TECNAIR LB
CLOSE CONTROL AIR CONDITIONERS

AIR CONDITIONERS

FOR

SURGICAL ROOMS

AND FOR

CLEAN ROOMS

INSTALLATION USE AND MAINTENANCE HANDBOO

1. GENERAL INFORMATIONS

1.1 CE DECLARATION OF CONFORMITY

The series H[1] and W[1] air conditioners that are the object of this declaration shall be installed and used according to the terms provided for in this «Installation and maintenance handbook», which are supplied together with the unit.

UNDER THESE CONDITIONS ONLY:

Shall we, the undersigned, take full responsibility for declaring that the units making the object of the present Declaration comply with the provisions set forth in the following Directives:

- **89/392/EEC**
- **93/68 EEC**
- **73/23 EEC**
- **89/336 EEC**

Uboldo, February 19th, 2001

([1]) Concerning the air conditioners series H and W with remote condensing unit, the Declaration of Conformity shall be valid only if the condensing unit is supplied by Tecnair LB together with the air conditioner. If the air conditioner is supplied by Tecnair LB without condensaers unit, the Manufacturer's Declaration of conformity shall be valid.

Tecnair LB

1.2 DECLARATION OF THE MANUFACTURER

The series Hand W air conditioners that are the object of this Declaration shall be installed and used according to the terms provided for in this «Installation and maintenance handbook», which are supplied together with the unit.

UNDER THESE CONDITIONS ONLY:

Shall we, the undersigned, take full responsibility for declaring that the units making the object of the present declaration comply with the provisions set forth in the following Directives:

- **89/392/EEC**
- **93/68 EEC**
- **73/23 EEC**
- **89/336 EEC**

Uboldo, February 19th, 2001

Tecnair LB

1.3 WARRANTY

The air conditioners described in this manual are subject to the present warranty terms, which are intended as accepted and automatically subscribed by the Customer when placing the order with TECNAIR LB.

The supplier hereby guarantees the correct construction and good quality of the product object of the supply, committing himself, during the warranty period specified herein, to repair, or supply spares for, at his sole discretion, in the shortest period, the parts and/or components that should present any material or construction or working defect invaliding them for their intended use, provided that the defect is not due to the purchaser's negligence, to any routine wear and tear, to the User's negligence or unskillfullness, to any damages by third parties, to Acts of God or Force Major, or to any other cause not ascribable to the original manufacturer of the equipment, and the Manufacturer shall not be held responsible for any direct or indirect damages of any kind and for any reason. Defected parts substitution is held in the Uboldo factory and all transport costs is made by the Commissioners

The warranty term is of 1 (one) year from the delivery date. The warranty term shall be automatically cancelled if the materials are repaired or modified or anyhow completed (e.g. air conditioners supplied without electrical board, or the like).

The above warranty and supply conditions shall be valid provided that the Customer has fulfilled all of his contract obligations, with main reference to the payment terms. It is understood that no employee or representative of TECNAIR LB, or sales representative or service centre or the like is authorized to grant any derogations to the above mentioned warranty terms.

WARNING

Before operating any unit, the contents of this handbook shall be carefully read and fully understood.

1.4 APPLICATION OF THE PRESENT MANUAL

The two series OH and OW have much in common. The most obvious difference is that the OH series is provided with the supply fan and the suction and exhaust one, and therefore can control both the over and under pressure in reference to the surrounding areas where It can therefore be used even in areas where toxic substances are present, therefore re-circulation in room is not acceptable and where all the air supplied must be then sucked and expelled outside. Contrarily the OW ***clean*** room series, which can control only areas where toxic substances are not present, and therefore can work with re-circulation, is provided only with the supply fans.

Another important difference is that the OH (surgical room) air conditioners are standard complete with all thermodynamic controls for the monitoring of the air conditions, whilst air conditioners for white

rooms, which can be for complete outside air or partially re-circulated air, are standard in cooling only version and as accessory have heating coil, humidifier and regulating inverters for ventilation.

In the following chapters indications of standard components to the machines, and add-ons, are always specified.

For the exact composition of the units reference is made to the order confirmation.

1.5 UNIT CODING

Your unit belongs to Tecnair's catalogue of air conditioners for surgical rooms. The different models are coded by letters and numerals indicating the unit's power and type of functioning, and the heat recovery system, if present. The coding shall be read as follows:

O	H	A	05	1	A	R407C	HP	HR
1	2	3	4-5	6	7	8	9	10

1	O	**Air supply direction**	O	Upflow air supply
2	H	**Series**	H	For surgical rooms
2			W	For clean rooms
3	A	**Typology of the cold generator**	A	Direct expansion coil with remote condenser
3			E	Direct expansion coil with remote condensing unit
3			U	Chilled water coil with remote water chiller
4-5	5	**Size**		Nominal horsepower
6	1	**Number of cooling circuits or number of rows of the cooling coil for water units**		
7	a	**Modify index**		
8	R	**Type of refrigerant fluid**		
9	HP	**Heat pump operation**		
10	HR	**Integrated heat recovery system**		

Figure 1: example of unit coding reading.

1.6 OPERATING LIMITS

1.6.1 Direct expansion air conditioners "H" series (R407C)

1.6.1.2 Unit operating limits

The indicated temperature and humidity limits of the treated air (external air mixture plus re-circulation entering into the unit) are valid for operating after the first transitory span, with nominal air flow and a prevalence of 800 pa. For lower air flow up to 10% the mentioned limits must be raised by one degree centigrade so to avoid too low evaporating temperatures.

We empathise that for external winter temperatures regularly lower than –5°C it is necessary to install in the fresh air duct a system for the pre heating of the fresh air, controlled by an anti freeze thermostat, by which it is possible to guaranty a raise in the temperature of at least four degrees so to reduce the humidity and avoid the risk of freezing the humidity which accumulates in the pre filter. We suggest that this system is

made with plain tubes because the possible fins are dirtied too quickly by the fresh air which in that point is not yet filtered.

We empathise that for temperatures lower than –20°C the possibility to install the air conditioner outdoor is excluded.

- **Units without heat recovery system version "L": low air flow:**
  temperature: minimum: -22°C, maximum: 38°C; humidity: lower: 10%, maximum: 100%

- **Units without heat recovery system version "H": high air flow:**
  temperature: minimum : -10°C, maximum: 30°C; humidity: lower: 10%, maximum: 100%

- **Units with heat recovery system version "L": low air flow:**
  temperature: minimum: - 40°C, maximum: 46°C; humidity: lower: 10%, maximum: 100%

- **Units with heat recovery system version "H": high air flow:**
  temperature: minimum: - 32°C, maximum: 40°C; humidity: lower: 10%, maximum : 100%

1.6.1.2 Operating limits for air cooled condensers

1.6.1.2.1 Minimum operating limit: minimum outdoor air temperature

- **Axial or radial air condenser with switch and speed variator:**
  minimum external air temperature: -20°C

- **Axial or radial air condenser with switch and without speed variator**:
  The speed variator can be installed in the internal electric panel of the unit.
  minimum external air temperature: -25°C

- **Axial or radial air condenser without switch and without speed variator**:
  This solution is not in conformity with the safety standards since the operator is not certain that the condenser is not remotely switched on whilst he is doing maintenance work. It is therefore mandatory that the switch installed away from the condenser and inside the building is of lockable type.
  minimum outdoor air temperature: -40°C

1.6.1.2.2 Maximum operating limit: maximum outdoor air temperature

It is suggested to select an air cooled condenser with the following deltaT between fresh air entering (project forecasted external temperature) and condensing temperature:

- **For maximum outdoor temperatures up to 30°C:**
  deltaT = 17°C

- **For maximum outdoor temperatures up to 35°C:**
  deltaT = 15°C

- **For maximum outdoor temperatures up to 40°C:**
  deltaT= 13°C

- **For maximum outdoor temperatures up to 46°C:**
  DeltaT = 10°C

- **For maximum outdoor temperatures over 46°C:**
  Ask our offices to select a unit with another refrigerant (R134)

1.6.1.3 Operating limits for internal air conditioners with built in water cooled condenser.

- **Water condensers: without pressostatic valve :**
  Entering water temperature between 25 and 40°C

- **Water condensers: with pressostatic valve :**
  Entering water temperature between 7 and 40°C

1.6.1.4 Air conditioners with chilled water coils

The temperature and humidity limits of the air to be treated (external air mixture plus re-circulation entering into the unit) are valid for operating after the first transitory span, with a nominal air flow and prevalence of 800 Pa, and for entering water temperatures to the coil of 7°C.

We empathise that for external winter temperatures regularly lower than –5°C it is necessary to install in the fresh air duct a system for the preheating of the fresh air, controlled by an anti freeze thermostat, by which it is possible to guaranty a raise in the temperature of at least four degrees so to reduce the humidity and avoid the risk of freezing the humidity which accumulates in the pre filter. We suggest that this system is made with plain tubes because the possible fins are dirtied too quickly by the fresh air which in that point is not yet filtered.

We empathise that for temperatures lower than –20°C the possibility to install the air conditioner externally is excluded.

- **Units without heat recovery system:**
  temperature: minimum : -22°C, maximum: 38°C; humidity: lower: 10%, maximum: 100%

- **Units with heat recovery system:**
  temperature: minimum : - 40°C, maximum: 48°C; humidity: lower: 10%, maximum: 100%

1.6.2 Direct expansion air conditioners “W” series (R407C)

1.6.2.1 Internal unit operating limits

the indicated temperature and humidity limits of the treated air (external air mixture plus re-circulation entering into the unit) are valid for operating after the first transitory span, with nominal air flow and a prevalence of 800 pa. For lower air flow up to 10% the mentioned limits must be raised by one degree centigrade so to avoid too low evaporating temperatures.

We empathise that for external winter temperatures regularly lower than –5°C it is necessary to install in the fresh air duct a system for the pre heating of the fresh air, controlled by an anti freeze thermostat, by which it is possible to guaranty a raise in the temperature of at least four degrees so to reduce the humidity and avoid the risk of freezing the humidity which accumulates in the pre filter. We suggest that this system is made with plain tubes because the possible fins are dirtied too quickly by the fresh air which in that point is not yet filtered.

We empathise that for temperatures lower than –20°C the possibility to install the air conditioner outdoor is excluded.

- **Version “L” units: low air flow:**
  temperature: minimum: -22°C, maximum: 38°C; humidity: lower: 10%, maximum: 100%

- **Version “H” units: high air flow:**
  temperature: minimum : -14°C, maximum: 30°C; humidity: lower: 10%, maximum: 100%

1.6.2.2 Operating limits for air cooled condensers

1.6.2.2.1 Minimum operating limit: minimum outdoor air temperature

- **Axial or radial air condenser with switch and speed variator:**
  minimum external air temperature: -20°C

- **Axial or radial air condenser with switch and without speed variator**:
  The speed variator can be installed in the internal electric panel of the unit.
  minimum external air temperature: -25°C

- **Axial or radial air condenser without switch and without speed variator**:
  This solution is not in conformity with the safety standards since the operator is not certain that the condenser is not remotely switched on whilst he is doing maintenance work. It is therefore mandatory that the switch installed away from the condenser and inside the building is of lockable type.
  minimum outdoor air temperature: -40°C

1.6.2.2.2 Maximum operating limit: maximum outdoor air temperature

It is suggested to select an air cooled condenser with the following deltaT between fresh air entering (project forecasted external temperature) and condensing temperature:

- **For maximum outdoor temperatures up to 30°C:**
  deltaT = 17°C

- **For maximum outdoor temperatures up to 35°C:**
  deltaT = 15°C

- **For maximum outdoor temperatures up to 40°C:**
  deltaT= 13°C

- **For maximum outdoor temperatures up to 46°C:**
  DeltaT = 10°C

- **For maximum outdoor temperatures over 46°C:**
  Ask our offices to select a unit with another refrigerant (R134)

1.6.2.3 Operating limits for internal air conditioners with built in water cooled condenser.

- **Water condensers: without pressostatic valve :**
  Entering water temperature between 25 and 40°C

- **Water condensers: with pressostatic valve :**
  Entering water temperature between 7 and 40°C

1.6.2.4 Air conditioners with chilled water coils

The temperature and humidity limits of the air to be treated (external air mixture plus re-circulation entering into the unit) are valid for operating after the first transitory span, with a nominal air flow and prevalence of 800 Pa, and for entering water temperatures to the coil of 7°C.

We empathise that for external winter temperatures regularly lower than –5°C it is necessary to install in the fresh air duct a system for the preheating of the fresh air, controlled by an anti freeze thermostat, by which it is possible to guaranty a raise in the temperature of at least four degrees so to reduce the humidity and avoid the risk of freezing the humidity which accumulates in the pre filter. We suggest that this system is made with plain tubes because the possible fins are dirtied too quickly by the fresh air which in that point is not yet filtered.

We empathise that for temperatures lower than –20°C the possibility to install the air conditioner externally is excluded.

- **Version "L" units: low air flow:**
  temperature: minimum : -22°C, maximum: 38°C; humidity: lower: 10%, maximum: 100%

- **Version "H" units: high air flow:**
  temperature: minimum : - 40°C, maximum: 48°C; humidity: lower: 10%, maximum: 100%

1.7 SPARE PART LIST

The spare part list, available under request to our Commercial Offices, emphasises the parts which don't have easy local reparability. Static parts, such as heat exchangers, closing panels and others. Rare faults are therefore not listed.

Universally retrievable parts, such as electrical motors, contactors, automatic switches refrigerating gasses are also not listed.

1.8 DOCUMENTS INCLUDED IN THE UNIT

All units come with:

- The present manual, for the unit description, installation and maintenance
- The installed Microprocessor manual (pCO²) for the start-up, operating parameter modification and the unit control operations.
- Wiring diagram
- Manufacturers conformity and testing declarations
- Instruction for moving and lifting the unit sticked (out of the packing)

2. COMPONENTS DESCRIPTION AND OPERATION

2.1 MICROPROCESSOR ADJUSTMENT

All the air conditioners are equipped with microprocessor pCO^2, which controls the temperature, humidity, air flow, and overpressure/depression in the controlled room with regard to the surrounding environment. All working parameters can be modified directly by the Customer through the user interface. Moreover, the air conditioner can be remote controlled.

Installed on the unit

Remote display for wall installation

Figure 2 describes the functions and other components supported by the micro pCO^2.

Functions	
Temperature control	YES
Humidity control	OH:YES, OW ACCESS
Stand by	YES
Remote control	ACCESSORY
Supported components	
3-points valves	YES
Modulating valves	YES
2 compressors	YES
2-step heater	YES
3-step heater	YES
Modulating heater	YES
Modulating humidifier	YES
Inverter on one compressor	YES
Inverter on exaust air	YES
Inverter on discharge air	YES
Accessories	
Remote alarm board	ACCESSORY
Serial RS422 board	NO

Serial RS485 board	ACCESSORY
Storage extension	ACCESSORY
Programming key	ACCESSORY

Figure 2: functions and components supported by pCO^2.

As for the modes of operation of microprocessor PCO2 please refer to the relevant user manual, **code 75802307A.0109,** containing all the instructions for the start up, modification of the working parameters, and management of the equipment itself.

2.2 START UP AND FUNCTIONIG LOGIC OF THE UNITS

2.2.1 OH Series starting up

On starting the unit up, the microprocessor opens the motorised dampers installed on the duct entry. This operation takes about 90 seconds, after which it starts up the fan for air discharge to the environment and that for air return and expulsion (if present). The air discharge fan controls the airflow evenness, as required, in spite of the increased pressure drop due to progressive filter clogging.

The air expulsion fan controls the overpressure or depression of the air-conditioned environment compared to any reference surrounding environment.

Afterwards, according to the temperature of the environment to treat, which is sensed by the temperature and humidity feeler installed in the air expulsion section, or,alternatively, inside the surgical room or in the air return ducts, the microprocessor shall start either the cooling or heating capacity.

Finally, according to the humidity in the environment, again, sensed by the previously mentioned feeler, the microprocessor shall start either the humidification or dehumidification.

2.2.2 OW Series starting up

Start up procedures are function of the installed components, therefore after the supply fans start-up, the temperate and humidity feeler (which is supplied loose and must be installed on the suction duct or in the controlled room) automatically activates through the microprocessor the standard cooling and, if present, also the re-heating and humdification.

2.3 DIRECT EXPANSION AIR CONDITIONERS OHA - OWA

The direct expansion coil air conditioners are all provided with two cooling circuits, with the exception of models OHA 41 and 51 and OWA 41 and 51, which are mono-circuit type. The standard units have an ON-OFF regulation of the cooling capacity, therefore the pCO^2 microprocessor starts up the compressor with its proportional or proportional-integral logic and stops it at the meeting of the set point. This regulation is valid in case of units working with a small fresh air flow and high recircultion. In case of 100% or high fresh air flow, or of very rigorous temperature an humidity control, the use of a frigorific capacity regulation device is warmly suggested.

Each circuit consists of an hermetic scroll compressor, a thermostatic expansion valve, and two pressure switches each. The low pressure one with automatic reset, but to be reset by the microprocessor keyboard too, doesn't stop definitely the cooling circuit. The high pressure one, for clear safety motifs, is with manual reset and stops the cooling circuit. In both cases the conditioner continues to function displaying the trip of the high or low pressure alarm.

A drier filter with sight glass is forecat on the refrigerant liquid line.

The compressor is scroll type with built-in integral electric protection to avoid any excessive electrical input and is equipped with a crankcase heater, and welding type connections to the supply pipe. The direct expansion coil is 4, 6 or 8 rows coil with copper tubes expanded into the aluminium fins.

A stainless steel condensate discharge back is always installed under the coil, and is connected with a central water trap with non return valve. The discharge from the humidifier is independent from the other one and is carried toward the right hand side panel of the unit. The discharge condensate bac always has a slight downwards inclination so to guarantee that it always remains empty.

2.4 COOLING CAPACITY REGULATION WITH INVERTER ON THE COMPRESSOR

On request, an inverter can be installed on one compressor to control optimally the feeding frequency and the directly proportional cooling capacity of the air conditioner. The cooling capacity regulation through inverter on the compressor is only used on heat pump air conditioners.

The inverter is controlled by the microprocessor with a 0Vdc – 10 Vdc signal. The inverter therefore varies continuously the feeding frequency of the compressor between the minimum value (30 Hz equal 0Vdc) and maximum value (60 HZ equal 10 Vdc) allowed. The maximum and minimum frequencies are indicated by the compressors Manufacturer. Particualrly the minimum frequency cannot be lower than 30 Hz so to avoid gripping the compressor due to insufficient oil return because of the too low refrigerant speed in the pipes.

The microprocessor starts the first compressor (the one equipped with the inverter) when the room temperature equals the set point plus 50% of the proportional band. For example, if the proportional band is 2°C and the set-point is 20°C, then the first compressor will start up when the feeler in the room senses 21°C) (cfr. Figure 3).

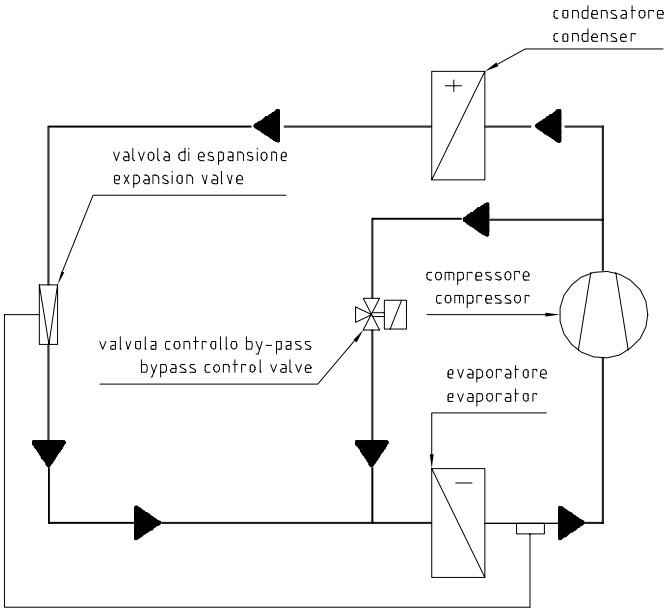
If the total capacity of the first compressor is enough to work off the room heat, the microprocessor will decrease the output signal to the inverter, and therefore, the inverter will adjust down to the minimum frequency set point.

If the room temperature equals the set point plus 100% of the proportional band, the microprocessor will start the second compressor up. This one, being without inverter, works at its maximum, whilst the other reduces its revolution speed, as we have already seen, to match the requested cooling capacity.

To assure the correct entrainment of the oil in the refrigerant under any working condition, at fixed time intervals, the microprocessor forces the compressor with inverter to top revolving speed for a fixed time. The stay time and frequency at top speed can be set by the user (cfr. *User handbook*) and depends on the corresponding duct length. The microprocessor is default-programmed to start the compressor at the maximum frequency for 5 minutes every 60 minutes.

2.5 COOLING CAPACITY REGULATION WITH ELECTRONIC HOT GAS INJECTION

The cooling capacity regulation is made by an electronic system, always controlled by the pCO microprocessor, of hot gas injection and refrigerant expansion (see following drawing), The hot gas, injection downstream the expansion valve, reduces the cooling capacity proportionately to the regulating demand, whilst part of the refrigerant expansion in the relative valve allows the suction temperature not to become too high, therefore compromising the good functioning of the compressor.



This system allows a modulation of the cooling capacity between 5% and 100% of the nominal one, therefore also with a great reduction of the absorbed power at the same time.

The injection valves opening is controlled by the microprocessor by a 0 – 10V signal, proportional to the percentage shift of the sensed temperature to the set point one in relationship the proportional band. The expansion valve is controlled by the over heating of the refrigeration gas exiting the evaporator.

The microprocessor activates the first compressor (the injection one) when the room temperature equals the set point, plus 50% of the proportional band. For example; if the proportionate band is of 2°C and the set point is of 20°C, the first compressor starts when the room temperature feeler measures a 21°C temperature (ref figure 3). In case of a single compressor will startup at 100% of the proportionate band.

If the room temperature is above 50% of the proportional band the microprocessor will also start the second compressor (if present). This, being without regulations, will always work at 100% of its capacity, whilst the first compressor modulates itself as seen above to ensure a perfect temperature regulation.

2.6 AIR CONDITIONERS WITH CHILLED WATER COIL OHA - OWA

STANDARS FOR BOTH OHU AND OWU SERIES

The hydraulic circuits of the chilled water units is made essentially of a big surface direct expansion cooling coil with copper tubes expanded into aluminium fins, and a three-way modulating valve. All internal tubes are copper made and are provided with thermal insulation.

The microprocessor controls the modulating valve with an analogic 0-10V output signals. The opening of the valve is proportional to the value of the signal sent by the microprocessor. On its turn, the voltage value is proportional to the required thermal or humidity load from the required set point. Verifying on the display the level of the valve's opening is always possible. With the machine switched off the valve returns in a totally closed position, whilst, in case of a lack of feeding tension the valve remains in the previous position.

For example, if the indicated proportionate band is of 2°C and the set point is of 20°C the exit tension value should be equal to 0 V when the measured temperature is of 20°C and will equal 10 V when the temperature is of 22°C. All this is shown on fig. 3.

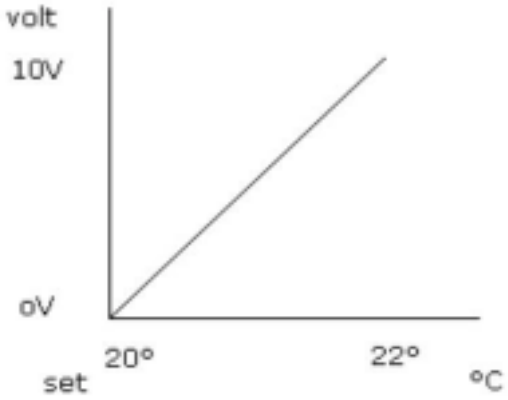


Figure 3

2.7 PREHEATING SECTIONS

The heating system is defined as preheating when the heat source is positioned upstream the cold source; reheating when its placed downstream. In case of cold water coils it's necessary to preheat the air to avoid freezing. In case of direct expansion cold coils the only hot source can be a single water or electric coil

installed downstream the cold one, with winter heating functions and summer post heating. Obviously in case of water coils its necessary that the hot water is retrievable both in summer and in winter.

The preheating water coil comes standard in the OH series, as an accessory in the OW series.

2.7.1 OH series: surgical room air conditioners

In all the types of air conditioners, the standard heating section is made of a 2-row hot water coil with a microprocessor-controlled three-way motorised valve.

The coil, like every other coil in the unit, is designed in such a way as to favour sterilisation thanks to a minimum 2.5mm fin spacing, and is epoxy painted (Alupaint). Alternatively, a fully microprocessor-controlled modulating electric heater can be installed as heating source with a thermal protection set to 70°, or a modulating steam heating coil can be installed. Both are controlled by the pCO^2 microprocessor, which comes standard with the units. Heat pump units use the frigorific circuit as a heating source.

