TECNAIR LV
CLOSE CONTROL AIR CONDITIONING

INSTALLATION, USE AND MAINTENANCE MANUAL

SCOPE OF THIS MANUAL:

DIRECT EXPANSION AND CHILLED WATER AIR CONDITIONERS

SERIES C

Techline

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Manual code 75803707A.0708

CONTENTS

1 HOW TO USE THIS MANUAL

This manual describes the procedures for the installation, use and maintenance of series C air conditioning units.

The following chapters contain information essential for obtaining the best performance from the unit you have purchased; TECNAIR LV therefore recommends that you study this manual carefully.

Some of the topics covered in this manual refer to the functions of the microprocessor controls; TECNAIR LV therefore advises your to read the **MICROPROCESSOR CONTROL USER MANUAL**, which is also supplied with the unit, in order to gain a full understanding of the components and functions of your air conditioner.

If after reading this manual you are still experiencing difficulties or require any further clarification, please do not hesitate to contact our after-sales service:

After-sales office
Tel. +39029699111 / Fax +390296781570
@: info@tecnairlv.it

1.1 IMPORTANT WARNINGS

The equipment described in this manual has been constructed to operate without risk for the intended purposes, provided that:

- The installation, connection, operation and maintenance of the appliance are carried out by qualified personnel in accordance with the instructions contained in this manual.
- All the conditions prescribed in the user manual for the unit's microprocessor control are observed.

Any other use or modification of the equipment,
unless expressly authorised by the manufacturer, is deemed improper.

Any injuries or damage sustained as a result of improper use shall be the sole responsibility of the user.

2 WARRANTY

TECNAIR LV air conditioners are subject to the following warranty conditions which are automatically deemed to have been understood and accepted by the customer at the time of placing the order.

TECNAIR LV guarantees that the products supplied are well made and of good quality. It undertakes during the period of warranty specified herein to repair or to replace with new at its own discretion, in the shortest time possible, those parts found to present recognised defects in materials, construction or workmanship that render them unfit for the intended use, provided that these faults are not the result of negligence on the part of the purchaser, neglect or inexperience of the user, normal wear and tear, damage caused by third parties, acts of God or other causes not arising out of manufacturing defects. TECNAIR LV however shall not be liable to for compensation for direct or indirect damage of any nature incurred for any reason.

Defective components will be replaced at the Uboldo manufacturing plant, and all transportation and replacement costs shall be borne by the Purchaser.

The duration of the warranty is 2 (two) years from the date of consignment.

The warranty shall be rendered void automatically if the equipment is repaired or modified or in any way completed (such as, for example, in the case of non-supply of an electrical panel or similar) or in the case of the installation of non-original parts (parts not supplied by TECNAIR LV).

The above warranty conditions apply provided that the Purchaser has fulfilled all contractual obligations and in particular those regarding payment.

3 DESCRIPTION OF THE UNIT

The machine in question is an air conditioner with direct expansion or chilled water coil designed for use in computer centres.

The cabinet consists of hot-galvanised sheet panels in a frame constructed of painted aluminium section; the panels are made from hot-galvanised sheet steel covered in a PVC film, 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 (polyurethane foam) protected by plastic film.

The machine comprises the following sections:

- Ventilation section: consisting of one or more plug fans.
- Filter section: self-extinguishing non-regenerable filters; the machine includes provision for the use of a differential pressure switch to allow display of clogged filter warning signal;
- Refrigeration circuit: comprising an expansion coil with copper pipes and aluminium cooling fins, a scroll compressor fixed to the machine frame on rubber mountings, thermostatic expansion valve, receiver-drier, plate-type condenser (accessory), low pressure switch (automatic reset) and high pressure switch (manual reset), pressurisation nitrogen charge, antifreeze lubrication oil charge;
- Water circuit (Series U): with cooling expansion coil with copper pipes in aluminium cooling fins, 3-way motorised valve with manual emergency control, water circuit with anti-condensation thermal insulation;
- Electrical power and control panel.

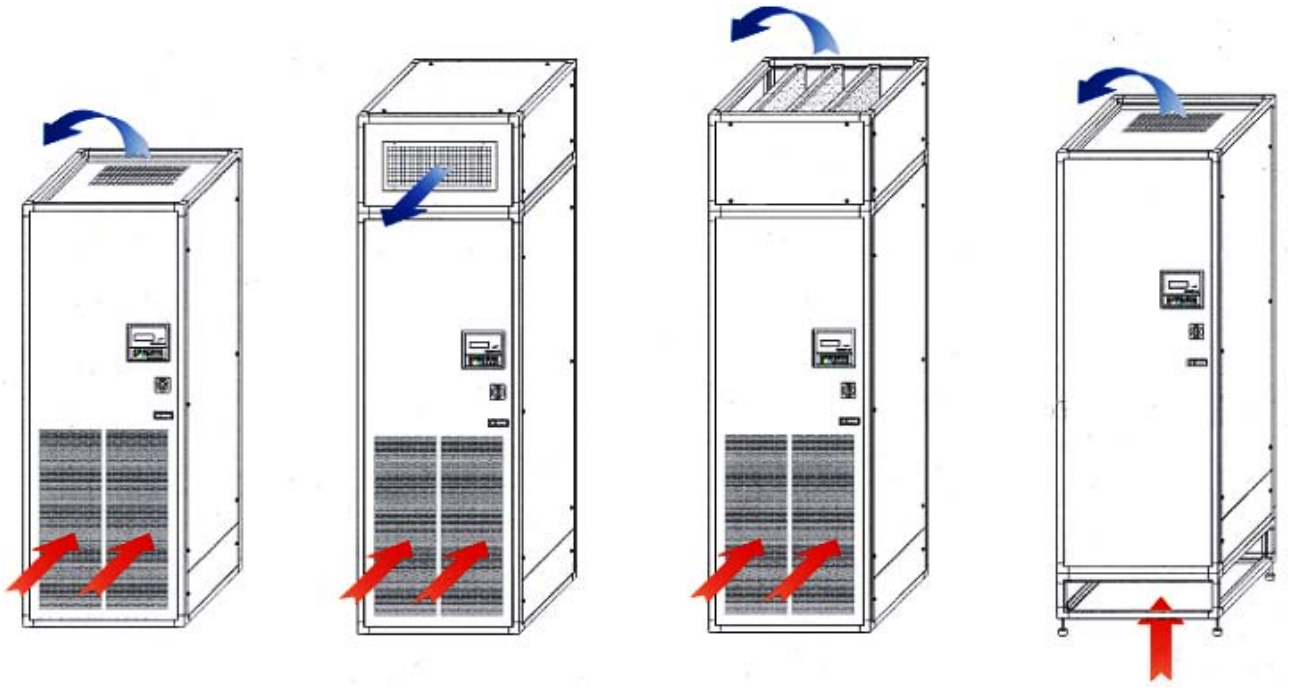
3.1 UNIT CODE

The code contains the following information:

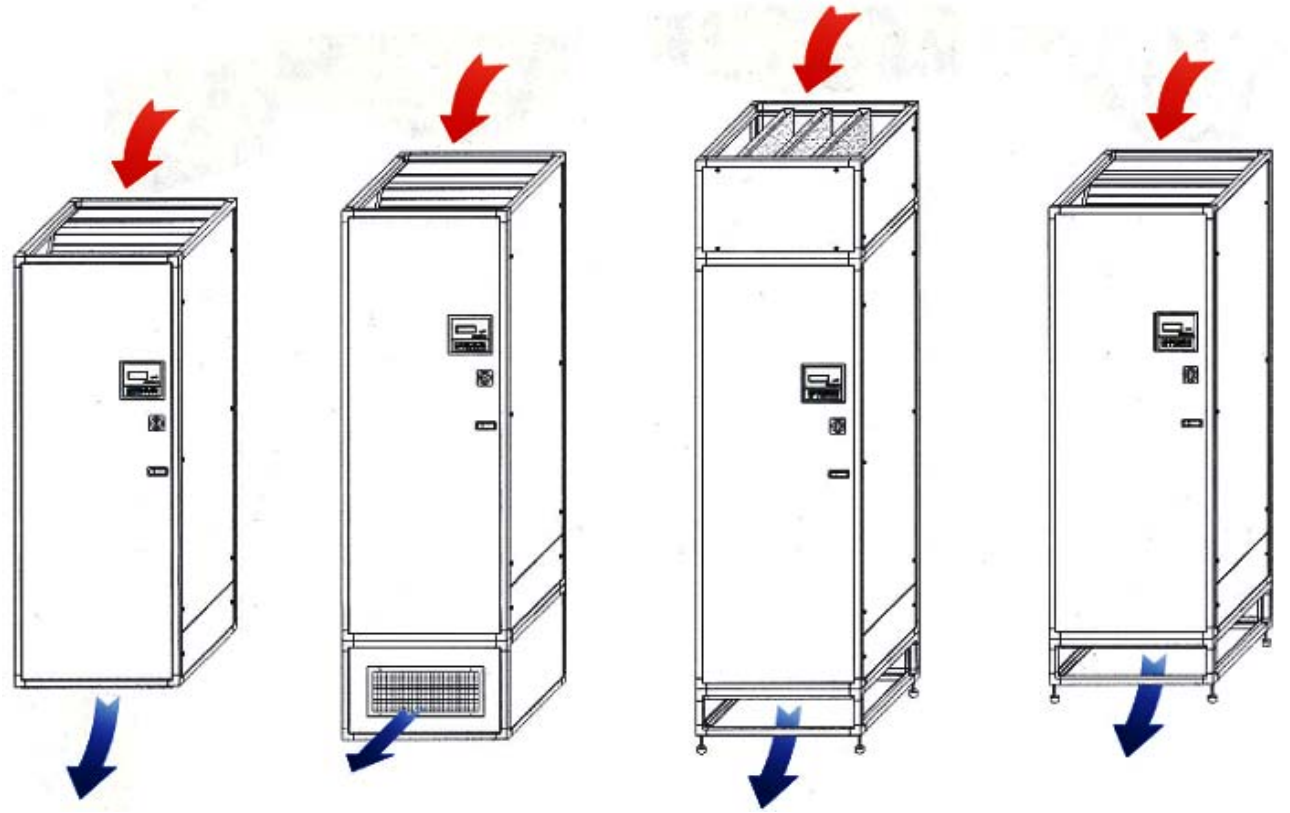
O	C	A	5	1	a	H	FC	R407C
1	2	3	4	5	6	7	8 - 9	10

1	**O**	Air discharge type:	**O**	Upflow air discharge
			U	Downflow air discharge
2	**C**	Series for technology rooms		
3	**A**	Cooling type:	**A**	Direct expansion coil with remote condenser
			U	Chilled water coil with remote cooling
4	**5**	Nominal size (nominal cooling capacity in TONS)		
5	**1**	Number of cooling circuits or number of rows on chilled water coil		
6	**a**	Series modification index		
7	**H**	Air flow rate/cooling capacity ratio	**H**	High air flow rate
			L	Low air flow rate
8	**FC**	FREE COOLING unit type		
9	**TS**	TWIN SOURCES unit type		
10	**R407C**	Refrigerant type		

3.1.1 O / OVER (UPFLOW DISCHARGE)



3.1.2 U / UNDER (DOWNFLOW DISCHARGE)



3.2 OPERATING LIMITS

SERIES C AIR CONDITIONING UNIT

UNIT TYPE	DIRECT EXPANSION		CHILLED WATER
CHARACTERISTICS	**L**	**H**	**-**
MAXIMUM TEMPERATURE	30°C	30°C	30°C
MINIMUM TEMPERATURE	21°C	19°C	20°C
MAXIMUM HUMIDITY	50%	50%	50%
MINIMUM HUMIDITY	20%	20%	20%
STORAGE CONDITIONS	Temperatures from-20°C to + 50°C		

CONDENSERS AND DRY COOLER

UNIT TYPE	AIR			WATER		
CHARACTERISTICS	**WITH VARIATOR AND ELECT. PANEL**		**WITHOUT VARIATOR AND ELECT. PANEL**	**WITH PRESSURE CONTROLLED VALVE**		**WITHOUT PRESSURE CONTROLLED VALVE**
MAXIMUM TEMPERATURE	IN air T°	Up to 30°C: ΔT = 17°C Up to 35°C: ΔT = 15°C Up to 40°C: ΔT = 13°C Up to 46°C: ΔT = 10°C		IN water T°	45°C	
MINIMUM TEMPERATURE		- 25°C	-40°C		7°C	25°C

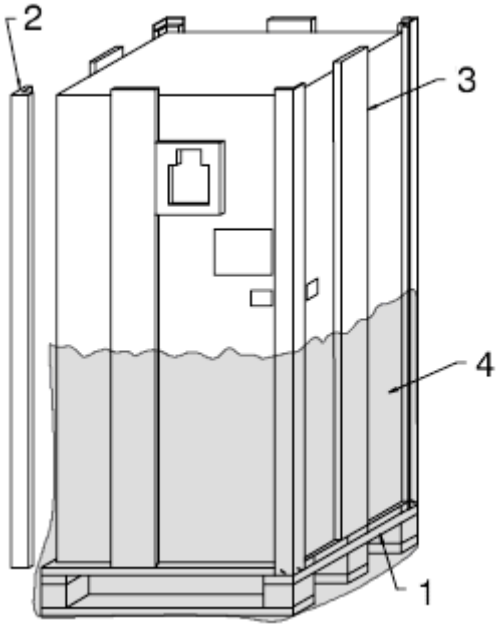
WATER CIRCUITS

TYPE	CHILLED WATER	HOT WATER	INTERNAL HUMIDIFIER	WATER-COOLED CONDENSER
MAXIMUM PRESSURE	16 bar (1.6 Mbar)	16 bar (1.6 Mbar)	8 bar (0.8 Mbar)	16 bar (1.6 Mbar)
MINIMUM PRESSURE	-	-	1 bar (0.1 Mbar)	1 bar (0.1 Mbar)
MAXIMUM ΔP AT VALVE	1 bar (100 Kpa)	1 bar (100 Kpa)	-	-
MAXIMUM TEMPERATURE	-	85°C	40°C	-
MINIMUM TEMPERATURE	5°C	-	1°C	-

4 INSTALLATION PROCEDURE

4.1 TRANSPORTATION

Unless otherwise agreed with the Customer, TECNAIR LV shall supply their machines ex works with standard packaging consisting of: wooden pallet (1), protective polystyrene packing (2,3) and polythene sheet (4).



During transportation the machines must not be laid on their sides or overturned but must remain in the vertical position at all times otherwise their internal components could be damaged.

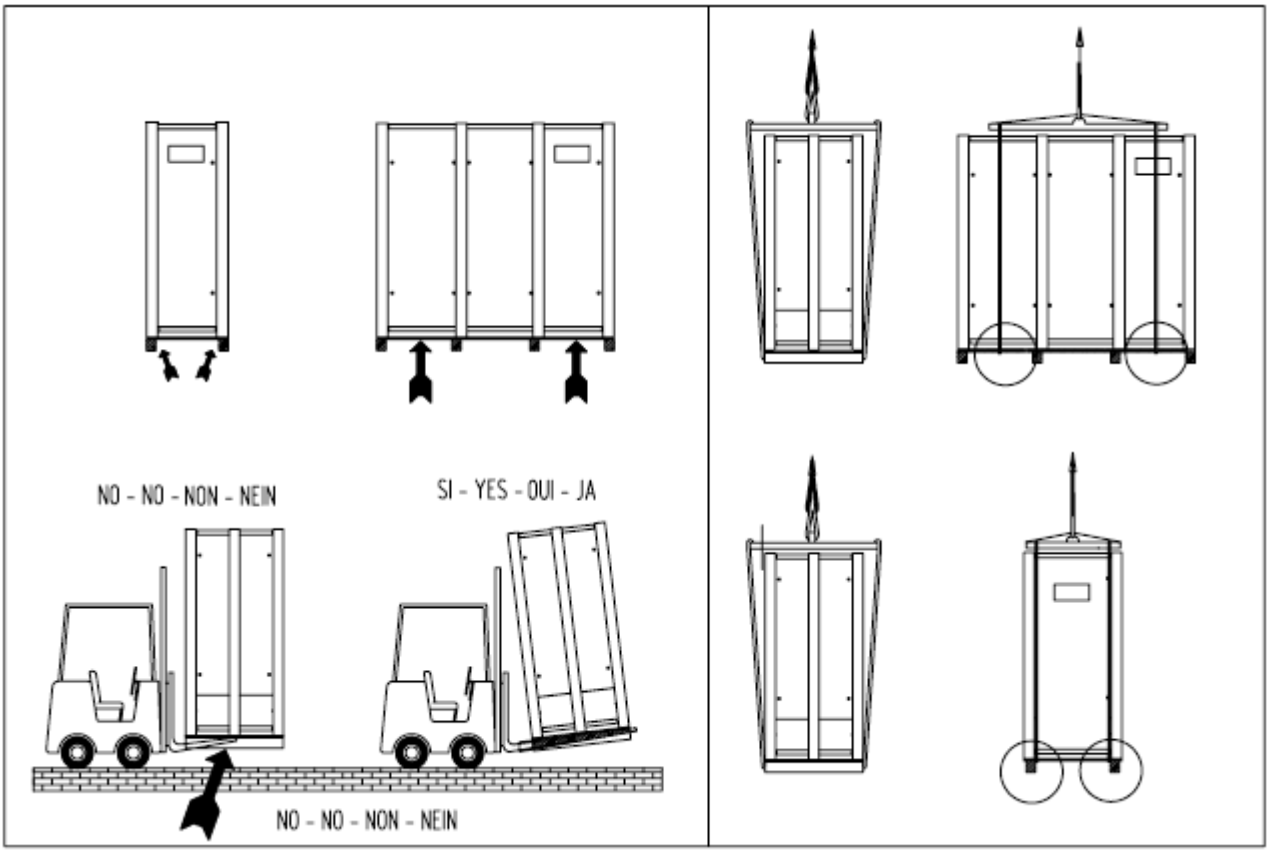
As the Carrier is always responsible for damage sustained by the goods during transport, before signing the delivery note to accept the supply, check the integrity of the packaging and that there are no visible signs of damage to the conditioner or the leakage of oil or refrigerant.

In the case of evident damage to the unit or if there is slightest doubt as to whether the conditioner has been damaged during transport, it is necessary to express your reservations in writing to the Carrier, whilst also informing the TECNASIR LV Sales Department.

4.2 RECEIVING THE MACHINES ON SITE

For unloading of the units, please observe the procedures indicated in the illustrations reproduced below, which are also affixed to the original packaging of the unit.

If the unit is not to be installed immediately after its arrival on site, it should remain in its original packaging and stored in a dry, enclosed area, preferably heated to a temperature of 15°C during the winter months.

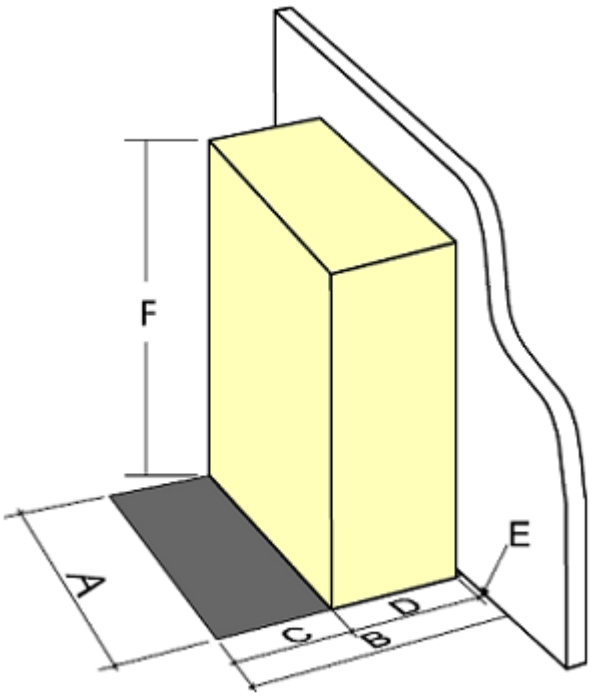


4.3 POSITIONING THE UNIT AND INSTALLATION CLEARANCES

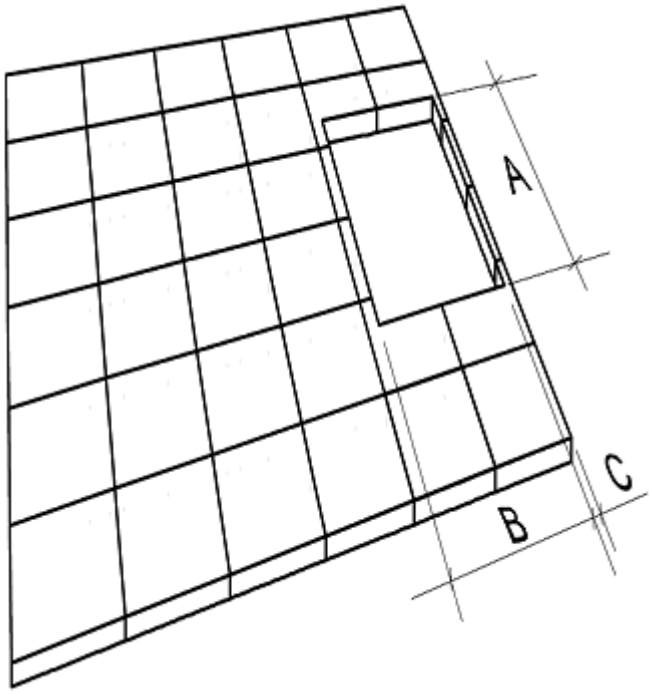
To avoid any problems and damage to the air conditioners during transportation, we recommend that the units should only be removed from their packaging when they have reached their final destination.

