INSTRUCTIONS, OPERATION AND MAINTENANCE MANUAL

AIR-CONDITIONING UNITS

SERIES T-TS-TA-PA

GENERAL INDEX

TCF Termoventilatori Condizionatori Felsinea Srl
40057 Cadriano di Granarolo Emilia (Bologna), via Giuseppe di Vittorio 5
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0. INTRODUCTION

This manual has been compiled by TCF Srl to provide the installer, customer and user with instructions intended to ensure the proper management and use of the air-conditioning units series T, TS, TA, PA from the delivery up to the commissioning.
The recommendations which follow are intended to ensure a continuous and durative operating life of the air-conditioning unit.
The procedures described below should be performed by skilled personnel with a good knowledge of air-conditioning systems design and operation, even though, thanks to the unit's simplicity of design, these could be carried out also by those unfamiliar with air handling.

1. DESCRIPTION OF THE AIR-CONDITIONING UNIT

1.1 COMPOSITION

The air-conditioning unit, in single-section or multiple sections, in its most complete execution, is made up from:

- Return section with one or more dampers
- Filters section
- Heat exchanger section (heating, cooling)
- Supply fan section

1.2 PERMITTED USE

TCF air-conditioning units are designed exclusively for CIVIL AND INDUSTRIAL AIR TREATMENT.
In case of CORROSIVE and/or EXPLOSIVE air flows, a number of special technical modifications must be made at the design stage which, altogether, adapt the machine for the treatment of special air flows.
The air-conditioning units must at all times be used strictly in accordance with the design conditions established at the time of contract in agreement with the customer. ANY OTHER USE SHALL CONSTITUTE IMPROPER USE AND IS THEREFORE DANGEROUS. THE MANUFACTURER MAY NOT BE HELD LIABLE FOR DAMAGE CAUSED BY NON-STANDARD USE OR ANY USE NOT ENVISAGED IN THE CONTRACT.

2. CONTROL, PACKING, TRANSPORTATION

2.1 FACTORY INSPECTION OF THE SUPPLY

Prior to shipping, each TCF air-conditioning unit is subject to all the functional tests listed on the attached UNIT INSPECTION SHEET. The controls concern:

- General machine dimensions
- Correct assembly of the various parts and sections
- Compliance with the various safety rules in force
- Integrity of all the system's component parts
- Application of the identification, operation and safety notices

On completion of the inspection, the Chief Inspector applies the EC mark demonstrating product compliance with prevailing European Union machine directives.

2.2 PACKING

The air-conditioning units are usually supplied as fully-assembled monoblocks.
Only if the customer expressly requests it, the units can be split into sections to facilitate transportation and carriage through narrow apertures, stairs or corridors.
Transportation of the machines, both monoblocks and broken-down units, may be:

- normal
- special

In the former case, TCF Srl does not normally pack the units.
In case of special transportation, the packing requested is agreed at the time of contract and is entirely on the customer's charge.

Fragile components supplied separate from the unit, such as humidifiers, exchangers, recuperators, filters, control boards etc., are always delivered packed.

2.3 LOADING,TRANSPORT,UNLOADING

TCF Srl disclaims any liability for damage occurred to the air-conditioning unit during loading, unloading and transportation. We therefore recommend that precautions be taken, including:

- The load must be firmly secured to ensure its integrity during transportation
- Handling must be performed without exerting force on protruding accessories (hydraulic attachments, handles, hinges, air locks, protection roof)
- Do not overturn the sections as you may otherwise break internal supports, components and dampers
- Do not subject the unit to violent impacts as you may damage its integrity
- If a forklift truck is used during the loading, unloading and handling operations, the forks of the truck must be at least the same length as the unit to ensure stability (fig. 1)
- If the air-conditioning unit is fitted with a continuous steel base frame, handling may be carried out with a crane, using cables firmly secured to rods (sufficient for the stress involved) passing through the holes provided in the base.

If a crane is used, proceed as shown in the illustration, using spacers to protect the structure (fig. 2).

- During transportation, protect the unit from atmospheric agents. Special care must be taken if the unit is supplied disassembled or designed for internal use.

Fig. 1

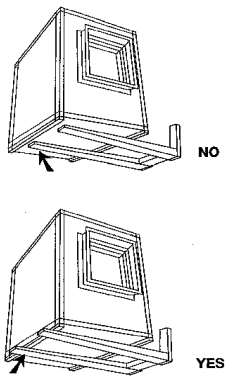

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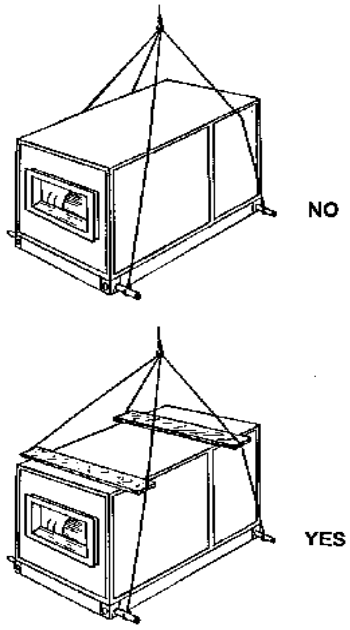
Fig. 2



3. ASSEMBLY ON SITE

3.1 POST-TRANSPORTATION CHECK

Upon arrival of the air-conditioning unit on site, TCF suggests the customers to perform an accurate check of the structure and of the components.
Should any transportation damage be detected, this must be notified on the delivery bill. The carrier must immediately file a report of the accident to obtain compensation from the insurance company.

3.2 PRESERVATION ON SITE

In order to keep the air-conditioning unit in good and efficient condition on site, the following steps must be taken first:

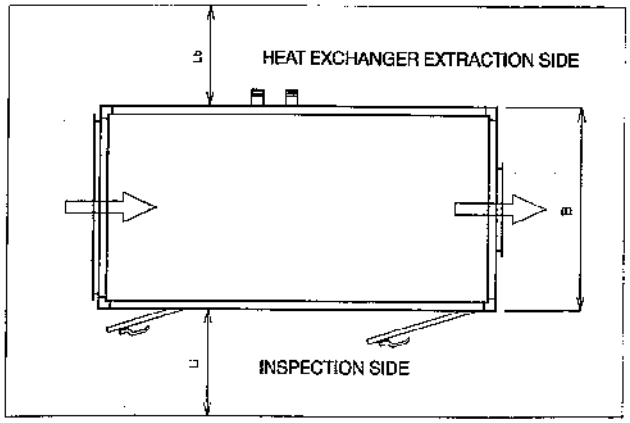
- prior to installation, position the unit and the accessories in a place offering the best possible protection against accidental knocks, dust and atmospheric agents
- carefully cover the inlets and outlets to prevent foreign matter from entering the unit and damaging the internal components
- extract the prefilters from the unit and put them in a protected place to preserve their filtrating efficiency. This is why the superior efficiency filters are delivered packed; they must be kept in their packages until the unit is put into service
- check that the hydraulic connections are protected by the relevant caps, as they were delivered by TCF. If they are not, plug them in order to protect them exchangers.

3.3 POSITIONING

3.3.1 Dimensions of installation room

The air-conditioning unit installation room must be of sufficient size to permit easy inspection, maintenance and component replacement. Accordingly, the following dimensions are recommended (fig. 3):

Fig. 3



- Heat exchanger extraction side:
  min. distance Lb = (B+0,2) m
  where B = machine width (m)
- inspection side:
  min. distance Li = 1.2 m

if you do not have the minimum space requirements as specified above, the units doors can, on request, be fitted using PVC clamps instead of hinges. In this case the minimum distance will be Li = 0,7 m.