2.7.1.1 Hot water coil heating capacity regulation (standard)

The regulation is entrusted to a three way modulating valve that is directly controlled by the microprocessor. The valve opens and closes in direct proportion to the set proportional band. For example; if the set proportional band is 2°C and the set point is 20°C, then the exit tension signal will be equal to 0 V when the measured temperature will be of 20°C it is equal 10V when the temperature is of 18°C.

2.7.1.2 Electric heater heating capacity regulation

The microprocessor sends a 0 – 10 Vdc tension signal to the electronic PWM regulator. The tension value is directly proportional to the temperature shifts from the set point.

For example, if the proportional band is 2°C and the set point is 20°C the microprocessor's exit tension value will be equal to 0V is equal 10V if the room temperature reaches 18°C.

2.7.1.3 Steam coil capacity regulation

The regulations made by the three way modulating valve specific for steam, and its functioning, is identical to those for hot water

We therefore must remember that steam coils can work until these conditions:

- Entrance steam temperature < 150°C
- Entrance steam pressure < 6 Bar

2.7.1.4 Heat pump heating capacity regulation

Functioning is identical reversed to the one for direct expansion cooling, only that here the four way valve, inserted in the circuit, sends the refrigerant to condensate inside the units internal coil therefore giving to the air its condensing heat.

We evidence the fact that the condensing heat is overabundant for the treatment of all fresh air, therefore in this case it's necessary to provide the accessory for the regulation of the cooling circuits capacity. In case of nearly total recirculation (max 20-25% fresh air) as in the majority of cases of clean room air conditioners OW series, the heat pump heating can be used even without the capacity regulations.

2.7.2 OW series: clean room air conditioners

A standard reheating coil is not forecasted. In case of necessity both electrical coils or hot water coils can be applied, both modulating controlled by the pCO^2.

2.8 REHEATING SECTION

Electrical modulating heater standard for series OH units, accessory for OW units

2.8.1 OH series: surgical room air conditioners

The standard coil is electrical with modulating regulations and thermal protection at 70°C. For further information refer to chapter 2.5.1.2.

Alternatively to the standard electrical coil its possible to install a water-reheating coil with three way modulating valve. For further information refer to chapter 2.5.1.1

2.8.2 OW series: clean room ari conditioning

A standard reheating coil is not forecast. In case of necessity both hot water coil and the electric one can be installed as option.

2.9 FAN SECTION

Installed fans are «plug fan» type, directly connected to the 2 poles frequency variable electrical motors. They have a characteristic very steep curve; therefore with a small air flow loss they can provide a higher static pressure so to compensate the progressive clogging of the filters.

Never the less in the both OH-surgical room- and Ow- Clean Room -units the supply fan comes standard with inverter so to guaranty a very constant airflow. In the same way the expulsion fan has its own standard inverter so to control the rooms over and under pressure (only in OH series).

The inverter is controlled by the standard microprocessor pCO^2 under the information of a differential pressostat applied internally the unit between the fan propeller and an area upstream of it where the airflow speed is close to zero. When the microprocessor feels the pressure difference between the two points is different from the one it calculates on the basis of the required air capacity, it intervenes on the fan speed so to correct all anomalies. For further information about the inverter refer to chapter 7.

For both series OH and OW units the fans, internal to the front panels, are protected by a safety grille for the safety of the operator.

2.10 AIR FILTRATION

2.10.1 Surgical room air conditioners with heat recovery system: OH…HR

The fans and the filters are located as shown in fig. 4

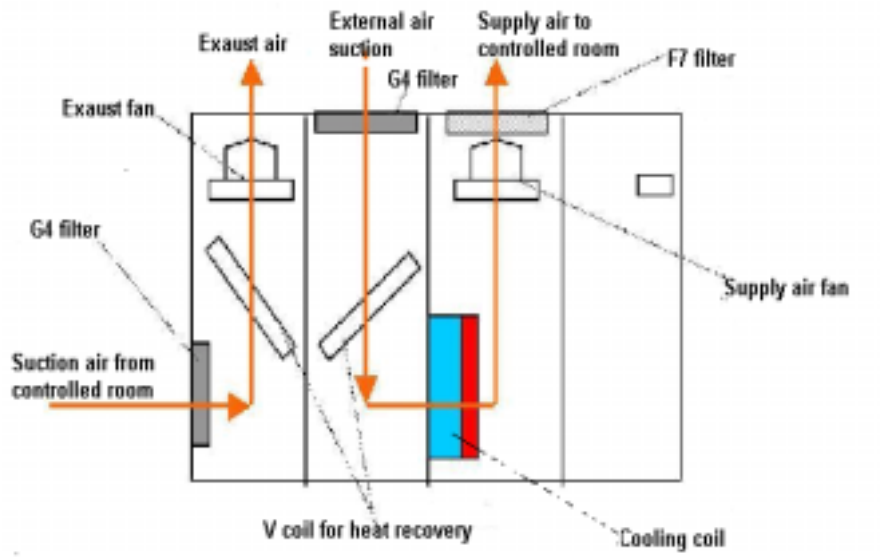


Figure 4: surgical rooms air conditioner with heat recovery

Alternative filters

In alternative to the G4 filter on the fresh air suction it is possible to install a F9 filter.

On the air discharge towards the controlled room it is possible to install a F9 filter.

2.10.2 Surgical room air conditioners without heat recovery: OH…

The fans and filters are located as shown in Fig. 5.

When a partial recircultion is requested, the by-pass damper (accessory) allows mixing the return air from the environment to the fresh one. The opening of the damper in opposed to the fresh one and is controlled by the microprocessor.

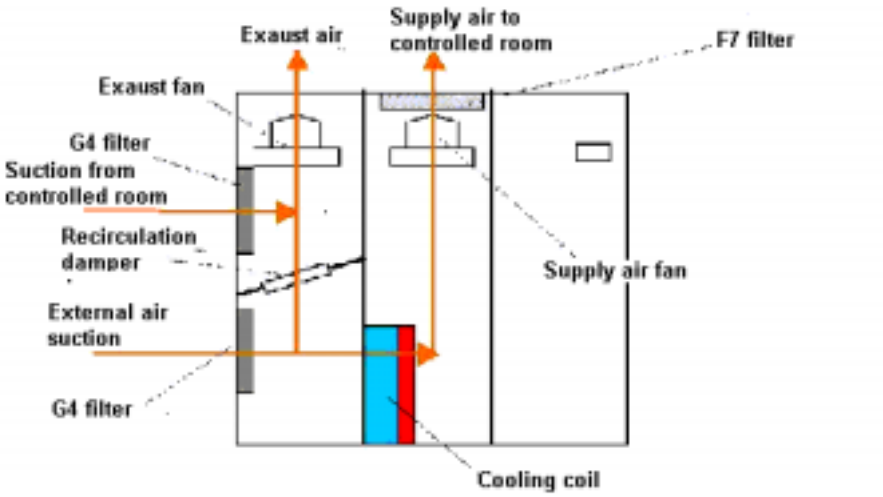


Figure 5: surgical room air conditioners without heat recovery

Alternative filters

In alternative to the G4 filter on the fresh air suction it is possible to install a F5 or an F7 filter. On the air discharge towards the controlled room it is possible to install a F9 or an H12 filter. In case of an H12 the maximum capacity will be a bit smaller.

2.10.3 Clean room air conditioners: OW

The fresh air opening is always placed on the top panel whilst the one for recalculating the air can be above, on the front, the back, or on the left hand side of the unit.

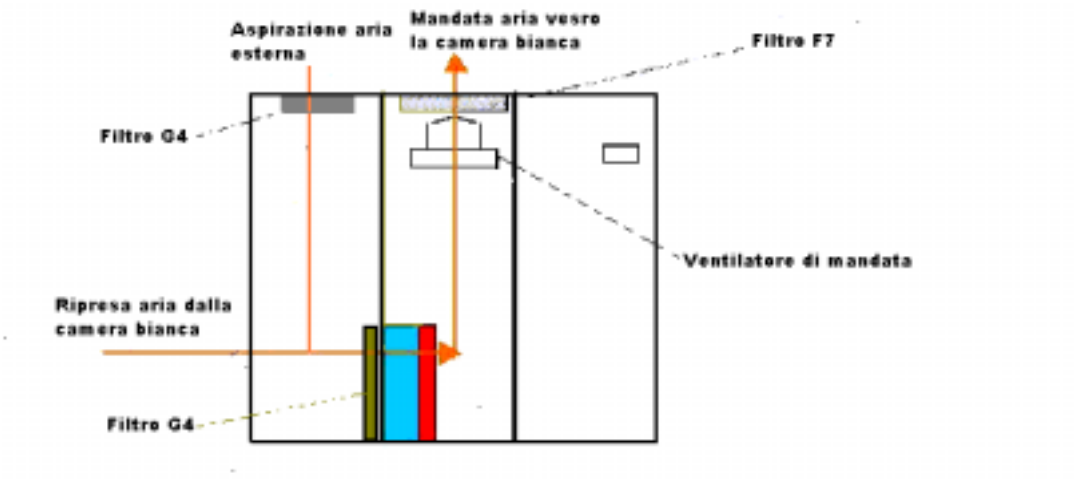


Figure 7: clean room air conditioners

2.11 CONTROLLING THE AIRFLOW QUANTITY TO THE ROOM

2.11.1 Surgical room air conditioners OH series

The regulation of the airflow is entrusted, through the microprocessor, to an inverter that controls the number of revolutions of the air-discharge fan based on two parameters; set airflow and filter clogging level.

The required airflow can be set directly in the manufacturer branch (see use handbook of the *p*CO^2 microprocessor), from a minimum to a maximum as a function of the air conditioner model in question. When shipping the unit, the airflow is pre-set at the corresponding rating requested by the Customer.

To guarantee the requested air flow, the microprocessor uses a calculation algorithm based on the pressure difference between the propeller of the air-discharge fan and a given dead point before it in which the air have speed almost at zero. Based on the pressure difference and on the type of the fan, the microprocessor calculates the current air flow and corrects it, as necessary sending a tension signal (4-20 mA) to the inverter. The inverter receives the signal from the microprocessor, and varies the feeding frequency of the air discharge fan in order to increase or decrease the air flow to the surgical room.

On starting the air conditioner up, the microprocessor forces a tension value corresponding to the required airflow towards the inverter. Every 10 seconds, the microprocessor carries out a new reading of the pressostat, and based on the current value it senses, it increases or decreases the voltage signal to the inverter by a step, corresponding to 10% of the working span, so as to keep the set value.

The progressive clogging of the three filters brings an airflow reduction. To maintain the airflow to the surgical room at the set value, the microprocessor increases the output signal to the inverter, which, in turn, increases the revolutions of the fan.

2.11.2 CONTROL OF THE CAPACITY TO THE CONTROLLED ROOM WITH THE CONSTANT PRESSURE METHOD IN THE SUCTION DUCT

As an alternative to the control method of constant air capacity to the controlled room described above, the same air can be controlled by maintaining a constant pressure inside the suction ducts.

This system is mandatory if one single unit must feed more than one room. The ducts infact are normally intersected by motorised dampers which are closed, partially (night stand by) or totally (sterilization), in case of non operability of the room itself.

To do this type of regulation Tecnair LB provides a differential pressure stat with the unit (0-500 pa) which is installed by the installer in the air suction duct towards the rooms closer to the unit and anyway after the F9 filter and before each connection to the different rooms.

The pressure stat is wired electrically to the electric panel's relative clamps as described in the unit's wiring diagram with a Belden type cable of a maximum length of 10 meters.

When this damper closes the pressure inside the duct raises. The pressure stat informs the microprocessor that confronts it with the setpoint and adjusts the revolution speed with the fans inverter.

This system guaranties a good control of the capacity even if the number of rooms to be controlled varies and acts as a correction of the reduction of capacity due to the progressive dirtying of the filters upstream the measuring point (the ones inside the unit). It is not anyway able to control the dirtying of the filters downstream the measuring point. It is therefore necessary that the filters upstream the measuring point are maintained in an optimum state so that the dirtying of the absolute filter is slower and gradual in time.

With this system there is no direct control of the capacity (the parameter which we must control), but indirectly by the pressure in the suction ducts, which is proportional to the capacity.

The regulating system for the installation is therefore a bit more complicated because of this need to act indirectly. It is therefore suggested to proceed as follows:

- Hypotise a loss of capacity for the system upstream the unit, with all the units operating and
  with clean filters es 500 Pa.
- Insert as depression set point this value es –250 Pa
- Verify room by room the reached air capacity
- If the reached capacity is not the desired one raise, for example of 5 Pa, the pressure set point
  and continue regulating it until the desired capacity is reached.

2.12 OVERPRESSURE/DEPRESSION

2.12.1 Controlling overpressure for OH series Conditioners

The regulation of the overpressure or depression in the environment is entrusted to an inverter that controls the revolutions of the direct driven fan for air return and exaust based on the following parameters:

- Set value for overpressure or depression in the environment;
- Changes in the environment condition.

The regulation of the pressure in the room is based on the principle that to keep an overpressure (depression) in an isolated environment, you just need to extract less (more) air than you put in. Thanks to the inverter on the air return fan, the air conditioners manufactured by Tecnair LB can reach the overpressure – depression set point with F5 Pa tolerance.

The value of the overpressure of the room with regard to a given reference environment (this value can be set by the user, see user handbook of the microprocessor pCO^2) is expressed in Pa and must fall within a –20 □ +20 Pa range. Of course, if the set point is negative, this means that depression must be kept in the surgical room with regard to the reference environment. The value of the pressure difference between the room and the reference environment is measured by a differential pressure switch (cfr. Chap. *Installing the differential pressure switch in the room*) and then sent to the microprocessor with a 4-20mA signal. Based on the pressure difference the microprocessor, to correct it as necessary, sends a tension signal (4-20 mA) to the inverter. The inverter receives the signal from the microprocessor, and varies the feeding

frequency of the air exaust fan in order to increase or decrease the pressure of the surgical room. The inverter varies the feeding frequency of the fan in direct proportion to the tension signal from the microprocessor: increasing/decreasing tensions correspond to increasing/decreasing frequencies (and therefore pressures).

If you need to maintain the overpressure in the surgical room, on starting the unit up, the microprocessor forces a 0Volt signal outgoing to the inverter of the air return fan. This 0Volt signal corresponds to the minimum Hz value set on the inverter, and therefore to the minimum revolving speed of the fan, which corresponds to an airflow extraction equalling about 10% of that supplied by the unit. Afterwards, every 15 seconds, the microprocessor reads the mA signal coming back from the differential pressure transducer installed in the room. As a function of the current value sensed, the microprocessor increases or decreases the output tension signal to the inverter so as to vary the frequency of the fan until the pressure difference between the room and the reference environment falls again within the □ 5 Pa from set-point. The regulation with depression set point follows the same principle, unless on starting the unit up, the microprocessor forces a 10Volt tension to the inverter, which corresponds to the maximum revolving frequency.

2.12.2 CONTROL OF THE CAPACITY WITH THE CONSTANT PRESSURE METHOD

As an alternative to the control method of constant air capacity to the controlled room described above, the same air can be controlled by maintaining a constant pressure inside the supply ducts.

This system is mandatory if one single unit must feed more than one room. The ducts infact are normally intersected by motorised dampers which are closed, partially (night stand by) or totally (sterilization), in case of non operability of the room itself.

To do this type of regulation Tecnair LB provides a differential pressure stat with the unit (0-1000 pa) which is installed by the installer in the air supply duct towards the rooms closer to the unit and anyway after the F9 filter and before each connection to the different rooms.

The pressure stat is wired electrically to the electric panel's relative clamps as indicated in the unit's wiring diagramwith a cable of belden type Of maximum length of 10 meters.When this damper closes the pressure inside the duct raises. The pressure stat informs the microprocessor that confronts it with the setpoint and adjusts the revolution speed with the fans inverter.

This system guaranties a good control of the capacity even if the number of rooms to be controlled varies and acts as a correction of the reduction of capacity due to the progressive dirtying of the filters upstream the measuring point (the ones inside the unit). It is not anyway able to control the dirtying of the filters downstream the measuring point. It is therefore necessary that the filters upstream the measuring point are maintained in an optimum state so that the dirtying of the absolute filter is slower and gradual in time.

With this system there is no direct control of the capacity (the parameter which we must control), but indirectly by the pressure in the supply ducts, which is proportional to the capacity.

The regulating system for the installation is therefore a bit more complicated because of this need to act indirectly. It is therefore suggested to proceed as follows:

- Hypotise a loss of capacity for the system, downstream the unit, with all the units operating and with clean filters.
- Insert as pressure set point this value
- Verify room by room the reached air capacity
- If the reached capacity is not the desired one raise, for example of 30 Pa, the pressure set point and continue regulating it until the desired capacity is reached.

2.12.3 Controlling overpressure for OW series air conditioners

Clean room air conditioners are built to make air conditioning in rooms where no dangerous substance is handled; therefore they work and control only the overpressure of the controlled room in relationship to the external conditions.

According to the precision of the overpressure tolerance demanded its possible to use two different systems.

2.12.3.1 Static control of the overpressure

This is obtained by two manual dampers (not provided by Tecnair) placed one on the suction mouth of the air from the room and the other on the mouth of the fresh air suction. During the start up of the conditioning installation the installer will measure, through a differential pressostat, the pressure difference between the controlled environment and another external reference one. Therefore regulatates the two dampers raising the fresh air flow if the desired overpressure is not yet met and diminishing it in the opposite case. With this system, simple and useful in environments which don't have frequent changes in conditions, such as doors and windows which open frequently, the overpressure of nearly 15 Pa can be controlled, with a tolerance of 8 - 10 Pa. The overpressure level must be verified periodically since an accidental modification of the damper position could delete it and therefore produce great damages to the environments production.

2.12.3.2 Automatic control of the overpressure (accessory)

Clean rooms have to always be maintained in overpressure so to guaranty that the pollution cannot enter from doors or small openings. The overpressure has to be kept so that in no case it can be cancelled by external causes, therefore it has to be well above the tolerance of the system which is approximately calculated to + - 5Pa. The overpressure must not be excessively high so not to create difficulties in opening the doors (even though these are mostly sliding type), or other problems. It is thought that the optimal level is of +15Pa; this is the Tecnair LB default value.

Overpressure control is obtained by controlling accurately the fresh air flow, which is supplied to the environment, on the basis of the information released by the differential pressostat, provided by us, and

installed by the client between the controlled environment and a reference one. The microprocessor compares the received signal from the pressostat with the previously set pressure set point and, if the overpressure is not reached, acts, according to the unit type, like we are going to explain.

2.12.3.2.1 Overpressure control for totally fresh air operating clean room air conditioners

Clean room air conditioners with totally fresh air treatment are marked by the letter “L: low air flow” after the numeric part of their code and have a single mouth opening for the air on which, as an option, a modulating motorized damper can be installed for controlling the room overpressure. This opening is dimensioned according to the units nominal air flow. For these very tough conditions, the air treatment components are selected and therefore the chilling coils are of 6 or 8 row type and even the humidifier is very large. Unless in very rare cases, in parallel to these units for the treatment of fresh air only, others are installed only for the recirculation for a capacity five or more times superior of that of the fresh air unit.

The microprocessor receives the information on the actual overpressure state of the environment from the differential pressostat, compares it with the set point previously set, and raises the dampers opening if the overpressure in the environment is not reached; reduces it if it’s too much. The units air flow therefore varies, in first approximation, in relationship to the level of air tightness in the controlled room: higher the air tightness of the room is, lower is the amount of fresh air necessary to overpressurise the environment. To guaranty the air flow (external + re-circulated) necessary for the demanded air quality in the room the re-circulation air conditioners are used.

2.12.3.2.2 Overpressure control for air conditioners for clean rooms operating with fresh air plus recirculation.

The air conditioners for clean room for treatment of fresh air plus re-circulation or only re-circulation are characterised by the letter “H: high air flow” after the numerical part of the unit’s code, and have two independent suction mouths. Normally in these units the fresh air flow, if present, is at maximum equal to 10 – 25% of the total one, the rest is re-circulated. Under these conditions the components are selected and therefore the chilling coils are of 4 rows whilst the humidifiers are smaller. This unit serves alone one room, or, can be set parallel to other units as stated in the previous point.

Units for total re-circulation cannot take up the function of controlling the overpressure since they don’t have the necessary quantity of fresh air (they don’t even have the relative mouth). In this case installation of the motorized damper is useless.

When the unit handles fresh air too, the overpressure control is obtained by two motorized dampers, modulating and counter placed on the mouth for the entrance of fresh air and on the re-circulation one. The two dampers are controlled by the microprocessor, with the information of the usual differential pressostat.

The microprocessor controls the overpressure raising or diminishing the fresh air dampers opening, and therefore the relative air flow, totally automatically. To a raise in fresh air corresponds an identical lowering of the re-circulated air flow, so that the total capacity towards the controlled room is constant in

time. This is in fact a necessary condition for a good control of the air quality within the controlled room. To do this it is therefore necessary that the two motorized dampers are of identical sizes.

On the extracted air mouth a modulating motorized damper is installed dimensioned for 25% of the total capacity of the unit. On the air re-circulation mouth, where an air flow higher than the fresh one, close to 75 – 90% of the total, passes, two parallel dampers are installed. A damper, motorized and modulating, is counter placed to the fresh air one and is identical to it, for approximately the 25% of the units air flow, whilst a second damper is dimensioned at 75% and with manual regulation. The two parallel dampers are placed on the re-circulation mouth of the unit and are flanged together so that the installer can connect to them a single suction duct.

It is up to the installer to forward think of a manual damper for precision regulations in case the ducts, the fresh air and the re-circulated one, have two different pressure drops (i.e. direct re-suction from the room and long duct for fresh air), which would make a prevalent air flow of one of the two and therefore consequent difficulties in controlling the overpressure.

2.13 HEAT RECOVERY SECTION

Only for OH…HR series air conditioners

The heat recovery system is based on heat exchange between the fresh air and the return one from the environment to control. The heat transfer between the two coils in the red circle of Figure 7 occurs through an appropriate circulation pump and expansion tank and uses water as exchange fluid. According to the current heating/cooling condition setting, the system gives or takes heat from the air being supplied to the unit. We suggest mixing glycole with the water charge in the heat recovery circuit to prevent it from freezing during winter functioning.

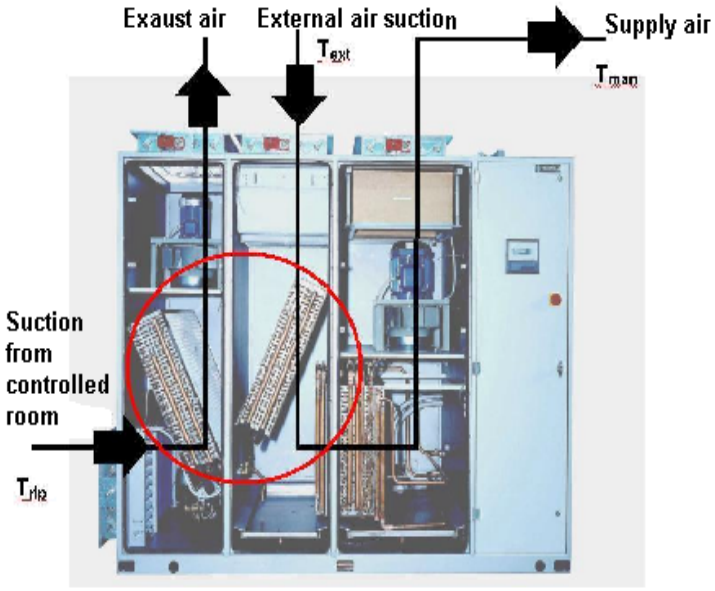


Figure 7: Heat recovery system.

The functioning of the heat recovery system depends on the value of temperatures $_{outdoor\ air}T$, $_{return\ air}T$, and $_{supply\ air}T$:

SUMMER FUNCTIONING

The condition $_{outdoor\ air}T > {}_{supply\ air}T$ is normally verified. If the condition $_{outdoor\ air}T > (_{return\ air}T + \Delta)$ is verified too, where Δ is a parameter that can be set from 2 through 5 (°C), the water circulation pump is working and cools the incoming fresh air down freely.

WINTER FUNCTIONING

The condition $_{outdoor\ air}T < {}_{supply\ air}T$ is normally verified. If the condition $_{outdoor\ air}T < (_{return\ air}T - \Delta)$ is also verified, the water pump is functioning. If $_{outdoor\ air}T < -1$ °C the pump is always working, in order to prevent the water of the heat recovery system from freezing.

Concerning how to fill the heat recovery system, see the related paragraph in chapter *Installation*.

