

INSTALLATION, USE AND MAINTENANCE HANDBOOK



AXIAL FAN ASSEMBLY

CFF – GFF – LFF – TFF SERIES

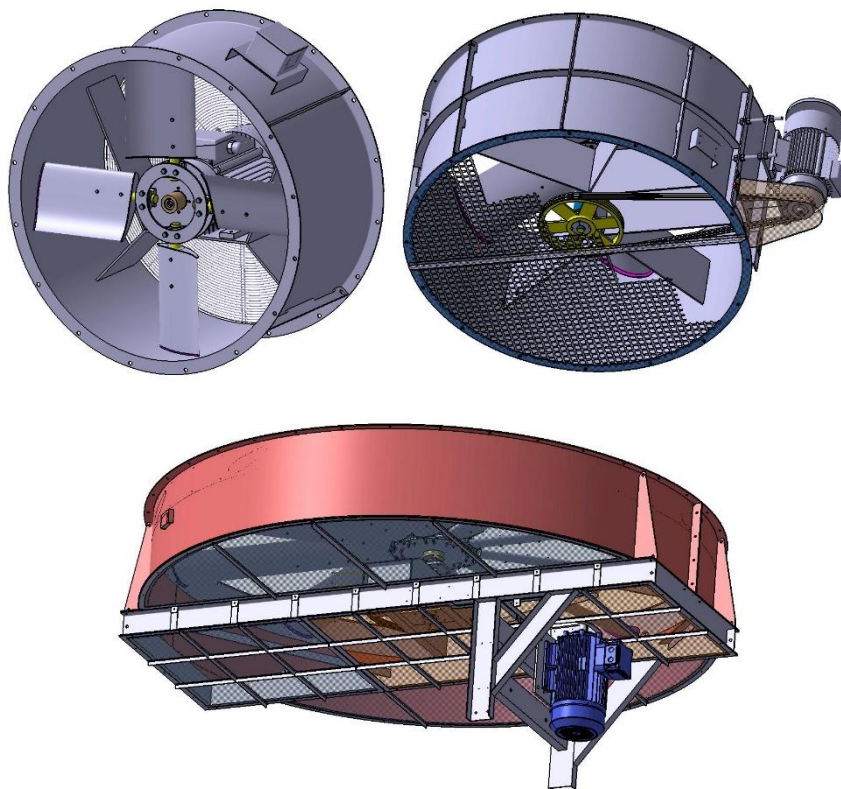


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1. INTRODUCTION

1.1. OVERVIEW

This handbook provides the necessary information to install and use the fan assembly of Ilmed Ventilazione Industriale S.r.l. (hereafter “IVI”) in its different configurations.

Information contained in this handbook is property of IVI; copying and disclosing, even partly, this information, is forbidden without authorization.

Machinery is designed in compliance with the Machinery Directive 2006/42/EC of the European Parliament and of the Council to assure a safe intended use when directions contained in this handbook are followed. If required, equipment can be manufactured in compliance with the ATEX directive 2014/34/EU, for use in environments exposed to explosion risks.

Series “CFF”, LFF”, “TFF” and “GFF” IVI fans are direct or belt-transmission (trapezoidal or toothed belt) fans, operated by an electric engine. These fans are suitable for industrial or naval applications where remarkable airflows are required, with a low or medium operating pressure. Typical configurations are described in the following paragraphs. These configurations may vary according to casing and engine production typologies, to the model of the impeller and to the presence of any accessories. Technical and performance-related characteristics of each model are reported on catalogues and drawings, provided by our technicians and commercial agents.

This handbook provides indications and directions to install and operate the equipment in safety conditions for the operator.

In compliance with the Machinery Directive, the handbook includes all general information for a safe assembly and installation of the impeller in a ventilation system; it also contains all routine service and maintenance actions that can be directly performed by the operator.

All topics are divided in sections; sections are divided in paragraphs and subparagraphs, all numbered in progression. Sections contain summary tables and pictures to ease the understanding of given information.

1.2. REFERENCE

Monographic manuals for auxiliary components are available; they contain information that may not be recalled in this handbook. You are encouraged to read all the manuals provided before each operation for mounting or repairing the components of the provided System. If you do not have all the necessary manuals, please contact the IVI for more information.

Besides this handbook, the following publications relevant to the equipment and its parts are available:

- Impeller handbook
- Diagrams applicable to any single installations (e.g. Data Sheet).
- External auxiliary systems handbooks. All publications concerning auxiliary units, which are not included in the equipment but are essential for the correct operation of the equipment itself (e.g. electric engine handbook).