3.3.2 Base frame

The permanent installation of the air-conditioning unit may be made:

- directly on the floor (fig. 4a)
- on a concrete bed (fig. 4b)
- on a steel section bed (fig. 4c)
- on a suspended base (fig. 4d)

Both the floor and the beds must be capable of withstanding the machine weight to within the required safety margins.
The air-conditioning unit must be positioned on a horizontal surface so as to prevent:

- damage to the fan motor units caused by uneven weights on the vibration dampers
- malfunctioning of the condensate drains
- difficulty in opening and closing the inspection doors

The horizontal alignment of the support surface must be checked with a SPIRIT LEVEL; adjustments may be made using STEEL SHIMS.

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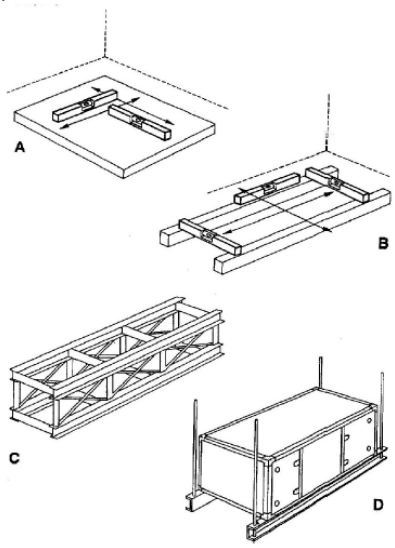
FIG. 4

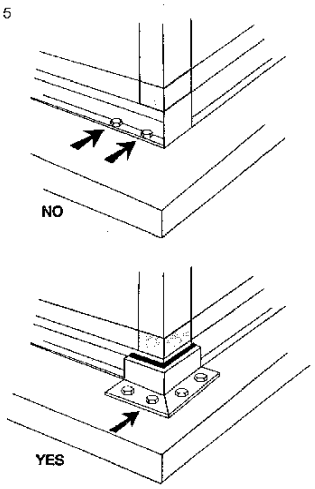


3.3.3 VIBRATION DAMPING

In order to ensure effective protection against vibrations, the air-conditioning unit must be installed as follows:

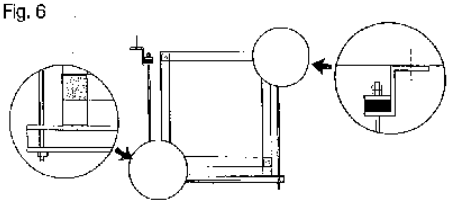
- suitable DAMPERS must be placed between the machine and the support surface, in material designed to withstand the weight involved
- the unit must not be fastened directly with screws but by means of brackets (fig. 5)

Fig. 5



Even in case of suspended installation of the unit, the supports must not be screwed directly into the ceiling; vibration damping material must always be placed between the support and the ceiling (fig. 6).

Fig. 6



4. CONNECTION TO SYSTEMS AND START UPS

4.1 CONNECTION TO DUCTS

At the point of connection to the air ducts, the air-conditioning units have a smooth or a flanged surface.
In order to optimise the connection with the ducts, you must:

- clean the connection edges between duct and unit
- fit a seal to the flanges in order to prevent air infiltration
- tighten the connecting screws firmly
- treat the joint with silicone to enhance the seal

If the connection is made with rubber canvas joints, make sure they are not tightened on assembly completion, so as to prevent damage or the transmission of vibrations.

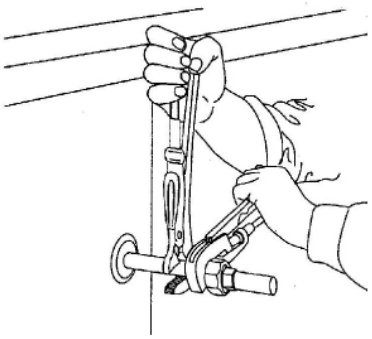
In order to ensure the tightness of the connections and the integrity of the unit, the weight of the ducts must under no circumstances bear down on the unit. The ducts must be supported by BRACKETS.

4.2 CONNECTION OF HEAT EXCHANGERS

In order to prevent damage to the exchanger at the joint between the steel manifold and the copper circuits, you must:

- use a pipe wrench to apply force in the opposite direction when making the connection to the mains pipe (fig. 7)
- fit brackets to support the connecting pipes; the weight of the pipes must under no circumstances bear down on the manifold.

FIG. 7



4.3.1 Water heat exchangers

In order to ensure an optimum heat exchange, you must:

- WASH the heat exchanger before connecting it to the water mains
- Once installed in a state-of-the-art fashion, any air present in the hydraulic circuit must be expelled using the appropriate valve

To allow an easy extraction of the heat exchanger during maintenance:

- the connections to the mains must be made in such a way as to allow removal of the exchanger
- ON-OFF VALVES must be installed to exclude the heat exchanger from the hydraulic circuit

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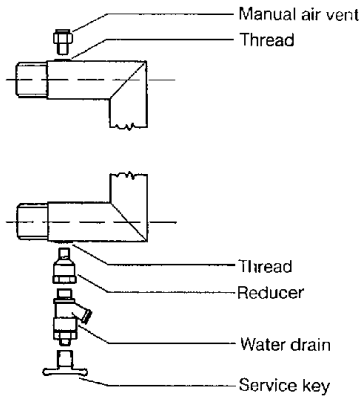
- on the lower manifold to allow for a complete drainage, and a VALVE must be fitted to the upper manifold to vent the air from the heat exchanger (fig. 12)

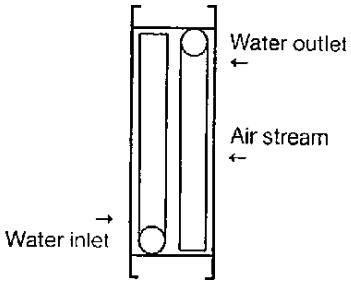
Fig. 12



The normal heat exchange in a heating or cooling water exchanger occurs in REVERSE CURRENT (fig. 9).

In presence of particularly low external temperatures, in order to prevent the formation of ice in the heating units, an EQUICURRENT heat exchange system may be provided (fig. 10). This configuration must be determined at the design stage and not during installation, since on obvious reduction in efficiency will result if a heat exchanger sized for reverse current is used for equicurrent operation.

FIG. 9



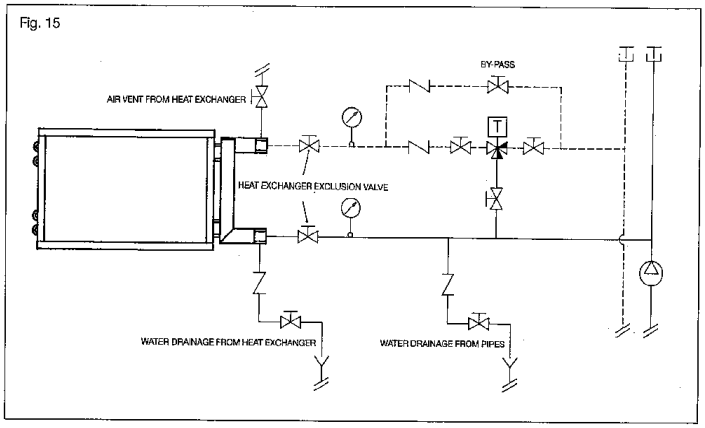
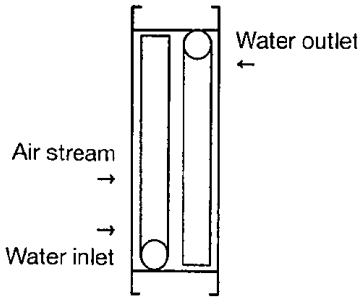


FIG. 10



The diagram (fig. 15) shows the 'standard' installation of a water-type heat exchanger.