2.14 HUMIDIFICATION (standard for OH series, accessory for OW)

2.14.1 Immersed electrodes humidifier

The humidifier installed in Tecnair LB's air conditioners works by Joule effect: by heating up, the water comes to the boil and thus evaporates.

All the air conditioners for surgical rooms can be equipped with one (standard) or two (accessory) cylinders of similar or different size. The electrodes humidifiers can modulate between 30% and 100% of their own capacity. In same case the 30% is to much, and the best solution is to install two of them in serie connected. Based on the required steam quantity, the microprocessor sets either one or both cylinders at work. This way, we obtain a rather precise regulation curve.

The humidifier is immersed electrodes «box-type». Its structure guarantees low costs for routine cylinder maintenance. The functioning of the humidifier is fully controlled by the microprocessor. Depending on the relative humidity set point, the control software controls the steam production and conductivity of the feeding water to the humidifier itself. The microprocessor also discharges automatically the cylinder for water renewal. The average life of a cylinder can vary from 500 to 1500 hours as a function of the hardness and conductivity of the feeding water.

For a correct functioning of the humidifiers, we recommend the following:

- **Always supply city water, with a mechanical filter 50 µm.**
- **Never use demineralised water.**
- **The conductivity of the feeding water to the humidifier shall be 125 to 1250 µS/cm**
- **The hardness of the feeding water to the humidifier shall be 15 to 40 °F.**
- **With harder water, use NO water softener, but a de-scale.**

The frequency of cylinder replacement is in direct proportion to the water hardness, because of the increase in scale; therefore, we suggest monitoring constantly the condition of the cylinders and make sure that all the operations described in chapter *Routine maintenance* are executed

The following table provides a merely QUALITATIVE description of what may happen when the water conductivity and hardness are not within the recommended limits.

	CONDUCTIVITY [µS/cm]		
HARDNESS [°fH]	< 350	350 ÷ 800	800÷1250
< 15	Soft water. Slow in gaining speed.	Probable foaming, corrosion, jump sparks.	Water subject to softening. Strong problems with foam, corrosion, and jump spark.
15 ÷ 40		**OPTIMUM CONDITION**	Foaming problems. Probably treated water and corrosion problems.
> 40			Many scales. Probable foaming.

Figure 8: behaviour of the humidifier based on the water conductivity and hardness.

REMARK

We suggest treating water with hardness exceeding 30 °fH, even if lower than 40 °fH. The maximum softening allowed is 40% of the initial hardness value. For example, if you start from hardness of 50 °fH, do not exceed 30 °fH (in this case, 40% of the initial value equals 20 °fH).

If water conductivity is higher than 1250 µS/cm, we suggest treating water appropriately and taking it back to the limits allowed.

The two cases with grey background refer to conditions that occur very rarely as they concern water very rich in scale and poor in the other dissolved salts.

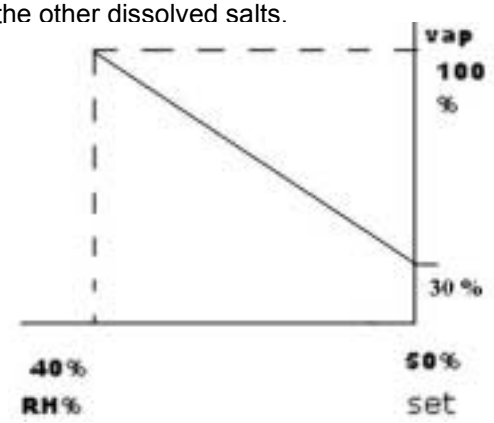


Figure 10:

2.14.2 Condair ESCO steam distributor

The microprocessor controls the humidification by controlling the servomotor of a valve through a 0-10Volt signal. Based on the signal from the microprocessor, the servomotor opens or closes the valve in proportion to the deviation of the ambient humidity value with respect to the set point. For example, if the band is 10% and the set point is 50%, then the valve will close completely at 50%, while it will is completely opened at 40%. Figure 11 illustrates the above said.

A top humidity humidostat, located in the fan compartment and connected with a solenoid valve placed before the steam distribution regulator, makes sure that the steam flow to the room is promptly stopped in case of regulation failures.

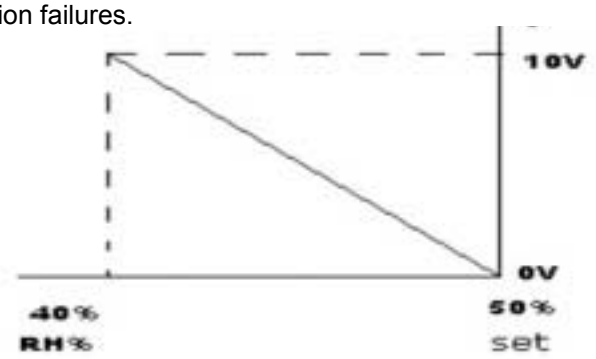


Figure 10: Regulation of the humidification with mains steam.

Steam limits:

- Entrance steam temperature < 152°C
- Entrance steam pressure < 5 Bar

2.15 DEHUMIDIFICATION

Standard on both Series OH and OW

The dehumidification can be executed through:

2.15.1 Compressorized Unit

In this case, the dehumidification start-up the compressor with inverter, if present. This way, the compressor provides all the cooling capacity necessary to take the air below the saturation curve, and thus the drops of water are worked off, so decreasing the humidity in the air. If the compressor is equipped with inverter (accessory), the regulation of the dehumidification is modulating. In this case the pCO^2 starts up the frigorific circuit at 80% of it's capacity,and then modulates

2.15.2 Chilled water unit

The dehumidification is obtained by first opening at 80% the chilled water valve; this valve is modulating-type and is fed by a 0-10V signal from the microprocessor. This way, the water provides all the cooling capacity necessary to take the air below the extreme saturation curve, and thus the drops of water are worked off, so decreasing the humidity in the air. The dehumidification is switched on by opening the

valve at 80%, then the microprocessor regulates it in a proportional way so to get a modulating dehumidification.

2.16 DIFFERENTIAL PRESSURE SWITCHES FOR CLOGGED FILTER INDICATION

The air conditioners produced by Tecnair LB are all equipped with differential pressure switches for measuring the pressure difference before and after the suction, discharge, and return filter. The microprocessor gives a signal when the pressure difference exceeds the set value (see Table 8). This type of alarm does not stop the unit, as it only has a signalling function.

The calibration of the clogged-filter pressure switches is normally executed by the Manufacturer during the testing. In any case, the values of intervention of each pressure switch can certainly be calibrated according to the requirements of the Customer, according to whether this one wishes the filter clogging signalling to be more or less timely. To change the intervention pressure value of a pressure switch, just unscrew the cover and turn the wheel toward the pressure drop value desired.

TYPE OF FILTER	POSITION	VALUE [Pa]
Filter G4	Air suction	180
Filter G4	Air return	180
Filter F9	Air discharge	450

Figure 11: summarises the default calibrations executed during the unit testing at Tecnair's:

2.17 SOUND ABSORBERS

The high LWS (sound power level) of the electro fans makes the installation of sound absorbers, mandatory at least in the supply and suction ducts towards and from the controlled room. The necessity of sound absorbers on the air expulsion and fresh air suction ducts must be studied according to the urban context of the installation. Noise absorbers are selected according to the following parameters:

- Air flow quantity
- LWS in octave band of the fans: declared by Tecnair in the offer or in the Order conformation in relationship to the exact projected working conditions.
- LPS (sound pressure level),which must be guaranteed in the controlled environment, normally 35 dB(A)
- Maximum pressure drop caused by the absorber: normally 80 Pa
- The sound absorbers must have the noise-absorbent panels un-inflammable, veloglass coverings or anyway a non destructible material and damped against humidity, and superficial protection in drilled galvanised or stainless panels.

As a pure indication we hypotised the use of straight sound dampers with length of 2000 mm.

3. INSTALLATION

3.1 TRANSPORT

During site handling, the unit shall be lifted and transported by a lift truck. The forks shall be inserted as shown in the appropriate drawing handed over to the forwarder; failing the lift truck, pass two ropes under the pallet on which the air conditioner rests. Moreover, use rigid spacing bars for the lifting, to make sure that these ropes cannot tread on the framework. This operation too is described in the aforesaid drawing.

3.2 UNIT ACCEPTANCE ON SITE

Unless otherwise agreed upon specifically with the Customer, TECNAIR LB delivers the units ex-works, standard packaged with a wooden pallet and a polyethylene protection sheet.

As the Carrier is always responsible for any damage the goods entrusted to him may suffer during the transport, before signing the delivery slip for acceptance, always check the packaging for integrity and the unit for possible visible damages, of oil or refrigerant leakage. If any evident damage is detected, or if you have the slightest doubt that the air conditioner may have suffered some hidden damages during transportation, you shall make your qualification to the carrier himself in writing, and, at the same time, inform Tecnair LB's Sales Department as well.

If the unit does not need to be installed immediately after the arrival on site, it shall be left in its original packaging and stored indoors, in a non-humid and heated (if possible) place, having temperature 15°C in winter.

If the storage extends for a long period, the Customer shall ask Tecnair LB's Sales Department for the procedures for executing the necessary routing checks on the unit condition.

3.3 CLEARANCE, ANTIVIBRATION SUPPORT AND POSITIONING

To prevent the unit from suffering any problem and damage during transportation, we suggest taking the packaging off only when it has reached the place of installation. Moreover, it is essential to check the floor where the unit is to be positioned: it must be such as to bear the weight of the unit, which can be easily drawn from the related commercial documentation or read directly on the identification plate inside the unit itself. During the installation, take care to leave enough room around the unit for routine and extraordinary maintenance operations, as indicated in the drawing attached to the confirmation of order.

In general, it is absolutely necessary to provide for approx. 80cm clearance all before the unit and 80cm on the right side. The units OHA 242 and OHU 308 need a further 80cm clearance behind the machine.

If the unit is to be installed on the floor, you shall need to place rubber or spring anti-vibration supports right under the unit (4 pieces or the models 41 and 51 and 6 pieces for the other models) chosen as a function of the unit weight and fixed to appropriate holes in the base.

3.4 ELECTRICAL CONNECTIONS

The external electrical connections of the air conditioner must fulfil the following requirements:

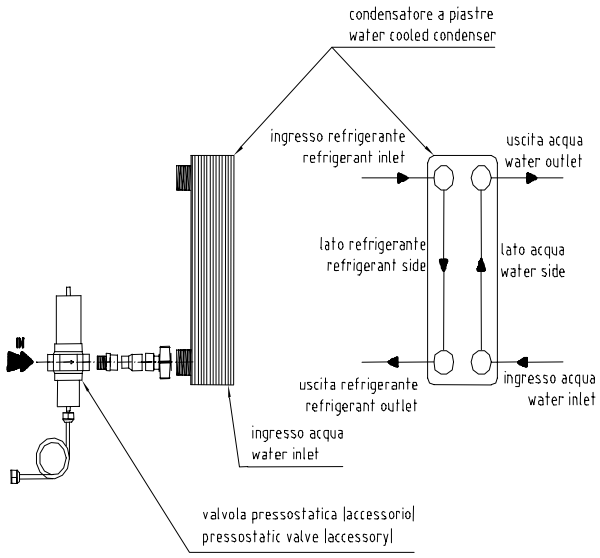
- **They shall be sized to support the maximum load in Ampere indicated in the electric wiring diagram and on the identification label placed inside the control section of the unit.**
- **The feeding line shall arrive to the unit directly from the external magnetotermic differential switch without any interruption or connection.**
- **The magnetotermic switch, mandatory to protect the feeding line against overcurrents, according to the European Rules (par. 7.2.1 and 7.2.6: CEI EN 60204-1), must be placed by the Installer as close as possible to the unit. The magnetotermic switch shall have a differential block from 30 to 300 mA to assure, in addition to the magnetotermic protection, the operators protection against direct or indirect contacts too. The differential bock protects the of the air conditioner against insulation faults too.**
- **The earthling shall be made using a cable with section as indicated in the wiring diagram.**
- **To prevent the microprocessor from suffering any working problem, no utility – not even if it is part of the plant itself, such as pumps, condensers, etc. – shall be connected after the external magnetotermic differential switch of the air conditioner. If this is indispensable, suitable anti-interference devices (R + C) shall be parallel connected with the relay coils of such utilities**

3.5 HYDRAULIC CONNECTIONS: CONDENSATE DISCHARGE

All air conditioners, with either direct expansion or chilled water coil, need the waste pipe to be connected with the central water trap, which canalises the condensate from the direct expansion coil. The humidifier waste water discharge tube shall be connected too. The connections must be made on the relevant fittings on the lower part of the right hand side panel. The connections already have an internal siphon and are two: one for the condensate drainage and the other for humidifier outlet.

3.6 HYDRAULIC CONNECTIONS: WATER COOLED CONDENSERS

As for the units fitted with frigorific circuit and water cooled condensers il (W as the third character), you shall also need to connect the feeding lines with the condensers. The tubes diameter is indicated in the technical documentation; the inlet (in the right lower part of the condenser) and outlet (in the higher right part). Anyhow the connections are shown on the following drawing.



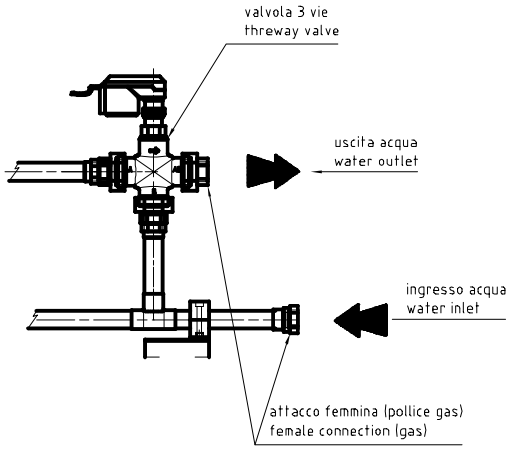
If the feeding water comes from a well or a river, two filters shall be installed in parallel, one of them as backup, with features conforming to the type of water used, to prevent the condenser from getting clogged due to impurities in the water.

Mainly in case of presence of a double floor, the use of the “Water alarm” option is recommended, so to have the possibility to close two solenoid valves installed on the hydraulic pipes and avoid room flooding due to an emergency or a break down of any component of the installation.

Otherwise the installation of two manual shut off valves in a very accessible position is mandatory.

3.7 HYDRAULIC CONNECTIONS: COLD OR HOT WATER COILS

As for the units fitted with chilled water coil (U as the third character), or with an hot water one, you shall also need to connect the feeding lines with them. The tubes diameter is indicated in the technical documentation; the inlet and outlet conenctions are shown on both the following drawing documentation and the appropriate self-sticking labels on the connections themselves.

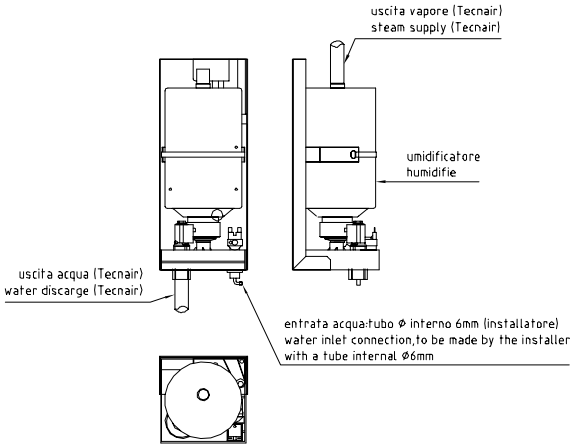


Mainly in case of presence of a double floor, the use of the “Water alarm” option is recommended, so to have the possibility to close two solenoid valves installed on the hydraulic pipes and avoid room flooding due to an emergency or a break down of any component of the installation.

Otherwise the installation of two manual shut off valves in a very accessible position is mandatory

3.8 HYDRAULIC CONNECTIONS: STEAM HUMIDIFIER

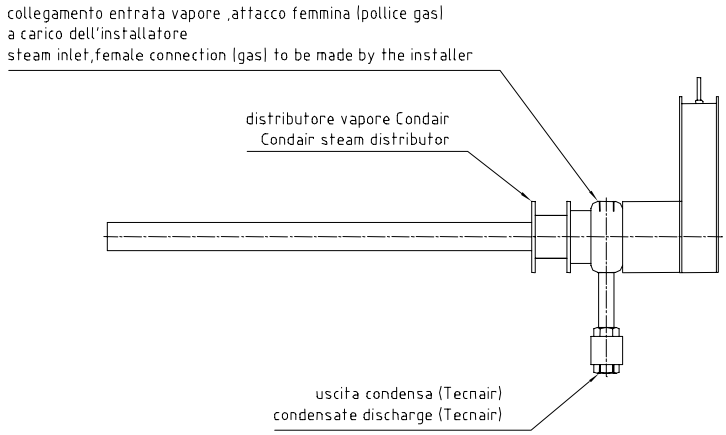
The humidifier shall be feeded with tap water as indicated in par. 2.14, through the relevant conenction in its bottom part. The sole connection to be made is the feding one as indicated in the following drawing, with arubebr pipe whose diameter is indicated in the order confirmation. The discharge connection is already carried ouside the unit by Tecnair.



3.9 CONNECTIONS TO THE NETWORK STEAM DISTRIBUTOR

The Condair steam flow regulator must be connected to the sterile network through stainless steel tubes from the relevant hole in its upper part, as indicated in the following drawing. The distributor resists to a pressure of 5 Bar though it is selected for it to be feeded 2 Bar. This is the sole connection to be made inside the unit because the discharge one is syphoned and carried outside from Tecnair.

The installation upstream of the steam distributor of a pressure reducer with manometer to guaranty that the feeding pressure is of two bars (absolute) is mandatory.



3.10 FRIGORIFIC CONNECTIONS

Type copper for diameters up to 26 - 28, hard-drawn Gelidus-type copper for larger diameters. To prevent copper dust or off-cuts from getting into the pipes, they shall not be cut with an arm saw, but only with a link pipe cutter; then, the pipe ends shall be thoroughly cleaned. If the pipe ends need to be welded, they shall be cleaned with a 00-type emery cloth in order to eliminate any possible trace of oxidation or dirt. Afterwards, the pipe shall be inserted into the joint and evenly heated until it reaches the stock melting point, so that it may easily come into the joint to weld.

3.10.1 Lines connecting a unit with a remote air or water cooled condenser

DISCHARGE (HOT GAS) LINE: It is located between the compressor output and the air condenser. To make the connection easier, inside the air conditioner a pipe section long approx. 20 cm is connected with the compressor output cock, that is, pinched and then welded to the free end.

After having made sure that the compressor valve is closed, the installer shall cut the pipe 5 cm before the welded end, and welds the pipe that runs up to the air condenser. The pipe diameter shall be selected as a function of the section of the connection to execute.

During its operation, the pipeline reaches 70° - 80°C temperature; as regards the good functioning of the unit, this pipeline does not need to be thermally insulated, as the loss of heat along this section is conducive to the good functioning of the cooling cycle.

Pipe insulation is required for safety reasons only where people may accidentally touch the pipeline, or when this one runs under floor in direct contact with the conditioned air.

LIQUID (RETURN) LINE: This pipeline connects the output of the condenser with the air conditioner input valve. It is weld connected with the condenser and the unit input valve. Its working temperature is approx. 40°C and does not require any thermal insulation, but with conditioning units that need to work in winter as well at temperatures below zero**.**

IMPORTANT*:* In case of installation with cooling lines longer than 10 meters with vertical sections and condenser installed in a higher position than the internal unit, two non-return valves (or check valve) shall be installed. The fisrt one on the supply line of the refrigerant liquid as close as possible to the compressor outlet. This serves to prevent the refrigerant from going back through the discharge pipeline up to the compressor due to the compressor stop, so damaging it at the start up and/or preventing the regular start up and causing a high pressure block. Of course, the valves shall be mounted vertically so as to respect the flow direction of the refrigerant. The second one shall be installed on the liquid refrigerant outlet from the condenser as close as possible to this one and in vertical position this valve forbides the refrigerant migration back to the condenser when the installation is switched off and the ambient temperature is very low.

3.10.2 Lines connecting a unit with a remote condensing unit

RETURN (SUCTION) LINE: It runs from the valve on the direct expansion coil output, and therefore from the unit output, to the remote condensing unit. Its working temperature is approx. 5°C; it needs to be insulated to prevent condensation.

LIQUID LINE: It runs from the output valve on the remote condensing unit to the input valve of the air conditioner. Its working temperature is approx. 40 °C and does not require any thermal insulation, barring the units that must work in winter too with temperatures below zero.

3.11 LINES LAYOUT FOR FRIGORIFIC CONNECTIONS

The correct route of the lines is fundamental to the good functioning of the units, and particular care shall be taken in choosing and laying down the compressor's supply pipeline, especially with long lines. In particular:

- The discharge line connecting the internal and the external units over the horizontal sections, shall be tipped down by 2% at least in the refrigerant flow direction.
- If the discharge pipeline needs to rise over 3 meters, a trap with the lowest bending radius shall be installed immediately before each rising section.
- A counter-trap as high as the highest part of the condensing coil shall be installed next to the condenser joint.
- All pipelines shall be clamped every 2 metres. The support fastening to the pipes shall be made so that no vibration is passed on, and so as to allow the normal thermal expansion of the pipes, due to temperature changes during the working.
- A ¼" charging valve shall be installed on both pipelines as close as possible to the external unit, in order to allow discharging and charging the circuit.
- The refrigerant input and output connections on the air condenser are identified by appropriate self-adhesive labels. In any case, we point out that the heat exchange between air and refrigerant shall work in **counter-current**. This means that the gas refrigerant input connection in the condenser is the farthest from the air inlet to the coil, that is, the closest to the fans. Vice versa, the refrigerant liquid output connection from the condenser is the farthest from the fans

REMARK; The drawing below shows only the discharge pipeline as that of the liquid does not require any special precautions.

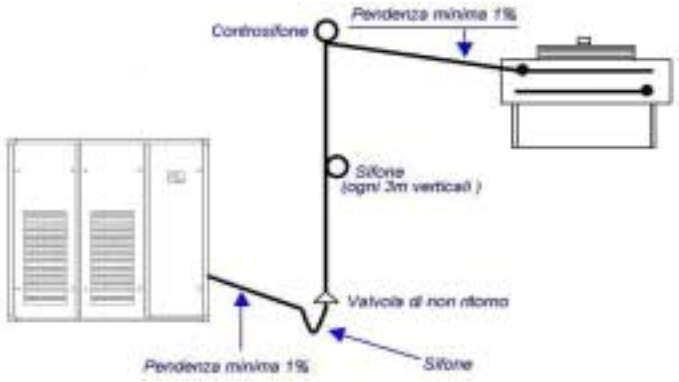


Figure 13: External unit higher than the internal unit.

3.12 LINES DIAMETERS FOR COOLING CONNECTIONS

The following diagrams – relating to 5°C evaporation temperature and 45°C condensation temperature – allow easily dimensioning the suction, fluid, and discharge cooling pipelines. Given the cooling capacity of the plant and the equivalent length of the line in question, the graphs permit to go back to the pressure drop per metre and therefore to the total pressure drop, which must always be lower than the peak marked in the top right-hand corner of the diagram.

For instance, if you want to calculate the diameter of a suction pipe having equivalent length equalling 24 metres, in a plant with cooling capacity equivalent to 28kW, we can draw 3 possible diameters from the diagram at the following page (lines intercepted by the vertical line at 24kW): ∅28, ∅35, ∅42.

If we choose ∅28, the diagram provides (ordinate of point A), a 1.05 kPa/m unit drop, and therefore a 25.2 kPa total drop along the line, which is higher than the suggested peak (20 kPa).

Conversely, if we choose the next greater diameter (35), we shall have a 0.4 kPa/m unit loss and a 9.6 kPa total loss, which acceptable. You are advised against using the greatest suggested diameter (42), even if this is in accordance with the maximum accepted pressure drop, because an excessive diameter may lower too much the refrigerant speed, which would result in bad oil entrainment.

