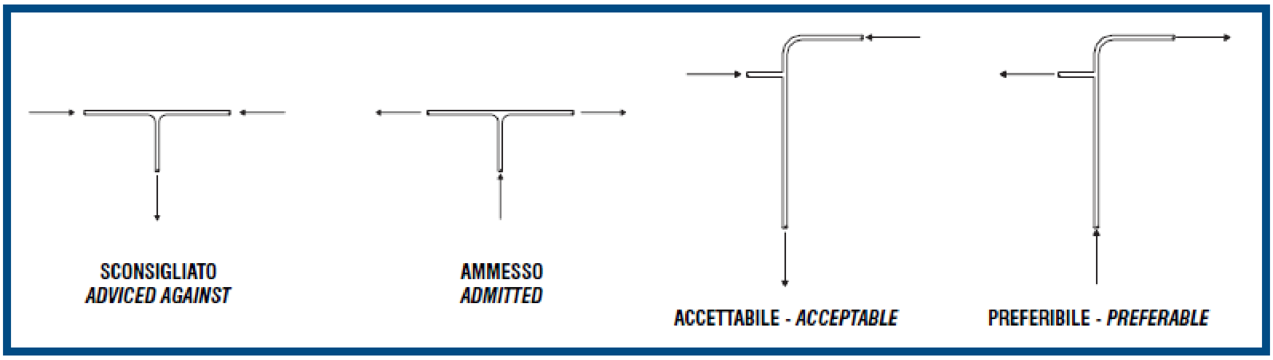
• Supports shall be installed to support the pipes weight and shall be spaced according to the following prescriptions:

Diametro del tubo (mm) - *Pipe diameter (mm)*	14 - 18	22 - 28	35 - 54	63
Distanze max fra i supporti (m) - *Max distance between the supports (mt)*	2	2,5	3	3,5

• Curves and joints cause pressure drops. Large-radius curves are strongly recommended; in case of barriers to overcome 45° curves are recommended if compared to 90°.



• T joint shall be made in accordance with the following prescriptions:



• The vibration and noise reduction is very important, and can be carried out by appropriate devices such as: resilient joints (strongly recommended for diameters higher than 50 mm), proper insulation to separate the pipe from the wall (if the pipe passes through the wall), flexible anchors.

• Pipe placing:

The installation of too many curves is not recommended, because each curve cause an increase rectilinear section. Moreover, the curves must be shaped with a large curvature radius. Be extremely careful to not reduce the pipe section because it could obstruct the normal flow of refrigerant, with consequent overwork for the compressor. The presence of too many curves in the plant could create friction and vibration, causing at the connection points pipes and vents slackening or breakage.

• Difference in height:

The difference in height recommended by the manufacturer shall be respected between the evaporating unit and the condensing units, otherwise cooling capacity, oil return and lubrication problems may occur.

• Flare connections

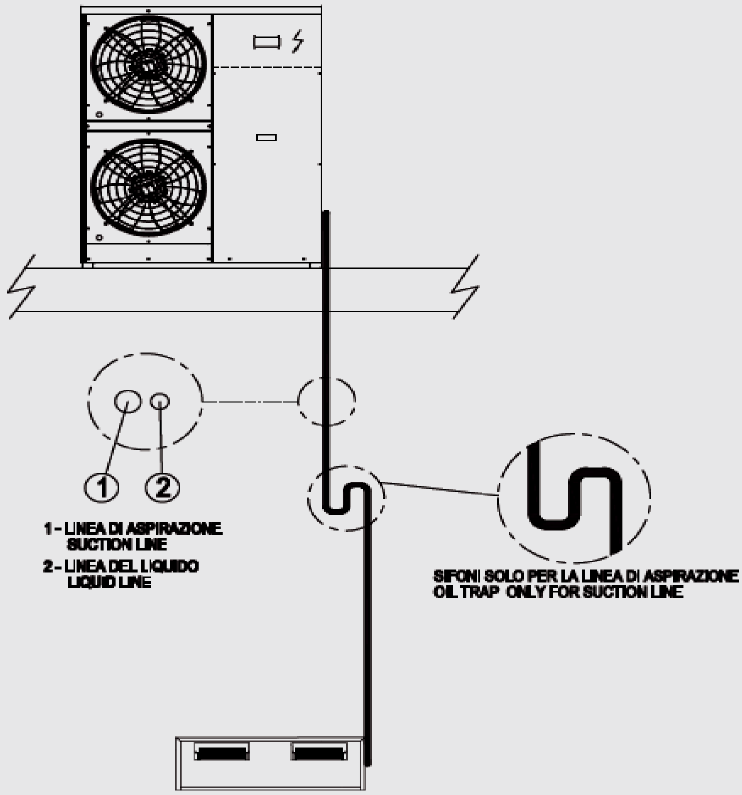
A good flare connection shall not be characterized by flash, especially in the conical contact section of the tap or of the connection and shall be able to work without friction.

