SYSTEMP

G Series P Series R Series TMC Series

TECHNICAL MANUAL
INSTALLATION & ROUTINE AND SPECIAL MAINTENANCE

systemair

SYMBOLS

WARNING!
This symbol is used to indicate helpful hints for the operator.

ATTENTION! DANGER!
This symbol is used to indicate situations or operations that may be potentially dangerous or that require the operator's attention.

RISK OF ELECTRIC SHOCK!
This symbol is used to indicate situations or operations posing a potential risk of electric shock to the operator.

DANGEROUS HANDLING!
This symbol is used to indicate situations or operations posing a potential risk of crushing to the operator.

HEAVY LOADS!
This symbol is used to indicate situations or operations involving the handling of heavy loads by the operator.

RISK OF BURNS!
This symbol is used to indicate situations or operations posing a potential risk of burns to the operator.

RISK OF CUTS!
This symbol is used to indicate situations or operations posing a potential risk of cuts or abrasions to the operator.

The Manufacturer adopts a policy of continuous development and therefore reserves the right to make changes and improvements to any product described in this document without prior notice. Technical data and dimensions are not binding.

CLOSE CONTROL
AIR CONDITIONERS

TECHNICAL MANUAL

INSTALLATION & ROUTINE AND SPECIAL MAINTENANCE

List of revisions				
Revision	**Date**	**Author**	**Chapters**	**Descriptions**
A	04/2011	AF	All	First version
B	12/2011	AF	All	Revision of contents
C	12/2012	AF	All	Revision of contents
D	03/2014	AF	All	Revision of contents and insertion of R series
E	05/2015	AF	All	Revision of contents for SySmart operation
F	05/2016	AF	All	Revision of contents
G	10/2017	AF	All	Revision of contents
H	04/2018	AF	All	Revision of contents and introduction of Free Cooling plenum
I	10/2018	AF	All	Revision of contents
J	03/2020	AF	All	Revision of contents for SySmart ^{3} operation
K	08/2020	AF	All	Revision of refrigerant lines, compressor oils and power line
L	02/2021	AF	All	Revision of contents
M	10/2021	AF	All	Revision of contents and insertion of new P series models
N	001/2022	AF	All	Revision of contents

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WARRANTY CONDITIONS

All Products of the Manufacturer or bearing the trademark of the Manufacturer are built according to the state of the art techniques, in compliance with the current reference standards, as stipulated in the certificate of conformity provided together with the products.

All Products of the Manufacturer or bearing the trademark of the Manufacturer are designed to be installed inside a system that controls them. The designer or installer of the product assumes all liability and risk relating to its installation in the destination system.

The Manufacturer and its Branches/Affiliates do not guarantee that all aspects of the product and any software included will comply with the requirements of the destination system. In this case, following specific agreements, the Manufacturer can act as a consultant for the successful start-up of the product, but will not be held liable, under any circumstances, for the smooth operation of the destination system.

All Products of the Manufacturer or bearing the trademark of the Manufacturer are subject to the following warranty which is deemed as entirely accepted and signed at the time of placing the order.

The warranty on the Products of the Manufacturer or bearing the trademark of the Manufacturer is valid for TWENTY-FOUR MONTHS (2 years) from the shipment date of the material.

If start-up is not carried out by Manufacturer-authorised technicians, the warranty is validated by submitting a completed copy of the product's technical start-up report.

During the warranty period, the Manufacturer, under its sole discretion and as quickly as possible, undertakes to repair or provide as new any parts with acknowledged defects relating to material, construction or workmanship, which make them unsuitable for their intended use.

The claim must be submitted in writing, indicating the details of the reported fault, the serial number or code of the product, where the fault was identified and indication of the component that caused the fault, if this is easily identifiable. The Manufacturer will accept no claim made over the phone.

For operational purposes, claims can only be accepted during office hours, Monday to Friday. If a request is submitted on a public holiday, the Manufacturer will consider it as received at the beginning of the next business day after it was sent.

Faulty components are replaced ex works (EXW). Transport costs are borne by the Customer, even if the warranty cover is applied, unless specified otherwise by the Manufacturer.

The costs to replace faulty components (labour, materials, refrigerant, etc.) are borne by the Customer, even if the warranty cover is applied, unless specified otherwise by the Manufacturer.

Materials replaced while under warranty are the property of the Customer, who must dispose of them according to current regulations. Any disposal costs are borne by the Customer.

If parts should be returned while under warranty, they must be returned no later than three (3) months from the shipment date of the replacement part, organised and at the expense of the Customer. Otherwise, all the parts will be charged at the applicable list price at the time of their shipment.

The Manufacturer is not liable to pay compensation for direct or indirect damage, of any kind and for any reason. The Manufacturer is also not liable for any delay in the supply of parts under warranty or in the execution of work under warranty.

WARRANTY RESTRICTIONS

The above mentioned warranty conditions are valid as long as the Customer has fulfilled all obligations according to the contract and in particular those relating to payment. A delayed payment or non-payment of the supply, even if partial, suspends any warranty. The warranty does not give the Customer any right to suspend or delay payments, which must be paid in any case according to the stipulations of the order and specified in the written order confirmation.

Without precluding due compliance with other instructions provided in the technical documentation supplied with the product, it must be noted that the following instructions must be complied with accordingly, in order for the warranty to be valid:

Transport and positioning

- Do not remove the product from its original packaging until it has reached the installation site.
- Do not drop, knock or shake the product, as the internal circuits and mechanisms may be irreparably damaged.
- Store the product in an environment that complies with the temperature and humidity limits specified in the technical documentation.

Installation

1) The product must be installed by skilled personnel who fulfil the adequate requisites for the task as defined by the regulations in the country where positioning and installation take place.
2) The system that will control the product must be implemented according to professional standards, according to the instructions provided in the technical documentation and the regulations of the country where positioning and installation take place, with particular attention to the setting up of:

- Water or cooling lines serving the product and the relevant components.
- Electrical power and connection lines of the product and the relevant components.
- Aeraulic lines of the product and the relevant components.

3) Do not install the product outdoors or in areas that are subject to adverse weather.
4) Do not install the product in areas where there is oil, or where there are oil vapours or various kinds of aerosols, and where there are flammable vapours.
5) Do not install the product in environments where there is equipment that generates electromagnetic waves, and where the line voltage is subject to great fluctuations.
6) Do not install the product in environments where the air contains corrosive pollutants, a high dust or salt content.
7) Do not install the product on vehicles or boats.

First start-up

1) The product must be started up by skilled personnel who fulfil the qualification requisites for the task as defined by the regulations in the country where positioning and installation take place.
2) The system controlling the units must be started up according to professional standard, according to the instructions provided in the technical documentation and the regulations of the country where positioning and installation take place.
3) A copy of the technical start-up report of the product must be delivered to the Manufacturer.

Use and maintenance

1) Do not use the product for applications other than those specified in the technical documentation.
2) Do not use the product in an environment that does not comply with the temperature and humidity limits specified in the technical documentation.
3) Perform maintenance cycles according to the schedules specified in the technical documentation.
4) Clean the product with neutral detergents. Do not use corrosive chemicals and solvents or aggressive detergents.

Furthermore, the Manufacturer reserves the right to void the warranty of the products sold if:

A) The labels or plates bearing the trademark of the Manufacturer and the serial number or the registration number of the product have been deleted and/or removed.
B) The product has been subjected to alterations or mechanical processes not specifically authorised by the Manufacturer.
C) The product has been used inconsistently with the instructions provided in the technical documentation and regulations of the country where positioning and installation take place, or for purposes other than what it was designed for.
D) The defects are due to negligence, incompetence, poor maintenance, carelessness and inability of the End-user, damage caused by third parties, unforeseeable circumstances or force majeure or for any other reason not attributable to defects in the construction quality.

The following are henceforth considered excluded from the warranty:

A) All parts with marginal defects that have a negligible effect on the value or function of the product.
B) All parts typically subject to sliding or rolling friction (bearings, brushes, etc.).
C) All parts typically subject to consumption (filters, humidifier cylinders, etc.).
D) All parts typically subject to oxidation or corrosion if not properly used or serviced (headers, wires and copper contacts or metal alloys, internal or external parts of the units, etc.).
E) All parts not supplied by the Manufacturer, even if these are an integral part of the system that controls the product.

SAFETY INSTRUCTIONS

All the Manufacturer's Products, or those distinguished by the Manufacturer's trademark have been designed and built for professional use in accordance with the applicable regulations. Check the complete list of applicable regulations in the EC declaration of conformity reported on the inside back cover of this manual, and supplied together with the product.

It is necessary to comply with the regulations of the State where the product will be laid and installed.

All the Manufacturer's Products, or those distinguished by the Manufacturer's trademark contain electrical and cooling systems that may be a source of danger to people or surrounding objects.

Therefore, in order to guarantee the safety of operating staff:

- The product must be installed, serviced and dismantled by skilled personnel who fulfil the qualification requisites for the task as defined by the regulations of the State where positioning and installation of the product take place.
- During installation, start-up, routine and special maintenance and dismantling, operating staff must comply with the health and safety instructions of the health and safety manager and the regulations of the State where the product will be positioned and installed.
- During installation, start-up, routine and special maintenance and dismantling, operating staff must wear the personal protective equipment (e.g. gloves, goggles, helmet, safety shoes) indicated by the health and safety manager and the regulations of the State where the product will be positioned and installed.
- The direct expansion units operate on R410a refrigerant, a fluorinated greenhouse gas subject to the Kyoto Protocol. Therefore, during installation, start-up, routine and special maintenance and dismantling, the health and safety instructions, professional disposal regulations of the refrigerant gas and regulations of the State where the product will be positioned and installed, must be complied with.
- During installation, start-up, routine and special maintenance and dismantling, operating staff must follow the instructions reported in the following manual.
- During normal product operation, it is prohibited to remove or bypass the protective panels and safety devices.
- Move the main switch into position 0 (Off) and check that the electrical power supply is isolated before performing any maintenance operations.
- Do not climb onto or enter the inside of the product.
- Any special opening tools must be positioned in a visible location near the unit.

The Manufacturer shall not be held liable for any damage to property or persons caused by improper use or unauthorised modifications to the product.

ATTENTION! DANGER!

Risk of immediate start-up after resetting the main switch if used as an emergency stop!

The main switch can be used as an emergency stop when the operator is near the machine (during start-up, operation and maintenance).

In this case, resetting the main switch will allow the machine to immediately restart, without any additional action by the operator.

RESIDUAL RISK

Transport, positioning and installation				
Area	**Hazard**	**Risk**	**Preventive measures**	**PPE**
Near product	Faulty lifting system that causes falls	Bruising, trauma	Keep a safe distance from the hazardous area while handling the unit	S1P shoes Cut-resistant gloves Safety helmet
	Unstable or unsuitable support that causes overturning	Bruising, trauma	Make sure the product has a suitable support for its weight, and that it is stable and level	S1P shoes Cut-resistant gloves Safety helmet
	Accidental impact with damage and leaking refrigerant	Burns, formation of vapours	Keep a safe distance from the hazardous area while handling the unit	S1P shoes Cut-resistant gloves Protective goggles Respirator

Start-up, use, routine and special maintenance and dismantling				
Area	**Hazard**	**Risk**	**Preventive measures**	**PPE**
Near product	Suction and subsequent expulsion from fan of objects, dust and substances present in the installation area	Bruising, trauma, dust inhalation	Clean the product installation area and check for the presence of foreign objects in the fan before starting the product	S1P shoes Cut-resistant gloves Safety helmet Protective goggles Respirator
	Fire following welds on water circuit/	Burns, formation of vapours	Clean the product installation area and check for the presence of foreign objects before welding	S1P shoes Welding gloves Protective goggles Respirator
	Projection of refrigerant from safety valve	Burns, formation of vapours, contact of oil with skin and eyes	Do not stand near the safety valve (when present)	S1P shoes Protective gloves Protective goggles Respirator
In contact with the product	Short circuit; incorrect sizing of the power cables or main switch	Electric shock, fire, formation of vapours	Check the fixing cables in the terminals, accurately select the power cables and main switch	S1P shoes Insulating gloves Protective goggles Respirator
	No ground connection	Electric shock	Remain electrically isolated from the ground	S1P shoes Insulating gloves
	Contact with hot surfaces	Burns	Avoid contact and insulate the piping	S1P shoes Protective gloves
	Condensation on the cooling pipes, if not insulated	Electric shock, slipping	Insulate the piping	S1P shoes Insulating gloves
	Contact with sharp or moving surfaces	Cuts, abrasions, bruising	Disconnect the power supply to the product and wait for the moving parts to stop	S1P shoes Cut-resistant gloves Safety helmet Protective goggles
	Oil leaks	Contact of oil with skin and eyes.	Avoid contact	S1P shoes Protective gloves Protective goggles

1 DESCRIPTION OF UNITS AND OPERATING LIMITS

1.1 P SERIES, G SERIES AND R SERIES UNITS

The machines in question are Close Control air conditioners with direct expansion or chilled water coil designed for use in technology centres. The machines in question are comprised of the following sections:

- The structure is made of hot-galvanised painted RAL 7024 sheet panels or in a frame constructed of aluminium section; the panels are made from hot-galvanised sheet steel painted RAL 7024, secured by quick-thread screws that can be unscrewed using a special safety wrench. The structure incorporates a thermal and acoustic insulation system using self-extinguishing materials protected by plastic film (polyurethane foam).

- Electrical power control panel with main switch door lock and microprocessor terminal.

- Supply fan section: consisting of one or more Plug Fan EC brushless electric fans (with electronic regulation) fixed to the machine's structure.

- Filtering section: self-extinguishing non-regenerable filters; the machine includes provision for the use of a differential pressure probe to allow display of the clogged filter warning signal.

- Cooling circuit (direct expansion versions): consisting of a direct expansion coil with expanded copper pipes inside aluminium fins and hot-dip galvanised steel sheet structure, copper cooling circuit with anti-condensation thermal insulation, scroll compressor fastened to the machine's structure with rubber vibration damping supports, electronic adjustment expansion valves (EEV), filter-drier, pressure probes for monitoring low pressure and high pressure, temperature probes for controlling temperature of intake, of the liquid and compressor discharge, high pressure manual reset safety sensor (PS HP 41 BarG).

- Water circuit (chilled water versions): consisting of a chilled water coil with expanded copper pipes inside aluminium fins, copper water circuit with anti-condensation thermal insulation, electric two- or three-way valve with emergency manual opening command.

- Electric multi-stage post-heating coil (Accessory): consisting of one or more filament heating stages with low thermal inertia, structure in hot-dip galvanised sheet steel, thermal protection system with manual reset thermostat.

- Immersed electrode humidifier (Accessory): consisting of a steam production cylinder, charge valve, discharge valve, support and water circuit in plastic.

1.2 TMC SERIES UNIT

The machines in question are air-cooled condensers with axial blowers. The machines in question are comprised of the following sections:

- The structure is made of painted RAL 9003 hot-galvanized steel sheet metal.

- Main switch.

- Ventilated section:composed of one or more electric axial fans fixed to the structure of the machine.

- Cooling circuit that consists of a condenser coil with expanded copper pipes in aluminium fins.

1.3 OPERATING LIMITS

WARNING!

The Manufacturer tests the hydraulic parts with dried compressed air. This ensures that no water is present in the water circuits, thereby preventing the possibility of freezing during storage prior to installation.

However, during storage, positioning and installation procedures, it is essential to take extra care not to fill the water circuits, even accidentally, before all the necessary antifreeze measures stipulated in the design specifications and in this manual have been implemented (e.g. Insulation, added glycols, etc.).

WARNING!

The ambient thermal load must not be less than 40% of the unit's rated cooling capacity in the case of direct expansion units.

A lower thermal load will lead to imprecise temperature and humidity control and frequent powering on/off of the compressor.

WARNING!

In very cold climates (from -10 ° C), in the case of inverter compressors and in the case of oversized condensers, the use of the LAC (Low Ambient Control) valve is recommended in order to avoid the risk of low condensation temperatures.

Air conditioners		
Infeed air temperature		
	Direct Expansion	**Chilled Water**
Maximum temperature	38°C	40°C
Minimum temperature	20°C	18°C
Maximum absolute humidity	11 g/kg	
Minimum absolute humidity	5,5 g/kg	
Maximum relative humidity	60%Rh	
Minimum relative humidity	25%Rh	
Minimum thermal load	40% of unit's rated cooling capacity	20% of unit's rated cooling capacity
Storage Conditions		
Temperatures from -20°C to + 45°C. Humidity from 10%Rh to 90 %Rh non-condensing. Store indoors and sheltered from weather elements.		

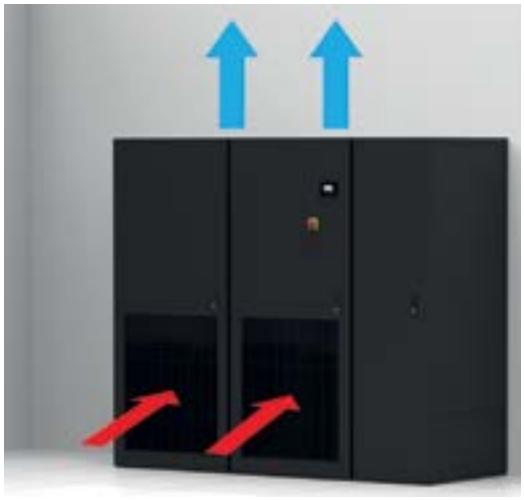
TMC Air-cooled condensers	
Infeed air temperature	
Maximum temperature	55 °C
Minimum temperature	- 40 °C
Storage Conditions	
Store in environments with temperatures no lower or higher than the functional limits.	

Water circuits				
	Chilled Water	**Hot Water**	**Plate Condenser**	**Internal Humidifier**
Maximum pressure	16 bar (1.6 MPa)	16 bar (1.6 MPa)	16 bar (1.6 MPa)	8 bar (0.8 MPa)
Minimum pressure	1 bar (0.1 MPa)	1 bar (0.1 MPa)	1 bar (0.1 MPa)	1 bar (0.1 MPa)
ΔP Maximum adjustment valve	1.8 bar (180 kPa)	1.8 bar (180 kPa)	1.8 bar (180 kPa)	-
Maximum temperature	40 °C	85 °C	45 °C	40 °C
Minimum temperature	5°C	5°C	-10 °C	5°C
Maximum glycol concentration	60%	60%	60%	-
Type of glycol	Ethylene	Ethylene	Ethylene	-

For different work conditions contact the Manufacturer

1.4 CONFIGURATION EXAMPLES

1.4.1 P SERIES - OVER (SUPPLY FROM ABOVE)



Standard version

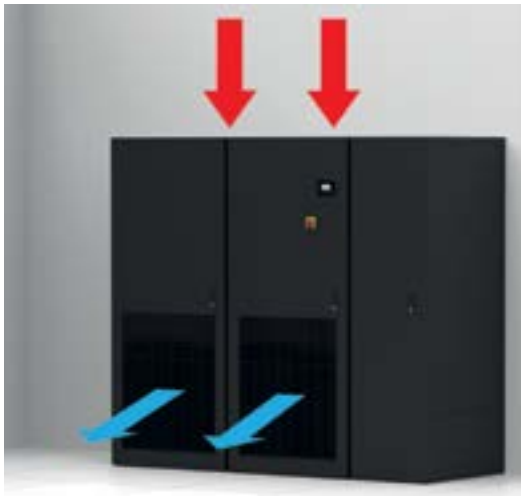
Version with supply plenum

Version with suction from the bottom and closed front panel

1.4.2 P SERIES - UNDER (SUPPLY FROM BELOW)

Standard version

Version with supply plenum



Version with front supply

1.4.3 G SERIES - UNDER (SUPPLY FROM BELOW)

Standard version

Version with closed supply plenum for installations above the raised floor

Version with rear supply and rear suction plenum

1.4.4 R SERIES - HORIZONTAL (HORIZONTAL/FRONT SUPPLY)

Standard version with rear suction and front and side

1.4.5 TMC SERIES - HORIZONTAL (HORIZONTAL INSTALLATION) AND VERTICAL (VERTICAL INSTALLATION)

Horizontal installation

Vertical installation

2 TRANSPORTATION, POSITIONING AND INSTALLATION PROCEDURES

2.1 OVERALL WEIGHT AND CLEARANCES FOR ROUTINE MAINTENANCE

2.1.1 OVERALL WEIGHT

WARNING!

If the units are installed on a normal floor, without vibration damping supports, it is necessary to place a layer of vibration damping material (rubber or equivalent material with a minimum thickness of 10 mm) between the machine and the floor to avoid transmitting vibrations to the structure of the building.

This layer of vibration damping material also makes up for floors that are not perfectly flat, guaranteeing the air seal between the elements and containing the noise level of the installation.

For correct installation of the units, and to ensure safety of the operators, it is essential to make sure that the surface on which the air conditioners are to be installed is capable of supporting the overall weight.

The overall weight can be found in the table below, for standard models (identified by the code number sequence).

Overall weight					
Standard models	Weight +/-5% kg	Standard models	Weight +/-5% kg	Standard models	Weight +/-5% kg
P Series					
071	170	**322**	430	**10**	125
141	225	**422**	535	**20**	150
211	280	**512**	540	**30**	245
251	305	**662**	685	**50**	250
301	360	**852**	705	**60**	270
321	385	**932**	745	**70**	280
361	460			**80**	375
461	470			**110**	410
				160	690
				220	810
Free Cooling and Two Sources P Series					
211	310	**512**	590	**50**	260
321	420	**662**	750	**70**	300
		852	770	**110**	435
461	520	**932**	1320	**160**	760
G Series					
461	620	**70**	540	**230 XH**	1250
612	690	**150**	840	**300**	1630
932	910	**150 XH**	865		
1342	1240	**230**	1220		
R Series					
121	220	**235**	235	**20**	145
201	235	**361**	235	**40**	210
Free Cooling and Two Sources R Series					
231	270			**40**	260

2.1.2 DIMENSIONS FOR INSTALLATION AND CLEARANCES

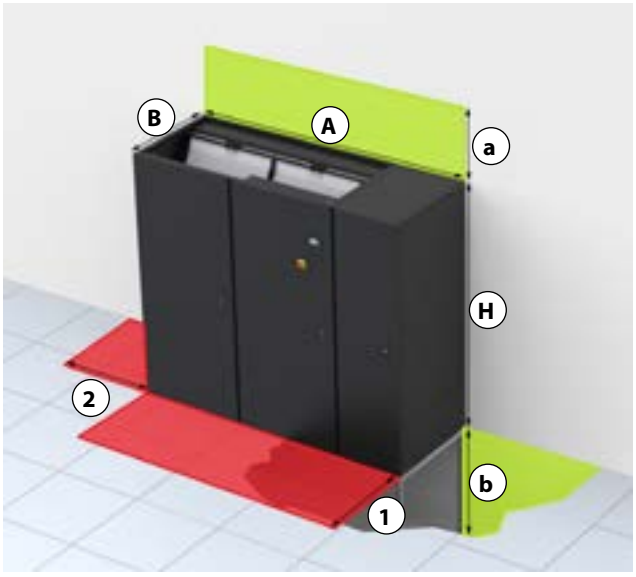
The figure below shows the dimensions to be taken into account during installation. For the exact values referring to the dimensions indicated in the figure, refer to the following table and, in any case, to the drawings supplied with the order confirmation.

The units must be positioned differently based on the type of unit, and always following the design and manufacturing requirements of the unit.

During installation, observe the clearances required for routine maintenance (and if special, if necessary) indicated in the order confirmation or the table below, with reference to the standard models (identified by the code number sequence).

Clearances P Series

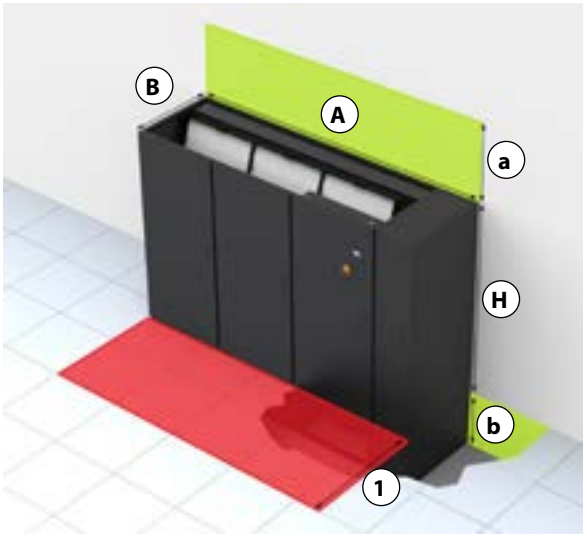
Over



Under

Standard models		Plan dimensions						
		Dimensions (mm)			Clearances (mm)		Routine Maintenance (mm)	
		Length	Depth	Height	Upper	Lower	Front	Left
		A	B	H	a	b	1	2
071 – 141	Over	750	600	1990	300	300	750	-
10 – 20	Under							
211 – 251	Over	860	880				860	
30 – 50	Under							600
301 – 321 – 322	Over	1410						-
60 - 70	Under							
361 – 461 422 – 512	Over	1750						
80 – 110	Under							
662 – 852	Over	2300						
	Under							
932	Over	2640						
160	Under							
932 TS	Over	3190						
	Under							
220	Over	3495						
	Under							

Clearances G Series

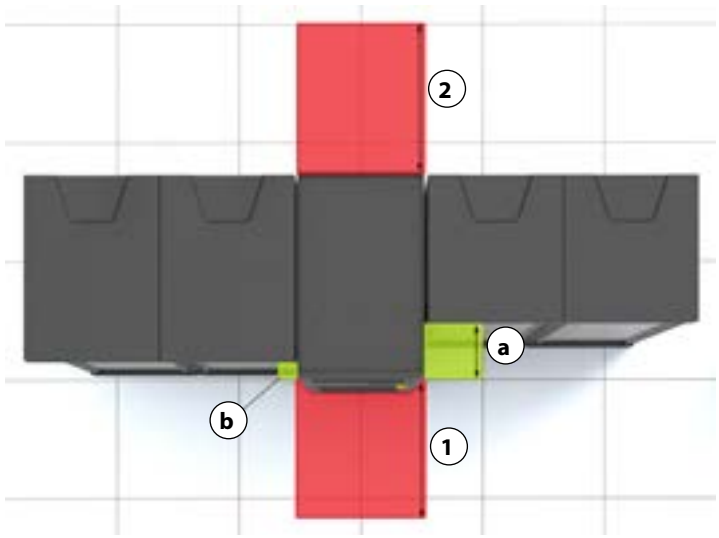


Standard models	Plan dimensions					
	Dimensions (mm)			Clearances (mm)		Routine maintenance (mm)
	Length	Depth	Height	Upper	Lower	Front
	A	B	H	a	b	1
70	1320	921	1990	300	550*	860
461 - 612	1490					
150	1840					
150 XH		1050	2350			
932	2390	921	1990			
230	2740					
230 XH		1050	2350			
1342	3120	921	1990			
300	4020					

*** Minimum height of ventilating plinth. Check definitive height when placing the order.**

Clearances R Series

Front view



Top view

Standard models	Plan dimensions						
	Dimensions (mm)			Clearances (mm)		Routine Maintenance (mm)	
	Length	Depth	Height	Front and side intake	Front intake	Front	Rear
	A	B	H	a	b	1	2
121- 201	300	1200	1975 + 70*	200	-	800	800
20							
231 - 361	600	1222	1985 + 30*	315	45		
40							

*** Height of the "Wheel kit" accessory**

2.2 TRANSPORT, HANDLING AND POSITIONING OF THE UNIT

DANGEROUS HANDLING! HEAVY LOADS!

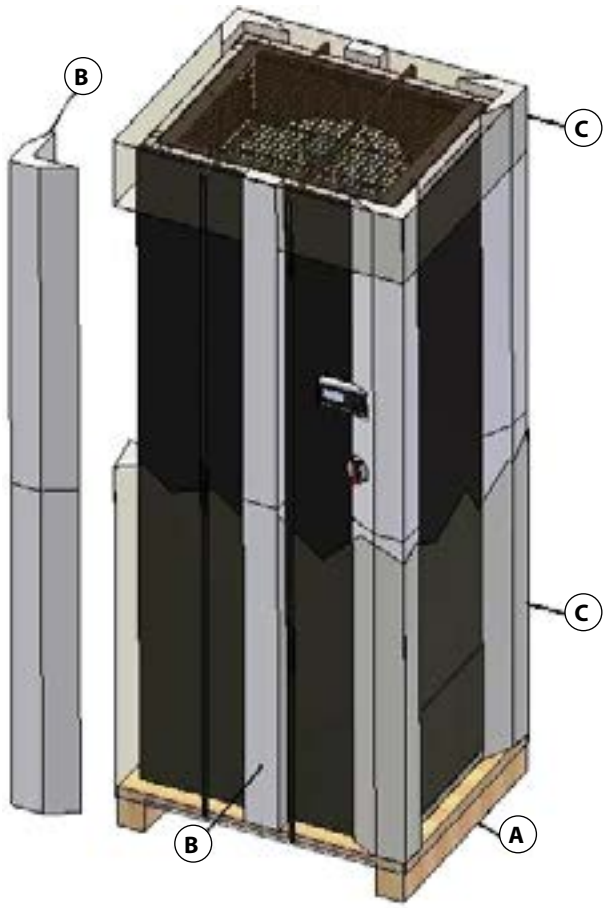
Always use suitable equipment to move the unit!

2.2.1 TRANSPORTATION AND RECEIVING THE MACHINES ON SITE

During transport the machines cannot be laid down or turned over; hence they must always stay in vertical position. Turning the unit over would cause damage to the internal components.

Unless otherwise and specifically agreed with the Client, the Manufacturer delivers its machines ex works (EXW) complete with standard packaging consisting of: loading pallet, shock-resistant polystyrene cladding and protective polyethylene film.

As the Carrier is always responsible for damage sustained by the goods during transport, before signing the delivery note to accept the supply, make sure the packaging is intact and that there are no visible signs of damage to the machine or traces of oil or refrigerant liquid leakage. If there is visible damage to the units, or if there is the slightest doubt that the conditioner may have concealed damage caused during transport, you must indicate your reservations in writing to the carrier themselves, while also informing the Manufacturer.



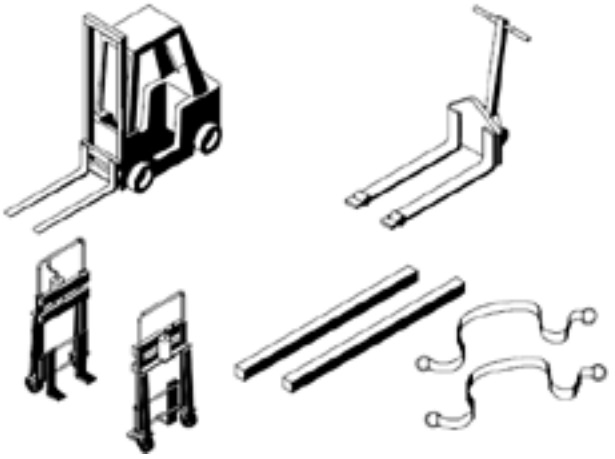
A Loading pallet
B Shock-resistant polystyrene cladding
C Protective polyethylene film

2.2.2 HANDLING THE UNITS

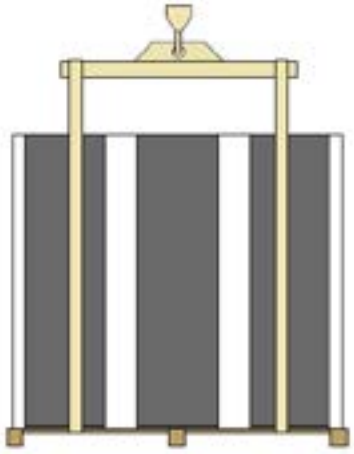
During site handling the machine must be left in its original packaging until it has reached the installation position.

The unit must be lifted and transported by means of a forklift truck, pallet truck, winch hoist or through a rope lifting system. In case of rope lifting, the ropes must be slid underneath the pallet the unit is fitted with, and stiff spacers must be arranged to ensure the ropes do not crush the unit's structure during lifting.

To avoid any form of damage it is necessary not to set the machines horizontally during storage, handling and installation operations.



Handling equipment



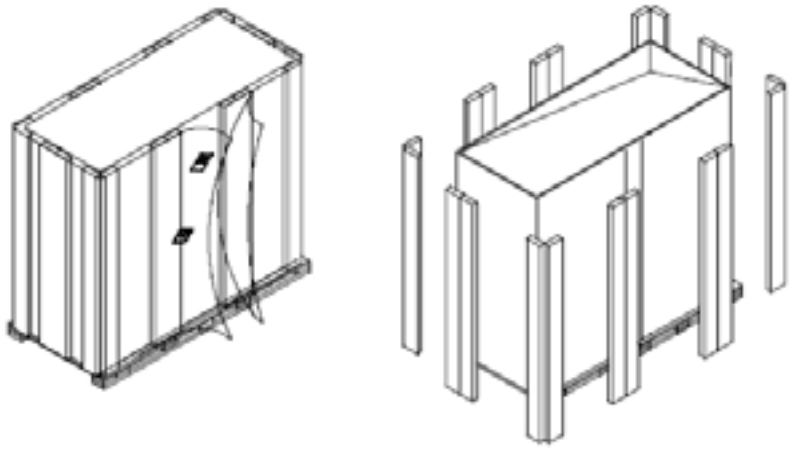
Position of ropes for lifting

2.2.3 REMOVING THE PACKAGING

If the unit is not to be installed immediately after its arrival on site, it should be stored in its original packaging, in a dry, enclosed area that is preferably heated during the winter months.

For final placement of the units the shipping packaging must be removed. Remove the packaging as follows:

1) Cut the protective polyethylene sheet that the unit is wrapped in, paying attention not to damage the paint while cutting.
2) Remove the shock-resistant polystyrene cladding.



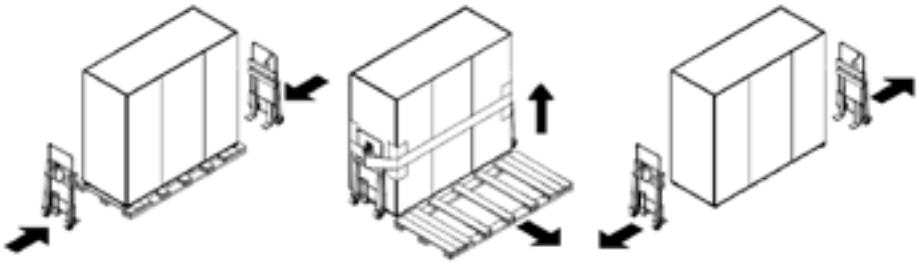
Removing the packaging

2.3 UNIT POSITIONING

2.3.1 UNIT POSITIONING WITH WINCH HOIST

To remove the unit from the wood pallet for final positioning, use one or more winch lifters of sufficient capacity (see previous chapters). Proceed as follows for the handling operations:

1) Remove the straps and clamps on the wooden pallet.
2) Push the winch lifters to the edge of the pallet while holding it securely.
3) Make sure the lifting parts of the winch lifters are positioned at the bottom of the unit.
4) Secure the units to the winch hoists by means of safety ropes, to avoid accidentally dropping the unit.
5) Lift the unit and remove the wooden pallet.
6) Bring the unit to the final installation position, taking care not to tilt it, thereby risking damage or drops.
7) Should the units need to be placed on a base or plenum, ensure this is already in the final installation position (see following chapters).
8) When placement is completed, remove the safety beds and extract the winch hoists.



Handling with winch hoist

2.3.2 WHEELS TO SET SERIES R IN POSITION (ACCESSORY)

R series units can be equipped with 4 wheels at the corners of the unit to facilitate handling during installation. If these wheels are ordered, they are supplied pre-installed, therefore, they will only need to be removed from the wooden pallet.

Positioning wheels

2.3.3 FRONT PANEL LOCKS, PANELS SCREWS AND COVER PLATES SCREWS

The front panels feature one-quarter turn safety locks. The type of insert, shown in the following image, requires a special key to be opened. Two copies of these keys are supplied with the unit, one fixed to the outside and one inserted inside the electrical panel as a backup.

The insert is the 8 mm square type, of standard size, therefore it is always possible to make a copy of the keys in specialised hardware stores, specifying the type of coupling required.

Front panel locks

Panel opening key

Insert type

The panels are fixed by screws with a TORX type insert, as indicated below:

Panels screws

Insert type

The cover plates are fixed with Phillips screws, as indicated below:

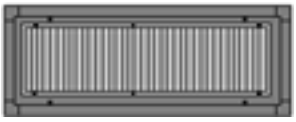
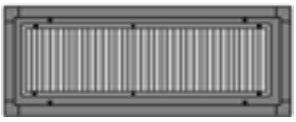
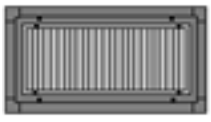
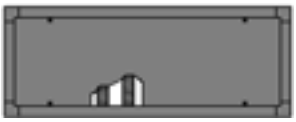
Cover plates screws

Insert type

3 PLENUMS, VENTILATED PLENUMS AND DUCT SECTIONS (ACCESSORY)

Various types of air distribution plenums are available as accessories for both the Under and Over versions of the unit.
During plenum and duct section installation it is advisable to place a seal (rubber or equivalent material with minimum 5 mm thickness) between them and the unit so as to guarantee the air-tightness of the element.

Below are the various types of plenums:

Plenums and duct sections		
Type	**Front View**	**Right/Left side view**
Plenum with solid panels(Drilling must be carried out by the customer) **G series ventilated plenums with solid panels**		
Plenum with front grilles **G series ventilated plenums with front grilles**		
Plenum with front and side grilles		
Soundproofed duct section		

3.1 PLENUM AND DUCT SECTION DIMENSIONS

The dimensions of the plenum and and duct section are found in the order confirmation or in the following tables for standard models (identified by the code number sequence).