It also essential to make sure that the floor on which the air conditioner is to be installed is capable of supporting its weight. The weight of the unit can be found in the commercial documentation or read directly from the data plate located inside the unit.

During installation, respect the clearances required for routine and major servicing indicated in the drawing enclosed with the order confirmation. The figure below shows the dimensions to be taken into account during installation. For the exact values of the dimensions indicated in the figure, refer to the drawings supplied with the order confirmation.



Installation dimensions

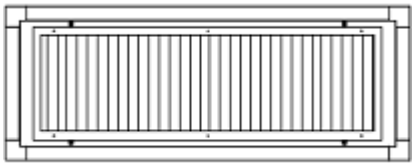
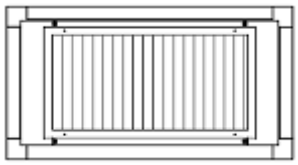
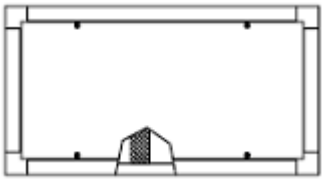
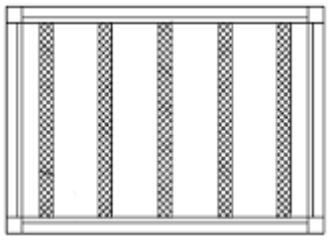
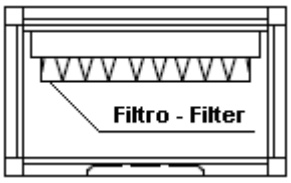
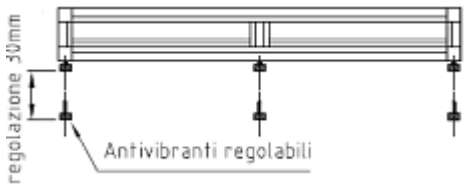
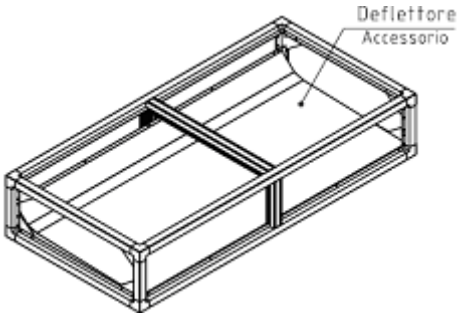


Hole for installation with raised floor

In all cases it is essential leave free space of approximately 800 mm over the entire width of the machine (C) and clearance of 50 mm at the rear of the unit (E).

4.4 PLENUMS AND PLINTHS

Various type of air distribution plenum and plinth are available as accessories for both the Under (U) and Over (O) versions of the unit. The various options are listed in the table below:

<table>
<tr><td rowspan="2">Plenum with front grille only or both front and side grilles</td><td>Front view</td><td>Right - Left side view</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td rowspan="2">Soundproofed duct section</td><td>Front view</td><td>Top view</td></tr>
<tr><td>  </td><td>  </td></tr>
<tr><td rowspan="2">Duct section with F7 filter</td><td colspan="2">Front - Rear view</td></tr>
<tr><td colspan="2"> 
</td></tr>
<tr><td rowspan="2">Adjustable plinth with baffle</td><td>Front view</td><td>Overview</td></tr>
<tr><td> 
</td><td> 
</td></tr>
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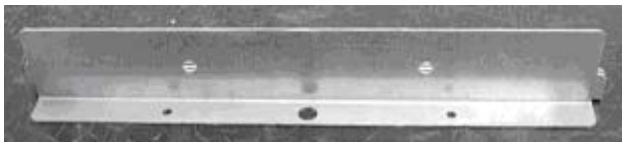
4.4.1 INSTALLATION OF PLENUMS AND DUCT SECTIONS

The plenums and duct sections at the top of the unit are to be installed using the four brackets supplied, which are to be fitted to the upper frame members of the unit.



Fixing bracket

To install the brackets proceed as follows:

1) Fix the brackets to the aluminium frame of the unit using self-tapping screws.

2) The brackets are to be positioned centrally on each side of the unit and fixed with two self-tapping screws.

3) Position the plenum/duct section making sure that the aluminium sections are properly aligned.

4.4.2 INSTALLATION OF THE ADJUSTABLE PLINTHS

The plinths are to installed as follows:

1) Position the plinth on the subfloor.

2) Adjust the vibration damping feet to ensure that the plinth is flush with the finished floor surface and perfectly level.

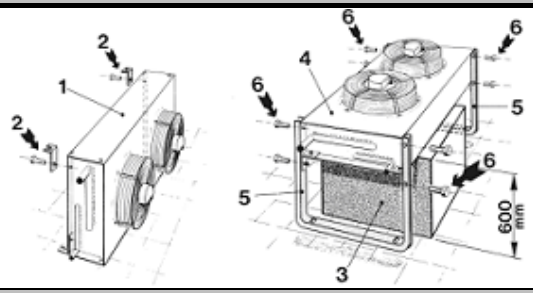
3) Position the unit on the plinth, making sure that the aluminium sections are properly aligned with each other.

4.5 CEA AIR-COOLED CONDENSERS

CEA air-cooled condensers must be installed in accordance with the following instructions:

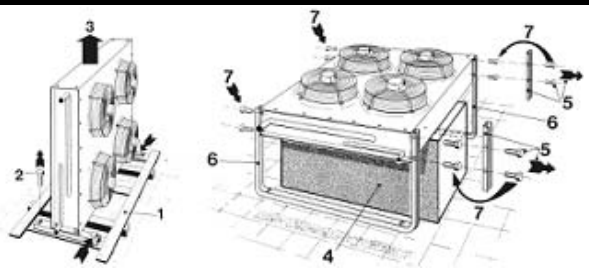
HORIZONTAL INSTALLATION

SINGLE ROW



1) Remove the condenser from the packaging.
2) Fit the fixing brackets (**2**) to the condenser (**1**).
3) Position the condenser horizontally (**4**)on a support (**3**).
4) Fix the feet (**5**)using the screws provided(**6**).

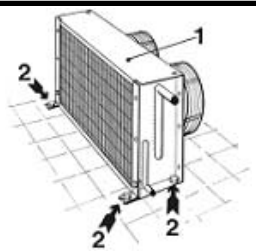
DOUBLE ROW



1) Remove the fixing screws (**2**) from the packaging (**1**) and remove the condenser (**3**).
2) Position the condenser horizontally on a support(**4**).
3) Remove the fixing brackets by undoing the relative screws (**5**).
4) Fix the feet (**6**) using the screws provided (**5**).

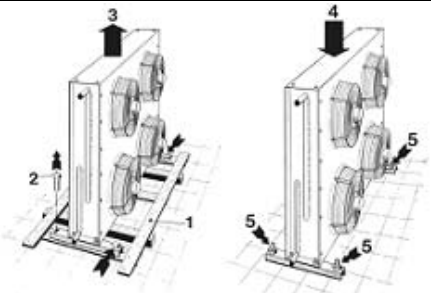
VERTICAL INSTALLATION

SINGLE ROW

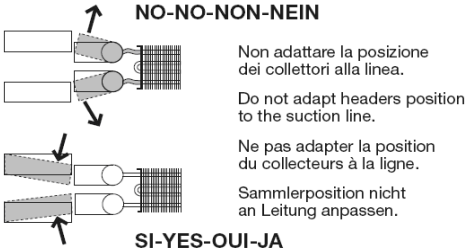


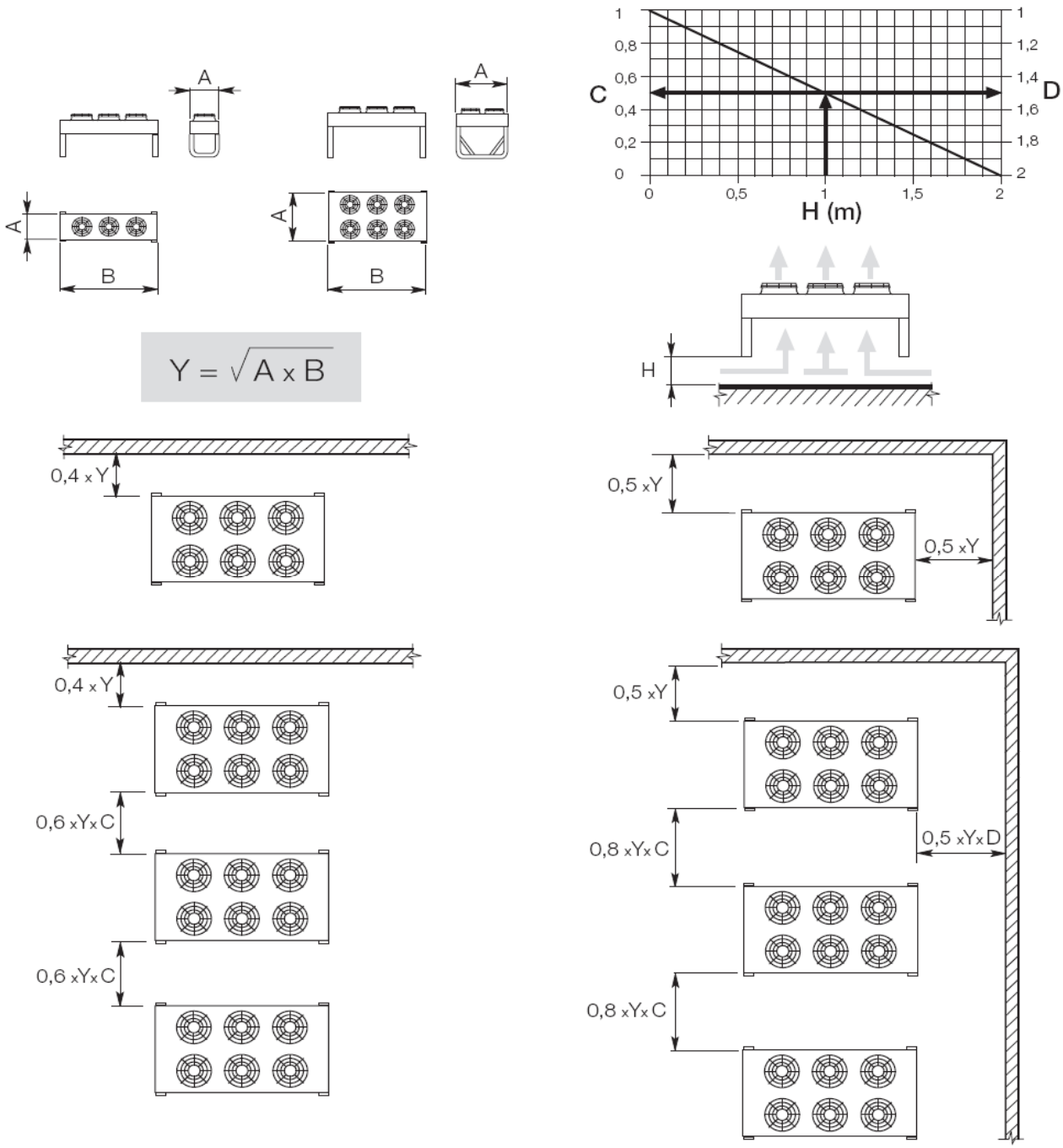
1) Remove the condenser from the packaging.
2) Position the condenser (**1**).
3) Fix the brackets using the screws provided (**2**).

DOUBLE ROW

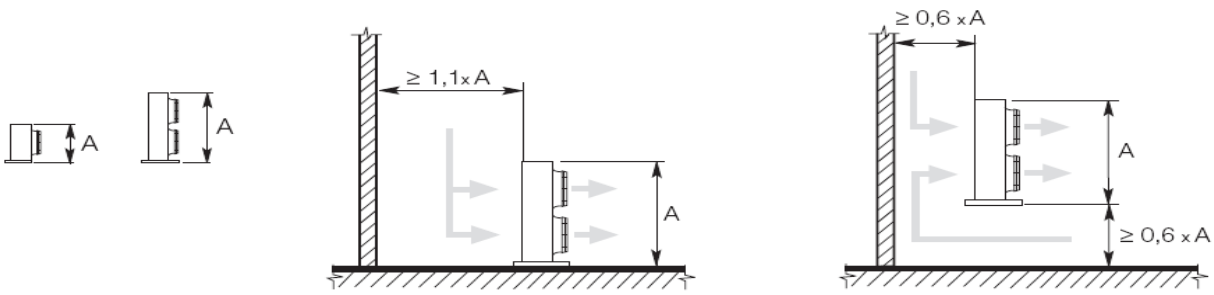


1) Remove the fixing screws (**2**) from the packaging (**1**) and remove the condenser (**3**).
2) Position the condenser (**4**).
3) Fix using the screws provided (**5**).





Clearances for horizontal installation



Clearances for vertical installation

4.6 WATER CONNECTIONS

WARNING!

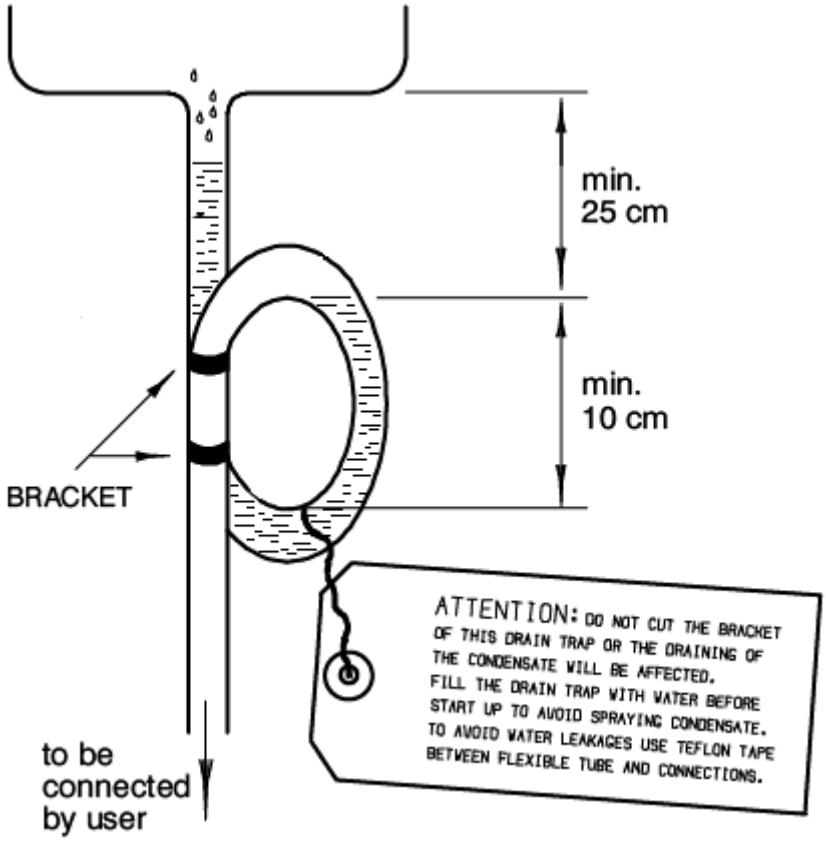
TECNAIR LV tests water components with dried compressed air at 24 Bar. This ensures that no water is present in the water circuits thereby preventing the possibility of freezing during storage prior to installation.

However, during the positioning and installation operations, it is essential to take special care not to fill the water circuits, even accidentally, before all the necessary antifreeze measures stipulated in the design specifications have been taken (e.g. insulation, addition of glycol, etc.).

4.6.1 CONDENSATE DRAIN AND SIPHONS

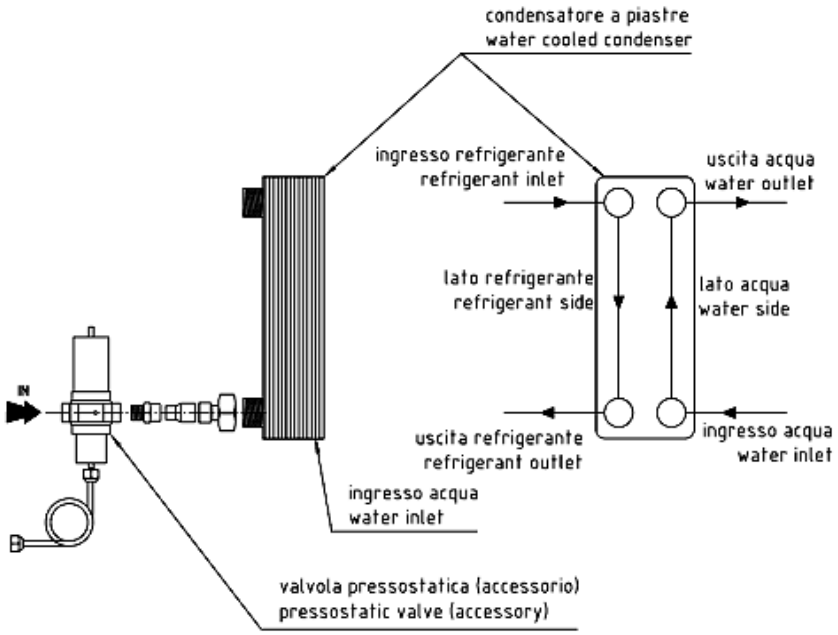
All air conditioners, whether direct expansion or water chilled coils, require a condensate drain connection between the machine and the building waste drains system and the humidifier drain.

The siphon, essential for draining condensate as the bowl is located in a point of negative pressure, is supplied already installed on the unit and is to be connected when the unit is placed in position by the installer. The humidifier drain, which does not require a siphon, is supplied ready connected to the termination of the condensate drain. The drain pipe used is 19x25 Retiflex with 1/2' fittings.



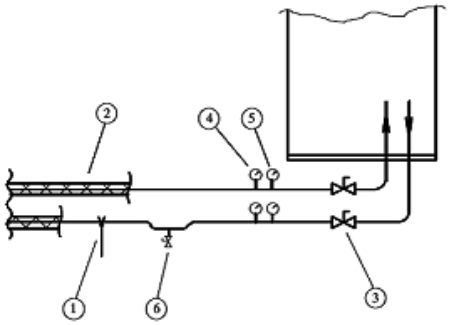
4.6.2 WATER-COOLED CONDENSERS

On machines with integral water-cooled condensers, it will be necessary to install the supply and discharge lines to the condenser. The diameters of the pipes and the inlet and the outlet unions are indicated in the order confirmation.



To ensure that circuit pipes are installed correctly, we recommend that the following indications are observed:

- Use pipes made of copper or steel
- Support pipes with suitable brackets (1)
- Insulate both pipes with Armaflex type insulation (2)
- Install shut-off valves to facilitate maintenance (3)
- Install a Thermometer (4) and Pressure gauge (5) on the inlet and outlet
- Install a drain outlet in the lowest part of the circuit (6)
- Use a water/glycol solution where necessary



4.6.3 PRESSURE CONTROLLED VALVE

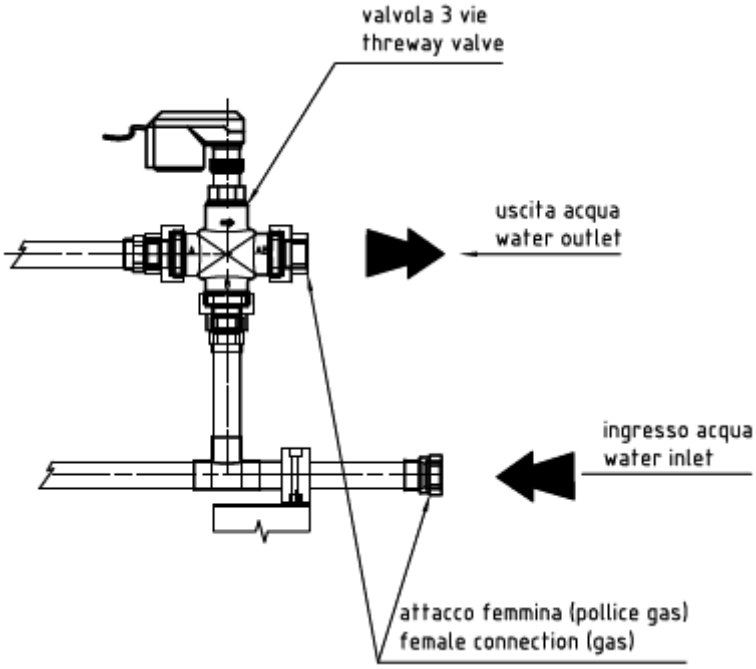
The pressure controlled valve (accessory) is essential when the water is supplied from a well, river or aqueduct; however it is not necessary when the water is supplied from a water tower. In practical terms, the valve is necessary if there is the possibility that the water temperature can fall so low during winter (e.g. below 15 degrees) that the machine's condensation temperature is consequently reduced too much). The valve is factory-installed on the condenser water inlet.

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 clogged by impurities in the water.