The ideal space between folder and pipe union shall be approximately 5 mm; during tightening it is recommended to apply a drop of oil to ease locking. Be careful not to apply the oil in the contact or sealing area with the pipe union, as the oil coating will tend to dry out.

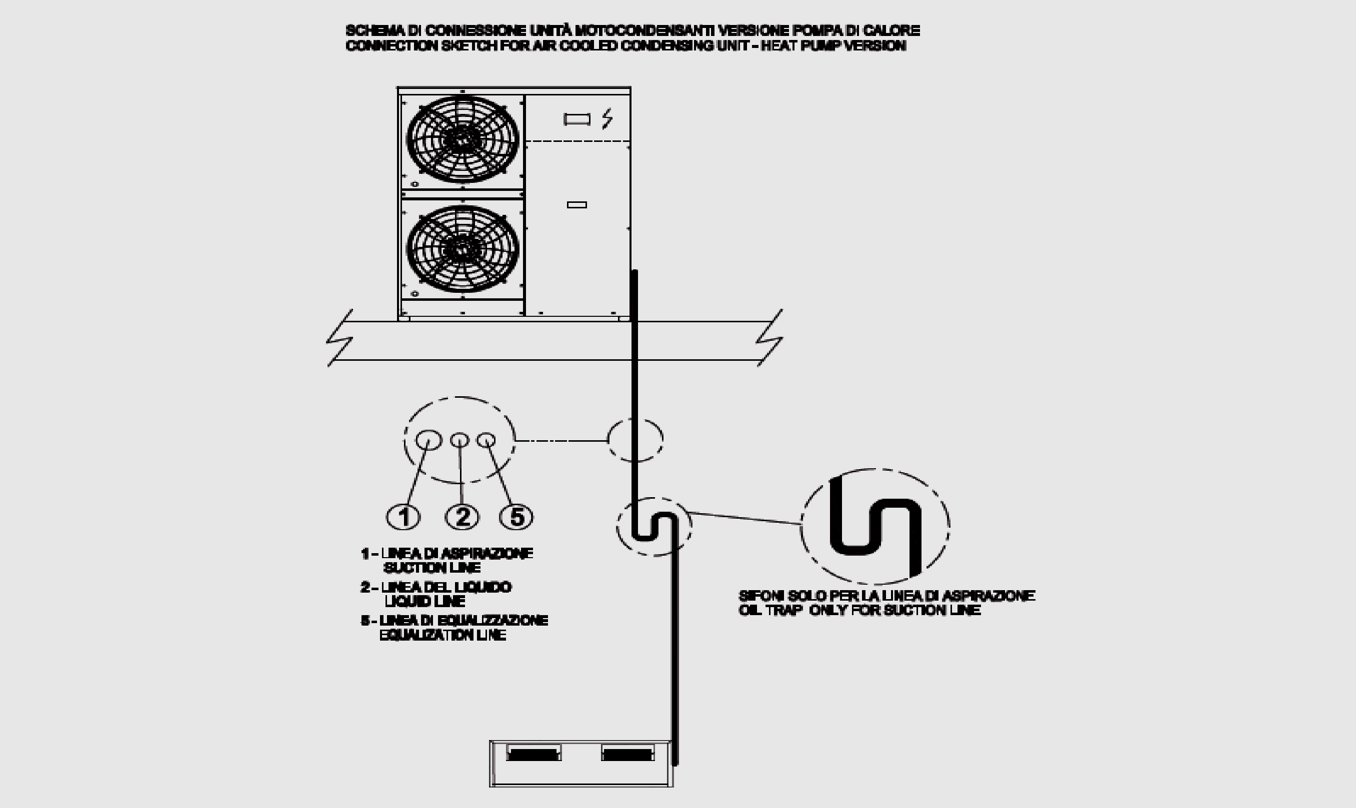
Maximum allowed distance between indoor and outdoor units

Oil traps shall be installed at the base of each vertical section with upward flow direction; a very long vertical pipe shall be equipped with an oil trap every 3-4 m distance.

SCHEMA DI CONNESSIONE UNITÀ MOTOCONDENSANTI VERSIONE CHILLER
CONNECTION SKETCH FOR AIR COOLED CONDENSING UNIT - COOLING ONLY VERSION



HEAT PUMP



Liquid receiver

The refrigerant charge of the unit depends from the heat exchanger capacity. For a reversible heat pump the heat exchangers work as condenser or as evaporator, in accordance to the cycle. The liquid receivers are installed on the refrigerant circuit and allow to store the charge difference between the two cycles.The placement of the liquid receiver shall be evaluated depending on the capacity of the heat exchangers of the plant and those installed on board of the unit.
For example:
Capacity of the heat exchanger on board: 10 liters
Capacity of the Remote heat exchanger: 6 liters
During chiller operating mode the heat exchanger on board works as a condenser, while the remote one works as evaporator. Viceversa during heat pump mode. The difference between the capacity of the two heat exchangers results in a refrigerant charge difference between the two cycles, it is therefore necessary to have a liquid receiver which capacity shall be properly sized to store the excess of refrigerant when a smaller refrigerant charge is required.