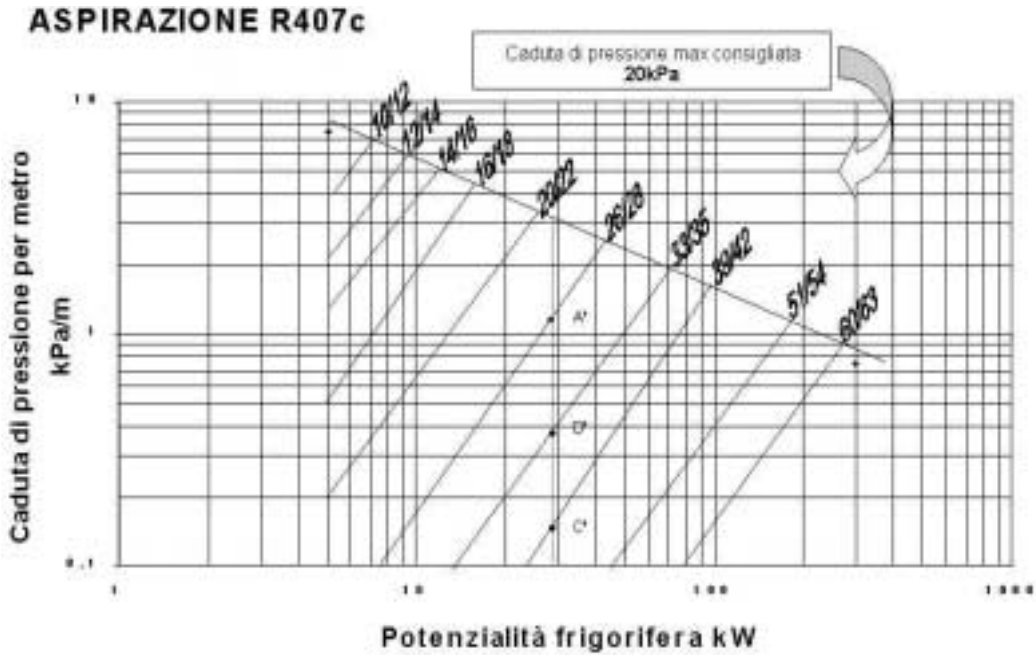


Figure 14 diagram for suction pipeline dimensioning.

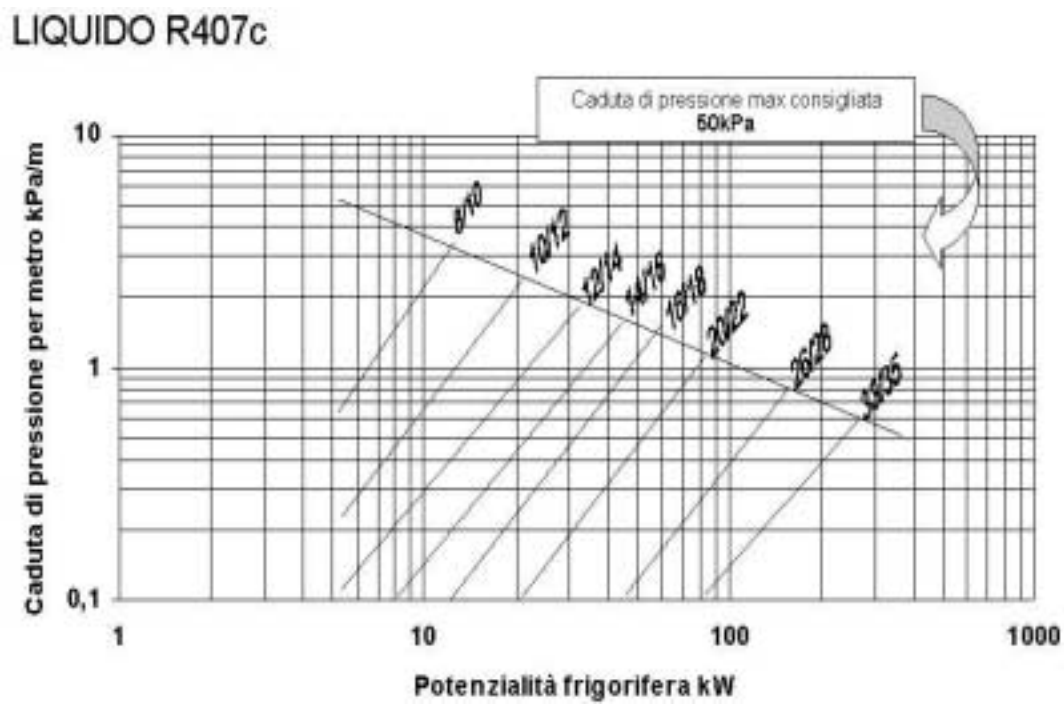


Figure 15: diagram for refrigerant pipeline dimensioning.

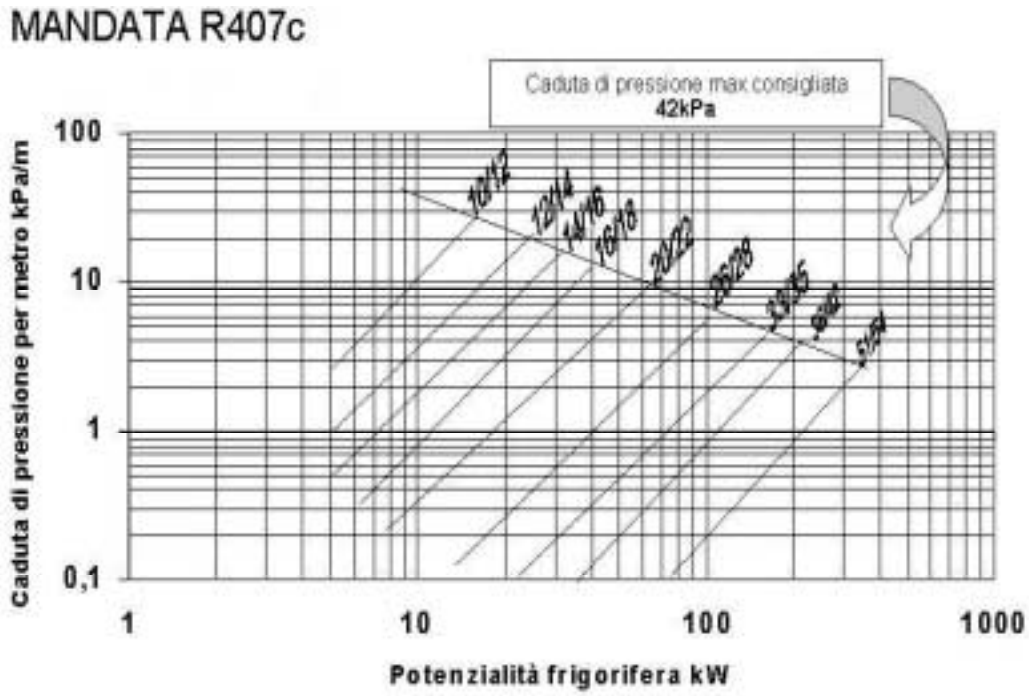


Figure 16: diagram for discharge line dimensioning.

Anyway, the following table can be use instead of the previously described method. It illustrates the diameters suggested for discharge, refrigerant, and suction pipelines, as a function of the size of the different units (expressed by the coding numerical order).

The table considers only two equivalent lengths for pipelines; for a more accurate dimensioning, you can certainly use the diagrams above, which are generally valid.

Unit size	Compressor		Pipelines up to 15 equiv. m			Pipeline: 15 to 30 equiv. m		
	Nom.hp	Rating Kw	Discharge	Liquid	Suction	Discharge	Liquid	Suction
21	2	6	12/14	10/12	16/18	14/16	10/12	20/22
31	3	10	14/16	10/12	20/22	16/18	10/12	20/22
41	3,5 hp	11	14/16	10/12	20/22	16/18	10/12	26/28
51	5 hp	15	16/18	10/12	26/28	20/22	14/16	26/28
71	6,5 hp	19	16/18	10/12	26/28	20/22	14/16	33/35
81	7,5 hp	25	20/22	14/16	26/28	26/28	14/16	33/35
101	10	30	20/22	14/16	33/35	26/28	16/18	33/35
121	12	36	26/28	14/16	33/35	26/28	16/18	39/42
151	15	45	26/28	16/18	33/35	26/28	20/22	39/42
72	2×3,5 hp	2×11	2×14/16	2×10/12	2×20/22	2×16/18	2×10/12	2×26/28
102	2×5 hp	2×15	2×16/18	2×10/12	2×26/28	2×20/22	2×14/16	2×26/28
132	2×6,5 hp	2×19	2×20/22	2×14/16	2×26/28	2×20/22	2×14/16	2×33/35
152	2×7,5 hp	2×25	2×20/22	2×14/16	2×26/28	2×26/28	2×14/16	2×33/35
202	2×10 hp	2×30	2×20/22	2×14/16	2×33/35	2×26/28	2×16/18	2×33/35
242	2×12 hp	2×36	2×26/28	2×20/22	2×33/35	2×26/28	2×20/22	2×33/35
302	2×15 hp	2×45	2×26/28	2×20/22	2×33/35	2×26/28	2×20/22	2×39/42

Figure 17: Inside/outside diameters of cooling lines.

Indeed, the columns relating to equivalent length up to 30m are true for longer sections as well; however, where this is possible, we suggest to lay the unit out in such a way as to not have any excessive lengths, resulting in a considerable flow resistance and consequent reduction of the exchanged cooling capacity.

NOTE: in case of heat pump units the frigorific lines to be selected are the liquid and the suction ones. Lines longer than 15 mt. are definitely not to be used.

3.13 COMPLETING THE REFRIGERANT CHARGE

The direct expansion air conditioners are shipped with only the necessary pressurization charge. The condensers are shipped without charge

The additional total charge of an air-conditioning plant with direct expansion units to be matched with a remote condensing unit (letter “A“, third position in the coding), is the sum of four factors:

Internal unit

Discharge line

Liquid line

Condenser

Conversely, with direct expansion units to be matched to a remote condensing unit (letter “E”, third position in the coding), the addends are the following:

Corresponding pipeline inside the air conditioner

Suction pipeline

Liquid line

Remote condensing unit (not supplied by Tecnair; please address to the related technical documentation)

In both cases, the replenishment due to the corresponding pipeline inside the air conditioner is null, as this is usually pre-charged during the testing.

To know the quantity of refrigerant to replenish for the condenser (model "A"), you just need to draw the volume from the relevant Tecnair documentation and multiply it by 0.3. Then, multiply the outcome by the specific weight of the refrigerant (1.02 kg_P/m^3, thus approximable to one).

Concerning the cooling pipelines, the replenishment is determined based on the diameter of the pipelines being used and on their length. Table 7 below features, for convenience, the refrigerant weight (kg per metre) for the liquid refrigerant, discharge, and suction lines (the refrigerant is question is R407C):

	Weight in kg per m length (R407C)					
Diameters	∅ 1 0 / 1 2	∅ 1 4 / 1 6	∅ 2 0 / 2 2	∅ 2 6 / 2 8	∅ 3 3 / 3 5	∅ 3 9 / 4 2
Liquid line	0,09	0,17	0,35	0,58	0,94	1,31
Discharge line	0,02	0,05	0,09	0,16	0,26	0,36
Suction line	0,002	0,004	0,007	0,012	0,020	0,027

Figure 18: weight of the refrigerant in the lines.

So, to obtain the charge corresponding to each pipeline, you just have to multiply the data in the table by the actual length of the contemplated pipelines. The sum of all the replenishments calculated (e.g. refrigerant + discharge + condenser in case of units with direct expansion coil) gives the total charge to replenish. We recommend the use of SUNISO 3 GS for units charged with R22 and MOBIL EAL ARTIC 22 BC and equivalent polyesters, for units with R407C.

3.14 CHARGE OF THE HEAT RECOVERY CIRCUIT

The heat recovery circuit is normally not filled in by Tecnair, as the percentage of glycols to put in the water vary according to the place of installation of the air conditioner, as well as to the capacity of the circuit.

It is essential to always use glycol water, if the outdoors temperature is expected to fall below freezing.

While filling in the circuit, first put the glycol and then the water.

If the plant is stably connected with the water network, install a disconnector before the plant itself.

The total capacities of the circuits in litres are the following:

OH 62/138: 36 litres

OH 152/208: 48 litres

OH 242/308: 67 litres

3.15 INSTALLING THE DIFFERENTIAL PRESSURE SWITCH IN THE ENVIRONMENT

The differential pressure switch to install in the air-conditioned environment is fundamental, as it sends microprocessor the continuous reading of the ambient pressure, and therefore it enable the microprocessor to execute the operations needed to maintain the right overpressure or depression in the controlled room.

The pressure switch used by Tecnair LB is DPT50-type, has two air-hydraulic inlets and a 5-pole terminal board. To be connect by a schelded cable (3x0,35 (AWG22) to the dedicat4ed terminal on the electri panel. **The connection cable is not provided by Tecnair**

The pressure difference between the room and the reference environment is measured through two small plastic transparent tubes with diameter 4/7. These two tubes are of standard length (2m): the first one represents the positive pressure reference and must always be fixed to the air-conditioned room by the free end; the other one represents the negative transducer reference and must be positioned in an environment surrounding the room, with natural pressure (for example, a passageway).

Figure 19: Room pressure switch – top view.

Figure 20: Room pressure switch – joint view.

The differential pressure switch can be mounted in several ways:

Mounting the body of the pressure switch in the room (figure 21)

Mounting the body of the pressure switch in the surrounding room (figure 21)

Mounting the body of the pressure switch in the false ceiling of the room (figure 22)

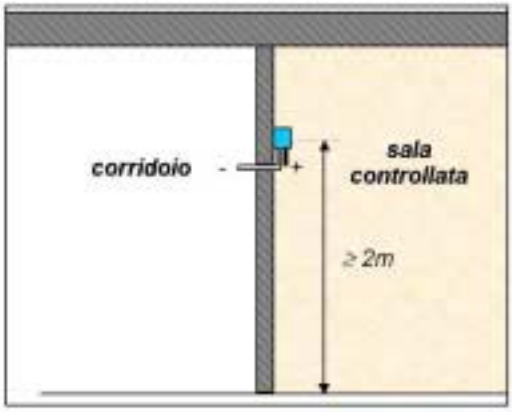


Figure 21: Mounting the differential pressure switch in the room.

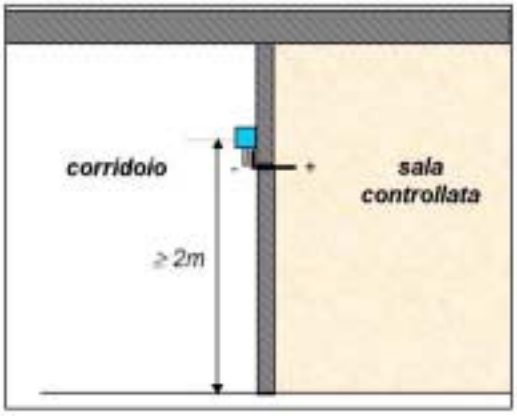


Figure 22: Mounting the differential pressure switch in the surrounding environment.

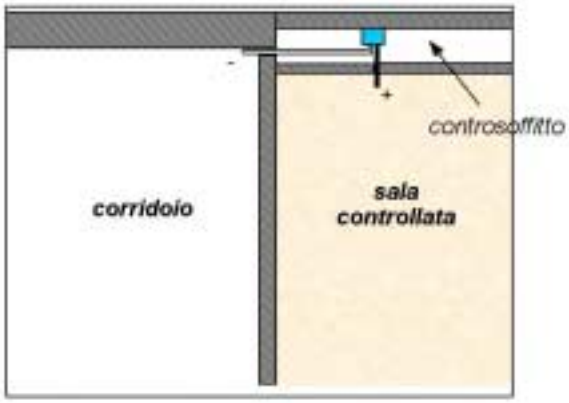


Figure 23: Mounting the body of the pressure switch in the false ceiling of the room

.

Anywhere you decide to install the differential pressure switch, it is essential that:

The tube with free end is connected with the positive outlet of the differential pressure switch; the free end must jut some centimetres out of the wall or false ceiling;

The pressure switch is installed not less than two metres over the floor, so as to be more protected against possible deposits of dust.

Concerning the electrical connections, the pressure switch receives two terminals: the feeding one (+24V) and the outgoing signal (4-20mA). The cable (AWG24 screened type – not supplied by Tecnair LB) shall be connected with the unit according to the respective terminals. It is essential that the cable be screened and be not, as far as possible, inserted in any runways or tube along the route to the unit, avoiding any angle route and/or too small bending radius.

Figure 24: terminal board of the differential pressure switch.

IMPORTANT: THE DIFFERENTIAL PRESSURE SWITCH SHALL NOT BE CALIBRATED

3.16 INSTALLING FOR THE AIR CONDITIONER REMOTE CONTROL INTERFACE

All the air conditioners produced by Tecnair are equipped with a user interface mounted on the unit. A second user interface can be installed inside or near the room to control the air conditioner directly from inside the room. This interface allows to:

- Fix the temperature and humidity set point;
- Modify the capacity of the air conditioner;
- Read the alarms intervened, if any;
- Stop or put the unit in stand-by;

The second interface is connected with the microprocessor on the unit as a local-network shared terminal. So, a 6-way flat telephone-type cable shall be brought in the environment up to the point of connection. The maximum length of the connection cable is 50m. Should you need to connect the second interface at a distance longer than 50m, the use of a shielded cable type AWG22 is mandatory. This cable must be connected to the two T derivation cards from the microprocessor card and the remote terminal are connected. One end of the cable must be entered in the rear of the terminal through a 6 pin plug, the other one in the second card of the microprocessor (MEDIUM CARD or CARD 2), placed inside the electric panel (this connection is better explained on the user manual of the pCO microprocessor). **The connection cable**

is not provided by Tecnair. At the two ends of the cable even the ferrite, provided with the unit, must be applied with the 2nd terminal (refer also to the PCO2 manual).

The second terminal can be either wall- or panel-mounted (see figures 25 e 26). As to the panel installation, the dimensions of the drilling jig shall be 167×108mm; the maximum thickness of the panel shall be 6mm. Conversely, concerning the wall installation, you shall need a mounting bracket and a 3-section standard wall box for the switches, in order to allow the cables to pass.

In case the second interface for remote control is to be installed inside the surgical room it is warmly suggested to protect it from sterilisation effects putting it in an IP54 box with transparent front panel

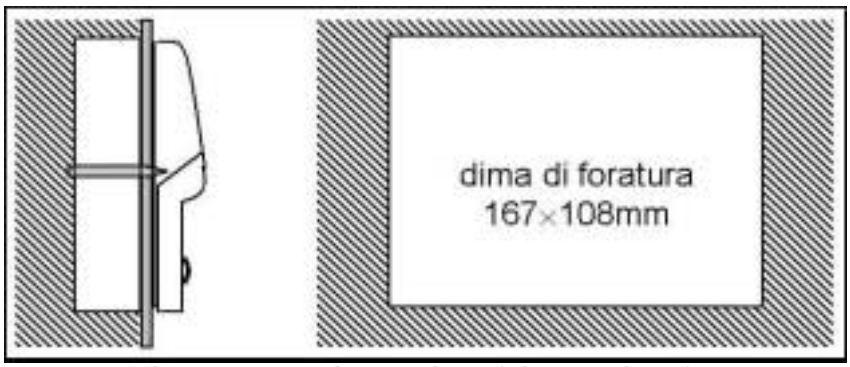


Figure 25: Panel-mounting of the user interface.

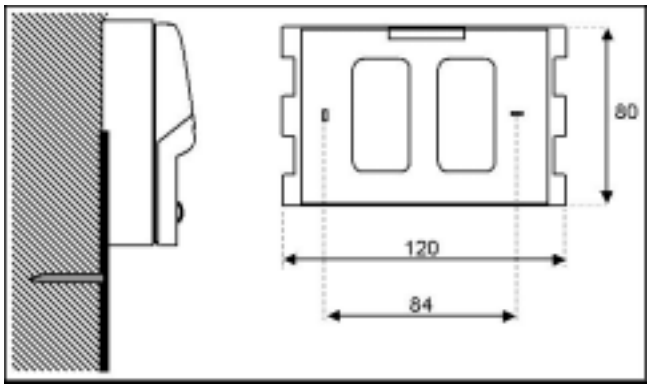


Figure 26: Wall-mounting of the user interface.

3.17 TEMPERATURE AND HUMIDITY FEELERS; POSSIBLE POSITIONINGS

The standard supplied feelers are always wall type. Should you like to install them in a duct the specific ones must be requested.The connection cable, of coxial type, is not provided by Tecnair.

3.17.1 Surgical room air conditioners OH series

According to the necessary installation type different positionings of the humidity and temperature feelers are possible. Tecnair LB has a standard solution, but also other solutions can be possible.

3.17.1.1 Standard positioning

Temperature and humidity feeler positioned in the suction section directly downstream the G4 filter. This position has the advantage of being installed in the factory, wired and tested with the unit. The feelers also are well protected from possible damages.

The inconvenient is that it feels the average of the temperature and humidity of the various controlled environments. If these have, as often occurs, endogenous thermal heat different for both entity and timing (i.e.; a surgical room and a sterilization room that don't work simultaneously) the shifts in the temperature and humidity are very high.

In case of a single surgical room the solution is valid, acceptable in case of surgical room plus awakening room (even if this is always cold since it doesn't have endogenous heat). Therefore the installation, in the auxiliary environments, of the re-heating water or electrical coils with automatic regulation is necessary.

This also obliges to insulate the suction ducts since otherwise the temperatures retrieved by the feelers could be different from the actual ones, and is in difficulty when the doors stay open and therefore the microprocessor reduces to the minimum the extraction air flow.

3.17.1.2 Fixed point regulation

Temperature feeler positioned in the supply van, immediately upstream of the air filter. Humidity feeler in the re-suction van, in the same position as above mentioned.

The temperature feeler regulates the hot and cold coils of the units so to have a constant supply temperature both in summer and in winter; i.e. 14°C. In this condition the relative humidity will be of nearly 90% whilst the absolute one will be maintained by the microprocessor the same as the desired one in the environment (excluding the endogenous humidity due to the presence of people).

The unit can be supplied without the re-heating coil. It is therefore necessary to install a hot water or electrical re-heating coil complete with each one of the ducts to the controlled rooms.

This system allows a good regulation in each environment; the only inconvenient being the necessity of re-heating each room at the expenses of the installer. The humidity tolerance is less good since the re-suction feeler feels the average of the various humidity's in the various served environments.

3.17.1.3 Combined Temperature and humidity feeler loose provided and installed in the room

This allows an optimum control of the conditions of the main room, and of the auxiliary ones by local re-heating coils with regulation. This type of installation has difficulties if the system serves a second room with a lot of endogenous airflow and maybe even not simultaneously to the first room where the feeler is installed; i.e. a surgical room and a sterilization room.

The temperature and humidity feeler must be positioned at a specific height (min 1.7 m) so not to be damaged accidentally by shocks and it is necessary to care for it during the sterilization process of the room.

The feeler must be connected to the µP of the unit by a cable which must travel through ducts.

3.17.1.4 Temperature and humidity feeler standard provided and installed in the re-suction duct of the room

The characteristics of this installation are the same as those in paragraph 2.15.1.3. The advantage is that the feeler is protected form shocks. The disadvantage is that it becomes difficult to control and clean. In this case it becomes necessary to request duct type feelers.

3.17.2 Clean room air conditioners OW series

The temperature and humidity feeler can be installed inside the unit only in case of total re-circulation or total fresh air, since the possible mix doesn't allow to measure the conditions of the room and therefore the relative control. Otherwise they must be installed by the installer on the wall of the room or in the re-suction ducts.

3.18 DISASSEMBLE AND DISPOSAL

Tecnair LB air conditioners must be disassembled by skilled technicians.

The following points must anyway be respected:

- Switch off the air conditioner directly from its microprocessor and then open the door lock main switch of the unit.
- Open the magnetotermic difefrential external switch to insulate the unit from the electric net.
- Remove the electric conenction from the eletcric panel of the unit
- Remove the refrigerant charge (if present) from the unit according to the local Rules for the ozone protection.
- Disconenct the frigorific lines fromthe unit.
- Disconenct the hidraulic lines, and the condenssate discharge.
- The unit disposal is subject to the local Rules.
- We suggest to contact a disassembling specialised Company
- The air conditioners are essentially made by aluminium, copper and steel

4 FIRST START UP

Before proceeding to the commissioning madae by Tecnair LB's technicians, it is mandatory to follow the instructions indicated in the following sheet (direct expansion units)

Surgical rooms and clean rooms with frigorific circuit; OHA and OWA models.
or with chilled water coil; models OHU and OWU

Start up date	
Start up location	

Operator name and signature	……
Client name and signature	……

Test to be done before calling our technician for the start up

The start up of the units with frigorific circuit (OHA, OWA) forecasts that the unit are fed for at least two hours before the arrival of the technician do to allow for the carter oil resistance of the compressor to arrive to the temperaturefor the refrigerant to evaporate and so to guaranty the correct functionment of the compressor.