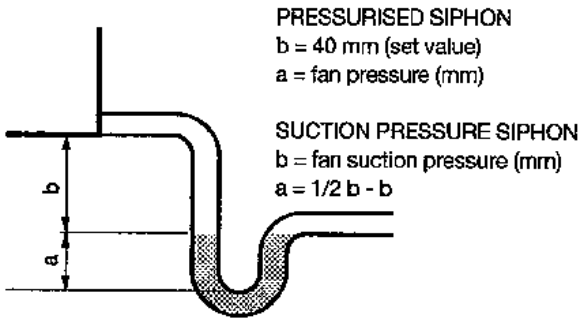
4.3 DRAINAGE AND SIPHONING

Before positioning the air-conditioning unit, make sure you have sufficient room to install the siphon and drainage pipe.

The humidification and cooling exchanger sections of the TCF units are fitted with a threaded drain pipe projecting laterally about 80 mm.

To allow for a regular outflow of water, every drain must be fitted with a correctly sized SIPHON (fig. 12).

FIG. 12



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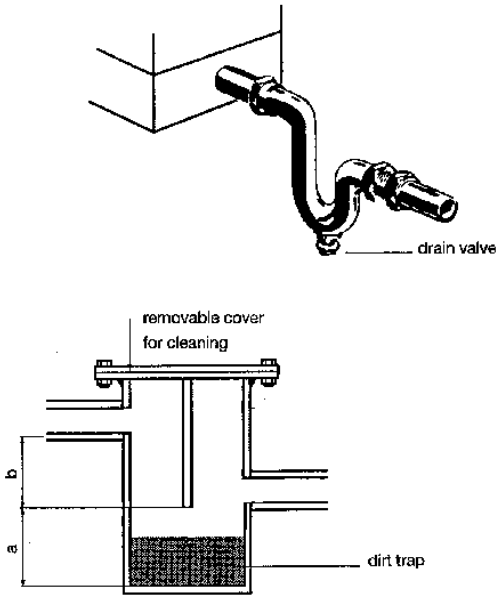
In order to prevent overflowing from the condensate collection tank and consequent flooding of the machine and the room it is installed in, the siphon must be fitted with a DRAIN VALVE to permit the removal of impurities which may deposit on the bottom (fig. 13).

FIG. 13

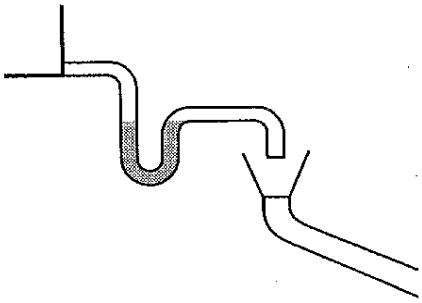


In order not to undermine the operation of the drainage system, pressurised siphons and siphons operating under suction pressure must not be connected together.

The WASTE PIPE (fig. 14) leading to the drainage network:

- must not be connected directly to the siphon in order to absorb air or waste backflow and to permit direct visual control of the correct outflow of waste water
- must have a diameter larger than the drain pipe and a minimum angle of 2% to ensure proper functioning.

FIG. 14



4.4 FILTRATING SECTIONS

Check the correct installation of the prefilters located in the relevant counterframes with safety springs or guides.

4.5 FAN-MOTOR UNITS (3-PHASES) series T

4.5.1 Electric motors

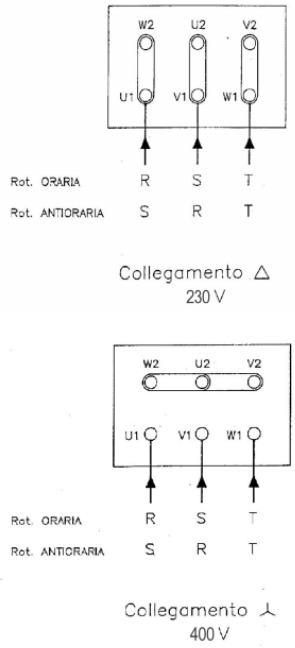
Before starting up the unit:

- inspect the motor CONTROL BOARD and check that the motor protection devices are sized for the maximum amperage, corresponding to the rated value on the plate.
- The TERMISTORS, if present, must not be connected to the power supply line of the electric motors since otherwise they would be damaged irreparably (operating voltage 1V)
- Check that the MAINS SUPPLY VOLTAGE is suited to that of the motors as indicated on the relevant plates

4.5.1.1 Connection for direct starting

The simplest electric motor start-up system is obtained by connecting the motor directly to the supply line. However, this method has limitations due to the high start-up current (pick-up); this type of start-up is recommended for power ratings up to 5,5kW for which TCF installs, as standard, 4-poles 220/380 V three-phase motors.
The wiring diagrams are shown in fig. 15.

FIG. 15

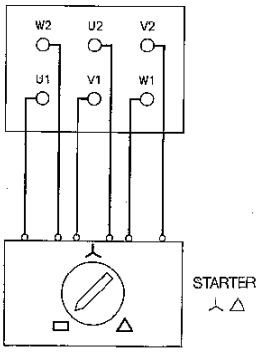


4.5.1.2 Connection with star-delta starting

If the motor start-up current exceeds the value permitted by the power supply, you may decide to choose for delta-star starting.
For this purpose TCF installs dual voltage 400/690V motors on its air-conditioning units starting from an output of 7,5kW, thus allowing the motor to operate normally at 400V (delta connection) and to start-up at 690V (star connection).

This arrangement reduces the starting current by approximately 30% of the current involved in case of direct starting.

FIG. 16



Wiring diagram for delta-star starter with three-phase motor, single speed, dual voltage.

4.5.1.3 Dual speed three-phase motors

The diagram in fig. 17 shows the connection of a TWO-SPEED MOTOR with two separate windings to the power supply.
TCF installs motors of this kind on the following units:

- 230/400V for power ratings up to 5,5kW
- 400/690V for power ratings from 7,5kW

This type of electric motor permits the delta-star connection by means of a starter.

The two-speed motors with a single DAHLANDER commutable winding (fig. 18) offer the advantage of generating greater power than motors of the same size but with separate windings.

4.5.1.4 Permitted start-up time

Because of the temperature increase, the start-up time of a motor may not exceed the value shown in table 1.
The data refer to start-ups at exercise temperature, whereas for cold start-ups such timings may be doubled.

TABLE 1

Grandezza motore	Metodi di avviamento	Tempo max di avviamento [sec], per avviamenti occasionali – Numero di poli 2	4	6	8
63	Avv. Diretto	25	40	-	40
71	Avv. Diretto	20	20	40	40
80	Avv. Diretto	15	20	40	40
90	Avv. Diretto	10	20	35	40
100	Avv. Diretto	10	15	30	40
112	Avv. Diretto	20	15	25	50
	Avv. Y/Δ	60	45	75	150
132	Avv. Diretto	15	10	10	20
	Avv. Y/Δ	45	30	30	60
160-250	Avv. Diretto	15	15	20	20
	Avv. Y/Δ	45	45	60	60

4.5.1.5 Recommended connection and protection accessories

For the sizing of cables and connections, please refer to the motor nameplate data and to the laws in force in the country where the unit is installed.