4.6.4 WATER COILS

It will be necessary to install inlet and outlet pipes on both machines with chilled water coils and those with hot water coils. The diameters of the pipes and the inlet and the outlet unions are indicated in the order confirmation.

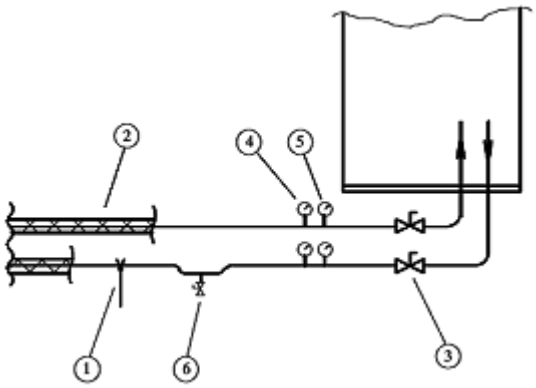
The water inlet and outlet unions are indicated in the figure below. The unions can also be identified by their adhesive labels.



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 and the outlet pipe is 1 bar (100 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 a pressure reducing valve upstream of the 3-way valve.

To ensure that circuit pipes are installed correctly, we recommend that the following indications are observed:

- Use pipes made of copper or steel
- Support pipes with suitable brackets (1)
- Insulate both pipes with Armaflex type insulation (2)
- Install shut-off valves to facilitate maintenance (3)
- Install a Thermometer (4) and Pressure gauge (5) on the inlet and outlet
- Install a drain outlet in the lowest part of the circuit (6)
- Use a water/glycol solution where necessary



4.6.5 INTERNAL IMMERSED ELECTRODE HUMIDIFIER

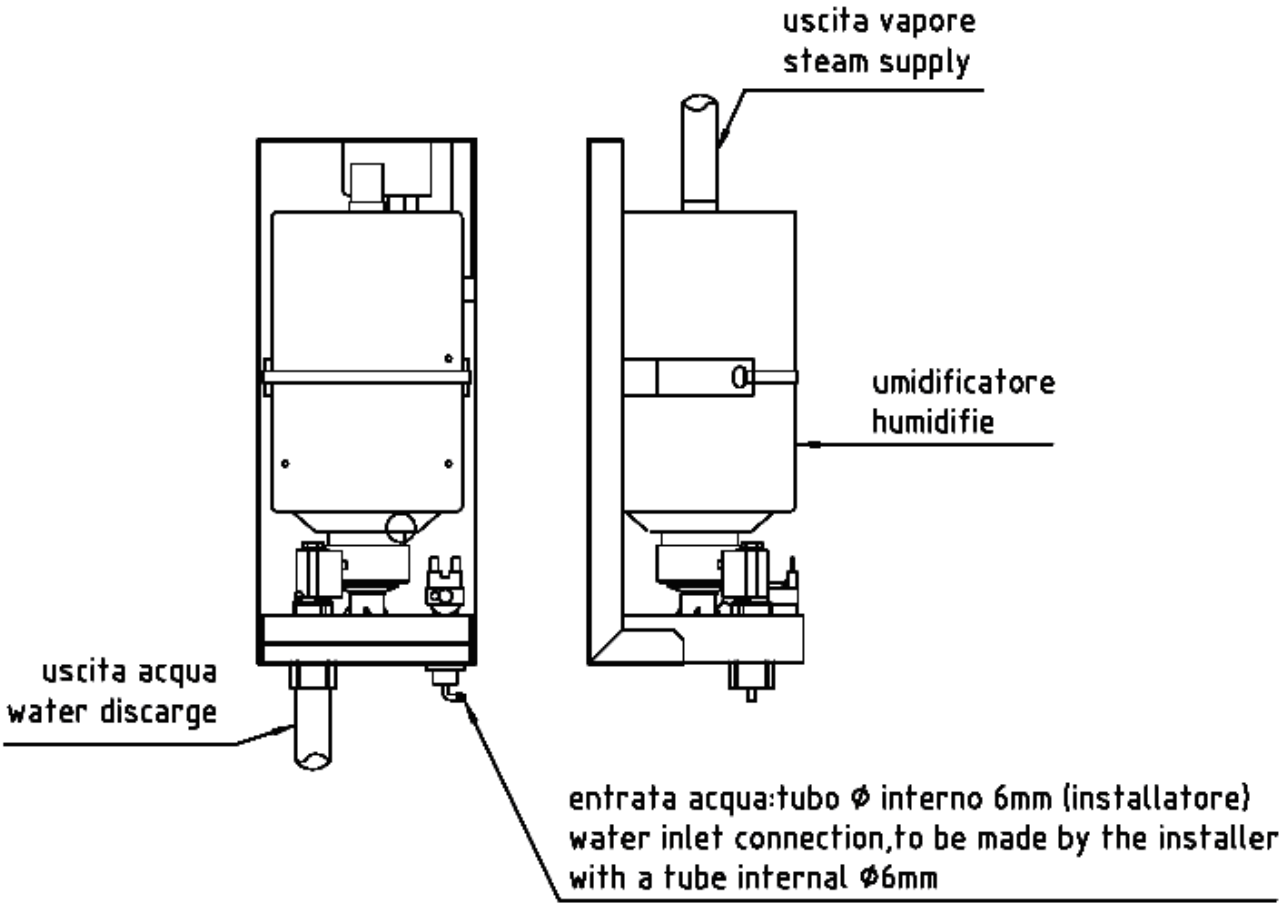
During installation of the unit it is necessary to connect a supply pipe (as shown in the figure) with the system characteristics indicated below. The discharge pipe is supplied ready-installed by Tecnair LB.

The water connection should satisfy the following conditions:

- A shut-off cock must be installed in the water supply pipe
- There must be a mechanical filter installed on the supply line
- The water temperature and pressure must be within the permitted value range 9)

For more information of the characteristics of the humidifier water circuit, please refer to the**User manual for the internal humidifier**.

WARNING!
DRAIN WATER AT 100 °C



4.7 REFRIGERANT CIRCUIT CONNECTIONS

The pipes must be made from Gelidus type copper, soft annealed for pipes with diameters 26 - 28, and hard drawn for larger diameter pipes.

To prevent copper dust or swarf from getting into the system, the pipes should be cut using a pipe cutter rather than a hacksaw. The ends of the pipes should then be carefully cleaned.

If the ends are to be soldered, they should be cleaned with grade 00 glasspaper to eliminate all oxidisation and dirt. After which the pipe should be inserted in the joint and heated evenly to the melting point of the solder so that flows easily around the joint

It is important to remember that the pipes should be as short as possible with bends kept to a minimum, as the cooling capacity of the circuit can be summarised as follows:

Total length of the pipes (discharge and return):

- > 20 m: - 2%
- > 40 m: - 4%
- > 60 m: - 6%

4.7.1 DISCHARGE OR HOT GAS LINE

This is the refrigerant line that connects the compressor outlet to the air-cooled condenser inlet.

To facilitate connection inside the air conditioner, there is a section of pipe approximately 20 cm long, of which one end is connected to the compressor outlet while the other end is crimped and soldered shut.

During operation of the air conditioner, the discharge line reaches a temperature of 70 - 80 °C. It is not necessary to thermally insulate this pipe as heat dispersal along this line facilitates correct operation of the refrigeration cycle. The pipes should only be insulated for safety reasons in cases where there is a possibility that someone could come into accidental contact with the discharge pipe.

4.7.2 LIQUID OR RETURN LINE

This is the pipe that connects the condenser outlet to the air conditioner inlet valve.

It is connected by soldered joints to the condenser and to the inlet valve. The operating temperature of this pipe is about 40°C; it does not need to be thermally insulated except in cases where the air conditioning system is also to operate in winter with temperatures below zero.

4.7.3 NON-RETURN VALVES ON DISCHARGE AND RETURN LINES

WARNING!

In installations with refrigeration circuit pipes longer than 10 metres with vertical pipe runs and the condenser located higher than the machine, it will be necessary to install a non-return valve on the refrigerant discharge pipe as near as possible to the compressor outlet.

This will prevent the refrigerant, in the event of the compressor shutdown, from flowing back down the discharge pipe to the compressor and thus damaging it at the next startup and/or preventing normal operation by causing a high-pressure blockage. Naturally the valve must be installed vertically and the right way round in accordance the refrigerant direction of flow.

In the case of pipe sections more than 20 m long and where minimum temperatures below -10°C may be expected, it will be necessary to install another non-return valve at the outlet of the air condenser, and as close to it as possible; the valve should be installed vertically to prevent the refrigerant from flowing back to the condenser when the system is off and the external temperature is very cold, and thereby preventing efficient condensation of the refrigerant the next time the compressor is started.

4.7.4 SOLENOID VALVE ON THE LIQUID LINE

The scroll compressors installed on TECNAIR LV air conditioners will not be damaged by the presence of any liquid refrigerant in the crankcase. However, when the refrigeration circuit is shutdown in the summer season, i.e. when the external temperature is just a few degrees higher than the internal temperature, the liquid refrigerant flows towards the compressor (the coldest point of the circuit) and, depending on the quantity of refrigerant in the system, floods it partially or completely. In this case, the high pressure switch may trip at the next startup.

It is therefore necessary to compare the refrigerant charge in the circuit, calculated as the sum of the contents of the various components of the circuit, with the maximum quantity compatible with correct operation without the solenoid valve on the liquid pipe, as indicated in the table below.

Size	Compressor		Maximum quantity of refrigerant (kg)
	Rated power (Hp)	Rated power (kW)	
21	2	6	2,8
31	3	10	3,6
41	3,5	11	5,4
51	5	15	5,4
71	6,5	22	5,4
81	7,5	24	7,3
101	10	30	10,0
131	12	40	12,5
151	15	46	13,5

Table of maximum compatible refrigerant quantities per circuit without installation of solenoid valve on liquid pipe

In the case that the calculated charge is greater than the maximum compatible quantity, it will be necessary to install a solenoid valve on the liquid line, which, by closing when the compressor is shut down, will prevent the refrigerant from flowing back towards the compressor through the liquid pipe.

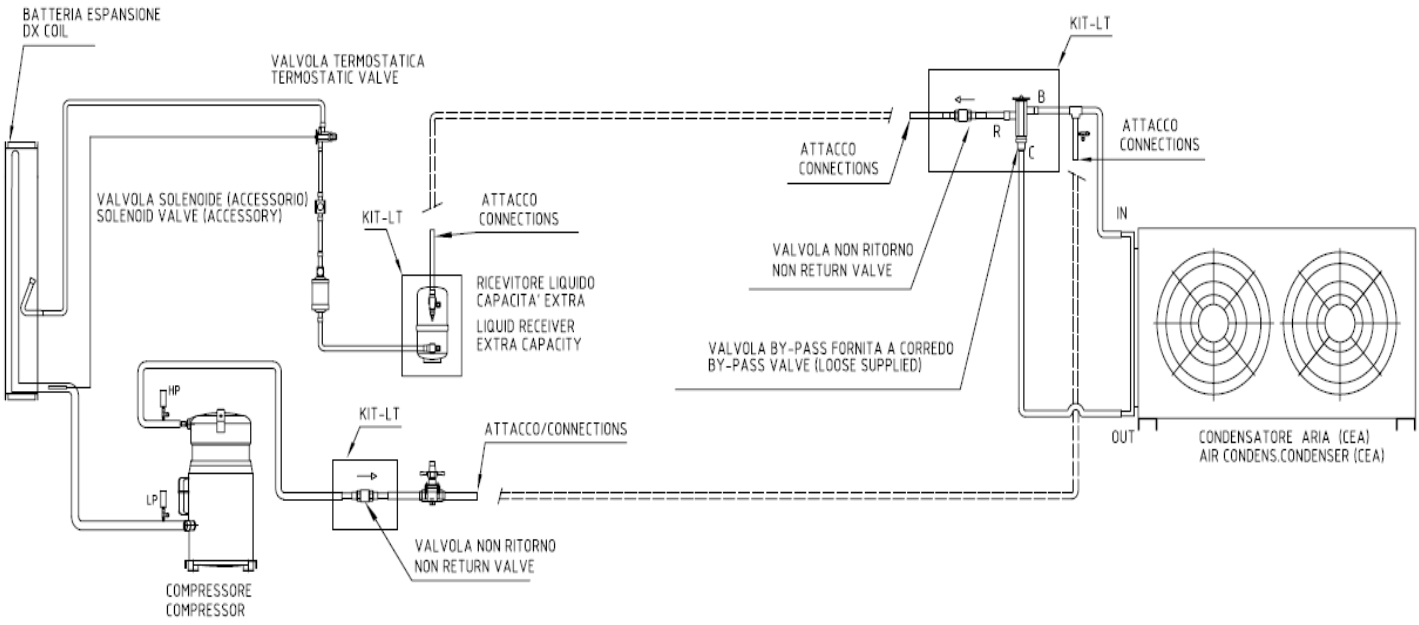
Obviously it is also necessary to prevent refrigerant from flowing back to the compressor through the discharge line. This is achieved by installation of the non-return valve on the discharge lines. The latter valve, unlike the solenoid valve, is not offered by TECNAIR LV as an optional accessory as it must be installed when the refrigeration circuit external to the machine is installed, while the solenoid valve is installed inside the machine itself.

4.7.5 VERY LOW EXTERNAL TEMPERATURE KIT

CEA air-cooled condensers, combined with Tecnair LV direct expansion air conditioners, are equipped as standard with air condensation pressure control via reduction of the air flow rate in accordance with the reduction in the condensation pressure. This system is very effective at external temperatures down to about - 20°C, thanks also to a 180 second delay on intevention of the low pressure switch on compressor startup. At external temperatures below this level and above all in the case of lengthy periods of non-use of the refrigeration circuit, the temperature of the liquid refrigerant can become so low that, in spite of the above-mentioned delay, the low pressure switch trips on compressor startup, thus making starting impossible.

This problem can be avoided by installing the “very low temperature kit” accessory, which consists of a condenser flooding valve installed on the refrigerant connections of the air condenser.

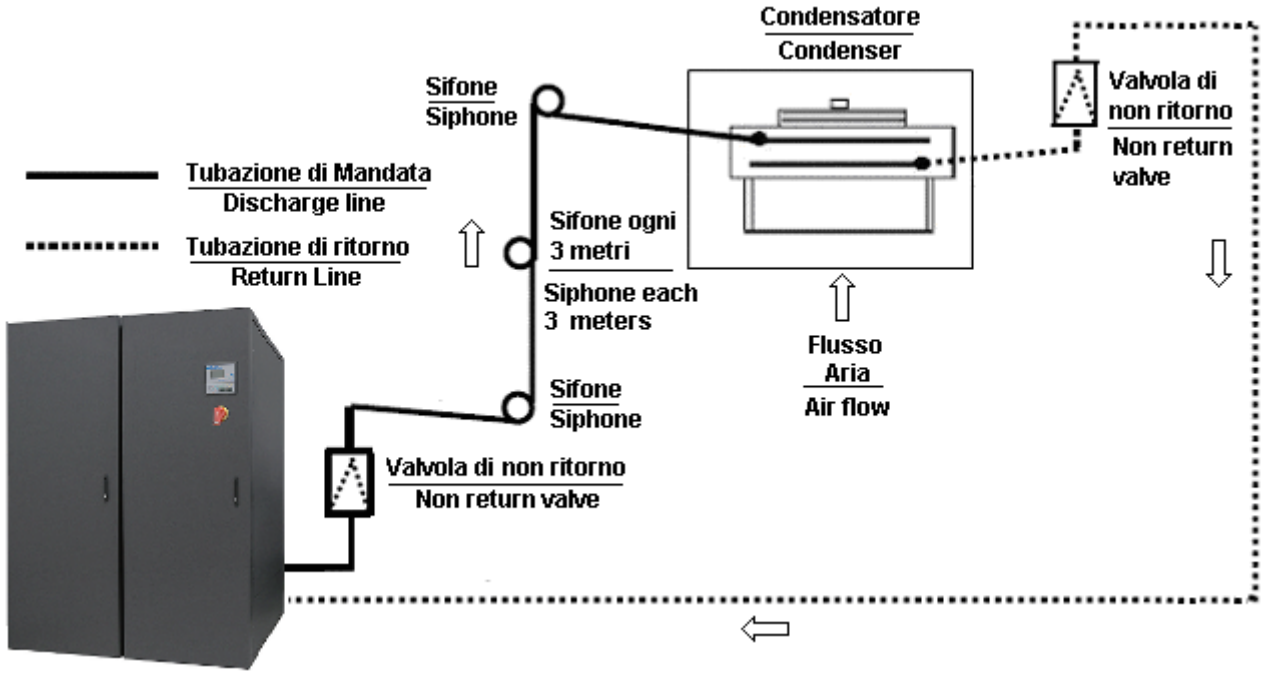
When the condensation temperature falls below -20°C, the valve progressively closes the condenser outlet, thereby flooding it and reducing proportionally the heat exchange. The refrigerant that bypasses the condenser is gaseous and at high temperature; it mixes with the liquid refrigerant at very low temperature at the condenser outlet, so that the resulting temperature is high enough to permit successful system startup. The volume of refrigerant present in the circuit must therefore be sufficient to be able to almost completely flood the condenser coil. During summer operation, however, the condenser coil must be almost completely free of liquid refrigerant in order to perform correctly. An oversize receiver is therefore installed in order to accommodate in summer the extra quantity of refrigerant that is required in winter to flood the condenser.



4.7.6 ROUTING OF THE REFRIGERANT CIRCUIT PIPES

Correct routing of the refrigerant circuit pipes is essential to the successful operation of the air conditioner. It is necessary to take special care in the selection and positioning of the compressor discharge and suction pipes, above all when these lines are relatively long and in particular:

- Horizontal sections of discharge pipes between the inside and outside components must have a gradient of at least 2% in the direction of refrigerant flow.
- If the discharge pipe has to rise above 3 m, a siphon with the minimum radius bend possible must be installed immediately before each rising section.
- Additional siphons must be provided every 3 m of rising pipe.
- Position a counter-siphon near the condenser union. The counter-siphon must be at least as high as the highest part of the condenser coil;
- All pipes must be secured with brackets every 2 metres. The pipe supports should prevent transmission of vibration and at the same time allow for normal expansion and contraction of the pipes due to temperature changes in operation.
- A 1/4" service valve must be installed on both pipes, as near as possible to the outside unit, to allow draining and charging of the circuit.
- The refrigerant inlet and outlet unions on the air-cooled condenser can be identified by their adhesive labels. In any case, note that the exchange of heat between the air and the refrigerant should occur in the **opposite direction to flow**. This means that the condenser inlet union for the gaseous refrigerant is the union furthest from the air inlet into the coil, i.e. the union nearest the fans. Likewise, the condenser outlet union for the liquid refrigerant is the union furthest away from the fans.



4.7.7 DIAMETERS OF REFRIGERANT CIRCUIT CONNECTION PIPES

Use the following table to determine the recommended diameters for the supply and return pipes in accordance with the machine size (given by the numerical sequence in the product code).

The values in the columns for pipe lengths up to 30m are also valid for longer lengths and do not need to be increased. However, it is advisable to position the air conditioners so that the pipes are kept as short as possible, to avoid significant loss of charge in the circuit and a consequent reduction in cooling capacity.

Size	Compressor		Pipes up to 15 mlong		Pipes from 15 to 30 m long	
	Rated power (Hp)	Rated power (kW)	Ø Discharge (mm)	Ø Liquid (mm)	Ø Discharge (mm)	Ø Liquid (mm)
21	2	6	Ø 12/14	Ø 10/12	Ø 14/16	Ø 10/12
31	3	10	Ø 14/16	Ø 10/12	Ø 16/18	Ø 10/12
41	3,5	11	Ø 14/16	Ø 10/12	Ø 16/18	Ø 10/12
51	5	15	Ø 16/18	Ø 10/12	Ø 20/22	Ø 14/16
71	6,5	22	Ø 16/18	Ø 10/12	Ø 20/22	Ø 14/16
81	7,5	24	Ø 20/22	Ø 14/16	Ø 26/28	Ø 14/16
101	10	30	Ø 20/22	Ø 14/16	Ø 26/28	Ø 16/18
131	12	40	Ø 26/28	Ø 16/18	Ø 26/28	Ø 16/18
151	15	45	Ø 26/28	Ø 16/18	Ø 26/28	Ø 20/22
72	2 × 3,5	25	2 × Ø 14/16	2 × Ø 10/12	2 × Ø 16/18	2 × Ø 10/12
102	2 × 5	30	2 × Ø 16/18	2 × Ø 10/12	2 × Ø 20/22	2 × Ø 14/16
142	2 × 6,5	42	2 × Ø 16/18	2 × Ø 10/12	2 × Ø 20/22	2 × Ø 14/16
162	2 × 7,5	45	2 × Ø 20/22	2 × Ø 14/16	2 × Ø 26/28	2 × Ø 14/16
202	2 × 10	64	2 × Ø 20/22	2 × Ø 14/16	2 × Ø 26/28	2 × Ø 16/18
262	2 × 12	75	2 × Ø 26/28	2 × Ø 16/18	2 × Ø 26/28	2 × Ø 16/18
302	2 × 15	90	2 × Ø 26/28	2 × Ø 16/18	2 × Ø 26/28	2 × Ø 20/22

Inside/outside diameters of refrigerant pipes

4.7.8 COMPLETION OF THE REFRIGERANT CHARGE

- **Direct expansion air conditioners are shipped pressurised with a nitrogen charge.**
- **Air-cooled condensers are shipped pressurised with a nitrogen charge.**
- **Machines with internal water-cooled condensers are supplied fully charged with refrigerant**

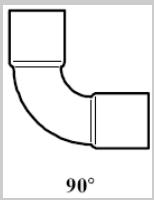
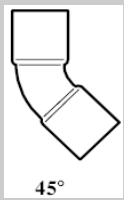
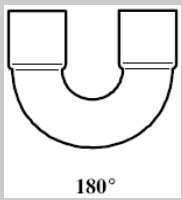
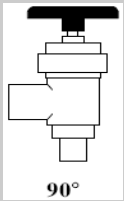
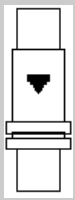
To charge the refrigerant circuit/s of a machine, it is necessary to consider that the total quantity of refrigerant required for a direct expansion unit equipped with remote condenser is determined by the summing the refrigerant contents of each individual component in the circuit. The refrigerant contents of the individual components are given in the following table.