POS	OPERATIVE DESCRIPTION	POSITIVE	NEGATIVE
1	***Visual verification of the hot gas supply ducts (only H & W)***		
1.1	Conformity verification of the supply tube diameter with what forecasted in the installation manual.		
1.2	Verification of the slope of the horizontal hot gas supply tubes in the direction of the refrigerant flow of at least 1%.		
1.3	Verification of the presence of the siphon at the base of each mounting tube and every 3 m and of a counter siphone in the highest point of it.		
1.4	Verification of the presence in the nearest point to the compressor of a non return valve. opening in the direction of the refrigerant's flow.		
1.5	Verification of the presence of the insulation of the tubes in the pieces of points where an occasional contact is possible by the operator (Temperature of the tubes works at approx 70/80°C)		
1.6	Verification fo the settings of the brackets on the supply tubes not to be too rigid every 3 m so to allow for dilatation.		
2	***Visual verification of tubes for the frigorific return liquid (only OHA, OWA)***		
2.1	Verification of the conformity of the diameter for the liquid tubes with what requested		
2.2	Verification of the presence of the brackets every 3 m		
3	***Verification of the opening of the frigorific circuit valves (OHA, OWA)***		
4	***Verification of the air cooled condensers (only OHA, OWA models)***		
4.1	Verification of the electric connections to the condenser switch		
4.2	Verification that the switch is in on position (feeded condensor)		
4.3	Verification that the frigorific connections of the condenser are in opposite streamdirection between the refrigerant and the air.		
4.4	Verification of the correct positioning of the condenser away from walls and/or other condensers so to avoid air recirculation which would not allow for it's good functionment		

5	***Verification electrical feeding***		
5.1	Verification of the connection of the three phases, neutral and ground connection.		
5.2	Verification that the feeding line has a tension tolerance of +/- 10%		

6.	***Verification of the hydraulic connections***	**POSTIIVE**	**NEGATIVE**
6.1	Verification the conformity of the entrance and exit of the cold and hot feeding. With the arrows on the connections to the unit and as shown in the installation manual of the unit		
6.2	Verification that the feeding tubes are fitted with hand valves outside the unit		
6.3	Verification that the condensing discharge tube does not have valves or counterpendences.		
6.4	Verification that the feeding water hardness is between 10 and 40 French degrees.		
6.5	Verification that the connections for the feeding of the humidifier connected to the sanitary water.		
6.6	Verification that the condensing discharged from the humidifier is connected to the drainage network without valves or counterpendances		

7	***Verification of the system for heat recovery (accessory)***		
7.1	Verification that the system has been charged with water and glycol in relationship to the forecasted minimum temperatures		

8	***Verification of the aeraulic connections and of the air filters***		
8.1	Verifcation that the air ducts are connected in conformity to the instructions		
8.2	Verification of the installation of the sound dampers at least twords the controlled room.		
8.3	Verification that the air ducts are insulated externaly		
8.4	Verification that the air filters on the supply and that terminal in the room are not installed so to avoid that they become dirty during the systems testing.		

9	***Verification of the differential pressostat for the control of the rooms pressure***		
9.1	Verfication of the connections ot the pressure plugs as descirbed in the installation manual : h min = 1700 mm		
9.2	Verifcation of the electrical connection from the pressostat to the electric pannel as described in the wiring diagrams and the installation manual.		

10	***Verification of the temperature and humidity feelers***		
10.1	Verification of the positioning as forecasted in the installation manual h min =1700 mm		
10.2	Verifcation of the electrical connections of the feelers to the elctrical pannel, as described by the wiring diagram or the installation manual.		

11	***Verification of the second interface for remote control: only if present***		
11.1	Verification of the positioning as forecasted in the installation manual h min =1700 mm		
11.2	Verifcation of the electrical connection of the interface to the electrical pannel as seen on the wiriing diagram or the installation manual		

NOTES FOR POSSIBLE ANOMALIES ENCOUNTERED DURING THE VERIFICATION PHASE
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4.1 ELECTRIC CONTROLS

Before proceeding with the operations it is necessary to check that power connections have been carried out correctly and that their operational level are in optimal conditions. Then it is recommended to control that every screw of the terminals are accurately tightened down, both as regard the connections effected on the terminal block and on the individual devices.

By mean of a voltmeter, make sure that the line voltage corresponds to that of the label with a +- 10% allowance. It is necessary, also, to check direction of the fans, starting them up without energizing the compressor. If the rotation of fans is not correct, it is sufficient to change the connections on the terminal board of two out of three phases of the feeding line of the machine.

Before staring up the compressor it is necessary to proceed to a control of the current absorption of the various fans, by an amperometric wrench on each phase, to be sure that they do not exceed the limits indicated on the electric wiring diagram supplied with the unit. If the absorption of one phase or of all the phases of a motor is higher than the limit, it should be checked that the fan is operating in normal mechanical conditions and eventually substitute the motor. When the compressors will be started up, it is necessary to control that their absorption is within the fixed limits.

N.B. For units with scroll compressor only, therefore with "A" or "W", as the third letter of the coding.

The units with scroll compressors are standard-equipped with devices controlling the feeding phases (sequencer). This device installed in the electric board is equipped with two LEDs (green and red) marked "electric connection OK" and "invert phase connection" respectively. When the red LED is on, the unit is not started up, for avoiding damages to the compressor.

4.2 CONTROLS OF REFRIGERATION CIRCUIT OPERATION

About four hours before starting up the compressors it is necessary to insert the general feeding switch so as to give voltage to the carter oil heater in order to minimize the concentration of the refrigerant present in the oil and the consequent involving of the same when the compressors are switched on, to avoid to damage them. This operation must be repeated every time it is necessary to start up the compressors after an idle period during which the voltage has been taken away by opening the general feeding switch.

This procedure is so important that the non-observance of it is voiding the guarantee of the machine.

After this, to start up the unit, first open the taps placed on the suction and discharge line of the compressors on the exit of the liquid receiver (if present) and all the other valves present on the frigorific circuit; at this point you can energize the unit pushing the ON button on the microprocessor or the selector on the units with electronic control. After 15 - 20 minutes of continuous operation of the machine it is necessary to check the good operation of the frigorific circuit; to do this you have to control the following operating point:

1. refrigerant charge of the circuit;
2. Evaporating pressure;
3. Condensing pressure;
4. Overheating of the suction line;
5. Sub cooling of the liquid line;
6. unclogging (if clogged) of the fluid line filter
7. Compressors power input;
8. High pressure switch good operation;
9. Low pressure switch good operation;
10. Operating temperature of the compressor.

As normally used by the air conditioning serviceman, here below we express condensing and evaporating pressures using the relevant temperatures.

4.2.1 Refrigerant charge control

This is the first control to be made on a frigorific circuit; in fact if the charge is not correct the control of all the operating parameters is without any sense. To control the charge it is enough to check at the liquid gauge. If bubbles are not present, it means that the charge is correct (pay attention that this control is not excluding that the charge is abundant); if there are bubbles it means that the charge is not complete or there is a leakage; in this case, identify the leak and repair it.

Under normal conditions the indicator with chromatic change must be in green color; if humidity is present in the circuit, the indicator tends to become yellow; in this case it means that humidity has been entered in the circuit during operations and therefore the refrigerant and the filter drier must be changed.

4.2.2 Evaporating pressure control

To make this control a manometer with scale end = 8bar must be connected with the relevant service valve ¼ " on the suction valve of the compressor; check that the compressor valve is open. Tecnair units are studied to have very large heat exchangers, and therefore very high evaporating pressures: about 3-6°C with input air temperature to the evaporator of 24°C. An evaporating pressure higher than the indicated cannot be caused by a blink on the frigorific circuit, but only by a too high condensing pressure. A too low evaporating pressure can be generated by several different causes (see diagnosis and failure repair: low pressure switch intervention.

4.2.3 Condensing pressure control

Connect a manometer (with scale end = 30 bar) with the relevant service valve ¼ " on the discharge valve of the compressor; check that the compressor valve is open.

For good operation of the frigorific circuit, the condensing pressure must be as constant as possible. A low condensing pressure causes low evaporating pressure with a consequent high dehumidification; too high condensing pressure is causes a low efficiency of the frigorific circuit and high electric power input.

Therefore, normally we try to keep in summer and winter a condensing pressure as close as possible to 45 °C. In order to do this it is mandatory that condensers are selected to have the capacity to dissipate the heat rejection of the unit (cooling capacity plus compressor power input) with a difference of temperature of 15 - 20 °C between air entering temperature to the condenser and condensing one.

So, when the external temperature is 30 °C the condensing temperature will be 45 -50 °C. Of course when the air temperature is higher than 30 °C the condensing temperature will be higher than 45- 50°C, but this cannot be avoided, and is not reasonably creating problems to the frigorific circuit.

Tecnair air-cooled condensers are provided with an electronic device made of a modulating pressure switch connected with a regulator, to reduce the revolution speed of the condenser fan when the condensing pressure is reduced due to the low ambient temperature. This device, water proof protection IP55, is placed on the air-cooled condenser fan panel and is allowing a constant condensing pressure also during night and winter.

In case the air conditioner is supplied without the relevant condenser, the revolution number variator for the condenser can be ordered as accessory and installed inside the electric panel.

The device is already factory set, but should you need to change it due to a blink or only to reset it, internally the cover a setting screw is provided. Turn this screw anti clock wise to increase the fan revolution number (reduce the condensing pressure); turn it clock wise to reduce the revolution number and consequently increase the condensing pressure.

On the modulating pressure switch on the liquid line sending the transformer the signal proportional to the condensation pressure there is a screw. Turn this screw clockwise/anticlock wise to decrease/increase the pressure in the circuit.

4.2.4 Sucked gas overheating control

Gas leaving the evaporator and arriving to the compressor is at the evaporating pressure but overheated. For a good operating of the frigorific circuit the difference between sucked gas temperature and the temperature corresponding to the evaporating pressure must be around 4 - 7 °C; this difference is called overheating.

If overheating is more than 7 °C it means that:

- Thermostatic valve is too close or defective. To open the thermostatic valve you have to remove the cap placed on the lower part of the valve; then rotate anticlockwise the control shaft that is under the cap by one turn and after 30 minutes to allow the circuit to stabilise, recontrol the overheating; if this is not enough turn an other turn.
- refrigerant charge is not complete (bubbles on the liquid indicator)
- Air inlet is too hot

If the overheating is less than 4 °C it means that:

- Thermostatic valve is too open or defective; to close it proceeds as already seen by rotating clockwise the control shaft.
- Air filter is dirty or the coil is clogged
- Fans are defective, wrong revolution

4.2.5 LIQUID REFRIGERANT SUBCOOLING CONTROL

Liquid refrigerant leaving the condenser is at the condensing pressure but sub cooled compared with the temperature corresponding to the condensing pressure. Normally sub cooling ought to be between 2 and 7 °C.

If sub cooling is less than 2 °C it means that the condenser cannot get rid of all the heating produced.

If sub cooling is more than 7 °C it means that the refrigerant charge is too high.

4.2.6 Filter liquid line clogging control

The filter on the refrigerating liquid line is of great importance in the units with refrigerating lines to be completed in the factory to avoid allowing the circulation of eventual dirt, impurities or other leftovers from the selling due to bad execution of the same lines which could therefore damage the compressor.

The clogging of the filter causes a pressure loss of the refrigerant and therefore a partial re vaporization , with the presence of bubbles in led and a slightly noticeable loss in the temperature of the tube upstream and downstream of the filter.

4.2.7 Compressor power input control

The compressor power input must be measured by an amperometric wrench on each single phase on the electric line from the relevant contactor to the compressor, and compared with the one indicated on the testing declaration of the unit.

4.2.8 High pressure switch control

Connect a pressure gauge with scale end = 30 bar with the servicing valve ¼ “ on the cock of the compressor and stop the fans of the air condenser. At 24 bars the high pressure gauge must stop the compressor. If at 25 bar the pressure switch has not intervened, stop immediately the unit and replace it.

4.2.9 Low presure switch control

Connect a pressure gauge with scale end = 8 bar with the servicing valve ¼ “ and close the suction cock of the compressor. At 1 bar the low pressure gauge must stop the compressor and start it up

automatically when the pressure is 2.5bar. If at 0.7bar the pressure switch has not intervened, stop immediately the unit and replace it.

NOTE

On starting the compressor, the low-pressure switch is delayed by 180 seconds.

4.2.10 Temperature of the compressor control

Temperature of the top of the scroll compressor must be about 60/70°C; temperature of the bottom must be about 25 - 30 °C. If temperatures are colder, and you can notice that the top of the compressor is covered by condensate water, it means that temperature of the refrigerant is too low and therefore liquid refrigerant tends to return to the compressor as a result of an insufficient level of overheating ensured by the thermostatic valve. Proceed as seen at paragraph “sucked gas overheating control”.

If the compressor head is too hot: 50 °C or more, it means that the thermostatic valve does not allow a sufficient refrigerant to pass to the evaporator, and that the overheating of the refrigerant is too high; therefore proceed as per paragraph “sucked gas overheating control”. This phenomenon can also be due to a defectuous compressor.

5. WASHING, CLEANING, AND DISINFECTION

5.1 WARNINGS

Before initiating any cleaning operation, it is indispensable to read carefully the following preliminary instructions and fully understand their content. All cleaning operations shall be executed observing such directions, as any improper procedure may cause serious damages to the equipment and/or harm the operator.

The air conditioners series “H” and “W” contain live and pressurised parts. Therefore, to avoid any possible hazard, it is indispensable to execute the following instructions before opening the unit and carrying out any cleaning operation:

Make sure that the electricity has been disconnected.

Make sure that all live parts (compressor in the driving compartment, expulsion air fan, and supply air fan) have come to a complete stop (that is, have ceased moving).

All the electric feeding circuits of the equipment have been opened.

These instructions refer exclusively to the cleaning of the air conditioner. Therefore, we take for granted that maintenance, cleaning, and/or disinfections of the other parts of the plant (inside of the ducts, vents and/or air diffusers to the environment, grille for air return from the room, germinal lamps, humidifier feeding water treatment system, condensate discharge system, etc.) have been carried out within the deadlines and following the procedures indicated by the relevant constructors and by the installer that has executed the system.

In fact, the execution of the only cleaning, washing and disinfections operations, even if executed observing the instructions contained in this handbook, is not enough to guarantee the necessary sterilisation of the whole system. Even if they are equipped with internal filters, Tecnair LB’s air conditioners series “H” have been designed to guarantee the environment air-conditioning, not its sterilisation. In fact, to obtain the required sterilisation in the environment, the installer shall mount, at its care and cost, hepa filters by each vent or air diffuser to the room.

The cleaning operations relating to the air conditioners series “H” used for conditioning operating theatres shall be executed by personnel previously and duly trained to this end by the hospital’s maintenance service, in order to prevent the air conditioners themselves from being contaminated by proliferations of bacteria. Only in this way, the health of the cleaning operators, medical staff, and of the patients entering in the rooms conditioned by these units in the future will be protected.

5.2 OUTFIT TO USE FOR EXECUTING CLEANING OPERATIONS

Unless otherwise specified by the physician in charge of the surgical room, the personnel entrusted with the cleaning operations should wear the clothes listed below, in order to both protect their health and safeguard the result of the operations they carry out on the unit:

A clean overall

Protection goggles

Latex gloves (during cleaning and disinfections operations on the operating compartment, the gloves shall be replaced as soon as they get dirty).

Antiseptic half-mask respirator

Top footwear

Once the cleaning operations have been terminated, all the clothes used for these activities shall be disposed of as contaminated waste, with the exception of the overall, which may be re-used, after appropriate washing and disinfections.

5.3 DISPOSING THE WASTE MATERIALS USED FOR CLEANING OPERATIONS

Cleaning these units originates both solid waste (replaced filters, operator clothing, worn-out belts (if any), etc.) and sewage (washing fluid and rinsing water residue).

The solid waste shall be put into hermetically sealed containers, and shall be disposed of together with the septic solid waste of the hospital. Conversely, the sewage can be discharged into the drain of the condensate discharge back fitted on the apparatus. These bacs shall be previously connected with the septic sewage system of the hospital.

5.4 CLEANING METHOD

As the air conditioners contain electric components (electric motors, terminal boards, feelers, etc.) that cannot bear plenum water jets or high temperature, and a cooling system that cannot undergo high pressure, when executing any cleaning operation, the operators shall not use:

Any jets of steam

Any jets of plenum water

The disinfectant and the water necessary for disinfecting and rinsing the apparatuses shall be used only in atomised form, and then be disposed of as septic sewage. You can obtain the atomised solution for cleaning the air conditioners using appropriate manual atomisers.

The cleaning and washing operations shall be executed using only water plus 4% ammonium chloride solution (or a chemically equivalent commercial solution), to atomise with a manual atomiser.

Each air conditioner can be divided into three sections:

TECHNICAL COMPARTMENT**:** containing the control systems and the compressors. No air circulation occurs in this compartment, so it normally doesn’t require any disinfection. Anyway, every three

month, when washing and disinfecting the operating compartments, or any time it is opened for maintenance operations, this compartment shall be cleaned following the specific procedure described in this handbook.

OPERATING COMPARTMENTS: containing the parts in which the air treatment occurs. This area is licked by both the outdoor air, which is treated and then supplied to the surgical room, and the air flow coming from the surgical room.

Despite the filtering systems adopted for the air suction, return and distribution systems, and the unit, bacteria may nest in these parts of the air conditioner in the long run, and proliferate during inactivity periods, which would make the later use of the unit unsafe from a hygienic standpoint.

Such compartments shall be washed and disinfected (according to the methods specified hereafter) at least once a month, and always-in case of surgical operations involving a risk of propagation of harmful bacteria.

Anyway, as the frequency and mode of use of the surgical rooms are various and different, the responsibility of deciding about the need for a washing and disinfections of such compartments pertains exclusively to the Physician in charge of the Ward in question.

EXTERNAL FRAMEWORK OF THE UNIT: The external framework of the unit is made of enamelled plate, so it only needs to be cleaned according to the criteria and following the specific procedure described in this handbook.

However, if the unit is installed directly in the surgical room or in any room in which any septic contamination may occur, it should be cleaned whenever the operating compartments are washed and disinfected, or even more frequently, to the sole discretion of the Physician in charge of the Ward in question.

Each section shall be cleaned with a different method, as each method applies to specific areas. Further, the following order shall be observed.

Cleaning the inside of the technical compartment

Washing and disinfecting the operating compartments

Cleaning the external framework of the unit

5.4.1 Procedure for cleaning the inside of the technical compartment

The inside of the technical compartment shall be cleaned with a vacuum cleaner equipped with an interchangeable paper filter, using a soft brush. Unless otherwise specified by the charge Physician, the filters of the vacuum cleaner do not require necessarily to be disposed of as septic waste.

The cleaning procedure to apply is the following:

Stop the unit and disconnect the electricity by turning the main shutter-blocking switch off.

Put a notice on the switch saying that the unit is under maintenance.

Open the shutter of the technical compartment by turning the appropriate key.

With the end piece of the vacuum cleaner, remove any trace of dust from the internal components and walls. This operation shall be executed from the top to the bottom.

Clean the internal walls with an alcoholic solution avoiding moistening the shutter washer. This operation shall be executed from the top to the bottom.

Clean the shutter washer with a wet cloth.

Dry scrupulously the internal walls and washer with a dry and clean cloth.

Close the shutter, taking care not to damage the washer.

If the operating compartments do not need to be washed and disinfected, connect the electricity again, by turning the main shutter-blocking switch on. At this point, the unit is ready to be set at work again.

5.4.2 Procedure for washing and disinfecting the inside of the oparting compartment

The inside of the operating compartments is licked by the outdoor air and by the airflow from the surgical room. This is why they can be subjected to accumulation and proliferation of pathogenic microorganisms, even if appropriate filters are installed both on the unit and on the air suction and discharge networks.

Therefore, they must be washed and disinfected on a regular basis.

Unless otherwise specified by the Physician in charge of the Ward in question, they shall be washed and disinfected:

At least once a month, regardless of the use of the apparatus.

Whenever any operation that may give rise to the propagation of pathogenic microorganisms is executed in the surgical room.

Before washing and cleaning the unit, it is absolutely necessary to empty the pre-heating (if any), as otherwise the efficacy of the washing of the chilled water coil would be very low. To empty the coil you need to close the manual valves on the hot water input and output ducts (mounted on the framework of the unit by the installer). The coil is connected with the ducts by appropriate vents. So isolated from the water ducts, the coil can be removed from the frame by unscrewing the 4 screws and sliding it on the special guide. Now the coil can be washed and sterilised like all the other parts.

The washing and disinfections procedure is the following:

Make sure you have all the necessary material and spare filters.

Stop the unit and disconnect the electricity by turning the main shutter-blocking switch off.

Put a notice on it saying that the unit is under maintenance.

Dismount and replace (if necessary) the pre-filter on the outdoor air intake. These filters can be disposed of as standard solid waste, as they should not be subject to bacterial contamination.

Dismount and replace the filter after the shut-off damper on the air return from the surgical room. The dismounted filter shall be put into a hermetically sealed container, and then disposed of following the same procedure as for the septic waste of the hospital. Great care shall be taken in cleaning the room between the airs return damper and the filter seat, where dirt is likely to deposit.

Dismount and replace the hepa filters before the vents and/or air diffusers to the room. The dismounted filters shall be put into hermetically sealed containers, and then disposed of following the same procedure as for the septic waste of the hospital.

Dismount the shutters of the operating compartments by turning the appropriate key.

Dismount the filters on the unit (G4-class filter on the air return, G4-class post-filter on the outdoor air suction, and G7-class post-filter on the air discharge). The dismounted filters shall be put into hermetically sealed containers, and then disposed of following the same procedure as for the septic waste of the hospital. The spare filters shall be mounted later; as otherwise, they may get damaged during the washing and disinfections.

Dismount the drops eliminator (if present).

Wash and disinfect the left-hand operating compartment with a 4% ammonium chloride solution to atomise by means of a hand atomiser in following order, until all the components are completely washed:

On the overpressure damper of the air expulsion.

On the return air fan, turning the runner by hand until it is completely washed.

On the heat recovery coil (if any) on the return airside. The coil shall be sprinkled abundantly with the solution from the top of its upper face until the solution comes out of the bottom side.

On all the pipelines running inside the compartment.

On the circulation pump of the heat recovery circuit (if provided).

On the blades of the return air damper.

In the room produced by the thickness of the panel between damper and filter.

On the framework of the return air post-filter.

On the internal walls of the compartment, acting from the top.

On the bottom bac.

Rinse abundantly the internal parts of the left-side operating compartment by atomising sterilised water with a manual atomiser. The rinsing operation shall be executed following the same sequence described at previous point i).

Wash and disinfect the central operating compartment with a 4% ammonium chloride solution to atomise with a hand atomiser in the order specified below, until all components are completely washed:

On the levers and blades of the outdoor air damper.

In the room produced by the thickness of the panel between damper and filter.

On the framework of the outdoor air filter.

On the heat recovery coil (if present) on the outdoor airside. The coil shall be sprinkled abundantly with the solution from the top of its upper face until the solution comes out of the bottom side.

On all the pipelines running inside the compartment.

a. On the bac beneath the heat recovery coil (if present).

b. On the assembly consisting of the pre-heating, cooling, and reheat coil. The assembly shall be sprinkled abundantly with the solution from the pre-heating coil side until the solution comes out of the reheat coil out on the right-hand operating compartment. Afterwards, the solution shall be sprinkled through the reheat coil until it comes out of the pre-heating coil.

c. On all the blades and levers of the by-pass damper (if present).

d. On the internal walls of the compartment, acting from the top.

e. On the bottom bac.

Clean and disinfect the supply air fan, turning the runner by hand until it is completely washed.

On the humidification system.

On all the pipelines running inside the compartment.

On the condensate discharge bac.

On the internal walls of the compartment, acting from the top.

On the bottom bac.

Rinse abundantly the internal parts of the right-hand operating compartment by atomising sterilised water with a hand atomiser. The rinsing shall be followed by the operations listed at previous point m) taking into account that between stage m4. And stage m5. The reheat coil needs to be rinsed (it was washed previously) in order to eliminate any accidental trace of solution from its surface.

Wash and rinse the components of the drops eliminator dismounted beforehand.

Mount the hot water heating coil back.

Mount the discharge adjusting damper back on the duct following the specific instructions provided by the installer that has laid the system.

Mount the new filters on the unit.

Clean the washer of the operating compartment shutters.

Make sure that all the internal parts are completely dry.

Mount the operating compartment shutters back, taking care not to damage the washers.

Connect the electricity by turning the main shutter-blocking switch on. Now the unit is ready to be set at work again.

5.4.3 Procedure for cleanind the external framework of the air conditioners

If the unit is installed inside the surgical room or in a communicating room (anaesthesia room, recovery room, post operation monitoring room, etc.), its external framework shall be cleaned whenever the operating compartments are washed and disinfected, unless otherwise instructed by the Physician in charge of the Ward. Conversely, if the unit is installed in a technical room not communicating with the surgical room, it may be cleaned every time the framework presents any trace of dust and/or grease mark.

The framework shall be cleaned as described below.

Disconnect the electricity by turning the main shutter-blocking switch off.

Put a notice on the switch saying that the unit is under maintenance.