1.3. HANDBOOK USE WARNINGS

1.3.1. PURPOSE AND LIMITS OF THIS USE AND MAINTENANCE HANDBOOK

This handbook is meant for all operators using and monitoring the equipment during operation time. The purpose of this handbook is to provide the following information:

- 1. All technical specification of the fan assembly.
- 2. Working place arrangement related to the environmental features and supply sources.
- 3. Accident-prevention regulations and information relevant to safety devices installed on equipment.
- 4. Expected use of equipment.

This handbook cannot replace the specific training operators shall have achieved previously on similar equipment or they can achieve on this equipment under the guidance of trained staff.

This handbook is intended for the owners and operators of IVI's products. Operating conditions vary considerably and cannot be individually analysed. Through experience, however, operators should not have any difficulty in developing their capabilities to ensure proper operation, safety and monitoring. However, the handbook cannot replace the specific preparation that operators must have previously achieved on similar equipment or the one they will be able to achieve on this machine under the guidance of trained personnel.

1.3.2. HANDBOOK CONSERVATION

The installation, use and maintenance handbook is an integral part of the IVI's products; keep it for future reference until the final dismantling of the equipment.

Keep the handbook always at hand for reference. Keep it with the utmost care in a safe place, and protect it from dust and moisture. In case of damage impairing even partial consultation, users must request a new copy to manufacturer.

1.3.3. HANDBOOK UPDATE

Photographs and illustrations are updated at the time of printing, but subsequent production modifications may cause a slight variation in IVI's fans. IVI reserves the right to redesign and modify the equipment as deemed necessary without prior notice. If a change has been made and the product you are experiencing is not found in this instruction manual or in the list of illustrated parts, please contact the IVI for the information and parts in progress.

This manual was prepared at the same time as the machine to which it refers. It may be considered unsuitable due to subsequent updates (even for similar equipment) based on new experiences. IVI reserves the right to modify, together with its production, the related manuals without the obligation to update what has been delivered previously. Any integrations sent to users should be kept along with the manual.

1.3.4. COOPERATION WITH USER

IVI is available to its customers to provide more information on the use and maintenance of our own machines as well as to take into consideration handbook suggestions in order to improve its fitness for purpose.

1.3.5. GENERAL SAFETY DEFINITIONS

OPERATOR

The operator is the individual authorized by plant safety manager to perform actions in his competence relevant to equipment management; he shall identify any danger for him and for exposed people and avoid connected risks. Authorization for equipment management is normally given due to operator proven skills, coming from its experience and training.

TECHNICIAN

Refer to skilled personnel.

SERVICEMAN

Refer to skilled personnel.

SKILLED PERSONNEL

Whoever has the technical skills in one or more specific fields, e.g. aeruolic and electrical. They can perform maintenance other than routine service operations. Skilled personnel may be a manufacturer employee, a manufacturer’s agent employee, a user employee or an external company employee.

EXPOSED PERSON

Whoever, for whatever reason, is fully or partly inside a dangerous area.

DANGEROUS AREA

The area inside and/or around the equipment where an exposed person puts at risk its own safety and health.

DANGER

Danger means a situation or a reason that is associated with one or more elements that may cause death or severe injuries to operator or exposed people.

RISK

The term risk defines, in this manual, a possible danger and, therefore, the chance for the operator or people exposed to be harmed.

1.3.6. EQUIPMENT TECHNICAL DEFINITIONS

AUXILIARY DEVICES

Defines any device not manufactured by IVI that is suitable for its own shape, specifications and size, to perform a side function in equipment operation.

FIRST START UP

Post-installation start up, including running tests.

SERVICE ACTIONS

Simple restoration or refuelling operations to be performed occasionally or at regular intervals that do not require, for their execution, the intervention of specialized personnel. Operator may perform service actions.



SERIES


The term series identifies a similar machine line that can perform its function, with specific features and modes.

TYPICAL INFORMATION

The term "Typical" identifies the features or operations that are valid for base equipment in standard configuration. Features may differ according to the single equipment configuration.

1.3.7. SYMBOLS USED IN THIS HANDBOOK

 <p>CAUTION</p>	<p>This term and its symbol identify a situation where non-compliance with the stated regulation could be the cause of danger to the operator or persons exposed, with the risk of injury or death.</p>
 <p>WARNING</p>	<p>This term and its symbol identify a situation for which non-compliance with the stated regulation may result in damage to the machine or its components.</p>

NOTE	This term recalls the attention of reader on some points of the described procedure.
	This symbol identifies a prohibition or an important indication concerning the safety of operator or people exposed, linked to the ATEX Directive. Special instructions for the safe use of fans are provided in accordance with ATEX Directive 2014/34/EU

1.4. EQUIPMENT INTENDED USE

The equipment this handbook refers to has been designed to be placed inside evaporation towers, heat exchangers, evaporation condensers and any industrial, civil and naval ventilation systems. The machine cannot be used for any purpose other than that for which it was designed.