FIG. 17

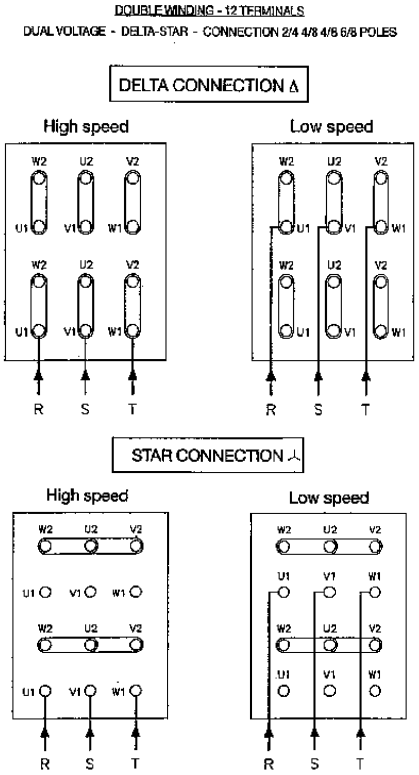
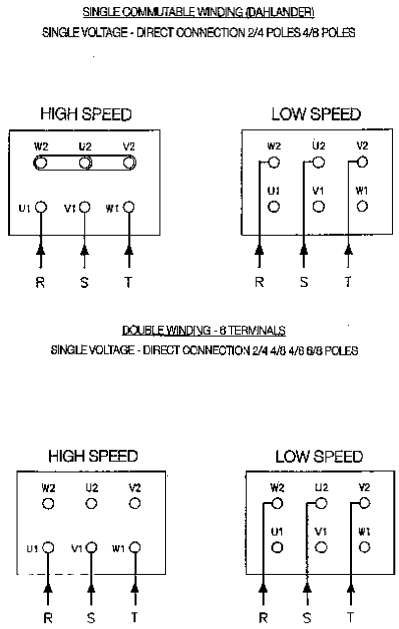


FIG.18



4.5.2 Fan

Before start-up, carry out the following checks:

- make sure that the fan wheel is functioning correctly by rotating it manually
- check that any safety clamp, fitted to prevent damage during transportation, has been removed from the dampers (fig. 19).

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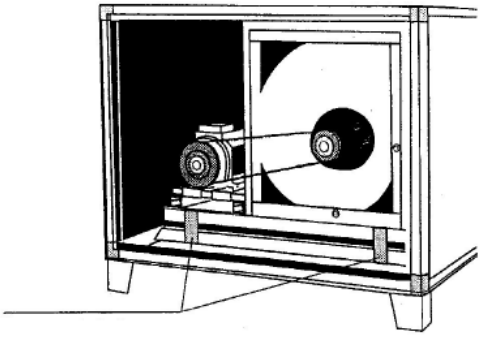
FIG. 19



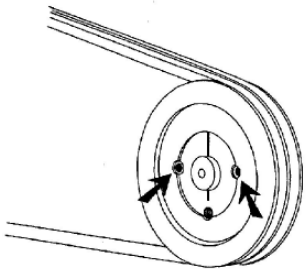
safety clamps

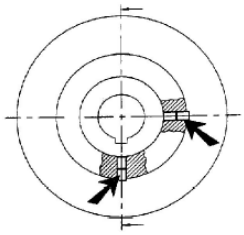
4.5.3 Transmission

Before starting the air-conditioning unit please check:

- the tension of the V-belts (section 5.2.3.1)
- that the pulleys are aligned (section 5.2.3.1)
- that the dowels, shown in fig. 20, in their possible installation positions, are doing their function of securing the pulleys to the hubs

FIG. 20





4.6 FAN-MOTOR UNITS (1-PHASES) series TS, PA, TA

4.6.1 Electric motors

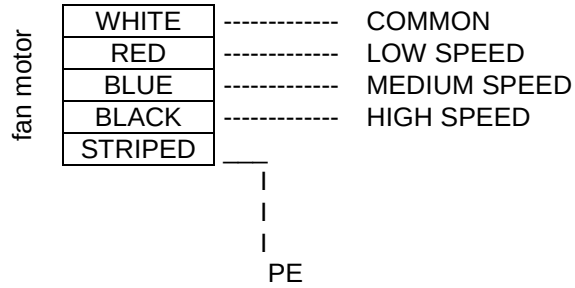
Before starting up the unit:

- inspect the motor CONTROL BOARD and check that the motor protection devices are sized for the maximum amperage, corresponding to the rated value on the plate.
- The thermal protections, if present, must not be connected to the power supply line of the electric motors since otherwise they would be damaged irreparably
- Check that the MAINS SUPPLY VOLTAGE is suited to that of the motors as indicated on the relevant plates

4.6.1.1 3-speed fans series TS and PA

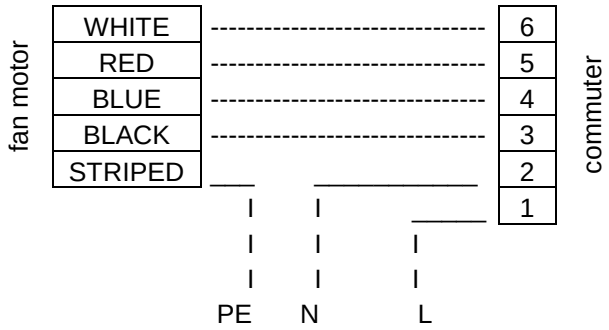
The scheme on fig. 21 shows the 'code colour' of the terminal plate installed on the fans used for the **TS** and **PA** series.

FIG. 21



The scheme on fig. 22 shows the connection of a fan motor actuated by the 3-speed selector type '6990'.

FIG.22

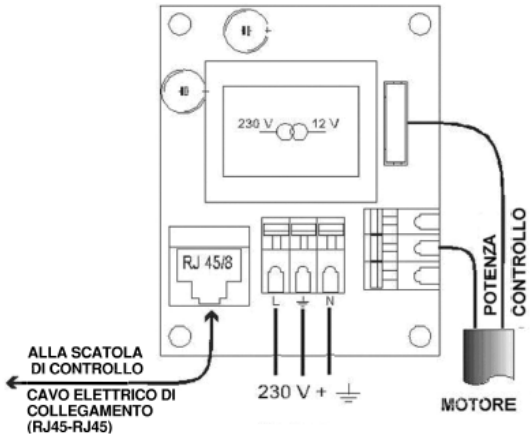


4.6.1.2 Self-regulating fans series TA

The ECM2 fans are supplied in 3 parts: the fan-motor assembly with power box (fig. 23) installed and wired, the control cable with connector RJ45, the control box.

The power circuit ECM2 is designed to be supplied at 230V – 50Hz.

FIG.23



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4.6.1.2.1 Selection of the airflow

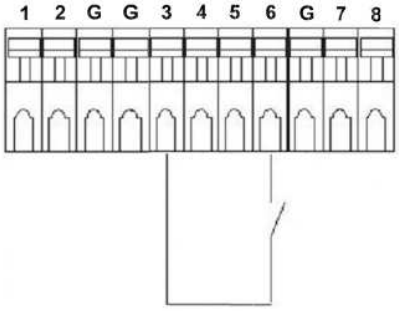
By operating on the control board (fig. 24) it is possible to select one of the 31 available speeds:

Position the dip-switches from 1 to 5 in the adequate position in order to obtain the desired air flow. The available combinations for each fan are indicated in the attachment 1 (page 16).

FIG. 24

In order to avoid all problems related to current peaks during the start-up, caused by the condensers charge of the motors power circuit, we have arranged for a softstop/softstart (waiting time – consumption = 0,05W) as indicated in the connection diagram of the control box (fig. 25). **In case this option is not used, it will be necessary to bridge the contact between the terminals 3-6.**

FIG.25



Closed=softstart Open=softstop

4.6.1.2.2 Alarm on the pressure

This alarm uses the dip-switches from 6 to 8, and allows to configure an alarm which will inform the user of a variation in pressure of +25, +50, +75, +100, +150, +200, +250 or +300 Pa in relation to the reference pressure. When these alarms activate, a LED light will switch on, and the transistor connected between the connectors G and 2 of the control box is a conductor.

a) how to memorize the reference pressure Pa_{ref}:

Pa_{ref} corresponds to the 'starting' pressure of the fan, that is the one corresponding to the initial operating point of the system (i.e. with clean filters). To elaborate the 'built-in' alarm you nee to memorize this pressure with the microprocessor. Memorizing procedure: see attachment 2 page 18.