Size	Compressor		Contents of refrigerant circuit (kg)
	Rated power (Hp)	Rated power (kW)	
21	2	6	0,4
31	3	10	0,5
41	3,5	11	0,5
51	5	15	0,5
71	6,5	19	0,8
81	7,5	25	1,0
101	10	30	1,2
131	12	36	1,6
151	15	45	1,9
72	2 × 3,5	25	2 x 0.5
102	2 × 5	30	2 x 0.5
142	2 × 6,5	42	2 x 0.8
162	2 × 7,5	45	2 x 1.0
202	2 × 10	64	2 x 1.2
262	2 × 12	75	2 x 1.6
302	2 × 15	90	2 x 1.9

Refrigerant contents of the unit

Weight of refrigerant in the discharge and liquid lines:

	Weight of refrigerant in kg per metre of pipe (R407C)					
Diameters	**Ø 10/12**	**Ø 12/14**	**Ø 14/16**	**Ø 16/18**	**Ø 20/22**	**Ø 26/28**
Liquid pipe	0,08	0,11	0,15	0,20	0,31	0,53
Discharge pipe	0,02	0,03	0,05	0,06	0,09	0,16

	 90°	 45°	 180°	 90°	
Diameters	**Equivalent metres (m)**				
Ø 12	0,50	0,25	0,75	2,10	1,90
Ø 14	0,53	0,26	0,80	2,20	2,00
Ø 16	0,55	0,27	0,85	2,40	2,10
Ø 18	0,60	0,30	0,95	2,70	2,40
Ø 22	0,70	0,35	1,10	3,20	2,80
Ø 28	0,80	0,45	1,30	4,00	3,30

Air-cooled condensers with CEA axial fans:

Model	Contents of refrigerant circuit (kg)	Model	Contents of refrigerant circuit (kg)
CEA 21c H/V	0,66	**CEA 91c H/V**	3,8
CEA 21c/LN H/V	1,0	**CEA 101c H/V**	5,2
CEA 31c H/V	1,32	**CEA 101c/LN H/V**	4,0
CEA 31c/LN H/V	2,0	**CEA 111c H/V**	5,3
CEA 41c H/V	1,32	**CEA 111c/LN H/V**	6,0
CEA 41c/LN H/V	1,9	**CEA 121c H/V**	4,0
CEA 51c H/V	1,95	**CEA 121c/LN H/V**	7,3
CEA 51c/LN H/V	2,9	**CEA 131c H/V**	4,0
CEA 61c H/V	2,58	**CEA 131c/LN H/V**	8,0
CEA 71c H/V	1,89	**CEA 151c H/V**	6,0
CEA 71c/LN H/V	3,6	**CEA 181c H/V**	8,0
CEA 81c H/V	2,88	**CEA 181c/LN H/V**	8,0
CEA 81c/LN H/V	4,0	**CEA 201c H/V**	10,5

Refrigerant contents of the circuit

For condensers not included in the CEA table, the refrigerant content will be 0.3 times the internal volume of the condenser indicated in the technical specifications supplied with the order confirmation.

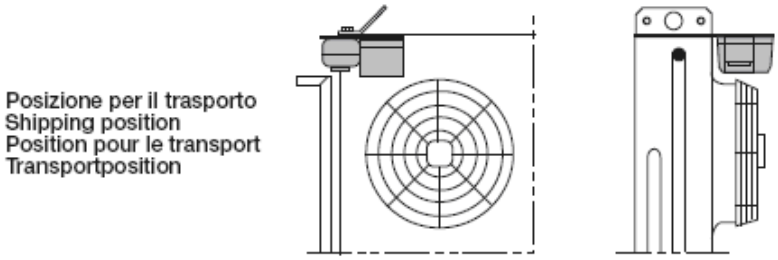
The sum of the refrigerant contents (air conditioner + liquid pipe + discharge pipe + condenser) gives the total refrigerant charge required by the system:

Refrigerant content of air conditioner OCA 71H:	0,8
Content of the CEA 61c H condenser:	2,6
10 metres of 16/18 diameter discharge pipe = 0.06 kg/m x 10 m =	0,6
10 metres of 10/12 diameter liquid pipe = 0.08 kg/m x 10 =	0,8
Total refrigerant content:	**4,8**

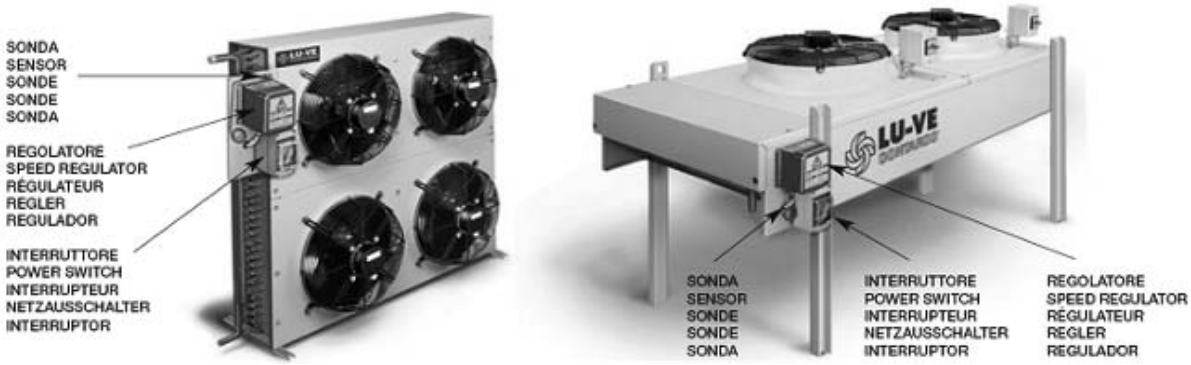
It is also necessary to add oil to the circuit in a quantity equal to approximately 5% of the total amount of refrigerant in the circuit. We recommend the use of SUNISO 3 GS for machines charged with R22 and MOBIL EAL ARTIC 22 BC or equivalent polyesters for machines charged with R407C.

4.7.9 PRESSURE REGULATOR OF CEA CONDENSERS

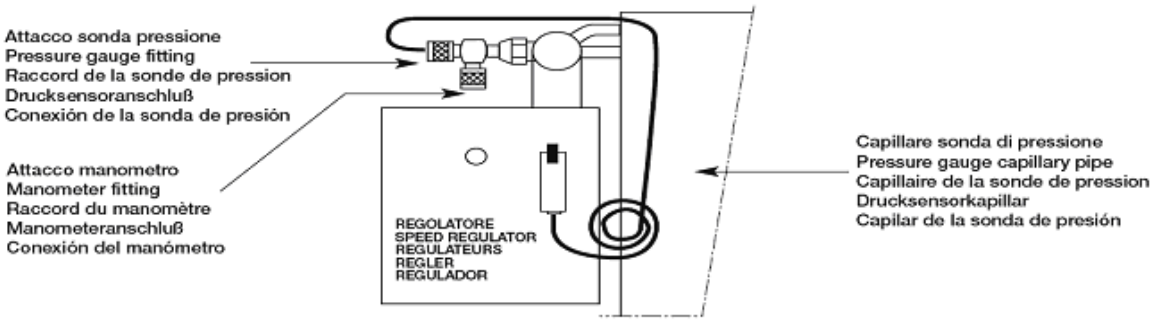
On completion of the installation of the condenser refrigerant connections, return the control panel to the vertical position to ensure a weatherproof seal, as shown in the figures below. The next tasks are to make the electrical connections and adjust the condensation pressure by way of the relative screw so that the condensation temperature, as read on the gauges, stabilises around 45 °C; turn screw 1 clockwise to increase rotation speed and anti-clockwise to decrease it. Where necessary, the minimum condenser speed, which is set by default to 45%, can be reduced by adjusting screw 2 in accordance with the diagram below.



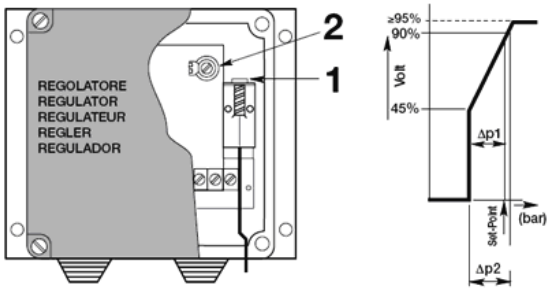
Positioning of the speed regulator for transport



Positioning of the speed regulator



Connection of the pressure sensor



Setting the evaporation pressure

4.8 ELECTRICAL CONNECTIONS

WARNING!
BEFORE CARRYING OUT ANY OPERATIONS ON THE UNIT, SET THE MAIN SWITCH TO POSITION "O"

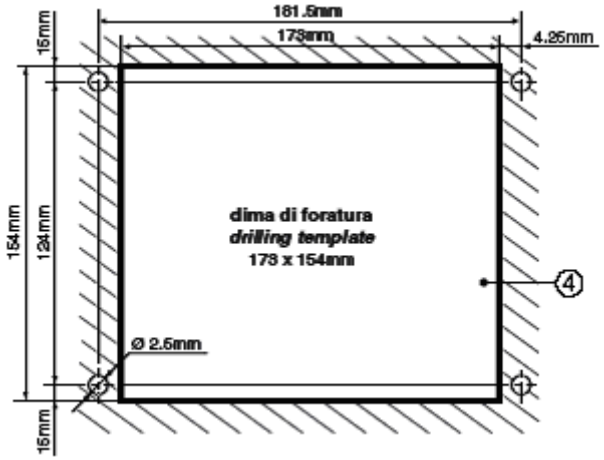
The external electrical connections of the air conditioner must satisfy the following prescriptions:

- They must be suitably dimensioned to withstand the maximum load in Amperes indicated on the electrical wiring diagram and on the data plate located inside the electrical compartment of the unit itself.
- The power supply must be within the following limits in order to avoid possible malfunction of the installed components:
  - Voltage tolerance limits: ± 10%
  - Frequency tolerance limits: ± 2%
- The power supply line from the external thermal-magnetic circuit breaker with Residual Current Device to the machine must be direct without any interruptions or junctions.
- A Residual Current Device with thermal-magnetic circuit breaker, the installation of which is responsibility of the Customer, is essential in order to provide overcurrent protection on the supply line (Articles 7.2.1 and 7.2.6 of standard CEI EN 60204-1), and must be located as near as possible to the machine. The thermal magnetic circuit breaker must be equipped with a residual current device (RCD) with a trip settings of 30 - 300 mA to provide protection for persons against both indirect and direct contact, in addition to thermal and magnetic overload protection. The RCD serves also to protect the air conditioner against insulation failure.
- The earth connection must be made with a conductor having the minimum cross-section indicated in the wiring diagram.
- To prevent operating problems with the microprocessor controls, it is necessary that no other loads (pumps, condensers, etc.), even those that are part of the same system, are connected downstream of the main switch of the air conditioner, unless explicit permission is granted by TECNAIR LV. If this condition cannot be met, it will be necessary to connect suppressors (R + C) in parallel with the coils of the relays of any such loads.
- The signal/control cables must be kept separate from high-current cables, power cables and any cables that are potential sources of electromagnetic interference.
- To avoid possible damage to electrical and electronic equipment caused by voltage surges in the electrical supply line, TECNAIR LV 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 electrical supply line.

4.8.1 INSTALLATION OF THE REMOTE CONTROL INTERFACE

If the complete terminal or reduced version is to be panel or recess mounted, the maximum thickness of the panel must be 6 mm; if the terminal is to recessed mounted in a wall, a masonry box with internal dimensions sufficient to accommodate the terminal and the connection cables must be provided.

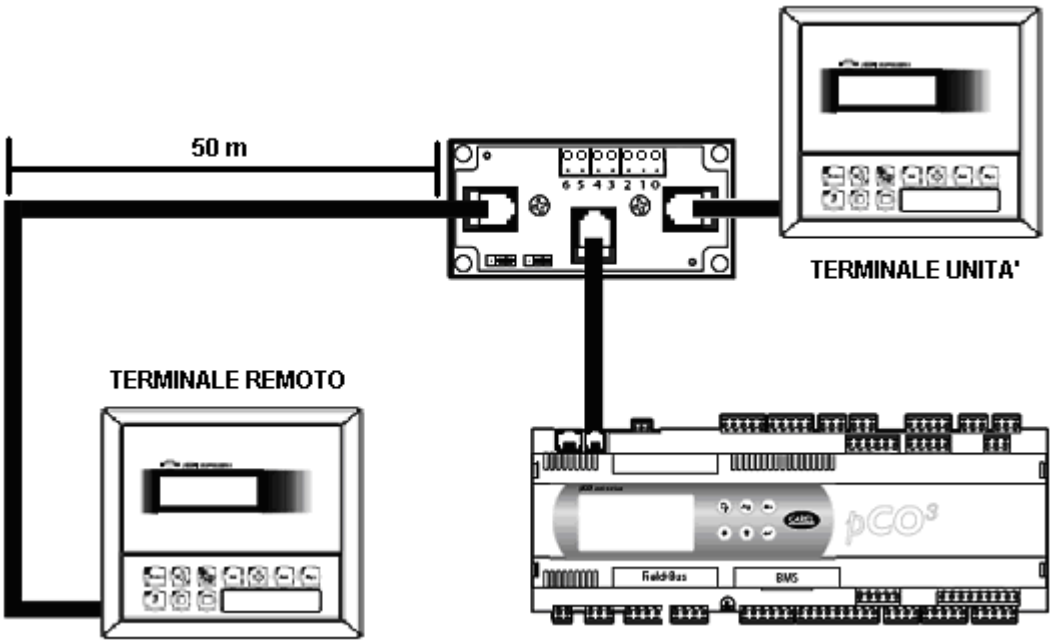
The drilling templates are illustrated below:



The user terminal is to be connected to the main board via a 6-wire telephone cable. To make the connection, it is sufficient to plug one of the telephone connectors into one of the terminals of the TCON6 board and the other into the terminal connector, as shown in the wiring diagram.

For safe connection, use the toroid supplied with the user terminal to avoid interference on the line could damage the memory or components of the board itself.

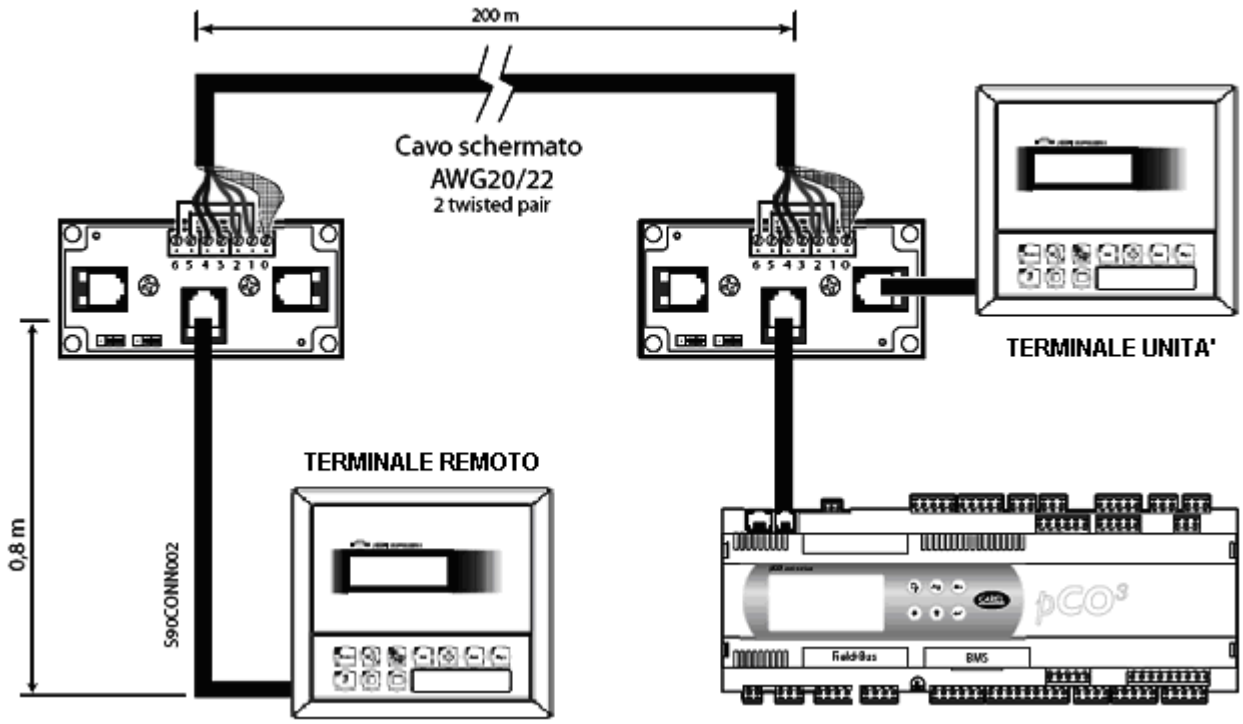
If the terminal is disconnected from the board when the unit is powered on, we advise waiting at least 5 seconds before reconnecting it.



Connection of the remote terminal

4.8.2 INSTALLATION OF THE REMOTE CONTROL TERMINAL AT A DISTANCE OF OVER 50 M

If the remote control terminal has to be installed at a distance of more than 50 m (up to a maximum of 200 m), two TCON6 boards must be used and connected together using a shielded AWG20/22 cable, as shown in the figure below. This is necessary to avoid significant signal loss between the terminal the microprocessor control.



Connection of a remote terminal (at over 50m)

5 CHECKS AND FIRST STARTUP

WARNING!
BEFORE CARRYING OUT ANY OPERATIONS ON THE UNIT, SET THE MAIN SWITCH TO POSITION "O"

Before the Manufacturer's personnel proceed with the testing and startup of the machines, the checks listed in the following form must be carried out.

DATE _____

PLACE _____

OPERATOR'S SIGNATURE _____

CUSTOMER'S SIGNATURE _____

Checks to be carried out before calling technician for startup

Machine startup with the refrigeration circuit requires that the units are 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 the compressor to ensure that the compressors functions correctly. The crankcase heaters switch on automatically when the machine is powered on.

REFRIGERANT CIRCUIT CHECKS

	DESCRIPTION	POSITIVE	NEGATIVE
1	Check discharge pipe diameter conforms with indications in the installation manual.		
2	Check 'horizontal' sections of the discharge line have a gradient of at least 1% in direction of refrigerant flow		
3	Check that siphons are installed at the lowest point of each rising pipe and every 3 m along rising pipe sections, as well as a counter siphon at the highest point of the rising pipe.		
4	Check the non-return valve is installed as near as possible to the compressor with the aperture in the direction of refrigerant flow (pipes longer than 5 m).		
5	Check the non-return valve is installed as near as possible to the compressor with the aperture in the direction of refrigerant flow (pipes longer than 10 m)		
6	Check that the discharge pipe is insulated in the sections where accidental operator contact is possible (pipe temperature in operation approx. 70/80°C)		
7	Check that support brackets are installed on the discharge pipe every 3 m and are not too tight so as to allow expansion of the pipe.		
8	Check liquid pipe diameter conforms with indications in the installation manual.		

9	Check that support brackets are installed on the discharge pipe every 3 m and are not too tight so as to allow expansion of the pipe.		
10	Check that the refrigerant circuit valves are open, including the valve on the hot gas injection pipe.		
11	Check the electrical connections to the condenser disconnect switch.		
12	Check that the disconnect switch is in the closed position (condenser powered on).		
13	Check the refrigerant pipe connections between the condenser and the evaporator are in the opposite direction to the air flow and the refrigerant flow.		
14	Check that the condenser is positioned correctly to prevent air recirculation that would otherwise impair performance.		
15	Check the charge level in the refrigerant circuit.		
16	Check the evaporation pressure.		
17	Check the condensation pressure.		
18	Check the superheating of the refrigerant aspirated by the compressor.		
19	Check the subcooling of the liquid refrigerant.		
20	Check that the liquid line filter is not clogged.		
21	Check the power consumption of the compressor.		
22	Check operation of the high pressure control switch.		
23	Check operation of the low pressure control switch.		
24	Check the compressor operating temperature.		