Installation into classified areas according to ATEX/2014/34/EU

- Devices to be used in hazardous areas are designed to meet official regulation requirements relevant to environments exposed to explosion risks. The design of the machines, suitable for the installation in classified areas is described in detailed in the ATEX technical file, stored by BUREAU VERITAS Certification Body. If such fans are installed or used improperly, or even slightly changed, their safety and reliability may be compromised, creating a potential serious danger for the operator or exposed people.
- Any device, equipment or additional parts used on fans or related to them, shall be compliant to the ATEX directive 2014/34/EU and compatible with data reported on the ID tag of the fan itself.
- If the fan is not marked with ATEX logo, it is not allowed to use them in an environment with an explosive atmosphere.

1.4.1. AXIAL FAN

IVI impellers are suitable for the work environments mentioned above.

The permissible diameter is any between 500mm and 15meters, using a wide range of profiles to provide the most cost-effective solution for each application.

The length of the blade is adjustable: it can be reduced in case of any interferences. The blades are internally reinforced by a steel shank, bolted and glued to the profile, specifically designed for excellent strain and stress distribution. Hubs are available in different dimensions to guarantee the highest resistance and reliability of fans.

Carbon steel components are galvanized or coated with epoxy resins for maximum corrosion protection. Alternative materials such as stainless steel or steel suitable for extremely low temperatures are available on request.

The fans, up to the diameter of 2300 mm, are supplied assembled and dynamically balanced. The blades of larger fans, which are supplied dismantled, are statically balanced against a reference blade to ensure complete interchangeability.

The axial fans line includes impellers with adjustable pitch angle (AP), variable pitch rotating during operation (AV) and with elastomeric support (EL) for applications with specific resonance problems. For more information, refer to the dedicated use and maintenance handbook.

1.4.2. SERVICE

This handbook provides all necessary information to use and manage the equipment. All required service interventions are therefore ruled by the conditions of use and warranty of the system itself. Address any further information, clarifications or technical assistance to the IVI Customer Service.

NOTE

When requesting assistance or ordering spare parts, always mention the equipment Identification Data (see the following paragraph).

1.4.3. CUSTOMER SERVICE

ILMED VENTILAZIONE INDUSTRIALE S.r.l.

Viale dei Mareschi, 15

10051, Avigliana (TO) - Italia

Phone +39 – 011. 93.25.555

E-mail: ivi.info@ilmed.it, ivi.sales@ilmed.it

1.4.4. EQUIPMENT IDENTIFICATION DATA

The main equipment identification data are printed on the dedicated plate on the machine itself (refer to Figure 1-1).

The tag contains the main useful details for the operator:

- IVI job reference e year of production
- Customer's reference, Purchase Order number and reference item
- Fan model, serial number and operating data
- Electrical motor type, serial number and operating data
- Electrical motor classification if applicable (i.e. ATEX)




 		
V.le dei Mareschi, 15 - 10051 Avigliana (TO) Italy Ph.+39011-93.25.555 - fax +39011-93.67.289		
JOB N°:	YEAR	
CUSTOMER'S REF. :		
P.O. N°:	ITEM:	
FAN MODEL. :		
S.N. FANS :		
Airflow [m3/h]:	P.st.:	
Motor type :	RPM:	
PWR(Kw) :	(A):	VOLT:
Hz	S.N. E.M.:	
		

Figure 1-1: Fan ID nameplate.

The fan identification code is encoded in Table 1-1, Table 1-2 shows some examples:

AAA – XX / Impeller Code	
AAA - XX	States the duct type
Impeller Code	Refer to the impeller handbook for further information.
CFF-04	Short casing with both ends flanged, direct coupling – B3 engine form
CFF-05	Short casing with both ends flanged, direct coupling – B5 engine form
GFF-01	Fan with geared electric motor and external engine transmission
GFF-04	Fan with geared electric motor and internal engine transmission
GFF-08	Short casing fan with both ends flanged, direct coupling with geared electric motor
LFF-04	Long casing with both ends flanged, direct coupling – B3 engine form
LFF-05	Long casing with both ends flanged, direct coupling – B5 engine form
TFF-01	Casing with both ends flanged, belt transmission – B3 form internal engine on base
TFF-09	Casing with bridge support, belt transmission – B3 form external engine on base
TFF-12	Casing with both ends flanged, belt transmission – B3 form external engine on base

Table 1-1: IVI fans identification code.