****
** *ATTENTION* **
** The alarm in pressure is fixed only for ONE selected **
** air volume. Changing this air volume modifies the **
** pre-set alarm – Pa_{ref} is no longer correct and has to **
** be re-initialized. **
****

b) how to fix the increase factor

The choice of the increase factor depends on the application. You may choose one increase out of 8 with the help of the dip-switches from 6 to 8.

DS 6-7-8	ΔPa per innescare l'allarme
000	25 Pa
001	50 Pa
010	75 Pa
011	100 Pa
100	150 Pa
101	200 Pa
110	250 Pa
111	300 Pa

0=OFF - 1=ON

ON = 1
OFF = O

4.7 Fan

Before start-up, carry out the following checks:

- make sure that the fan wheel is functioning correctly by rotating it manually

4.8 NOISE LEVEL

The computation and control of noise emissions has today become particularly important, both during the design and installation phases.
The sound pressure values of our machines are indicated in our technical catalogues or may be supplied directly by our Technical Department according to the requested aeraulic characteristics.
Being therefore aware of the sound emissions produced by the unit, the designer must make sure that, in treated environments, maximum values established by current regulations are not exceeded.
It must however be stressed that every environment has its own acoustic characteristics, which can considerably affect the sound pressure values of mechanical ventilation systems.
THE NOISE LEVEL DATA SUPPLIED BY US SHOULD CONSEQUENTLY BE CONSIDERED AS A CALCULATION BASE FOR DEEPER CONSIDERATIONS, WHICH WILL TAKE INTO ACCOUNT THE SYSTEM AND BUILDING STRUCTURE AS A WHOLE.

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5. MAINTENANCE

5.1 FOREWORD

TCF recommends that its customers carry out PREVENTIVE MAINTENANCE on the air-conditioning units in order to ensure a long-term efficiency.
Such air-conditioning units require little maintenance and have been designed to make each operation as easy and safe as possible.

5.2 FILTRATING SECTIONS

The filtrating sections require the most frequent maintenance in order to:

- ensure that the air is filtered with the required efficiency in the treated environment;
- prevent the components of the air-conditioning unit from damaging

5.2.1 Reconditionable synthetic filters

These are cells measuring 50 or 100mm in thickness, also known as PREFILTERS, which offer the advantage of being reconditionable.
The RECONDITIONING may be performed using two different methods, depending on the type of dust to be treated:

- in case of DRY DUSTS, a compressed air jet has to be directed against the filter in the opposite direction to normal operation
- in case of WET DUSTS, the filtration diaphragm has to be washed (without removing it from the frame), if necessary using domestic detergents. To avoid damaging the filter, the temperature of the water must not exceed 50°C. Do not use solvents or caustic soda. Let the diaphragm dry by evaporation and refit it only when it is perfectly dry.

TCF recommends TO CHECK THE CONDITION OF THE FILTERS ON A WEEKLY BASIS.

THE PREFILTERS MUST BE RECONDITIONED EVERY 7-20 DAYS depending on the type of environment being treated. After 7 to 10 reconditioning operations, the diaphragms will tend to deteriorate and its original characteristics will be impaired; it should therefore be replaced.

5.2.2 Non-reconditionable bag filters

These are filters with an efficiency between EU5 and EU9.
They CANNOT BE RECONDITIONED as this would damage their dirt accumulation capacity and efficiency.
In order to preserve the filtration diaphragm as long as possible, the condition of the prefilters must be carefully monitored.
Moreover, TCF recommends to check the state of the gaskets of the frame and the springs every week, to prevent air from by-passing the bag without being filtered.

5.2.2.1 Replacement load loss chart

TABLE 2. Pressure drop to substitute the filters

FILTER TYPE	INITIAL dH (mm)	FINAL dH (mm)	RECOMMENDED REPLACEMENT (mm)
— SYNTHETIC BAG FILTERS			
EU 4	15	30	25
EU 5	9	20	15
EU 7	11	23	15
EU 9	14	30	20
— RIGID BAG FILTERS			
EU 6	10	45	30
EU 7	10	60	30
EU 9	13	60	30

5.3 HEAT EXCHANGERS

5.3.1 Water heat exchangers

In order to maintain an optimum water/air heat exchange, the following MAINTENANCE OPERATIONS must be performed regularly on the exchangers:

- At the beginning of each operating season, remove the air present in the heat exchanger circuit using the relevant air relief valve;
- At the beginning of each operating season, remove dust and deposits from the finned pack. Proceed as follows:

1. use a jet of compressed air in the opposite direction to the air flow during normal unit operation, or
2. wash the finned pack with water, non-corrosive components and a wire brush

- Remove any deposit from the condensate drain pan. This operation must be repeated every month in order to prevent flooding of the machine and of the room where it is installed.

To avoid causing irreparable damage to the heat exchangers, you must make sure that the primary fluid will not freeze when winter comes. For this purpose TCF recommends the following steps:

- in case of prolonged standstill of the heat exchanger circuits, they should be completely drained
- where an anti-freeze system based on heating elements is provided, to protect the exchanger, make sure that the control board is constantly powered;
- on systems operating with anti-freeze mixture, check their efficiency and fill them up or replace if necessary

  ANTI-FREEZE LIQUID MUST NEVER BE INTRODUCED INTO A CIRCUIT NOT SPECIFICALLY SIEZED FOR THIS PURPOSE as it would jeopardize the correct operation of the pump and the efficiency of the heat exchanger.

5.3.2 Extraction of the heat exchangers

Frequently insufficient space in the room makes it often impossible to carry out the necessary maintenance on the heat exchanger while installed inside the unit.
In these cases it is necessary to extract the exchanger, an operation which calls for the utmost care.
To remove the exchanger you must:

- make sure that you have enough room for the removal and temporary accommodation of the heat exchanger
- consider that an ordinary Cu/Al coil has a mass of approximately 10 kg/m2 of frontal area per row; therefore, prepare supports if necessary
- completely drain the heat exchanger
- remove the unit panel covering the hydraulic connections and the panel through which the exchanger will be removed
- release the heat exchanger by undoing the relevant clamps and extract it
- on completion of the maintenance operations, restore the ideal operating conditions of the exchanger;

5.4 FAN SECTION

5.4.1 Fan

In order to keep the fan in perfect working order, WE RECOMMEND YOU TO CHECK THE FOLLOWING AT LEAST ONCE A MONTH:

- The cleanliness of the shell and wheel; remove any deposits
- Damage and corrosion to the fan components; in case remedy with zinc-powder paint
- The tightness of the parts comprising the fan section
- Seal of the vibration-damping joint fitted to the fan supply mouth
- Cleaning and lubrication of any DAPO control air locks. Lubrication of this part must be performed every six months
- Absence of abnormal noises due to deterioration of the bearings. If necessary, replace them. The fans mounted on the TCF units are fitted wither with oilless bearings (design life 2000 hours) or pedestal bearings, depending on the operating conditions. The pedestal bearings require periodic lubrication. THE LUBRICATION INTERVALS show in table 3 are subject to the environmental conditions and the maximum temperature range during operation.

TABLE 3.
Lubrication of fan support bearings

ENVIRONMENTAL COND.	TEMP. RANGE °C	LUBRICATION INTERVALS
CLEAN	UP TO 50	6 ÷ 12 MONTHS
	50 ÷ 70	2 ÷ 4 MONTHS
	70 ÷ 100	2 ÷ 6 WEEK
	100 AND OVER	1 WEEK
DIRTY	UP TO 70	1 ÷ 4 WEEKS
	70 ÷ 100	1 ÷ 2 WEEKS
	100 AND OVER	1 ÷ 7 DAYS
MAXIMUM HUMIDITY		1 WEEK

RECOMMENDED GREASE:
MOBILUX3 (MOBIL), ALVANIA GREASE3 (SHELL), BEACON3 (ESSO)

5.4.2 Motor

In order to maintain the motor in perfect working order, TCF recommends the FOLLOWING MONTHLY CHECKS:

- Cleanliness: remove any deposits
- Absence of abnormal noise due to deterioration of the bearings

Powerful motors fitted with grease nipples require periodic lubrication. The greasing intervals, under normal operating conditions, are shown in Table 4.