WATER CIRCUIT CHECKS

	DESCRIPTION	POSITIVE	NEGATIVE
25	Check that the inlet and outlet of the hot and cold water supplies conform with the arrows marked on the fittings or, if these are missing, with the drawings in the installation manual for the machine.		
26	Check that all the liquid supply pipes are provided with manual shut-off cocks just outside to the machine, and that theses cocks are open.		
27	Check that the condensate drain outlet does not have taps or sections with upward gradients.		
28	Check that the hardness of the water supply is between 10 and 40 French degrees.		
29	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.		

ELECTRICAL POWER SUPPLY CHECKS

	DESCRIPTION	POSITIVE	NEGATIVE
30	Check the connection of the three phases, neutral and earth.		
31	Check that the power supply voltage and frequency are within the tolerance limits of +/- 10%.		

CHECKS FOR AMBIENT SENSOR AND REMOTE TERMINAL CONNECTIONS (IF PRESENT)

	DESCRIPTION	POSITIVE	NEGATIVE
32	Check positioning as described in the installation manual.		
33	Check that electrical connection between the sensors and the electrical panel is as indicated in the wiring diagram and the installation manual.		

NOTES ON ANOMALIES ENCOUNTERED DURING CHECKS

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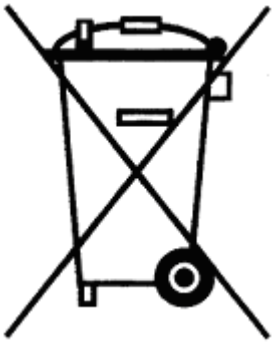
6 DEACTIVATION, DISASSEMBLY AND SCRAPPING

WARNING!
BEFORE CARRYING OUT ANY OPERATIONS ON THE UNIT, SET THE MAIN SWITCH TO POSITION "O"

TECNAIR LV air conditioners must only be dismantled by specialised technical personnel. In any case, the following points must be observed:

- Switch off the air conditioner first by way of the microprocessor control
- Open the machine's main door lock switch
- Open the external thermal-magnetic circuit breaker to isolate the air conditioner from the electrical power supply.
- The refrigerant contained in the air conditioner should be disposed of in accordance with the waste disposal and safety regulations applicable in the country of installation.
- Disconnect, where applicable, the refrigerant lines, the water connections and the condensate drain lines from the air conditioner.
- The scrapping of air conditioner is subject to the prevailing legal requirements in the country of installation.
- TECNAIR LV recommends that you contact an authorised waste disposal contractor for this purpose.
- Air conditioners are made primarily from raw materials such as aluminium, copper and steel.

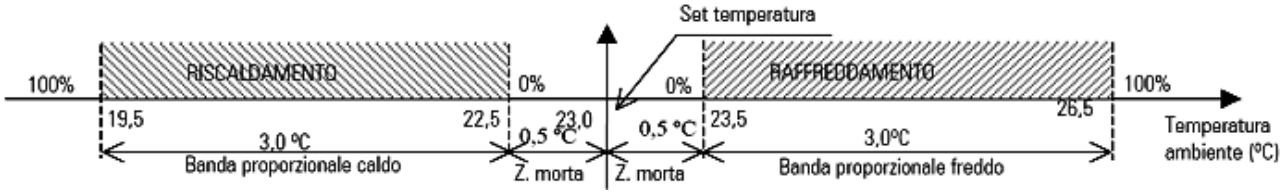


7 USE OF THE AIR CONDITIONING UNIT

7.1 TEMPERATURE CONTROL

The heating and cooling devices are controlled in accordance with the temperature readings measured by the ambient sensor (or return air sensor) This temperature reading is compared with the set-point temperature, and the heating and cooling devices are activated according to the difference between these temperature values. The proportional band determines the operating range of the air conditioner and may assume different values during heating and cooling. The dead band identifies a range around set-point in which no control action takes place.

The following diagrams illustrate the behaviour of the heating and cooling devices. The percentage values indicate the degree to which the modulating valves are opened.



7.1.1 PROPORTIONAL CONTROL

The control action is a proportional function of the difference between the desired temperature or humidity value (set-point) and the value actually measured expressed as a percentage of the proportional band.

This mode, which is the default control mode, ensures good temperature and humidity control in normal ambient conditions.

7.1.2 PROPORTIONAL + INTEGRAL CONTROL

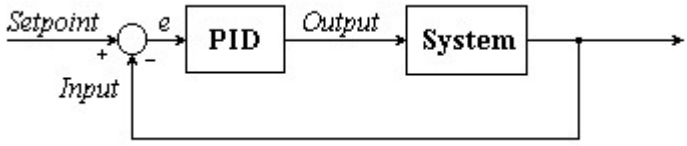
The control action is a function of the percentage difference on the proportional band between the desired temperature and the calculated average temperature in the “integration time”.

In this way the control operates on the basis of an historical log of the values assumed by the temperature during the integration time and not just on the basis of the instantaneous temperature value. This eliminates the effect of any sudden and temporary changes in the temperature.

This control mode can be selected in cases where there are more stringent requirements for precision control.

7.1.3 PROPORTIONAL + INTEGRAL + DERIVATIVE CONTROL

Increases system damping and stability, thus enhances the other two control actions (with their respective benefits) while maintaining stability. The control action is effected in accordance with the function:



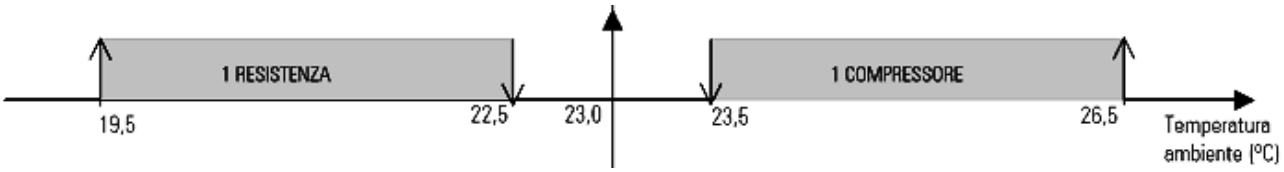
$$Output = Kp * (e + \frac{1}{Ti} * \int e \cdot dt + Td \frac{de}{dt})$$

where ***Kp*** represents the proportional band, ***e*** represents the error ***(Input - Set-point)***, i.e. the difference between the actual value and the set-point value, ***Ti***and ***Td*** are respectively the derivation and integration times, from the time interval taken into consideration and the error interval. We advise that initially only Proportional Control is used, adjusting the ***Kp*** value until satisfactory operation is obtained; at this point integral control action ***Ti*** may be introduced, while simultaneously reducing the ***Kp*** so as not to impair system stability. Finally, on introducing derivative control action ***Td***, the system tends to stabilise and it will therefore be possible to increase the ***Kp*** value again.

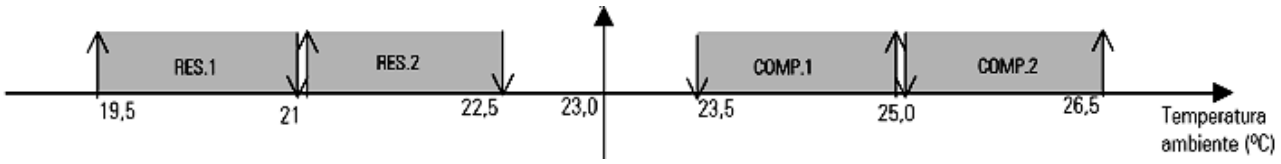
This control mode can be selected in cases where there are more stringent requirements for precision control and the unit inlet temperatures are not constant (excessive external air).

7.1.4 DIRECT EXPANSION AIR CONDITIONERS

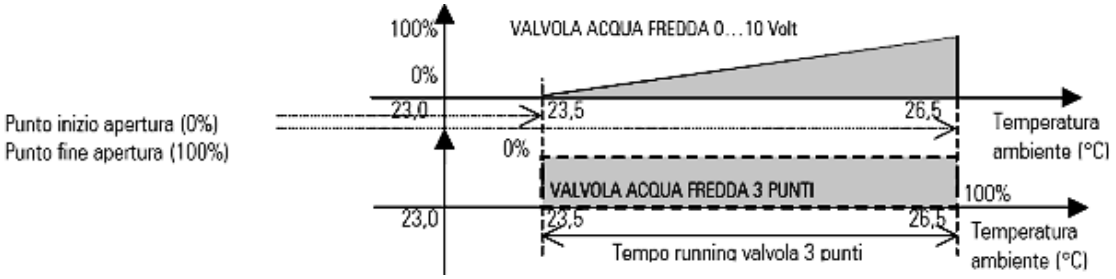
- **AIR CONDITIONER WITH A SINGLE COMPRESSOR**



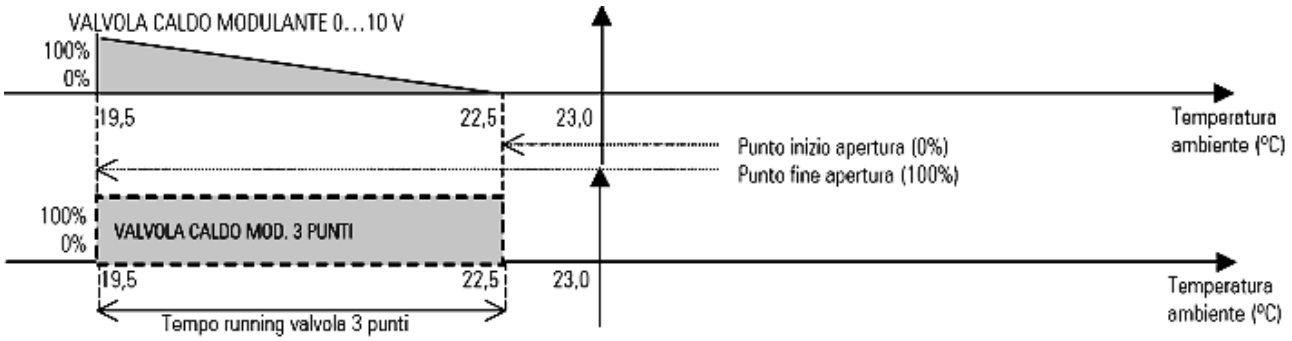
- **AIR CONDITIONER WITH TWO COMPRESSORS**



7.1.5 CHILLED WATER AIR CONDITIONER



7.1.6 HEATING WATER COILS



7.1.7 COOLING CAPACITY CONTROL WITH HOT GAS INJECTION VALVE

Control of cooling capacity is achieved through an electronic hot gas injection system. Injection of hot gas downstream of the thermostatic valve reduces cooling capacity in proportion to the request from the control system.

With this system it is possible to modulate the cooling capacity between 50% and 100% of the rated capacity, and obtain a corresponding reduction in power consumption. The opening of the injection valve is controlled by a 0 to 10V signal directly proportional to the percentage difference of the temperature from the set-point in relation to the proportional band.

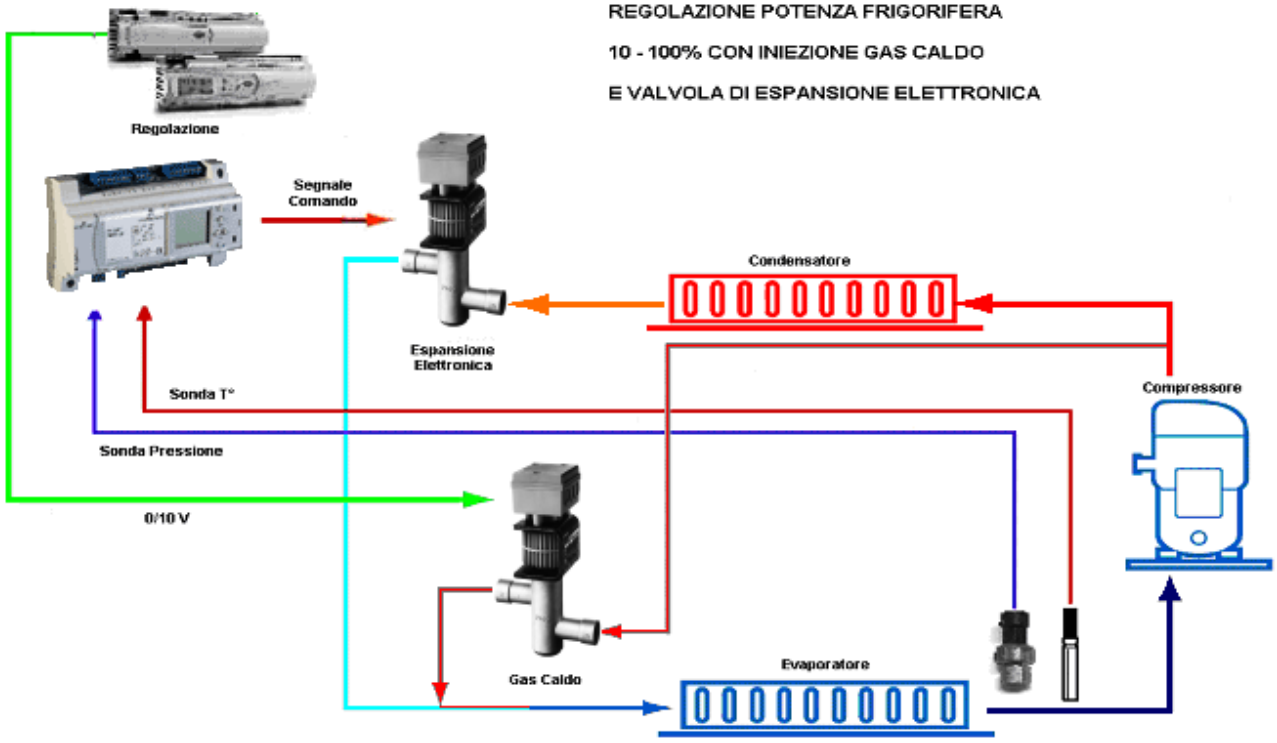
7.1.8 COOLING CAPACITY CONTROL WITH HOT GAS INJECTION VALVE AND ELECTRONIC EXPANSION VALVE

In cases where a 50% reduction in cooling capacity is not compatible with the requirement for perfect system control, installation of an electronic expansion valve in place of the standard thermostatic expansion valve allows electronic control of the hot gas to reduce cooling capacity down to just 10% of the system's rated capacity.

The electronic expansion valve (EEV) allows control of superheating on the suction line for more efficient and versatile operation of the refrigeration system.

It is efficient, because the optimisation and stabilization of the flow of refrigerant to the evaporator increases the overall output of the system while at the same time guaranteeing safety (less frequent tripping of the low pressure control switch, less liquid refrigerant returning to the compressor, ...).

The following diagram shows a typical system layout. The priorities to be considered for optimal control of the refrigeration system are a high and constant cooling capacity as well as stable superheating.



7.2 SUPPLY AIR TEMPERATURE CONTROL (LIMIT)

7.2.1 µAC MICROPROCESSOR

With the µAC microprocessor control it is possible to install a supply sensor (limit) for display of the supply temperature and control of the relative low supply temperature alarm.

Below the set limit, the cold components will be progressively deactivated at temperature intervals of 3 °C. In dehumidification, low supply temperature control is not available.

7.2.2 pCO MICROPROCESSOR CONTROL

With the pCO microprocessor control, high and low supply temperature management is effected by way of various types of control in accordance with system requirements.

High temperature can be controlled in the following ways:

- **ALARM ONLY:** after the time delay, an alarm is generated
- **STOP HOT:** when the alarm threshold is exceeded, the hot component is deactivated; if, after the time delay, the temperature has still not fallen below the threshold, an alarm is generated.
- **HOT + COLD:** when the alarm threshold is exceeded, the cold component is activated proportionally to maintain the temperature below the alarm threshold. If after the time delay the temperature has still not fallen below the threshold, an alarm is generated.

Low temperature can be controlled in the following ways:

- **ALARM ONLY:** after the time delay, an alarm is generated
- **COLD STOP:** when the alarm threshold is exceeded, the cold component is deactivated; if, after the time delay, the temperature has still not risen above the threshold, an alarm is generated.
- **HOT + COLD:** when the temperature exceeds the alarm threshold, the hot component is activated proportionally to maintain the temperature above the alarm threshold. If after the time delay the temperature has still not risen above the threshold, an alarm is generated.

7.3 HUMIDITY CONTROL

Humidification control action is effected proportionally by way of the following components:

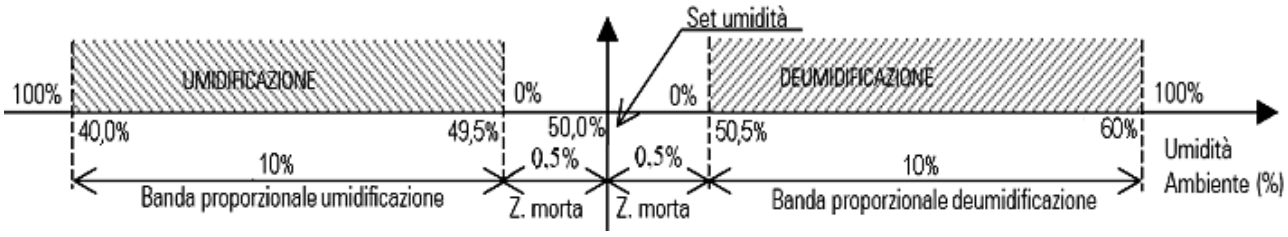
- Integrated immersed electrode humidifier
- External humidifier (not supplied by TECNAIR LV)

Proportional control provides a modulating effect on the quantity of steam produced, which in the case of the integrated humidifier ranges from to 8 to 100% of the total production, for both types of microprocessor control.

Dehumidification control is effected by a startup/opening step of the cold component with activation at the limit of the proportional control band. Once the component has been activated, the control proceeds by regulating the cooling capacity, in the case of the hot gas bypass or water chilled coil, up to the set-point.

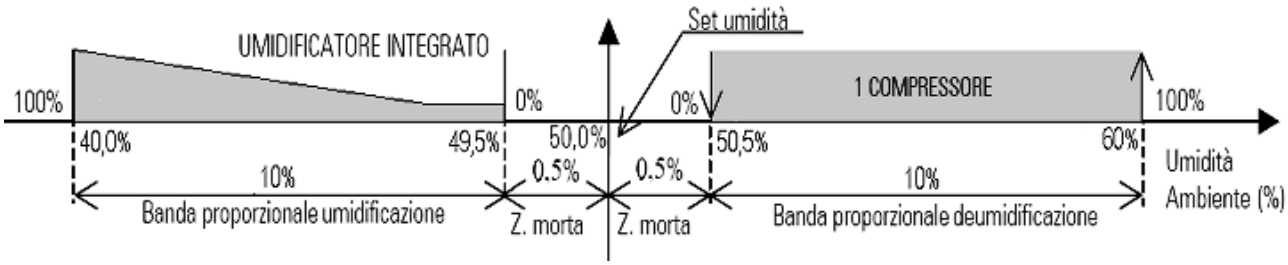
The cooling capacity is never reduced below 60% of the total to allow the effect of dehumidification.

The figure illustrates the system described above:

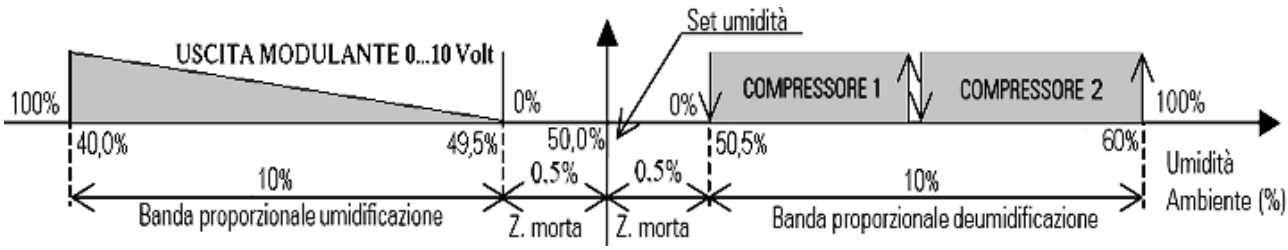


7.3.1 DIRECT EXPANSION AIR CONDITIONERS

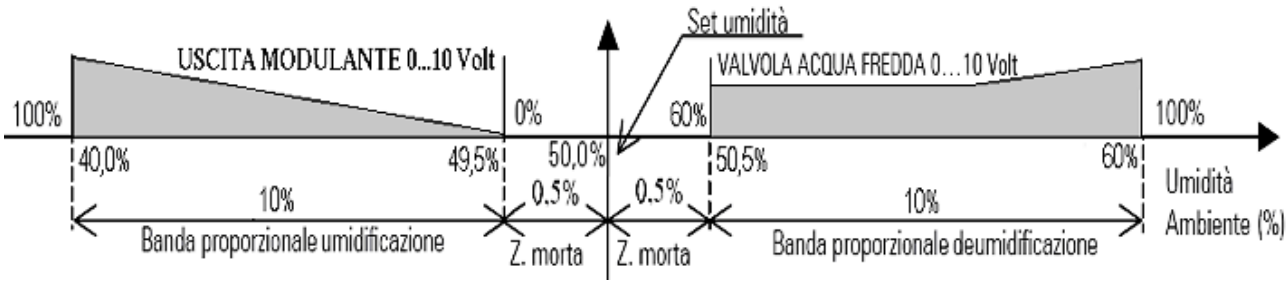
- **AIR CONDITIONER WITH A SINGLE COMPRESSOR**



- **AIR CONDITIONER WITH TWO COMPRESSORS**



7.3.2 CHILLED WATER AIR CONDITIONER



7.3.3 SIMULTANEOUS HUMIDIFICATION AND COOLING

Cooling the air increases its relative humidity until it reaches saturation point. It is clear that the air's capacity to absorb vapour depends on its relative humidity and falls to zero near saturation point. Attempting to humidify air in these conditions, i.e. immediately after cooling, causes the vapour to condense and the consequent formation of puddles of water inside the machine, as well as significant energy wastage.

