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1. GENERAL INFORMATION

Carefully read the instructions contained in this manual.

Special attention should be paid to the sections following the wording **WARNING as, if not complied with, can cause injuries to people and/or damages to the fan.**

Note: store the manual for future reference. We reserve the right to improve and make changes to the manual, products and accessories without any obligation to update previous productions and manuals. This manual, which applies to all ranges of fans, is supplied complete with the TECHNICAL SHEET/ADDENDUM of the specific range.

SCOPE AND RELEVANCE OF THIS MANUAL

This manual, produced by the manufacturer, is an integral part of the fans; as such, the manual must always be kept with the fan until the fan is scrapped and it must be easily available for its quick consultation both by installers and users. Should the machine be sold, the manual must be given to the new owner as an integral part of the fan. Before starting any operation with or on the fan, it is compulsory for the staff involved to carefully read this manual. Should this manual go missing, get damaged or partly illegible, a new copy must be requested to the approved retailer, or directly to the manufacturer, and it must be checked that the date of the change is earlier than the date of purchase of the machine. This manual has been produced in order to ensure a safe installation and use of the fans and it contains safety warnings and information to avoid accidents at work; therefore, the instructions it contains must be fully and strictly applied. Furthermore, these instructions do not represent the only procedures to be followed to ensure safety; each operation carried out on moving and/or live parts such as installation and maintenance operations requires special care to be taken, and must be carried out only by qualified and suitably trained staff. The safety regulations enforced by current standards must be strictly adhered to by all the operators of the machine.

NOTE: qualified staff is regarded as staff who has a specific technical knowledge in aerodynamic and electric system components.

Any future changes made to the safety regulations must be acknowledged and implemented. This manual contains all the information related to all the fans, i.e. not only standard fans, but also specially designed fans. As it is impossible to know beforehand all different and potential designs or changes which differ from the standard product, the manufacturer shall be responsible for adding the required enclosures to this manual.

INTRODUCTION

The fans can be used to handle flow of clean or slightly dusty air (unless otherwise stated), adhering to the operating conditions shown in the technical catalogues and in the technical datasheet; they can also be used in more complex systems, machines or plants. All fans can also be manufactured in special versions, which must be previously agreed with the manufacturer. Using the fan separately from the systems it is built in should be avoided; should this requirement arise, please contact the manufacturer. The correct operation and life of the fans requires a number of planned checks and maintenance operations described later in the manual.

2. DESCRIPTION AND TECHNICAL FEATURES OF FANS

CENTRIFUGAL FANS

In the centrifugal (or radial) fans, the air enters the impeller horizontally and is radially discharged in a scroll-shape housing. Their performance is suitable for medium or low air flows and for medium or high pressures. The performance of each fan is shown in the technical catalogues. The range includes centrifugal fans with impeller with forward curved blades, impellers with backward curved blades and impellers with radial blades. The range of centrifugal fans includes standard versions, suitable to handle clean or slightly dusty air with a temperature between -20°C and +40°C, or special versions. Such features are described in the technical catalogues and in the enclosed technical datasheet, which must be consulted to identify the suitability of the fan to handle the fluid treated by the plant where the fan will be installed.

The fans with forward curved blade and radial blade impellers must always be operated when connected to pipes or equipment whose resistance reduce the flow rate in order to reach the current input values compatible with the values (ampère - A) printed on the electric motor nameplate. Should the fan operate above the nominal flow rate value (with bell mouth), the motor would overload, leading to possible faults. Therefore: if the circuit resistance has been worked out, the fan will generate the required flow rate and the motor will use the power shown in the nameplate. If the circuit resistance is higher than the calculated resistance, the fan will generate a lower flow rate than the required value and the motor will draw less power. If the circuit resistance is lower than the calculated resistance, the fan will generate a higher flow rate than the required value and the motor will draw more power.

The fan with backward curved blade type impeller can also operate with circuits which generate lower resistances than those

calculated without the risk of burning the motor as they inherently do not significantly increase the flow rate when the circuit resistance is reduced. These fans draw the maximum power when they approach the highest performance value. It is recommended to install on the circuit a regulating shutter, to be set up when starting the system. For further information, please read the technical catalogues.

AXIAL FANS

Axial fans feature an axial air flow in a "cross flow" configuration. Their performance is suitable for medium or high air flows and for medium or high pressures. The performance of each fan is shown in the technical catalogues. The range of axial fans includes standard versions, suitable to handle clean or slightly dusty air with a temperature between -20°C and +40°C, or special versions. Such features are described in the technical catalogues and in the enclosed technical datasheet, which must be consulted to identify the suitability of the fan to handle the fluid treated by the plant where the fan will be installed. Based on their construction, they can essentially be divided in two types:

Ducted axial fan: consisting of an impeller and a motor mounted in a cylindrical casing; the fan is driven directly from the motor (direct coupling) or by means of pulleys and belts (indirect coupling)

Wall-mounted axial fan: with directly coupled impeller and motor mounted on a panel or ring.