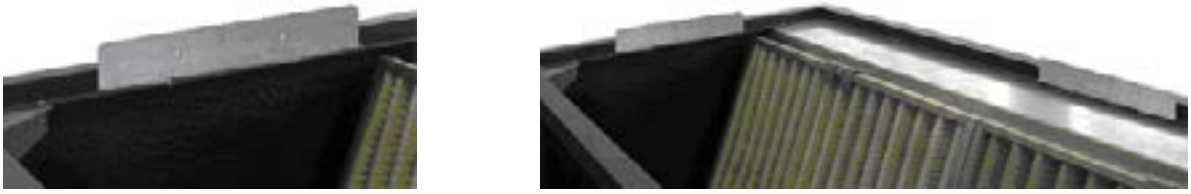
Plenum and duct section dimensions			
Standard models	**Plan dimensions (mm)**		
	Length	**Depth**	**Height**
P Series			
071 – 141 – 10 – 20	750	580	450 / 550 (Lower plenum)
211 – 251 – 30 – 50	860	850	550
301 – 321 – 322 – 60 – 70	1410		
361 – 461 – 422 – 512 – 80 – 110	1750		
662 – 852	2300		
932 – 160	2640		
932 TS	3190		
220	3495		
G Series			
70	1320	900	550
461 - 612	1490		
150	1840		
150 XH		1020	
932	2390	900	
230	2740		
230 XH		1020	
1342	3120	900	
300	4020		

3.2 INSTALLATION OF PLENUMS AND DUCT SECTIONS ABOVE THE UNIT

Depending on the type of plenum, they are attached in two different ways:

- Unit with sheet metal structure: With bolts inserted in the relative holes.
- Unit with aluminium profile structure: With brackets.

With bracket-mounted models, the brackets need to be attached to the unit's aluminium uprights with self-drilling screws. The brackets should be attached, in a central position, to each side of the unit.



Securing the brackets

Do the following to install plenums and duct sections:

1) Place a seal on the plenum profiles (rubber or equivalent material with minimum 5 mm thickness) and position the plenum on the unit, taking care to line the profiles up.
2) Attach the unit to the plenum with duly-sized self-drilling screws or bolts (models without clamping brackets).

A Plenum

Example of installation with upper plenum

3.3 INSTALLATION OF PLENUMS AND VENTILATED PLENUMS (G SERIES UNIT) UNDER THE UNIT

When installing plenums under the unit, it is advisable to place a layer of vibration damping material (rubber or equivalent material with a minimum thickness of 10 mm) between them and the floor to avoid transmitting vibrations to the structure of the building.

The interposition of vibration damping material also enables the recovery of a slight lack of flatness of the floor and to contain the noise level of installation.

Do the following to install a plenum under the unit:

1) Set the plenum on the floor and place a seal (rubber or other equivalent material with minimum 5 mm thickness) on the plenum profiles.
2) Position the unit on the plenum, making sure that the sections are properly aligned with each other.
3) Attach the unit to the plenum with duly-sized self-drilling screws or bolts (optional).

A Plenum

Example of installation with lower plenum

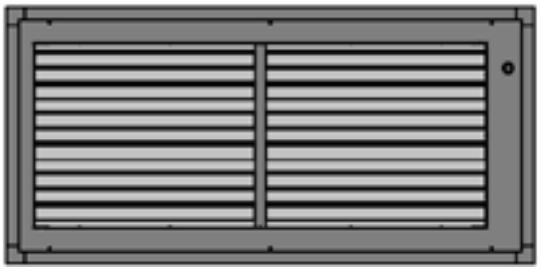
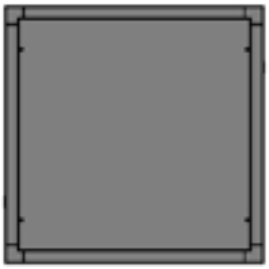
4 FREE COOLING PLENUM (ACCESSORY)

WARNING!

If the Free Cooling plenum is used with chilled water units, it is essential to use glycol if outdoor temperatures below 5°C are expected!

Free Cooling plenums can be supplied as an accessory for the Under version units. These plenums make it possible to use outdoor air to cool the environments, and consist of:

- A structure in galvanised sheet metal or in aluminium sections (depending on the model).
- Two panels fitted with motorised dampers.
- Three solid panels.

Free cooling plenum (standard configuration)	
Front and rear view	**Right/Left side view**
	

4.1 FREE COOLING PLENUM DIMENSIONS

The dimensions of the Free Cooling plenums are found in the order confirmation or in the following table for standard models (identified by the code number sequence).

Free Cooling plenum dimensions				
Standard models	**Plan dimensions (mm)**			
	Length	**Depth**	**Height**	**Damper depths**
P Series				
071 – 141 – 10 – 20	750	580	580	130
211 – 251 – 30 – 50	860	850	850	
301 – 321 – 322 – 60 – 70	1410			
361 – 461 – 422 – 512 – 80 – 110	1750			
662 – 852	2300			
932 – 160	2640			
220	3495			
G Series				
70	1320	900	900	130
461 - 612	1490			
150	1840			
150 XH		1020	1020	
932	2390	900	900	
230	2740			
230 XH		1020	1020	
1342	3120	900	900	
300	4020			

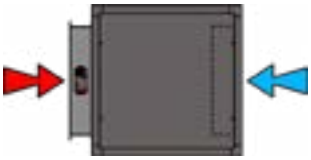
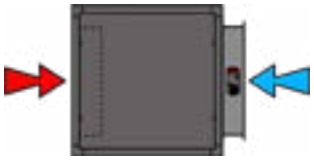
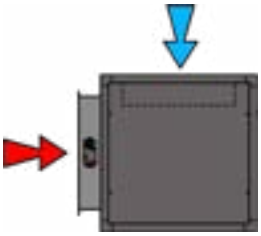
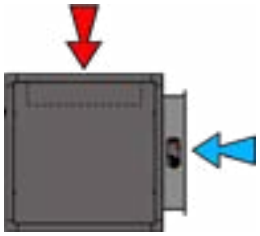
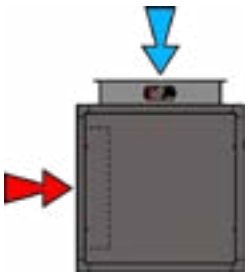
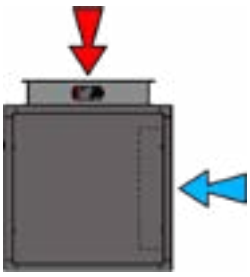
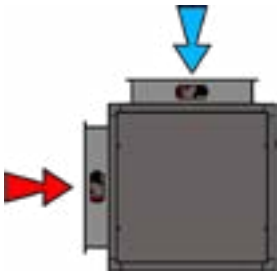
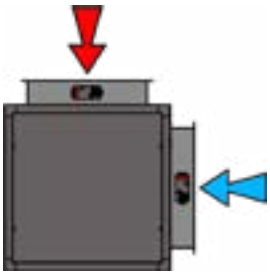
4.2 MOUNTING FREE COOLING PLENUMS

4.2.1 DAMPER POSITIONING

Free Cooling plenums are supplied with a standard configuration, for transport, with the dampers positioned at the front and back inside the plenum.

When mounting and installing the plenum, the position of the dampers can be changed so that they can be adapted to the system requirements. Position it as follows:

1) Define the position of the dampers (see table below).
2) Remove the screws to take the panels off.
3) Place the panels in the final position.
4) Screw the panels on with the screws.

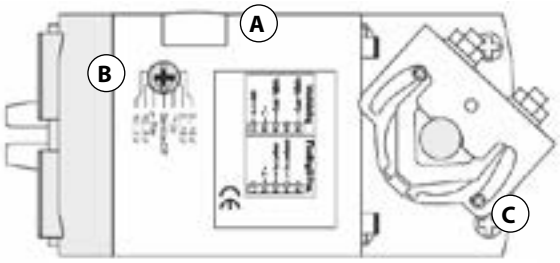
Position of the Free Cooling plenum dampers	
	
	
	
	
	

4.2.2 ADJUSTING THE OPENING OF THE DAMPERS

If it is necessary to always guarantee a percentage of outdoor air intake or room air recirculation, the opening of the dampers can be adjusted with the servomotors installed on them:

Adjust by calibrating the limit switch screws on the servomotor. Adjust as follows:

1) Set the motor at "Service OFF" with the function selector.
2) Adjust the position of the limit switch blocks.
3) Test movement of the dampers with the manual release button.



A Manual release button
B Function selector
C Limit switch blocks

4.2.3 INSTALLATION OF FREE COOLING PLENUM ABOVE THE UNIT

Depending on the type of plenum, they are attached in two different ways:

- Unit with sheet metal structure: With bolts inserted in the relative holes.
- Unit with aluminium profile structure: With brackets.

With bracket-mounted models, the brackets need to be attached to the unit's aluminium uprights with self-drilling screws. The brackets should be attached, in a central position, to each side of the unit.

Securing the brackets

Do the following to install Free Cooling plenums:

1) Place a seal on the plenum profiles (rubber or equivalent material with minimum 5 mm thickness) and position the plenum on the unit, taking care to line the profiles up.
2) Attach the unit to the plenum with duly-sized self-drilling screws or bolts (models without clamping brackets).

A Free Cooling plenum

4.2.4 SETTING UP THE DUCT FOR OUTDOOR AIR INTAKE

For optimal operation of the Free Cooling plenum, the outdoor air damper will have to be connected to the outside of the building so that it can draw in outdoor air:

The installer will set up the connection duct and outdoor air intake. It is advisable to provide:

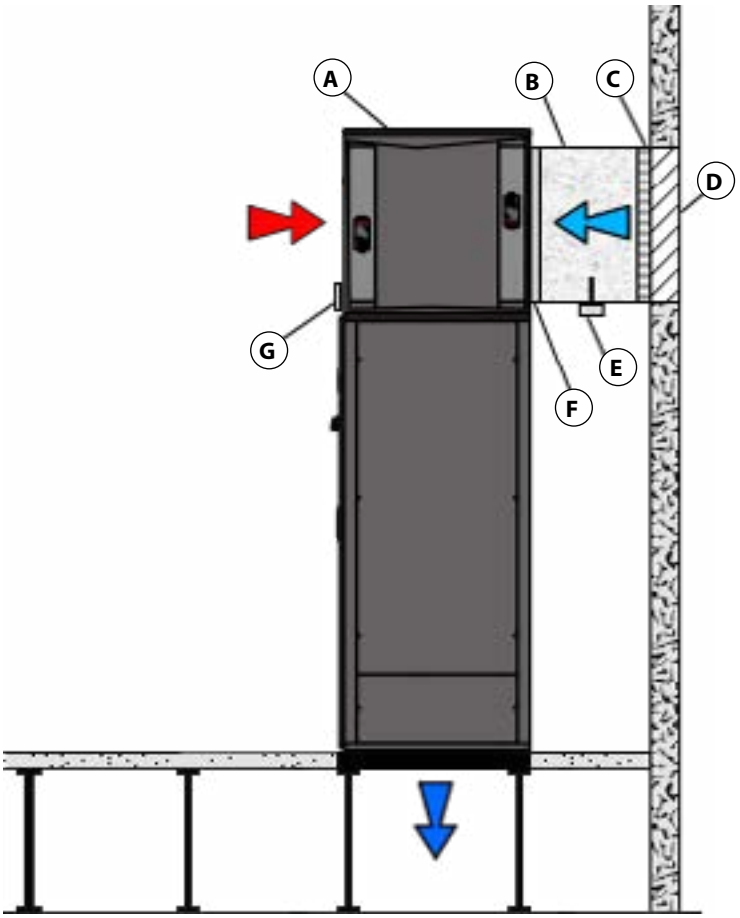
- An external opening with slots or grilles to prevent rainfall, harmful animals and human entry.
- An outdoor air filtration system, with G4 efficiency level.
- A vibration damping joint, connected to the plenum, to prevent the propagation of any vibrations from operation of the unit.

4.2.5 INSTALLATION OF FREE COOLING PLENUM TEMPERATURE PROBES

For optimal operation of the Free Cooling plenum, it will be necessary to position the outdoor air and return air temperature probes, both supplied as standard:

The outdoor air temperature probe, to be installed on the duct, must be positioned in the outdoor air intake duct so that it can detect the outdoor air temperature.

The return air temperature probe, to be installed on the wall, must be positioned so that it can detect the controlled room temperature.



A Free Cooling plenum
B Outdoor air duct
C G4 outdoor air filter
D Outdoor air intakeprotec-tion grille
E Outdoor air temperature probe
F Vibration damping joint
G Return air temperature probe.

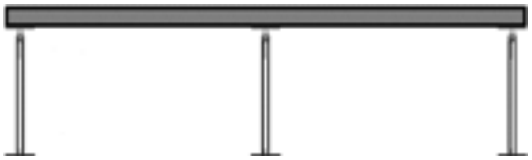
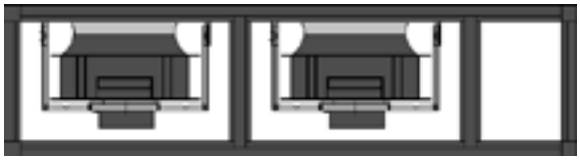
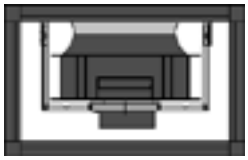
5 ADJUSTABLE AND VENTILATED PLINTHS (ACCESSORY)

When installing plinths it is advisable to place a layer of vibration damping material (rubber or equivalent material with a minimum thickness of 10 mm) between them and the floor to avoid transmitting vibrations to the structure of the building.

The interposition of vibration damping material also enables the recovery of a slight lack of flatness of the floor and to contain the noise level of installation.

It is also advisable to place a seal (rubber or equivalent material with minimum 5 mm thickness) between them and the unit so as to guarantee the air-tightness of the element.

Below are the various types of plenums and plinths:

Adjustable and ventilated plinths		
Type	**Front View**	**Right/Left side view**
Adjustable plinths		
Ventilated plinths (G Series)		

5.1 PLINTH DIMENSIONS

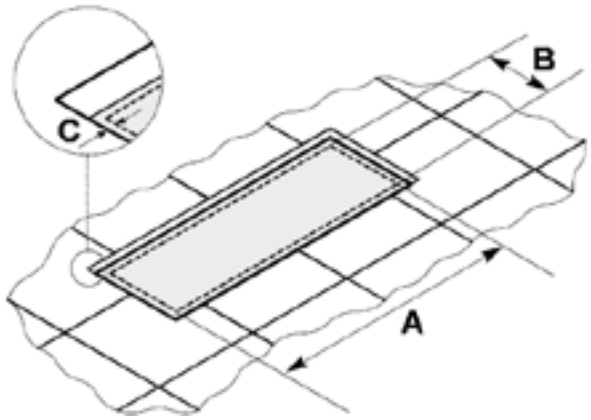
The dimensions of the plinths are found in the order confirmation or in the following tables for standard models (identified by the code number sequence).

Adjustable and ventilated plinth dimensions			
Standard models	**Plan dimensions - Standard model dimensions (mm)**		
	Length	**Depth**	**Minimum/Maximum height**
P Series			
071 – 141 – 10 – 20	750	580	300/600
211 – 251 – 30 – 50	860	850	
301 – 321 – 322 – 60 – 70	1410		
361 – 461 – 422 – 512 – 80 – 110	1750		
662 – 852	2300		
932 – 160	2640		
932 TS	3190		
220	3495		
G Series			
70	1320	900	550 (set height) 1000 (set height)
461 - 612	1490		
150	1840		
150 XH		1020	
932	2390	900	
230	2740		
230 XH		1020	
1342	3120	900	
300	4020		

5.1.1 SIZING THE HOLE FOR THE INSTALLATION OF THE PLINTHS IN THE FINISHED FLOOR SURFACE

To permit correct installation of the bases a hole must be made in the floor tiles. The dimensions of the plinths are found in the order confirmation or in the following tables for standard models (identified by the code number sequence).

Raised floor hole size



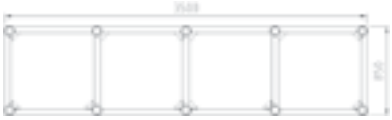
Standard models	Dimensions (mm)		
	Length	Depth	Tolerance
	A	B	C
P Series			
071 – 141 – 10 – 20	750	580	10
211 – 251 – 30 – 50	860	850	
301 – 321 – 322 – 60 – 70	1410		
361 – 461 – 422 – 512 – 80 – 110	1750		
662 – 852	2300		
932 – 160	2640		
932 TS	3190		
220	3495		
G Series			
70	1320	900	10
461 - 612	1490		
150	1840		
150 XH		1020	
932	2390	900	
230	2740		
230 XH		1020	
1342	3120	900	
300	4020		

5.2 ADJUSTABLE PLINTH ASSEMBLY

Adjustable plinths come unassembled in a specific kit, accordingly it will be necessary to assemble them as explained in the chapters below.

5.2.1 POSITIONING SUPPORT PROFILES

Position the metal supporting profiles supplied with the assembly kit on a flat surface according to the diagram below.

Supporting tube placement			
Models	**Position**	**Models**	**Position**
071 – 141 **10 – 20**		**662 – 852**	
211 – 251 **30 – 50**		**932** **160**	
301 – 321 – 322 **60 – 70**		**932 TS**	
361 – 461 – 422 – 512 **80 – 110**		**220**	

5.2.2 90° BRACKET AND THREADED TUBULAR SUPPORT INSTALLATION

WARNING!

Join the tubular elements so that they form a perfect right angle

To install 90° brackets, supporting profiles and threaded tubular supports, do the following:

1) Take the 90° brackets.		4) Take the threaded tubular supports.	
2) Place the 90° brackets in the corners of the supporting profiles, lined up with the respective clamping holes.		5) Position the threaded tubular supports between two supporting profiles so that the outer edge of the support is flush with the outer surface of the supporting profiles.	
3) Attach the 90° brackets with the self-drilling screws provided with the kit, using a battery-powered screw gun.		6) Secure the threaded tubular supports between two supporting profiles by the self-drilling screws provided with the kit (use the holes and slots provided on the threaded tubular supports), using a screw gun.	

5.3 ADJUSTABLE PLINTH HEIGHT DEFINITION AND ADJUSTMENT

The adjustable plinth support system is composed of two parts:

- One drilled tubular supporting foot.
- One threaded tubular support.

The height must be adjusted as instructed in the next chapters.

5.3.1 ADJUSTABLE PLINTH HEIGHT DEFINITION

The threaded tubular support allows heights to be manually adjusted between 600 and 530 mm with the bolt on the support.

For heights below 530 mm it is necessary to cut the tubular supporting feet to adapt them to the required measurement. The rule that needs to be followed to calculate the measurement of the tubular supporting foot is:

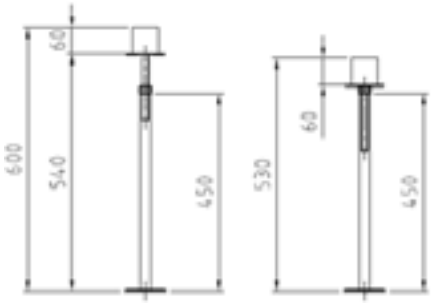
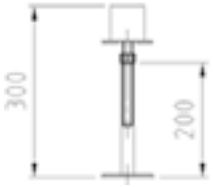
Tubular supporting feet height = Plinth height in mm – 100 mm

5.3.2 ADJUSTABLE PLINTH HEIGHT ADJUSTMENT

ATTENTION! DANGER! DANGEROUS HANDLING!

Maximum permitted range of the threaded tubular support is 90 mm!

Greater ranges can cause damage to the supporting feet and a risk of the units falling!

Examples of adjusting the tubular supporting feet	
Adjustment from 600 mm to 530 mm The height is adjusted from the hex nut on the threaded tubular support which is screwed in to reduce the height of the plinth.	
Plinth height 480 mm Cut the 450 mm cylindrical tube to 380 mm (480-100). Adjust the height for the last time by turning the hex nut.	
Plinth height 300 mm Cut the 450 mm cylindrical tube to 200 mm (300-100). Adjust the height for the last time by turning the hex nut.	

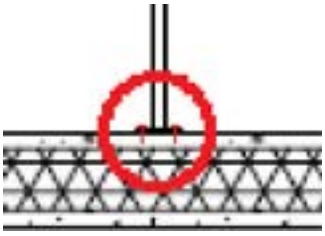
5.4 INSTALLATION OF ADJUSTABLE AND VENTILATED PLINTHS ON FINISHED FLOOR SURFACE

ATTENTION! DANGER! DANGEROUS HANDLING!

Placing the unit on the plinth before fixing the feet to the slab and positioning the raised floor can cause damage to the supporting feet and a risk of the units falling!

The plinths are installed in the finished floor surface as follows:

1) Place the plinth on the slab. With adjusted plinths, attach the feet to the slab with suitable plugs.



2) Adjust the feet to ensure that the plinth is flush with the upper edge of the finished floor surface and perfectly level.

3) Place a seal on the plinth profiles.
4) Position the unit on the plinth, making sure that the aluminium sections are properly aligned with each other.

Example of installation with plinth

6 TMC AIR-COOLED CONDENSER PLACEMENT AND INSTALLATION

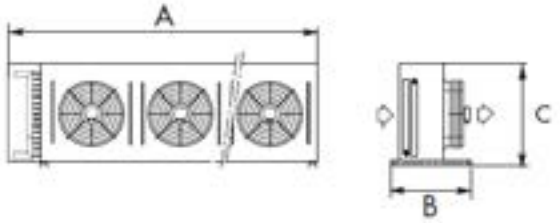
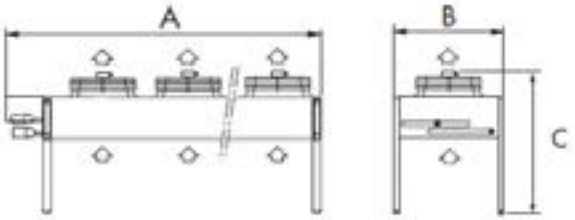
6.1 DIMENSIONS FOR INSTALLATION AND CLEARANCES

The figure below shows the dimensions to be taken into account during installation of the TMC air-cooled condensers. For the exact values referring to the dimensions indicated in the figure, refer to the following table and, in any case, to the drawings supplied with the order confirmation.

The units must be positioned differently based on the type of unit, and always following the design and manufacturing requirements of the unit.

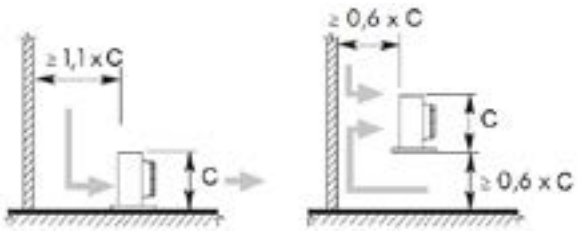
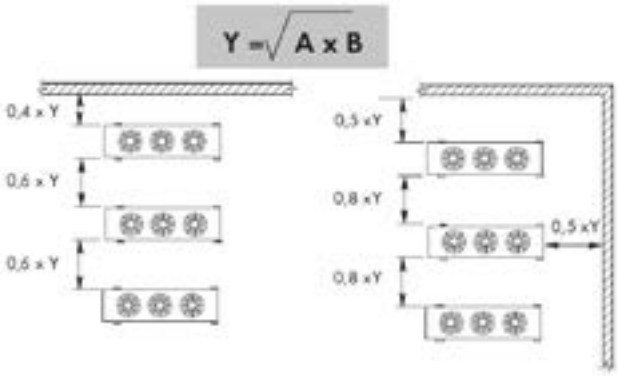
During installation the required spaces for optimal operation must be complied with, as set out in the following table for standard models (identified by the code number sequence).

TMC condenser dimensions

Vertical Installation (V)	Horizontal Installation (H)
	

Standard models	Length (A)	Depth (B)		Height (C)		Fixing holes Ø	Weight
		V	H	V	H		
	mm	mm		mm		mm	kg
11	882	480	550	510	818	10	27
19	1582						44
31	1225	570	900	830	1050	13	67
35							71
40	2225						104
49							112
55							112
63							120
84	3225						157
92							170

Clearance space calculation

Vertical Installation (V)	Horizontal Installation (H)
	

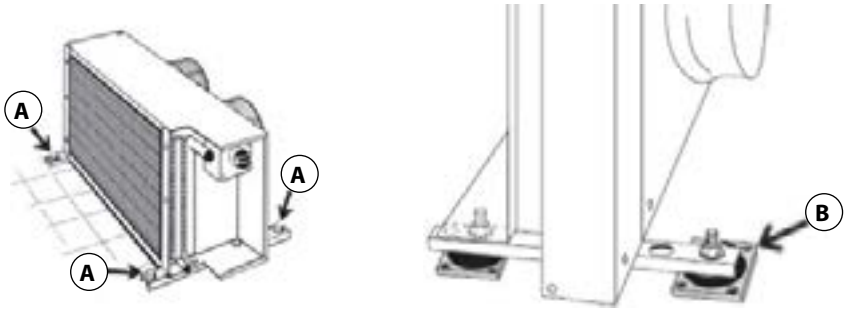
6.2 TMC AIR-COOLED CONDENSER INSTALLATION

DANGEROUS HANDLING! HEAVY LOADS!

Always use suitable equipment to move the unit!

6.2.1 VERTICAL INSTALLATION (V)

TMC air-cooled condensers must be installed according to the following instructions:



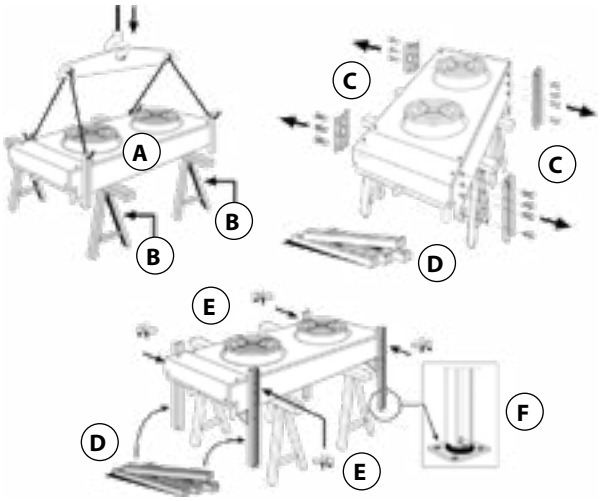
A Brackets
B Vibration damping supports (accessory)

Vertical installation (V)

1) Remove the condenser from the packaging.
2) Place the condenser in a vertical position.
3) Attach the brackets using the screws or install the supplied vibration damping supports (accessory).

6.2.2 HORIZONTAL INSTALLATION (H)

TMC air-cooled condensers must be installed according to the following instructions:



A TMC Condenser
B Supports
C Transport supports
D Feet for horizontal installation (H)
E Fixing screws
F Vibration dampers(accessory)

Horizontal installation (H)

1) Remove the TMC condenser from the packaging.
2) Place the condenser on the supports.
3) Remove the transport supports and place the fixing screws aside for later.
4) Position the feet for horizontal installation.
5) Fasten the feet in the final position with the screws previously removed.
6) Install the supplied vibration damping (accessory).

7 CONNECTION OF CONDENSATE DISCHARGE AND HUMIDIFIER

7.1 CONNECTION OF CONDENSATE DISCHARGE AND HUMIDIFIER

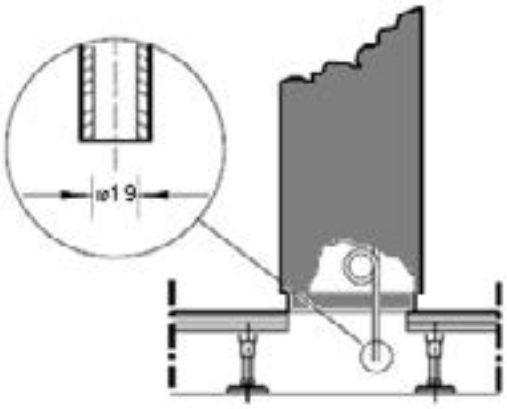
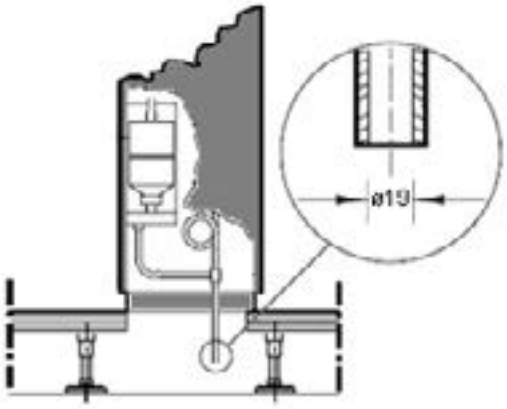
RISK OF BURNS!

The drainage water of the humidifier may reach temperatures of 100 °C!

All air conditioners, whether direct expansion or water chilled coils, require a condensate discharge connection, and the humidifier discharge of the building waste drainage system.

The trap, essential for draining condensate as the bowl is located in a point of negative pressure, is supplied already installed on the unit and should be connected when the unit is placed in position by the installer. The discharge pipe is Retiflex type with external diameter of 25 mm (internal 19 mm).

The humidifier discharge, which does not require a trap, is supplied ready connected to the termination of the condensate discharge.

Connection of condensate discharge and humidifier discharge	
	
Condensate discharge	**Condensate discharge with humidifier**
Hose	
Connection diameter Ø (mm)	
External	**Internal**
25	19

WARNING!

The condensate discharge is supplied with a trap!

Do not remove the trap supplied with the unit!

In order to avoid drainage problems do not add siphons to the drainage line and plan on a funnel type fitting!

7.2 CONDENSATE BOOSTER PUMP CONNECTION (ACCESSORY)

RISK OF BURNS!

The drainage water of the humidifier may reach temperatures of 100 °C!

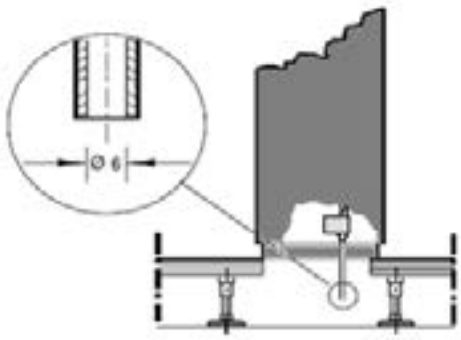
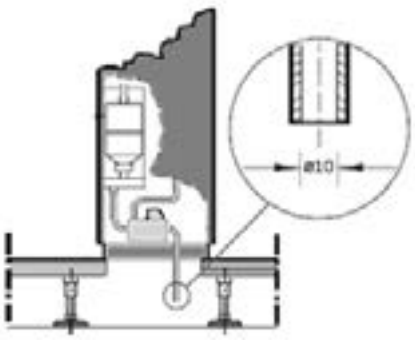
All conditioners, both direct expansion and chilled water, can be supplied with a condensation pumping trap (accessory).



Condensation booster pump

When the unit is installed the drain pipe must be connected to the building's sewage network by the installer. The drainage pipe is flexible and transparent, with an external diameter of 9 mm (internal 6 mm).

In case the unit is fitted with submerged electrode humidifier (accessory), it will be connected to the pump.

Connection of condensate discharge pump and humidifier discharge pump			
			
Condensate discharge		**Condensate discharge with humidifier**	
Hose			
Connection diameter Ø (mm)			
External	**Internal**	**External**	**Internal**
9	6	14	10

Condensate booster pump specifications				
Values		**Pump model**		
		SI33	**SI1830**	**SI82**
Maximum flow rate	l/h	30	400	500
Maximum line difference	m	5		
Maximum line length	m	30		

WARNING!

In order to avoid drainage problems do not add siphons to the drainage line and plan on a funnel type fitting!

8 WATER CIRCUIT CONNECTIONS

8.1 CHILLED WATER CIRCUITS CONNECTION

WARNING!

If the chilled water unit is used with Free Cooling plenum, it is essential to use glycol if outdoor temperatures below 5°C are expected!

It will be necessary to install water inlet and outlet pipes for machines with chilled water coils. The inlet and outlet fittings are identified in the order confirmation or in the following tables for standard models (identified by the code number sequence).

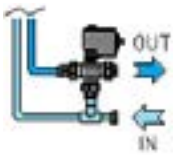
Water connections				
Standard models	**Fitting diameter Ø**		**Threading**	**Water circuit volume**
	Inches	**DN**	**ISO 7/1**	**dm³**
P Series				
10	3/4″	20	Female	3.5
20	1″	25		7
30	1-1/4″	32		10
50				16
60				19
70	1-1/2″	40		28
80				22
110				38.5
160	2″	50		56
220				76.5
G Series				
70	1-1/2″	40	Female	26.5
150	2″	50		59.5
150 XH				63,9
230	2-1/2″	65		79,5
230 XH				90,8
300				118
R Series				
20	1″	25	Female	11.5
40	1-1/4″	32		17.5

The maximum pressure of the water supply to the coils is 16 bar (1.6 MPa). The maximum pressure difference between the water inlet pipe to the valve and the outlet pipe is 1.8 bar (180 kPa), as at pressure differences greater than this value the return spring would not be able to shut off the water flow. In the event of greater pressure differences, it will be necessary to install pressure reducing valves upstream of the valve.

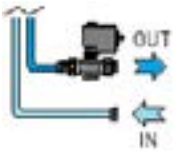
8.1.1 SETTING UP THE CHILLED WATER CIRCUITS

The positions of the water inlet and outlet connections are indicated in the figure below. The connections can also be identified by the adhesive labels applied on the pipes of the unit near the connections.

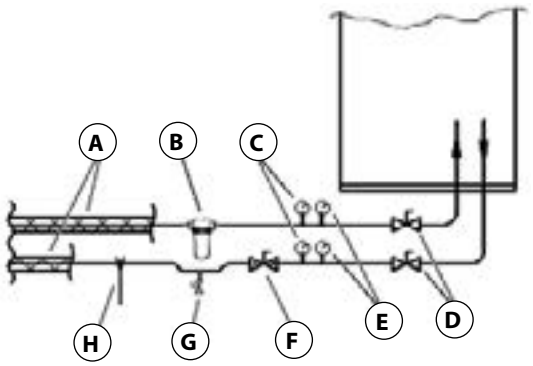
3-way valve



2-way valve



Water connections



Water circuit supply line

A Armaflex insulation
B Mechanical filter
C Thermometer
D Shut-off valve
E Pressure gauge
F Balancing valve
G Discharge
H Supports

To ensure that circuit pipes are installed correctly, we recommend you follow the instructions below:

- Use piping suited to the circuit pressure (copper, steel or plastic).
- Secure pipes with suitable brackets.
- Insulate both pipes with Armaflex type insulation.
- Install shut-off valves to facilitate maintenance.
- Install a Thermometer and Pressure gauge on the inlet and outlet.
- Install a discharge outlet at the lowest part of the circuit.
- Install a 50 µ mechanical filter on the supply line.
- Install a balance valve on the return line.
- Use water and glycol where necessary.

8.1.2 POWER VALVE - WATER FLOW ADJUSTMENT SYSTEM (ACCESSORY)

This accessory entails installation of a measuring device to control the instantaneous water flow of the system. The maximum admissible water flow set-point for the unit may be adjusted within the SySmart^3 electronic control. Should this threshold be exceeded, SySmart^3 will restrict valve opening to maintain water flow rate below it, resuming normal operation as soon as the system goes back to normal.

It is also possible to install probes on the water circuit to detect the water temperature on inlet and outlet, which make it possible to calculate the units' instantaneous cooling power, as well as its temperature delta.

Water flow measuring device

8.2 CHILLED WATER CIRCUITS CONNECTION - TWO SOURCES DESIGN

It will be necessary to install water inlet and outlet pipes for Two Sources units as it was for machines with chilled water coils. The inlet and outlet fittings are identified in the order confirmation or in the following tables for standard models (identified by the code number sequence).

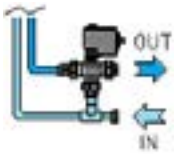
Water connections				
Standard models	**Fitting diameter Ø**		**Threading**	**Water circuit volume**
	Inches	**DN**	**ISO 7/1**	**dm³**
P Series				
50	3/4"	20	Female	5
211	1"	25		5.5
321	1-1/4"	32		18
70				16
110				22
461 - 512	1-1/2"	40		22.5
662 – 852				27.5
932				34,8
160				28.5
R Series				
231	1"	25	Female	15.5
40	1-1/4"	32		22.5

The maximum pressure of the water supply to the coils is 16 bar (1.6 MPa). The maximum pressure difference between the water inlet pipe to the valve and the outlet pipe is 1.8 bar (180 kPa), as at pressure differences greater than this value the return spring would not be able to shut off the water flow. In the event of greater pressure differences, it will be necessary to install pressure reducing valves upstream of the valve.

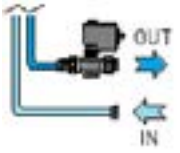
8.2.1 SETTING UP THE CHILLED WATER CIRCUITS - TWO SOURCES DESIGN

The positions of the water inlet and outlet connections are indicated in the figure below. The connections can also be identified by the adhesive labels applied on the pipes of the unit near the connections.