For this reason, series C units are equipped with devices to interrupt humidification during operation, according to the type of microprocessor control installed:

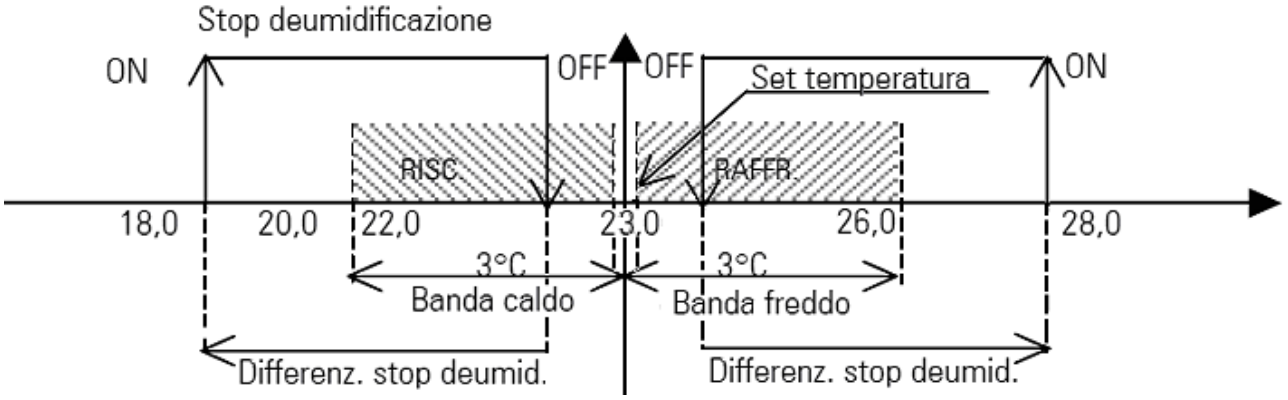
- **µAC:**
  - **Direct Expansion Unit:** Humidification is inhibited electro-mechanically.
  - **Chilled Water unit:** Humidification is permitted.
- **pCO:**
  - **All units:** Humidification is inhibited by way of the User parameter (default setting).

Should it be necessary to humidify the air at the same time as cooling it, so as to obtain, for example, a humidity of over 50%, then we recommend installing an external room humidifier.

7.3.4 DEHUMIDIFICATION LOCK

In cases where a post-heating coil (accessory) is not installed, problems of low temperature supply air may occur during dehumidification. In this case, a software lock intervenes to prevent a significant drop in room temperature.

If the air conditioner is dehumidifying and the temperature exceeds 150% of the proportional band, the microprocessor will inhibit dehumidification, thereby giving priority to temperature control. Dehumidification may restart, if still required, when the temperature reaches 50% of the proportional band.

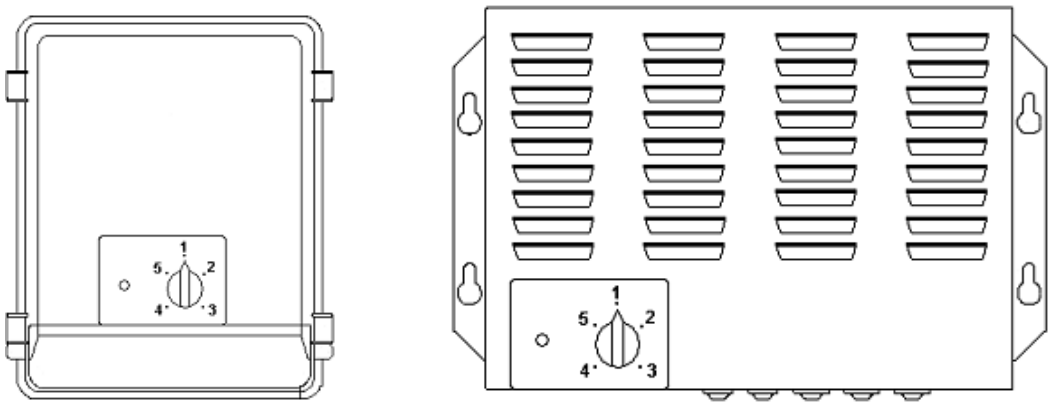


8 VENTILATION

8.1 FANS WITH 5-SPEED AUTO-TRANSFORMER

If it is expected that it will be necessary to vary the air flow rate during startup or use of the air conditioner, an auto-transformer may be installed to regulate the fan motor input voltage and thus the fan speed.

The auto-transformer affords the possibility to reduce the fan speed in 3 to 5 steps. Each step corresponds to a 15% reduction in the air flow rate.



5-speed auto-transformers

8.2 FANS WITH 0-10 V MODULATING CONTROL (pCO)

This type of fan affords the possibility to modulate the fan speed and thus the air flow rate by way of a 0 - 10 V control signal. This signal is generated by the pCO microprocessor control in accordance with one of three different control strategies:

8.2.1 CONSTANT FLOW RATE CONTROL

This control type is recommended in cases where F7 filters are installed on the supply duct in order to avoid frequent filter changes. With the aid of a pressure sensor, supplied pre-installed inside the machine and connected to the fan outlet, the pCO is able to calculate the instantaneous air flow rate and thus control the fan speed accordingly to ensure a constant air flow rate even in the event of clogged air filters which otherwise would significantly reduce the air flow.

This control type is configured by Tecnair LV during machine testing. The desired flow rate is entered from the keypad in the relative User parameter (see User Loop in the microprocessor control manual).

8.2.2 CONTROL WITH CONSTANT PRESSURE IN THE UNDERFLOOR OR SUPPLY DUCT

This is the ideal control type for areas divided into a number of different rooms with air distribution through the underfloor passages or through supply ducts with motorised dampers controlled by local thermostats. In this case once the desired temperature is reached in a room, the damper is closed, leading to a rise in the pressure in the underfloor passages or supply ducts and a consequent undesirable increase in the air flow delivered to the other rooms. The pressure sensor which is supplied pre-installed, informs the microprocessor control of any increase in pressure due to the partial or complete closure of one or more dampers. The microprocessor control therefore controls the speed of the fans in order to adjust the air flow rate and bring the pressure back within the set-point range. This solution is suitable for machines with chilled water coils. On direct expansion machines, it is only suitable with modulating control of cooling capacity.

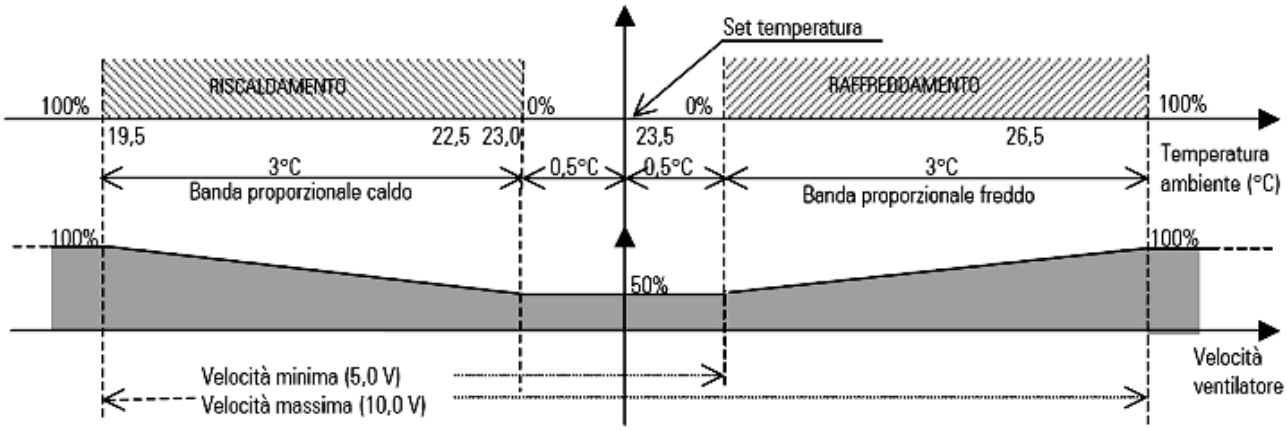
This control type is configured by Tecnair LV during machine testing. The desired pressure value is entered from the keypad in the relative User parameter (see User Loop in the microprocessor control manual).

8.2.3 CONTROL OF AIR FLOW RATE ACCORDING TO COOLING CAPACITY

The pCO controls the fans so as to modulate the air flow rate in accordance with the cooling capacity requested by the system. This can make for significant energy savings and a reduction in noise levels, particularly when operating with partial loads.

The minimum and maximum speed limits applied are defined by Tecnair LV according to the type of unit and thus the fan model installed. The minimum speed will in any case never be below 30%.

This solution can be applied on chilled water coil machines. On direct expansion machines, it is only suitable with modulating control of cooling capacity.



Example speed control from 50% to 100%

9 FREE COOLING AND TWIN SOURCES (pCO)

9.1 WATER FREE COOLING

The “Water Free Cooling” system installed on OCA…/FC - UCA…?/FC conditioners consists of an additional cold water coil, integrated in the machine’s finned evaporator coil pack, and a 3-way moudulating valve controlled by the microprocessor control.

As long as the external condition allow the water chiller to respond fully or partially to the request for cooling, the microprocessor control excludes compressor intervention completely or limits it to the absolutely essential, thus making for a considerable reduction in energy consumption. The compressors and the cold coil may therefore operate simultaneously.

The Free Cooling system is configured by Tecnair LV during machine testing, on the request of the customer.

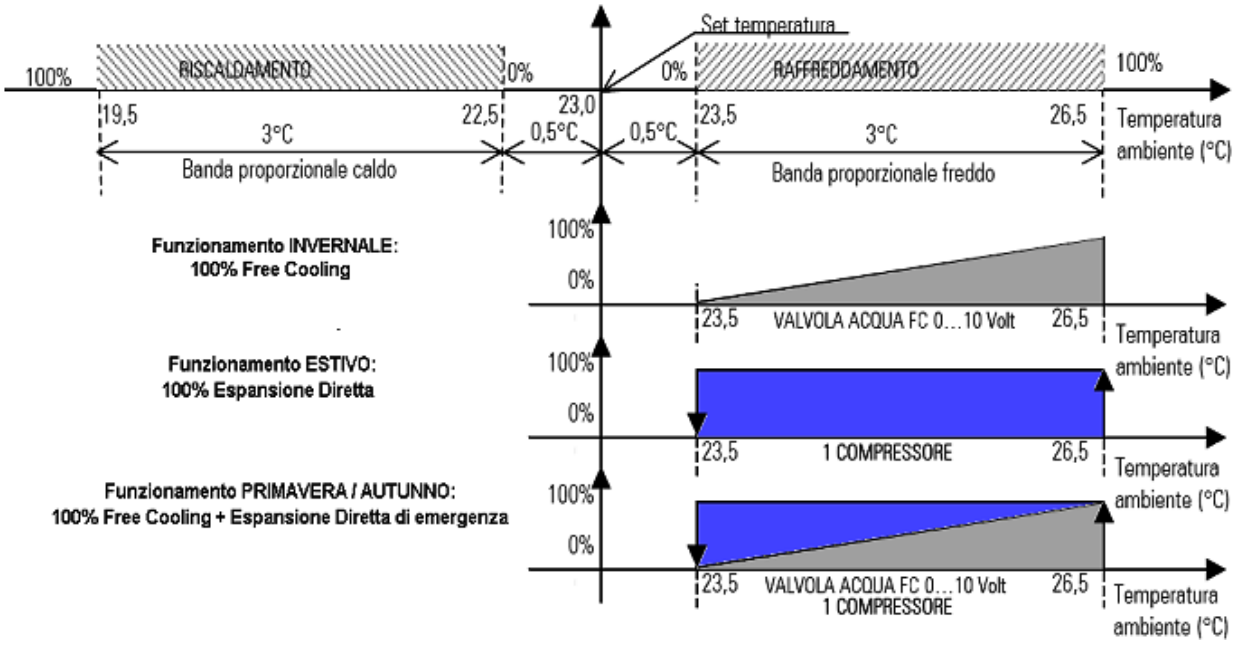
9.1.1 FREE COOLING CONTROL

The Free Cooling system is only enables when the following control logic conditions are met:

$$T_{FC} - T_{AMB} \geq \Delta_{FC}$$

Where T_{FC} is the temperature of the water entering the conditioner, T_{AMB} is the ambient temperature and Δ_{FC} is the activation delta value for Free Cooling operation(Default 4 °C).

The figure illustrates the system described above:



9.2 DIRECT EXPANSION TWIN SOURCES

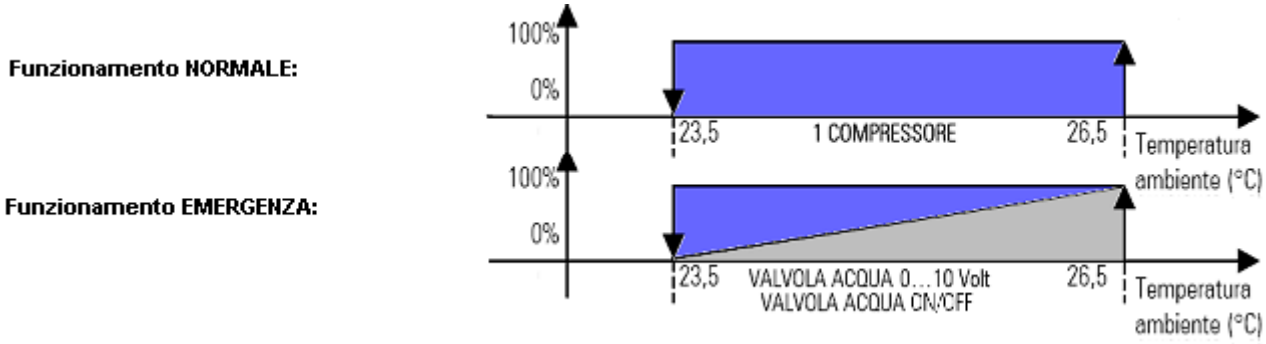
The “Direct Expansion Twin Sources” system installed on OCA…/TS - UCA…?/TS conditioners consists of an additional cold water coil, integrated in the machine’s finned evaporator coil pack, and a 3-way modulating valve controlled by the microprocessor control.

With this operating system, the compressors do not start as long as the cooling capacity of the chilled water system remains available. The direct expansion circuit is activated automatically in the event of an emergency, when the chilled water system is at the limit of its capacity or is out of service.

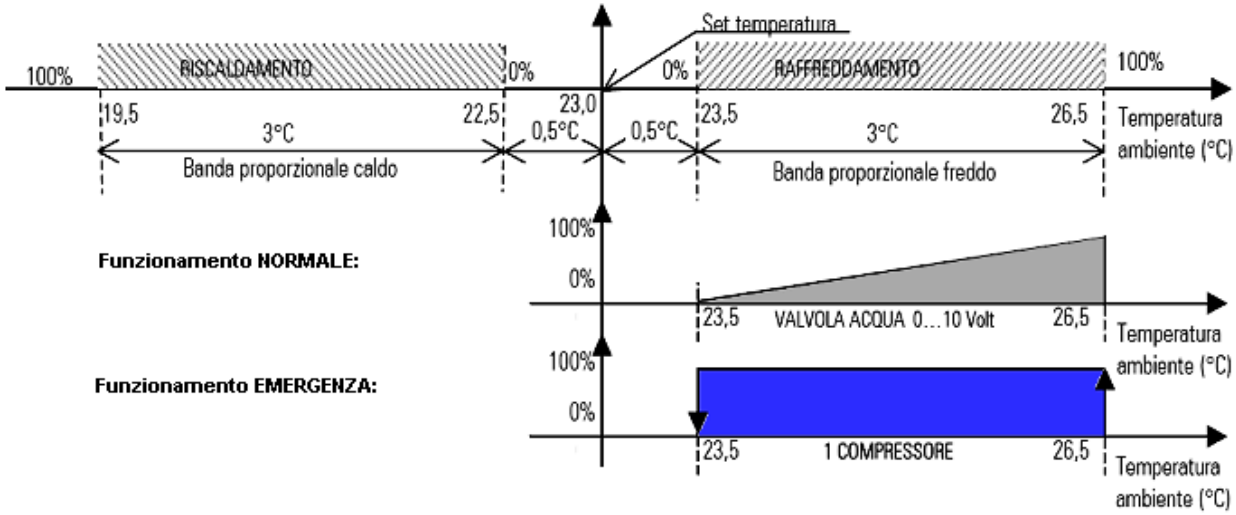
The same system can also be used as the primary source of cooling for the direct expansion circuit and, in an emergency, as the water coil connected to the drinking water supply, with an operation similar to that previously described.

The Twin Sources system is configured by Tecnair LV during machine testing, on the request of the customer.

9.2.1 DIRECT EXPANSION - WATER TWIN SOURCES(OCA…?/TS - UCA…/TS)



9.2.2 WATER - DIRECT EXPANSION TWIN SOURCES(OCA…/TS - UCA…/TS)



9.3 WATER CHILLED TWIN SOURCES

The “Water chilled Twin Sources” system installed on conditioners OCU…?/TS -? UCU…?/TS consists of an additional cold water coil, integrated in the machine’s finned evaporator coil pack, and a 3-way modulating valve controlled by the microprocessor control.

In this operating system, the second water circuit does not enter into operation as long as the cooling capacity of the chilled water system remains available. The secondary water circuit is activated automatically in the event of an emergency, when the chilled water system is at the limit of its capacity or is out of service.

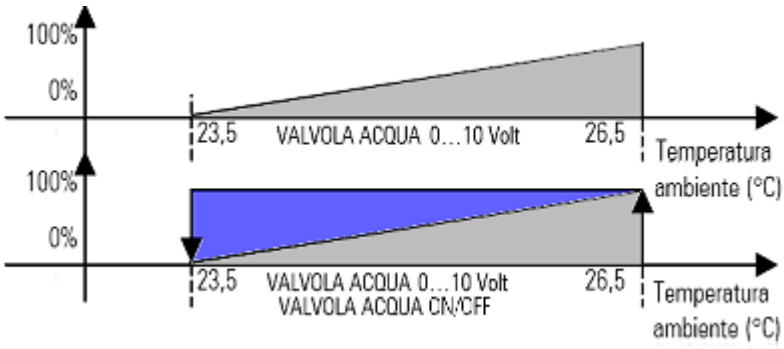
This system may also use an ON-OFF valve installed in place of the modulating valve on the secondary circuit.

The Twin Sources system is configured by Tecnair LV during machine testing, on the request of the customer.

9.3.1 WATER - WATER TWIN SOURCES(OCU…/TS - UCU…/TS)

Funzionamento NORMALE:

Funzionamento EMERGENZA:



10 LOCAL NETWORK

10.1 MASTER - SLAVE LOCAL NETWORK

Provides increased operating security in rooms where this is necessary through the Master - Slave configuration. In this type of local network the units are all activated with the exception of one designated slave unit, which remains on standby. The cooling capacity is thus divided between the active units until a critical situation or an increase in demand causes the slave unit to be activated to meet the additional cooling requirement. During normal operation, the units operate in rotation to ensure that the total operating hours are distributed evenly amongst all the units.

The µAC microprocessor can control a maximum of **6 units**, while the pCO microprocessor can control up to **8 units**.

10.2 CASCADE LOCAL NETWORK(pCO)

Unlike the master - slaveversion, in rooms where the thermal load is not constant, it is possible to apply a cascade type local network to increase energy savings. Normally only one unit is in operation and the other slave units only start operating in the event of a critical situation to meet the increased thermal demand from the room in question. During normal operation, the units operate in rotation to ensure that the total operating hours are distributed evenly amongst all the units.

This function is only possible with the pCO microprocessor, which can control a maximum of **8 units**.