For further information, please consult the technical catalogues.

3. GENERAL SAFETY WARNINGS

ASSESSING SAFETY CONDITIONS

The fans can be installed in 4 different working conditions:

- A With free inlet and outlet (not ducted)
- B free inlet and ducted outlet
- C ducted inlet and free outlet
- D ducted inlet and outlet

SAFETY NETS

WARNING: The manufacturer cannot know the type of final installation and therefore supplies the guards (for inlet and/or outlet) on customer's request, who is responsible for assessing the system safe conditions. Should other types of guards be required, the final installer, or whoever acts on his behalf, must carry out a risk assessment specifically related to the type of installation required and therefore insert the suitable safety systems according to the type of application. In order to ensure full compliance with Machine Directive 2006/42/EC these systems must be well built, in order to avoid any risk of injury and must be fixed securely by requiring a special tool to remove them.

The provision of safety nets changes the aerodynamic efficiency of the fan: all losses of load, including those generated by the safety nets or by other accessories, must be assessed at the design stage according to the speed, the air density, the temperature and all other issues which contribute to change their impact in the system.

Both the final user and the installer must take into account other types of risks, more specifically those caused by foreign bodies entering the fan, or by mixtures different from those allowed. It is also necessary to take into account other risks during the routine and unscheduled maintenance operations, which must be carried out safely, by disconnecting or isolating the motor power supply, with suitable safety devices and with other precautions specified in more details in the following sections, which list the safety warnings and maintenance sections.

WARNING! Fitting safety nets does not fully avoid foreign bodies from entering the fan. If hazardous bodies or particles should get mixed up with the treated air, the user must carry out a full risk assessment able to identify their possible dimensions; if the diameter of the standard safety net is not enough to ensure the minimum safety requirements, the user must take all the precautionary measures required to avoid any residual risk.

WARNING: Periodically check the efficiency of the guards; should they become faulty or too worn which could negatively affect their operation, they must be replaced. After the installation, all the main technical features of the fan must be checked (that the guards have not been removed and/or damaged and/or changed) and, if necessary, a global risk assessment for the fan in relation to its application.

RISKS CAUSED BY IMPROPER USES

- Do not insert your hands or other parts of the body near moving parts
- Do not insert your hands or other parts of the body beyond the guards
- Do not remove, dispose of or change the guards
- Do not remove, dispose of or change any monitoring devices
- Do not use the fan in environments different from those specified
- Unauthorised operators are not allowed to carry out any kind of operation on the fan
- Reset the safety systems before restarting the fan after carrying out operations which required their removal.
- Make sure that all safety devices are in full working order
- Make sure all the safety and information plates fitted on the fan are in good conditions
- Securely tighten all drives or adjusting screws
- The staff who carries out any operation on the fan must use the required PPE
- Do not use loose clothing
- Do not touch fans used to handle high temperature fluids.

FAN INHERENT RISKS

- Dragging by moving parts
- Dragging by the fan inlet
- Violent ejection of an object entered in the fan through the outlet
- Risk of burns or scalding caused by very hot outer surfaces of the fan.
- Risk of breakages for: Too many vibrations

Overspeed
Overtemperature

RISKS DURING MAINTENANCE

- Carry out a routine maintenance plan to avoid structural subsidence and mechanical faults over time
- When cleaning the impeller, even with the power supply disconnected, the impeller could still move by inertia or by natural or forced air currents coming from the other equipment connected to the same system: there is therefore a serious risk of shearing and/or pinching. For this reason, the impeller must be mechanically locked.

It is strictly forbidden:

- to work on the fan whilst in operation
- to remove the guards when the fan is operating
- to work on the fan without disconnecting the power supply.

NOISE

The fan noise levels are stated in dB(A) and are shown in the technical datasheet (enclosed).

WARNING: The user may detect different values from those shown according to the fan operating environment. It is always recommended to isolate the fan from the ground and from the ducting with antivibration mountings and couplings and, when necessary, provide effective soundproofing systems in order to protect staff health.

The user and the employer must comply with current legislation in terms of assuring daily protection from excessive noise to all operators (as required by current European and national standards) and, if needs be, to require as mandatory the use of personal protective equipment (ear defenders, etc.) according to the overall sound pressure level identified in a single working area and to the daily levels operators are exposed to.

MECHANICAL RISKS

There are no mechanical risks. The fan is mechanically protected by accident-preventing fixed or removable guards fitted to all moving parts, in compliance with standards UNI 10615.