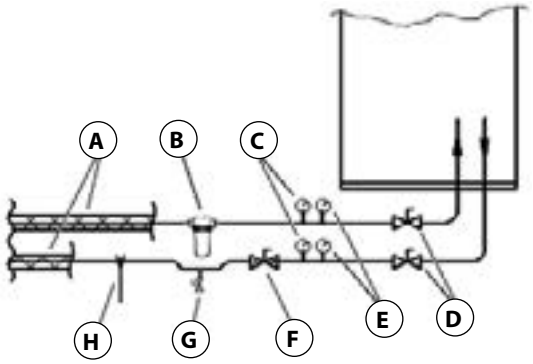
3-way valve



2-way valve



Water connections



Water circuit supply line

A Armaflex insulation
B Mechanical filter
C Thermometer
D Shut-off valve
E Pressure gauge
F Balancing valve
G Discharge
H Supports

To ensure that circuit pipes are installed correctly, we recommend you follow the instructions below:

- Use piping suited to the circuit pressure (copper, steel or plastic).
- Secure pipes with suitable brackets.
- Insulate both pipes with Armaflex type insulation.
- Install shut-off valves to facilitate maintenance.
- Install a Thermometer and Pressure gauge on the inlet and outlet.
- Install a discharge outlet at the lowest part of the circuit.
- Install a 50 µ mechanical filter on the supply line.
- Install a balance valve on the return line.
- Use water and glycol where necessary.

8.3 CHILLED WATER CIRCUITS CONNECTION - FREE COOLING DESIGN

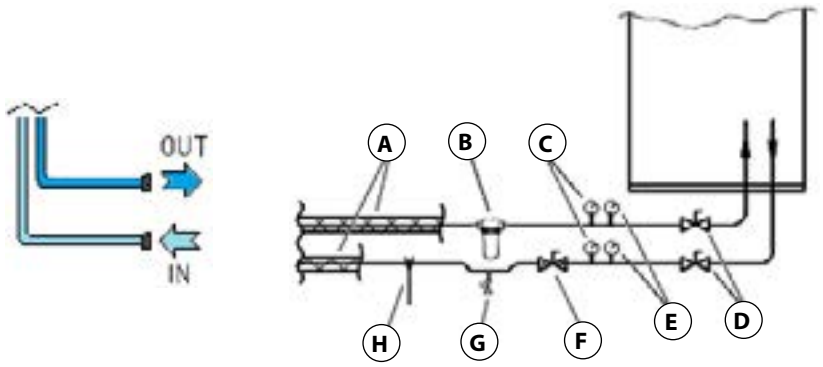
Machines in Free Cooling execution are supplied with water circuits connected to the pre-set valve and water condenser. Accordingly it will be necessary to set up the circuit water supply and discharge lines. The diameters of the pipes and the inlet and outlet fittings are identified in the order confirmation or in the following tables for standard models (identified by the code number sequence).

Water connections				
Standard models	**Fitting diameter Ø**		**Threading**	**Water circuit volume**
	Inches	**DN**	**ISO 7/1**	**dm³**
P Series				
321	1-1/4″	32	Female	18
461 - 512	1-1/2″	40		26.5
662 – 852				33.5
R Series				
231	1″	25	Female	17.5

The maximum pressure of the water supply to the coils is 16 bar (1.6 MPa). The maximum pressure difference between the water inlet pipe to the valve and the outlet pipe is 1.8 bar (180 kPa), as at pressure differences greater than this value the return spring would not be able to shut off the water flow. In the event of greater pressure differences, it will be necessary to install pressure reducing valves upstream of the valve.

8.3.1 SETTING UP THE CHILLED WATER CIRCUITS - FREE COOLING DESIGN

The positions of the water inlet and outlet connections are indicated in the figure below. The connections can also be identified by the adhesive labels applied on the pipes of the unit near the connections.



A Armaflex insulation
B Mechanical filter
C Thermometer
D Shut-off valve
E Pressure gauge
F Balancing valve
G Discharge
H Supports

Water connections **Water circuit supply line**

To ensure that circuit pipes are installed correctly, we recommend you follow the instructions below:

- Use piping suited to the circuit pressure (copper, steel or plastic).
- Secure pipes with suitable brackets.
- Insulate both pipes with Armaflex type insulation.
- Install shut-off valves to facilitate maintenance.
- Install a Thermometer and Pressure gauge on the inlet and outlet.
- Install a discharge outlet at the lowest part of the circuit.
- Install a 50 µ mechanical filter on the supply line.
- Install a balance valve on the return line.
- Use water and glycol where necessary.

8.4 WATER-COOLED CONDENSER WATER CIRCUITS CONNECTION (ACCESSORY)

For machines with incorporated water-cooling condenser it is necessary to set up the condenser supply and discharge lines. The diameters of the pipes and the inlet and outlet fittings are identified in the order confirmation or in the following tables for standard models (identified by the code number sequence).

<table>
<tr><th colspan="8">Water connections</th></tr>
<tr><th rowspan="3">Standard models</th><th colspan="3">Plate condenser</th><th colspan="3">Adjustment valve</th><th rowspan="2">Water circuit volume</th></tr>
<tr><th colspan="2">Fitting diameter Ø</th><th>Threading</th><th colspan="2">Fitting diameter Ø</th><th>Threading</th></tr>
<tr><th>Inches</th><th>DN</th><th>ISO 7/1</th><th>Inches</th><th>DN</th><th>ISO 7/1</th><th>dm3</th></tr>
<tr><td colspan="8">P Series</td></tr>
<tr><td>071 - 141</td><td rowspan="3">3/4″</td><td rowspan="3">20</td><td rowspan="11">Male</td><td rowspan="2">1″</td><td rowspan="2">25</td><td rowspan="11">Female</td><td>0.7</td></tr>
<tr><td>211</td><td>1.5</td></tr>
<tr><td>251</td><td rowspan="3">1-1/4″</td><td rowspan="3">32</td><td rowspan="3">1-1/4″</td><td rowspan="3">32</td><td>1.6</td></tr>
<tr><td>301 - 321</td><td rowspan="3">1-1/4″</td><td rowspan="3">32</td><td>2</td></tr>
<tr><td>361</td><td>2.5</td></tr>
<tr><td>461</td><td rowspan="2">3/4″</td><td rowspan="2">20</td><td>3</td></tr>
<tr><td>322 - 422</td><td>1″</td><td>25</td><td>1.2</td></tr>
<tr><td>512</td><td rowspan="3">1-1/4″</td><td rowspan="3">32</td><td rowspan="3">1-1/4″</td><td rowspan="3">32</td><td>1.6</td></tr>
<tr><td>662</td><td rowspan="3">1-1/4″</td><td rowspan="3">32</td><td>2</td></tr>
<tr><td>852</td><td>2.5</td></tr>
<tr><td>932</td><td>3</td></tr>
<tr><td colspan="8">G Series</td></tr>
<tr><td>612</td><td>3/4</td><td>20</td><td rowspan="2">Male</td><td rowspan="2">1-1/4″</td><td rowspan="2">32</td><td rowspan="2">Female</td><td>1.6</td></tr>
<tr><td>461 - 932</td><td>1-1/4″</td><td>32</td><td>3</td></tr>
<tr><td colspan="8">R Series</td></tr>
<tr><td>231</td><td>3/4</td><td>20</td><td rowspan="2">Male</td><td>1″</td><td>25</td><td rowspan="2">Female</td><td>1.2</td></tr>
<tr><td>361</td><td>1-1/4″</td><td>32</td><td>1-1/4″</td><td>32</td><td>2</td></tr>
<tr><td colspan="8">For models with several circuits the figures are intended per circuit</td></tr>
</table>

If the water supply is obtained from a well or river, two filters of suitable characteristics for the type of water must be installed in parallel, (one as backup for the other) to prevent the condenser from becoming dirty from impurities in the water.

The maximum pressure of the water supply to the water-cooled condensers is 16 bar (1.6 MPa), the minimum is 1 bar (1 MPa).

8.4.1 CONDENSATION PRESSURE ADJUSTMENT MODULATING VALVE (ACCESSORY)

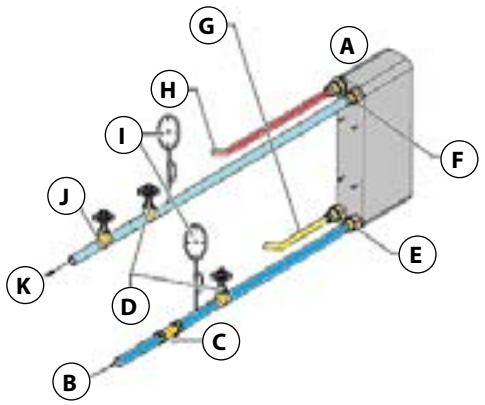
The condensation pressure adjustment modulating valve is indispensable in case of well, river, mains water supply and in all cases where water temperature might drop during the winter time at such low temperatures (below 15°C) that the machine's condensation temperature is excessively lowered. The valve is factory-installed on the condenser water outlet.

The positions of the water inlet and outlet connections are indicated in the figure below. The connections can also be identified by the adhesive labels applied on the panel of the unit near the connections. The maximum pressure of the water supply to the water-cooled condensers is 16 bar (1.6 MPa), the minimum is 1 bar (1 MPa).

The maximum pressure difference between the water inlet pipe and the outlet pipe is 1.8 bar (180 kPa), as at pressure differences greater than this value the return spring would not be able to shut off the water flow. In the event of greater pressure differences, it will be necessary to install pressure reducing valves upstream of the valve.

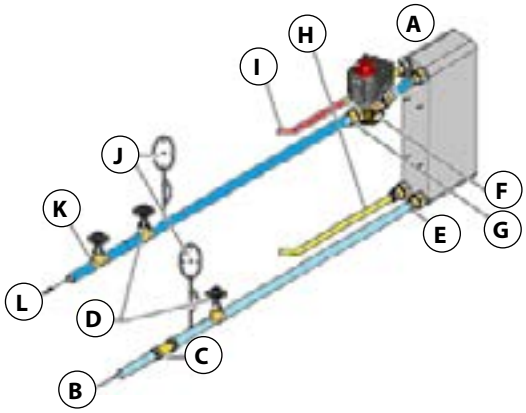
8.4.2 SETTING UP THE WATER-COOLED CONDENSER WATER CIRCUITS

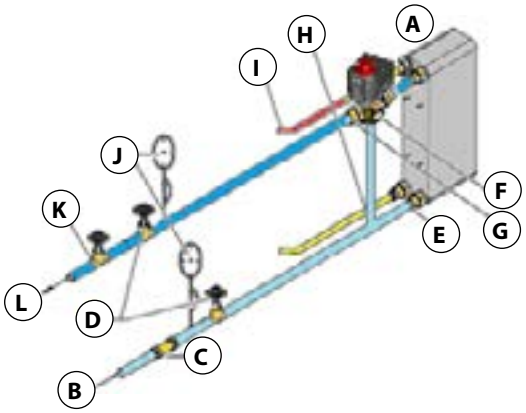
The positions of the water inlet and outlet connections are indicated in the figure below. The connections can also be identified by the adhesive labels applied on the pipes of the unit near the connections.



A Plate condenser
B Condenser water inlet
C Water discharge
D Shut-off valve
E Inlet fitting
F Outlet fitting
G Liquid line
H Hot gas line
I Thermometers and pressure gauges
J Balancing valve
K Condenser water outlet

Non-regulated water-cooled condensers water circuit supply line





A Plate condenser
B Condenser water inlet
C Water discharge
D Shut-off valve
E Inlet fitting
F Condensation pressure adjustment modulating valve (accessory)
G Outlet fitting
H Liquid line
I Hot gas line
J Thermometers and pressure gauges
K Balancing valve
L Condenser water outlet

Water circuit supply line for water-cooled condensers with 2 and 3-way regulation valve

To ensure that circuit pipes are installed correctly, we recommend you follow the instructions below:

- Use piping suited to the circuit pressure (copper, steel or plastic).
- Secure pipes with suitable brackets.
- Insulate both pipes with Armaflex type insulation.
- Install shut-off valves to facilitate maintenance.
- Install a Thermometer and Pressure gauge on the inlet and outlet.
- Install a discharge outlet at the lowest part of the circuit.
- Install a 50 µ mechanical filter on the supply line.
- Install a balance valve on the return line.
- Use water and glycol where necessary.

8.5 CONNECTION OF THE INTERNAL SUBMERGED ELECTRODE HUMIDIFIER (ACCESSORY)

The units may be fitted with a submerged electrode humidifier to control environmental humidification.

This type of humidifier exploits the conductivity of the water in the cylinder to produce steam. Applying voltage to the electrodes in the cylinder, current will flow between the electrodes that will heat the water until it reaches boiling point.

The humidifier is adjusted with the electronic board installed in the electric panel. The humidifier's work conditions may be checked with the display on the machine.

Submerged electrode humidifier

8.5.1 WATER CONNECTIONS OF THE SUBMERGED ELECTRODE HUMIDIFIER

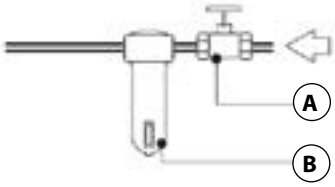
During installation of the unit, you are required to connect the supply piping of the internal humidifier to the water line of the system. The following table shows the type of water connection fitting.

Water connections				
Flexible hose adaptor		**Threaded fitting**		
				
Connection diameter Ø (mm)		**Connection diameter Ø**		**Threading**
External	**Internal**	**Inches**	**DN**	**ISO 7/1**
8	6	3/4	20	Male

Submerged electrode humidifier cylinder specifications				
Values		**Humidifier model**		
		3 kg/h	**8 kg/h**	**15 kg/h**
Steam production	kg/h	0.6 - 3.2	1.0 - 8.0	2.0 - 15.0
Cylinder volume	dm^3	1.1 - 3.3	0.9 - 5.4	2.2 - 9.8
Instantaneous supply flow rate	l/min	0.6	0.6	1.2
Instantaneous discharge flow rate	l/min	10		

8.5.2 SETTING UP THE SUBMERGED ELECTRODE HUMIDIFIER WATER CIRCUITS

The submerged electrode humidifier's supply line shall have the features set out in the table below:



A Shut-off cock
B Mechanical filter

Humidifier water supply line

To ensure that circuit pipes are installed correctly, we recommend you follow the instructions below:

- A shut-off cock must be installed on the water supply pipe (A).
- A 50 µ mechanical filter must be installed on the supply line (B).
- The water pressure must range between 1-8 bar (100 and 800 kPa).
- The water temperature must range between 1 and 40 °C.
- The instantaneous water flow rate must not be lower than the nominal flow rate of the supply solenoid valve (0.6 - 1.2 l/min)
- Do not treat with softeners or demineralisation plants.

Once installation is complete, bleed the supply pipe for approximately 30 minutes, channelling the water directly to the drain pipe without letting it enter the humidifier. This will eliminate any waste or processing substances that could block the filling valve and/or create foam during boiling.

8.5.3 CHEMICAL/PHYSICAL CHARACTERISTICS OF THE WATER SUPPLY

The correct functioning of the humidifier mainly derives from the chemical/physical characteristics of the supply water. There is no reliable relationship between water hardness and conductivity and between conductivity and cylinder production!

The cylinder supplied as standard with the units is suitable for water with a specific conductivity at 20 °C between **350 and 750 µS/cm (MEDIUM conductivity)**. If the characteristics of the humidifier feed water do not comply with this type of water, it is possible to consider replacing the standard cylinder with special cylinders suitable for the following conditions:

1) Cylinders for **LOW conductivity**: Suitable for water with a specific conductivity at 20 °C between **75 and 350 µS/cm**.
2) Cylinders for **HIGH conductivity**: Suitable for water with a specific conductivity at 20 °C between **750 and 1250 µS/cm**.

The following table shows the limit values for correct operation of the various types of cylinders available:

Limit values for feed water of immersed electrode humidifiers					
Values		**Waters with low salt content**		**Normal waters**	
		Minimum	**Maximum**	**Minimum**	**Maximum**
Hydrogen ion activity	pH	7	8,5	7	8,5
Specific conductivity at 20 °C	$\sigma_{R\ 20\ °C}$ - µS/cm	75	350	350	1250
Total dissolved solids	TDS - mg/l	70	325	325	1160
Fixed residue at 180 °C	R_{180} - mg/l	50	230	230	815
Total hardness	mg/l $CaCO_3$	50*	160	100*	400
Temporary hardness	mg/l $CaCO_3$	30**	100	60**	300
Iron + Manganese	mg/l Fe + Mn	0	0,2	0	0,2
Chlorides	ppm Cl	0	20	0	30
Silica	mg/l SiO_2	0	20	0	20
Residual chloride	mg/l Cl_2	0	0,2	0	0,2
Calcium Sulphate	mg/l CaSO4	0	60	0	100
Metallic impurities, solvents, thinners, soaps, lubricants	mg/l	0	0	0	0
*** Not less than 200% of the chloride content in mg/l Cl - ** Not less than 300% of the chloride content in mg/l Cl**					
Do not treat with softeners or demineralisation plants!					
Should the features of the humidifier's supply water not comply with the features of the special cylinders, alternative systems will need to be assessed that cannot be integrated inside the unit, such as resistor or ultrasound humidifiers					

9 COOLING CONNECTIONS

9.1 ROUTING OF THE COOLING CIRCUIT PIPES

WARNING!

Correct pipe routing is crucial for good conditioner operation. It is necessary to be particularly careful in the choice and set-up of the supply and liquid pipes, especially with very long lines.

It is important to remember that the pipes should be SHORT AND WITH THE LEAST BENDS POSSIBLE since the cooling capacity of the circuit can be reduced based on its length.

9.1.1 DEVELOPMENT OF OIL TRAPS (SIPHONS) IN VERTICAL UPRIGHTS OF SUPPLY PIPE

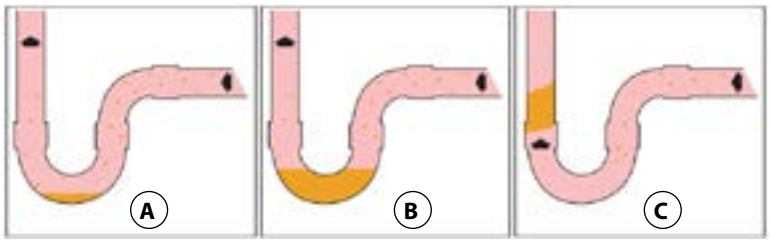
WARNING!

When developing the oil traps (Siphons), ensure the oil traps (Siphons) are developed with a 180° curve section.

In the presence of vertical climbing sections (Uprights), in order to allow the oil return to the compressor, oil traps (Siphons) must be inserted.

The operating principle of the oil traps is very simple and is similar to that of a siphon:

1) The oil that cannot be drawn from the refrigerant accumulates inside the trap (Siphon):
2) The trap continues to accumulate oil until it is completely blocked.
3) The obstruction causes the refrigerant pressure to rise in such a way as to push the accumulated oil upwards (Boost).



A Stage 1: Accumulation
B Stage 2: Obstruction
C Stage 3: Boost

Operating principle of oil traps (Siphons)

In order to work properly, the oil traps must be placed:

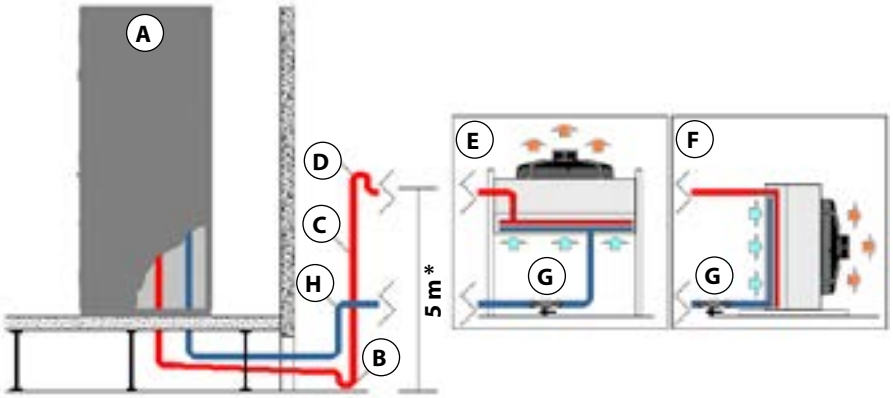
- **At the start of each vertical section, and**
- **Every 5 metres of piping if the vertical line is particularly high.**

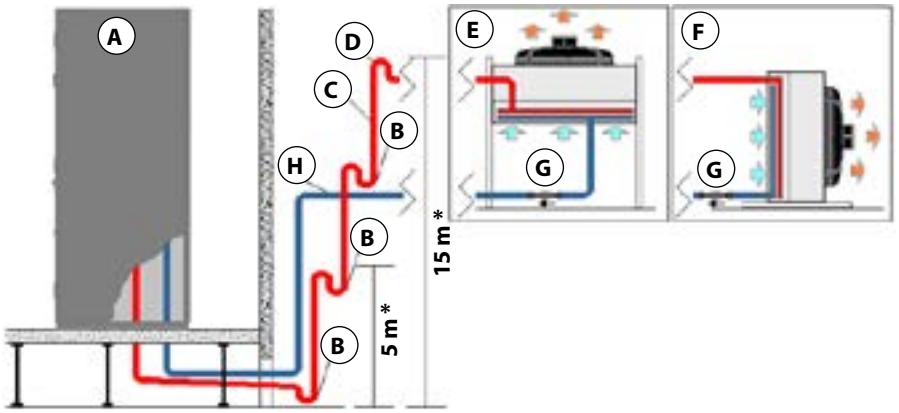
9.1.2 BACK-SIPHON AT END OF SUPPLY LINE UPRIGHTS

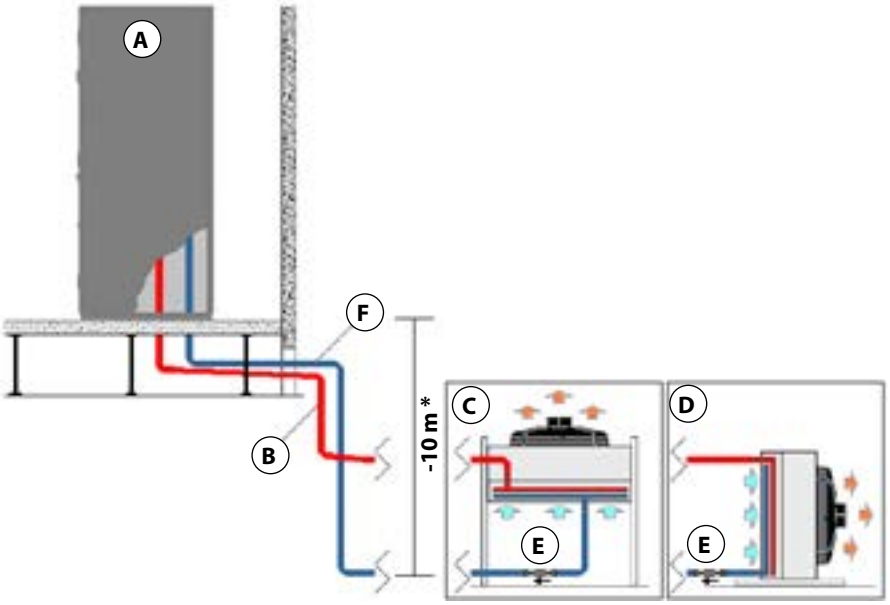
In the presence of vertical climbing sections (Uprights), a back-siphon needs to be created at the end of the upright.

The back-siphon prevents any liquid refrigerant present in the piping from returning to the compressor when the latter is inactive.

9.1.3 COMMON EXAMPLES OF COOLING CIRCUITS

Installation with condenser on plane (Height difference 0 ÷ 5 m)		
		**A Unit** **B Oil traps (Siphons)** **C Supply line** **D Back-siphon** **E Air-cooled condenser (horizontal installation)** **F Air-cooled condenser (vertical installation)** **G Check valve** **H Liquid line** *** Suggested maximum vertical height difference**
Suggested maximum vertical height difference		5 m
Supply pipe precautions		Ensure a gradient of 2% along the horizontal sections toward the condenser
		Insert oil traps (siphons) at the start of each vertical climbing section
		Insert a back-siphon on the supply pipes at the end of the vertical section
Supply pipe insulation	**Internal**	Required
	External	For aesthetic reasons only, or in the event of risk of contact with people
Liquid pipe precautions		Install the check valve as close as possible to the air-cooled condenser
Liquid pipe insulation	**Internal**	Required
	External	Only if exposed to the sun, for aesthetic reasons only, or in the event of risk of contact with people

Installation with condenser up high (Height difference 5 ÷ 15 m)		
		**A Unit** **B Oil traps (Siphons)** **C Supply line** **D Back-siphon** **E Air-cooled condenser (horizontal installation)** **F Air-cooled condenser (vertical installation)** **G Check valve** **H Liquid line** *** Suggested maximum vertical height difference**
Suggested maximum vertical height difference		15 m
Supply pipe precautions		Ensure a gradient of 2% along the horizontal sections toward the condenser
		Insert oil traps (siphons) at the start of each vertical climbing section
		Insert oil traps (siphons) every 5 metres of vertical climbing section
		Insert a back-siphon on the supply pipes at the end of the vertical section
Supply pipe insulation	**Internal**	Required
	External	For aesthetic reasons only, or in the event of risk of contact with people
Liquid pipe precautions		Install the check valve as close as possible to the air-cooled condenser
Liquid pipe insulation	**Internal**	Required
	External	Only if exposed to the sun, for aesthetic reasons only, or in the event of risk of contact with people

Installation with condenser down low (Height difference -1 ÷ -10 m)		
		**A Unit** **B Supply line** **C Air-cooled condenser (horizontal installation)** **D Air-cooled condenser (vertical installation)** **E Check valve** **F Liquid line** *** Suggested maximum vertical height difference**
Suggested maximum vertical height difference		-10 m
Supply pipe precautions		Ensure a gradient of 2% along the horizontal sections toward the condenser
Supply pipe insulation	**Internal**	Required
	External	For aesthetic reasons only, or in the event of risk of contact with people
Liquid pipe precautions		Install the check valve as close as possible to the air-cooled condenser
Liquid pipe insulation	**Internal**	Required
	External	Only if exposed to the sun, for aesthetic reasons only, or in the event of risk of contact with people

9.1.4 INSTALLATION WITH MIXED ROUTING

The pipe routing of the system to be developed may have characteristics similar to more than one of the examples described above. In such systems, it is important that the following instructions be followed for each type of section:

Supply pipes	
Vertical climbing sections (Uprights) (Height difference 0 ÷ 15 m)	
Ensure a gradient of 2% along the horizontal sections toward the condenser	
Insert oil traps (siphons) at the start of each vertical climbing section	
Insert oil traps (siphons) every 5 metres of vertical climbing section	
Insert a back-siphon on the supply pipes at the end of the vertical section	
Vertical descending sections (Uprights) (Height difference -1 ÷ -10 m)	
Ensure a gradient of 2% along the horizontal sections toward the condenser	
Line insulation	
Internal	Required
External	For aesthetic reasons only, or in the event of risk of contact with people

Liquid pipes	
Install the check valve as close as possible to the air-cooled condenser	
Internal	Required
External	Only if exposed to the sun, for aesthetic reasons only, or in the event of risk of contact with people

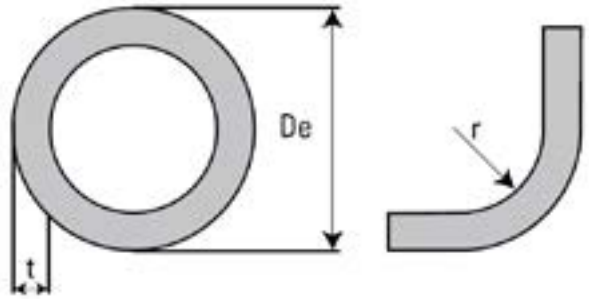
9.2 COOLING CIRCUIT SIZING

9.2.1 TYPES OF PIPING TO BE USED

The pipes must be made of copper that is suitable for direct expansion cooling circuits as required by standard EN 12735-1. Annealed copper coils may be used (diameters up to 7/8"), as well as hard-drawn copper bars.

In conformity with the EN14276-1 and EN14276-2 standards, the minimum recommend thickness for gas supply line piping, in particular where there are curves, for air condensed units using R410a refrigerant, it must be equal to values present in the table attached here below.

Copper pipe specifications



External diameter Ø		Minimum pipe thickness	Minimum curvature radius
De		t	r
Inches	mm	mm	mm
3/8"	**10**	0.8	20
1/2"	**12**	0.8	20
5/8"	**16**	1	26
3/4"	**18**	1	27
7/8"	**22**	1	66
1-1/8"	**28**	1.2	100

9.2.2 CALCULATION OF THE EQUIVALENT PIPE LENGTH

For correctly sizing the unit cooling lines it is necessary to calculate the equivalent length of refrigerant piping. When referring to equivalent length it means the linear length of the pipes coupled to the equivalent lengths of additional elements of the circuit, such as curves, therefore, the formula for calculation is as follows:

TOTAL EQUIVALENT LENGTH (m) = LINEAR LENGTH OF PIPE SECTIONS (m) + EQUIVALENT LENGTHS OF CIRCUIT COMPONENTS (m)

The following table includes equivalent length of the most common components of a cooling line:

Equivalent lengths of the cooling circuit components

External diameter Ø		Curve 45°	Curve 90°	Elbow 90°	Curve 180°	T-Fitting
Inches	mm	m				
3/8"	**10**	0.24	0.26	0.39	0.50	0.56
1/2"	**12**	0.26	0.28	0.43	0.54	0.61
5/8"	**16**	0.27	0.31	0.46	0.62	0.76
3/4"	**18**	0.30	0.40	0.58	0.80	0.92
7/8"	**22**	0.35	0.46	0.70	0.92	1.10
1-1/8"	**28**	0.45	0.55	0.82	1.10	1.38

9.2.3 DIAMETERS OF COOLING CIRCUIT CONNECTION PIPES

The diameters of the supply, liquid and suction pipes are identified in the order confirmation or in the following tables for standard models (identified by the code number sequence).

The diameters provided in the table were sized considering the characteristics set forth in the following table:

Cooling line sizing criteria		
Specifications	**Supply pipes**	**Liquid pipes**
Equivalent Length (per section)	50 m	
Vertical height difference	15 m / -10 m	
Cooling capacity	Nominal specifications as per catalogue	
Evaporation Temperature	9 °C	
Condensation temperature	45°C	
Liquid refrigerant temperature	43 °C	
Refrigerant speed	Greater than 7 m/s	Less than 1.5 m/s
Head loss	Less than 1 Bar	Less than 2 Bar
For refrigeration lines with greater equivalent lengths or greater vertical differences, contact the manufacturer.		

Cooling line sizing				
Standard models	**Supply pipe Ø**		**Liquid pipe Ø**	
	Inches	**mm**	**Inches**	**mm**
P Series				
071	1/2“	12	3/8“	10
141	5/8“	16	1/2“	12
211 322 - 422	3/4“	18	5/8“	16
251 - 301 - 321 - 361 512 - 662	7/8''	22	5/8“	16
461 852 - 932	1-1/8''	28	3/4“	18
G Series				
612	7/8“	22	5/8“	16
461 932	1-1/8''	28	3/4“	18
1342	1-1/8''	28	7/8“	22
R Series				
121	1/2“	12	3/8“	10
201 - 231	3/4“	18	5/8“	16
361	7/8''	22	5/8“	16
For models with several circuits the figures are intended per circuit				

9.3 COOLING CIRCUIT INSTALLATION

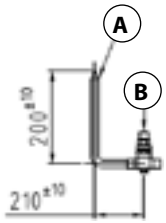
9.3.1 COOLING CIRCUIT INSTALLATION PRECAUTIONS

In order to correctly implement the cooling circuit, the following precautions need to be complied with:

- **Do not leave the circuit outdoors for an extended time, to prevent excessive formation of humidity.**
- **To prevent copper dust or swarf from getting into the system, the pipes should be cut using a pipe cutter rather than a hacksaw.**
- **It is necessary to carefully clean the pipe endings using the specific pipe reamer.**
- **If the ends are to be soldered, they should be cleaned with grade 00 sandpaper to eliminate all oxidisation and dirt.**
- **To avoid the curvature radius being too narrow or flattening the piping, bend the pipes with a suitable pipe bender of sufficient diameter.**
- **Prepare the end part of the piping to house the part to be fitted, widen the diameter with a suitable expander for copper pipes of sufficient diameter.**
- **Welding must be carried out through capillary brazing with oxyacetylene welding torch. The welding alloy must be copper or a copper-silver alloy.**
- **During welding protect the components with a damp cloth to prevent overheating.**

9.4 UNIT COOLING PIPE CONNECTION

The refrigerant inlet and outlet connections on the unit can be identified by their adhesive labels. To facilitate connection inside the unit, there is a section of pipe approximately 200 mm long, with relative cock, crimped and welded shut on the free end.



A Cooling line fitting
B Cock

9.4.1 COOLING CIRCUIT FITTING SIZES

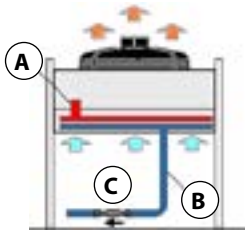
The diameters of the units' cooling connections for supply and liquid pipes (depending on the size of standard models identified by the code number sequence) are indicated in the order confirmation or in the following table:

Cooling circuit fitting sizes		
Standard models	**Supply pipe fittings Ø**	**Liquid pipe fittings Ø**
P Series		
071	12 mm ODS	12 mm ODS
141 - 211 322 - 422	16 mm ODS	12 mm ODS
251 - 301 - 321 - 361 - 461 512 - 662 - 852 - 932	22 mm ODS	16 mm ODS
G Series		
461 612 - 932	22 mm ODS	16 mm ODS
1342	28 mm ODS	22 mm ODS
R Series		
121	1/2" SAE male flare	1/2" SAE male flare
201	5/8" SAE male flare	1/2" SAE male flare
231	16 mm ODS	12 mm ODS
361	22 mm ODS	16 mm ODS

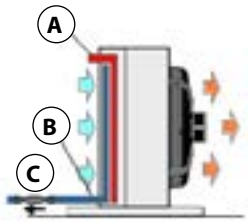
9.5 AIR-COOLED CONDENSER CONNECTION

The refrigerant inlet and outlet connections on the air-cooled condenser can be identified by their adhesive labels. To facilitate the connection there is a section of pipe approximately 100 mm long, crimped and welded shut on the free end.

A check valve (supplied loose) has to be installed on the liquid pipe. When installing the valve, make sure the direction of the arrow matches the direction of flow. The check valve can be installed with a vertical or inclined longitudinal axis and the arrow facing upward, and with a horizontal axis.



Horizontal installation



Vertical installation

A Supply line fitting
B Liquid line fitting
C Check valve

9.5.1 TMC CONDENSER CONNECTION DIMENSIONS

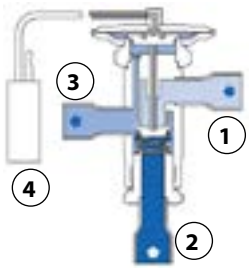
The diameters of the TMC condensers' cooling connections for supply and liquid pipes (depending on the size of standard models identified by the code number sequence) are indicated in the order confirmation or in the following table:

TMC condenser connection dimensions					
Standard models	Supply pipe fittings Ø	Liquid pipe fittings Ø	Standard models	Supply pipe fittings Ø	Liquid pipe fittings Ø
	mm ODS	mm ODS		mm ODS	mm ODS
11	16	16	**49**	28	28
19	16	16	**55**	28	28
31	22	22	**63**	28	28
35	28	28	**84**	35	28
40	28	28	**92**	42	35

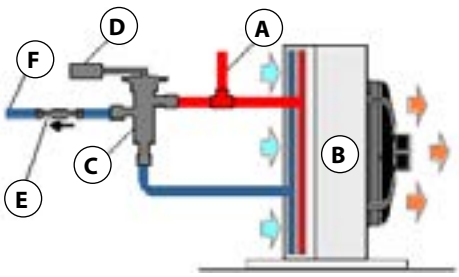
9.5.2 LAC (LOW AMBIENT CONTROL) VALVE CONNECTION (ACCESSORY)

The purpose of the LAC (Low Ambient Control) valve is to by-pass the condenser, injecting hot gas into the liquid pipe, to keep the pressure of the liquid refrigerant stable below 20 BarG. It is recommended to use the LAC valve in very cold climates, in the case of inverter compressors and in the case of condensers that are oversized compared to the actual needs of the units.

The LAC valve (included with the supply) must be installed on the air-cooled condenser's cooling connections as shown in the figure. The temperature probe needs to be left free to read the ambient temperature. Moreover, a check valve (not supplied) has to be installed on the liquid pipe. When installing the valve, make sure the direction of the arrow matches the direction of flow. It is advisable to install the check valve with vertical axis and the arrow facing upwards; installations with inclined or horizontal longitudinal axes are tolerable.



LAC valve



LAC valve connection

1 Hot gas connection (D)
2 Condenser outlet connection (C)
3 Liquid line connection (R)
4 Temperature probe

A Hot gas line
B Air-cooled condenser
C LAC (Low Ambient Control) valve
D Temperature probe
E Check valve
F Liquid line

9.5.3 PRECAUTIONS FOR BRAZING

RISK OF BURNS!

Burn hazard during cooling circuit brazing procedures!

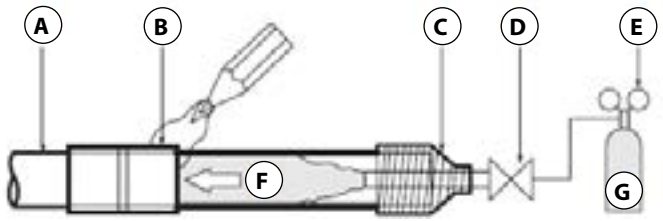
WARNING!

Check the nitrogen flow during brazing. If brazing is performed without using nitrogen, a strong layer of rust will develop inside the pipes, which may damage the valves and compressor and hinder the unit from operating correctly.

When performing brazing while feeding nitrogen into the pipe, the nitrogen must be regulated with a pressure reduction valve at 0.2 Bar (20 kPa) (just sufficient to be felt on the skin).