EXAMPLES

CFF-04 / ALU/20n/05n/BA1/01000/AP	Short casing of 1000mm diameter, with electric motor direct coupling and impeller AP with 5 blades mounting aluminium chord 20.
GFF-08 / FRP/59n/07n/F2-D/03000/AV	3000mm diameter fan, with geared electric motor direct coupling and impeller AV with 7 blades mounting FRP chord 59.

Table 1-2: Examples of IVI fans.

1.4.5. SPARE PARTS

Only original IVI spare parts should be used. Address your request to the IVI Customer Service, always stating to the following information:

- Equipment ID data (refer to Figure 1-1)
- Code, name and technical description of the part to be replaced
- Destination of the requested parts.

1.4.6. EC MARK AND CONFORMITY DECLARATION

The IVI fan bears the CE mark, stating its compliance to the Directive 2006/42/EC of the European Parliament and of the Council.

The equipment is delivered with a signed “EC Compliance Statement” referring to the Directive. This document must be carefully kept by the equipment owner and shown upon request by the appropriate authorities. The “EC Compliance Statement” is an essential part of the equipment; in case of transfer, the statement must be handed to the new owner.

In “EC Compliance Statement” is also declared the compliance of the ventilator to the following other directives:

- The Low Voltage Directive (LVD) 2014/35/EC
- The Electromagnetic Compatibility Directive (EMC) 2014/30/EC

For further certifications, not included in this paragraph, refer to the Unit identification nameplate placed on all IVI product.

1.4.7. ATEX MARK

The ATEX mark is a code including the following items:


	II	2	G	c	T3	X
A symbol identifying equipment used in dangerous areas	Group of belonging according to ATEX	ATEX category	Type of dangerous atmosphere (G: gas P: powder)	Protection type (c: manufacturing safety)	Temperature class range	Special directions for safe use (see in handbook where the EX symbol is present)

Table 1-3: ATEX mark.

The ATEX mark must be carefully checked before fan installation, to make sure that the fan is suitable for use in the type of dangerous atmosphere inside the installation location.

For further information, refer to ATEX Directive 2014/34/EU.

1.5. GENERAL INFORMATION AND SAFETY RULES

This section contains information prescribed by the Machinery Directive, essential for observance and compliance with safety regulations in general, for the evaluation of risks arising from the use of the equipment use and environment conditions of use.

Failure to comply with indications contained in this section and further directions contained in this handbook may jeopardize safety conditions established during the design stage and result in operator injuries.

1.5.1. REGULATORY REFERENCES

Any individual component and the IVI fan as a whole have been designed taking into account existing EC harmonized standards, in addition to other European and national standards applicable in accordance with the Machinery Directive 2006/42/EC.

The main harmonized regulations taken into consideration are:

- ISO 12100:2010 – Safety of machinery -- General principles for design -- Risk assessment and risk reduction

- ISO 12499:2009 - Industrial fans - Mechanical safety of fans - Guarding
- ISO 13857:2008 - Safety of machinery - Safety distances to prevent hazard zones being reached by upper and lower limbs
- IEC 60204-1:2016 - Safety of machinery - Electrical equipment of machines - Part 1: General requirements
- EN 61000-6-3:2007+A1:2011 - Electromagnetic compatibility (EMC). Generic standards. Emission standard for residential, commercial and light-industrial environments
- EN 61000-6-4:2007+A1:2011 - Electromagnetic compatibility (EMC). Generic standards. Emission standard for industrial environments
- EN 60529:1992+A2:2013 - Degrees of protection provided by enclosures (IP code)
- ISO 7000:2014 - Graphical symbols for use on equipment - Registered symbols
- ATEX Directive 2014/34/EU - Equipment and protective systems intended for use in potentially explosive atmospheres

1.5.2. ENVIRONMENTAL CONDITIONS

1.5.2.1. TEMPERATURE, ALTITUDE AND HUMIDITY

Please refer to data sheet of JOB. Every condition is different.

1.5.2.2. FREQUENCY AND RESONANCE

All impellers, regardless of the manufacturer, have natural frequencies that must be as far as possible from the exciting frequencies of the system. Operation under resonance conditions or near resonance can cause high stress on the structural elements and on the fan, with risk of breakage. For more information, contact the IVI Customer Service.

1.5.2.3. OPERATING ENVIRONMENT AND CORROSION

Environmental conditions may cause deterioration of support structures and fan components. During periodic inspections, check all fasteners and replace them if necessary.