The material inlet and outlet openings are protected by the installer or by a grille which avoids people from coming into contact with moving parts or by another device. In any case, for all maintenance operations, and after making the machine safe, it is compulsory for the operator to use personal protective equipment. It is forbidden to stop the fan before the fluid inside it has reached a temperature lower than 60°C, to avoid excessive heat from damaging the motor or the monobloc. Should it be impossible to reach this temperature, external cooling systems must be provided. When the fan is not working, if its internal temperature increases, the user must use all means available to reduce the temperature to values lower than 60°C before starting up the fan.

Before starting up the fan, make sure all guards are correctly installed. The inspection door must be removed only with special tools and only when the fan has been stopped.

The maintenance operations must be carried out in totally safe conditions by disconnecting the fan from the motive power. The manufacturer shall not be responsible for damages to things or injuries to people caused by missing safety devices if, at the time of ordering, the Customer does not specifically require them.

4. TRANSPORT, ACCEPTANCE AND STORAGE

TRANSPORT

All fans are packaged in cardboard boxes or fixed on pallets to ease their transport. The manufacturer shall be responsible only up to the time of loading. Transport must be carried out in total safety; the haulier is therefore responsible for suitably securing the load. The fan should be moved by using suitable equipment, as prescribed by directive 89/391/EEC and later directives. Manual handling from the ground is specified by Directive 89/391/EEC and later directives; a weight of 20kg is generally accepted when lifted below the shoulder but above ground level.

WARNING: When handling objects over long distances and over uneven ground, the impeller must be locked in position to avoid vibrations from damaging the bearing races. When handling the fans in particularly adverse environments, such as when travelling on a ship or on uneven grounds, or when lifting the fans with a crane to reach elevated installation sites, all warranties supplied will become void for drive parts and, more specifically, for bearings and mountings, if they are not suitably protected. If in doubt, ask the manufacturer. The transport position specified by the manufacturer for the fan or its single components must be complied with.

WARNING: Stacking or applying loads onto the fans is strictly forbidden.

ACCEPTANCE

All fans are tested, balanced and inspected before shipping. The fan is identified from the data printed on the identification label affixed to the fan itself. The fans are supplied with a legally required warranty. The warranty starts from the delivery date and covers all faults caused by poor workmanship or construction faults. If, when the goods are received, damages are noticed, they must be immediately reported to the haulier and to the manufacturer: the manufacturer shall not be held responsible for damages caused during transport. Damaged fans should not be used or repaired, as this would make all warranties void. Check that the fan matches with the order (design, rotation, power and polarity of the motor installed, accessories, etc.); no non conforming returns will be accepted after installation has taken place.

WARNING: The range of fans is complete with all safety devices in compliance with current standards, available on request (see technical datasheet). The manufacturer shall not be responsible for damages to things and injuries to people caused by missing safety devices, nor shall it be responsible for any damages caused by misuse and/or failure to adhere to the instructions described in this manual.

STORAGE

Avoid the fan from being subject to knocks, which could damage it.

Resistance to chemicals: environments containing corrosive substances, however slight, must be avoided.

It is essential to avoid that the fan impeller is not operational for long periods of time, both when stored and whilst the system where the fan will be built in is set up. During these periods of time, periodically check the fan by manually turning it to avoid

bearing damage. The manufacturer shall not be responsible for damages to drive parts caused by prolonged fan inactivity. Do not store fans near machines which generate vibrations, to avoid the bearings from being subject to the same type of stresses. Special care must be taken when handling large impellers or shafts, if they are received disassembled for transport reasons, to avoid balancing problems.

In case of prolonged storage, ensure the fan is protected from dust, humidity and ultraviolet rays.

5. INSTALLATION AND START-UP

INSTALLATION

WARNING: The installation must be carried out only by qualified staff.

Start by removing the fan from its packaging or from the pallet, then dispose of the packaging and of all its parts in areas specifically designated for waste disposal (waste disposal sites etc...). Never leave parts of the packaging and plastic bags within reach of children or people who are unable to understand the associated dangers. Use personal protective equipment (gloves etc...) as prescribed by Directive 89/686/EEC and later directives.

User lifting equipment suitable for the fan weight and size.

Use tie rods of suitable length and of the right quantity and latch them in the slots provided on the fan frames. If necessary, use the motor lifting eyebolts in order to avoid load imbalance if the motor weight is significant. **It is strictly forbidden to lift the whole fan using only the motor latching points.**

Do not lift the fan from the shaft, the motor or the impeller. The machine is normally shipped assembled, fixed to a pallet and always protected from the elements. Only use the latching points provided for lifting the fan by evenly spreading the load. Avoid uncontrolled rotations.

The weight of each fan is shown in the enclosed technical datasheet.

Check that the impeller has not been knocked or deformed during transport, is securely fixed to its rotation shaft, is able to freely turn around its axis and that no foreign body is interfering with the impeller operation.

The user must provide a suitable support surface for the dimensions and weight of the fan and well levelled in order to avoid deformations which could damage the frame of the fan.