Use a suitable nitrogen pressurisation brazing kit and proceed as follows:

1) Connect the kit to the circuit as shown in the picture below.
2) Open the nitrogen feed cocks.
3) Ensure the nitrogen feeding pressure does not exceed 0.2 Bar (20 kPa).
4) If necessary protect the components with a damp cloth to prevent overheating.
5) Proceed with heating the pipe section with an oxyacetylene welding torch.
6) Add welding material until weld is completed by capillarity.



A Cooling lines
B Spot requiring brazing
C Insulating tape
D Manual valve
E Pressure reduction valve
F Nitrogen
G Nitrogen cylinder

9.5.4 SEAL TEST OF THE COOLING CIRCUIT WITH NITROGEN PRESSURISATION

Once the cooling circuit is completed, a verification of soldered joints and union fittings by way of nitrogen pressurisation is recommended.

Use a suitable nitrogen pressurisation circuit test kit and proceed as follows:

1) Connect the kit to the circuit.
2) Open any cocks and/or solenoid valves on the circuit.
3) Ensure no circuit sections can remain isolated.
4) Open the nitrogen delivery valve.
5) Reach test pressure for R410a systems, shown on the suitable kit pressure gauge. The recommended pressure is between 40 and 42 Bar (4 - 4.2 MPa):
   - If the pressure does not reach this value, this means that there is a leak in the circuit.
   - If it reaches the recommended pressure, maintain it for at least one hour. The test is considered a success if, in such a period of time, there is no decrease in pressure. Otherwise, it means there is a leak in the circuit.
6) Should a leak be found, proceed with the repair and repeat the previous operations, otherwise proceed with vacuum drying operations of the cooling line (see the next chapter).

Kit for nitrogen pressurisation test

9.6 COOLING CIRCUIT VACUUM DRYING OPERATIONS

WARNING!

Remote condenser air conditioners are shipped pressurised with nitrogen.

Air-cooled condensers are shipped pressurised with nitrogen.

WARNING!

Air conditioners with internal water-cooled condensers are supplied FULLY CHARGED with refrigerant.

After all connections and seal test operations, included in the previous chapters, have been completed for the cooling circuit, it is necessary the vacuum drying operation of the cooling circuit.

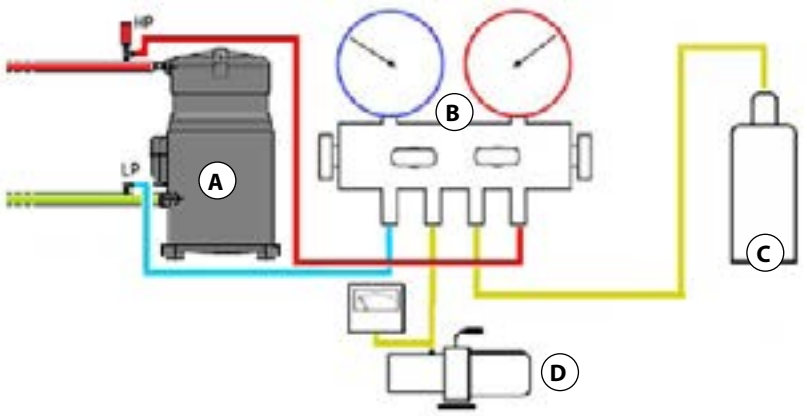
The vacuum drying operation of the cooling circuit is necessary to remove any residue of the technical gasses used for soldering and seal tests, atmospheric air and the water vapour that is part of it. By creating a vacuum inside the cooling line by means of a vacuum pump, the boiling point of water (100 °C at atmospheric pressure) is lowered to the point that, once it reaches a value lower than the temperature of the environment, humidity in the pipes turns into vapour and can, therefore, be ejected. **Vacuum pumps** are necessary to perform this operation suited to the cooling circuits (flow rate of 50 litres/minute).

The procedure for carrying out vacuum in the circuit is the following:

1) Connect the pressure gauges to the cooling circuit as shown in the next picture.
2) Connect the vacuum pump and refrigerant tank to the pressure gauges.
3) Power the machine (but not the compressors) to heat the possible crankcase oil heater.
4) Verify that all circuit cocks are open.
5) Bring the pressure gauges in position for operation in vacuum phase (carry out the vacuum simultaneously from both the liquid side and the gas side).
6) Start the vacuum pump.
7) The correct vacuum that can be achieved at the installation site is approximately - **1 BarG (1 mBarA**).
8) Leave the pump running for a few hours (min. 2 hours):

- If, within two hours, the pump is unable to reach approximately **- 1 BarG (1 mBarA)**, this means that there are still traces of humidity or there is a leak.
- If a vacuum of approximately **- 1 BarG (1 mBarA)** is reached, maintain it for at least one hour. The test is considered a success if, in such a period of time, there is no increase in pressure. If otherwise, it means that there is still humidity inside the pipes, or there is a leak.

9) Should there be a leak, proceed with repairing it and repeat the previous operation, otherwise:
10) Close the pressure gauges and switch off the pump.
11) Disconnect the pump and move on to refrigerant charging operations.



A Compressor
B Pressure gauges
C Refrigerant
D Vacuum pump

9.7 CHARGING THE COOLING CIRCUIT

9.8 PRECAUTIONS

WARNING!

This equipment is exclusively meant for professionally prepared operators that know the fundamentals of cooling, cooling systems, cooling gasses and the possible damages that pressured equipment may cause.

The compressor must exclusively operate with refrigerants indicated by the manufacturer. Oxygen must never be allowed to enter the inside of the compressor. Do not start-up the compressor when there are significant vacuum conditions inside of it.

The units are designed to operate with R410a refrigerant. Do not dispose of R410a refrigerant as household waste as it is a fluorinated greenhouse gas subject to the Kyoto Protocol, with a Global Warming Potential (GWP_{100}) of 2088. The refrigerant must be disposed of in accordance with the legislation in force in the country where the units are installed.

Do not tamper or modify the calibration of the safety and control systems. It is recommended to wear suitable protection such as glasses and gloves; some unit components can cause physical injuries to the operator.

9.8.1 CALCULATION FOR THE QUANTITY OF REFRIGERANT IN THE CIRCUIT

WARNING!

The weights set forth in the tables are theoretical and may change when there are accessories and special configurations!

Refrigerant charging must be carried out as shown in the subsequent chapters!

The indicative quantity of refrigerant in the circuit is determined by the amount of refrigerant contained in each single element of the circuit, according to the following formulas:

1) Refrigerant content of the units with remote condenser:

TOTAL REFRIGERANT CONTENT (kg) = UNIT CONTENT (kg) + ACCESSORY CONTENT (kg)+ SUPPLY PIPE CONTENT (kg) + LIQUID PIPE CONTENT (kg) + REMOTE CONDENSER CONTENT (kg)+ LT KIT CONTENT (kg)

2) Refrigerant content of the units with integrated water-cooled condenser:

TOTAL REFRIGERANT CONTENT (kg) = UNIT CONTENT (kg) + ACCESSORY CONTENT (kg) + WATER-COOLED CONDENSER CONTENT (kg)

The values of the individual circuit elements are given in the following tables.

Cooling line refrigerant content			
External diameter Ø		Weight of refrigerant per metre of pipe (kg/m)	
Inches	mm	Liquid	Supply
3/8"	**10**	0.05	0.007
1/2"	**12**	0.10	0.013
5/8"	**16**	0.16	0.022
3/4"	**18**	0.23	0.031
7/8"	**22**	0.32	0.043
1-1/8"	**28**	0.56	0.075

Unit refrigerant content									
Standard models	Unit	Oil separator	Water-cooled condenser	Hot gas	Standard models	Unit	Oil separator	Water-cooled condenser	Hot gas
	kg					kg			
P Series									
071	2.00	0.15	0.25	0.30	**322**	2.50	0.20	0.40	0.65
141	2.40	0.20	0.25	0.30	**422**	2.70	0.20	0.40	-
211	2.60	0.20	0.40	0.45	**512**	4.40	0.20	0.55	-
251	4.15	0.20	0.55	0.45	**662**	5.20	0.20	0.70	-
301	5.00	0.20	0.70	0.65	**852**	5.20	0.20	1.45	-
321	5.00	0.20	0.70	0.65	**932**	7.70	0.20	1.45	-
361	5.15	0.20	0.90	-					
461	5.15	0.20	1.45	-					
Free Cooling and Two Sources P Series									
211	2.80	0.20	0.40	-	**302**	2.25	0.20	0.40	-
301	4.10	0.20	0.70	-	**512**	3.20	0.20	0.55	-
					662	4.40	0.20	0.70	-
461	5.80	0.20	1.45	-	**852**	4.40	0.20	0.90	-
G Series									
461	7.60	0.20	1.10	-	**612**	4.70	0.20	0.55	-
					932	7.40	0.20	1.10	-
					1342	10,70	-	-	-
R Series									
121	2.10	0.15	-	-	**231**	3.35	0.20	0.40	-
201	2.80	0.20	-	-	**361**	6.00	0.20	0.70	-
Free Cooling and Two Sources R Series									
231	3.20	0.20	0.40	-					
For models with several circuits the figures are intended per circuit									

TMC condenser refrigerant content					
Standard models	Condenser	LAC valve	Standard models	Condenser	LAC valve
	kg			kg	
11	0.45	0.30	**49**	2.05	1.40
19	0.55	0.40	**55**	2.05	1.40
31	1.10	0.75	**63**	2.65	1.75
35	1.55	1.00	**84**	3.05	2.00
40	1.55	1.00	**92**	4.10	2.70
Non-TMC condenser refrigerant content					
For non TMC condensers, the refrigerant content, expressed in kg, is provided by the following expression:					
Coil volume (dm^3) x Kref = Refrigerant content (kg)					
Standard condensers			**Condensers with LAC valve**		
Kref			**Kref**		
0.37			0.61		

9.9 LUBRICATING OIL FILLING IN THE CIRCUIT

WARNING!

The quantity of lubricating oil necessary for the system to operate must be checked in ALL units, even those with the oil separator.

Correct lubricating oil charging is crucial for good operation of the direct expansion circuit, in fact, having no lubricating oil causes problems to the circuit, such as mechanical breakage of the compressor.

9.9.1 TYPE OF LUBRICATING OIL IN UNITS

Standard lubricating oil specifications		
	Panasonic	**SIAM**
Name	DAPHNE HERMETIC OIL **FV68S**	DAPHNE HERMETIC OIL **FV50S**
Type	PVE	
Kinematic viscosity @ 40°C	69,6 mm^2/s	50,7 mm^2/s
Density @ 15°C	0.93 g/cm^3	
Flash Point	>= 180 °C / 356 °F	
Pour point	-32,5 °C	-37,5 °C

9.9.2 INITIAL CONTENT OF LUBRICATING OIL IN UNITS

Initial content of lubricating oil in the units							
Standard models	**Compressor ON/OFF**	**Inverter Compressor**	**Oil separator**	**Standard models**	**Compressor ON/OFF**	**Inverter Compressor**	**Oil separator**
	Litres				**Litres**		
P Series							
071	0.6	0.4	0.3	**321 - 361 662**	2.8	1.7	0.3
141 - 211 322 - 422	1.7	1.7	0.3	**461 852 - 932**	3.5	1.6	0.3
251 - 301 512	2.5	1.7	0.3				
G Series							
612	2.8	1.7	0.3	**461 932**	3.5	1.6	0.3
				1342	4,5	-	-
R Series							
121	-	0.4	0.3	**361**	-	1.7	0.3
201 - 231	-	1.7	0.3				
For models with several circuits the figures are intended per circuit							

9.9.3 THEORETIC LUBRICATING OIL CONTENT IN THE CIRCUIT

$$\frac{\text{TOTAL REFRIGERANT LOAD (kg)}}{8} = \text{OIL CONTENT REQUESTED IN CIRCUIT (l)}$$

9.9.4 CONTENT OF LUBRICATING OIL IN THE OIL TRAPS (SIPHONS)

Content of lubricating oil in the oil traps		
External diameter Ø		**Oil volume**
Inches	**mm**	**Litres**
1/2"	**12**	0.006
5/8"	**16**	0.012
3/4"	**18**	0.018
7/8"	**22**	0.027
1-1/8"	**28**	0.054

9.9.5 CHECK OF CORRECT LUBRICATING OIL LOAD AND EVENTUAL CIRCUIT TOP-UP

It is always necessary to check whether lubricating oil needs to be added to the cooling circuit. The quantity of lubricating oil depends on the total refrigerant load and system characteristics. To determine whether or not the cooling circuit needs to be topped up with lubricating oil, the following formula can be used

TOP UP OIL (l) = (CIRCUIT OIL CONTENT (l) + OIL TRAP CONTENT (l)) - INITIAL COMPRESSOR CONTENT (l)

Example calculation for a system with P series units, model 251, TMC 35 with LAC valve, with inverter compressor and piping with a vertical upright of 10 and total equivalent length of 40 m:

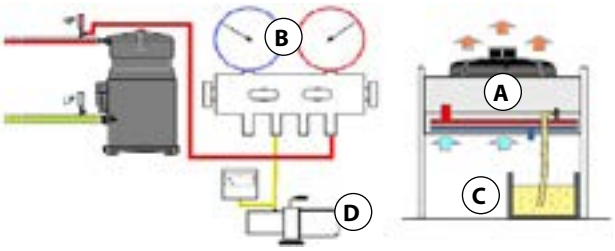
- Initial content of lubricating oil in compressor: **1.7 l**
- Total refrigerant load: 15 kg R410a; oil content requested in the circuit: 15 ÷ 8 = **1.875 l**
- Number of oil traps: 2 x 7/8"; oil trap content: 2 x 0.027 = **0.054 l**
- **Required top-up: (1.875+0.054) - 1.7 = 0.23 l**

9.9.6 LUBRICATING OIL TOP-UP IN THE CIRCUIT

If the lubricating oil in the compressor must be topped up, there are 2 charging types that can be used:

- **OIL TOP-UP DURING THE VACUUM PHASE:**

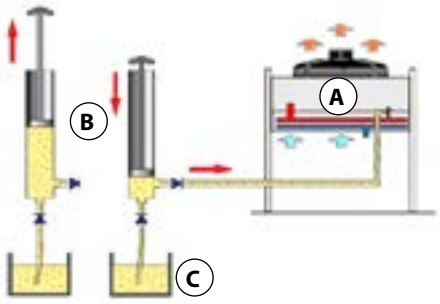
1) Connect a capillary to the air-cooled condenser.
2) Submerge the capillary in a container.
3) Fill the container with the amount of oil needed.
4) Connect the pressure gauge unit from the high pressure side.
5) Proceed with the vacuum operations from the high pressure side.
6) The oil will be drawn into the circuit.
7) Once charging is complete, proceed with the vacuum operations.



A Air-cooled condenser
B Pressure gauges
C Oil
D Vacuum pump

- **OIL TOP-UP WITH REFRIGERANT CHARGING CIRCUIT:**

1) For topping-up use a specific pump.
2) Connect the pump to the air-cooled condenser through the appropriate emission valve .
3) Connect the specific capillary to the intake valve.
4) Submerge the capillary in a container.
5) Fill the container with the amount of oil needed.
6) Activate the pump for the oil to enter the circuit.



A Condenseur à air
B Oil pump
C Oil

9.9.7 CHARGING THE CIRCUIT WITH REFRIGERANT

WARNING!

Cooling circuit recharging operations need to be carried out with the unit running. Make sure that the electrical connections are correct.

Always charge the refrigerant in its liquid state. Make sure that the connections between pipes and cylinder are always set up correctly.

Before charging the circuit, check that the refrigerant cylinder is equipped with a dip tube for the liquid refrigerant.

Equipped with dip tube		Not equipped with dip tube	
	**Charge the liquid refrigerant with the cylinder in the up-right position.**		**Charge the liquid refrigerant with the cylinder in the upside down position.**

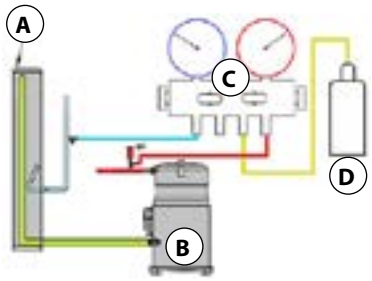
RISK OF BURNS!

Some parts of the cooling circuit may be hot!

It is recommended to perform refrigerant charge operations with ambient temperature within the unit's operating limits. A lower or higher temperature may compromise the actual circuit charge.

In order to charge completely proceed as follows (keeping in mind that the refrigerant must always be charged in liquid phase):

1) Make sure that circuit cocks are completely opened.
2) Check that the pressure gauges are compatible with the pressure of the refrigerant used (R410a).
3) Connect the pressure gauges to the cooling circuit as shown in the picture.
4) Check that the refrigerant tank is the type of refrigerant used (R410a).
5) Place the refrigerant tank on the calibrated scales.
6) Connect the refrigerant tank to the pressure gauge unit.
7) Place the pressure gauge in "Charge" position.
8) Open the HIGH PRESSURE SIDE filling valve to insert refrigerant until it approximately reaches 2/3 of the calculated quantity.
9) Open the recharging valve on the LOW PRESSURE SIDE, adding enough refrigerant to eliminate the empty condition.
10) Load any amount of top up oil through the provided valve placed on the compressor.
11) Feed the unit and wait for a few minutes.
12) Place the unit on ON, starting up the fans.
13) Start the compressor, being especially careful with double circuit units.
14) Verify overheating and operational parameters in order to evaluate the charge.
15) Calibrate the remote condenser speed variator to the temperature of required condensation.
16) Open the recharge valve on the LOW PRESSURE SIDE to integrate small amounts of refrigerant to fulfil the correct operating values.



A Coil
B Compressor
C Pressure gauges
D Refrigerant

9.10 TMC CONDENSER PRESSURE REGULATOR (ACCESSORY)

As accessories, speed regulation systems are available, installed inside the unit, for the remote condenser fans. Two different types of regulation are available, depending on what type of condenser is used.

9.10.1 ELECTRONIC CUT-OFF (AC) FAN SPEED REGULATORS

Electronic cut-off speed regulators are normally used to proportionally and continuously vary the speed of condensers with AC fans, with 230 Vac power supply, suitable for cut-off control.

These work with simple voltage variators, whose control signal is supplied by the unit's SySmart regulator through a 0-10 Vdc signal.

They are controlled by specific SySmart regulator parameters, accordingly you need to refer to the relative user manual for their adjustment.

Electronic cut-off fan speed regulators

9.10.2 ELECTRONIC FAN (EC) 0-10 Vdc SPEED REGULATION SIGNAL

The 0-10Vdc speed control signal is normally used to proportionally and continuously vary the speed of condensers with EC electronic fans, or condensers with built-in control.

The 0-10 Vdc control signal is sent by the unit's SySmart regulator.

The signal is regulated by specific SySmart regulator parameters, accordingly you need to refer to the relative user manual for their adjustment.

9.11 CHECKING THE REFRIGERANT LOAD AND COOLING CIRCUIT OPERATION

WARNING!

The compressor needs to be started up a few minutes prior to running the checks!

Correct plant operation, which depends on the choice of fundamental components and the dosage of the refrigerant load, can be checked from the cooling circuit operating values.

A correctly-installed unit that operates within the limits provided in this manual, will present values according to the following table:

Operating values of cooling circuits	
Evaporation pressure	Between **8 BarG** and **12 BarG**
Evaporation temperature	Between **4 °C** and **15 °C**
Suction temperature	Between **10 °C** and **21 °C**
Overheating	Stable at **6 K**
Compression ratio	Greater than **1,6**
Discharge temperature	Between **55 °C** and **80 °C**
Condensation pressure	Between **20 BarG** and **38 BarG**
Condensation temperature	Between **35 °C** and **60 °C**
Desuperheating	Between **20 K** and **30 K**
Liquid temperature	Between **25 °C** and **50 °C**
Sub-cooling	Between **2 K** and **10 K**
EEV expansion valve opening	Lower than **90%**

For units with two cooling circuits, the operating values will be checked with both circuits running.

Values differing from those provided in the table can mean that there is an incorrect refrigerant charge or operating conditions that do not comply with the limits set forth herein.

9.11.1 VERIFY THE REFRIGERANT CHARGE WITH THE DC INVERTER COMPRESSOR

During cooling capacity throttling stages, the operating values may appear satisfactory, however, they may no longer be correct at higher compressor speeds.

It is therefore essential that the compressor works at maximum speed before proceeding with the verification of the operating values of the circuit.

WARNING!

Once the charging operations of the cooling circuit are complete, it is mandatory to log the full amount of refrigerant introduced in the circuit on the CE marking found in the unit.

9.12 PRECAUTIONS AGAINST REFRIGERANT LEAKS

The direct expansion units operate on R410a refrigerant. R410a refrigerant is completely safe, non-toxic and non-flammable. This notwithstanding, it is considered a fluorinated greenhouse gas subject to the Kyoto Protocol, with a Global Warming Potential (GWP_{100}) of 2088.

According to the REGULATION (EC) no. 517/2014, it is also mandatory for qualified personnel in charge of running the system to carry out periodic checks to identify any leaks, at the regular intervals indicated below:

A) Devices containing less than 3 kg of fluorinated greenhouse gas are not subject to periodic checks for leaks.

B) Devices containing fluorinated greenhouse gas in quantities equal to or greater than 5 tonnes of CO_2 equivalent (3 kg) but less than 50 tonnes of CO_2 equivalent (24 kg): at least every 12 months (1 year) or, if a leak detection system is installed, at least every 24 months (2 years);

C) Devices containing fluorinated greenhouse gas in quantities equal to or greater than 50 tonnes of CO_2 equivalent (24 kg) but less than 500 tonnes of CO_2 equivalent (240 kg): at least every 6 months or, if a leak detection system is installed, at least every 12 months (1 year);

For units subject to periodic checks for leaks (points B and C), it is mandatory for the installer (or qualified personnel in charge of running the system) to create a register for each unit, which records:

- The quantity and type of fluorinated greenhouse gas;
- The quantity of fluorinated greenhouse gas added during installation, maintenance or due to leaks;
- The quantity of fluorinated greenhouse gas recovered during maintenance, repair or permanent dismantling operations;
- If the quantity of fluorinated greenhouse gas recovered has been recycled or regenerated, include the name and address of the recycling or regeneration company, and where applicable, the certificate number;
- The dates and results of the periodic checks carried out for the identification of any leaks.
- The identify of the company that carried out the installation, provided assistance, performed maintenance, and where applicable, repaired or dismantled the devices, including, where applicable, the relative certificate number.

9.13 CHECKING THE MAXIMUM CONCENTRATION OF REFRIGERANT

The direct expansion units operate on R410a refrigerant. R410a refrigerant is completely safe, non-toxic and non-flammable. Nonetheless, as it contains different chemical compounds than those found in the air, it poses the risk of suffocation if its concentration exceeds the maximum level for the environment where the unit is installed.

Accordingly, when a direct expansion air conditioner is installed, it is necessary to make sure that even in the case of a refrigerant leak, the density does not exceed the maximum risk level for the operators.

The unit of measure of concentration is kg/m^3, or the refrigerant weight in kg contained in 1 m^3 of air.

Based on current European standards, the maximum level of concentration for environments frequented by humans is 0.44 kg/m^3 for R410a refrigerant.

The concentration of refrigerant can be calculated as follows:

$$\frac{\text{TOTAL QUANTITY OF REFRIGERANT (kg)}}{\text{AMBIENT MINIMUM INTERNAL VOLUME (m}^3\text{)}} \leq 0.44\ \text{kg/m}^3$$

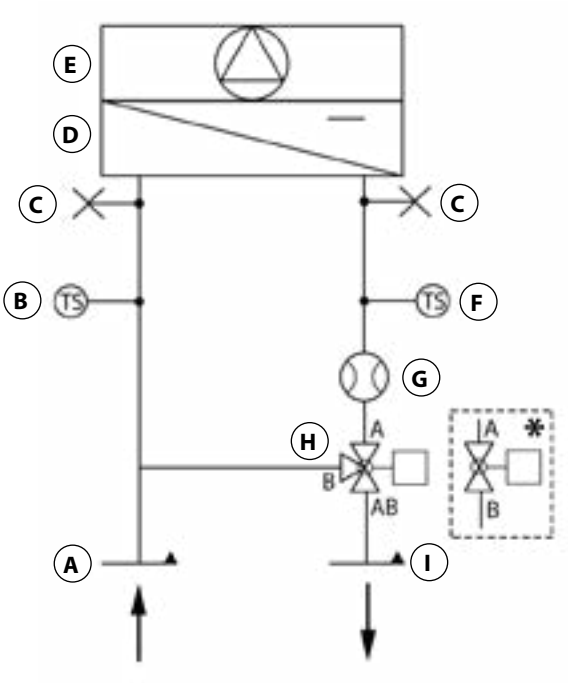
If the concentration of the refrigerant exceeds the maximum level, it will be necessary to implement adequate safety measures, such as openings to adjacent rooms or an overridden extraction system controlled by a leak detector.

If the concentration of refrigerant exceeds the maximum level, it will also be necessary to provide a conveying pipe, to be connected to the safety valve installed on the liquid receiver, in order to ensure the discharge of refrigerant to the outside of the room in case of intervention of the same.

10 EXAMPLES OF WATER AND COOLING CIRCUITS

10.1 EXAMPLE OF CHILLED WATER CIRCUIT

The following image represents the water circuit of chilled water units.

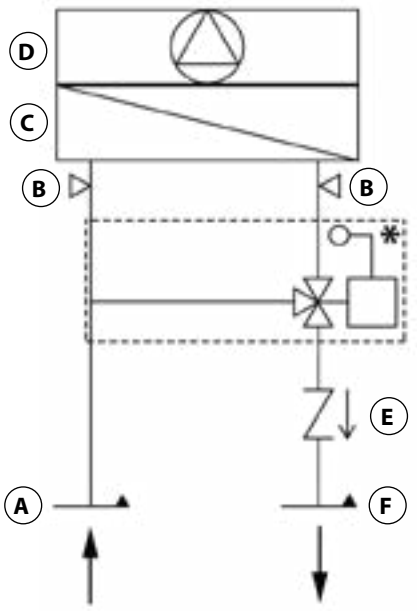


A Water inlet
B Inlet water temperature (accessory)
C Manual air vent valves
D Chilled water coil
E Fan
F Outlet water temperature (accessory)
G Water flow measuring device (accessory)
H 3-way ball valve
I Water outlet

*** 2-way ball valve (accessory)**

10.2 TMC AIR-COOLED CONDENSER COOLING CIRCUIT

The following image represents the cooling circuit of a TMC air-cooled condenser.



Hot gas line (HP gas: PS 41 Bar - TS 64 °C):

A Hot gas line
B Pressure intake SAE 1/4" male flare
C Air-cooled condenser
D Fan

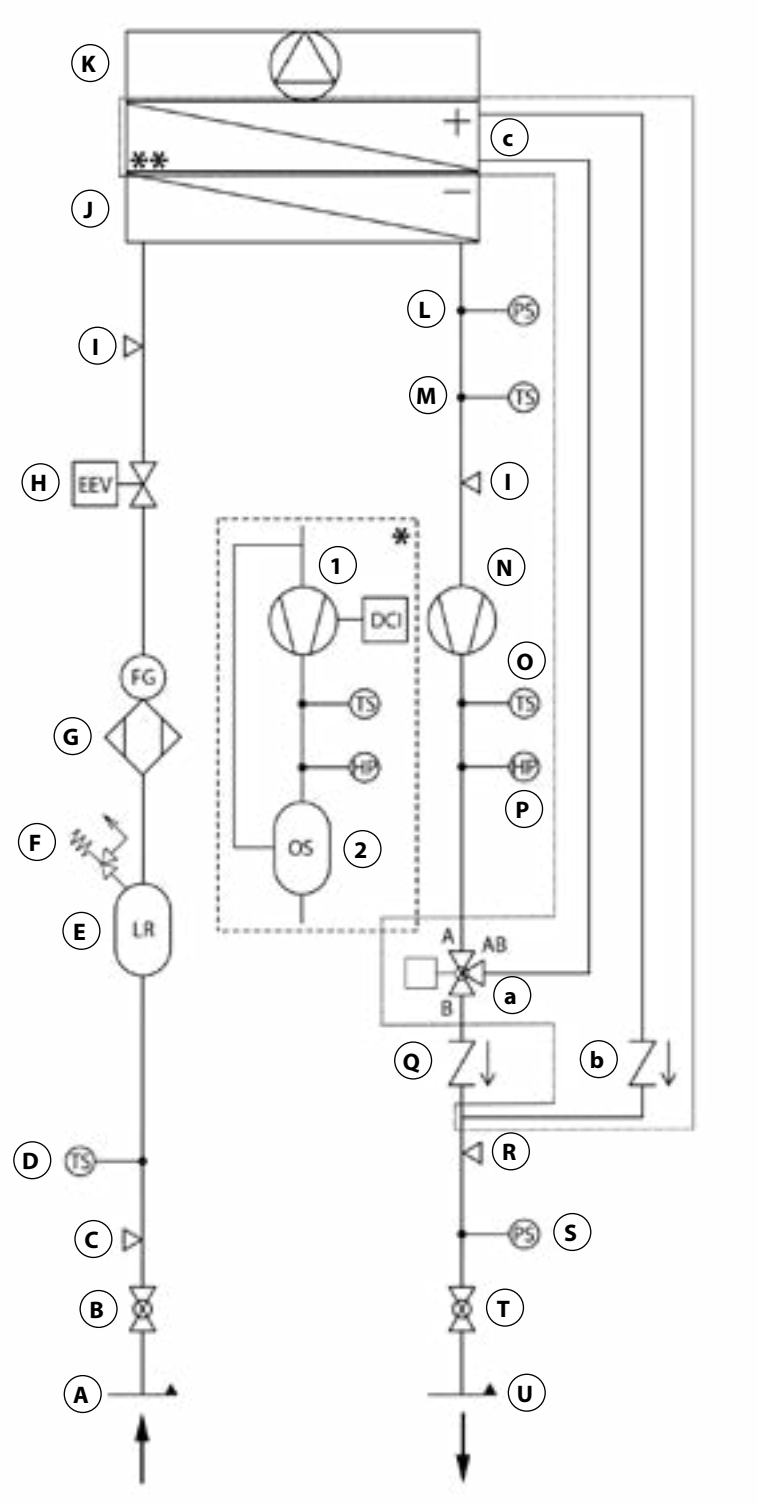
Liquid line (HP liq: PS 45 Bar - TS 68 °C):

E Liquid line check valve
F Liquid line

*** LAC (Low Ambient Control) Valve (Accessory)**

10.3 COOLING CIRCUIT WITH SINGLE COMPRESSOR AND REMOTE CONDENSER

The following image represents the cooling circuit in units with single compressor and remote condenser.



Liquid line (HP liq: PS 45 Bar - TS 68 °C):

A Liquid line
B Liquid line cock
C Pressure intake SAE 5/16" male flare
D Liquid temperature probe
E Liquid receiver
F Safety valve (44 Bar)
G Dehydrator filter with liquid sight glass
H Electronic expansion valve

Suction line (LP: PS 22 Bar - TS 38 °C):

I Pressure intake SAE 5/16" male flare (for refrigerant charging)
J Direct expansion coil
K Fan
L Evaporation pressure probe
M Suction temperature probe

Hot gas line (HP gas: PS 41 Bar - TS 64 °C):

N Compressor
O Discharge temperature probe
P High pressure switch with manual reset (41 Bar)
Q Hot gas line check valve
R Pressure intake SAE 5/16" male flare
S Condensation pressure probe
T Hot gas line cock
U Hot gas line

*** DC inverter compressor (accessory):**

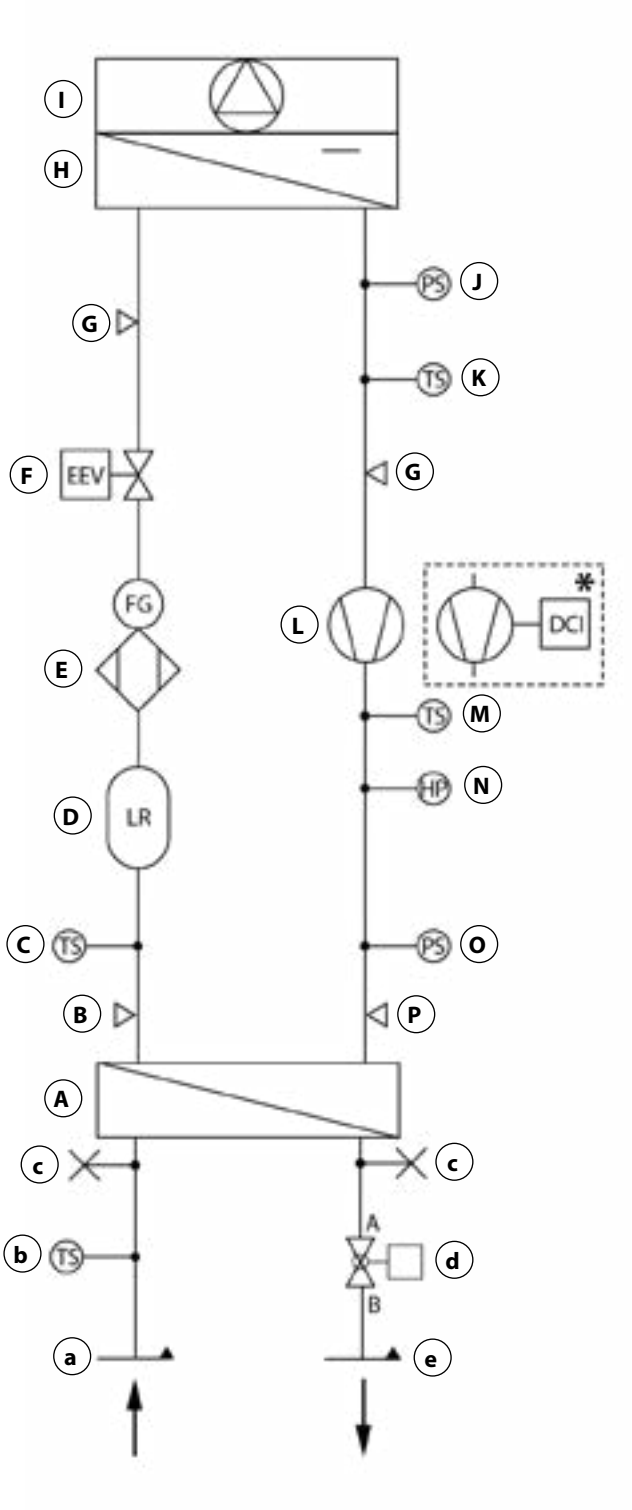
1 DC inverter compressor
2 Oil separator

**** Hot gas post-heating (accessory):**

a 3-way hot gas valve
b Check valve
c Hot gas post-heating coil

10.4 COOLING CIRCUIT WITH SINGLE COMPRESSOR AND WATER-COOLED CONDENSER

The following image represents the cooling circuit in units with single compressor and air-cooled condenser.



Cooling circuit:

Liquid line (HP: PS 41 Bar - TS 64 °C):

A Water-cooled condenser
B Pressure intake SAE 5/16" male flare
C Liquid temperature probe
D Liquid receiver
E Dehydrator filter with liquid sight glass
F Electronic expansion valve

Suction line (LP: PS 22 Bar - TS 38 °C):

G Pressure intake SAE 5/16" male flare (for refrigerant charging)
H Direct expansion coil
I Fan
J Evaporation pressure probe
K Suction temperature probe

Hot gas line (HP: PS 41 Bar - TS 64 °C):

L Compressor
M Discharge temperature probe
N High pressure switch with manual reset (41 Bar)
O Condensation pressure probe
P Pressure intake SAE 5/16" male flare

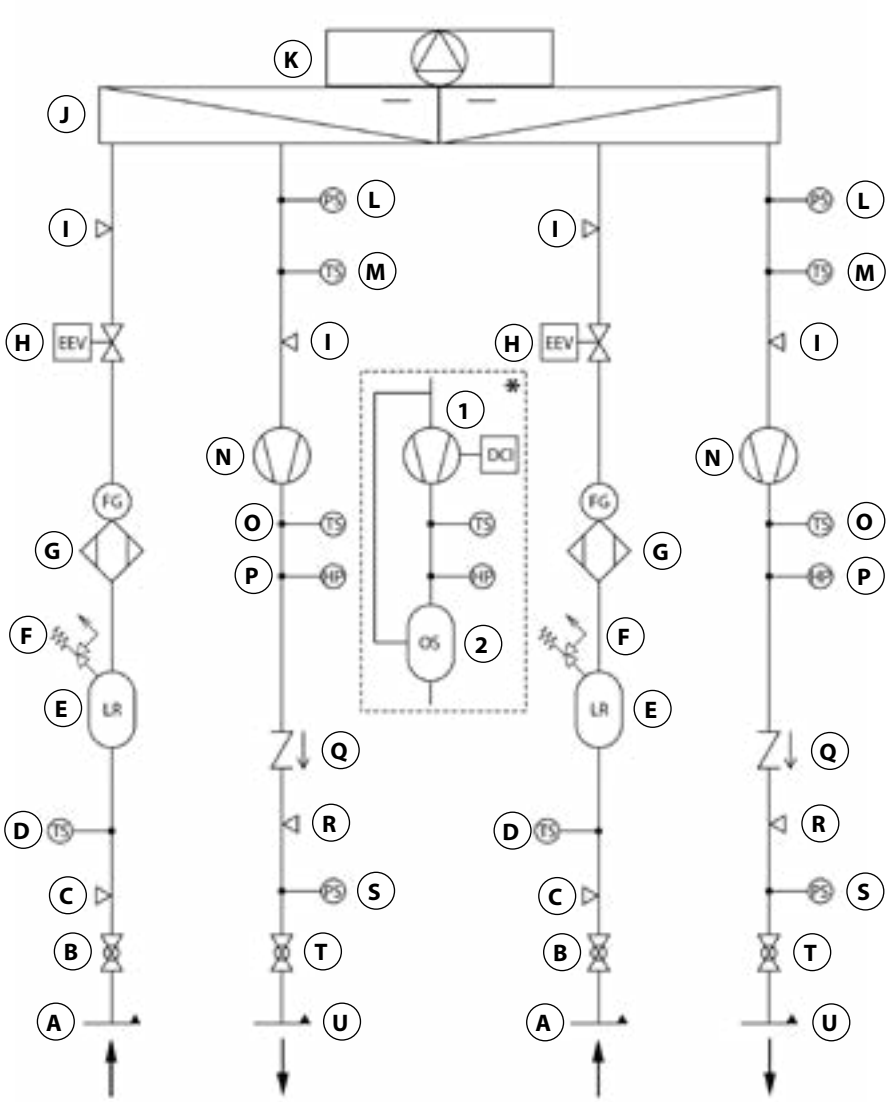
*** DC inverter compressor (accessory)**

Water circuit:

a Water inlet
b Inlet water temperature for dry cooler regulation (accessory)
c Manual air vent valves
d Adjustment valve of water-cooled condenser (accessory)
e Water outlet

10.5 COOLING CIRCUIT WITH DOUBLE COMPRESSOR AND REMOTE CONDENSER

The following image represents the cooling circuit in units with double compressor and remote condenser.