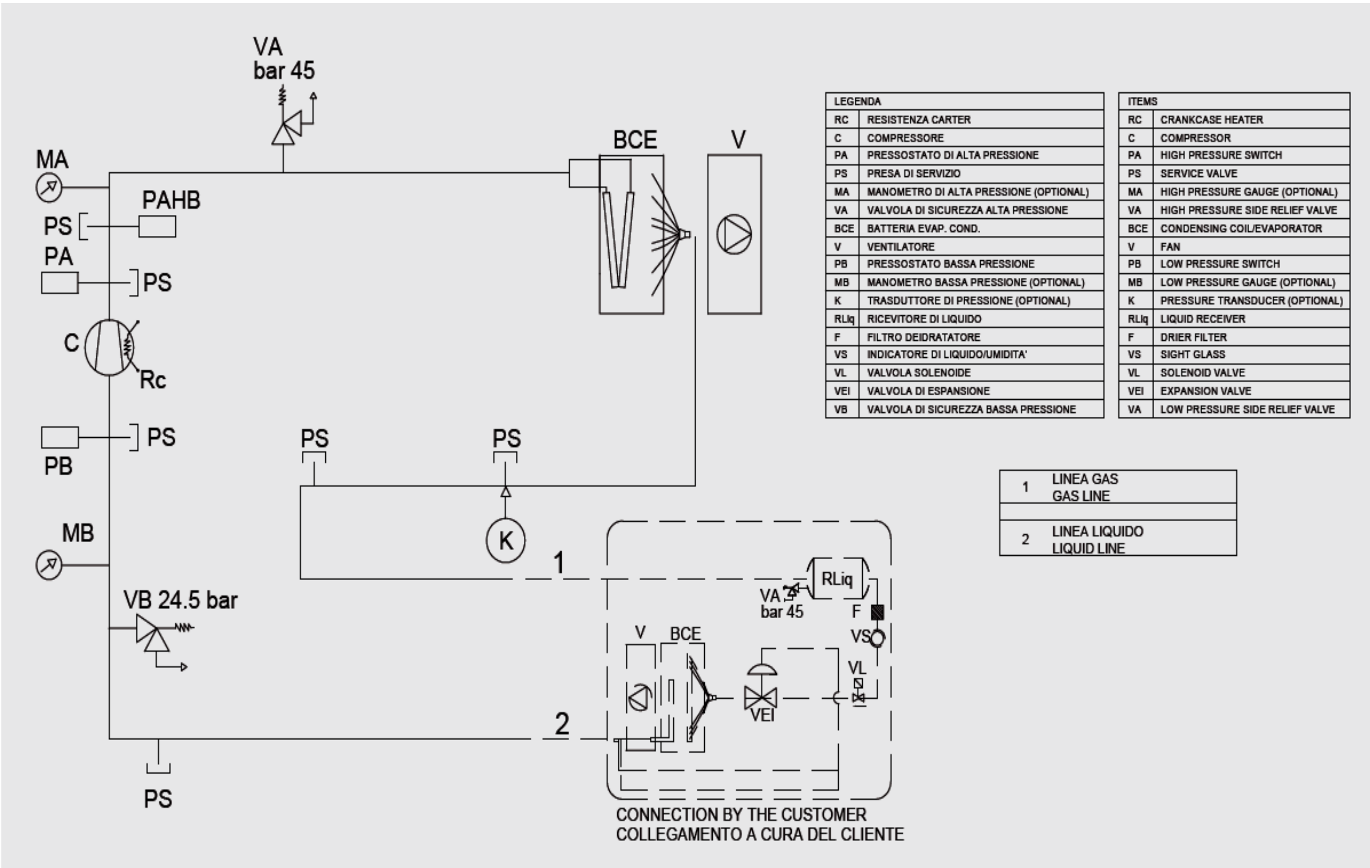
Liquid receiver sizing
Here below an evaluation method for the liquid receiver sizing is shown. The described method is proposed to give an approximate indication for the selection of the proper liquid receiver. The volume values obtained may change depending on the specific plant requirements and shall therefore be evaluated in the plant design.
VReceiver= 0.4x(V1 – V2)
V1: volume of the unit’s heat exchanger (please contact Trane to obtain this information)
V2: Volume of the remote heat exchanger.
If V receiver has positive sign, the receiver shall be placed so as to be filled in heat pump mode and discharged in chiller, otherwise it shall be placed so as to be filled in chiller mode and emptied in the heat pump.
In addition, the liquid receiver capacity shall be sized in accordance to the total refrigerant charge of the plant, in order to store the entire amount of refrigerant in the plant in case maintenance.

Installation diagram and placing of the liquid receiver

CHILLER
The units are equipped with one refrigerant circuit entirely constructed with copper tubes, each with:
• high pressure switches;
• low pressure switches;
• relief valve on high pressure line.

An optional connection kit is available for the connection to the indoor evaporating units. It includes:
• thermostatic expansion valve;
• filter dryer with sight glass;
• liquid line solenoid valve.