When installing the fan on steel structures, it is essential to ensure that these structures have a natural minimum frequency higher than 50% of the fan speed. In order to avoid that the vibrations are transferred through the foundation, it is advisable to fit antivibration mountings in suitable points. The fan must be fixed in the points provided by paying special attention not to deform the structure. The systems connected must be separately supported and must be located on the same axis as the fan entrances to avoid stresses on the fan with needless tensions which could deform the structure. It is recommended to connect the fan by means of couplings able to reduce vibrations generated by the fan.

Securely fix the fan by inserting screws with suitable diameter and correctly tightened, in all the fixing holes provided.

WARNING: when access to entrances (moving parts) is not ducted or protected with other means, a safety net must be fitted in compliance with standard EN ISO 12499 and later standards (accessory supplied on request).

WARNING: the fan outlet must NOT be located in areas occupied by people or animals, in order to avoid that objects or impurities, even if small, could be ejected at high speed and cause injuries.

In order to ensure the correct operation of the fan, it is recommended to make sure certain distances are maintained, such as 1.5 times the impeller diameter as the distance from a wall for free mouth inlets, 2.5 times the impeller diameter as distance from the first bend from the fan bell mouth; the same applies for outlet or inlet ducts; please note that it is advisable that the bends have a minimum internal bend radius equal to the pipe diameter. The installer and/or final user must provide the suitable motor ventilation equipment when a suitable heat exchange cannot be ensured such as in the event of prolonged inactivity, when the motor works at high temperatures, or when used by means of frequency regulators. If the motor is not adequately cooled, its features can be negatively affected and possibly lead to its breakage; therefore, in this event, the manufacturer's warranty will become void, as well as the warranty granted by the motor manufacturer.

WARNING: Do not remove the guards; removing any of the guard even when the machine has stopped can lead to dangerous conditions

WARNING: Adhere to the minimum installation distance; when performing maintenance operations, confined spaces cause hazards and problems.

IT IS FORBIDDEN TO COMMISSION THE MACHINE WITHOUT MAKING SURE IT IS IN PRISTINE CONDITIONS.

Before starting any installation, make sure the machine is safe and, if necessary, make it safe. The fan must be installed by ensuring the surrounding space is sufficient to allow normal fitting/removing, cleaning and maintenance operations to be carried out.

The following guidelines should be adhered to when carrying out the installation:

- The surface selected to support the fan static, dynamic load and inherent frequency must be level and sturdy. When the inherent fan frequency coincides with the natural frequency of the mounting, both frequencies act alongside each other, leading to a condition of resonance: the amplitude of oscillations will increasingly grow to infinity, and the structure will be subject to ever growing deformations. In this case, the fan mounting must be changed in order to change its natural frequency of resonance. Sometimes, a resonance is generated only in transients, i.e. when starting or stopping machinery. Resonance must be avoided whenever possible. For industrial, high speed fans, using reinforced concrete slabs is recommended.
- Vibration reduction components must be inserted between the fan and its interfaces (floor and pipes) (suitably sized antivibration mountings and antivibration couplings). The mountings should not be fully squeezed and should be able to support a basic frame instead of the single fan components. When selecting the mountings, it is recommended to contact the manufacturer. In nearly all cases, the fans are supplied preassembled and therefore, before installation, it is sufficient to check the tension of any belts, the condition of the bearings, the level of the fan and, generally speaking, all components. If the fan should be shipped disassembled for transport reasons, the manufacturer must enclose suitable instructions to correctly assemble it; the assembling operation must be carried out by a qualified person. The design and execution of the connection between the fan and the power mains must be carried out by an experienced electrician. Beyond 5.5kW, a star delta, inverter or other type of gradual start-up must be fitted. It is recommended to fit a choker valve to reduce the start-up power input. The fans can have very long start-up times and power input peaks equal to the electric motor nameplate amperage highest

multiplier; the whole electrical system must therefore be sized in relation to the duration and start-up power inputs.

ELECTRICAL CONNECTION

WARNING: The electrical connection must be carried out by qualified staff.

Check that the power voltage values printed on the motor nameplate match with the data on the power line it is connected to. To connect the motor, refer to the electrical diagram included in the connection box.

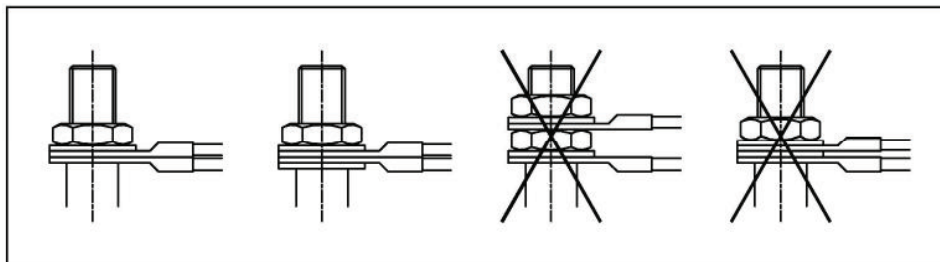
The user must electrically connect the fan to earth: a correct earthing of the motor and the controlled machine avoids tensions and eddy currents in the bearings. It is recommended that the motors controlled by means of an electric frequency inverter are fitted with PTC protection thermistors against motor overtemperatures. Using electrical frequency converters can increase vibrations and noise levels.