Liquid line (HP liq: PS 45 Bar - TS 68 °C):

A Liquid line
B Liquid line cock
C Pressure intake SAE 5/16" male flare
D Liquid temperature probe
E Liquid receiver
F Safety valve (44 Bar)
G Dehydrator filter with liquid sight glass
H Electronic expansion valve

Suction line (LP: PS 22 Bar - TS 38 °C):

I Pressure intake SAE 5/16" male flare (for refrigerant charging)
J Direct expansion coil
K Fan
L Evaporation pressure probe
M Suction temperature probe

Hot gas line (HP gas: PS 41 Bar - TS 64 °C):

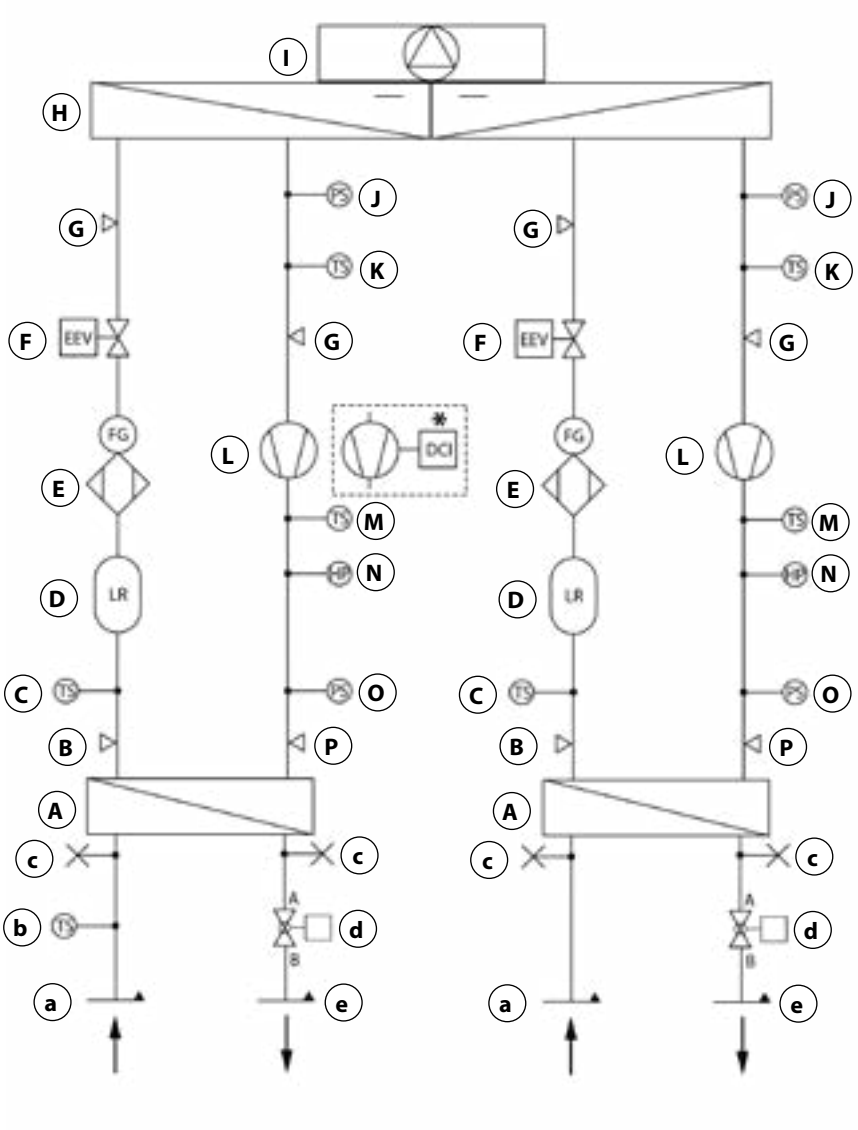
N Compressor
O Discharge temperature probe
P High pressure switch with manual reset (41 Bar)
Q Hot gas line check valve
R Pressure intake SAE 5/16" male flare
S Condensation pressure probe
T Hot gas line cock
U Hot gas line

*** DC inverter compressor (accessory):**

1 DC inverter compressor
2 Oil separator

10.6 COOLING CIRCUIT WITH DOUBLE COMPRESSOR AND WATER-COOLED CONDENSER

The following image represents the cooling circuit in units with double compressor and water-cooling condenser.



Cooling circuit:

Liquid line (HP: PS 41 Bar - TS 64 °C):

- **A Water-cooled condenser**
- **B Pressure intake SAE 5/16" male flare**
- **C Liquid temperature probe**
- **D Liquid receiver**
- **E Dehydrator filter with liquid sight glass**
- **F Electronic expansion valve**

Suction line (LP: PS 22 Bar - TS 38 °C):

- **G Pressure intake SAE 5/16" male flare (for refrigerant charging)**
- **H Direct expansion coil**
- **I Fan**
- **J Evaporation pressure probe**
- **K Suction temperature probe**

Hot gas line (HP: PS 41 Bar - TS 64 °C):

- **L Compressor**
- **M Discharge temperature probe**
- **N High pressure switch with manual reset (41 Bar)**
- **O Condensation pressure probe**
- **P Pressure intake SAE 5/16" male flare**

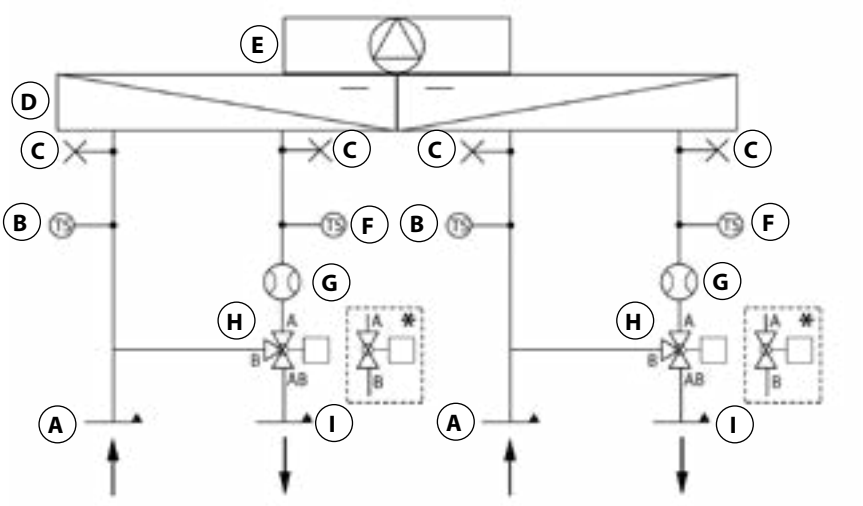
*** DC inverter compressor (accessory)**

Water circuit:

- **a Water inlet**
- **b Inlet water temperature for dry cooler regulation (accessory)**
- **c Manual air vent valves**
- **d Adjustment valve of water-cooled condenser (accessory)**
- **e Water outlet**

10.7 TWO SOURCES WATER CIRCUIT WITH CHILLED WATER CIRCUITS

The following image represents the water circuit of chilled water two sources units.

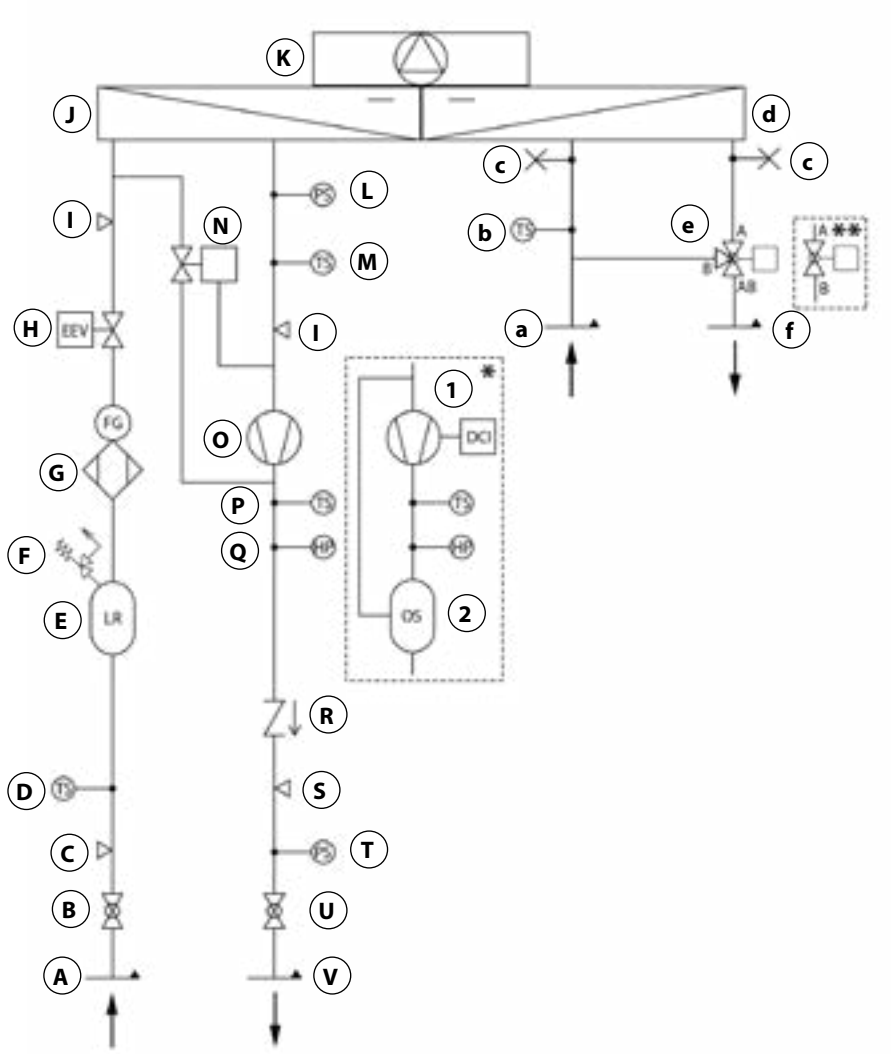


A Water inlet
B Inlet water temperature (accessory)
C Manual air vent valves
D Chilled water coil
E Fan
F Outlet water temperature (accessory)
G Water flow measuring device (accessory)
H 3-way ball valve
I Water outlet

*** 2-way ball valve (accessory)**

10.8 TWO SOURCES COOLING CIRCUIT WITH SINGLE COMPRESSOR AND REMOTE CONDENSER

The following image represents the cooling circuit in two sources units with single compressor and remote condenser.



Cooling circuit:

Liquid line (HP liq: PS 45 Bar - TS 68 °C):

- **A Liquid line**
- **B Liquid line cock**
- **C Pressure intake SAE 5/16" male flare**
- **D Liquid temperature probe**
- **E Liquid receiver**
- **F Safety valve (44 Bar)**
- **G Dehydrator filter with liquid sight glass**
- **H Electronic expansion valve**

Suction line (LP: PS 22 Bar - TS 38 °C):

- **I Pressure intake SAE 5/16" male flare (for refrigerant charging)**
- **J Direct expansion coil**
- **K Fan**
- **L Evaporation pressure probe**
- **M Suction temperature probe**
- **N Antifreeze hot gas injection valve**

Hot gas line (HP gas: PS 41 Bar - TS 64 °C):

- **O Compressor**
- **P Discharge temperature probe**
- **Q High pressure switch with manual reset (41 Bar)**
- **R Hot gas line check valve**
- **S Pressure intake SAE 5/16" male flare**
- **T Condensation pressure probe**
- **U Hot gas line cock**
- **V Hot gas line**

*** DC inverter compressor (accessory):**

- **1 DC inverter compressor**
- **2 Oil separator**

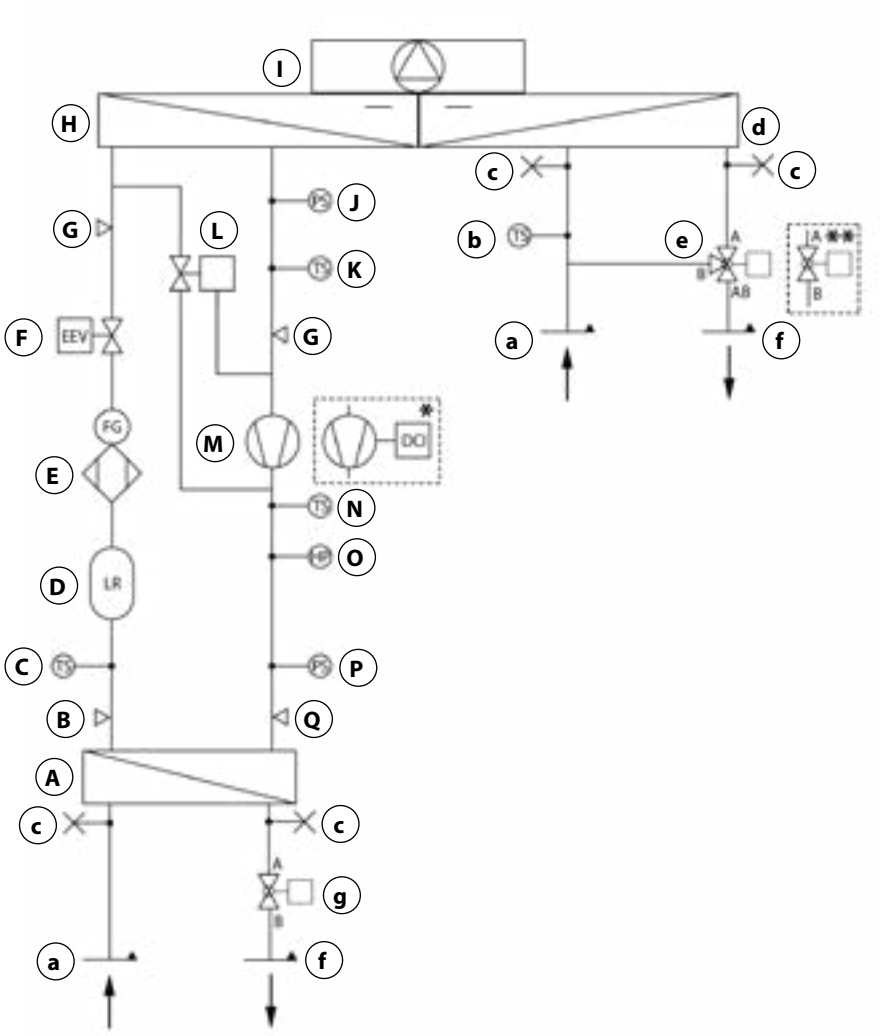
Water circuit:

- **a Water inlet**
- **b Inlet water temperature**
- **c Manual air vent valves**
- **d Chilled water coil**
- **e 3-way ball valve**
- **f Water outlet**

**** 2-way ball valve (accessory)**

10.9 TWO SOURCES COOLING CIRCUIT WITH SINGLE COMPRESSOR AND WATER-COOLED CONDENSER

The following image represents the cooling circuit in two sources units with single compressor and water-cooling condenser.



Cooling circuit:

Liquid line (HP: PS 41 Bar - TS 64 °C):

- **A** Water-cooled condenser
- **B** Pressure intake SAE 5/16" male flare
- **C** Liquid temperature probe
- **D** Liquid receiver
- **E** Dehydrator filter with liquid sight glass
- **F** Electronic expansion valve

Suction line (LP: PS 22 Bar - TS 38 °C):

- **G** Pressure intake SAE 5/16" male flare (for refrigerant charging)
- **H** Direct expansion coil
- **I** Fan
- **J** Evaporation pressure probe
- **K** Suction temperature probe
- **L** Antifreeze hot gas injection valve

Hot gas line (HP: PS 41 Bar - TS 64 °C):

- **M** Compressor
- **N** Discharge temperature probe
- **O** High pressure switch with manual reset (41 Bar)
- **P** Condensation pressure probe
- **Q** Pressure intake SAE 5/16" male flare

*** DC inverter compressor (accessory)**

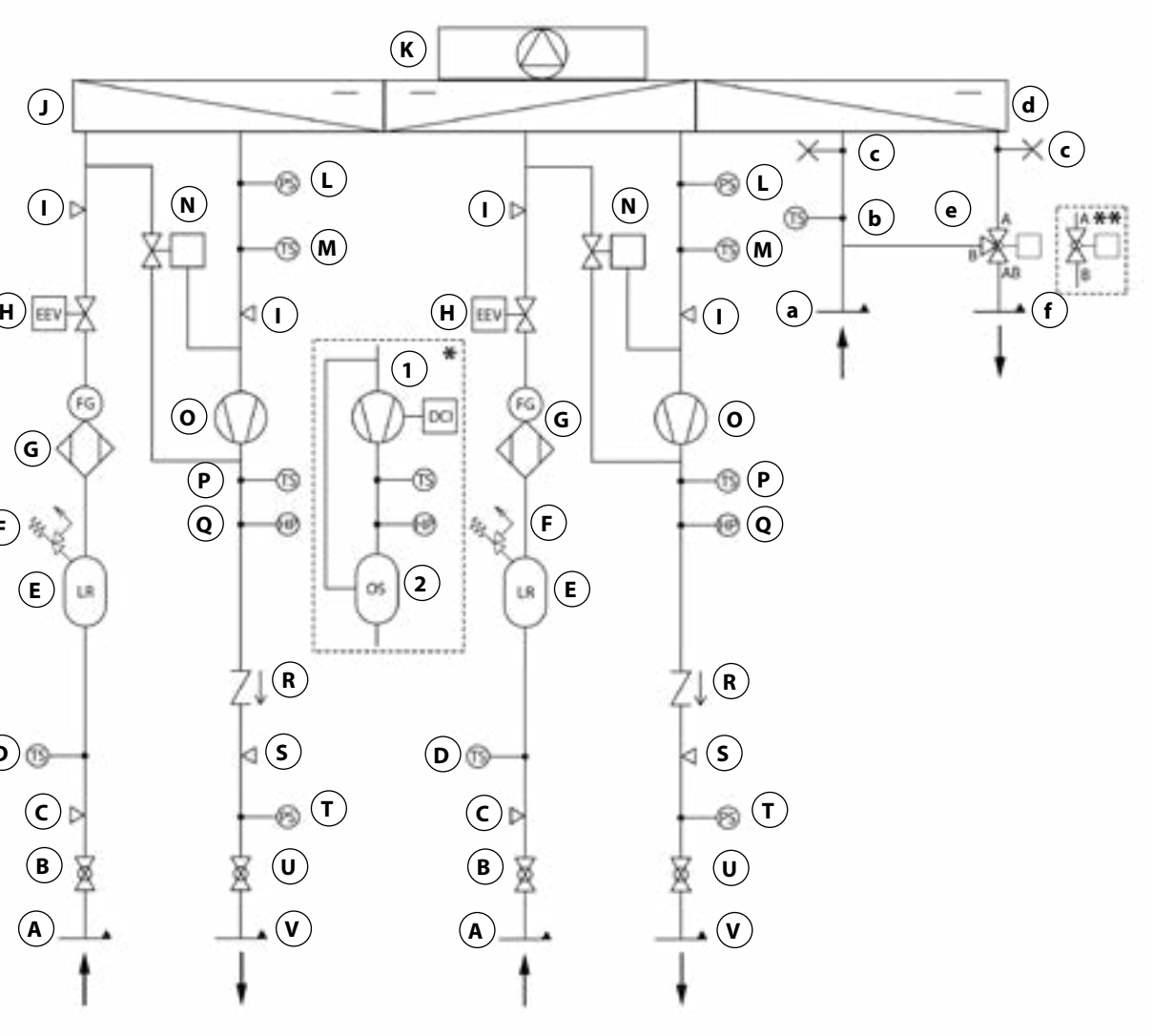
Water circuit:

- **a** Water inlet
- **b** Inlet water temperature
- **c** Manual air vent valves
- **d** Chilled water coil
- **e** 3-way ball valve
- **f** Water outlet
- **g** Adjustment valve of water-cooled condenser (accessory)

**** 2-way ball valve (accessory)**

10.10 TWO SOURCES COOLING CIRCUIT WITH DOUBLE COMPRESSOR AND REMOTE CONDENSER

The following image represents the cooling circuit in two sources units with double compressor and remote condenser.



Cooling circuit:

Liquid line (HP liq: PS 45 Bar - TS 68 °C):

- **A Liquid line**
- **B Liquid line cock**
- **C Pressure intake SAE 5/16" male flare**
- **D Liquid temperature probe**
- **E Liquid receiver**
- **F Safety valve (44 Bar)**
- **G Dehydrator filter with liquid sight glass**
- **H Electronic expansion valve**

Suction line (LP: PS 22 Bar - TS 38 °C):

- **I Pressure intake SAE 5/16" male flare (for refrigerant charging)**
- **J Direct expansion coil**
- **K Fan**
- **L Evaporation pressure probe**
- **M Suction temperature probe**
- **N Antifreeze hot gas injection valve**

Hot gas line (HP gas: PS 41 Bar - TS 64 °C):

- **O Compressor**
- **P Discharge temperature probe**
- **Q High pressure switch with manual reset (41 Bar)**
- **R Hot gas line check valve**
- **S Pressure intake SAE 5/16" male flare**
- **T Condensation pressure probe**
- **U Hot gas line cock**
- **V Hot gas line**

*** DC inverter compressor (accessory):**

- **1 DC inverter compressor**
- **2 Oil separator**

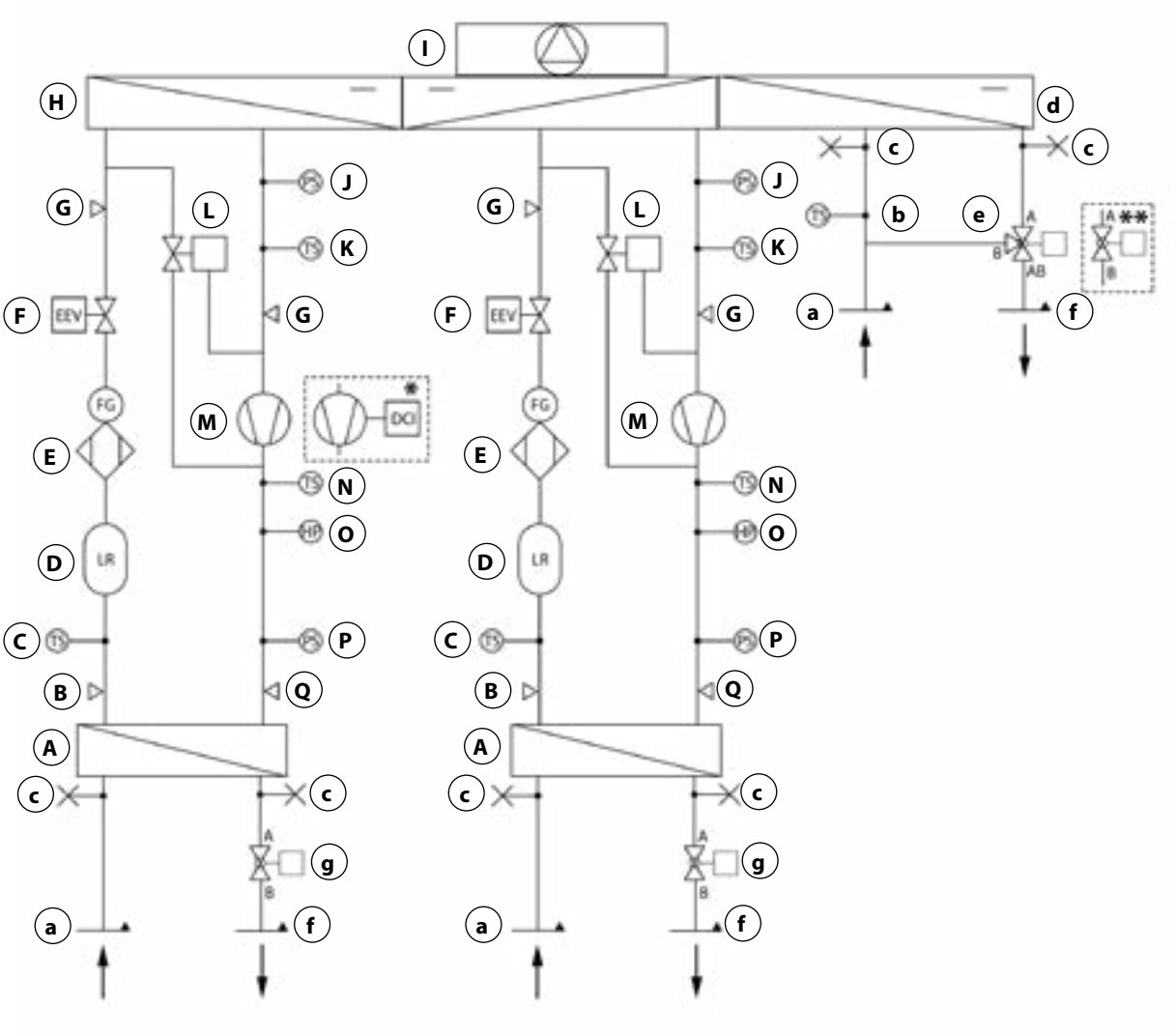
Water circuit:

- **a Water inlet**
- **b Inlet water temperature**
- **c Manual air vent valves**
- **d Chilled water coil**
- **e 3-way ball valve**
- **f Water outlet**

**** 2-way ball valve (accessory)**

10.11 TWO SOURCES COOLING CIRCUIT WITH DOUBLE COMPRESSOR AND WATER-COOLED CONDENSER

The following image represents the cooling circuit in two sources units with double compressor and water-cooling condenser.



Cooling circuit:

Liquid line (HP: PS 41 Bar - TS 64 °C):

- **A** Water-cooled condenser
- **B** Pressure intake SAE 5/16" male flare
- **C** Liquid temperature probe
- **D** Liquid receiver
- **E** Dehydrator filter with liquid sight glass
- **F** Electronic expansion valve

Suction line (LP: PS 22 Bar - TS 38 °C):

- **G** Pressure intake SAE 5/16" male flare (for refrigerant charging)
- **H** Direct expansion coil
- **I** Fan
- **J** Evaporation pressure probe
- **K** Suction temperature probe
- **L** Antifreeze hot gas injection valve

Hot gas line (HP: PS 41 Bar - TS 64 °C):

- **M** Compressor
- **N** Discharge temperature probe
- **O** High pressure switch with manual reset (41 Bar)
- **P** Condensation pressure probe
- **Q** Pressure intake SAE 5/16" male flare

*** DC inverter compressor (accessory)**

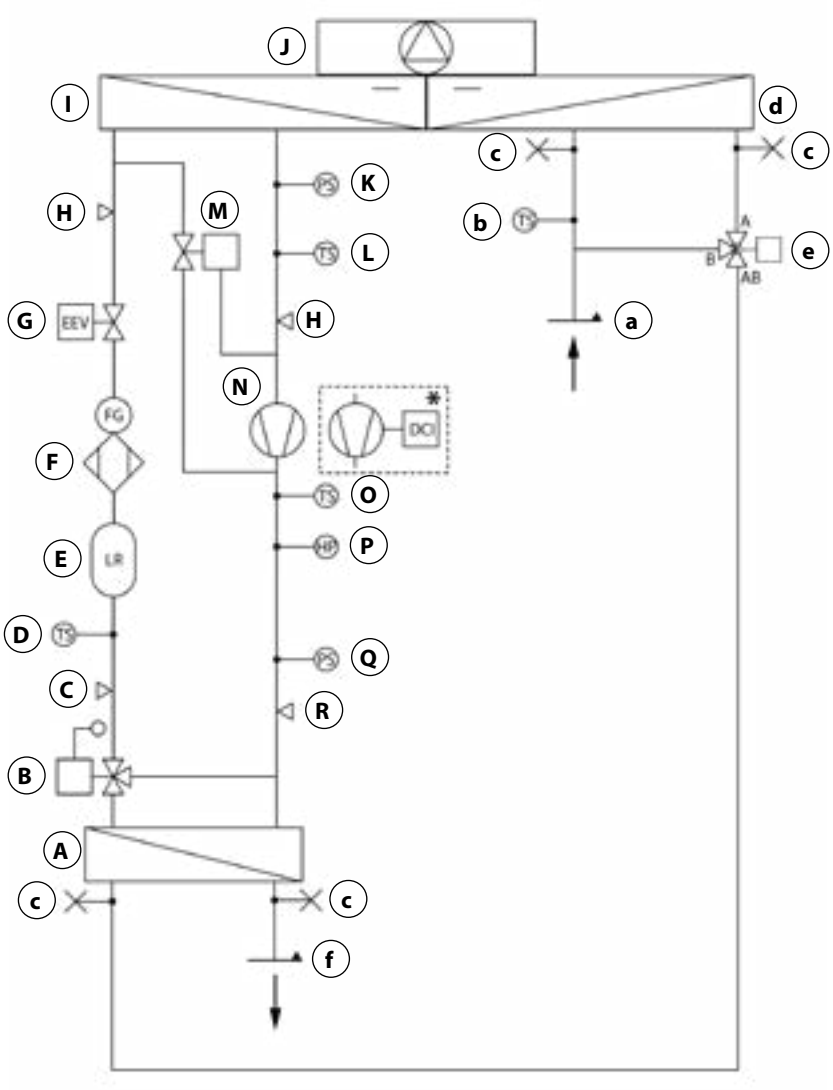
Water circuit:

- **a** Water inlet
- **b** Inlet water temperature
- **c** Manual air vent valves
- **d** Chilled water coil
- **e** 3-way ball valve
- **f** Water outlet
- **g** Adjustment valve of water-cooled condenser (accessory)

**** 2-way ball valve (accessory)**

10.12 COOLING CIRCUIT WITH FREE COOLING AND SINGLE COMPRESSOR

The following image represents the cooling circuit of the free cooling units with single compressor.



Cooling circuit:

Liquid line (HP: PS 41 Bar - TS 64 °C):

- **A** Water-cooled condenser
- **B** LAC valve for controlling condensation pressure
- **C** Pressure intake SAE 5/16" male flare
- **D** Liquid temperature probe
- **E** Liquid receiver
- **F** Dehydrator filter with liquid sight glass
- **G** Electronic expansion valve

Suction line (LP: PS 22 Bar - TS 38 °C):

- **H** Pressure intake SAE 5/16" male flare (for refrigerant charging)
- **I** Direct expansion coil
- **J** Fan
- **K** Evaporation pressure probe
- **L** Suction temperature probe
- **M** Antifreeze hot gas injection valve

Hot gas line (HP: PS 41 Bar - TS 64 °C):

- **N** Compressor
- **O** Discharge temperature probe
- **P** High pressure switch with manual reset (41 Bar)
- **Q** Condensation pressure probe
- **R** Pressure intake SAE 5/16" male flare

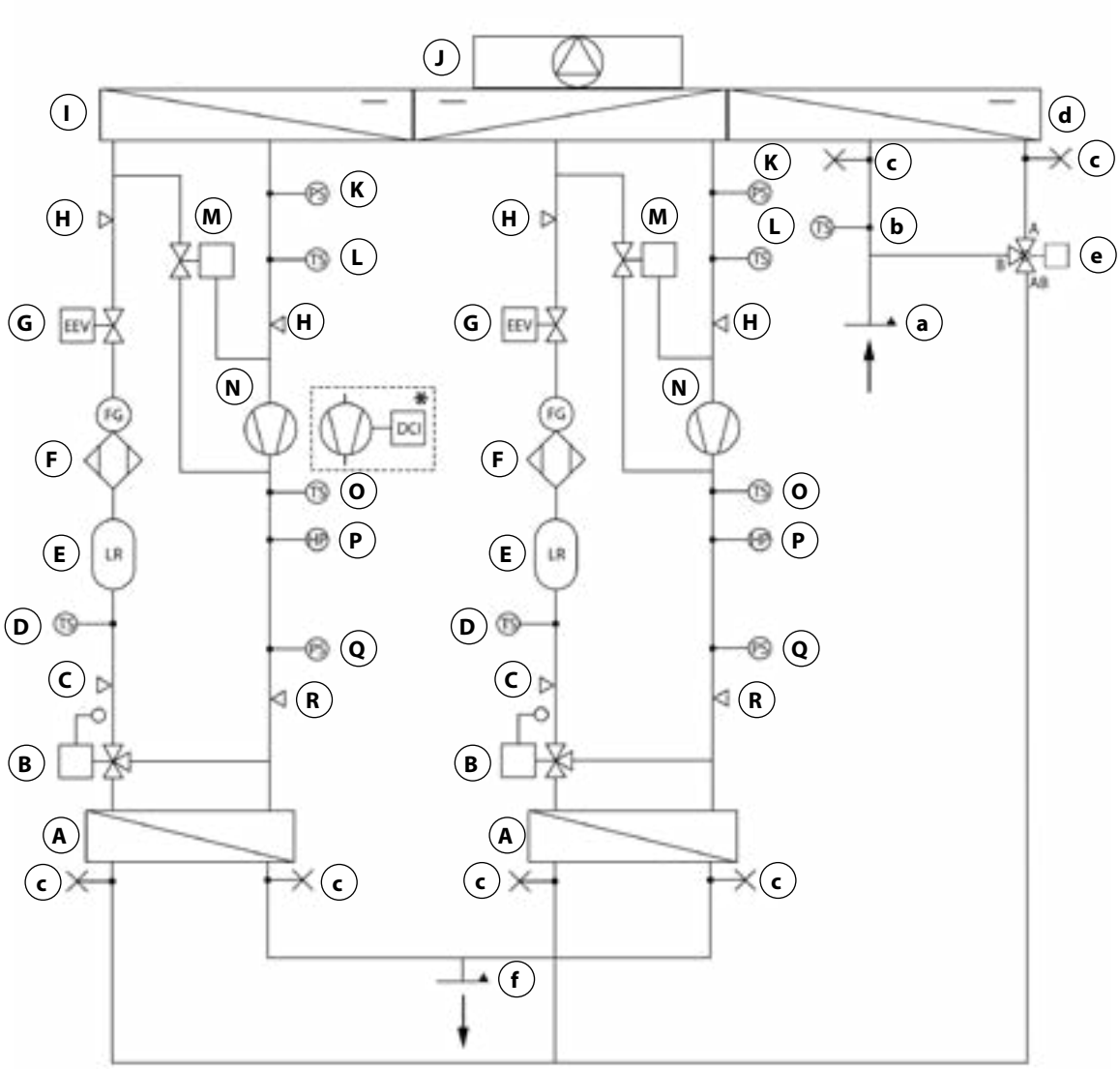
*** DC inverter compressor (accessory)**

Water circuit:

- **a** Water inlet
- **b** Inlet water temperature
- **c** Manual air vent valves
- **d** Chilled water coil
- **e** 3-way ball valve
- **f** Water outlet

10.13 COOLING CIRCUIT WITH FREE COOLING AND DOUBLE COMPRESSOR

The following image represents the cooling circuit of the free cooling units with double compressor.



Cooling circuit:

Liquid line (HP: PS 41 Bar - TS 64 °C):

- **A** Water-cooled condenser
- **B** LAC valve for controlling condensation pressure
- **C** Pressure intake SAE 5/16" male flare
- **D** Liquid temperature probe
- **E** Liquid receiver
- **F** Dehydrator filter with liquid sight glass
- **G** Electronic expansion valve

Suction line (LP: PS 22 Bar - TS 38 °C):

- **H** Pressure intake SAE 5/16" male flare (for refrigerant charging)
- **I** Direct expansion coil
- **J** Fan
- **K** Evaporation pressure probe
- **L** Suction temperature probe
- **M** Antifreeze hot gas injection valve

Hot gas line (HP: PS 41 Bar - TS 64 °C):

- **N** Compressor
- **O** Discharge temperature probe
- **P** High pressure switch with manual reset (41 Bar)
- **Q** Condensation pressure probe
- **R** Pressure intake SAE 5/16" male flare

*** DC inverter compressor (accessory)**

Water circuit:

- **a** Water inlet
- **b** Inlet water temperature
- **c** Manual air vent valves
- **d** Chilled water coil
- **e** 3-way ball valve
- **f** Water outlet

11 ELECTRICAL CONNECTIONS

WARNING!

It is necessary to always refer to the electrical diagram supplied with the unit.

The electrical wiring diagram suggests dimension values for the electricity line and the corresponding protective devices.

WARNING!