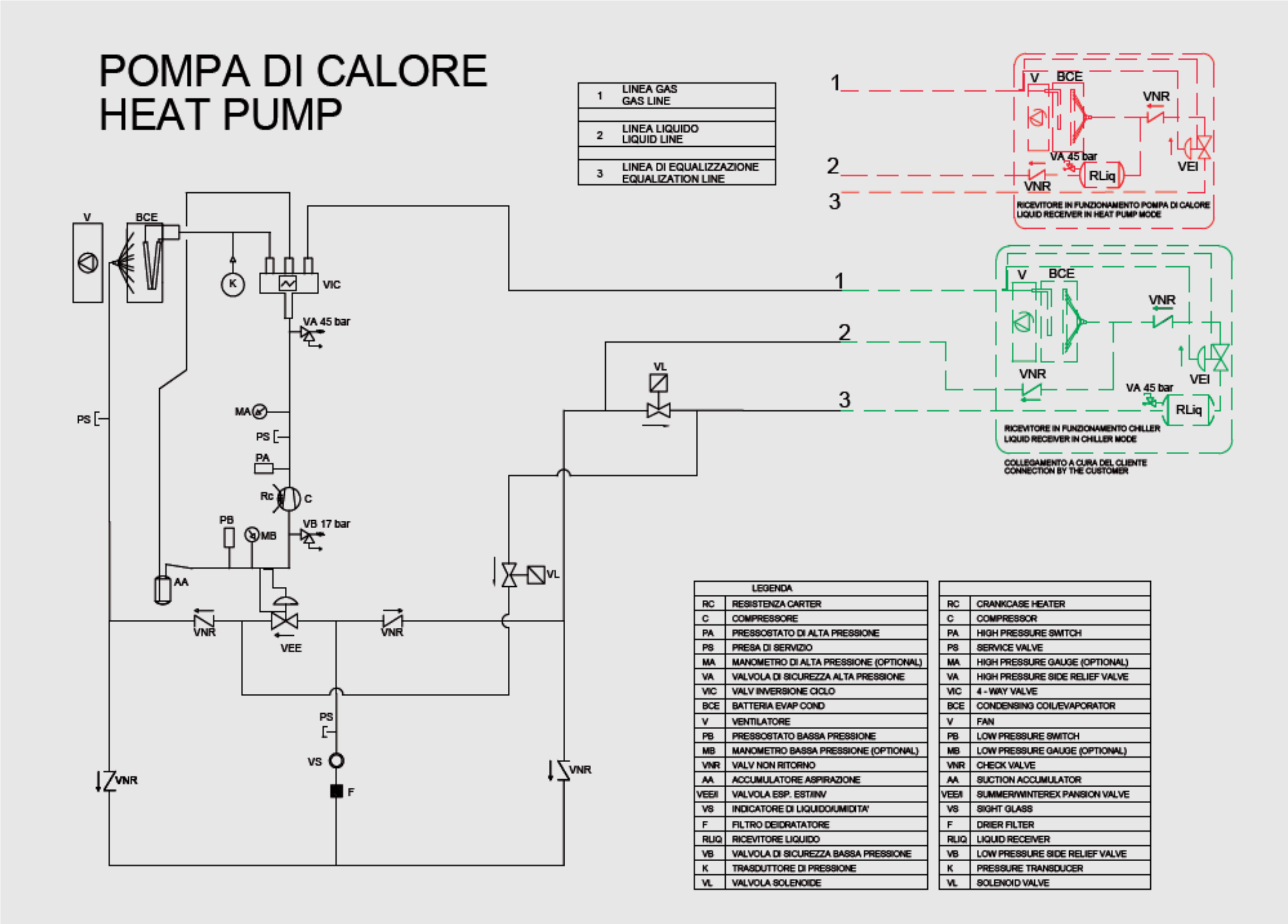
Different sizes of liquid receivers are available as options according to specific needs of the plant.
The installation of the liquid receiver is a designer’s responsibility.
In case of maintenance the liquid receiver may be used to stock the entire refrigerant volume of the plant.



HEAT PUMP
The units are equipped with one refrigerant circuit entirely constructed with copper tubes, each with:
• high pressure switches;
• low pressure switches;
• relief valve on high and low pressure line
• thermostatic expansion valve for heat pump operating mode;
• 4-way reverse valve;
• solenoid valves for the cycle inversion;
• check valves;
• liquid accumulator on suction line
• filter dryer with sight glass.

An optional connection kit is available for the connection to the indoor evaporating units. It includes:
• thermostatic expansion valve for chiller operating mode;
• check valve on the liquid line.

Different sizes of liquid receivers are available as options according to specific needs of the plant.
The installation of the liquid receiver is a designer's responsibility.
In case of maintenance the liquid receiver may be used to stock the entire refrigerant volume of the plant.



As mentioned in the previous paragraph, the liquid receiver location for ZHM versions shall be evaluated in accordance to the refrigerant charge delta of the two cycles. In this example, the higher refrigerant charge is required for the chiller mode; therefore the liquid receiver shall be placed in a location that ensure the proper filling during the operation in heat pump mode and the proper emptiness during chiller mode (red circle).