Clean the framework with an alcoholic solution (or equivalent commercial one) by sprinkling it on the surface, and then remove it with a clean cloth by wiping firmly. For no reason the framework shall be cleaned with solvents (acetone, benzene, petrol, trichloroethylene, etc.) or with powers or abrasive creams which might damage it. If the unit is installed in the surgical room, the cloths used for the cleaning shall be put into hermetically sealed containers and then be disposed of together with the septic waste of the hospital.

Connect the electricity again, by turning the main shutter-blocking switch on. At this point, the unit is ready to be set at work again.

6. MAINTENANCE

6.1 FILTER MAINTENANCE

The filters must be replaced whenever the relevant alarm asks for cleaning. The filter clogging can be foreseen by checking the frequency of the request for cleaning. This way, this operation can be executed during the normal unit stops, so avoiding interrupting the unit functioning in vain. It is important to remember that before carrying out this intervention, the air conditioner must be cut off, and a notice must be put on it saying that the unit is under maintenance. To execute the cleaning, the filters must be removed from the unit, after cutting it off and after opening the back shutters. Only the shutters indicated in the drawing enclosed to the unit shall be opened, using the appropriate key.

During the designing of the air conditioners, special care has been taken in eliminating all the sharp edges or surfaces inside the units themselves, especially by those spots where the user needs to accede for routine maintenance. However, there are some inner points that still present a risk of cut for the user: water drain bac, coil fins, etc. So it is fundamental for the operator to be very careful on removing and then re-inserting the air filters to not cutting his/her hands.

The G4 class filters normally installed on the outdoor air suction and on the expulsion air from the surgical room cannot be clean and must be replaced. Their average life is about one month. Also the F7 class filter that is normally installed on the air supply to the surgical room cannot be clean and must be replaced. Its average life is about three months. A sticker shall be put on the spare filters marking the date of the replacement in order to have a reference of the residual life of the filters at all times. The filters shall be disposed of together with the special waste of the hospital.

The air conditioners can absolutely not work without the filters, so you are strongly recommended to purchase a series of spare filters from Tecnair, to ensure the continuative functioning of the air conditioners.

6.1 HUMIDIFIER MAINTENANCE

All the air conditioner series “H” are equipped with an electronic modulating humidifier for controlling the relative humidity in the environment. As previously mentioned, it is necessary to monitor very carefully the steam production cylinder, and to analyse as much carefully the feeding water. The microprocessor generally analyses the water conductivity during the normal operation of the unit, and the analysis can be visualised on the display (Cfr. *Use handbook*). However, we suggest to perform chemical sampling analyses on a regular basis to make sure that the water conductivity and hardness values fall within the limits indicated above.

The member of the humidifier that require annual checks are the following:

- Intake/discharge solenoid valve: remove solid scales, if any (use no compressed air).
- Hydraulic circuit: remove scales, if any, from the whole water route of the water intake valve to the steam production cylinder; check it for leaks or dripping.
- Steam supply duct: check it for clogging along the route.

- Humidity feeler: re-adjust it, as necessary. Do not use any compressed air or solvents for cleaning the feeler sensor!!

If the unit is disabled, we suggest draining all the water in the cylinder.

The steam production cylinder must be replaced whenever the lime scales inside the cylinder itself prevent the water to pass sufficiently. As previously said, the frequency of the replacements depends on the feeding water conditions: the more the water is rich with salts and/or impurities the more frequently the cylinder shall be replaced.

The worn cylinder shall be replaced as explained below:

- Make sure that the automatic no-tension drain function is set (see Use handbook)
- Stop the unit and cut it off.
- Drain and remove the cylinder.
- Install the spare cylinder.

The worn cylinder shall be disposed of as described below:

- Cut the plastic shell along its circumference using a hacksaw.
- Unscrew the electrode nuts on the cylinder.
- Remove the metal electrodes and separate them from the plastic crosspiece, if any.

The plastic part of the cylinder is made of polypropylene, and therefore it can be recycled completely; the metal part is made of plate, and therefore it can be recycled as ferrous material.

6.2 FAN MAINTENANCE

We recommend checking the fan fins for cleanliness on a regular basis, and removing any dirt or fouling mark, which may, in the long run, compromise the balancing the runner and damage the bearings.

Moreover, we recommend checking the fan motor cooling fins for cleanliness. If, during the operation, any anomalous noise is produced, identify the defect, stop the unit, and solve the anomaly, replacing the fan or the motor, if necessary.

6.4 COOLING CIRCUIT MAINTENANCE

The cooling circuit does not need any maintenance operation, but only periodical checks, which shall be executed as indicated in chapter "*Starting the unit up*" starting from searching possible leakages, shown by bobbles in the liquid flow indicator.

Check the condition of the cooling coil and clean it, if necessary, with hot water and soap, by means of a brush with long and soft bristles. Compressed air may be used as well, provided that it is oil free.

6.5 ELECTRIC HEATER MAINTENANCE

It is enough to check it for cleanliness and regular Ampere absorption, according to the provisions indicated in the relevant data sheet. If the electric heater is modulating type, check occasionally the modulator for good functioning, which can be made by verifying the proper behaviour of the unit during the heating, by visualising the 0-10V tension outgoing to the modulator from the microprocessor on the related window. (See Use handbook)

7 INVERTER 160 SSC

The air conditioner of the “H” series produced by Tecnair come standard equipped with an inverter on the supply fan and on the expulsion for the control of the air capacity necessary to guaranty the necessary air change in the environment and for the control of the overpressure/depression in the room in regards to a reference environment .

Also a compressor is provided with inverter for the modulation of the frigorific capacity.

The inverters mounted on the air conditioner of the “H” series are essentially the two described underneath. The main difference being that the supportable capacity of the connected charge.

7.1 SERVICE INSTRUCTIONS INVERTER 160 SSC

7.1.1 NOTE

This document does not substitute the user manual supplied by the manufacturer of the inverter delivered with the air conditioner.

TECNAIR LB recommends to consult this manual for further details..

7.1.2 GENERALITIES

L’inverter 160 SSC can be controlled by:

- Program Keypad Module;
- DeviceNet Communication Module
- RS-232 Communication Module;

For proper applications Tecnair uses the programming keyboard with which it is possible to visualise and modify the units parameters

The Program Keypad Module provides the following features::

- 6-digit, 7-segment LED display
- Nine keys for programming;
- Two directional LED indicators.

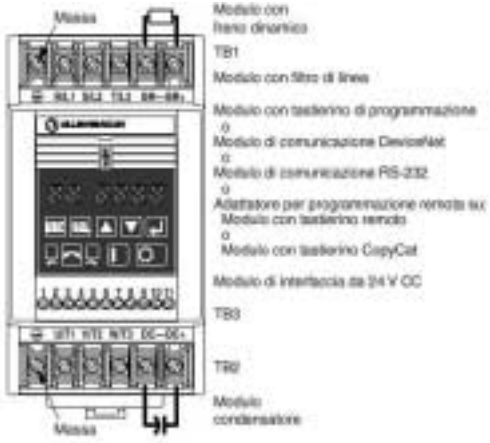


Figure 29: frontal view of the inverter .

7.1.3 FUNZIONI DEL MODULO CON TASTIERA DI PROGRAMMAZIONE

Figure 30: Program Keypad Module.

Parameter Number Display

Indicates which Display or Program Group parameter is active.

Program Mode
Flashes when in program mode.

Parameter Value/Fault Number
Displays the parameter value or fault code number.

Escape
The ESCape key allows you to toggle between the Display and Program modes. When the Program mode is active, this key will disable the editing of a parameter

Select
The SELect key enables editing of a parameter value when the Program mode is active. When you press this key, the Program Mode Indicator flashes..

Up/Down Arrow Keys
Use the Up/Down Arrow keys to scroll through a list of parameters, or increase and decrease parameter values. Press and hold either key to increase scrolling speed. Real time frequency adjustment can be achieved when using P58 - [Internal Frequency] and P59 - [Frequency Select]. Refer to Chapter 5 for further information..

Enter
Pressing this key causes the current value displayed to be entered into memory (only while in the Program mode). When you press this key, the Program Mode Indicator remains on, but stops flashing.

Direction LEDs (Indicators)
The appropriate LED will illuminate continuously to indicate the commanded direction of rotation. If the second LED is flashing, the drive has been commanded to change direction, but is still decelerating..

IMPORTANT: Actual motor rotation could be different if motor leads are not connected properly..

Reverse Mode (change direction)

This function is only active when P46 - [Input Mode] is set to 2. When active, pressing this key causes the motor to ramp down to 0 Hz and then ramp up to its set speed in the opposite direction. When the motor is running, pressing this key causes the (currently illuminated) LED to flash, indicating motor rotation while decelerating to zero. The other LED will illuminate indicating the commanded direction.

Start
This function is only active when P46 - [Input Mode] is set to 2. When active, pressing this key initiates a start command..

Stop
Pressing the Stop key will cause the motor to stop, using the selected stop mode. Refer to the P34 - [Stop Mode] parameter. If the drive has stopped due to a fault, pressing this key will clear the fault..

Important: The Stop key is always active in all control modes.

7.1.4 PROGRAMMAZIONE

I parametri dell'inverter 160 SSC sono divisi in due gruppi:

1. Display parameters are *read only* (they cannot be programmed)
2. Program parameters *can* be changed to fit your motor control requirements

Di seguito sono descritte le operazioni da compiere per visualizzare i parametri dei due gruppi suddetti.

– Accendere l'inverter, sul display è visualizzato l'ultimo parametro attivo prima dello spegnimento. Se il parametro appartiene al gruppo programma la spia della modalità programma si accende (cfr. Figure 31). Premere il tasto Escape per passare al gruppo di parametri selezionato e poi i tasti freccia su/freccia giù per a visualizzare il parametro desiderato.

Figure 31: parametro del gruppo programma.

Following is an example of the programming steps required to change a *Program Group* parameter setting.:

- To program the value of a *Program Group* parameter, enter the Program Group by pressing the ESCape key. The Program Mode Indicator will illuminate. (**cfr. Figure 31**).
– Press the Up/Down keys until the desired parameter displays..
- Press SELect. The Program Mode Indicator flashes, indicating that you can use the Up/Down keys to change the parameter value. (**cfr. Figure 32).**

Figure 32: modalità Programma attiva.

– Cambiare il valore del parametro selezionato con i tasti freccia su/freccia giù. Tenendo continuamente premuto uno dei due tasti il valore aumenta o diminuisce più velocemente

When the desired value displays, press the Enter key. This writes the new value to memory. The Program Mode Indicator will stop flashing and the display will flash once indicating that the new value has been accepted.. If at any time (while in the program mode) you wish to abort the editing process, press the ESCape key. The original value of the parameter will remain unchanged and you will be exited from the Program mode.

NOTE

In addition, power must be cycled or P56 - [Reset Function] must be set to 2 for the change to take effect..

If you reset to factory defaults, you cannot use the Program Keypad Module for start or reverse control until it is selected using P46 setting 2..

7.1.5 DISPLAY GROUP PARAMETERS (READ ONLY)

This group of parameters consists of commonly viewed drive operating conditions such as output frequency, output voltage, output current and frequency command. All parameters in this group are *read only*..

The last user-selected Display Group parameter is saved when power is removed and is displayed by default when power is reapplied..

Par.	Parameter name	Description	Min. /Max	Units
01	**Output Frequency**	Displays the output frequency at TB2 terminals U, V & W (T1, T2 & T3).	0,0/240,0	Hz
02	**Output Voltage**	Displays the output voltage present at TB2 terminals U, V & W (T1, T2 & T3).)	0/Max Voltage	V
03	**Output Current**	Displays the output current present at TB2 terminals U, V & W (T1, T2 & T3).	0/2 x Drive Rated Output Current	A
04	**Output Power**	Displays the output power present at TB2 terminals U, V & W (T1, T2 & T3).	0/2 x Rated Drive Output Power	KW
05	**Bus Voltage**	Displays the DC Bus Voltage level..	0/400 – 230 V 0/800 – 460 V	V
06	**Frequency Command**	Displays the frequency that the drive is commanded to output..	0,0/240,0	Hz
07	**Active Fault**	Displays the coded active fault number..	0/48	
08	**Heatsink Temperature**	Displays the temperature of the drive heatsink..	69/150	C
09	**Drive Status**	Displays the status of the drive in a binary coded format. **Important:** 0 = Inactive, 1 = Active. Bit 0 Running Bit 1 Forward Bit 2 Accel Bit 3 Decel	0000/1011	
10	**Drive Type**	Used by Rockwell Automation field service personnel.	Numeric Value	
11	**Firmware Version**	Visualizza la versione firmware dell'inverter.	Fixed Value	
12	**Input Status**	Displays the open (0) and closed (1) state of the inputs to TB3 in binary coded format as follows:	0000/1111	

Input Mode	Bit 3 **Polarity**	Bit 2 TB3-6	Bit 1 TB3-8	Bit 0 TB3-5

		0	0=Positive analog input 1= Negative analog input	Start	Stop	Run Reverse		
		1		Run Forward	Stop	Run Reverse		
		2		N/P	Stop	N/P		
		3		Run Forward	Stop	Run Reverse		
		4		Run Forward	0 = Accel.2 / Decel.2 0 = Accel.1 / Decel.1	Run Reverse		
		5		Run Forward	Coast to Rest Stop	Run Reverse		
		6		Run Forward	0=TB3 control 1=Keyèpad or Comm.	Run Reverse		
		7		Run Forward	0= Anal Freq Select. 1=int. Freq. Select.	Run Reverse		
		8		Run Forward	0=open 1=close	Run Reverse		
		9		Run Forward	0=PI 1=Sel freq. int.	Run Reverse		
		Status of Bit 3 for Input Mode 8 is TB3-2 is: 0 = Open, 1 = Closed.						
13	**Power Factor Angle**	Displays the angle in electrical degrees between motor voltage and motor current.					0,0/180,0	Degrees
14	**Memory Probe Display**	Used by Rockwell Automation field service personnel.					Numeric Value	
15	**Preset Status**	Displays the open (0) and closed (1) state of TB3 inputs SW1, SW2 and SW3 in binary coded format. Bit 0 SW 1 Bit 1 SW 2 Bit 2 SW 3 (1) Bit 3 Not used					0000/0011	
16 (2)	**Analog Input**	Displays the analog input as a percent of full scale. Used in setting P60 - [Zero Offset], P75 - [Analog Input Minimum], and P76 - [Analog Input Maximum]. **Important:** On initial set up of the drive, apply a 0V or 4 mA analog command to the drive. Once applied, if the value of this parameter displays something other than zero, program that value into P60 - [Zero Offset]. Please note that the value of [Zero Offset] will be subtracted from the value of this parameter..					–150,0/+150,0	%
17	**Fault Buffer 0**	This parameter stores the last fault that occurred..					0/48	
18	**Fault Buffer 1**	This parameter stores the second most recent fault that occurred.					0/48	
19	**Fault Buffer 2**	This parameter stores the third most recent fault that occurred..					0/48	

(1) Questo ingresso vale solamente per il modello a velocità prestabilita.
(2) This parameter applies only to the Analog Signal Follower model..

7.1.6 PROGRAM GROUP PARAMETER

This group contains parameters whose values *can* be programmed..

Par.	Parameter Name	Description	Min. /Max	Default	Fan
30	**Accel Time 1**	Time for the drive to ramp from 0.0 Hz. to P33.	0,0/600,0 s	10,0 s	20
31	**Decel Time 1**	Time for the drive to ramp from P33 to 0.0 Hz. The rate is linear for any decrease in command frequency unless P53 Seconds	0,0/600,0 s	10,0 s	20
32	**Minimum Frequency**	Lowest frequency that drive will output continuously..	0/240 Hz	0 Hz	10/20
33	**Maximum Frequency**	Highest frequency the drive will output..	0/240 Hz	60 Hz	See fan and motor

34	**Stop Mode Select**	Determines stopping mode used by the drive when a stop is initiated..	0/3	0	1
35	**Base Frequency**	Set value to rated nameplate frequency of motor..	10/240 Hz	50 Hz	50
36	**Base Voltage**	Set value to rated nameplate voltage of motor..	230/460 V	20 V + Nominal input voltage	380/400 (dipende linea)
37	**Maximum Voltage**	Sets the highest voltage that the drive will output. P37 must be greater than or equal to P36 units	230/460 V	20 V + Nominal input voltage	Same value P.36
38	**Boost Select**	Sets the boost voltage and redefines the Volts per Hz curve. Settings 0-8 can provide increased torque at low frequency. Settings 9 – 12 are used to reduce energy consumption.	0/12	2	12
39	**Skip Frequency**	Works in conjunction with P40 creating a range of frequencies at which the drive will not operate continuously.	0/240 Hz	240 Hz	240
40	**Skip Frequency Band**	Determines the band around the P39 parameter.The actual band width will be 2 times P40 - 1/2 the band above and 1/2 the band below. A value of zero will disable the skip frequency.	0/30 Hz	0 Hz	0
41	**Motor Overload Select**	Bulletin 160 provides Class 10 overload protection. Settings 0 – 2 select the derating factor for the I 2 t overload function..	0/2	0	1
42	**Motor Overload Current]**	Set to motor nameplate Full Load Amps (FLA).ricalcolare l'assorbimento del motore alla frequenza massima impostata. Valore impostato in percentuale della corrente nominale di uscita dell'inverter.	0,1/200%	115	115
43	**Current Limit**	Maximum output current allowed before current limiting occurs. Value set in percent of drive rated output current.	1/180%	150	150
44	**DC Hold Time**	The time that P45 will be applied to the motor when P34 is set to 0, 2 o 3.	0,0/25,0 seconds	0,0 seconds	0
45	**DC Hold Voltage**	DC Voltage level applied to the motor during braking when P34 is set to 0, 2 o 3	0/115 V	0 V	0
46	**Input Mode**	Configures the TB3 control inputs for various 3-wire or 2-wire control schemes.. Also enables/disables the Program Keypad Module,. This parameter cannot be programmed while the drive is running. In addition, power must be cycled or P56 must be set to 2 for the change to take effect.	0		1
47	**Output Configure**	Determinestheon/offpointforthe TB3.	0/10	0	9
48	**OutputThreshold**	Determinestheon/offpointforthe TB3outputrelaywhen P47 is set to 6, 7, 8, and 10. Settings 6 = from 0 to 240 Hz; 7 = 0 - 180%; 8 = 0 - 815 Volt; 10 = 0 - 180°	0/815	0	0
49	**PWM Frequency**	Carrier frequency for the PWM output waveform.	2,0/8,0 kHz	4,0 kHz	4,0
50	**RestartTries**	Maximum number of times the drive will attempt to reset a fault. Faults 03 – 20 will automatically reset according to this parameter setting.	0/9	0	9
51	**RestartTime**	Time between restart attempts..	0,0/300,0 seconds	10 seconds	10,0
52	**DB Enable**	Enables/disables external dynamic braking. This parameter cannot be programmed while the drive is running.	0/100	0	0
53	Curve S	Enables a fixed shape S-Curve.	0/10	0	0
54	**Clear Fault**	Setting this parameter to a 1 performs a fault reset.When the fault reset function is complete, the value is automatically set back to 0. This parameter cannot be programmed while the drive is running.	0/1	0	0
55	**Memory Probe Address**	Used by Rockwell Automation field service personnel..			
56	**Reset Functions**	Drive parameters and their associated defaults are reset according to the following descriptions: 0 Idle State 1 Reset defaults (restores all parameter settings to factory defaults). 2 Update Input Mode (restores the drive to most recent programmed After the reset/update function is complete, this parameter will set itself to "0..	0/2	0	0
57	**Program Lock**	When set to 1, all parameters will be protected against change by unauthorized personnel.	0/1	0	0

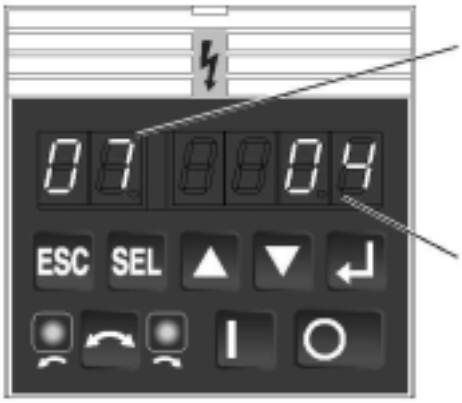
58	**Internal Frequency**	When P59 is set to a 1, this parameter will provide the drive frequency command.This parameterwillchangethe frequencycommandin“Real time” using the up/down arrow keys. Maximum value is set in P33. Once the desired command frequency is reached, the Enter key must be pressed to store this value to EEPROM memory. If the ESC key is used before the Enter key, the frequency will return to the original value following the normal accel/decel curve.	0,0/240,0 Hz	60 Hz	60
59	**Frequency Select**	Selects the source of the frequency command for the drive..	0/1	0	0
60 (1)	**Zero Offset**	Used to add or subtract any system offset to the analog input. This parameter cannot be programmed while the drive is running.	–50,0/+ 50,0 %	0 %	0
61	**Preset Frequency 0**	The programmed value sets the frequency that the drive outputs when selected.	0,0/240,0 Hz	3,0 Hz	3,0
62	**Preset Frequency 1**	The programmed value sets the frequency that the drive outputs when selected.	0,0/240,0 Hz	20,0 Hz	20,0
63 (2)	**Preset Frequency 2**	The programmed value sets the frequency that the drive outputs when selected.	0,0/240,0 Hz	30,0 Hz	30,0
64 (2)	**Preset Frequency 3**	The programmed value sets the frequency that the drive outputs when elected..	0,0/240,0 Hz	40,0 Hz	40,0
65	**Preset Frequency 4**	The programmed value sets the frequency that the drive outputs when selected.	0,0/240,0 Hz	45,0 Hz	45,0
66	**Preset Frequency 5**	The programmed value sets the frequency that the drive outputs when selected.	0,0/240,0 Hz	50,0 Hz	50,0
67 (2)	**Preset Frequency 6**	The programmed value sets the frequency that the drive outputs when selected.	0,0/240,0 Hz	55,0 Hz	55,0
68 (2)	**Preset Frequency 7**	The programmed value sets the frequency that the drive outputs when selected.	0,0/240,0 Hz	60,0 Hz	60,0
69	**Accel Time 2**	Time for the drive to ramp from 0.0 Hz to P33 [Maximum Frequency].	0,0/600,0 s	20 s	20,0
70	**Decel Time 2**	Time for the drive to ramp from P33 - [Max.Frequency] to 0.0 Hz. The rate is linear for any decrease in command frequency unless P53 to a value other than 0. Minimum deceleration time must be set based on the applied motor size..	0,0/600,0 s	20 s	20,0
71	**IR Compensation**	The programmed value adds a voltage to the output based on the torque current..	0/150 %	50%	50
72	**Slip Compensation**	This parameter compensates for the inherent slip in an induction motor.. **ATTENTION:** Hazard of personal injury or equipment damage exists due to unpredictable changes in motor speed. Do not use P72 and P83 to disable PI control while the drive is running. Disable PI control only when the drive is stopped.	0,0/5,0 Hz	2,0 Hz	2,0
73	**Reverse Disable**	When this parameter is set to a 1, reverse is disabled.The reverse command may come from the analog input, TB3-5, the keypad or a serial command. This parameter cannot be programmed while the drive is running..	0/1	0	1
74 (1)	**Analog Select**	Settings: 0 = unipolar analog input 0 to +10V 1 = bipolar analog input -10 to +10V This parameter cannot be programmed while the drive is running..	0/1	0	0
75 (1)	**Analog Input Minimum**	Minimum analogic input Sets the percent of analog input used to represent P32 If the minimum analog input equals minimum frequency, no action is needed. If it is desired to adjust the analog input to equal P32 use P16 to adjust the analog input to the desired level using P60 and then enter this value into P75. Analog inversion can be accomplished by setting this value larger than P76. Do not adjust this parameter until setting P60 This parameter cannot be programmed while the drive is running.			0,0
76 (1)	**Analog Input Maximum**	Sets the percent of analog input used to represent P33. If the maximum analog input equals maximum frequency, no action is needed. If it is desired to adjust the analog input to equal P33 use P16 to adjust the analog input to the desired level using P60 and then enter this value into P76. Analog inversion can be accomplished by setting this value smaller than P75. This parameter cannot be programmed while the drive is running.	0,0/150,0 %	100,0 %	100

78	**Compensation**	**0** No compensation. **1** Some drive/motor combinations have inherent instabilities which are exhibited as non-sinusodial motor currents. This setting attempts to correct this condition. **2** Some motor/load combinations have mechanical resonances which can be excited by the drive current regulator. This setting slows down the current regulator response and attempts to correct this condition.	0/2	0	0
79	**[Software Current Trip]**	This provides a software instantaneous current trip similar to the 300% hardware current trip. This value is the percent above the P43 at which the drive trips immediately. A setting of zero disables the Software Current Trip.	0/50 %	0 %	0
80	**Stall Fault Time**	This selects the amount of time the drive must be in a stall condition before it causes a stall fault. 0 = Normal stall time, approximately 60 seconds 1 = 2 times normal stall time 2 = 4 times normal stall time 3 = 6 times normal stall time 4 = 8 times normal stall time 5 = Stall fault disabled **ATTENTION:** Continuous operation at high currents caused by a stall can cause motor damage.	0/5	0	0
81 (1)	**PI Proportional Gain**	Proportional gain used by the PI regulator. This parameter is scaled so that when it is set to 1.0, the process response is 1 Hz when the process error is 1%. The correct value for this parameter depends on the dynamics of the process being controlled, as well as the desired response. This parameter is active when P46	0/10,00	0,01	0,01
82 (1)	**PI Integral Gain**	Integral Gain used by the PI regulator. This parameter is scaled so that when it is set to 1.0, the process response is 10 Hz/sec when the process error is 1%. The correct value for this parameter depends on the dynamics of the process being controlled, as well as the desired response. This parameter is active when P46 setting 9 is used.	0/10,00	0,01	0,01
83 (1)	**PI Process Reference**	The PI control will regulate to this set point value. It represents a percentage of the analog input. This parameter is active when P46 setting 9 is used. This parameter along with P72 also activates PI control in drives using Firmware Version FRN 7.06. See page 5-17 for PI Control Setup and Activation instructions. **ATTENTION:** Hazard of personal injury or equipment damage exists due to unpredictable changes in motor speed. Do not use P72 and P83 to disable PI control while the drive is running. Disable PI control only when the drive is stopped.	0/100 %	0,0 %	0,0
84 (1)	**PI Dead Band**	The PI control will ignore errors less than this value. This parameter is active when P46 setting 9 is used.	0/10,0 %	0,0 %	0,0

(1) This parameter applies only to the Analog Signal Follower model...
(2) Questo ingresso vale solamente per il modello a velocità prestabilita.