Avoid splicing

For signal cables:
Connect one end only ofshielding to earth

Do not install with power cables

The electrical connections of the air conditioner must satisfy the following prescriptions:

- The sizing of the power supply line, to be carried out by the installer, must comply with the indications provided in the technical documentation and the regulations of the country where the installation is carried out.The Manufacturer is not liable for any damage resulting from incorrect sizing.
- The electronic devices inside the unit are not compatible with IT distribution systems (Neutral insulated from the earth) as they could be damaged.
- To avoid potential damage to electrical and electronic equipment caused by voltage surges in the electricity supply line, the Manufacturer recommends evaluating the necessity of installing SPDs (Surge Protection Devices) appropriately rated for the type of installation and the frequency of direct lightning strikes on the electricity supply line (EN 62305/1-4).
- To prevent operating problems with the system, it is necessary that no other loads, even those that are part of the same system, are connected downstream of the main switch for the air conditioner, unless explicit permission is granted by the Manufacturer.
- The electronic devices inside the unit require that the differential protection is calibrated from 30 to 300 mA, in order to prevent untimely interventions.
- The electrical power supply line must have the following characteristics in compliance with EN 60654-2 & EN 61000-4-11 standards, in order to prevent possible malfunction of the installed components:

Characteristics of the standard unit electrical supply line				
Type	**Nominal values**	**Permissible tolerance**		
		%	**Minimum**	**Maximum**
400 Vac – 3-phase– 50 Hz				
Voltage	400 Vac	± 15%	340 Vac	460 Vac
Difference of voltage between the phases	0 Vac	± 2%	- 8 Vac	+ 8 Vac
Frequency	50 Hz	± 2%	49 Hz	51 Hz
460 Vac – 3-phase– 60 Hz				
Voltage	460 Vac	± 15%	391 Vac	529 Vac
Difference of voltage between the phases	0 Vac	± 2%	- 8 Vac	+ 8 Vac
Frequency	60 Hz	± 2%	58.8 Hz	61.2 Hz
380 Vac – 3-phase– 60 Hz				
Voltage	380 Vac	± 15%	323 Vac	437 Vac
Difference of voltage between the phases	0 Vac	± 2%	- 7.6 Vac	+ 7.6 Vac
Frequency	60 Hz	± 2%	58.8 Hz	61.2 Hz

Variations, short interruptions and voltage dips

In the presence of variations, interruptions and voltage dips of short duration and / or intensity, the unit maintains its normal performance. If they are longer and / or of greater intensity, it is possible that the unit will shut down, or the components belonging to the unit.

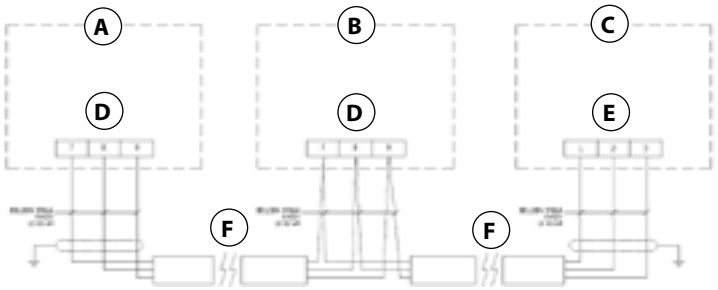
Upon restoration of the correct values of the supply voltage, the equipment restarts automatically, without losing the stored data and consistently with the status of the components that are part of the unit.

11.1 RS485 SERIAL COMMUNICATION BOARD CONNECTION (Modbus RTU - BACnet MS/TP)

The SySmart³ microprocessors can be connected to a supervision and/or BMS (Building Management System) network, which adopts the Modbus RTU (Standard) or BACnet MS/TP (Accessory) protocol through a dedicated RS485 serial board.

Using this type of board it is also possible to connect the gateways necessary to interface the SySmart³ with networks that use different protocols to those available as accessories.

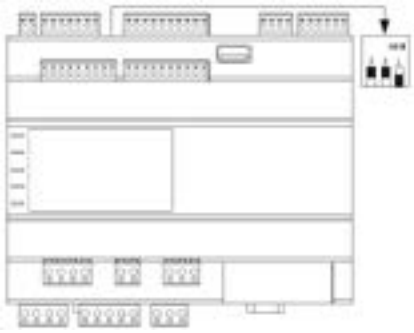
To create a connection to the RS485 board, simply connect the units from the terminals on it (see wiring diagram for further information):



A Unit 1
B Unit 2
C BMS / Supervision system/Gateway
D RS485 output terminals
E RS485 input terminals
F RS485 connection cable

In order to guarantee correct serial communication between the network-connected units, it may be necessary to insert a 120 Ω terminating resistor.

SySmart³ microprocessors fitted with suitable micro switches for activating suitable 120 Ω terminating resistors if set to ON.



Set micro switch RS485LT2 (1) to ON to activate the 120 Ω terminating resistor

The type of cable to be used for the connection must have the following features:

Main features of serial communication cable		
Type	Data transmission cable	
Application	EIA RS485 Interface	
Shielding	Tinned copper braid - Cover at least 65%	
Cross-section and number of conductors	2 x 0.35 mm² - AWG 22 + 1 x 0.35 mm² - AWG 22	
Stranding	Twisted pairs	
Nominal loss (1 MHz)	dB/100m	1.64
Maximum DC resistance for conductor at 20°C	Ω/km	49
Insulation resistance at 20°C	MΩ*km	5000
Mutual capacitance c-c / c-s	nF/km	40 - 70
Inductance	mH/km	0.7
Impedance	Ohm	120 +/- 0.12
Maximum length	m	100
Example		

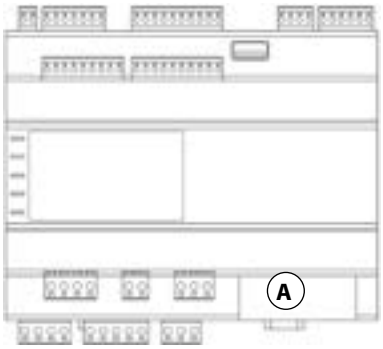
11.2 ETHERNET RJ45 PORT CONNECTION (Modbus TCP - BACnet IP - Web Server)

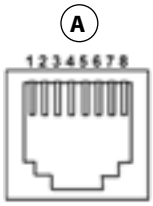
The SySmart³ microprocessors can be connected to a supervision and/or BMS (Building Management System) system, which adopts the Modbus TCP (Standard) or BACnet IP (Accessory) protocol through a dedicated RJ45 serial board.

Through the RJ45 serial board it is also possible to view supervision Web pages through the Web Server function (Accessory).

To make the connection to the Ethernet network, simply connect the SySmart³ microprocessors through the RJ45 port on the board:

RJ45 Connection (BACnet IP configuration)





A RJ45 Ethernet

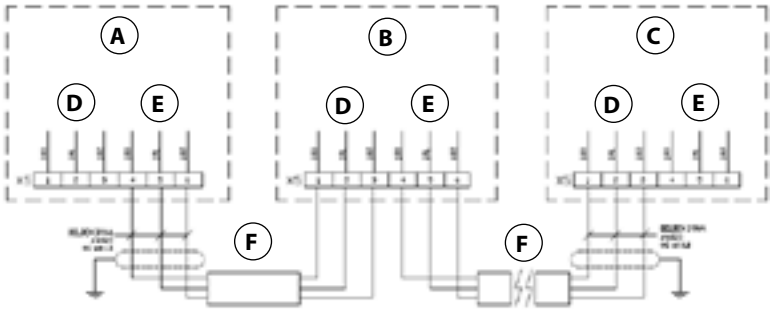
The type of cable to be used for the connection must have the following features:

Main features of ethernet communication cable		
Type	LAN/ethernet cables Cat. 6/6A	
Application	IEEE 802.3: 10Base-T; 100Base-T; 1000Base-T; 10GBase-T	
Shielding	Pair shielded with Aluminium/Polyester foil (PiMF)	
Cross-section and number of conductors	4 x 2 x 0.13 mm² - AWG 26	
Stranding	Twisted pairs	
Maximum DC resistance for conductor at 20°C	Ω/km	130
Insulation resistance at 20°C	MΩ*km	> 2000
Mutual capacitance c-c / c-s	pF/km	43
Impedance	Ohm	100 +/- 5
Maximum length	m	100
Example		

11.3 CANbus LAN CONNECTION (ACCESSORY)

SySmart³ microprocessors can be interconnected in a CANbus LAN (Accessory) that allows several units to run so as to optimise the regulation of the air-conditioned rooms.

To create a LAN, simply connect the units from the terminals on it (see wiring diagram for further information). Refer to the next chapter for connecting the remote terminal.



A **Unit 1**
B **Unit 2**
C **End unit (max. 12)**
D **CANbus network input terminals**
E **CANbus network output terminals**
F **CANbus network connection cable**

The connection cable is supplied together with the units. If a change is required, the type of cable to be used for the connection must have the following features:

Main features of serial communication cable		
Type	Data transmission cable	
Application	EIA RS485 Interface	
Shielding	Tinned copper braid - Cover at least 65%	
Cross-section and number of conductors	2 x 0.35 mm² - AWG 22 + 1 x 0.35 mm² - AWG 22	
Stranding	Twisted pairs	
Nominal loss (1 MHz)	dB/100m	1.64
Maximum DC resistance for conductor at 20°C	Ω/km	49
Insulation resistance at 20°C	MΩ*km	5000
Mutual capacitance c-c / c-s	nF/km	40 - 70
Inductance	mH/km	0.7
Impedance	Ohm	120 +/- 0.12
Maximum length	m	100
Example		

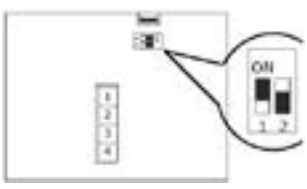
11.3.1 CANBUS LOCAL NETWORK TERMINATING RESISTORS

WARNING!

Set micro switches to ON to activate 120 Ω terminating resistor IN THE FIRST (Unit 1) and LAST UNIT OF THE LOCAL NETWORK.

In order to assure correct serial communication between the units connected in a CANbus network, the network must have terminating resistors at both ends. SySmart³ microprocessors and user terminals are fitted with suitable micro switches for activating suitable 120 Ω terminating resistors if set to ON.

Set micro switch CANLT (3) to ON to activate the 120 Ω terminating resistor

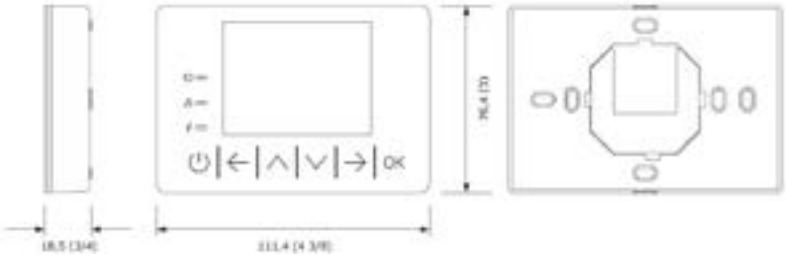


Set micro switch 2 to ON to activate the 120 Ω terminating resistor.

11.4 REMOTE CONTROL TERMINAL CONNECTION (ACCESSORY)

If the terminal is to be panel or recess-mounted, the maximum thickness of the panel must be 6 mm; if the terminal is to be recess-mounted in a wall, it is necessary a square recess-mounted resin box for 6 (3+3) modules (506E BTicino type).

The dimensions and drilling template are as follows:

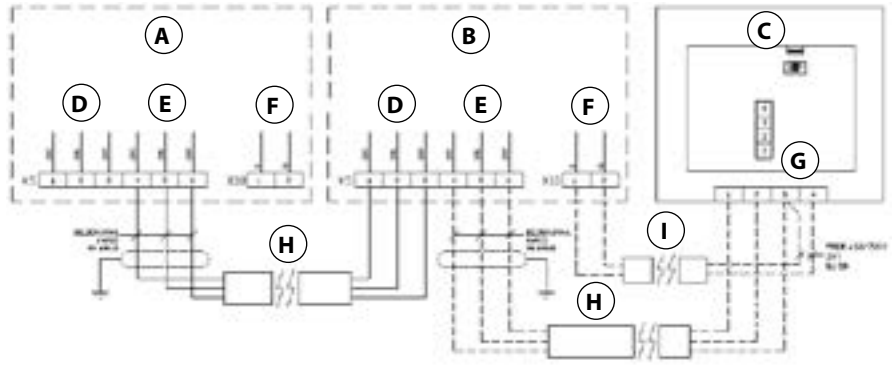


Remote terminal dimensions

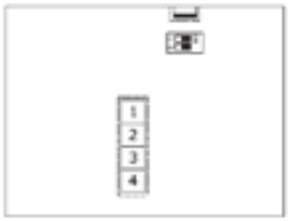
In order to power the remote display through the unit, it needs to be enabled for such connection through the dedicated accessory.

The connections to the remote display must be made as indicated in the electrical wiring diagram supplied with the unit. The figure below shows the connection diagram and terminal box of the remote terminal.

Connection of the remote terminal



A	**Unit 1**
B	**End unit (max. 12)**
C	**Remote Terminal (accessory)**
D	**CANbus network input terminals**
E	**CANbus network output terminals**
F	**Remote terminal power supply terminals (accessory)**
G	**Remote terminal connection terminal box**
H	**CANbus network connection cable**
I	**Remote terminal power supply cable**

Rear view of the terminal	Pin		Meaning
	**1**	**Vac / +**	+ Power supply (24 VAC or 20 ... 40 VDC)
	2	**Vac / -**	- Power supply (24 VAC or 20 ... 40 VDC) CAN GND
	3	**CAN +**	CAN H (+)
	4	**CAN -**	CAN L (-)

The connection cable between the remote display and the CANbus communication network must have the characteristics described in the previous chapter. The power cable of the display must have the following characteristics:

Main features of the power supply cable		
Type	FS18OR18 300/500 Vac cable	
Shielding	Not required	
Cross-section and number of conductors	2 x 1 mm^2	
Maximum length	m	100
Example		

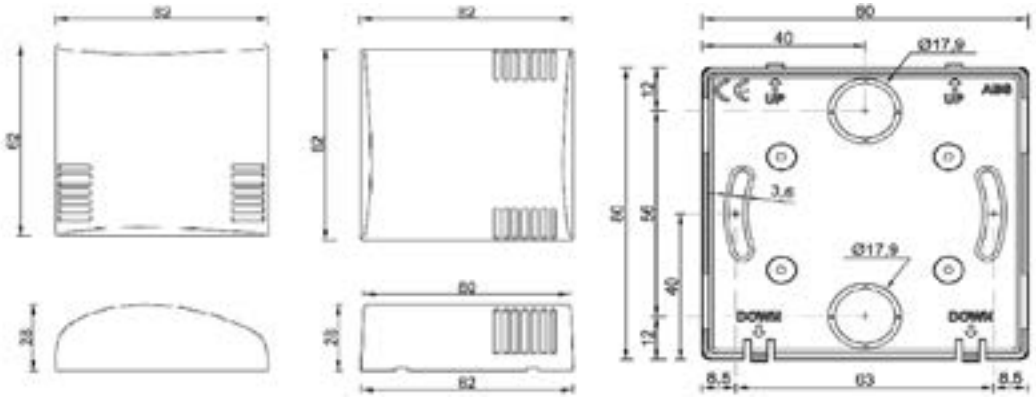
11.5 WALL-MOUNTED TEMPERATURE AND HUMIDITY PROBE CONNECTION (ACCESSORY)

The supplied temperature and humidity probe allows managing the room temperature and humidity detection in systems where return detection is not real or satisfying like, for example, systems with partial outside air introduction in the return.

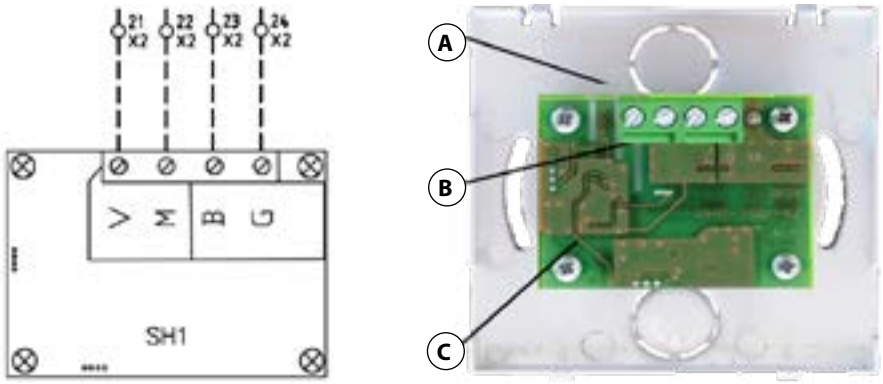
The supplied probe is of wall installation type. It is recommended to position the probe at a minimum height of 1600 mm off the floor for the most reliable temperature readings.

The connections must be made as indicated in the electrical wiring diagram supplied with the unit. The figure below shows the probe's connection terminal board and the position of the jumpers for correct operation of said probe.

Wall-mounted temperature and humidity probe



Size and drilling jig for wall-mounted installation



A Probe support
B Connection terminals
C Electronic board

Temperature and humidity probe connection

The type of cable to be used for the connection must have the following features:

Main features of the connection cable		
Type	FR2OH2R16 450/750 Vac signal transmission cable	
Shielding	Tinned copper braid - Cover at least 65%	
Cross-section and number of conductors	4 x 0.35 mm²	
Maximum length	m	100
Example		

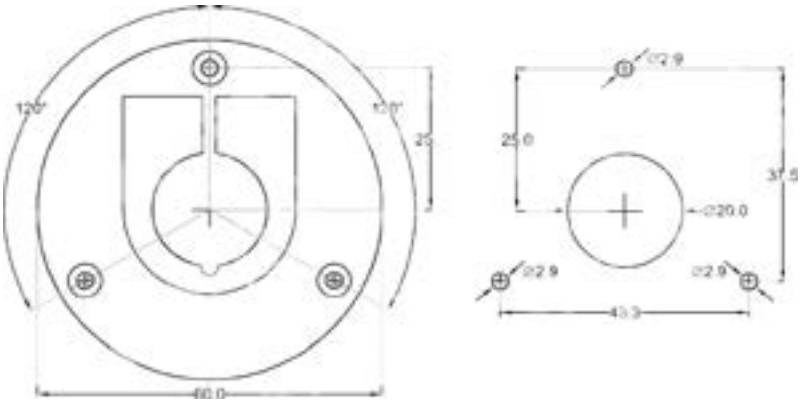
11.6 DUCTED TEMPERATURE AND HUMIDITY PROBE CONNECTION (ACCESSORY)

The supplied temperature and humidity probe allows managing the room temperature and humidity detection in systems where return detection is not real or satisfying like, for example, systems with partial outside air introduction in the return.

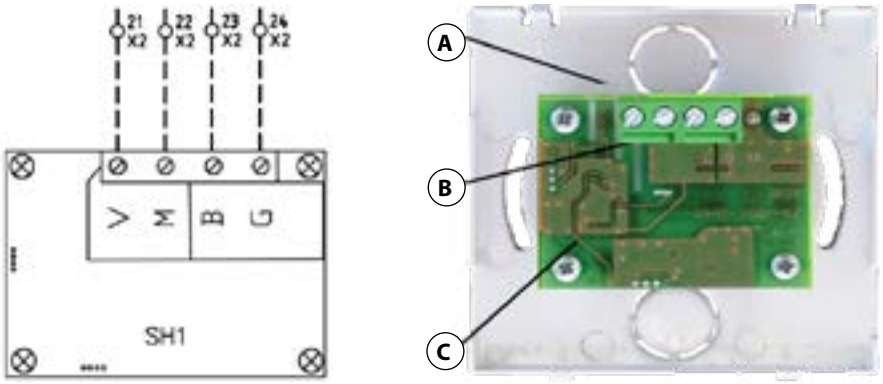
The supplied probe is the duct installation type. It is recommended to position the probe at the centre of the duct for the most reliable temperature readings.

The connections must be made as indicated in the electrical wiring diagram supplied with the unit. The figure below shows the probe's connection terminal board and the position of the jumpers for correct operation of said probe.

Ducted temperature and humidity probe



Drilling template for duct installation



A Probe support
B Connection terminals
C Electronic board

Temperature and humidity probe connection

The type of cable to be used for the connection must have the following features:

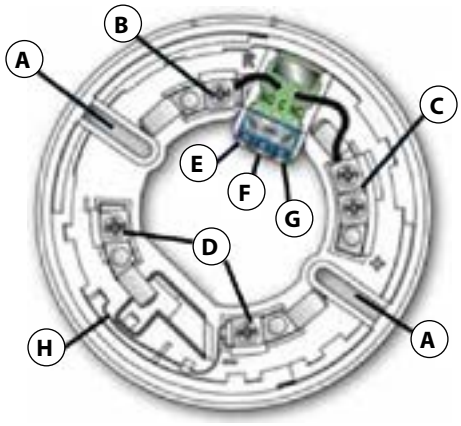
Main features of the connection cable		
Type	FR2OH2R16 450/750 Vac signal transmission cable	
Shielding	Tinned copper braid - Cover at least 65%	
Cross-section and number of conductors	4 x 0.35 mm^2	
Maximum length	m	100
Example		

11.7 CONNECTION OF THE SMOKE AND FLAME DETECTORS SUPPLIED (ACCESSORY)

The smoke and flame detectors supplied detect the presence of smoke or flames in the environment.

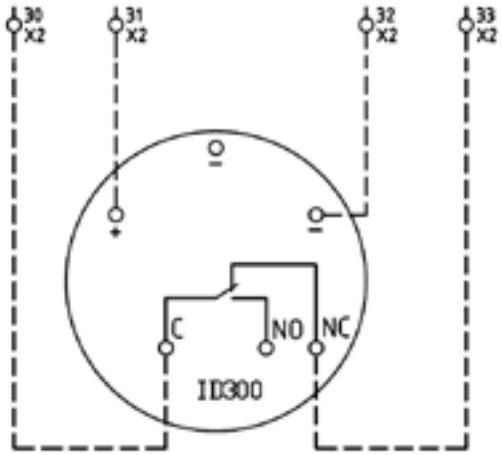
The supplied probe is of wall installation type. The connections must be made as indicated in the electrical wiring diagram supplied with the unit. The terminal board for connecting the sensor is shown in the figure below.

Smoke and flame sensors



A Anchor holes
B "R" terminal
C "+" terminal
D "-" terminal
E "NO" relay terminal
F "C" relay terminal
G "NC" relay terminal
H Blade for short circuit

Anchor base and connection



Connection of the smoke and flame sensors

The type of cable to be used for the connection must have the following features:

Main features of the connection cable		
Type	FS18OR18 300/500 Vac cable	
Shielding	Not required	
Cross-section and number of conductors	4 x 1 mm²	
Maximum length	m	100
Example		

11.8 WATER DETECTION PROBE CONNECTION (ACCESSORY)

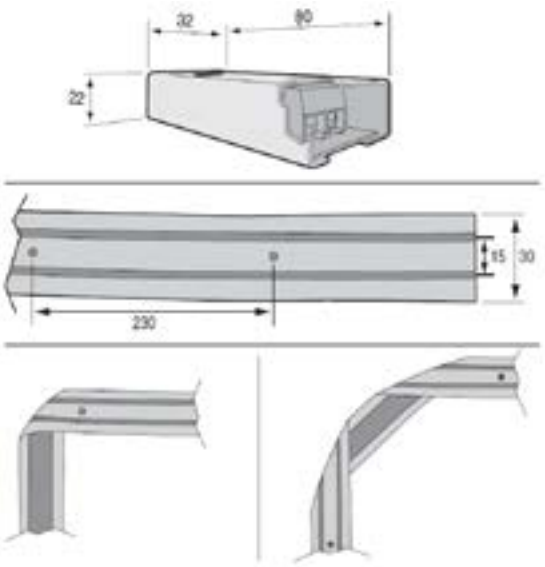
The accessory for detecting the presence of water provides an alarm if the probe, supplied with the device, is even partially covered with water.

The probes are comprised of an anti-corrosive metal container (local probe) or a fabric belt (belt probe). Inside the probes there are two stainless steel metal electrodes to read the alarm condition.

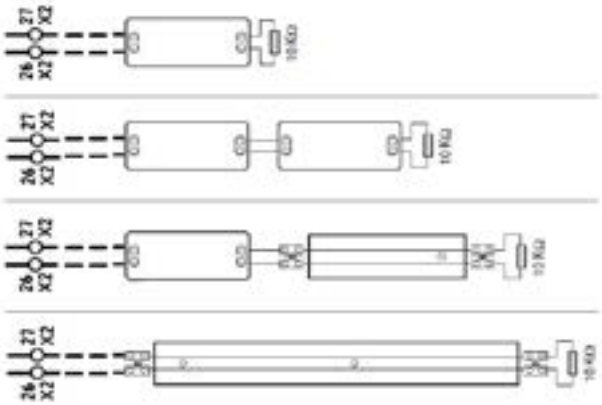
The water presence probe must be positioned in the area being controlled and connected as shown on the wiring diagram supplied with the unit, being careful to ensure that the detection part is positioned correctly.

It is possible to connect multiple probes in series to control a wider area. The following figure shows an example of connection.

Water detection probe



Probe dimensions



Probe connection

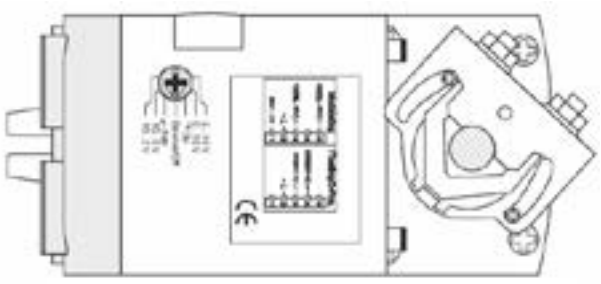
The type of cable to be used for the connection must have the following features:

Main features of the connection cable		
Type	FS18OR18 300/500 Vac cable	
Shielding	Not required	
Cross-section and number of conductors	2 x 1 mm²	
Maximum length	m	100
Example		

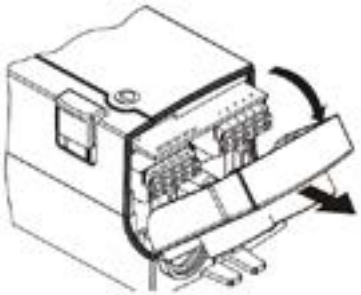
11.9 CONNECTION OF FREE COOLING PLENUM MOTORISED DAMPER ACTUATORS (ACCESSORY)

The Free Cooling plenum accessory has two motorised dampers controlled by the regulator through a 0-10 Vdc signal.

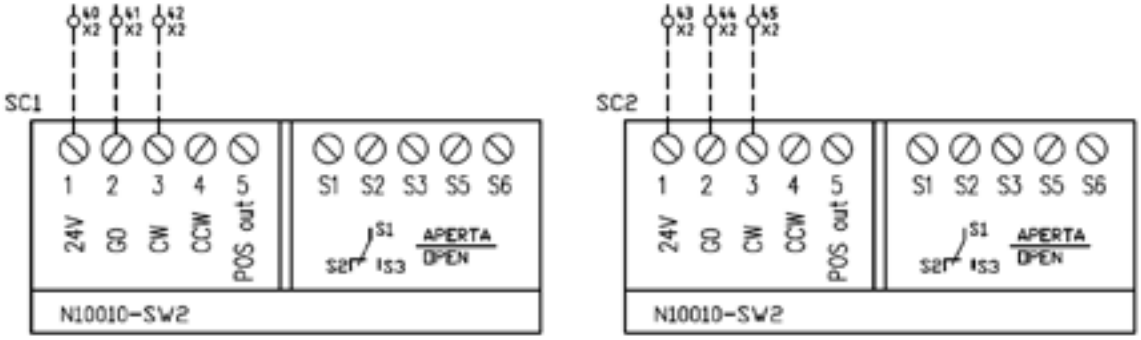
The damper actuators are supplied mounted on the dampers, and equipped with 3 metres of pre-wired cable in the actuators. The actuator cables have to be connected inside the unit's electrical panel, as shown in the figure:



Motorised damper actuator



Position of damper actuator connection terminals



Connection of the damper actuators

The type of cable to be used for the connection must have the following features:

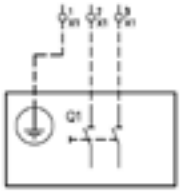
Main features of the connection cable		
Type	FS18OR18 300/500 Vac signal transmission cable	
Shielding	Not required	
Cross-section and number of conductors	3 x 0.5 mm^2	
Maximum length	m	100
Example		

11.10 AIR-COOLED CONDENSER POWER SUPPLY AND REGULATION CONNECTION (ACCESSORY)

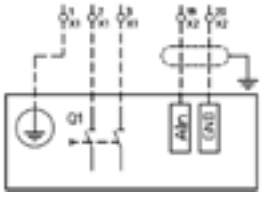
Air-cooled condensers can be supplied with two types of electric power supply and regulation, as an accessory:

1) A 230 Vac power supply with cut-off regulation, dedicated to condensers with AC fans.
2) A 230 Vac or 400 Vac protected line (depending on the type of condenser) and a 0-10 Vdc signal line for the regulation of condensers with EC fans.

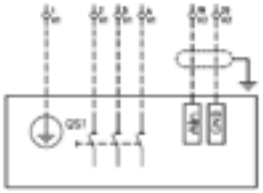
When installing the unit, the power supply line of the air-cooled condensers must be set-up as shown in the figure below.



Connection with 230 Vac cut-off regulation



Connection with 0-10 Vdc regulation and 230 Vac power supply



Connection with 0-10 Vdc regulation and 400 Vac power supply

The type of cable to be used for the connection must have the following features:

Main features of the connection cable		
230 Vac power supply with cut-off regulator		
Type	FS18OR18 300/500 Vac cable	
Shielding	Not required	
Cross-section and number of conductors	8 A variator	3 x 1.5 mm²
	12 A variator	3 x 2.5 mm²
Maximum length	m	100
Example		
230 Vac power supply		
Type	FS18OR18 300/500 Vac (1.5-2.5 mm²)/ FG16OR16 600/1000 Vac (4 mm²) cable)	
Shielding	Not required	
Cross-section and number of conductors	10 A	3 x 1.5 mm²
	16 A	3 x 2.5 mm²
	20 A	3 x 4 mm²
Maximum length	m	100
Example		
400 Vac power supply		
Type	FS18OR18 300/500 Vac (1.5-2.5 mm²)/ FG16OR16 600/1000 Vac (4 mm²) cable)	
Shielding	Not required	
Cross-section and number of conductors	10 A	4 x 1.5 mm²
	16 A	4 x 2.5 mm²
	20 A	4 x 4 mm²
Maximum length	m	100
Example		
0-10 Vdc regulation signal line		
Type	FR2OH2R16 450/750 Vac signal transmission cable	
Shielding	Tinned copper braid - Cover at least 65%	
Cross-section and number of conductors	2 x 0.35 mm²	
Maximum length	m	100
Example		

12 ROUTINE AND SPECIAL MAINTENANCE

WARNING!

The product must be serviced by skilled personnel who fulfil the adequate requisites for the task as defined by the regulations in the country where positioning and installation of the product take place.

Routine and special maintenance checks					
	Routine maintenance to be carried out by the user				
	Special maintenance to be carried out by the maintenance service or service centre				
Components		**Check at least every**			
		1 Week	**1 Month**	**3 Months**	**6 Months**
Control micro-processor	Make sure the system works properly	X			
	Check for any alarms	X			
	Check the mother board connections				X
	Check the control boards and displays				X
	Make sure that the sensor readings on the unit are correct				X
Air filters	Check filters for clogging		X		
	Check filter status: Fastening, any damage			X	
	Check operation and calibration of differential pressure sensors				X
Humidifier	Check the condition of the cylinder		X		
	Carry out the automatic cylinder washing procedure		X		
	Check the condition of the charging and discharge valves			X	
	Inspect the gaskets/seals			X	
	Replace the cylinder if necessary			X	
Fans	Check the general condition: corrosion, fastening, cleanliness			X	
	Verify the noise of the motor			X	
	Check the impeller: vibrations, unbalancing			X	
	Verify the absorbed current				X
	Clean the impeller and the motor				X
Electrical panel	Clean the components with compressed air			X	
	Check the unit's power supply				X
	Check the correct tightening of the clamps				X
	Check the power consumption of electrical components				X
	Test safety devices				X
Water circuits	Check operation of the 3-way valves			X	
	Check circuits for leaks			X	
	Bleed air from circuits			X	
	Check circuit temperatures and pressures			X	
	Check the amount of glycol in the circuit				X
	Make sure the water circulates properly				X
Cooling circuits	Check the operating temperatures and pressures			X	
	Check the condition of the compressor			X	
	Check the condition of the liquid sight glass filter			X	
	Check operation of the safety devices				X
	Check the amount of refrigerant in the circuit				X
Condensers	Check the condition of the remote condenser			X	
	Check the calibration of the remote condenser regulator			X	
	Check that the remote condenser is receiving power correctly				X
	Check the adjustment valve of the water cooled condenser				X
	Verify the circulation of water/air in the condenser				X

12.1 ROUTINE MAINTENANCE

12.1.1 CONTROL MICROPROCESSOR MAINTENANCE

For further and more detailed information concerning regulation, see theMICROPROCESSOR OPERATING MANUAL.

The microprocessor requires periodical checks to verify operational statuses and the presence of possible alarms in components that may compromise proper unit operation.

For further information concerning alarms and operations, see the installed microprocessor operating manual.

12.1.2 MAINTENANCE ON THE AIR FILTERS

ATTENTION! DANGER!

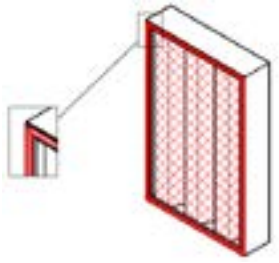
Risk of immediate start-up after resetting the main switch if used as an emergency stop!

The main switch can be used as an emergency stop when the operator is near the machine (during start-up, operation and maintenance). In this case, resetting the main switch will allow the machine to immediately restart, without any additional action by the operator.

WARNING!

The filters are non-regenerable.

It is advisable to replace with original pieces only. Filters that do not conform to the original filters may not be compatible with the unit performance and cause operating problems.



WARNING!

To guarantee the efficiency of the filters, it is necessary to install a 15 x 3 mm seal.

The Manufacturer's air conditioners are equipped with, on all installed filters, differential pressure sensors in order to monitor pressure loss of the dirty filter. The microprocessor signals when the measured pressure difference exceeds the set value. To change the trip setting of a differential pressure switch, simply unscrew the cover and turn the setting dial to the desired pressure drop value.

FILTER TYPE	POSITION	VALUE [Pa]
G4 Filter	Return	250
M5 filter (Accessory)	Return	250

12.1.3 AIR FILTER REPLACEMENT

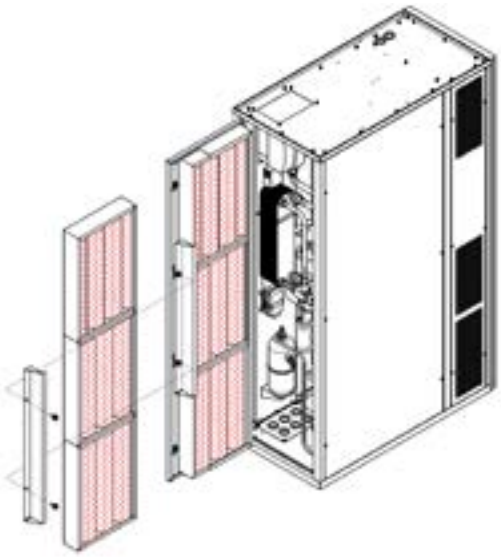
To replace the air filters the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

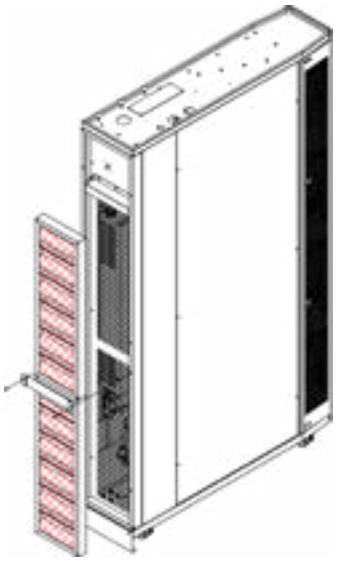
1) Set the main switch to "0".
2) Open the panels via the relevant safety locks.
3) Remove the filter support by turning the screws.
4) Replace the dirty filters with clean ones.
5) Position the support and secure it with the screws.
6) Close the panels and return the main switch to "I".

Position P unit air filters with air supply facing upwards

Position P unit air filters with air supply facing downwards

Position G unit air filters





Position R unit air filters

12.1.4 MAINTENANCE OF INTERNAL HUMIDIFIER

ATTENTION! DANGER!

Risk of immediate start-up after resetting the main switch if used as an emergency stop!

The main switch can be used as an emergency stop when the operator is near the machine (during start-up, operation and maintenance). In this case, resetting the main switch will allow the machine to immediately restart, without any additional action by the operator.

RISK OF BURNS!

The cylinder may be hot! Let cool before handling or use protective gloves

RISK OF ELECTRIC SHOCK!

Set the main switch to "0" before every activity

The service life of the humidifier cylinder depends on various factors, including: correct sizing and operation, the supply water, which must fall within the nominal values, the hours of use and correct maintenance. After a variable period of time, the cylinder will inevitably need to be replaced. To meet the above requirements, follow the instructions below.