In case of excess refrigerant charge in heat pump mode, the liquid receiver shall be placed in a location that ensure the proper filling during the operation in chiller mode and the proper emptiness during heat pump mode(green circle).

The choise of the liquid receiver capacity and its placing is the responsibility of the designer of the plant

Remote terminals control

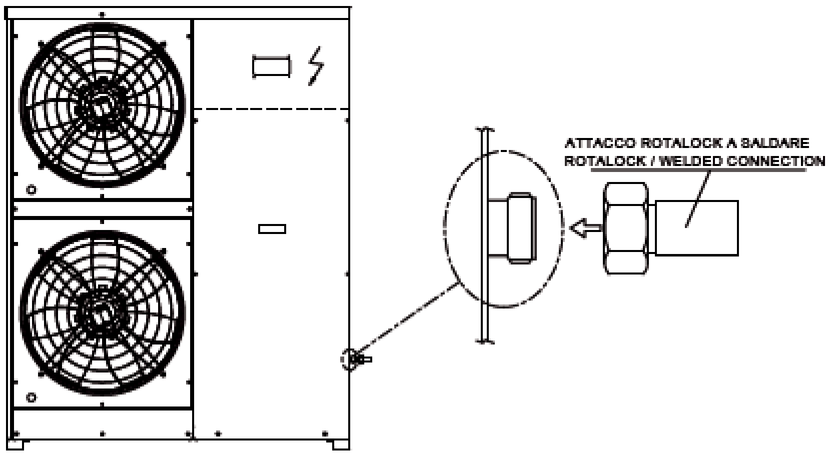
The units can be connected to hydronics or direct expansion terminals. In both case sit is necessary to be sure that terminals pumps and fans are switched on before the compressors is switched and they have to switch off after the compressor is switched off.

Expansion valve

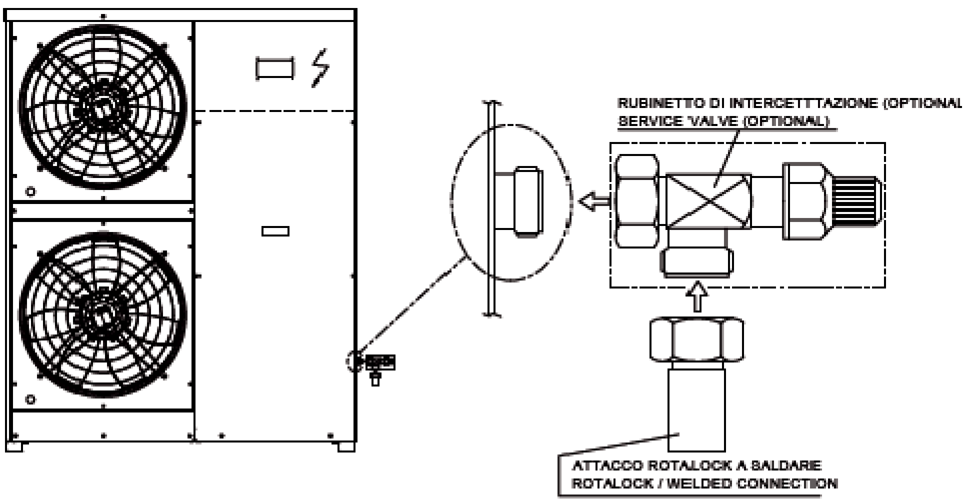
The expansion valve for the cooling operating mode shall be placed next to the terminal.

Refrigerant connection

The liquid, suction and equalization lines present rotalock connection. Rotalock welded connection are included as standard equipments but supplied separately.



Service valves are available as options, supplied separately.



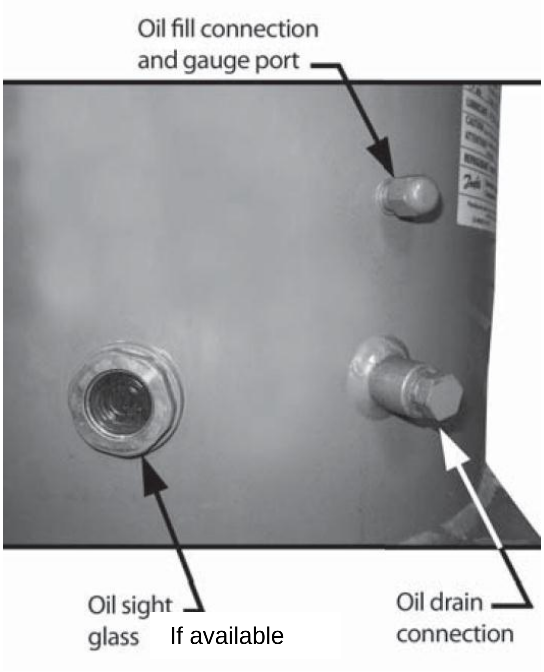
Temperatura (°C) - *Temperature (°C)*	**-20**	**0**	**25**	**50**	**75**	**100**	**125**
Dilatazione (mm/m) - *Expansion (mm/mt)*	0	0,4	0,7	1,1	1,5	1,9	2,3