9.1.7 FAULT INFORMATION

Keypad Module Fault Display



If a fault occurs, P07 - [Active Fault] is displayed.

Error code.

Figure 33: Ready/Fault Indicating Panel

When a fault occurs, the cause must be corrected before the fault can be cleared. After corrective action has been taken, any of the following actions will clear the fault.

• Press the Program Keypad Module's Stop button.

• Disconnect power to the drive, wait one minute, reapply power.

• Cycle the input signal at TB3-8 to the drive.

• Set P54 - [Clear Fault] to 1.

Included is a list and description of drive faults and problems that may occur.

Fault num.	Fault name	Fault description	Corrective action
03	Power Loss Fault	The DC Bus voltage remains below 85% nominal on power up for longer than 5 seconds.	Monitor the incoming AC line for low voltage or line power interruptions..
04	UnderVoltage Fault	The DC Bus voltage fell below the minimum rated voltage. For 200-240VAC input drives, the under-voltage trip occurs at a bus voltage of 210VDC (equiv-alent to a 150VAC incoming line voltage). For 380- 460VAC rated drives, the undervoltage trip occurs at a bus voltage of 390VDC (equivalent to a 275VAC incoming line voltage).	Monitor the incoming AC line for low voltage or line power interruptions.
05	OverVoltage Fault	The maximum DC Bus voltage has been exceeded. For 200-240VAC input drives, the overvoltage trip occurs at a bus voltage of 400VDC. For 380-460VAC input drives, the overvoltage trip occurs at a bus voltage of 800VDC.	Motor regeneration has caused a bus overvoltage. Monitor the incoming AC line for excessive voltage. Extend the decel time or install a dynamic brake module or external capacitor module.
06	Motor Stall Fault	The motor has stalled due to an excessive motor load.	A longer acceleration time or a reduced load is required...
07	Motor Overload Fault	An internal electronic overload trip has occurred. An excessive motor load exists.	Reduce the motor load until the drive output current does not exceed the current set by P42 . Reduce P38 .
08	Over Temperature Fault	Excessive heat has been detected.	Clear blocked or dirty heat sink fins. Check ambient temperature. Check for a blocked or non-operating
11	Operator Fault	The keypad has been removed while the drive is powered.	Clear the fault. Do not remove the keypad under power..
12	Overcurrent Fault	An overcurrent has been detected in the hardware trip circuit.	Check for a short circuit at the drive output or for excessive load conditions at the motor.
13	Software Over Current Fault	Motor current exceeded value set in parameter 79	A longer acceleration time, reduced load, or removal of motor shaft blockage is required..
20	Drive Overload Fault	An internal electronic overload trip has occurred. The drive is over heating.	Clear blocked or dirty heat sink fins. Check ambient temperature. Check for blocked or non-operating fan. Reduce motor load current..
32	EEPROM Fault	The EEPROM has invalid data. Reset using P56 -	Set to1 and cycle power..
33	Max Retries Fault	Max Retries Fault The drive failed to reset within the number of retries set in P50	Repair the system fault.
36	Incompatible Fault	Incompatible communication module installed.	Verify compatibility of communication module.
38	Phase U Fault	A phase to ground fault has been detected between the drive and the motor in phase U.	Check the wiring between the drive and the motor. Check the motor for a grounded phase. Check that ground is not connected to U.

39	Phase V Fault	A phase to ground fault has been detected between the drive and the motor in phase V.	Check the wiring between the drive and the motor. Check the motor for a grounded phase..
40	Phase W Fault	A phase to ground fault has been detected between the drive and the motor in phase W.	Check the wiring between the drive and the motor. Check the motor for a grounded phase.
41	UV Short Fault	Excessive current has been detected between these two drive output terminals.	Check the motor and external wiring to the drive output terminals for a shorted condition..
42	UW Short Fault	Excessive current has been detected between these two drive output terminals.	Check the motor and external wiring to the drive output..
43	VW Short Fault	Excessive current has been detected between these two drive output terminals.	Check the motor and external wiring to the drive output terminals for a shorted condition.
46	Intermittent Phase Fault	An external short occurred while running diagnostics	. Check wiring between the drive and the motor. Check for more than one shorted output..
48	Reprogram Fault	Occurs when the drive parameters are reset to default.	Clear the fault..

These faults have an auto reset feature.. This feature automatically clears overvoltage, undervotage, and overtemperature faults 1 second after the fault condition is removed. Refer to P51

8. TROUBLE ANALYSIS

The following chapter aims at assisting the operator in searching possible troubles in the unit equipment. Starting from the type of problem in question, indication is given of the possible sequential causes of the trouble itself and the possible remedies.

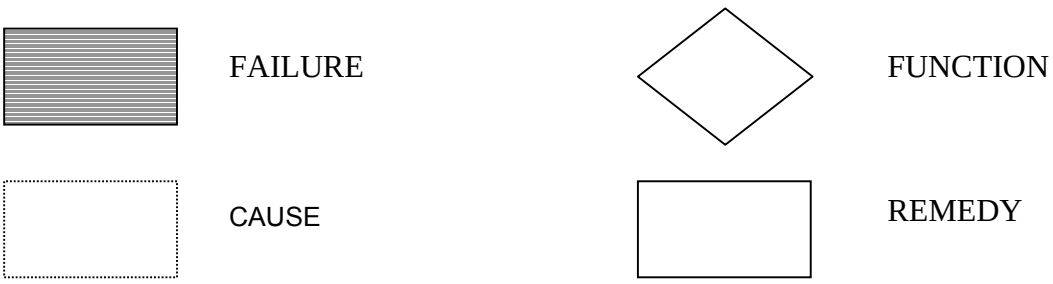
The description of the causes is general, so it takes into consideration the most complete possible versions of the units; the operator shall take care to identify, from time to time, only the matters of interest and/or the functions actually featured in the unit in question.

Any intervention on the unit shall be carried out only by competent skilled personnel.

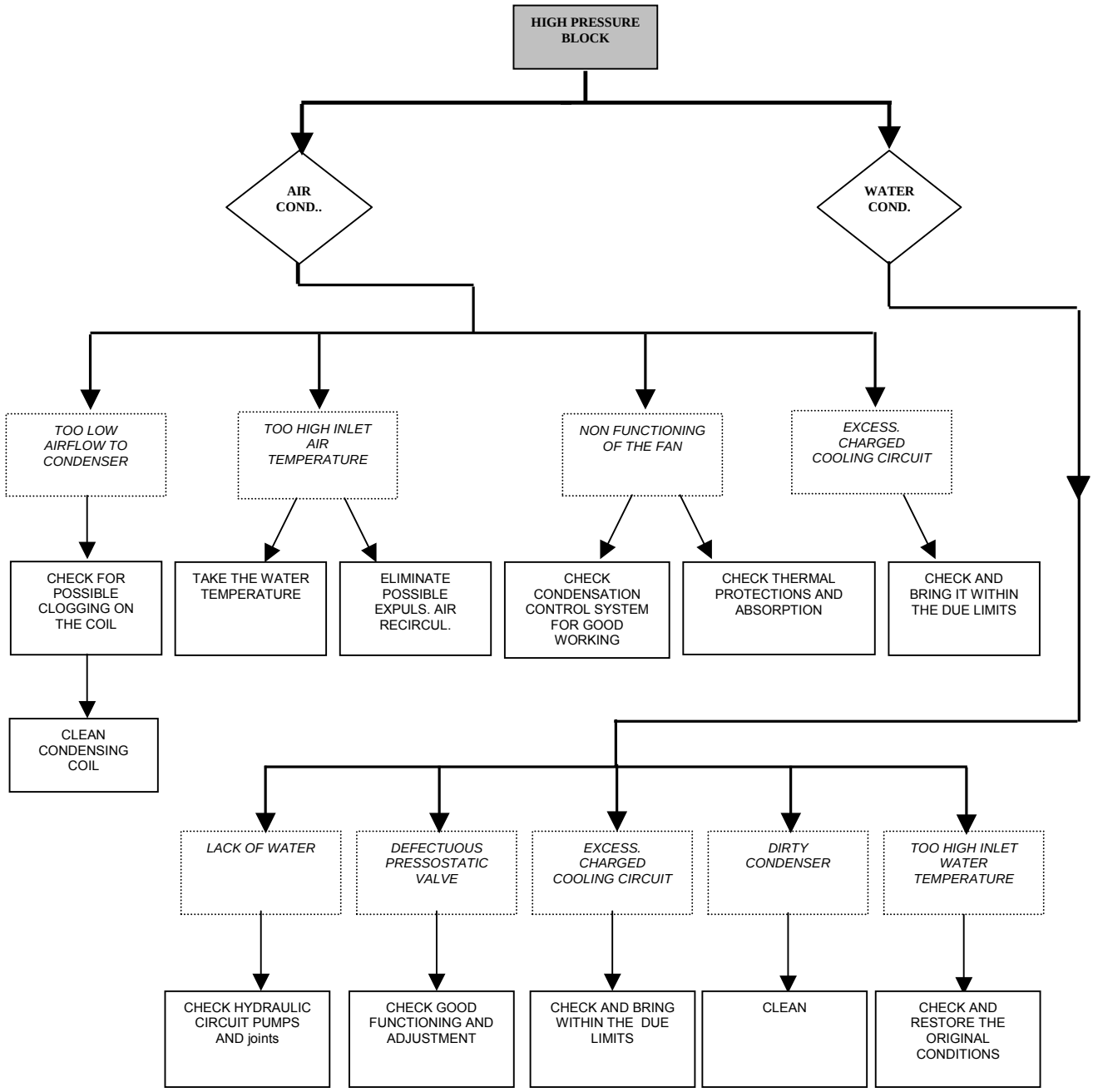
We recommend not executing any kind of operation if you have not enough knowledge of the unit working principle.

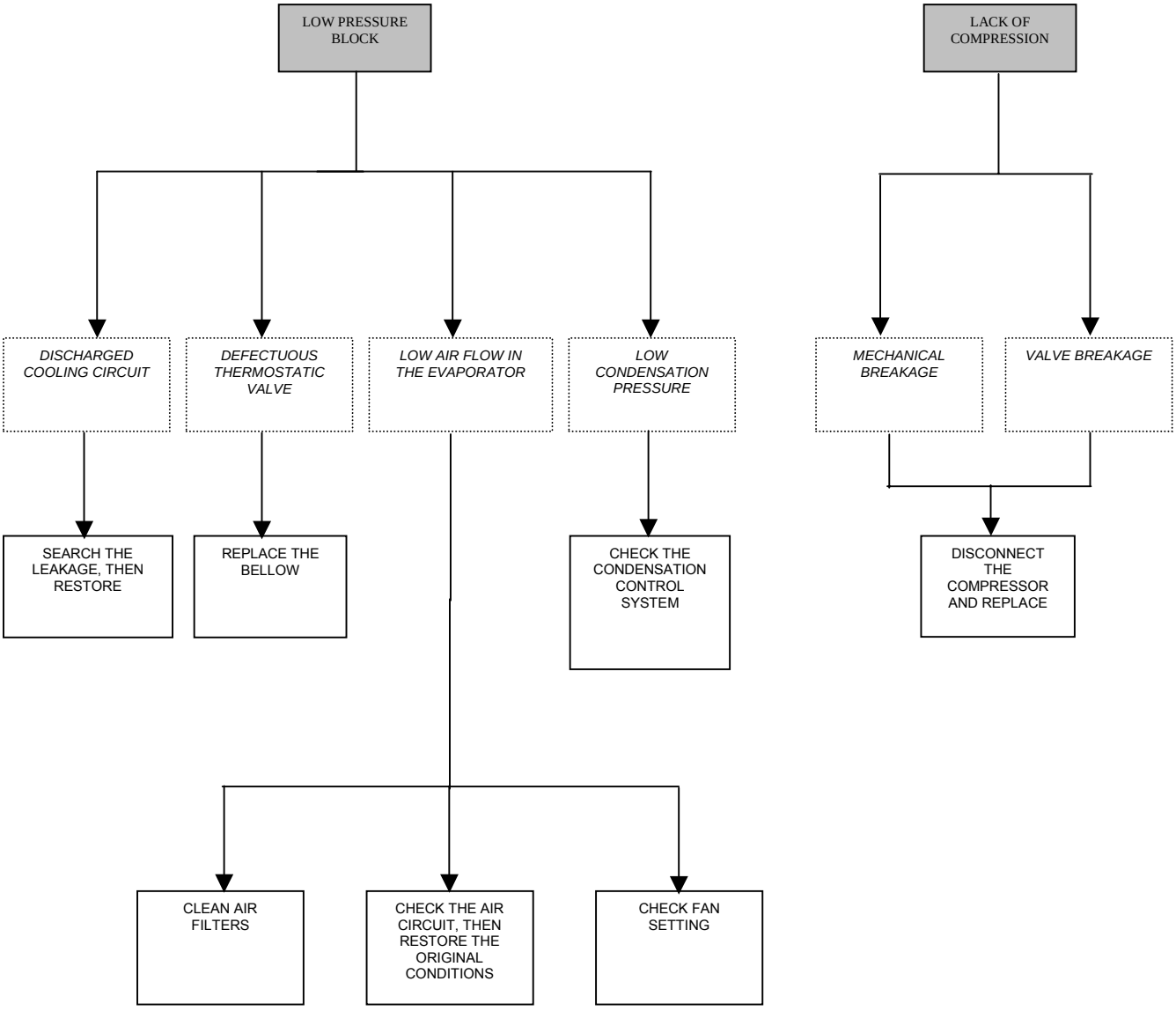
Before executing any operation, cut the tension out!!

Legend of the failure diagram

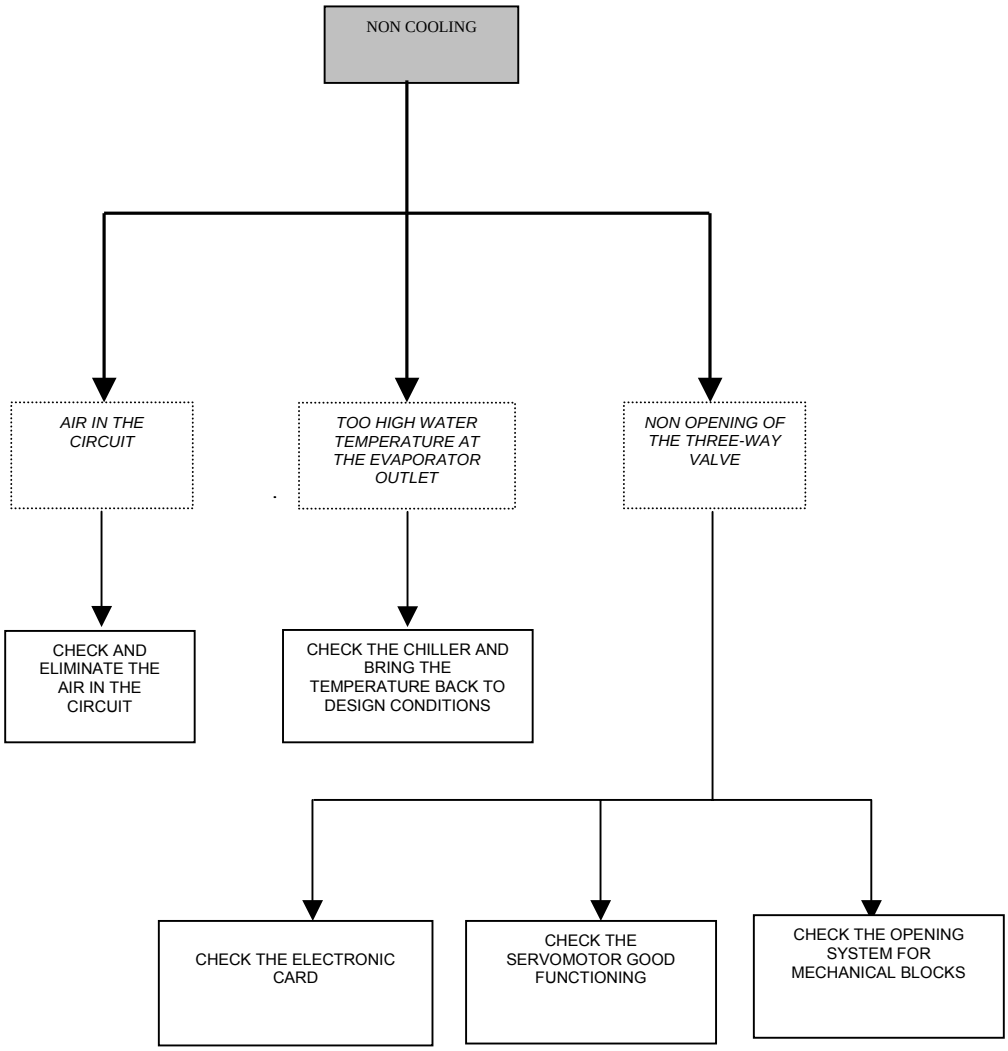


8.1 «A», «E» AIR CONDITIONERS – COOLING CIRCUIT PROBLEMS

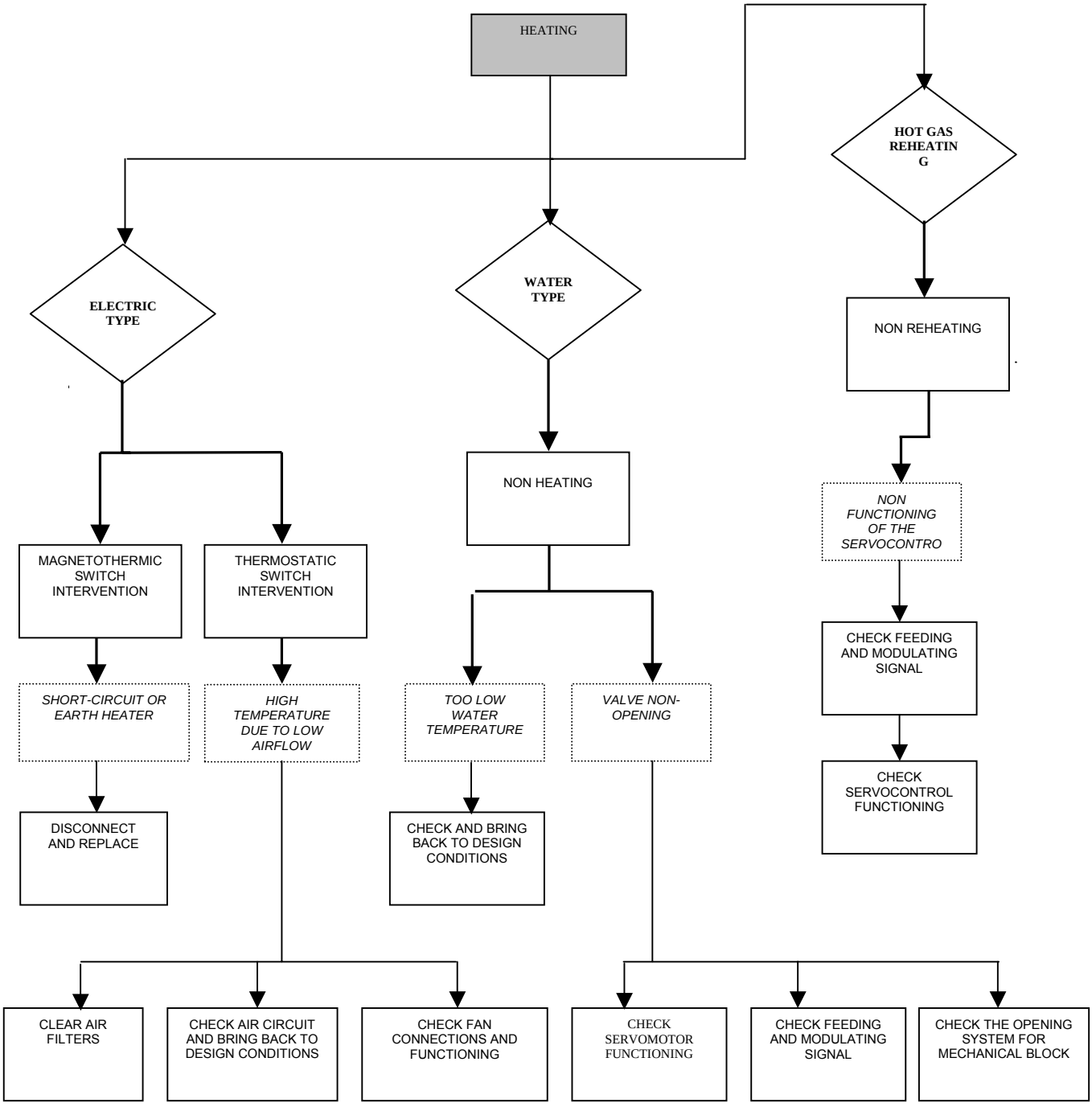



LOW PRESSURE BLOCK
LACK OF COMPRESSION
DISCHARGED COOLING CIRCUIT
DEFECTUOUS THERMOSTATIC VALVE
LOW AIR FLOW IN THE EVAPORATOR
LOW CONDENSATION PRESSURE
MECHANICAL BREAKAGE
VALVE BREAKAGE
SEARCH THE LEAKAGE, THEN RESTORE
REPLACE THE BELLOW
CHECK THE CONDENSATION CONTROL SYSTEM
DISCONNECT THE COMPRESSOR AND REPLACE
CLEAN AIR FILTERS
CHECK THE AIR CIRCUIT, THEN RESTORE THE ORIGINAL CONDITIONS
CHECK FAN SETTING