The humidifier requires periodic checks to ensure correct operation and extended cylinder lifetime. These checks should be performed as follows:

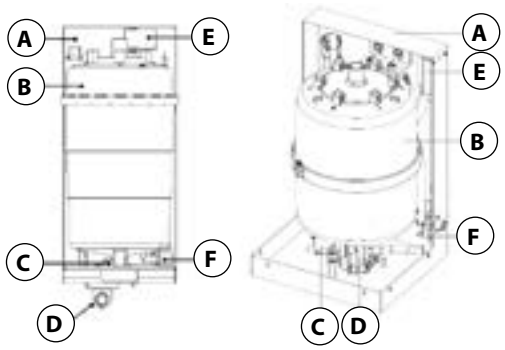
- **No later than the first 300 hours of operation:** Check operation, make sure there are no significant leaks of water, and check the general condition of the housing. Make sure that no sparks or arcs between electrodes are formed during operation.
- **Quarterly and never less frequently than every 1000 hours of operation:** Check operation, make sure there are no significant leaks of water, and replace the cylinder if necessary.
- **Annually and never less frequently than every 2500 hours of operation:** Proceed with changing the cylinder

After prolonged use, and above all in the event of water with a high salt content, solid deposits may cover the electrodes completely and adhere to the side walls. In some cases the heat produced may deform the cylinder and, in more serious cases, may create holes in the plastic wall with resulting leaks of water into the tray. To prevent this problem, increase the frequency of checks, halving the intervals between maintenance procedures.

12.1.5 CYLINDER REPLACEMENT

To replace the humidifier cylinder the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

1) Drain all water from the cylinder using the relative function.
2) Set the main switch to "0".
3) Open the panels via the relevant safety locks.
4) Slide out the cylinder steam tube.
5) Detach the electrical connections from the top of the cylinder.
6) Release the cylinder from its fixture and lift to remove.
7) Connect the new cylinder and secure to the support.
8) Close the panels and return the main switch to "I".



A Load bearing frame
B Cylinder
C Drain solenoid valve/pump
D Drain fitting
E Filling tank + conductivity meter
F Feed solenoid valve

Internal humidifier components

12.2 SPECIAL MAINTENANCE

RISK OF ELECTRIC SHOCK!

Set the main switch to "0" before every activity

RISK OF BURNS!

Some parts of the cooling circuit may be hot!

RISK OF CUTS!

Sharp parts!

ATTENTION! DANGER!

Risk of immediate start-up after resetting the main switch if used as an emergency stop!

The main switch can be used as an emergency stop when the operator is near the machine (during start-up, operation and maintenance). In this case, resetting the main switch will allow the machine to immediately restart, without any additional action by the operator.

12.2.1 MAINTENANCE OF THE ELECTRICAL CONTROL PANEL AND ELECTRICAL COMPONENTS

For the electrical control panel and electrical components maintenance the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

1) Check the unit's power supply.
2) Check the electrical connections and make sure the terminals are properly tightened.
3) Check the power consumption of electrical components.
4) Test safety devices.
5) Change protection fuses, if required.
6) Clean the components with compressed air jets from a minimum distance of 30 cm (to avoid damaging plastic parts), paying particular attention to the cooling fans and heat sinks.

12.2.2 REPLACING THE CONTROL MICROPROCESSOR

To replace the control microprocessor the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

1) Set the main switch to "0".
2) Open the panels via the relevant safety locks.
3) Disconnect all connectors on the board.
4) Remove the microprocessor from the DIN guide.
5) Replace with the scheduled original spare part.
6) Close the panels and return the main switch to "I".
7) Proceed with configuration, as specified in the SySmart^3 microprocessor technical manual.

12.2.3 FAN MAINTENANCE

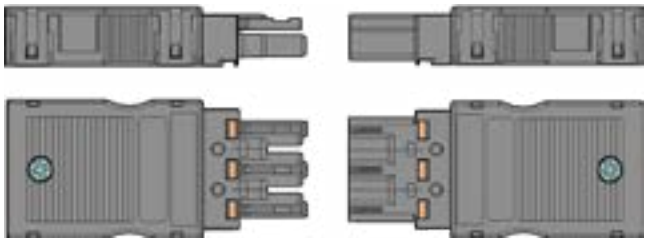
For fans maintenance the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

1) Check the general condition: corrosion, fastening, cleanliness.
2) Verify the noise of the motor.
3) Check the impeller: vibrations, unbalancing.
4) Verify the absorbed current.
5) Clean the impeller and the motor.

12.2.4 REPLACING THE FANS

To replace the fans the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

1) Set the main switch to "0".
2) Open the panels via the relevant safety locks.
3) Disconnect the electrical connections from the terminal block of the fan.
4) Remove the fan from its seat.
5) Replace with an original spare.
6) Carry out electrical connections from the terminal board of the fan as specified in the wiring diagram.
7) Close the panels and return the main switch to “I”.



Plugs and sockets for quick connection

12.2.5 FAN AUTO-ADDRESSING IN CASE OF REPLACEMENT

During the auto-addressing process the NEW FANS will have to be connected ONE AT A TIME.

In the event of fas replacement, the SySmart³ microprocessor features a check and auto-addressing function of the Modbus master network. In the event of a communication alarm of one or more fans the SySmart³ microprocessor will start checking whether there are new fans in the network.

If the SySmart³ microprocessor finds a non configured fan (new) in the network, it will change the address to that of the faulty one. If there is an alarm on several fans, this fan will be given the first free address.

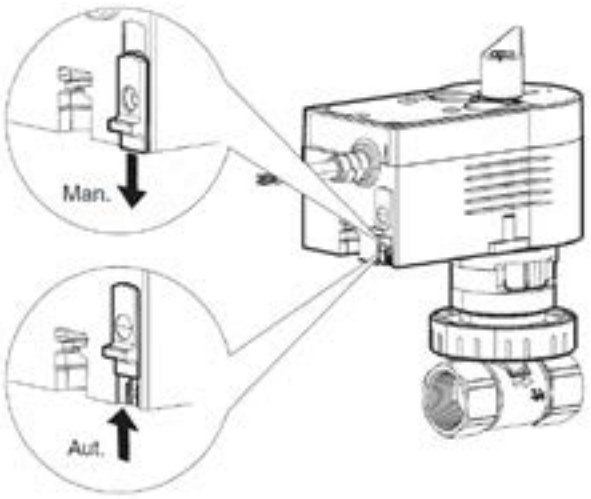
12.2.6 MAINTENANCE OF WATER CIRCUITS

For the water circuit maintenance the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

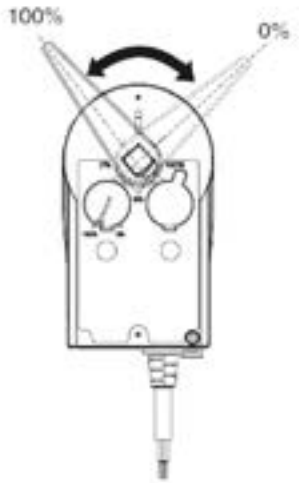
1) Check circuits for leaks.
2) Bleed air from circuits.
3) Check circuit temperatures and pressures.
4) Check operation of the 3-way valves.
5) Check the amount of glycol in the circuit.
6) Make sure the water circulates properly.

12.2.7 MANUAL WATER VALVE OPENING AND CLOSING WITH ACTUATOR WITH RING NUT CONNECTION

To manually open the water valves the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

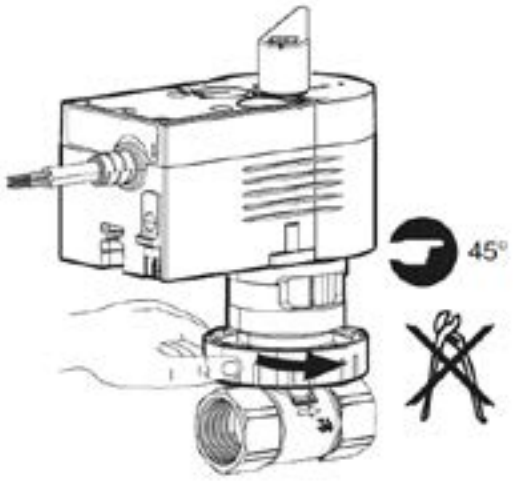


1) Open the panels via the relevant safety locks.
2) Press the dedicated release button for manual opening.
3) Move the position indicator to the desired position (100% - Open or 0% - Closed).
4) Press the release button again to return to automatic operation.
5) Close the panels.

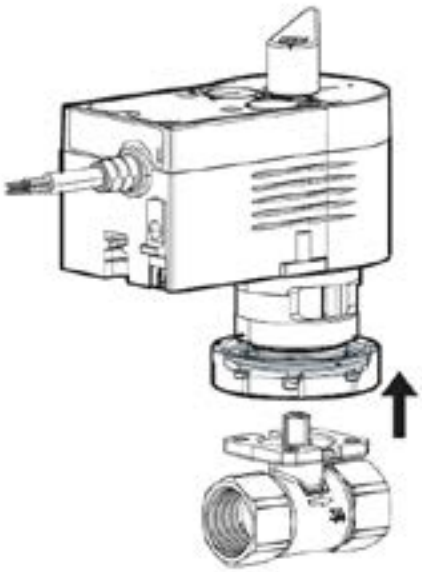


12.2.8 REPLACEMENT OF WATER VALVE ACTUATORS WITH RING NUT CONNECTION

To replace the actuators of the water valves, proceed as follows:



1) Set the main switch to "0".
2) Open the panels via the relevant safety locks.
3) Disconnect the electrical connections from the actuator.
4) Remove the actuator by means of the ring nut. Do not use equipment.
5) Replace with an original spare.
6) Make the electrical connections of the actuator as per the wiring diagram.
7) Close the panels and return the main switch to "I".



12.2.9 REPLACEMENT OF MAIN COMPONENTS OF THE WATER CIRCUITS

To replace the components of the circuits (pumps, coils, valves, etc.) the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

1) Set the main switch to "0".
2) Open the panels via the relevant safety locks.
3) Close the shut-off valves placed on the water circuit upstream of the valve.
4) Manually open the valve, as specified in the previous chapters.
5) Open the vents placed next to the coil and the cock on the circuit and drain the water.
6) Remove the component from its seat.
7) Replace with an original spare.
8) Open the water circuit paying close attention to vent the air.
9) Check for any leaks.
10) Restore the regulation valve
11) Close the panels and return the main switch to "I".

12.2.10 COOLING CIRCUIT MAINTENANCE

For the cooling circuit maintenance the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

1) Check the work pressures and temperatures from the screen of the SySmart controller microprocessor.
2) Check overheating, sub-cooling and desuperheating from the screen of the SySmart controller microprocessor.
3) Check the condition of the liquid sight glass filter.
4) Check operation of the safety devices.
5) Check the calibration and operation of the regulation components.
6) Check the refrigerant charge level and make sure there are no circuit leaks.
7) Check the condition of the cooling coil. Any cleaning needs to be carried out with hot water and soap, using a brush with long, soft bristles. It is also possible to use compressed air as long as it is oil-free.

12.2.11 REPLACEMENT OF THE MAIN COMPONENTS OF THE COOLING CIRCUIT

ATTENTION! DANGER!

Neither the circuit nor the compressor must be left in open air for more than 15 minutes to avoid humidity contaminating the oil.

To replace the main components of the cooling circuit (valves, sight glass filter, coils etc.) the following instructions must be complied with, without prejudice to full compliance with safety obligations arising from use of the equipment:

1) Set the main switch to "0".
2) Open the panels via the relevant safety locks.
3) Collect all refrigerant (with the special recovery pump, pressure gauges and rechargeable tank). This gas may be re-used.
4) Open the cooling circuit by unscrewing the service needle valves with the provided key.
5) Disconnect any electrical connections of the components in question.
6) Remove the component by cutting the pipes next to it and install the new component.
7) Braze everything as indicated in the previous chapters.
8) Close the cooling circuit by re-applying the service needle valves using the appropriate spanner.
9) Perform a test using pressurised Nitrogen to verify that the system is airtight, as specified in the previous chapter.
10) With soap lather, check all new soldering has been carried out and leave under pressure for at least 24 hours.
11) After the required time, perform a pressure check with the provided pressure gauges.
12) When the test has been completed, empty out all of the nitrogen and proceed to the vacuum phase.
13) Vacuum the cooling circuit, as specified in the previous chapters.
14) Close the panels and return the main switch to “I”.
15) Charge with new Freon, as specified in the previous chapters.
16) Check the operating conditions of the cooling circuit, as specified in the previous chapters.

12.2.12 COMPRESSOR REPLACEMENT

ATTENTION! DANGER!

Neither the circuit nor the compressor must be left in open air for more than 15 minutes to avoid humidity contaminating the oil.

To replace the compressor the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

1) Set the main switch to "0".
2) Open the panels via the relevant safety locks.
3) Collect all refrigerant (with the special recovery pump, pressure gauges and rechargeable tank). This gas cannot be re-used and must be regenerated.
4) Open the cooling circuit by unscrewing the service needle valves with the provided key.
5) Disconnect all electrical connections from the terminal board of the compressor.
6) Cut the suction and supply pipes next to the compressor.
7) Remove the fixing screws and extract the compressor, always keeping it vertical.
8) Check for any remaining oil in the cooling circuit and perform an acidity test (Virginia Parker ETK TEST KIT or similar).
9) Should the system be extremely contaminated with carbon or from decomposition of oil products due to burning of the compressor, it is necessary to eliminate all this contamination by cleaning up all cooling components (pipes, evaporation coils, condenser, liquid receiver) with special clean-up fluid that is easily evaporated (Parker ParFlush Kit or similar).
10) Blow NITROGEN into the whole cooling circuit to eliminate all clean-up fluid.
11) Install a filter-drier and de-acidifier on the suction line of the compressor (Parker SLD Series or similar).
12) Replace the inspection filter on the liquid line with one that is a filter-drier and de-acidifier Sporlan Parker WSG Series or similar).
13) Install a new compressor, always keeping it vertical.
14) Weld everything as indicated in the previous chapters.
15) Close the cooling circuit by re-applying the service needle valves using the appropriate spanner.
16) Perform a test using pressurised Nitrogen to verify that the system is airtight, as specified in the previous chapter.
17) With soap lather, check all new soldering has been carried out and leave under pressure for at least 24 hours.
18) After the required time, perform a pressure check with the provided pressure gauges.
19) When the test has been completed, empty out all of the nitrogen and proceed to the vacuum phase.
20) Vacuum the cooling circuit, as specified in the previous chapters.
21) Close the panels and return the main switch to "I".
22) Charge with new refrigerant, as specified in the previous chapters.
23) Check the operating conditions of the cooling circuit, as specified in the previous chapters.

12.3 MAINTENANCE OF TMC AIR-COOLED CONDENSERS

12.3.1 MAINTENANCE OF TMC AIR-COOLED CONDENSER FANS

For air-cooled condenser fans maintenance the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

1) Check the general condition: corrosion, fastening, cleanliness.
2) Verify the noise of the motor.
3) Check the impeller: vibrations, unbalancing.
4) Verify the absorbed current.
5) Clean the impeller and the motor.

12.3.2 REPLACING THE TMC AIR-COOLED CONDENSER FANS

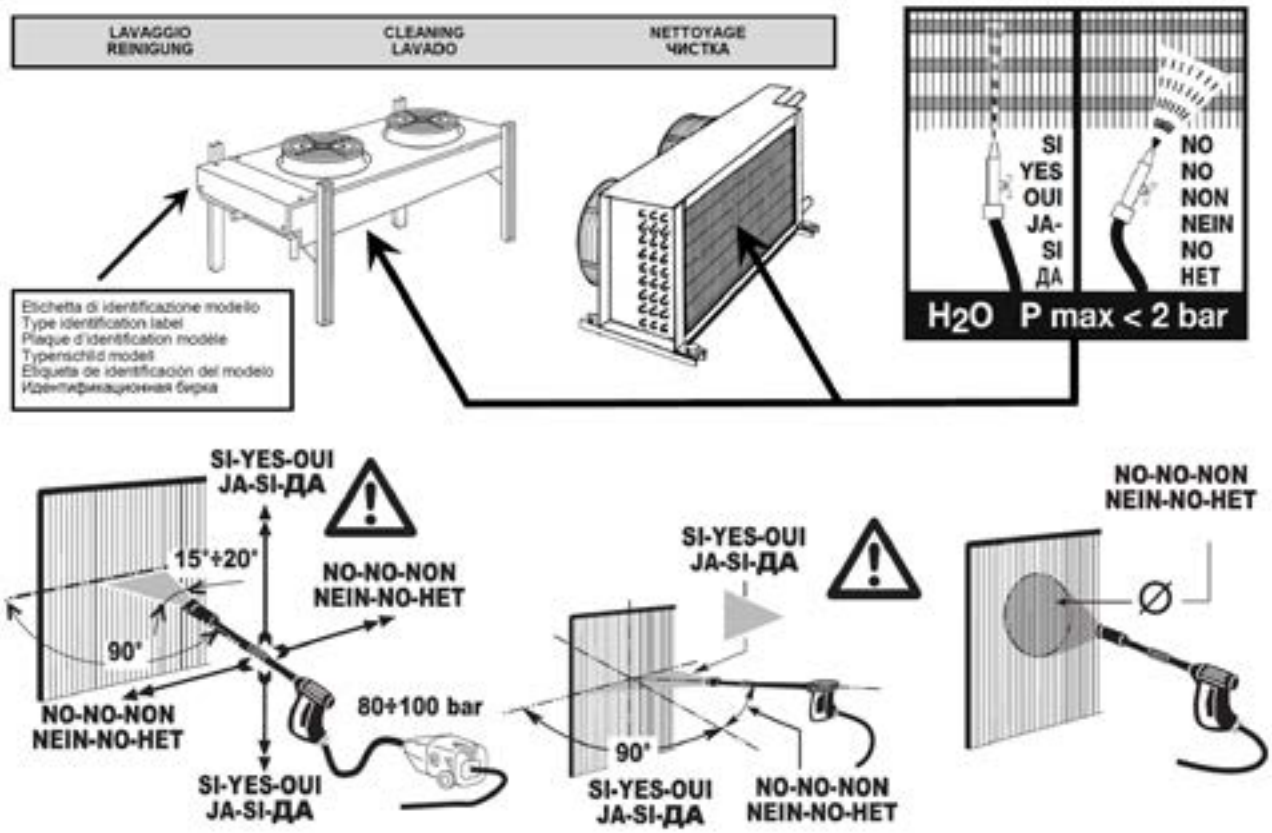
To replace the air-cooled condenser fans the following instructions must be observed, as well as full compliance with safety obligations regarding use of the equipment:

1) Set the main switch to "0".
2) Disconnect the electrical connections from the terminal block of the fan.
3) Remove the fan from its seat.
4) Replace with an original spare.
5) Connect the electrical connections from the terminal block of the fan.
6) Bring the main switch back to the "I" position.

12.3.3 CLEANING THE COILS OF THE TMC AIR-COOLED CONDENSERS

Notes for correct cleaning:

1) Use a flat or "fan-shaped" spray nozzle.
2) Maximum water pressure: < 2 bar with tap water and 80÷100 bar with pressure washer.
3) Keep the water spray at right angles to the fin edge both vertically and horizontally.



13 DEACTIVATION, DISMANTLING AND DISPOSAL

WARNING!

The product must be dismantled by skilled personnel who fulfil the adequate requisites for the task as defined by the regulations in the country where positioning and installation of the product take place.

For the deactivation, dismantling and disposal of the units, the following must also be considered:

- The direct expansion units contain R410a refrigerant, a fluorinated greenhouse gas subject to the Kyoto Protocol. Therefore, during dismantling, the health and safety provisions, professional disposal regulations of the refrigerant gas and regulations of the country where the product will be positioned and installed, must be complied with.
- This device may contain hazardous substances (oil, glycol, etc.), therefore improper use or incorrect disposal may have negative effects on human health and the environment. Public or private waste collection systems are to be used for disposal, as defined by local laws and regulations.
- The units are made mostly of recyclable materials. It is therefore recommended to carry out a separate collection of these materials.

13.1 DISPOSAL OF MATERIALS CONTAINED IN UNITS

Disposal activities inherent to the product are carried out at three separate times. Once the materials have been separated as indicated below, these must be assigned the CER codes and then sent for disposal according to the provisions of the national legislation in force.

- **Disposal of packaging:**

1) Packaging must be disposed of taking care to separate recyclable materials (see the following table):

- **Disposal of substances during maintenance operations:**

1) Waste material resulting from maintenance operations must be sorted for disposal, separating any recyclable materials.
2) The air filters must be disposed of as special waste depending on the substances contained therein, originating from the environment in which the units operate.
3) If the cooling system needs to be emptied, regulations concerning the recovery and professional disposal of the refrigerant gas in the country where the product is positioned and installed, must be complied with.
4) If the compressor oil needs to be replaced, it must be disposed of in accordance with the regulatory provisions of the country where the product is positioned and installed.
5) The gas filters must be disposed of as materials contaminated by the compressor oil, in accordance with the regulatory provisions of the country where the product is positioned and installed.
6) The copper pipes may contain traces of compressor oil.

- **Disposal at end of unit's service life:**

1) Waste material resulting from dismantling operations must be sorted for disposal, separating any recyclable materials (see the following table).
2) The air filters must be disposed of as special waste depending on the substances contained therein, originating from the environment in which the units operate.
3) If the cooling system needs to be emptied, regulations concerning the recovery and professional disposal of the refrigerant gas in the country where the product is positioned and installed, must be complied with.
4) If the compressor oil needs to be replaced, it must be disposed of in accordance with the regulatory provisions of the country where the product is positioned and installed.
5) The gas filters must be disposed of as materials contaminated by the compressor oil, in accordance with the regulatory provisions of the country where the product is positioned and installed.
6) The copper pipes may contain traces of compressor oil.

13.1.1 LIST OF THE MATERIALS CONTAINED IN THE UNITS

The following table lists the materials used, **upon shipment**, to produce the units.

Standard packaging P series - G series - R series units				
Material	**Composition**	**Weight**	**Recyclability**	**CAS n° or Alloy**
Pallets	ISPM15 fumigated wood	33%	100%	-
Plastic film	PE	33%	100%	9002-88-4
Polystyrene	EPS 6	33%	100%	9003-53-6

P series - G series - R series units				
Material	**Composition**	**Weight**	**Recyclability**	**CAS n° or Alloy**
Galvanised sheet metal	Steel/Zinc	70%	95%	DX51D + Z150
Aluminium	-	13%	95%	91728-14-2
Copper	-	12%	96%	65357-62-2
Plastic	ABS	2%	85%	97048-04-09
Plastic	PE	2%	85%	9002-88-4
Paint	Epoxy/Polyester	0.2%	-	-
Refrigerant	R410a	See chapters above	99%	-
Compressor oil	PVE	See chapters above	80%	-
Other materials	Miscellaneous	0.8%	-	-

Standard packaging TMC Series units				
Material	**Composition**	**Weight**	**Recyclability**	**CAS n° or Alloy**
Cage	ISPM15 fumigated wood	33%	100%	-
Plastic film	PE	33%	100%	9002-88-4

TMC Series Unit				
Material	**Composition**	**Weight**	**Recyclability**	**CAS n° or Alloy**
Galvanised sheet metal	Steel/Zinc	52%	95%	DX51D + Z150
Aluminium	-	24%	95%	91728-14-2
Copper	-	23%	96%	65357-62-2
Plastic	ABS	0.5%	85%	97048-04-09
Plastic	PE	0.3%	85%	9002-88-4
Paint	Epoxy/Polyester	0.2%	-	-

14 APPENDIX 1: RECOMMENDED EQUIPMENT

The table below lists the equipment required to perform unit installation, start-up and maintenance.

Heavy duty American type pipe wrench

Set of flathead screwdrivers

Adjustable wrench

Set of Phillips screwdrivers

Reversible ratchet wrench

Set of Torx® screwdrivers

Cordless drill

Grinder or saw

Pipe-bending device for copper pipes

Expander for copper pipes

Pipe cutter for copper pipes

Pipe reamer for copper pipes

Oxygen/propane soldering kit

Nitrogen pressurisation kit

4-way manometric unit with hoses (R410a)

High performance vacuum pump

Electronic scale

Refrigerant suitable for the unit (R410a)

Digital multimeter with current clamp

Electronic leak detector

15 APPENDIX 2: PRELIMINARY CHECKS AND FIRST START-UP

WARNING!

The product must be installed and started up by skilled personnel who fulfil the adequate requisites for the task as defined by the regulations in the country where positioning and installation of the product take place.

15.1 PRELIMINARY CHECKS

15.1.1 VERIFICATION OF POSITION AND INSTALLATION

	Description	Positive	Negative
1	Check that the units received comply with the order and transport documents.		
2	Check for any damage due to transport or positioning of the unit.		
3	Check that the packaging of the unit is completely removed.		
4	Check that the unit is placed flat and sufficiently insulated from the floor and walls (if necessary).		
5	Verification of compliance with the space for routine maintenance.		
6	Check for obstructions on the supply and return air vents and the front of the machine.		
7	Verify that the environmental conditions are favourable so as to enable the start-up and there is no hazard.		

15.1.2 VERIFYING THE DISCHARGE CONNECTIONS

	Description	Positive	Negative
1	Verify that the condensate and humidifier discharges are connected properly to the discharge line.		
2	Verify that the trap in the unit has not been removed.		
3	Make sure the drain line has no counter slopes or traps that may prevent the regular flow of water.		

15.1.3 WATER CIRCUIT CHECKS

	Description	Positive	Negative
1	Check that the inlet and outlet of the hot and cold water supplies conform with the arrows marked on the fittings.		
2	Check that all liquid supply pipes have manual shutoff taps just outside the machine, and that these taps are open.		
3	Check that the humidifier supply fitting is connected to the mains drinking water supply and that it is provided with a manual shut-off valve just outside the machine.		
4	Verify that the hydraulic circuits have been adequately cleaned.		
5	Verify that there is no air in the hydraulic circuits.		
6	Verify that there is water in the circuit and that the pressures are within the operating limits.		
7	Verify that the water temperature entering the circuit is consistent with that indicated in the project and is within the operating limits.		
8	Verify any presence and concentration of glycol in the circuit and that it is consistent with that indicated in the project.		

15.1.4 CHECKS ON THE WATER CONDENSED DIRECT EXPANSION CIRCUIT

	Description	Positive	Negative
1	Make sure the cooling circuit valves are open.		
2	Verifying the water circuit connections.		
3	Check that all liquid supply pipes have manual shutoff taps just outside the machine, and that these taps are open.		
4	Verify that the hydraulic circuits have been adequately cleaned.		
5	Verify that there is no air in the hydraulic circuits.		
6	Verify that there is water in the circuit and that the pressures are within the operating limits.		
7	Verify that the water temperature entering the circuit is consistent with that indicated in the project and is within the operating limits.		
8	Verify any presence and concentration of glycol in the circuit and that it is consistent with that indicated in the project.		

15.1.5 CHECKS ON THE AIR CONDENSED DIRECT EXPANSION CIRCUIT

	Description	Positive	Negative
1	Diagram of cooling circuit		
2	Check that the supply and liquid pipe diameter fulfils the indications in the installation manual.		
3	Check that the horizontal sections of the supply and liquid pipes have a gradient of at least 1% in the direction of refrigerant flow.		
4	Make sure there are oil traps at the base of each rising pipe and every 5 m rising pipe section (raised condenser).		
5	Make sure the check valve is installed as near as possible to the compressor with the aperture in the direction of refrigerant flow (raised condenser).		
6	Make sure the check valve is installed as near as possible to the compressor with the aperture in the direction of refrigerant flow (lowered condenser).		
7	Check that the supply pipe is insulated in the sections where accidental operator contact is possible (Pipe temperature in operation approx. 70/80 °C).		
8	Check that support brackets are installed on the supply and liquid pipe are not too tight, so as to allow expansion of the pipe.		
9	Check that cooling circuit pipe connections of the condenser with the evaporator are opposite the flow direction of the air flow.		
10	Check that the condenser is positioned correctly, to prevent air recirculation that would otherwise impair performance.		

15.1.6 CHECKS OF THE VACUUM OF THE AIR CONDENSED DIRECT EXPANSION CIRCUIT

	Description	Positive	Negative
1	Make sure the cooling circuit valves are open.		
2	Check opening of the solenoid valve (if present on circuit).		
3	Check the seal of the cooling circuit.		
4	Check the high and low side pressure gauges connection in VACUUM position.		
5	Check the vacuum level of the cooling circuit.		

15.1.7 REFRIGERANT CHARGE OF THE AIR CONDENSED DIRECT EXPANSION CIRCUIT

	Description	Positive	Negative
1	Check the high and low side pressure gauges connection in CHARGING position.		
2	Check the correspondence of refrigerant with that used by the unit (R410a)		
3	Check HIGH PRESSURE side introduction of an amount of refrigerant equal to 2/3 of the total calculated content.		
4	Check final refrigerant charge by filling in through the suitable fitting downstream of the expansion valve.		

15.1.8 ELECTRICAL POWER SUPPLY CHECK

	Description	Positive	Negative
1	Check the connection of the three phases, neutral and earth.		
2	Verify that the characteristics of the electrical supply line fall within the operating limits and comply with that indicated in the wiring diagram.		
3	Verify that the electrical connections with the condenser isolator fall within the operating limits and comply with that indicated in the wiring diagram.		

15.1.9 VERIFY CONNECTIONS TO ROOM PROBE, REMOTE TERMINALS, LAN AND RS485 SERIAL BOARD (IF PRESENT)

	Description	Positive	Negative
1	Make sure the RS485 board is wired as indicated on the wiring diagram and in the installation manual.		
2	Check the activation of the terminating resistance of the RS485 network.		
3	Check connection of LAN cable as indicated in the electrical wiring diagram and the installation manual.		
4	Check the activation of the opening and terminating resistance of the LAN.		
5	Check the positioning of the remote terminal as described in the installation manual.		
6	Check that the electrical connection between the remote terminal and the electrical panel is as indicated in the wiring diagram and the installation manual.		
7	Check the positioning of the room probes as described in the installation manual.		
8	Check that electrical connection between the sensors and the electrical panel is as indicated in the electrical wiring diagram and the installation manual.		
9	Check the positioning of the smoke and flame detectors as described in the installation manual.		
10	Check the electrical connection between the smoke and flame sensors, as indicated in the electrical wiring diagram and the installation manual.		
11	Check the positioning of the water detection probes as described in the installation manual.		
12	Check that the electrical connection between the water detection sensors and the electrical panel is as indicated in the electrical wiring diagram and the installation manual.		
13	Check the wiring of the closing resistance of the water detection sensors.		

15.2 FIRST START-UP

WARNING!

Starting up or checking machines with cooling circuit requires the units to be powered on for at least two hours prior to the arrival of the technician, in order to allow the compressor's crankcase oil heater to reach working temperature and allow evaporation of any refrigerant deposited in it and guarantee correct compressor operation.

The crankcase heaters switch on automatically when the machine is powered on.

15.2.1 UNIT SUPPLY

	Description	Positive	Negative
1	Make sure the disconnecting switch is ON (unit powered).		
2	Make sure the disconnecting switch of the condenser is ON (condenser powered on).		
3	Make sure the phase sequencer is working properly (direct expansion unit).		
4	Make sure all electrical utilities of the unit are correctly powered.		

15.2.2 TURNING THE UNIT ON

	Description	Positive	Negative
1	Check the setting of the unit Set-point.		
2	Check the settings of the microprocessor user parameters.		
3	Check unit switch-on with the ON/OFF key.		

15.2.3 REFRIGERANT CHARGE OF THE AIR CONDENSED DIRECT EXPANSION CIRCUIT

	Description	Positive	Negative
1	Check the high and low side pressure gauges connection.		
2	Make sure the compressor switch is on.		
3	Check the evaporation pressure.		
4	Check the condensation pressure.		
5	Check the overheating of the refrigerant aspirated by the compressor.		
6	Check the sub-cooling of the liquid refrigerant.		
7	Check that the liquid line filter is not clogged.		
8	Check the correct calibration of the condenser speed regulator.		

15.2.4 QUANTITY OF REFRIGERANT IN THE CIRCUIT

	Description	Type	Kg
1	Charging refrigerant during the start-up phase.		
2	Adding refrigerant on site.		

15.2.5 CHECKING COOLING CIRCUIT OPERATION

	Description	Value	Positive	Negative
1	Evaporation pressure			
2	Evaporation temperature			
3	Suction temperature			
4	Overheating			
5	Compression ratio			
6	Discharge temperature			
7	Condensation pressure			
8	Condensation temperature			
9	Desuperheating			
10	Liquid temperature			
11	Sub-cooling			

15.2.6 CHECKING CORRECT COMPONENT OPERATION

	Description	Value	Positive	Negative
	Fans			
1	Check fan current consumption.			
2	Check flow sensor operation.			
3	Check reading of the differential pressure probe (if present).			
	Compressors			
1	Check the current absorbed by the compressor.			
2	Check operation of the high pressure probe.			
3	Check operation of the low pressure probe.			
4	Check correct operation of the electronic expansion valve.			
5	Check the water-cooled condenser condensation regulation.			
	Water circuit			
1	Make sure the valves open.			
2	Check the position of the valves.			
3	Check the flow and temperature of the water entering and exiting the unit.			
	Electric coils			
1	Check the current consumption of the electric coil.			
2	Check correct operation of the electric coil.			
	Humidification			
1	Check the current absorbed by the humidifier.			
2	Check correct operation of the humidifier.			
3	Make sure the water charges correctly.			
4	Make sure the water discharges correctly.			
	Local network			
1	Check correct operation of the LAN.			
2	Check rotation of the unit in LAN.			
	Miscellaneous			
1	Check correct operation of the dirty filter alarm.			
2	Check correct operation of the water alarm.			
3	Check correct operation of the smoke and flame detectors.			
4	Ensure that the remote OFF is working.			
5	Carry out a general check of the unit's electrical components.			

15.2.7 MAKE SURE THE UNIT IS OPERATING CORRECTLY

	Description	Positive	Negative
1	Ensure that the set temperature is reached.		
2	Ensure that the set humidity is reached.		
3	Check correct general operation of the unit.		

15.2.8 NOTES ON ANOMALIES ENCOUNTERED DURING CHECKS

16 APPENDIX 3: FAULT DIAGNOSIS

WARNING!

Maintenance operations must be carried out by professionally trained technicians

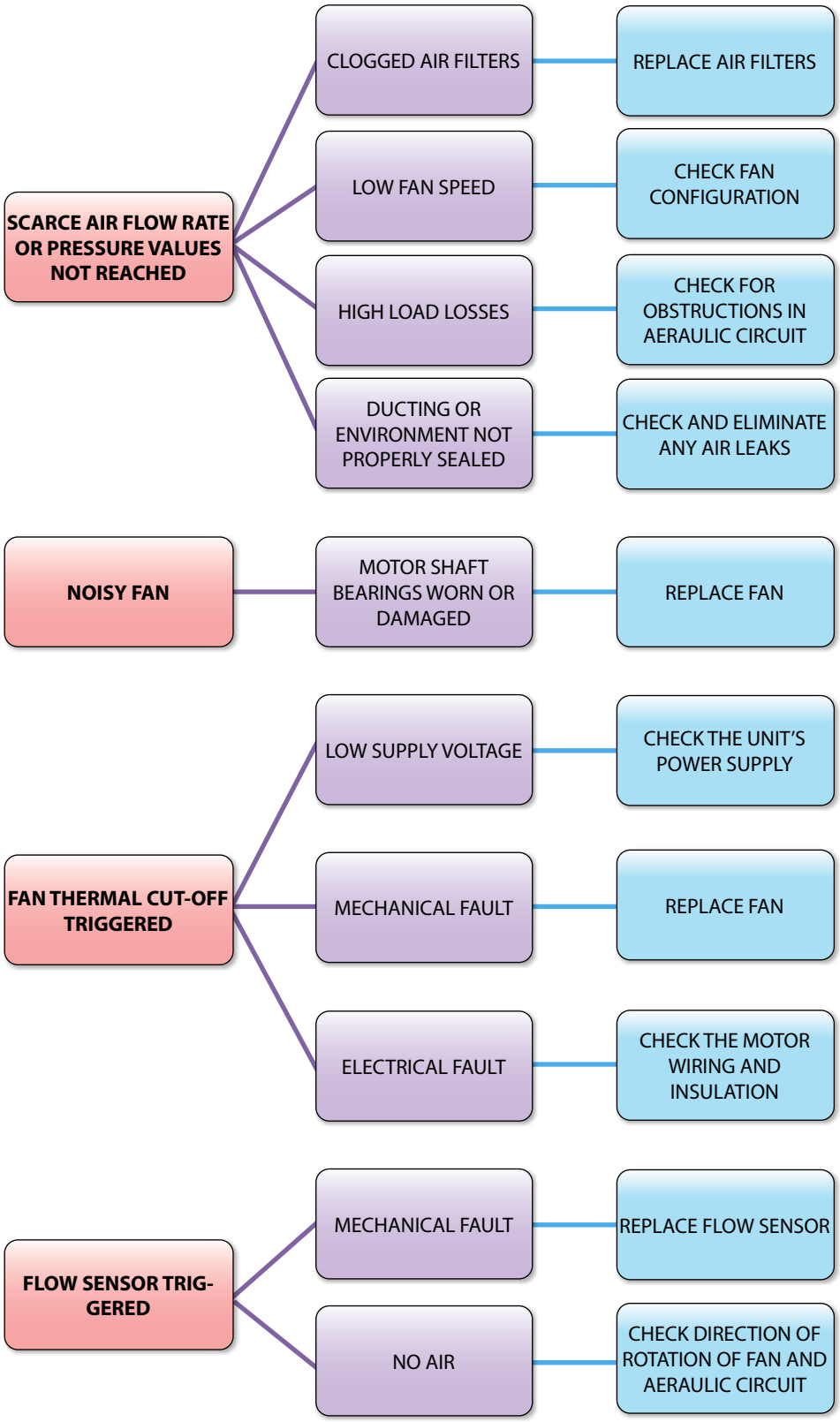
This chapter contains information to assist the operator in tracing any faults that may arise with the machine. Starting with a description of the nature of the problem, we provide indications on the probable causes and possible solutions. The causes described are generic and therefore also apply to the most complete versions of the machine; it is the task of the operator to determine which part of the information provided applies to the machine in question.