Unit operation

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 ¼" Schrader connection.
To refill oil, it is necessary to discharge the refrigerant in the unit, recovering it in adequate cylinders. Then vacuum until you reach a pressure of about 6 Pa to remove any trace of humidity from the circuit. Then load the unit with a small amount of refrigerant and fill oil from the proper connection for refilling.
Add oil until the oil sight glass is flat within the upper and lower limits indicated by the corresponding notches. At this point refill the previously discharged amount of refrigerant as in the indications above. Restart the compressor. Run for 20 minutes at full load and check the oil level.



Power supply to the auxiliary circuit

The power supply to the auxiliary circuit is 220V for all the units. Connection to the power circuit is inside the panel and is carried out in the factory. The compressor oil heaters, the protections against compressor over temperature and the cooling water safety indicator are connected so as to always be operative, as long as the electrical panel is power sup-plied

Start-Up preliminary procedures

Initial checks

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.

Open the discharge valve of the compressor. Open the liquid shutoff valve placed on the liquid line. Measure the suction pressure. If it is lower than 0.42 MPa jumper and strain the solenoid valve on the liquid line. Bring the suction pressure to 0.45 MPa, then remove the jumper. Charge all the water circuit progressively. Starts up the water pump of the evaporator with the calibration valve shut and then slowly open it.

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

Refrigerant seals control

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

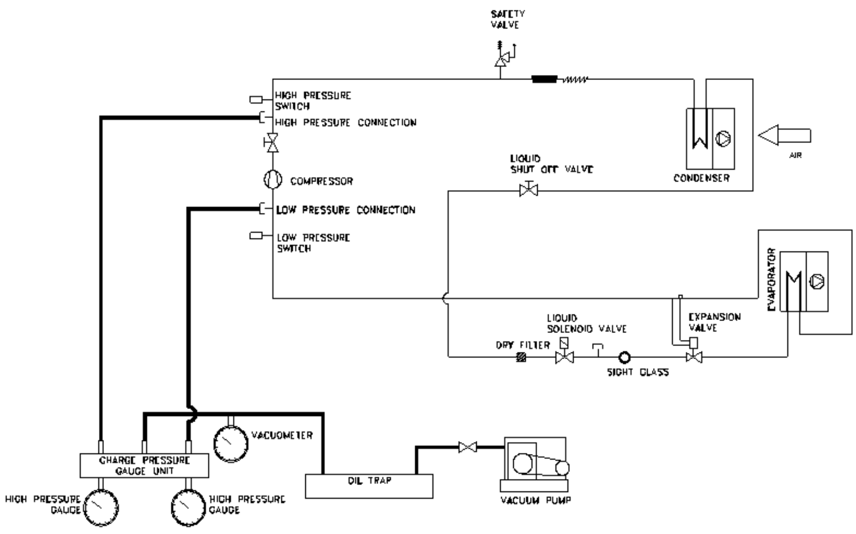
After having eliminated the leakage, the system has to be dehydrated with a vacuum pump up to at least 1mm Hg - absolute pressure (1 Torr o 133.3 Pa). This is the minimum recommended value to dehydrate the plant.

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.