WARNING: in case a fan is installed away from the control panel and/or location, a service multipole switch must be provided near the fan itself (accessory supplied on request). In fact, routine maintenance operations may require the fan guards to be removed. Given the high risk associated to this condition, in compliance with Standard EN ISO 12499 relating to fan mechanical safety, another switch must be fitted near the fan to allow maintenance engineers to directly control the power supply connected to the fan.

Select the safety system and the power cables (voltage reduction during the start-up stage must be less than 3%) according to the technical features printed on the motor nameplate. In the event of fire, the range of fumes and heat extractor fans must be fitted with an automatically and separately activated safety electrical system. Make the connection according to the diagram shown on the nameplate or contained in the terminal box. Tighten the nuts fitted on the terminals, cable ends and power cables to the torque value (Nm) shown below.

Terminal	M 4	M 5	M 6	M 8	M 10	M 12	M 14	M 16
Steel	2	3,2	5	10	20	35	50	65
Brass	1	2	3	6	12	20	35	50

Do not insert washers or nuts between motor cable ends and input cables ends (figure below).



WARNING: it is compulsory for the installer to connect the fan to the electrical power supply and to install it in the environment where it will be used in compliance with current standards (IEC 60364). Thermal cutouts: check the type of cutout installed before carrying out the connection; for thermistors, a special release relay is required.

WARNING: To use thermal cutouts, take the required measures in order to avoid hazards associated with a sudden re-start. Any anti condensation resistors (heaters) must be supplied by separate power lines. They cannot be powered with the motor in operation. Do not connect the motor in case of doubts on how to interpret the connection diagram or, if the connection diagram is missing, contact the manufacturer. All motors used are full voltage direct start type or delta-triangle start type for powers higher than 5.5kW. In any case, the connection diagram provided with the motor is the diagram to be followed, which is inside the motor connection box.

START-UP

OPERATIONS TO CARRY OUT BEFORE START-UP:

Check the tightness of all nuts and bolts (with special attention to the locking screws of the impeller on the shaft, of the motor and the mountings) and the alignment.

Check that the fan blade turns freely by turning it manually.

Check that any shutters or flow rate regulators are in the open position for axial fans, closed for centrifugal fans. During the start-up stage, this operation avoids dangerous motor overloads.

Check the lubrication of moving parts.

For indirectly driven fans, check the belt tension, as shown in the technical datasheet.

Check the insulation resistance between the windings and earth, which must be, with winding at 25°C, higher than 10MΩ. Lower values normally indicate that there is condensation in the windings. Should this happen, ask a specialised company to dry it.

WARNING: Do not touch the terminals during and immediately after the measurement as the terminals are live.

Note the impeller direction of rotation shown by the arrow (if provided) located on the impeller blades or on the fan itself.

The installer must interface the machine with the required start-up/stop controls, emergency stop, reset after an emergency stop by complying with current standards (EN 60204-1, EN 1037, EN 1088, EN 953).

WARNING: The fan frame must be earthed; furthermore, it must be verified that all its components have the same potential.

The installer must connect the fan to the earthing circuit and check the potential is effectively the same on all its components before starting the machine.

OPERATIONS TO BE CARRIED OUT AFTER START-UP:

Check that the direction of rotation matches with the direction shown by the arrow.

Check that the input current does not exceed the current shown on the product identification label and/or motor nameplate. To have a reliable information, allow a reasonable period of stabilising time. In the delta/triangle connection, the reading must be car-

ried out upstream of the change-over switch; if this is not possible, detect the live current on any of the six wires at the terminal box and multiply this value by 1,73. Avoid consecutive start-ups of the motor as this would cause continuous overloads, and overheat the electrical parts. Before start-up, allow enough time to cool down.

Check the bearing temperatures after the first hours of operation, as these are the most critical. If necessary, stop the fan and restart it only after reaching the ambient temperature. Then check that the temperature is lower than the previously measured temperature.

By means of a vibrometer, check that the vibrations are not excessive by referring to the following paragraph.

After a few hours of operation, check that the vibrations have not slackened the tightness of the nuts.

IMPELLER BALANCING AND VIBROMETRIC CHECK

All the impellers installed on the fans are balanced in compliance with standard ISO 14694 "Industrial fans - Specifications for balance quality and vibration levels", and with standard ISO 1940-1.

The fan vibration level is then tested, still in compliance with standard ISO 14694.