TABLE 4

Greasing of motor bearings

MOTORE RPM	—	3000	1500	1000	750
GREASE EVERY (HOURS)	—	5000	10000	20000	25000

NOTE: The bearings must be greased more frequently in harsh operating conditions.

5.4.3 Transmission (only T series)

In order to ensure optimum drive efficiency and to avoid damaging the fan motor unit, the transmission must be kept in perfect working conditions.
The following must be CHECKED EVERY MONTH:

- The operating condition and dirtiness of the transmission; remove any deposits
- Damage to the drive (cracks on belt and pulleys, frayed belt edges, worn belts and pulleys). If necessary, replace the damaged part(s)
- The perfect alignment of the transmission
- The tension of the belt (see section 5.4.3.1)

5.4.3.1 Determining belt tension

To alter the tension of the driving belts you must remove the motor.
To facilitate this operation the motors are positioned on:

- guides
- belt-tensioning slides

in both cases it is easy to tighten or slacken the driving belt by means of the lock nuts and adjusting screws.

In order to determine DRIVING BELT TENSION, you must:

- establish a centre distance (I) and block the drive
- using a spring-operated torque wrench, apply a force (P) on the midway point of the belt (perpendicular to it) to obtain a deflection equal to 1/64 of the centre distance (approx. 16mm/m)
- check that the applied force is within the values indicated in table 5, if not, set a new centre distance and repeat the test

TABLE 5

BELT SECTION	MINOR PULLEY DIAMETER (mm)	FORCE P (daN)
A	70 ÷ 120 125 ÷ 180	9 ÷ 15 13 ÷ 18
B	112 ÷ 140 150 ÷ 225	18 ÷ 26 23 ÷ 30
C	180 ÷ 225 250 ÷ 400	36 ÷ 53 48 ÷ 70
SPZ	67 ÷ 90 95 ÷ 150	11 ÷ 20 17 ÷ 25
SPA	90 ÷ 132 140 ÷ 224	20 ÷ 35 30 ÷ 45
SPB	140 ÷ 224 236 ÷ 355	35 ÷ 50 43 ÷ 65

FIG. 26

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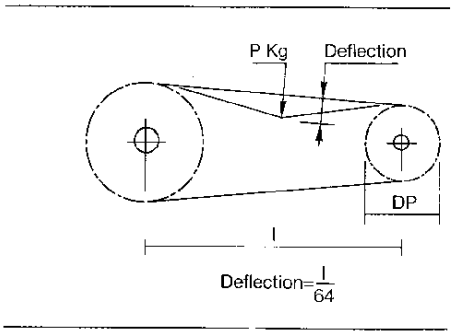
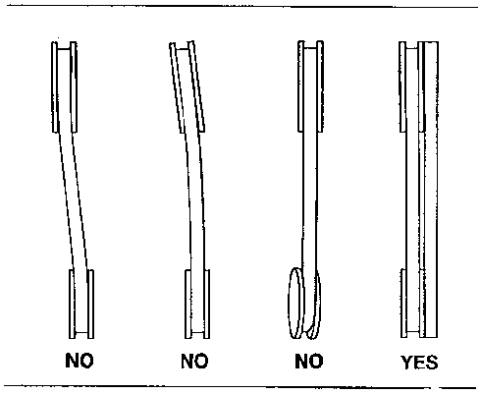


If the tension is not correct, the following will occur:

- if the belt is slack, it will wear out rapidly and the drive system will be inefficient
- if the belt is too tight, the motor and fan bearings will be damaged

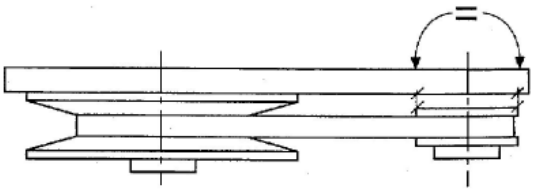
whenever the belts are tightened, you must check that the drive belts are aligned using an ordinary RULER (fig. 27)

FIG.27



If the pulleys are of different thickness, you must check their equivalence as shown in fig. 28 to ensure correct installation.

FIG. 28



5.4.3.2 Replacement of driving belt

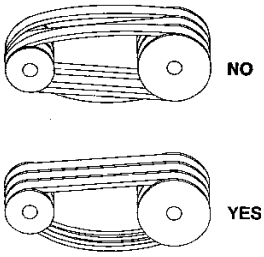
To REPLACE THE DRIVING "V" BELT:

- loosen the drive and remove the worn-out belt
- check the condition and wear of the pulleys and replace them if necessary
- introduce the new belt without forcing; any forcing could impair the transmission and shorten its service life
- align the drive and tension the belt
- check the belt tension after about 10 working hours

5.4.3.3 Drive with multiple-race pulleys

- in case of drives with several belts, the belts must be replaced at the same time. This means that there must not be belts presenting different states of wear in the same transmission system
- the number of belts must always match the number of races
- in this type of drive system, the belt slack must be on the same side, as shown in fig. 29, before they are tightened

FIG. 29



5.5 TROUBLESHOOTING

The most common MALFUNCTIONS in air-conditioning units are:

- reduced flow rate
- increased flow rate (excluding TA units)
- reduction in heat exchanger efficiency
- abnormal noise

5.5.1 Reduction in flow rate

This is the result of an uncontrolled increase in resistance in the air moving circuit which alters the fan operating point.
The most frequent causes are:

- excessively clogged filters
- formation of frost or ice on the front surface of the prefilters in particularly damp and cold climates on units operating entirely with external air
- blockage of the intake grille(s) (especially external air intake)
- fully or partially closed control air locks
- activation of fire dampers
- deposits on cell blocks and heat exchangers
- inefficient fan motor unit drive

5.5.2 Increased flow rate

If the sum of the resistances in the aeraulic circuits is less than the value considered at the design stage, the most common causes are:

- incorrect setting of any mechanical flow controls or zone air locks
- non-replacement of filters after ordinary maintenance operations
- open or partially closed inspection doors

5.5.3 Reduced heat exchanger efficiency

The most common causes are:

- clogging of finned pack
- formation of air bubbles inside the exchangers

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- feed fluids at temperatures lower than the design temperature
- malfunction or breakdown of control valve actuators
- water flowrate below design values

5.5.4 Abnormal noise level

With regard to the fan, the causes may be:
- worn-out or defective bearings
- fan off-balance
- foreign matter in the fan wheel

With regard to the electric motor, the causes may be:
- worn-out or defective bearings
- loose cooling fan and/or fan guard
- magnetic noise during frequency reductions with inverter (applications below 22Hz are not recommended as a rule)

With regard to the drive system, the causes may be:
- slipping of belt
- worn belt
- misaligned pulleys
- pulley with play on key

in order to remedy the malfunctions listed above (and not the entire air-conditioning system), CONSULT THE CHAPTER RELATED TO THE MAINTENANCE (ch. 5) OR, IF THE PROBLEM PERSISTS, CONTACT OUR TECHNICAL DEPARTMENT.