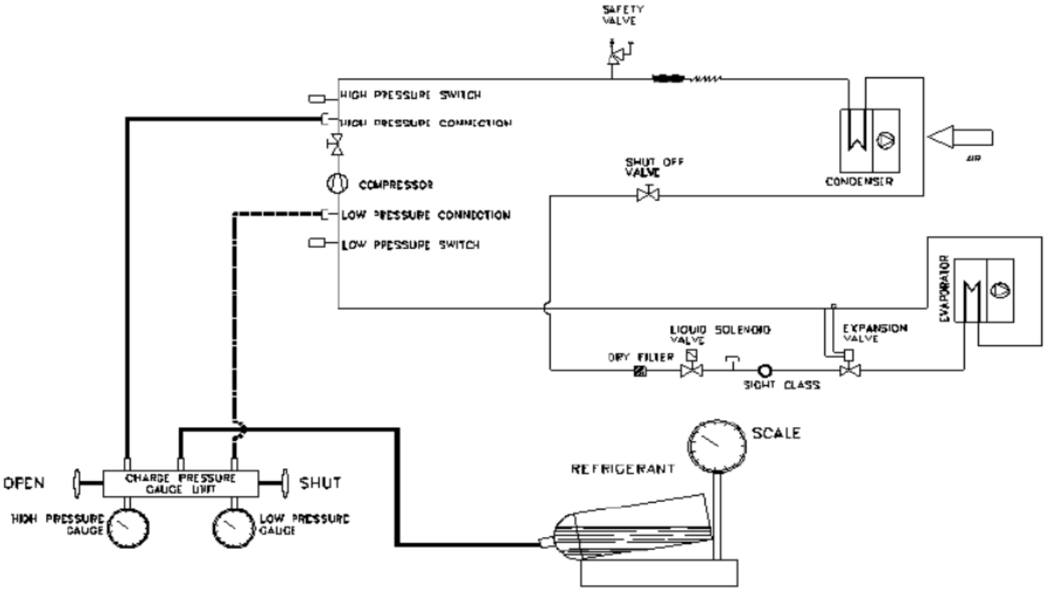


Cooling circuit diagram with connection to vacuum pump

Refrigerant charge

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

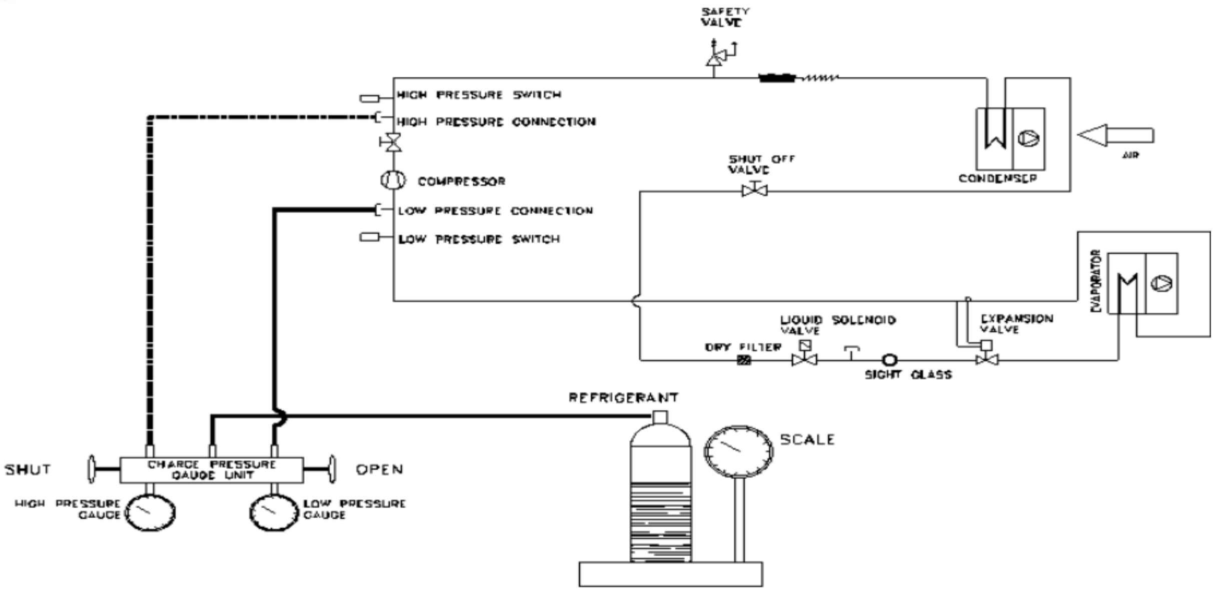
Completely open the valve for it to close the service connection. Connect the refrigerant cylinder to the service connection without tightening the connection. Half close the liquid shut off valve. If the circuit has been dehydrated and vacuum, load liquid with the cylinder upside down. Weigh and charge 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

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…) 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 up the unit by pressing the ON/OFF button. About 20 seconds pass from the moment in which the start up request of the unit is given to the moment in which the (first) compressor starts. Three hundred and sixty seconds will pass from the last shut down to the next start up of the same compressor.
Check the rotation direction of the fans and rotative compressors. If it is not the right one, invert two supply phases.
Ensure that all the safety and control equipment is functioning correctly. Control the temperature of the water coming out of the evaporator and regulate the control setting if necessary. Control the oil level.

Warm up

Once the units have been installed, making connections, electrical connections (with the relevant electric panel) carried out, the following steps must be followed to start up the unit:
1) After making sure that the general switch has been connected (as suggested on the label put on the electric panel), switch on the unit through the thermostat in the requested mode, switching on the electric panel fan.
2) Check the fan rotation direction and in case reverse the phases on terminals inside the electric panel.
3) Set the thermostat to the required temperature, which has to be lower than the ambient one in summer mode. In this position, the compressor and the outdoor unit fan motor start running; check the fan and the compressor rotation direction and if it is necessary all the operations concerning the inversion of the phases have to be repeated. Starting from this moment, while the air handling unit fan will be continuously running, the outdoor unit will run or will stop according to the thermostat needs.

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.

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 oxidisation 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.