10.3 CRITICAL SITUATIONS

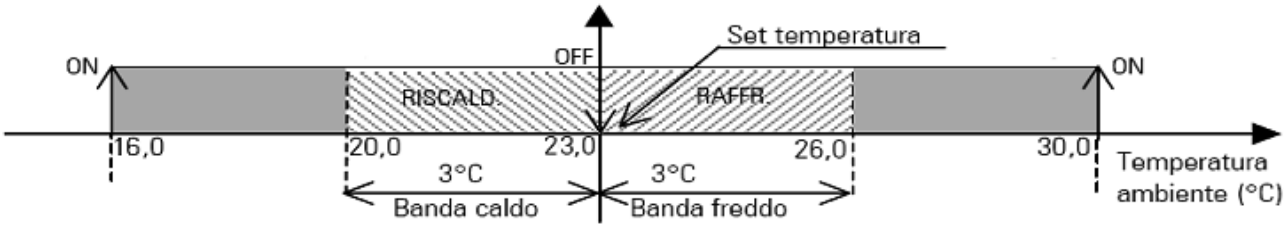
The units in the local network are activated in the following critical situations:

- One of the circuit boards is without power (black-out);
- A major alarm is generated in one of the circuit boards;
- One of the circuit boards is disconnected from the network (line disconnected);

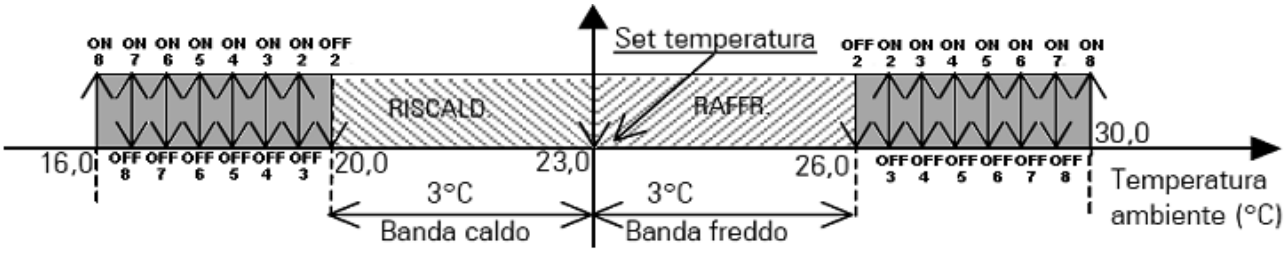
If a critical situation arises on one of the standby units, no action is taken by the network other than to signal the alarm on the unit in question.

10.4 EMERGENCY OPERATION

- **MASTER - SLAVE UNITS UNITS**



- **UNITS IN CASCADE NETWORK (pCO)**



11 ROUTINE AND MAJOR MAINTENANCE

WARNING!
BEFORE CARRYING OUT ANY OPERATIONS ON THE UNIT, SET THE MAIN SWITCH TO POSITION "O"

11.1 PROGRAMMED MAINTENANCE CHART

The recommended unit maintenance programme is summarised in the following chart:

COMPONENTS		CHECK EVERY			
		1 MONTH	3 MONTHS	6 MONTHS	1 YEAR
FANS	Check general condition: corrosion, mountings, cleanliness		X		
	Check motor noise		X		
	Check the rotor: vibration, imbalance		X		
	Check power consumption			X	
	Clean the rotor and the motor		X		
AIR FILTERS	Check the condition of the filters: Mountings, signs of damage	X			
	Check filters are not clogged	X			
	Check operation and calibration of differential pressure switches			X	
MICROPROCESSOR CONTROL	Check the system operates correctly	X			
	Check the display LEDs and the alarm status		X		
	Check the mother board connections			X	
	Check the control and display boards			X	
	Check that the unit's sensor readings are correct			X	
INTERNAL HUMIDIFIER	Check the condition of the cylinder	X			
	Carry out the automatic cylinder washing procedure	X			
	Check the condition of the filling and drain valves		X		
	Carry out manual washing with limescale preventer		X		
	Inspect the gaskets/seals		X		
	Renew if necessary		X		

ELECTRICAL PANEL	Check the unit is receiving power correctly			**X**	
	Check the electrical connections			**X**	
	Check the power consumptions of electrical components			**X**	
	Test safety devices			**X**	
	Renew protection fuses				**X**
WATER CIRCUITS	Check circuits for leaks			**X**	
	Bleed air from circuits			**X**	
	Check circuit temperatures and pressures			**X**	
	Check operation of the 3-way valve		**X**		
	Check the quantity of glycol in the circuit			**X**	
	Check the water circulates correctly			**X**	
REFRIGERANT CIRCUITS	Check the operating temperatures and pressures			**X**	
	Check the condition of the compressor		**X**		
	Check the condition of the liquid sightglass filter			**X**	
	Check operation of the safety devices			**X**	
	Check the calibration and operation of the control valves		**X**		
	Check the refrigerant charge level and for circuit leaks		**X**		
	Check the lubricating oil level		**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 pressure controlled valve of the water cooled condenser		**X**		
	Check the condenser water circulates correctly		**X**		

11.2 MAINTENANCE OF THE FANS

Fan maintenance operations must be carried out in conditions of maximum safety and always with the unit switched off

During maintenance, check the following:

- Periodically check that the fan blades are clean and remove all dirt and encrusted deposits that could affect the balance of the rotor and thus damage the bearings.
- Check that the cooling fins of the fan motors are clean. If the fans produce any unusual noises during operation, switch off the machine and identify and rectify the problem, renewing the fan or the motor if necessary.

11.3 REFRIGERATION CIRCUIT CHECKS

The refrigeration circuit does not require maintenance other than the periodic checks indicated the chapter “Start up”.

The first of these checks is to look for leaks, as indicated by the presence of small bubbles visible in the liquid viewed through the sight glass.

The cooling coil must be inspected and, if necessary, cleaned with hot soapy water using a brush with long soft bristles. Compressed air may also be used providing that it is free of oil.

11.4 MAINTENANCE OF THE ELECTRICAL BATTERY

It is sufficient to check that the battery is clean and that the power consumption in Amps is as specified in the technical data sheet. If the machine is equipped with a modulating electrical battery, it is advisable to also check occasionally that the modulator is functioning correctly. To do this, it is sufficient to check that the machine behaves correctly during heating operation, with the relative screen page showing a voltage of 0-10 V for the microprocessor control output to the modulator. (See User Manual).

11.5 MAINTENANCE OF THE ELECTRICAL PANEL

Clean using a compressed air jet at a minimum distance of 30 cm (to avoid damaging plastic parts), pay particular attention to cooling fans and heat sinks.

11.6 MAINTENANCE OF THE AIR FILTERS

On TECNAIR LV air conditioners, all air filters are equipped with differential pressure switches to monitor pressure loss caused by clogging. 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 differential value.

FILTER TYPE	POSITION	VALUE [Pa]
G4 filter	Suction	120

G4 filters cannot be regenerated and therefore must be renewed.

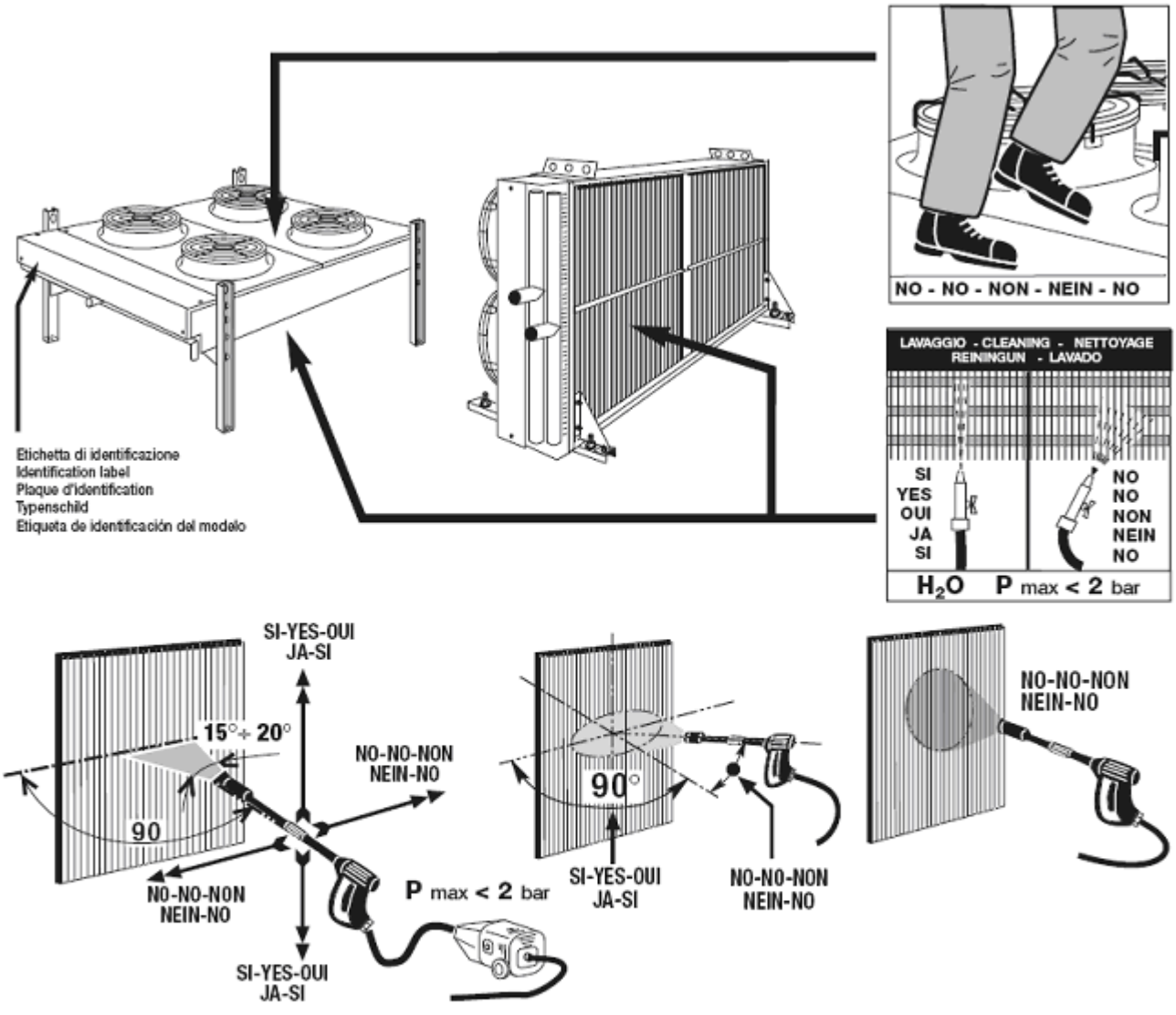
NOTE: To ensure the efficiency of the filters, it is necessary to install the 15x3 mm seal. (supplied with replacement filters)

11.7 MAINTENANCE OF CEA AIR-COOLED CONDENSERS

Air-cooled condensers require regular inspection of the evaporator coils, which should be cleaned if the cooling fins become clogged with dirt.

It is also necessary to check the fan power draw as well as check for abnormal fan noise and the condition of the speed control.

The coils should be cleaned in accordance with the following indications:



NOTE PER UN CORRETTO LAVAGGIO:

- getto a "ventaglio" Ø lama piatta.
- pressione acqua P max < 2 bar
- mantenere il getto d'acqua perpendicolare al filo aletta del pacco alettato nei due sensi.

NOTES FOR CORRECT CLEANING:

- Ø flat fan spray.
- water pressure P max < 2 bar
- keep the water spray at right angles to the fin edge of the both vertically and horizontally.

INSTRUCTIONS A SUIVRE POUR UN NETTOYAGE CORRECT:

- jet d'eau "en éventail".
- pression d'eau P max < 2 bar
- projetter l'eau perpendiculairement aux ailettes dans les deux sens.

ANWEISUNGEN FÜR KORREKTE REINIGUNG:

- "Fächer" -Strahl Ø Flachklinge.
- Wasserdruck P max < 2 bar
- Den Sprühstrahl in beide Richtungen senkrecht zur Lamellenreihe des Wärmetauscherblocks halten.

NOTAS PARA UN LAVADO IDÓNEO:

- presión agua 80÷100 bar.
- mantener el chorro de agua perpendicular al borde de la aleta del paquete aleteado en ambos sentidos.

12 FAULT DIAGNOSIS

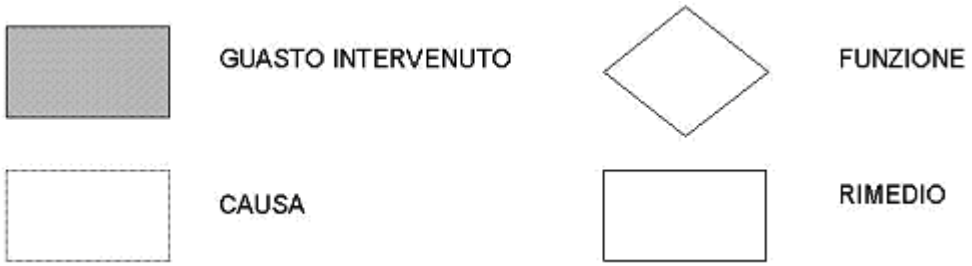
WARNING!
BEFORE CARRYING OUT ANY OPERATIONS ON THE UNIT, SET THE MAIN SWITCH TO POSITION "O"

This chapter contains information to assist the operator in tracing any faults that may arise with the machine Starting from a description of the nature of the problem, we provide indications on the probable causes and possible remedies. 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 of the information provided applies to the machine in question.

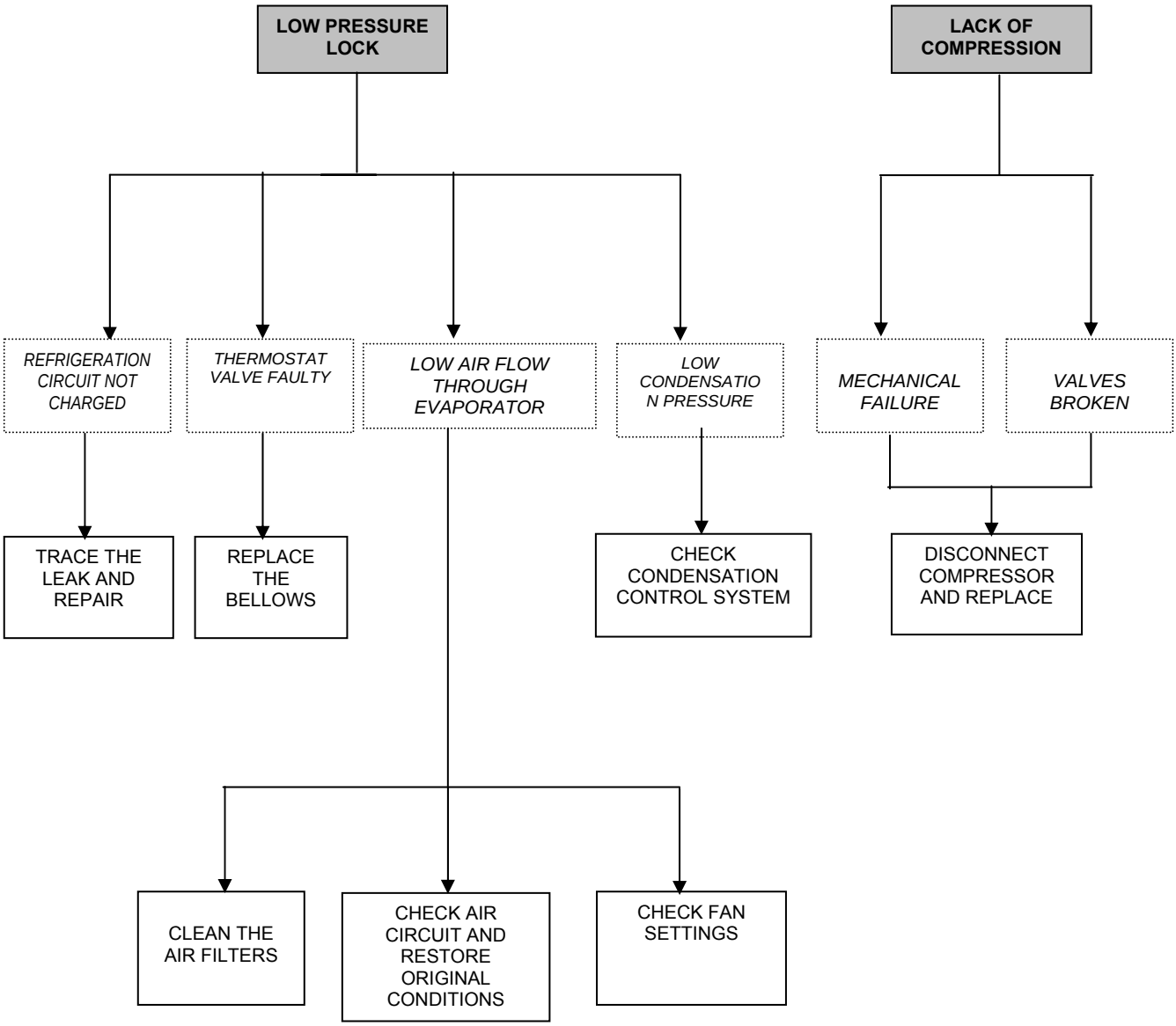
All servicing and repair of the machine must be carried out by qualified personnel only.

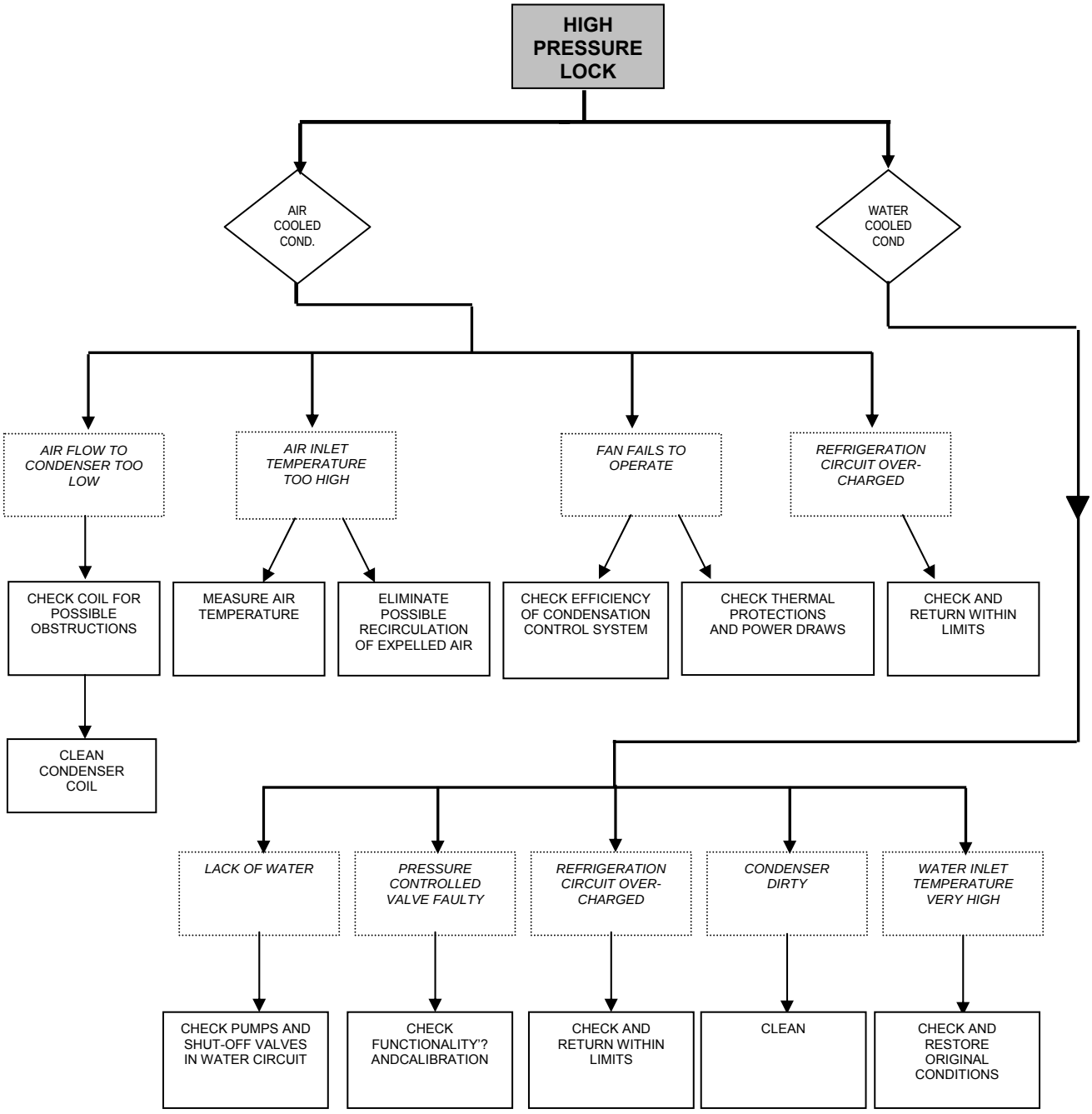
We strongly recommend that you do not attempt any operations on the machine unless you have a good understanding of its operating principles.