6. SAFETY

6.1 SAFETY-RELATED FEATURES OF AIR-CONDITIONING UNITS

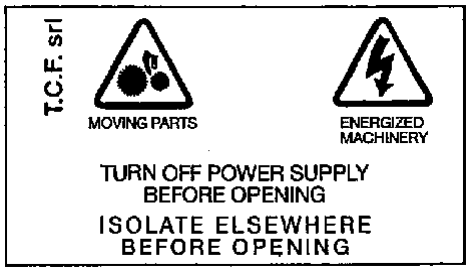
TCF Srl has fitted its air-conditioning units with every possible safety feature to prevent accidents, especially during start-up and maintenance.
Some of the SAFETY FEATURES are listed below:
- INSPECTION DOORS THAT CAN ONLY BE OPENED WITH A KEY are installed in the sections housing rotating parts and drives
- the GRATES and HOUSINGS protecting rotating parts and drives can only be removed with a key
- the outside of the structure has ROUNDED EDGES
- elimination of sharp-edged steel sheet parts inside and outside of the unit
- use of SELF-TAPPING SCREWS WITH NON-PROTUDING TIPS inside sections and panels

we always recommend to install, inside the fan section, an ELECTRIC ISOLATOR, which has the function of preventing the fan-motor assembly from getting started during maintenance operations, thus jeopardising the safety of the technician.

6.2 SAFETY NOTICES APPLIED TO THE UNITS

The inspection doors of the air-conditioning unit carry SAFETY NOTICES drawing the operator's attention to the danger connected with moving parts and warning him to disconnect the system power before opening the inspection doors (fig. 30).

FIG. 30



6.3 PRACTICAL ACCIDENT-PREVENTION TIPS

- Open the inspection doors only when the fan is at a standstill
- Before carrying out maintenance work on the fan motor unit, make sure that the motor cannot be restarted by accident
- Before operating on the motor, make sure that it has cooled down completely
- In order to protect your hands, use a lever to remove the belts
- Block the fan wheel before maintaining it, since (especially when the belt is removed) the 'updraft effect' caused by the ducts could make it rotate and cause injury

7. WARRANTY

TCF Srl guarantees its products for 12 months from shipment date.
The warranty covers the normal operation of the individual components installed on our units, such as motors, fans, heat exchangers, humidifiers and other parts.
It should be stressed that the warranty covers manufacturing defects in these parts, while their efficiency is categorically excluded since this is determined by the characteristics of the aeraulic and hydraulic systems and by the design, and does not therefore fall within our sphere of responsibility.
TCF therefore undertakes to replace any individual component which malfunctions as rapidly as possible and subject to stocks. The part should be sent (freight costs pre-paid) to our headquarters and the replacement part will be sent ex-works.
Please note, too, that the warranty does not include the service of our personnel for the replacement of the part on site; this cost is entirely on the installer's account.
On receipt of the returned material deemed to be defective, an inspection will be carried out to establish whether the part reveals abnormalities justifying application of the warranty.
If it is established that the defect is due to external factors, the replacement part will be charged to the customer.
It should furthermore be noted that the warranty shall not apply in the case of tampering or in case the failure is a consequence of incorrect installation or connection.
On this behalf, reference will be made to the instructions contained in this Installation, Operation and Maintenance Manual which accompanies each of our machines.

TCF Srl

8. ATTACHMENT 1

DD 9-9 ECMd2 1/2							
	Dip-switches	Portata "alta"	Portata "media"	Portata "bassa"	Pa max	W ass max	I max
	1 à 5	m³/h	m³/h	m³/h	Pa	W	A
31	11111	2900	1915	960	165	550	3,3
30	11110	2825	1870	930	205	560	3,4
29	11101	2750	1815	910	240	570	3,4
28	11100	2670	1760	880	270	570	3,4
27	11011	2595	1710	855	290	570	3,4
26	11010	2515	1660	830	305	560	3,4
25	11001	2440	1610	805	315	550	3,3
24	11000	2360	1560	780	320	535	3,3
23	10111	2285	1510	755	325	530	3,2
22	10110	2210	1460	730	335	515	3,2
21	10101	2130	1405	705	345	500	3,1
20	10100	2055	1355	680	350	490	3,0
19	10011	1980	1305	650	355	480	2,9
18	10010	1900	1255	630	365	465	2,9
17	10001	1825	1205	600	370	550	2,8
16	10000	1745	1150	600	380	435	2,7
15	01111	1670	1100	600	390	425	2,6
14	01110	1590	1050	600	400	415	2,6
13	01101	1515	1000	600	410	400	2,5
12	01100	1440	950	600	420	395	2,5
11	01011	1360	900	600	430	385	2,4
10	01010	1285	850	600	440	375	2,4
9	01001	1205	800	600	450	365	2,3
8	01000	1130	745	600	460	355	2,3
7	00111	1050	700	600	480	350	2,2
6	00110	975	644	600	595	340	2,2
5	00101	900	600	600	515	330	2,1
4	00100	820	600	600	530	325	2,0
3	00011	745	600	600	545	320	2,0
2	00010	670	600	600	560	320	2,0
1	00001	600	600	600	580	315	2,0
0	00000	Softstop	Softstop	Softstop	-	-	-

Pa max / W ass max e I max : dati per le portate "alte"

DD 10-10 ECMd2 3/4							
	Dip-switches	Portata "alta"	Portata "media"	Portata "bassa"	Pa max	W ass max	I max
	1 à 5	m³/h	m³/h	m³/h	Pa	W	A
31	11111	3800	2510	1255	220	810	4,7
30	11110	3690	2435	1220	275	850	4,9
29	11101	3590	2370	1185	320	875	5,0
28	11100	3490	2305	1150	350	890	5,1
27	11011	3370	2225	1110	390	910	5,2
26	11010	3270	2160	1080	420	920	5,3
25	11001	3170	2090	1045	445	925	5,3
24	11000	3050	2015	1005	470	925	5,3
23	10111	2950	1945	975	485	925	5,3
22	10110	2850	1880	940	505	915	5,3
21	10101	2750	1815	910	520	905	5,2
20	10100	2645	1745	875	530	895	5,1
19	10011	2545	1680	840	540	880	5,0
18	10010	2445	1615	805	550	860	5,0
17	10001	2345	1550	775	560	845	4,9
16	10000	2240	1480	740	570	825	4,8
15	01111	2140	1415	705	580	810	4,7
14	01110	2040	1345	700	595	795	4,6
13	01101	1920	1265	700	600	775	4,5
12	01100	1820	1200	700	620	760	4,4
11	01011	1720	1135	700	635	740	4,3
10	01010	1620	1070	700	655	725	4,3
9	01001	1515	1000	700	665	710	4,2
8	01000	1415	935	700	690	690	4,1
7	00111	1300	860	700	710	675	4,0
6	00110	1200	790	700	730	660	3,9
5	00101	1095	725	700	755	650	3,9
4	00100	995	700	700	770	640	3,8
3	00011	895	700	700	795	635	3,8
2	00010	790	700	700	815	630	3,8
1	00001	700	700	700	835	625	3,7
0	00000	Softstop	Softstop	Softstop	-	-	-

Pa max / W ass max e Imax : dati per le portate "alte"