All servicing and repairs of the machine must be carried out by qualified personnel only.

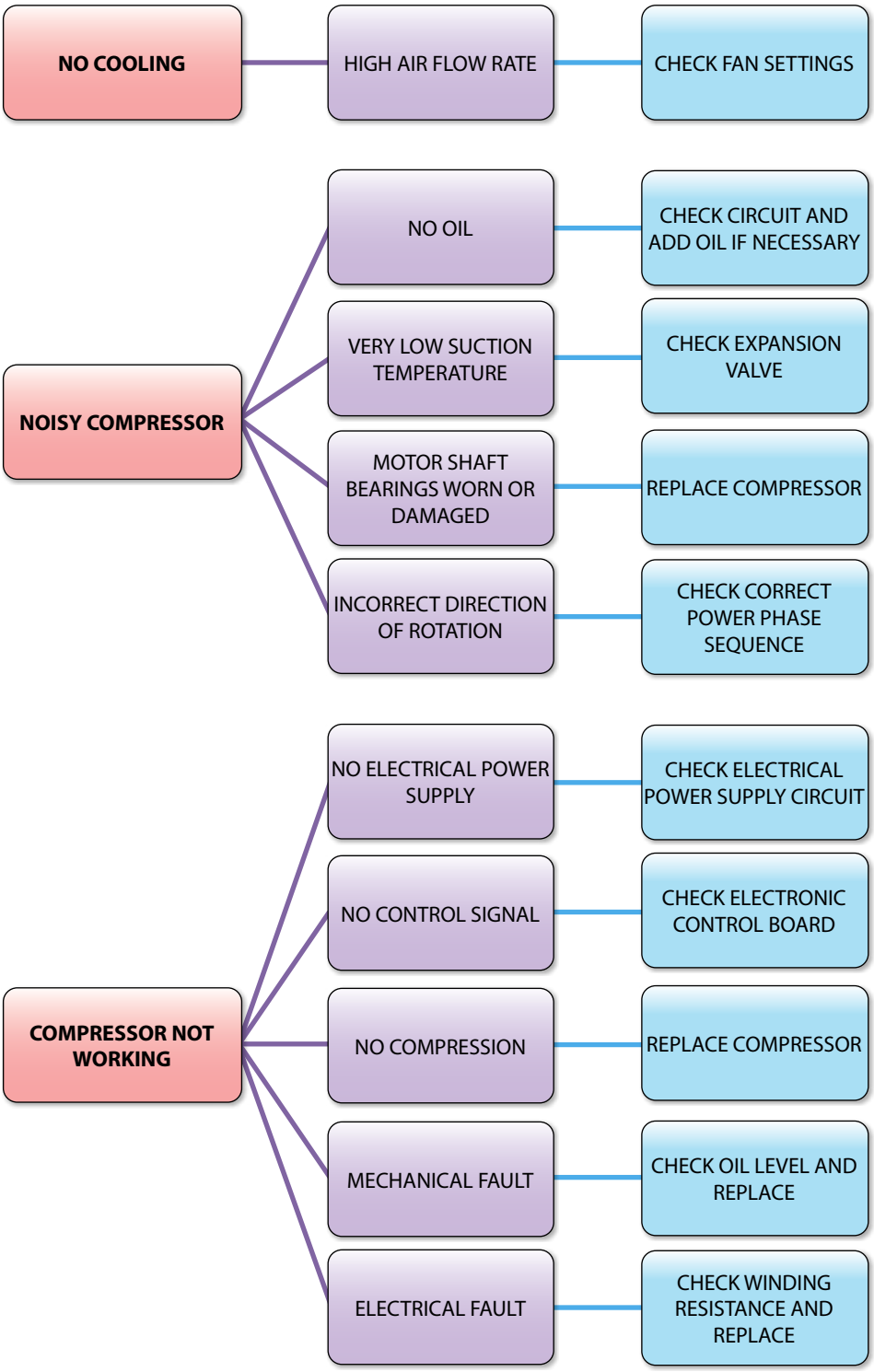
It is recommended not to perform any type of operation without sufficient knowledge of the machine's main operating principles.

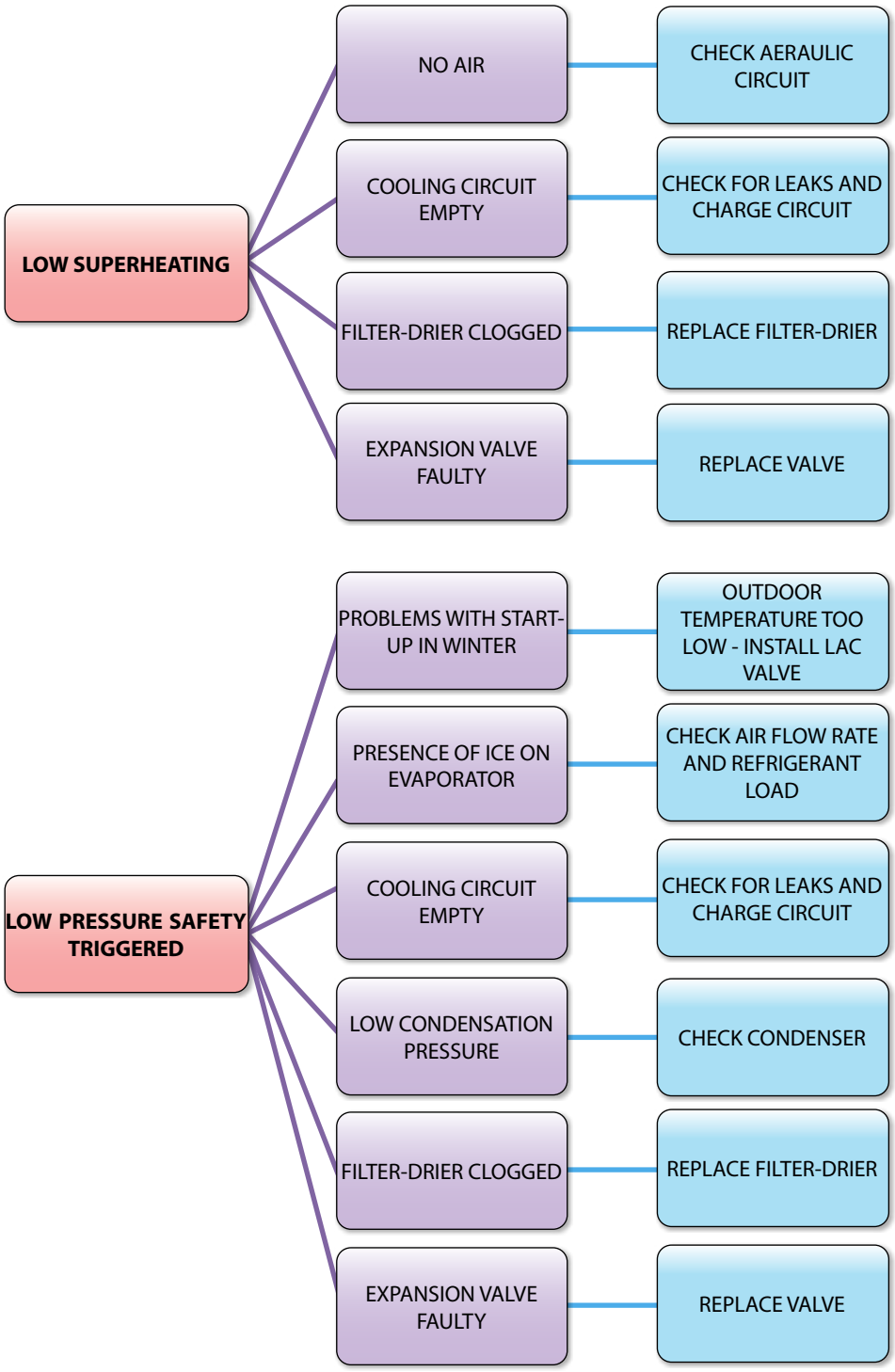
Key:

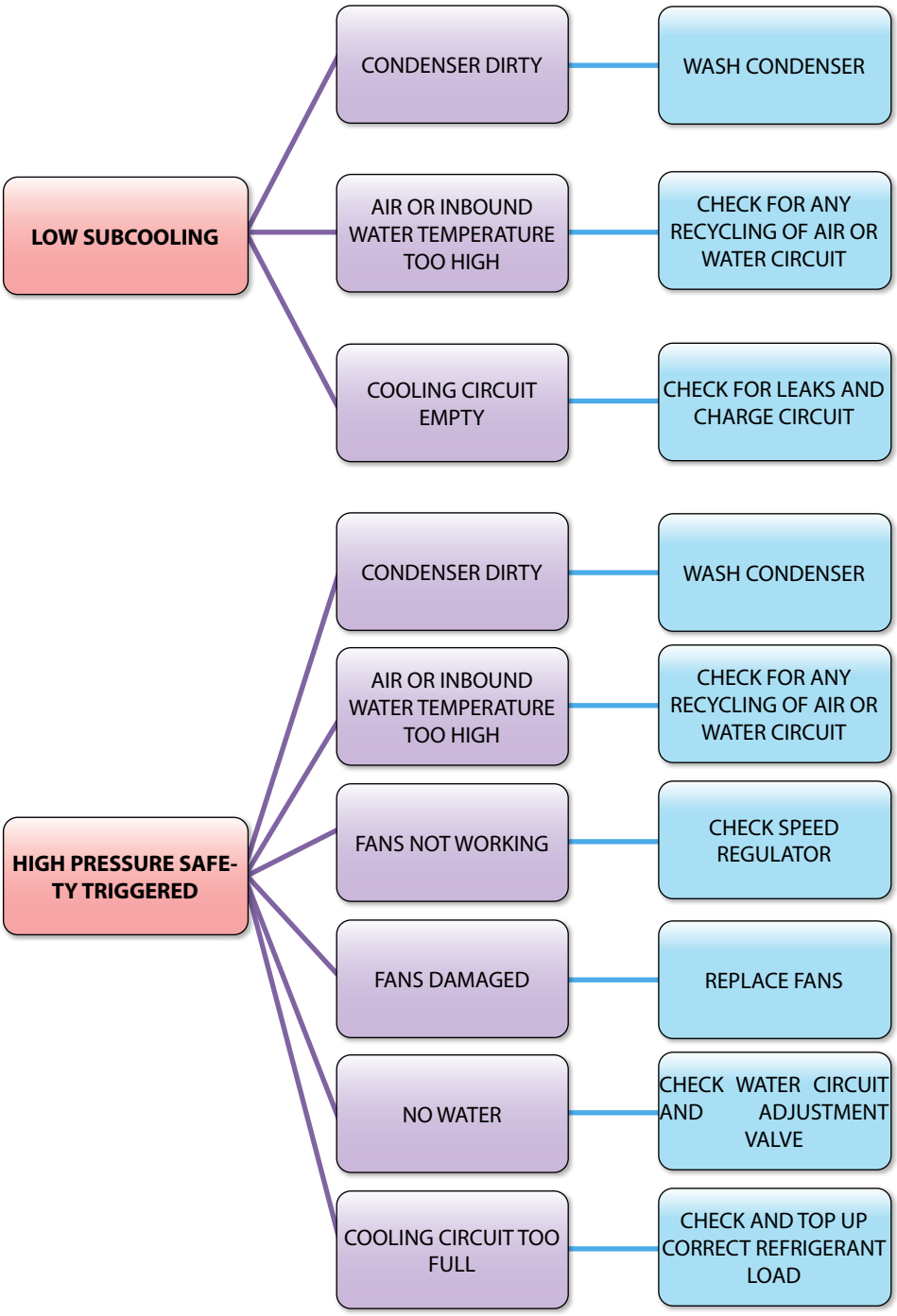
16.1 PROBLEMS WITH VENTILATION



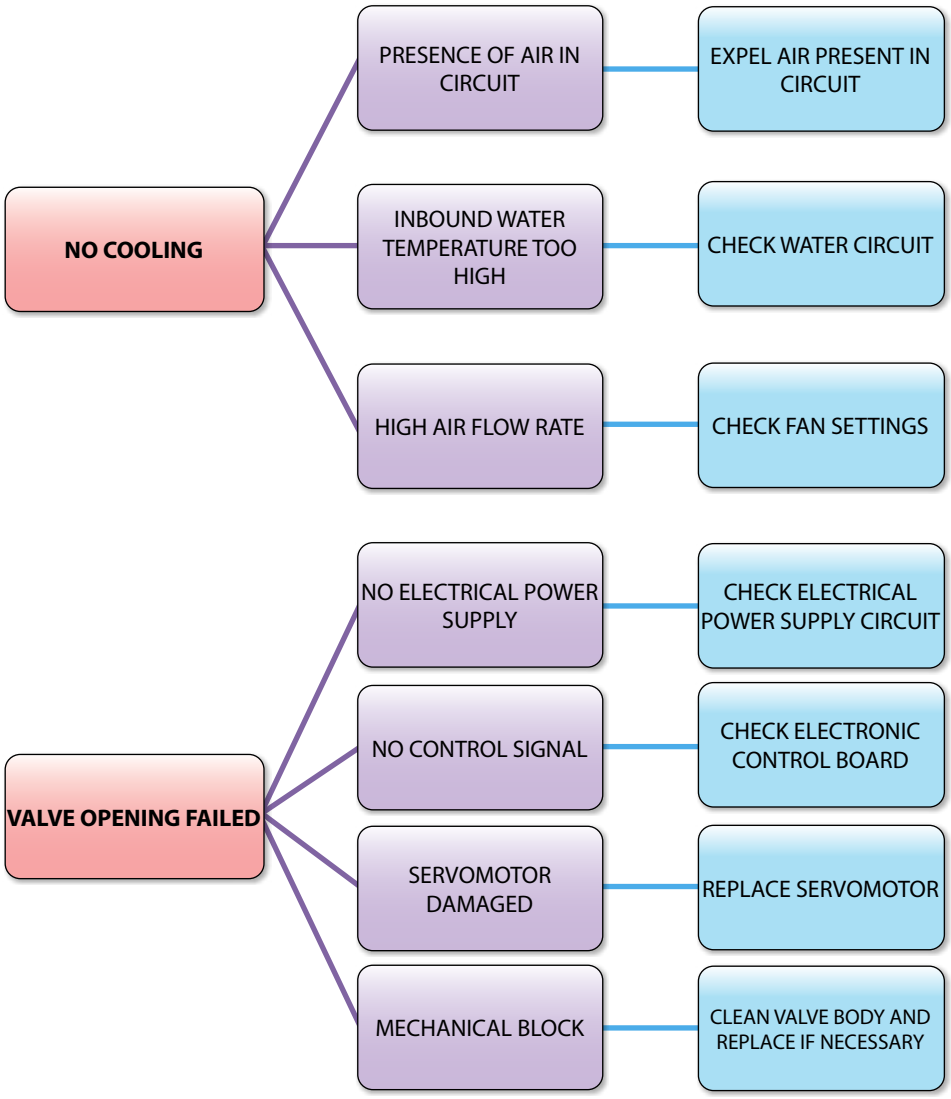
16.2 PROBLEMS WITH DIRECT EXPANSION COOLING CIRCUIT



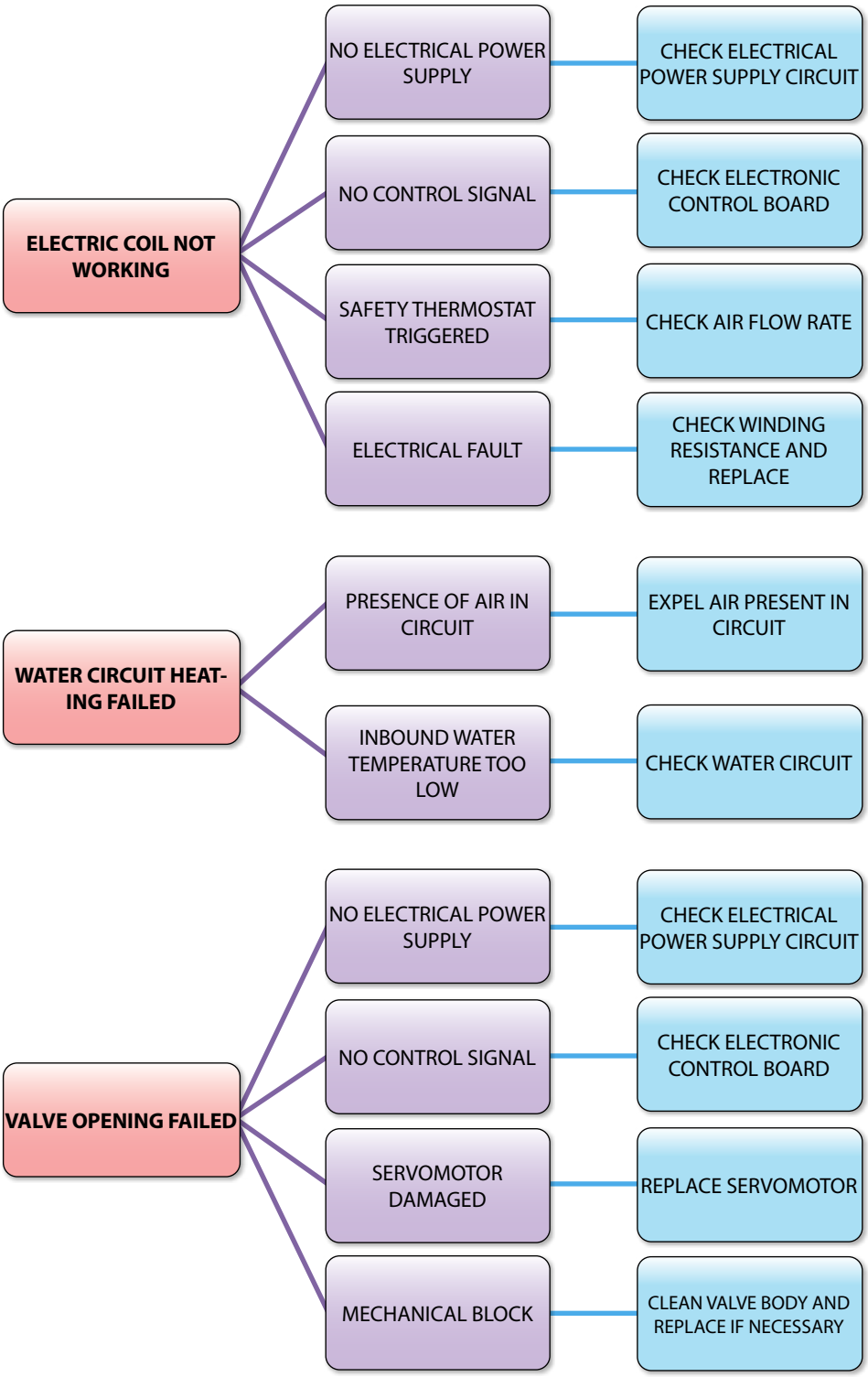

LOW SUPERHEATING
NO AIR
CHECK AERAULIC CIRCUIT
COOLING CIRCUIT EMPTY
CHECK FOR LEAKS AND CHARGE CIRCUIT
FILTER-DRIER CLOGGED
REPLACE FILTER-DRIER
EXPANSION VALVE FAULTY
REPLACE VALVE
LOW PRESSURE SAFETY TRIGGERED
PROBLEMS WITH START-UP IN WINTER
OUTDOOR TEMPERATURE TOO LOW - INSTALL LAC VALVE
PRESENCE OF ICE ON EVAPORATOR
CHECK AIR FLOW RATE AND REFRIGERANT LOAD
COOLING CIRCUIT EMPTY
CHECK FOR LEAKS AND CHARGE CIRCUIT
LOW CONDENSATION PRESSURE
CHECK CONDENSER
FILTER-DRIER CLOGGED
REPLACE FILTER-DRIER
EXPANSION VALVE FAULTY
REPLACE VALVE


LOW SUBCOOLING
CONDENSER DIRTY
WASH CONDENSER
AIR OR INBOUND WATER TEMPERATURE TOO HIGH
CHECK FOR ANY RECYCLING OF AIR OR WATER CIRCUIT
COOLING CIRCUIT EMPTY
CHECK FOR LEAKS AND CHARGE CIRCUIT
HIGH PRESSURE SAFE-TY TRIGGERED
CONDENSER DIRTY
WASH CONDENSER
AIR OR INBOUND WATER TEMPERATURE TOO HIGH
CHECK FOR ANY RECYCLING OF AIR OR WATER CIRCUIT
FANS NOT WORKING
CHECK SPEED REGULATOR
FANS DAMAGED
REPLACE FANS
NO WATER
CHECK WATER CIRCUIT AND ADJUSTMENT VALVE
COOLING CIRCUIT TOO FULL
CHECK AND TOP UP CORRECT REFRIGERANT LOAD

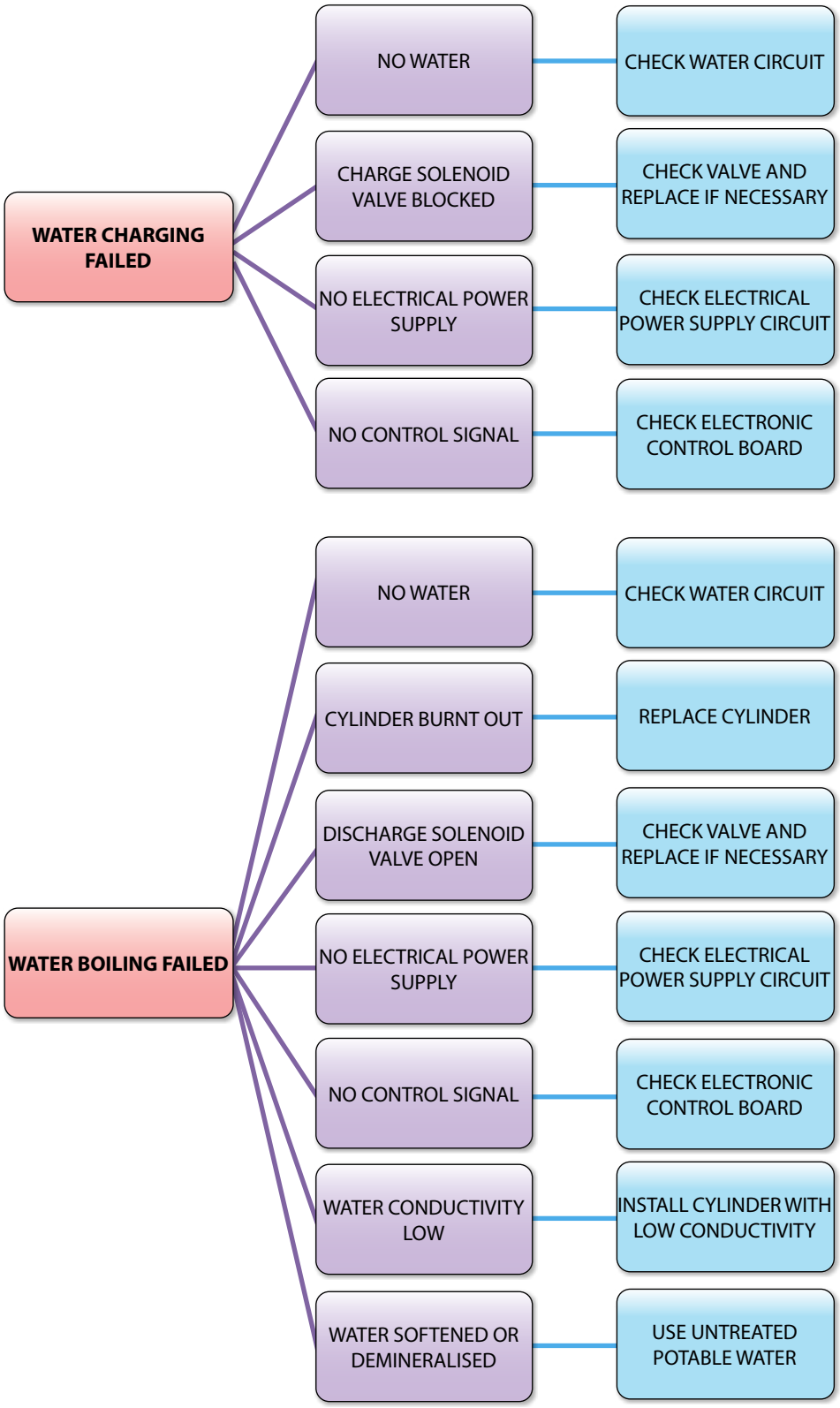
16.3 PROBLEMS WITH CHILLED WATER CIRCUIT

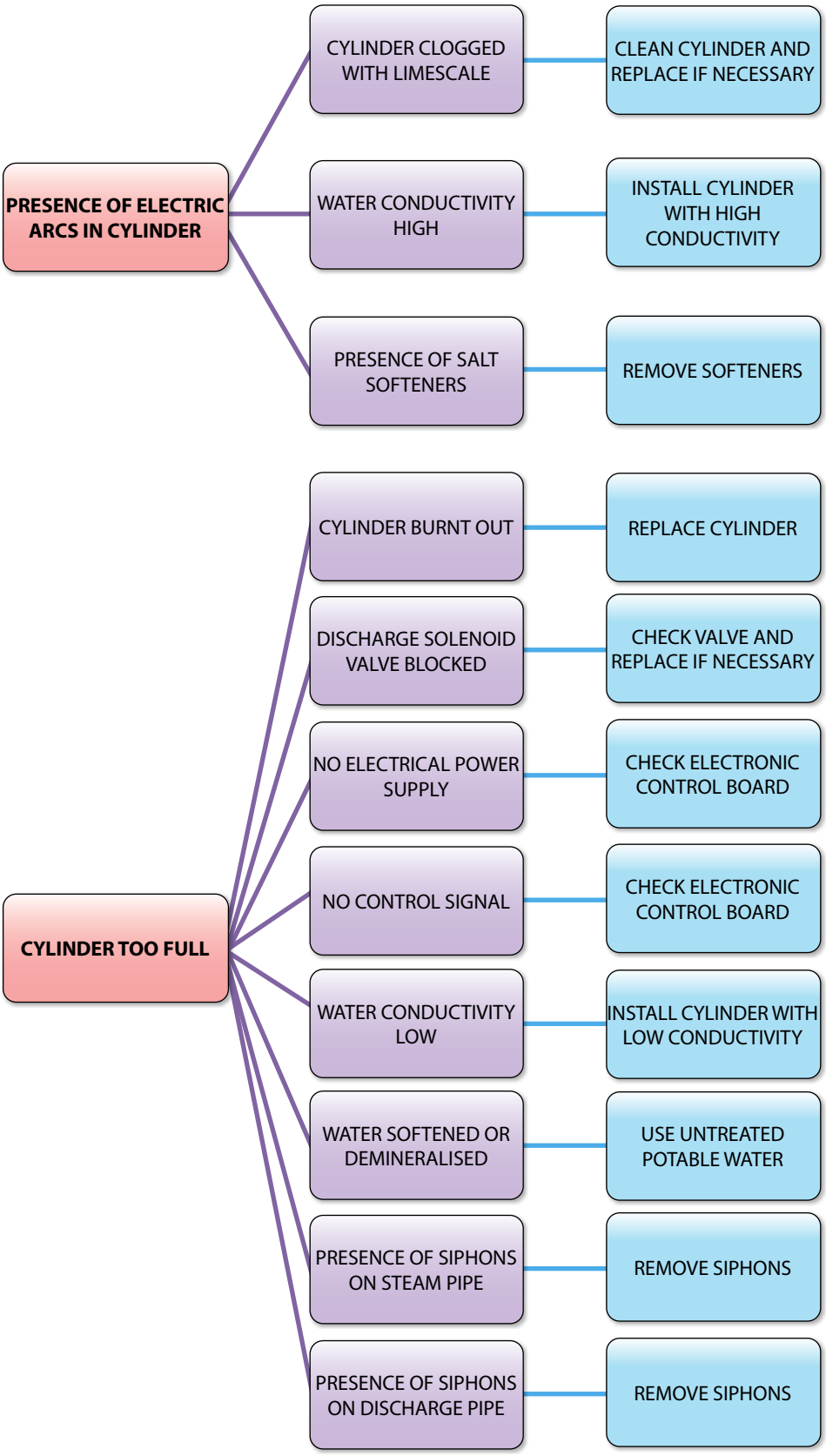


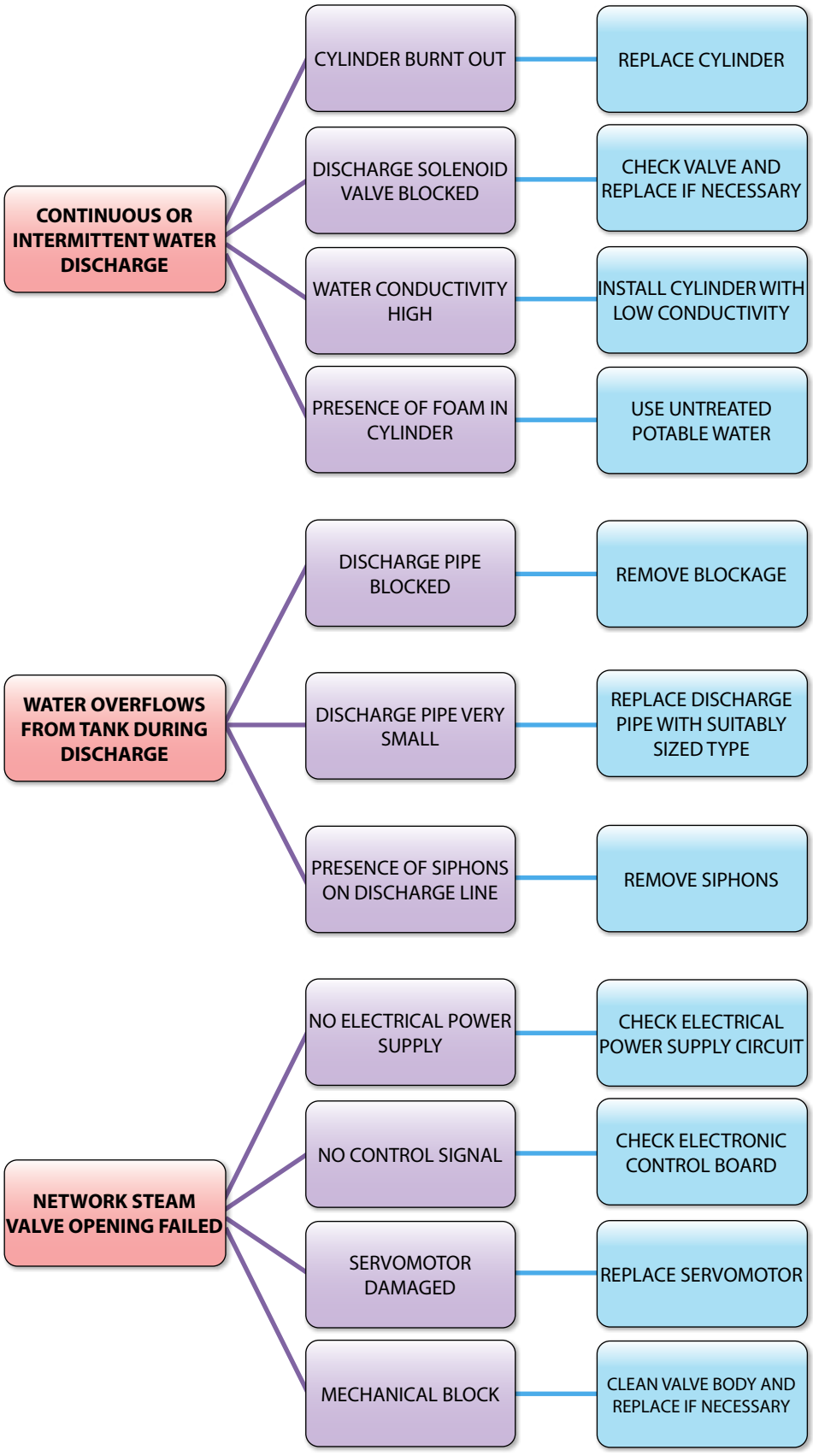
16.4 PROBLEMS WITH HEATING SECTION



16.5 PROBLEMS WITH HUMIDIFICATION




PRESENCE OF ELECTRIC ARCS IN CYLINDER
CYLINDER CLOGGED WITH LIMESCALE
CLEAN CYLINDER AND REPLACE IF NECESSARY
WATER CONDUCTIVITY HIGH
INSTALL CYLINDER WITH HIGH CONDUCTIVITY
PRESENCE OF SALT SOFTENERS
REMOVE SOFTENERS
CYLINDER TOO FULL
CYLINDER BURNT OUT
REPLACE CYLINDER
DISCHARGE SOLENOID VALVE BLOCKED
CHECK VALVE AND REPLACE IF NECESSARY
NO ELECTRICAL POWER SUPPLY
CHECK ELECTRONIC CONTROL BOARD
NO CONTROL SIGNAL
CHECK ELECTRONIC CONTROL BOARD
WATER CONDUCTIVITY LOW
INSTALL CYLINDER WITH LOW CONDUCTIVITY
WATER SOFTENED OR DEMINERALISED
USE UNTREATED POTABLE WATER
PRESENCE OF SIPHONS ON STEAM PIPE
REMOVE SIPHONS
PRESENCE OF SIPHONS ON DISCHARGE PIPE
REMOVE SIPHONS


CONTINUOUS OR INTERMITTENT WATER DISCHARGE
CYLINDER BURNT OUT
REPLACE CYLINDER
DISCHARGE SOLENOID VALVE BLOCKED
CHECK VALVE AND REPLACE IF NECESSARY
WATER CONDUCTIVITY HIGH
INSTALL CYLINDER WITH LOW CONDUCTIVITY
PRESENCE OF FOAM IN CYLINDER
USE UNTREATED POTABLE WATER
WATER OVERFLOWS FROM TANK DURING DISCHARGE
DISCHARGE PIPE BLOCKED
REMOVE BLOCKAGE
DISCHARGE PIPE VERY SMALL
REPLACE DISCHARGE PIPE WITH SUITABLY SIZED TYPE
PRESENCE OF SIPHONS ON DISCHARGE LINE
REMOVE SIPHONS
NETWORK STEAM VALVE OPENING FAILED
NO ELECTRICAL POWER SUPPLY
CHECK ELECTRICAL POWER SUPPLY CIRCUIT
NO CONTROL SIGNAL
CHECK ELECTRONIC CONTROL BOARD
SERVOMOTOR DAMAGED
REPLACE SERVOMOTOR
MECHANICAL BLOCK
CLEAN VALVE BODY AND REPLACE IF NECESSARY

17 NOTES

EC DECLARATION OF CONFORMITY

The manufacturer declares, under its own responsibility, that the equipment covered by this manual:

- Is intended for installation in air conditioning systems. It is prohibited to place this equipment into operation before the system has been declared as compliant with the provisions of the applicable Directives.
- It satisfies the requirements of the following harmonised standards:

EN ISO 14120:2015	Safety of machinery - Guards - General requirements for the design and construction of fixed and movable guards
EN ISO 13849-2:2012	Safety of machinery - Safety-related parts of control systems - Part 2: Validation
EN ISO 13850:2015	Safety of machinery - Emergency stop function - Principles for design
EN ISO 12100:2010	Safety of machinery - General principles for design - Risk assessment and risk reduction
EN ISO 14118:2018	Safety of machinery - Prevention of unexpected start-up
EN 60204-1:2018	Safety of machinery - Electrical equipment of machines - Part 1: General requirements
EN IEC 61000-6-2:2019	Electromagnetic compatibility (EMC) – Part 6-2: Generic standards - Immunity for industrial environments
EN IEC 61000-6-4:2019	Electromagnetic compatibility (EMC) – Part 6-4: Generic standards - Emission for industrial environments
EN 378-2:2016	Refrigerating systems and heat pumps - Safety and environmental requirements - Part 2: Design, construction, testing, marking and documentation

- It satisfies the requirements of the following directives:

2006/42/EC	Directive concerning machinery, which amends directive 95/16/EC (recast)
2014/30/EU	Directive concerning the harmonisation of the legislation of member states in relation to electromagnetic compatibility (recast)
2014/68/EU	Directive concerning the harmonisation of the legislation of member states in relation to the availability on the market of pressure equipment

The pressure equipment covered by this declaration satisfies the requirements of Directive 2014/68/EU in the following ways:

- Chilled water unit: compliant as per art. 4 para. 3.
- Direct expansion unit with liquid receiver with volume less than 4.8 l: complies with category PED I.
- Direct expansion unit with liquid receiver with volume greater than 4.8 l: complies with category PED II.
- Assessment module: A2 / Certificate No. Z-IS-TAK-MUC-13-10-2086600-106

  Notified Body No. 0036: TÜV SÜD Industrie Service GmbH, Ridlerstrasse 65, 80339 München - Germany

TEST CERTIFICATE

The manufacturer declares, under its own responsibility, that the equipment covered by this manual has passed the functional and electrical safety tests with a positive outcome in accordance with the procedures of the Vision ISO 9001:2008 certified quality management system.

The Manufacturer adopts a policy of continuous development and therefore reserves the right to make changes and improvements to any product described in this document without prior notice. Technical data and dimensions are not binding.

Manual code 30218040 "TRANSLATION OF THE ORIGINAL INSTRUCTIONS"