Key to the fault diagnosis diagram:

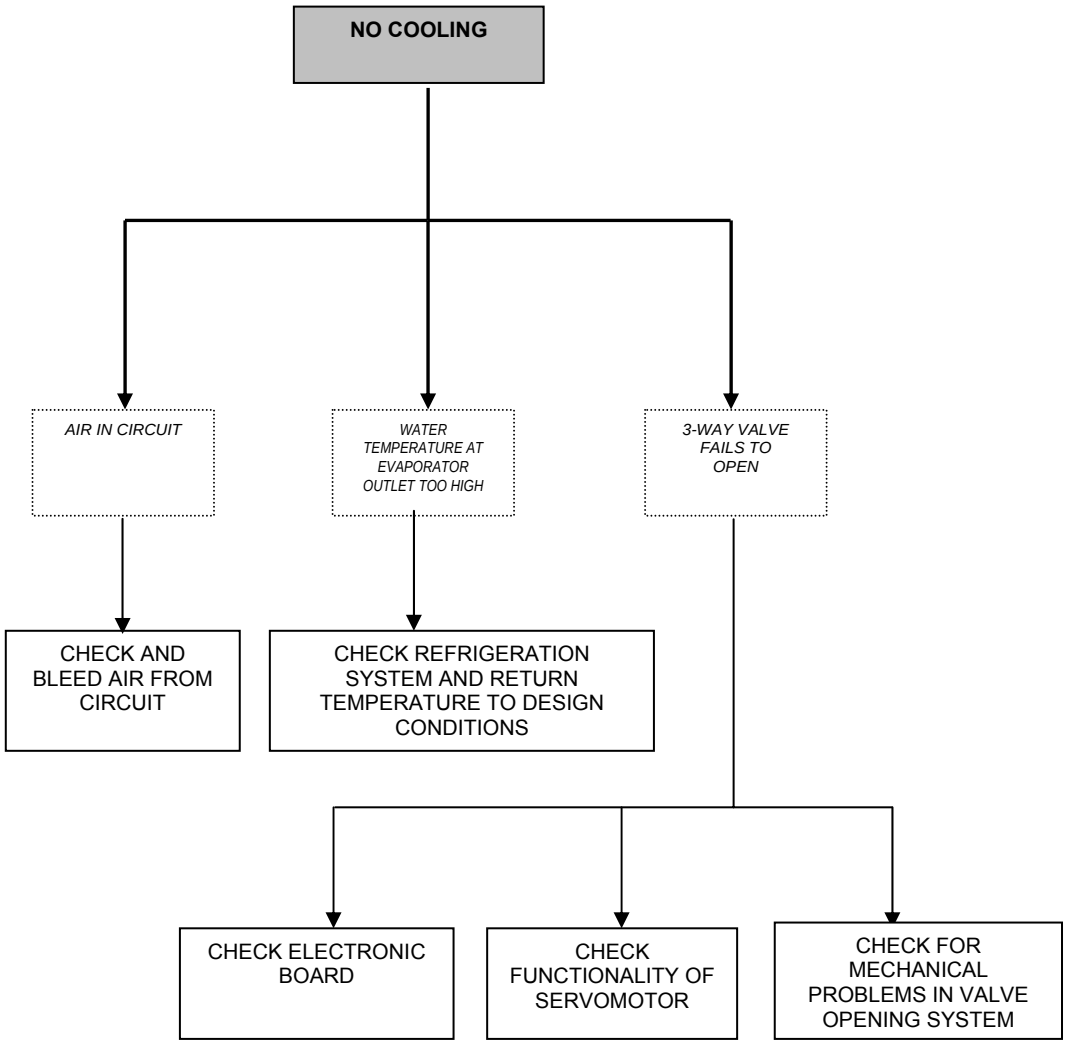


12.1 DIRECT EXPANSION AIR CONDITIONERS - REFRIGERATION CIRCUIT PROBLEMS

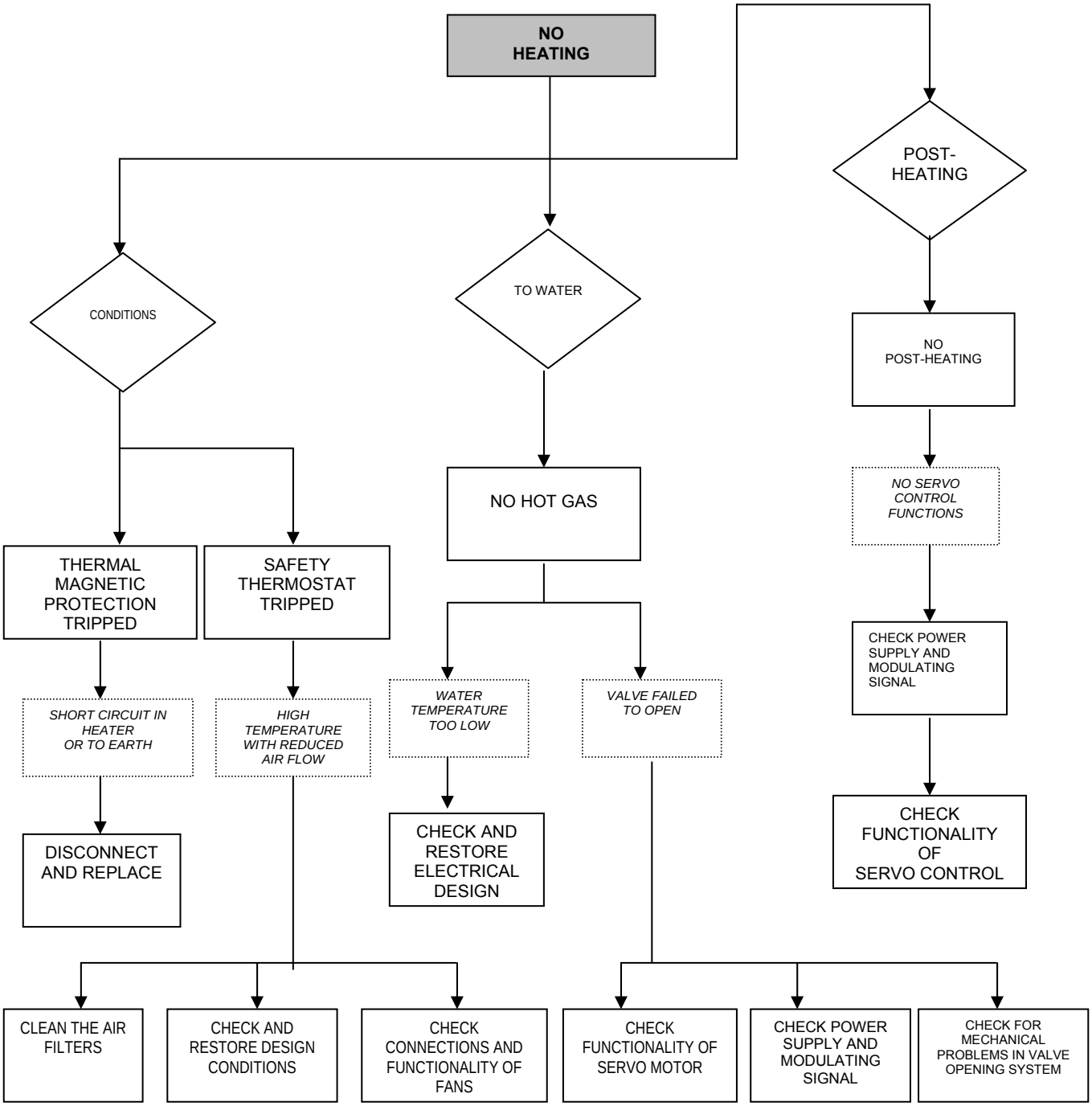



HIGH PRESSURE LOCK
AIR COOLED COND.
WATER COOLED COND
AIR FLOW TO CONDENSER TOO LOW
AIR INLET TEMPERATURE TOO HIGH
FAN FAILS TO OPERATE
REFRIGERATION CIRCUIT OVER-CHARGED
CHECK COIL FOR POSSIBLE OBSTRUCTIONS
MEASURE AIR TEMPERATURE
ELIMINATE POSSIBLE RECIRCULATION OF EXPELLED AIR
CHECK EFFICIENCY OF CONDENSATION CONTROL SYSTEM
CHECK THERMAL PROTECTIONS AND POWER DRAWS
CHECK AND RETURN WITHIN LIMITS
CLEAN CONDENSER COIL
LACK OF WATER
PRESSURE CONTROLLED VALVE FAULTY
REFRIGERATION CIRCUIT OVER-CHARGED
CONDENSER DIRTY
WATER INLET TEMPERATURE VERY HIGH
CHECK PUMPS AND SHUT-OFF VALVES IN WATER CIRCUIT
CHECK FUNCTIONALITY'? ANDCALIBRATION
CHECK AND RETURN WITHIN LIMITS
CLEAN
CHECK AND RESTORE ORIGINAL CONDITIONS

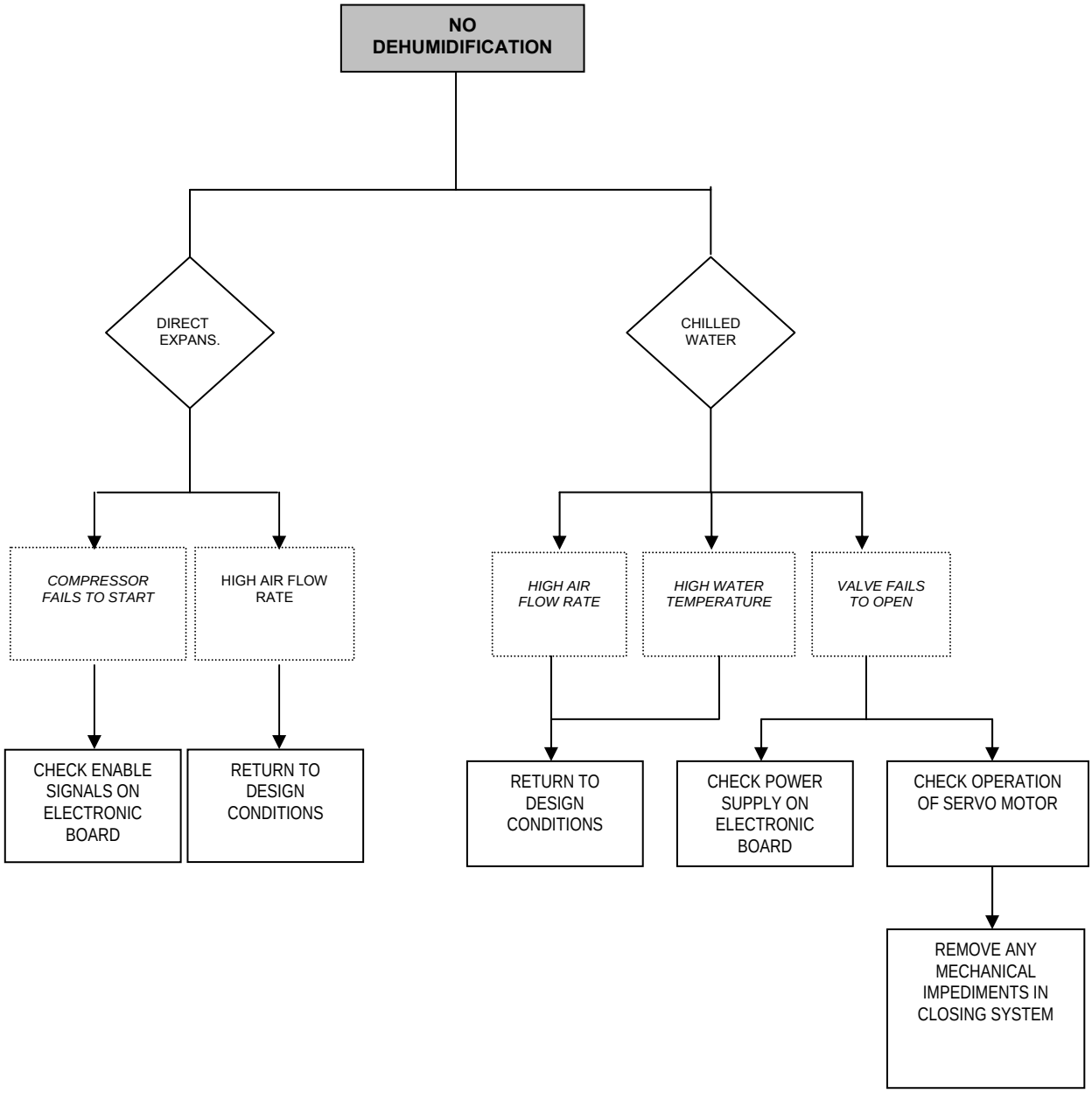
12.2 CHILLED WATER AIR CONDITIONER - WATER CIRCUIT PROBLEMS

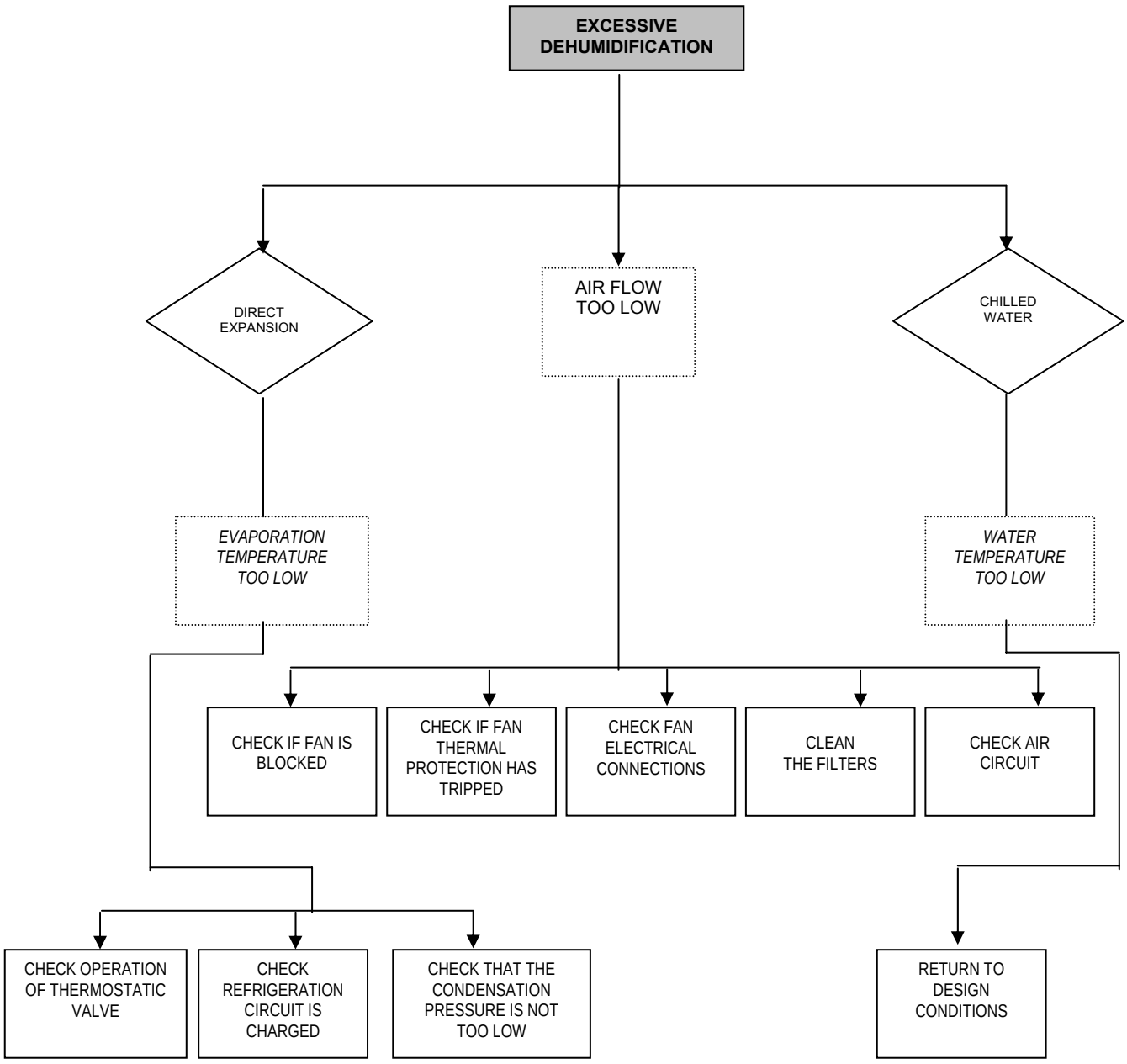


12.3 HEATING SECTION PROBLEMS

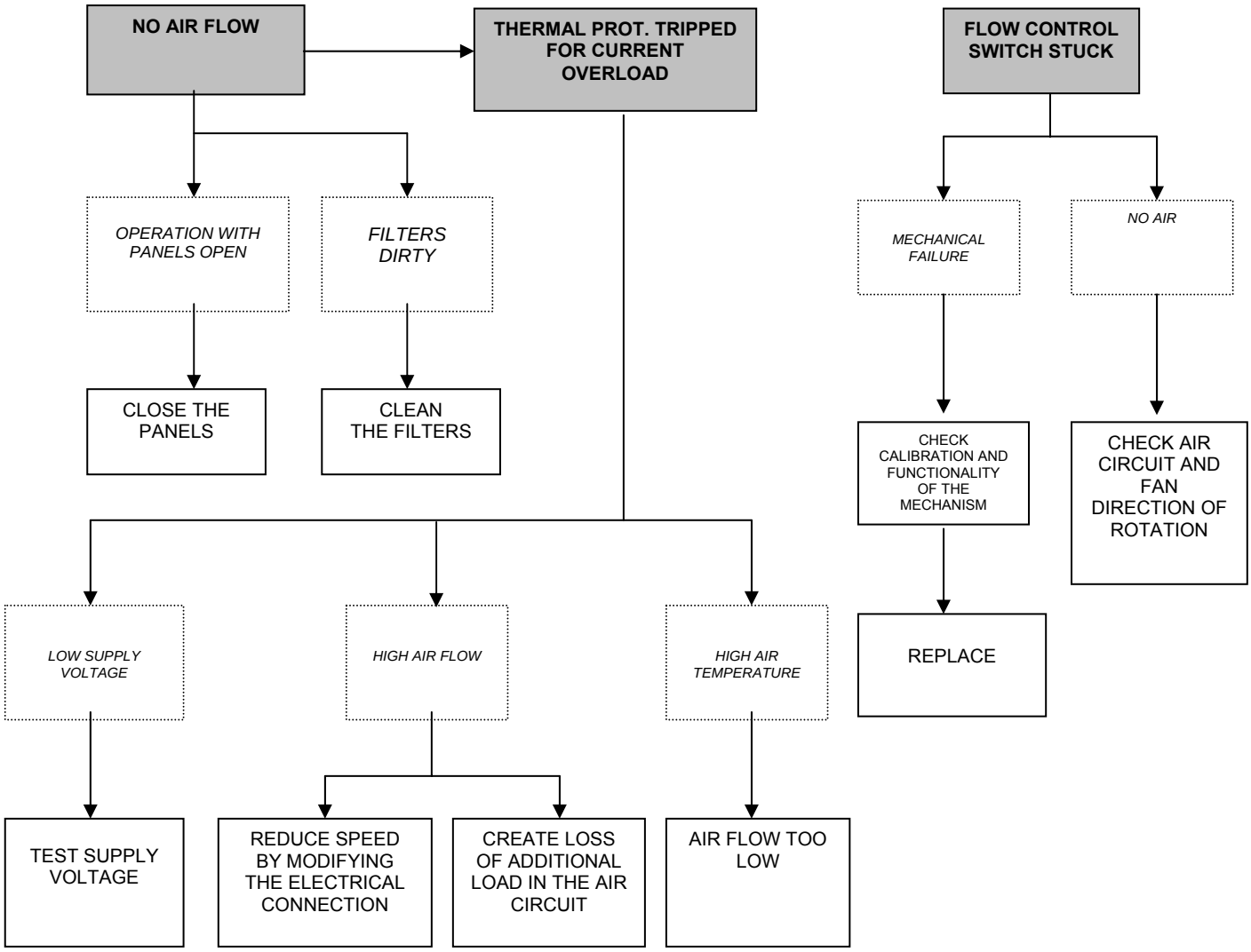


12.4 DEHUMIDIFICATION PROBLEMS




EXCESSIVE DEHUMIDIFICATION
DIRECT EXPANSION
AIR FLOW TOO LOW
CHILLED WATER
EVAPORATION TEMPERATURE TOO LOW
WATER TEMPERATURE TOO LOW
CHECK IF FAN IS BLOCKED
CHECK IF FAN THERMAL PROTECTION HAS TRIPPED
CHECK FAN ELECTRICAL CONNECTIONS
CLEAN THE FILTERS
CHECK AIR CIRCUIT
CHECK OPERATION OF THERMOSTATIC VALVE
CHECK REFRIGERATION CIRCUIT IS CHARGED
CHECK THAT THE CONDENSATION PRESSURE IS NOT TOO LOW
RETURN TO DESIGN CONDITIONS

12.5 VENTILATION PROBLEMS



13 GLOSSARY

- **Proportional band:** defines a temperature range of just a few degrees starting from the setpoint, within which the system operates the control devices.
- **Default:** this term is used to describe the values (e.g. set-point and proportional band values) that will be automatically applied by the system if the operator fails to set them.
- **Free Cooling**: introduction of external air into the environment by opening a damper or using cold water, thereby cooling the environment and saving energy.
- **Step:** defines an area of the proportional band (of temperature or humidity) within which a device is switched on and at the same time defines the values at which the device is switched on and off.
- **Supply:** the air delivered to the room by the air conditioner.
- **Screen page:** a page displayed on the screen.
- **Ramp:** the operating range of a modulating valve from 0% to 100%
- **Range:** range of values that may be assumed by a parameter.
- **Return - Suction:** air from the controlled environment returned to the air conditioner.
- **Set-point:** defines the temperature (or humidity) value to which the control system is set; the system activates the hot or cold control devices until the temperature (or humidity) in the controlled environment matches the set-point.
- **3-point valve - modulating valve:** the 3-point valve is a commonly used valve that is operated by 2 relays:, one to control the opening and one to control the timed closing of the valve; the modulating valve is controlled by a signal with voltage varying from 0 to 10 V.
- **Dead band - neutral band:** defines a very narrow temperature range between the set-point and the proportional band within which the control devices are not operated.

14 NOTES