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DD 11-11 ECMd2 1/1							
	Dip-switches	**Portata "alta"**	**Portata "media"**	**Portata "bassa"**	**Pa max**	**W ass max**	**I max**
	1 à 5	m³/h	m³/h	m³/h	Pa	W	A
31	11111	4400	2905	1450	160	1030	5,8
30	11110	4260	2810	1405	235	1080	6,1
29	11101	4145	2735	1370	285	1120	6,3
28	11100	4015	2650	1325	320	1145	6,4
27	11011	3900	2575	1285	380	1165	6,5
26	11010	3770	2490	1245	410	1180	6,6
25	11001	3655	2410	1205	450	1190	6,6
24	11000	3525	2325	1165	470	1185	6,6
23	10111	3410	2250	1125	495	1180	6,6
22	10110	3280	2165	1080	505	1165	6,5
21	10101	3165	2090	1045	510	1155	6,5
20	10100	3035	2005	1000	545	1130	6,4
19	10011	2920	1925	965	545	1110	6,2
18	10010	2790	1840	920	555	1090	6,1
17	10001	2675	1765	885	565	1060	6,0
16	10000	2560	1690	845	570	1035	5,9
15	01111	2430	1605	800	575	1005	5,7
14	01110	2315	1530	765	585	970	5,5
13	01101	2185	1440	750	590	950	5,4
12	01100	2070	1365	750	595	930	5,3
11	01011	1940	1280	750	620	905	5,2
10	01010	1825	1205	750	635	885	5,1
9	01001	1695	1120	750	665	870	5,5
8	01000	1580	1045	750	685	855	4,9
7	00111	1450	955	750	715	840	4,8
6	00110	1335	880	750	735	825	4,8
5	00101	1205	795	750	760	815	4,7
4	00100	1090	750	750	790	800	4,6
3	00011	960	750	750	815	790	4,6
2	00010	845	750	750	840	780	4,5
1	00001	750	750	750	860	775	4,5
0	00000	Softstop	Softstop	Softstop	-	-	-

Pa max / W ass max e I max : dati per le portate "alte"

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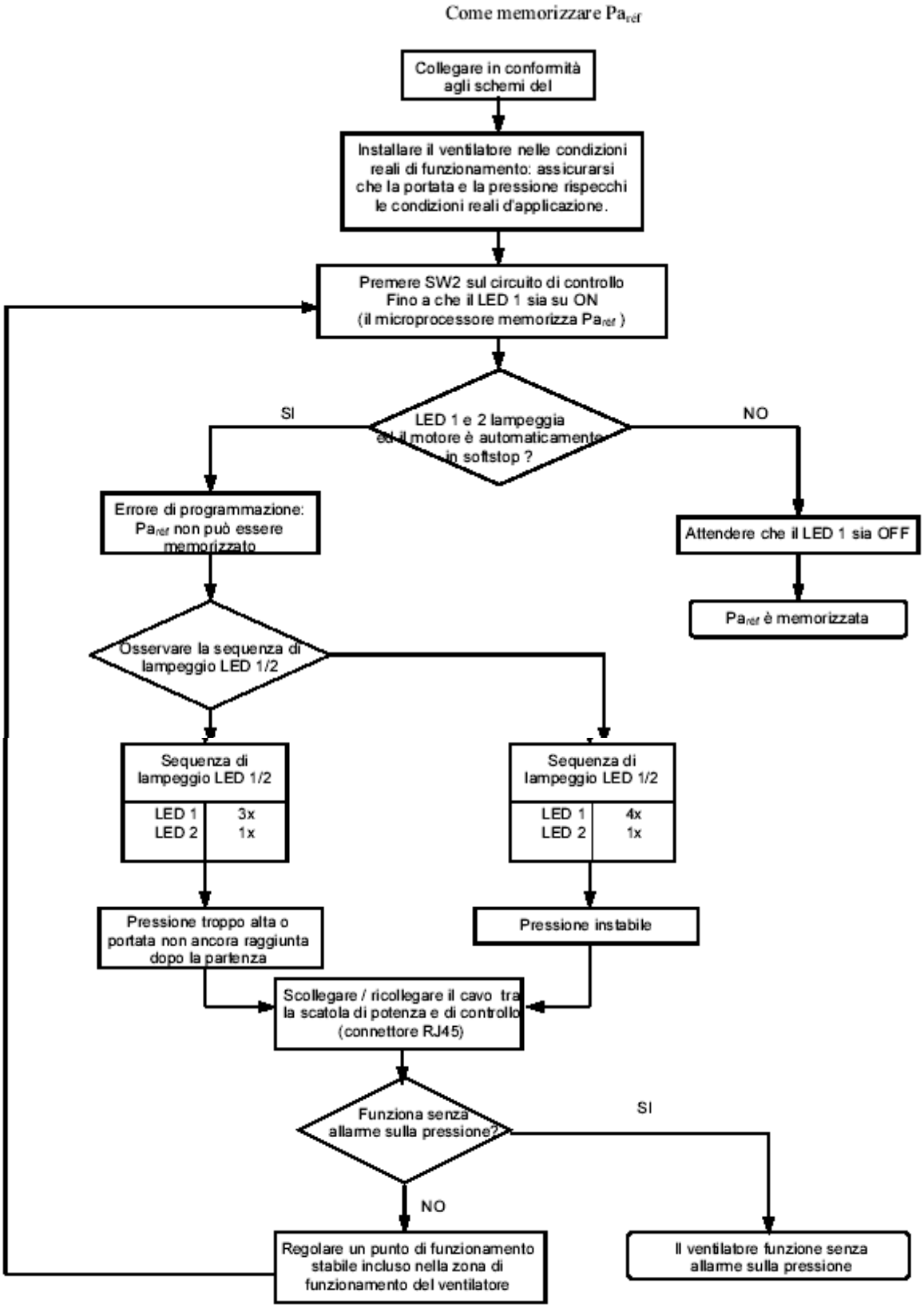
9. ATTACHMENT 2



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10. **ATTACHMENT 3**: Characteristics of input/output signals

Attention: all connections not compliant with the specifications may damage the circuit irreversibly. This might redefine the warranty conditions.

Cables and connections

1. Control cables

All the connections must be carried out in strict compliance with the wiring diagram indicated in this document. The connection cables must be shielded, of maximum section 0,5 mm². The mass braid of the cable must be connected to a G connector of the control box. In order to prevent all interferences, we recommend to separate the cable of all the external sources of disturbance. Use one of the cables of the following list (or equivalent):

LIYCY
LI2YCHM2
LIFYCYB
LIYCPY
LIYCPCY
LI2YCHM2B
LIYSTY
LI2YSTCY

2. Connecting cables between the power box and the control box

UTP cable / category 5 / 8 threads. Maximum length = 100 m
RJ45 connectors: no particular specification

External contacts K'1 and K'2:

Contacts free from potentials
Mx. impedence : 10 KΩ

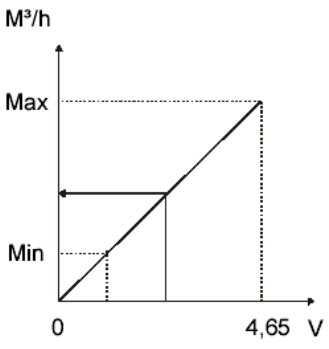
12V feed available on output:

Output voltage: 12 Vdc ±2% (between the connector G and 7)
Max. available I: 80 mA

Output signal: 'feedback' of the rate

Analogic signal between the connectors G and 8 of the control circuit corresponding to the airflow of the fan
Minimum impedence: 10 MΩ. Tolerance: ±5%

Ventilatore	CID ventilatore	Portata minima		Portata massima
		Portata	Tensione (V)	4,65 V
DD 9-7 TH ECM 1/2	720054	400	0,92	2000
DD 9-9 ECM 1/2	720055	600	0,95	2900
DD 10-10 ECM 3/4	720056	700	0,85	3800
DD 11-11 ECM 1/1	720057	750	0,78	4400
DP 6-6 ECM 1/2	720058	500	1,05	2200
DP 9-7 TH ECM 1/1	720059	600	0,77	3600
DP 9-9 ECM 1/1	720060	1100	0,89	5700
DS 10-4 ECM 1/2	720061	300	0,92	1500
DS 11-4 ECM 1/2 (*)	720062	400	0,97	1900
DS 12-5 ECM 3/4 (*)	720063	600	1,06	2600



Example: If you measure 2,38V within G and 8 on a DD 9-9 ECMd2, the airflow of the fan is (2900*(2,38/4,65)) m³h 1485.

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