The in situ vibration level check must be carried out in compliance with standard ISO 14694, according to the fan category and within the limits shown below.

Table 1 – Fan application categories

Applications	Examples	Motor power limits	Application category
Residential use	Ceiling-mounted, wall-mounted and AC window-fitted fans	≤0,15 ≥0,15	BV-1 BV-2
HVAC and agricultural use	Ventilation and air conditioning of residential and commercial buildings	≤3,7 ≥3,7	BV-2 BV-3
Industrial and energy production processes, etc.	Air filtering rooms, mines, convections, combusted air, pollutant control, wind tunnels	≤300 ≥300	BV-3 See ISO 10816-3
Maritime and transport fields	Locomotives, road transport vehicles, cars	≤15 ≥15	BV-3 BV-4
Transit/tunnel	Underground emergency ventilation, tunnel and garage fans, tunnel jet fans.	≤75 ≥75 None	BV-3 BV-4 BV-4
Petrochemical process	Noxious gases, process fans.	≤37 ≥37	BV-3 BV-4
IT chip production	Sterile environments	None	BV-5

Table 2 – vibration limits for tests carried out *in situ*

Condition	Application category	Hard mounting mm/s		Flexible mounting mm/s	
		peak	r.m.s.	peak	r.m.s.
Start-up	BV-1	14,0	10	15,2	11,2
	BV-2	7,6	5,6	12,7	9,0
	BV-3	6,4	4,5	8,8	6,3
	BV-4	4,1	2,8	6,4	4,5
	BV-5	2,5	1,8	4,1	2,8
Alarm	BV-1	15,2	10,6	19,1	14,0
	BV-2	12,7	9,0	19,1	14,0
	BV-3	10,2	7,1	16,5	11,8
	BV-4	6,4	4,5	10,2	7,1
	BV-5	5,7	4,0	7,6	5,6
Stop	BV-1	Note 1	Note 1	Note 1	Note 1
	BV-2	Note 1	Note 1	Note 1	Note 1
	BV-3	12,7	9,0	17,8	12,5
	BV-4	10,2	7,1	15,2	11,2
		7,6	5,6	10,2	7,1

Note 1 The switching off levels for fans belonging to BV-1 and BV-2 grade application must be established according to their history

It is recommended to use the "r.m.s." values – Values in mm/s unfiltered

6. MAINTENANCE AND CLEANING

Maintenance operations of fans are relatively simple, but they still require routine operations aimed to maintain their efficiency of all their components and to avoid damages which would negatively affect their good working order and people's safety. The interval of maintenance operations depends on the fan effective operating conditions. In ideal and continuous operating conditions, it is advisable to subject the fan to a maintenance operation after the first 100 hours of operation, then every 3000 hours for directly coupled fans.

If the technical datasheet contains a table summarising the planned maintenance operations which states the frequency they should be carried out at, strictly follow these instructions. Before starting any maintenance operations, stop and drain the fan and put the machine in a safe condition (see chapter 7). When removing any dust from inside the machine, make sure not to disperse it in the surrounding environment.

Impeller: it is recommended to constantly check that the impeller is clean. If layers of material, dust, greasy substances etc. should build up on the impeller, they would cause it to get unbalanced and would lead to damages to drive parts and/or to the electric motor. During the cleaning operations, all parts of the impeller must be cleaned; any residues in confined areas could lead to more unbalance of a more even layer of dirt, therefore the cleaning operation must be thorough. More specifically, for impellers with curved blades, conveying statically charged materials or containing adhesives or resins can cause a build-up on the back of the blades. Therefore a thorough cleaning is recommended to make sure any residual dirt is evenly spread, thus avoiding any unbalance. If the cleaning operation is required too often, it is advisable to replace the impeller with an impeller with a specially profiled blade. For more information, contact the manufacturer. When abrasive powders or highly corrosive air are taken in by the fan, the vibrations may be caused by the wear and tear of the impeller. In this case, replace it with a genuine part. The manufacturer shall not be responsible for damages occurring to drive parts and/or to the motor caused by dirt on the impeller.

Scroll: clean the internal parts by removing any foreign body; check the condition of the welding and their resistance to oxidation.

Motor: the motor must always be kept in clean conditions so that it does not have any traces of dust, dirt or other impurities. Periodically check that it works without vibration or abnormal noises, that the ventilation circuit inlet (if present) is not obstructed, leading to potential overheating of the windings.

Bearings: the majority of motors we use are fitted with life lubricated watertight bearings, which do not require lubrication. Their life varies according to the actual operating conditions (number of start-ups etc.) and the operating ambient conditions (temperature, presence of dust etc.). Our fans are sized in order to give at least 20,000 hours of operation (according to the model) for continuous operation, in ideal environment and conditions. However, we recommend the bearings to be replaced every 4 years with bearings with the same features as the original bearing. For models requiring a periodic lubrication, read the technical manual, which contains the lubricating instructions and intervals. If in doubt, contact the manufacturer. **Nuts and bolts:** check that they are not oxidised; oxidation will jeopardise their functionality; replace them with identical nuts and bolts and systematically tighten them.