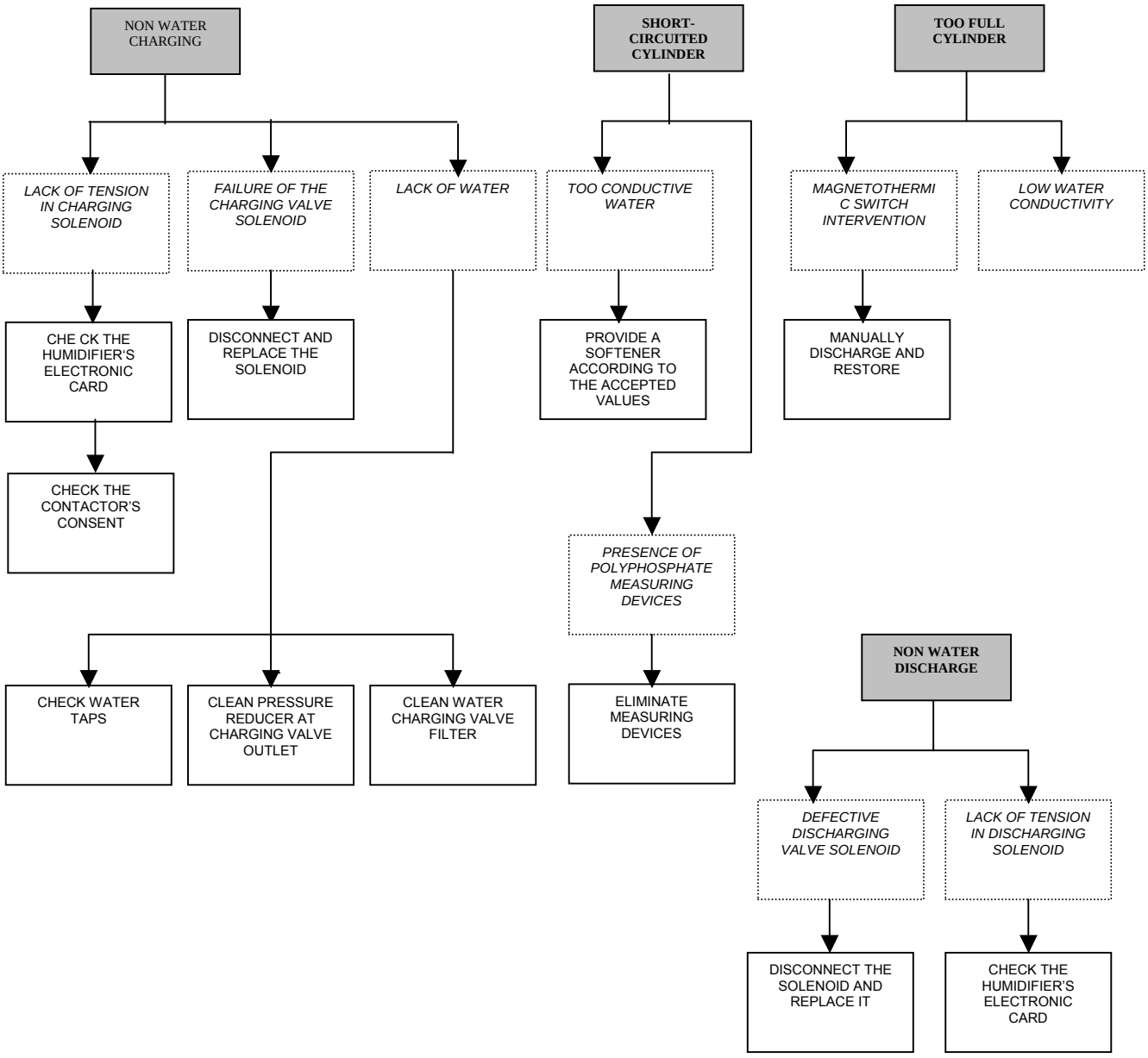
8.2 «U» AIR CONDITIONERS – HYDRAULIC CIRCUIT PROBLEMS

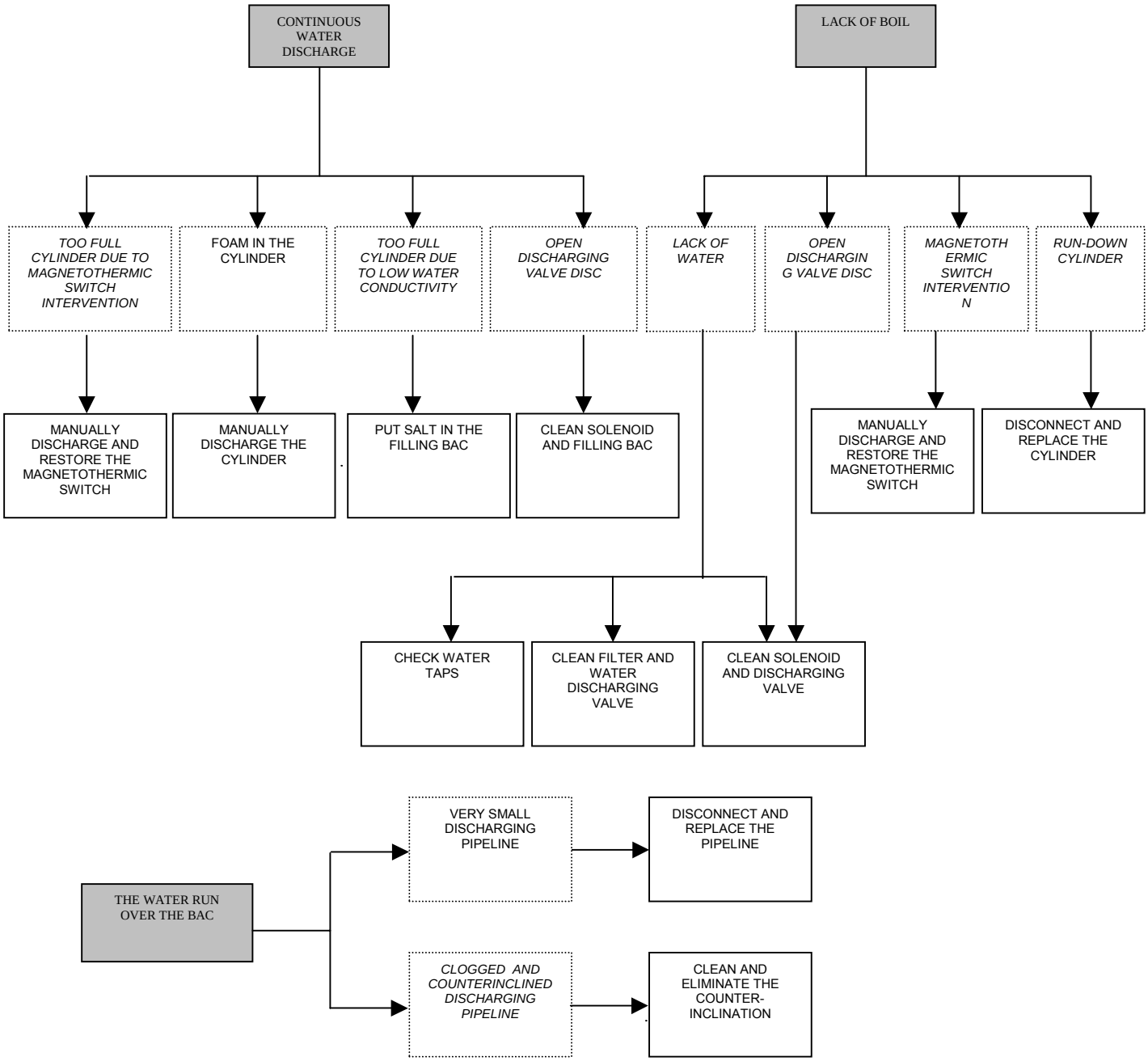


8.3 HEATING SECTION PROBLEMS

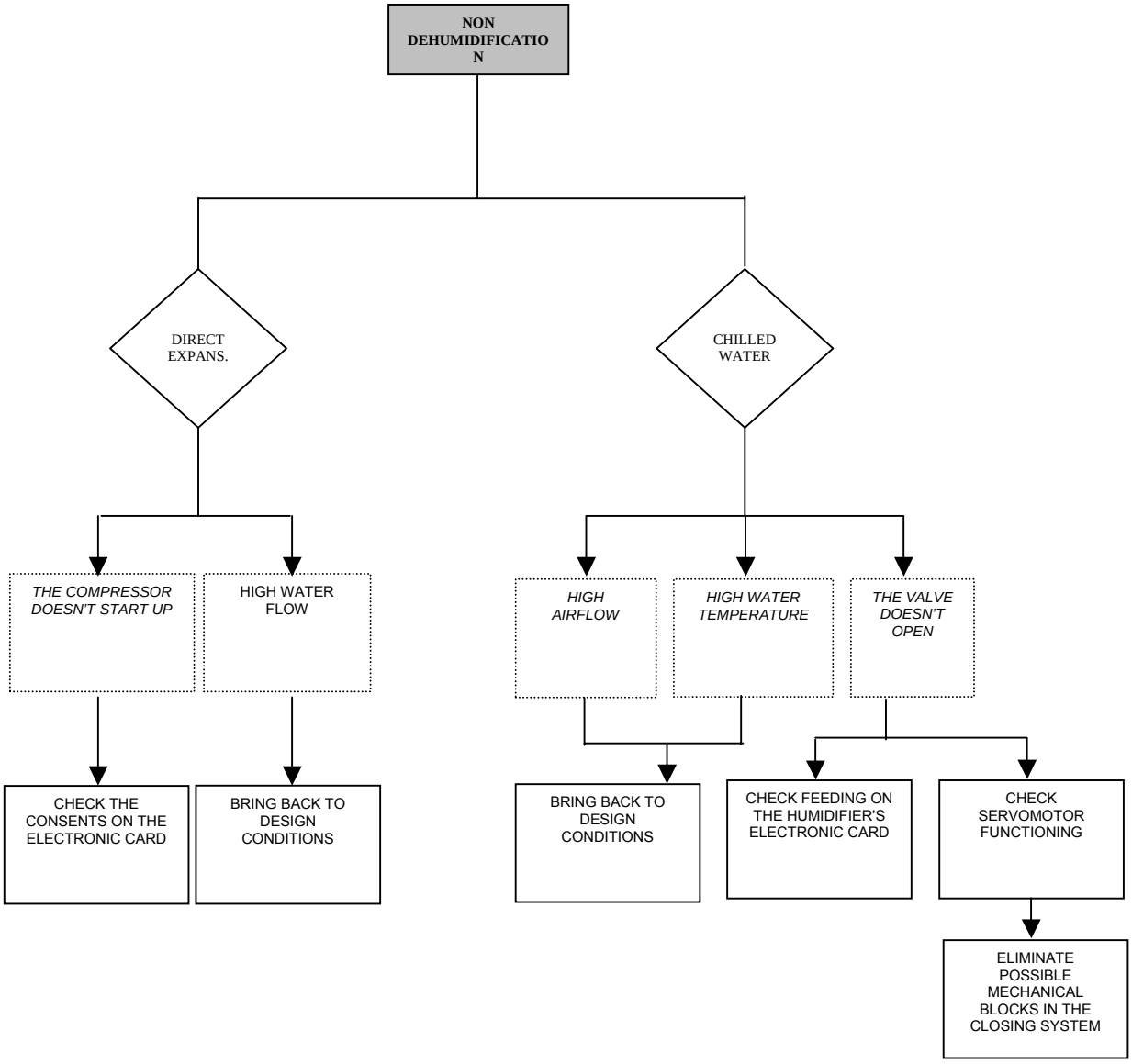


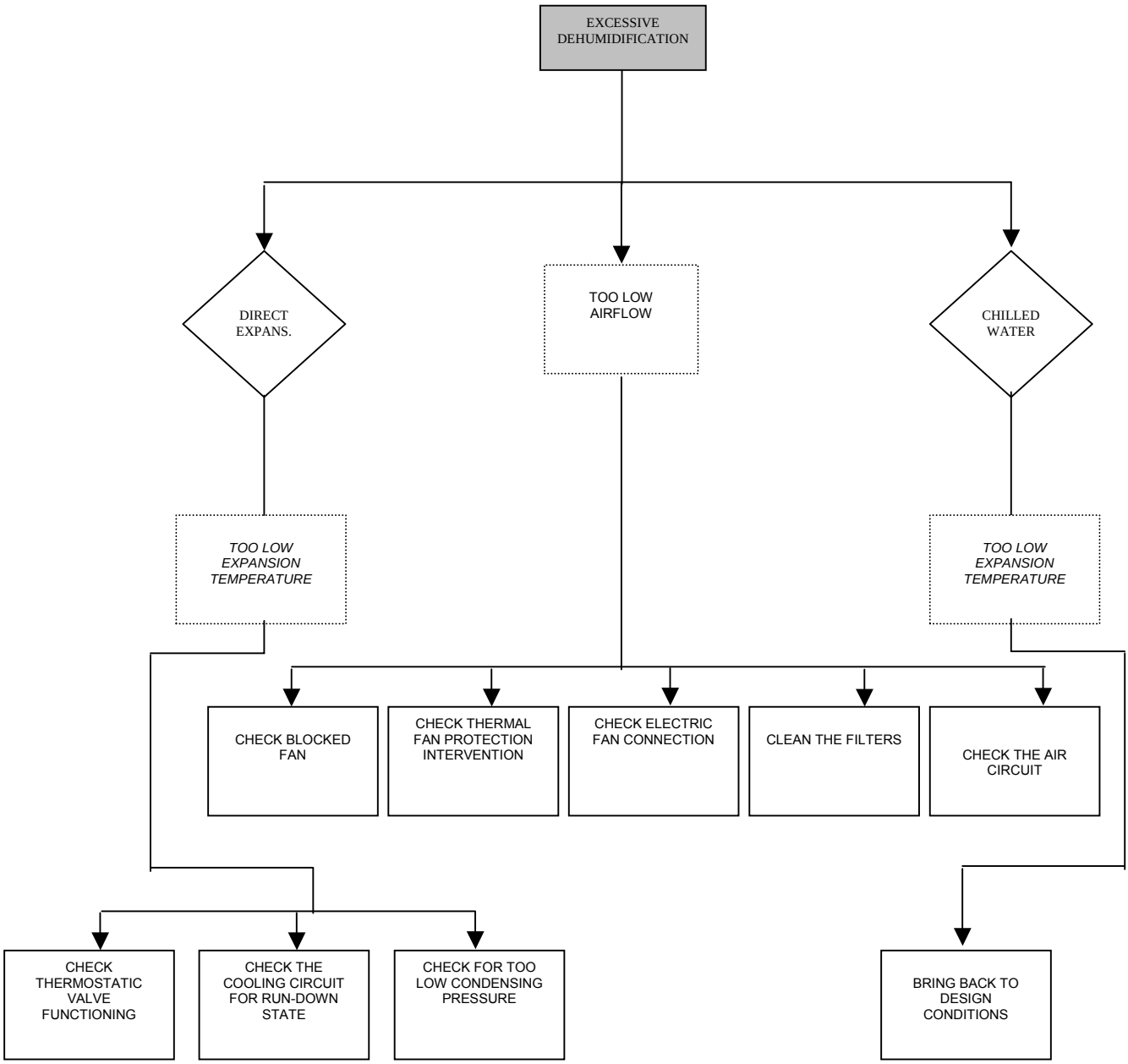
8.4 HUMIDIFIER PROBLEMS



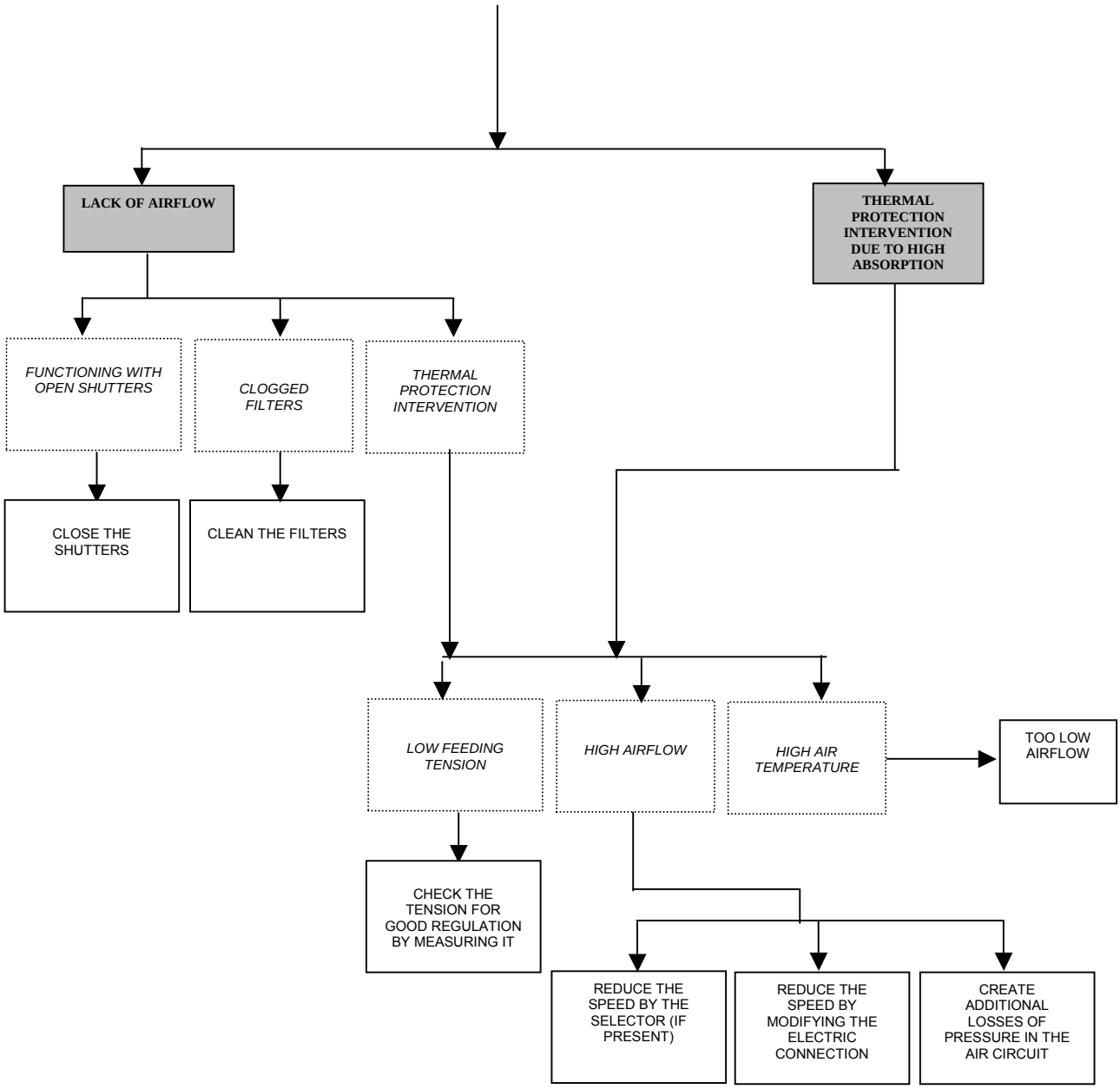

CONTINUOUS WATER DISCHARGE
LACK OF BOIL
TOO FULL CYLINDER DUE TO MAGNETOTHERMIC SWITCH INTERVENTION
FOAM IN THE CYLINDER
TOO FULL CYLINDER DUE TO LOW WATER CONDUCTIVITY
OPEN DISCHARGING VALVE DISC
LACK OF WATER
OPEN DISCHARGIN G VALVE DISC
MAGNETOTH ERMIC SWITCH INTERVENTIO N
RUN-DOWN CYLINDER
MANUALLY DISCHARGE AND RESTORE THE MAGNETOTHERMIC SWITCH
MANUALLY DISCHARGE THE CYLINDER
PUT SALT IN THE FILLING BAC
CLEAN SOLENOID AND FILLING BAC
MANUALLY DISCHARGE AND RESTORE THE MAGNETOTHERMIC SWITCH
DISCONNECT AND REPLACE THE CYLINDER
CHECK WATER TAPS
CLEAN FILTER AND WATER DISCHARGING VALVE
CLEAN SOLENOID AND DISCHARGING VALVE
THE WATER RUN OVER THE BAC
VERY SMALL DISCHARGING PIPELINE
DISCONNECT AND REPLACE THE PIPELINE
CLOGGED AND COUNTERINCLINED DISCHARGING PIPELINE
CLEAN AND ELIMINATE THE COUNTER-INCLINATION

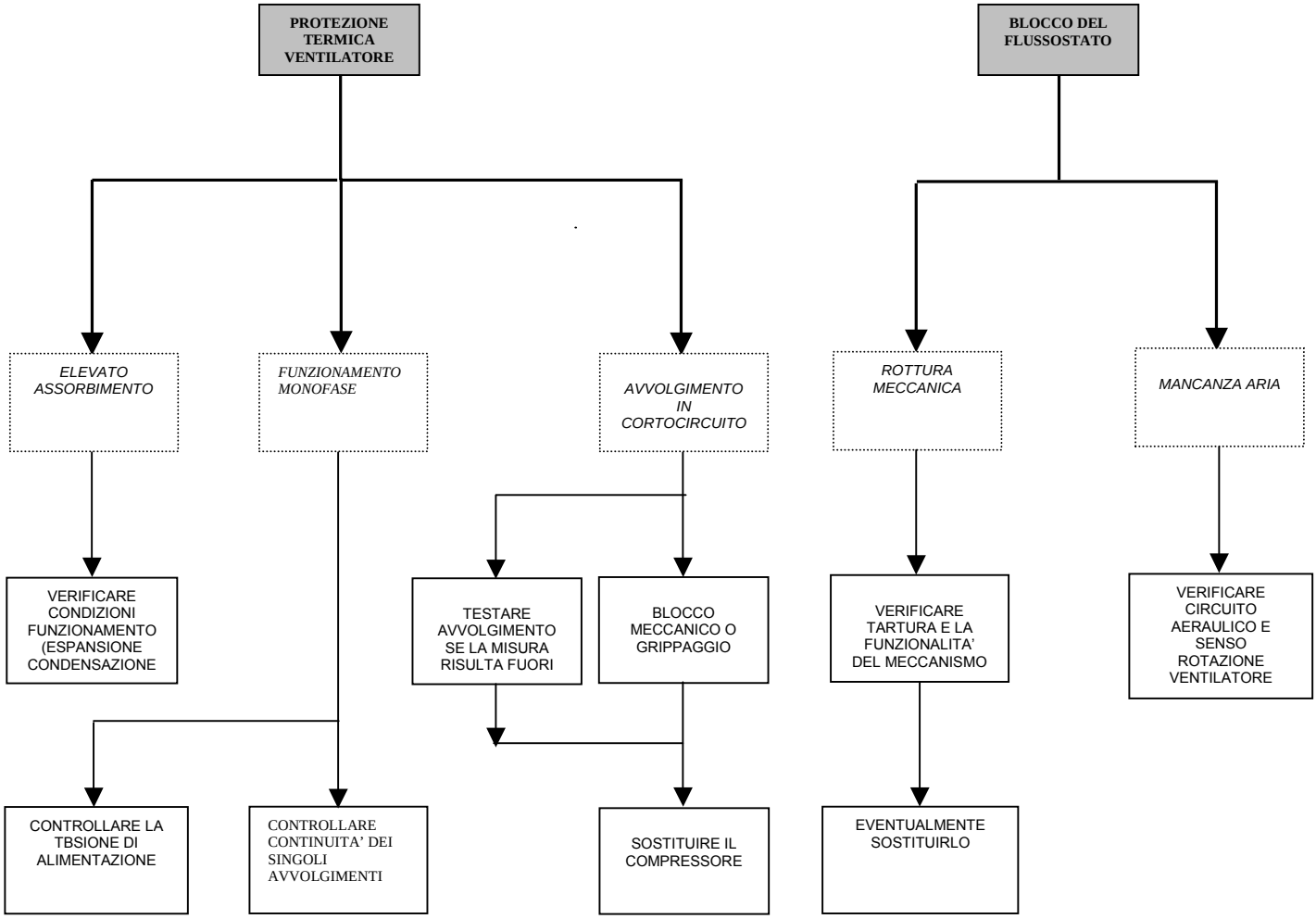
8.5 DEHUMIDIFICATION PROBLEMS




EXCESSIVE DEHUMIDIFICATION
DIRECT EXPANS.
TOO LOW AIRFLOW
CHILLED WATER
TOO LOW EXPANSION TEMPERATURE
TOO LOW EXPANSION TEMPERATURE
CHECK BLOCKED FAN
CHECK THERMAL FAN PROTECTION INTERVENTION
CHECK ELECTRIC FAN CONNECTION
CLEAN THE FILTERS
CHECK THE AIR CIRCUIT
CHECK THERMOSTATIC VALVE FUNCTIONING
CHECK THE COOLING CIRCUIT FOR RUN-DOWN STATE
CHECK FOR TOO LOW CONDENSING PRESSURE
BRING BACK TO DESIGN CONDITIONS

8.6 **FAN PROBLEMS**




PROTEZIONE TERMICA VENTILATORE
BLOCCO DEL FLUSSOSTATO
ELEVATO ASSORBIMENTO
FUNZIONAMENTO MONOFASE
AVVOLGIMENTO IN CORTOCIRCUITO
ROTTURA MECCANICA
MANCANZA ARIA
VERIFICARE CONDIZIONI FUNZIONAMENTO (ESPANSIONE CONDENSAZIONE
TESTARE AVVOLGIMENTO SE LA MISURA RISULTA FUORI
BLOCCO MECCANICO O GRIPPAGGIO
VERIFICARE TARTURA E LA FUNZIONALITA' DEL MECCANISMO
VERIFICARE CIRCUITO AERAULICO E SENSO ROTAZIONE VENTILATORE
CONTROLLARE LA TBSIONE DI ALIMENTAZIONE
CONTROLLARE CONTINUITA' DEI SINGOLI AVVOLGIMENTI
SOSTITUIRE IL COMPRESSORE
EVENTUALMENTE SOSTITUIRLO