Description of the operations	Recommended frequency
Control of compressor oil level	monthly
Control of the suction temperature (superheating)	monthly
Control of the hydraulic circuit water filling	monthly
Control of electric absorption fan motors and compressor	monthly
Control of power supply and auxiliary power	monthly
Control of refrigerant charge through liquid sight glass (if available)	monthly
Control of the state of the carter electric heaters	monthly
Carrying out tightening of all the electrical connections	monthly
Coil cleaning	monthly
Control of the functioning of the compressor solenoid valves and liquid line	seasonal
Control of the setting of the regulation and safety thermostat	quarterly
Control of the state of the fan and compressor contactors	quarterly
Functional test of the evaporator heater	quarterly
Noise control of the engine and fan bearings (if available)	seasonal
Pressure tank state checking	yearly

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 valves	1 per type
Pressostats	1 per type
Pressure gauge	1 per type
Contactors and relays	1 per type
Thermal protectors	1 per type
Carter electric heaters	1 per type
4-way 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

2 YEARS	
COMPONENTS	QUANTITY
Fuses	all
Drier filters	all
Solenoid valves	all
Thermostatic valves	all
Pressostats	all
Pressure gauge	all
Contactors and relays	all
Thermal protectors	all
Carter electric heaters	all
4-way 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

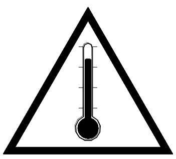
5 YEARS	
COMPONENTS	QUANTITY
Fuses	all
Drier filters	all
Solenoid valves	all
Thermostatic valves	all
Pressostats	all
Pressure gauge	all
Contactors and relays	all
Thermal protectors	all
Carter electric heaters	all
4-way valves	all
Check valves	all
Safety valves	all
Sight glasses	all
Fans and motors	all
Electronic components	all
Compressors	all
Heat exchangers	1 per type

Improper uses

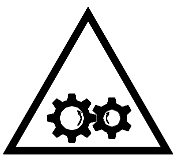
The unit is projected and built up to grant the maximum safety in its proximity, as well as to resist to the aggressive environmental conditions. The fans are protected by grilles. Residual risks are indicated with warning labels.

SAFETY SYMBOLS

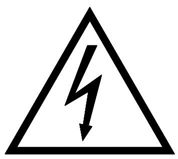
DANGER:
General danger



DANGER:
Temperature



DANGER:
Handling parts



DANGER:
Cut off voltage

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.

Dimensional drawing and weights

Refer to product catalogs.

Appendix

Pipes diameters table for RAUS

size	Suction diameter [mm]	Liquid diameter [mm]
RAUS 040	18	12
RAUS 060	22	12
RAUS 070	22	12
RAUS 080	28	16
RAUS 100	28	16
RAUS 110	28	16

Pipes diameters table for RAUX

size	Suction diameter [mm]	Liquid diameter [mm]	Balancing diameter [mm]
RAUX 040	18	12	12
RAUX 060	22	12	12
RAUX 070	22	12	12
RAUX 080	28	16	16
RAUX 100	28	16	16
RAUX 110	28	16	16

Rotalock connections diameters table for RAUS

size	Suction diameter [inch]	Liquid diameter [inch]
RAUS 040	1"¼	1"
RAUS 060	1"¼	1"
RAUS 070	1"¼	1"
RAUS 080	1"¼	1"¼
RAUS 100	1"¼	1"¼
RAUS 110	1"¼	1"¼

Rotalock connections diameters table for RAUX

size	Suction diameter [inch]	Liquid diameter [inch]	Balancing diameter [inch]
RAUX 040	1"¼	1"	1"
RAUX 060	1"¼	1"	1"
RAUX 070	1"¼	1"	1"
RAUX 080	1"¼	1"¼	1"¼
RAUX 100	1"¼	1"¼	1"¼
RAUX 110	1"¼	1"¼	1"¼

Condensing Coil for RAUX

size	Volume [dm^3]
RAUX 040	5,8
RAUX 060	6,9
RAUX 070	6,9
RAUX 080	7,8
RAUX 100	11,7
RAUX 110	11,7

Additional R410a refrigerant charge for a linear meter of pipe

Diameter (mm)	Gas (Kg/m)	Liquid (Kg/m)
6	0.0014	0.0133
10	0.005	0.051
12	0.008	0.079
16	0.014	0.139
18	0.019	0.182
22	0.029	0.285
28	0.045	0.445
35	0.074	0.729
42	0.111	1.082
54	0.182	1.779
64	0.281	2.721
67	0.289	2.825
76	0.377	3.689

Liquid receiver code	Liquid receiver capacity [l]	Connection diameter [mm]
131036482	0,58	16
161032442	1,1	10
PZ01H218	1,6	12
PZ01H216	2,3	12
PZ01H217	3,4	16
PZ03M016	3,9	12
AZ01T433	4,5	28
PZ11R074	5,3	22
PZ12R075	8,0	22
AZ01T434	10,0	28
WZ01R048	10,7	22
AZ01V320	14,0	28
AZ01T429	16,0	28
AZ01T430	18,0	35
AZ01T432	19,0	35
WZ01R783	19,0	28
AZ01T431	22,0	35
WZ01Q883	35,0	28
WZ01Q884	22,0	28
WZ01Q883O	35,0	35
WZ031L13	24,0	43
WZ301J51	30,0	28
WZ01Q984O	40	35
WZ01R441	50,0	35

For different liquid receivers , please contact your local Trane sales office.

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

Trane has a policy of continuous product and product data improvement and reserves the right to change design and specifications without notice.

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