Check the condition of the seals after removing all bolted parts (inspection door, disk etc). When the seals no longer ensure the correct tightness, they must be replaced.

During the cleaning stages, the user must select suitable products to the type of system and to the safety datasheet of the conveyed product.

Before starting the fan, make sure no metal foreign bodies are left inside the fan body.

Repeat the required operations before and after start-up (chapter 5).

CHECKING MINIMUM SAFETY DISTANCES

At each maintenance operation, it must be checked that all the spaces between the impeller and the mouthpiece, between the back of the impeller and the adjacent wall, between the shaft passage and the seal have not decreased or changed in any way.

- The screws could have come loose and a fan realignment may be required
- The fan may have got deformed and some components or the whole fan may need replacing.

WARNING: If the technical datasheet contains a table with the minimum values between spaces, these values must be carefully checked.

ROUTINE MAINTENANCE

In a typical fan, the planned maintenance operations are the bearing lubrication operations (if they are not watertight) and the belt tensioning operations. Before starting the maintenance operations, make sure the machine is safe to operate.

Carry out maintenance operations only with the machine switched off. As for maintenance operations, the user must ensure that the tools and equipment used are of a suitable class for the environment. If the machine maintenance requires some hot processes, thoroughly clean it before starting the work.

UNSCHEDULED MAINTENANCE

Fan special applications sometimes require specific unscheduled maintenance operations, such as replacing the impeller or the motor.

Unscheduled maintenance operations must be carried out only by qualified staff, who must follow specific instructions provided by the manufacturer, according to the type of fan and operation.

After carrying out any type of unscheduled maintenance operation, the start-up procedures described in chapter 5 must be repeated.

7. STOP AND DRAINAGE

WARNING:

- When high temperature fluids are conveyed, the fan must be refrigerated or its content must be mixed with cold air before starting any operation: the operator could get burnt when touching parts of the fan or when coming into contact with any fluid left inside
- If chemicals are conveyed, which could collect at the bottom, draining plugs must be placed under the fan and the fan must

be drained before opening it.

MAKING THE MACHINE SAFE

From now on, "making the machine safe" entails the following operations:

- Make sure the machine is disconnected from all power supplies
- Make sure all moving parts have come to a full stop
- Wait until the internal and external temperature of the machine has reached a value which is not too hot to the touch
- Provide suitable lighting for the area around the machine (by giving the operators electrical lights, if necessary)
- Mechanically lock up all moving parts.

For any operation to be carried out on the machine (maintenance and cleaning), the operators must wear the required personal protective equipment (PPE).

8. DISPOSAL

When the fan reaches the end of its life, the final user or whoever acts on his behalf must correctly dispose of it. This operation requires some important operations to be carried out:

- separate the electrical components from the mechanical components
- drain the lubricants
- separate different materials such as plastics, steel, copper etc.

All materials must be separately disposed of

Dispose of the materials in special recycling areas; do not litter the environment.

9. OPERATING PROBLEMS

Bear in mind that, if an aeraulic system is not working, there may be more than one cause. All causes must be identified and systematically removed.

Some possible faults, causes and solutions for aeraulic systems:

9.1	Difficult start-up	<p>Reduced power voltage.</p> <p>Motor start-up torque too low.</p> <p>Unsuitable fuses for the start-up conditions.</p> <p>Unsuitable assessment of the fan inertia and of the coupling components.</p> <p>Too much power drawn.</p>	<p>Check the motor nameplate data</p> <p>Close the shutters until full speed is reached (does not apply to axial fans). If this is case, replace the motor with a more powerful motor.</p> <p>Replace.</p> <p>Work out again the inertial momentum and, if needs be, fit a new motor on the fan.</p> <p>See 9.2</p>
9.2	Power input higher than the value shown on the identification label and/or the motor nameplate.	<p>Rotation speed too high.</p> <p>Air density higher than the project data.</p> <p>The fan works with excessive pressure.</p> <p>The motor turns at a lower speed than its normal rotating speed.</p>	<p>Replace the motor and/or the pulleys and/or redesign the system.</p> <p>As above.</p> <p>Redesign the system or replace the type of fan.</p> <p>Check the power voltage and, if needs be, rectify it. Check that the winding is not defective and, if so, repair or replace.</p>
9.3	Air flow rate too low. At the nominal rotation speed, the input power is reduced, especially for the centrifugal fans with forward curved blades or with radial blades. The power input is less affected for centrifugal backward blade fans.	<p>Obstructed pipes and/or blocked up inlet points.</p> <p>Rotation speed too low.</p> <p>Working pressure higher than the design specified pressure.</p> <p>Blocked up impeller.</p>	<p>Clean pipes and hoods, check shutter position.</p> <p>Check power voltage and check motor connections, check drive ratios; if needs be, rectify it. Check that the belts do not slip; if they do, restore their correct tension.</p> <p>Design error; replace the motor and/or the pulleys, replace and/or adapt the circuit.</p> <p>Clean the impeller.</p>

		<p>Reversed direction of rotation.</p> <p>Overloaded filter.</p> <p>Inlet turbulence in the same direction of rotation as the impeller.</p> <p>Change of sections, tight and close bends, sudden widening or bends which do not allow the dynamic inlet pressure to be normally recovered.</p>	<p>Check the electrical connection. Check the winding connection on the motor terminal box.</p> <p>Clean or replace the filter.</p> <p>Install flow straighteners.</p> <p>Design error; change or replace the circuit.</p>
9.4	Air flow rate too high. At the nominal rotation speed, this causes the fans with forward curved blades and with radial blades to draw too much current.	<p>Rotation speed too high.</p> <p>Estimated circuit load losses too high.</p> <p>Wrong direction of rotation of the impeller</p> <p>Air leaks or open access doors, poorly manufactured or badly installed pipes or components, bypass shutters not fully closed</p>	<p>Check the power voltage and, if needs be, rectify it. Check the drive ratio, if needs be, rectify it.</p> <p>Partly close the shutters and/or reduce speed until the required performance is achieved.</p> <p>Check the direction of rotation. A reversed, curved or flat blade impeller which turns in the reverse direction of rotation operates like an impeller with forward curved blades and this would cause an excessive flow rate, and draw too much power. If this is case, restore the correct direction of rotation.</p> <p>Check the system by replacing the non conforming components.</p>
9.5	Pressure too low	<p>Rotation speed too low.</p> <p>Reversed direction of rotation.</p> <p>Flow rate higher than the design value due to incorrect circuit size and/or air temperature different from the temperature considered in the circuit design.</p> <p>Damaged impeller.</p>	<p>See 9.3</p> <p>See 9.3</p> <p>Change the drive ratios and/or replace the fan, replace or adapt the circuit.</p> <p>Check the impeller and, if needs be, replace it with a genuine part.</p>
9.6	Air pulses.	<p>The fan operates at almost zero flow rate conditions</p> <p>Unstable flow, obstructions or bad inlet connection which creates unstable air inlet conditions (vortexes).</p> <p>Alternate flow disconnection and reconnection at a diverging channel walls.</p>	<p>Change the circuit and/or replace the fan.</p> <p>Redesign the inlet by placing deflectors, clean and/or restore the inlet.</p> <p>Redesign the circuit and/or replace the fan.</p>
9.7	Reduced performance after a period of satisfactory operation.	<p>Loss in the fan upstream and/or downstream circuit.</p> <p>Damaged impeller.</p>	<p>Check the circuit and restore its original conditions.</p> <p>Check the impeller and, if needs be, replace it with a genuine part.</p>
9.8	Too much noise. Normally, all fans generate noise, but this should	<p>Too many revolutions are required to achieve the required performance.</p>	<p>Use of soundproofed casings and/or sound dampers. Replace the fan with a larger fan able to give the same performance or with a lower</p>

	<p>become a worrying issue when the level is unacceptable. This noise can be identified as a noise caused by air, mechanical parts, electrical buzzing noise or a combination of these factors. Whilst the noise caused by air can increase because of obstructions near the fan inlet or outlet, an excessive noise is more commonly caused by the wrong choice or installation of the fan.</p>	<p>The impeller scrapes on the enclosure.</p> <p>Bearings worn.</p> <p>Eccentricity between rotor and stator.</p> <p>Winding vibrations</p> <p>Positioning in a resonant area</p>	<p>peripheral speed.</p> <p>Check the fitting position of the impeller and the pipes; if needs be, correctly restore their position.</p> <p>Check the condition of the bearings; if needs be, lubricate them or replace them with an identical bearing.</p> <p>Check that the axis is identical; if needs be, restore or replace the electrical motor with a suitable type.</p> <p>Can be reduced with higher quality motors</p> <p>Move the fan or use soundproofed casings</p>
9.9	Too many vibrations	<p>Unbalanced rotating parts.</p> <p>Unsuitable mounting structure: with a natural frequency close to the fan rotation speed natural frequency.</p> <p>Slackened screw connections</p> <p>Defective bearings</p>	<p>Check impeller balance; if necessary, reset it to the values shown in diagram 1. Check the drive alignment or the pulley balance. Check that the shafts are straight.</p> <p>Strengthen and/or change the natural frequency of the mounting structure by using weights.</p> <p>Tighten the nuts and bolts</p> <p>Check the wear of the bearings (specially the watertight bearings) and their lubrication.</p>