When using equipment in a corrosive environment, it is necessary to adapt the maintenance modes and times in order to avoid excessive wear of the components. Where severe corrosion conditions are expected, use inhibitors or special surface protection treatments. For information or advice, contact the IVI Customer Service.

1.5.2.4. ILLUMINATION

The site that hosts the machine must be illuminated in such a way as to be able to easily identify the control devices and shutdown.

Lighting must make it possible to carry out routine maintenance operations in safety conditions. The responsibility of compliance with the regulations in force, regard to the manner in which to provide the illumination, is assigned to the user.

1.5.2.5. VIBRATIONS

In aeraulic systems, the impeller is, in general, the only rotating element with high mass and, therefore, subject to highlighting anomalies of the installation itself. As a result, the fan is often considered a source of vibration due to bad balancing. All IVI fans and / or all their main components are dynamically (hubs, impellers up to 2300 mm diameter, at least with Q grade 6.3) or statically (blades with at least Q 16 grade) balanced before delivery, as required by the standards STANDARD API 661 (7th Edition, July 2013).

NOTE

It is possible to provide different degrees of balancing. Contact the IVI Customer Service for more information.

A periodic monitoring of the system can indicate in advance the deterioration of its components, for example: the bearings are the structural uprights, the bolted connections and so on, which can lead to possible malfunctions. The measurement of vibration is used to detect when a component of a fan or of the transmission system is in the process of initial malfunction. The operating conditions indicated in the diagrams, shown below, provide data about the state of vibration of a generic fan. For vibration detection it is advisable to use magnetic head vibration sensors positioned, according to the type of installation, on the supports, as close as possible to the fan.

The sensors (refer to Figure 1-2) must be installed in such a way that the vibrations are detected in the three directions: vertical, longitudinal and transverse. During the measurements, the vibration amplitudes and the relative frequencies will be detected. Analysing the detected data, according to the axis on which the vibrations act, the causes of the vibrations can be identified. Vibration amplitudes are an indication of the need for maintenance.

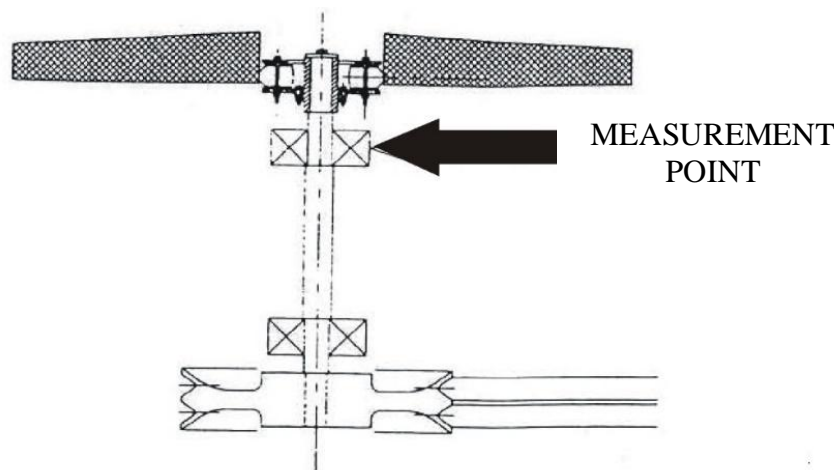


Figure 1-2: Recommended position for vibration measurement points.

Figure 1-3 shows the different limits or levels of acceptance for vibrations according to ISO 10816-3, referring to the evaluation of machine vibrations by means of measurements on non-rotating parts. For details about the classification of the machines and the types of foundation, this standard is used for the necessary clarifications.

In order to use the table, it is necessary to identify the type of foundation, rigid or flexible, and the nominal power of the machines, grouped into four groups:

- Group 1: large machines with rated power greater than 300 kW; electric machines with axle height $H > 315$ mm.
- Group 2: medium-sized machines with rated power greater than 15 kW up to 300 kW included; electric machines with an axis height of $160 \text{ mm} < H < 315$ mm.

- Group 3: pumps with fin impeller and with separate motor (centrifugal, mixed flow or axial flow) with rated power greater than 15 kW.
- Group 4: pumps with fin impeller and with built-in motor (centrifugal, mixed flow or axial flow) with rated power greater than 15 kW.

Once the machine's group is identified, it is possible to compare the measured vibrations with the evaluation zones for each group to allow a qualitative evaluation of the vibrations of a given machine and to provide possible guidelines on possible measures to be taken.

- Zone A (Blue): the machine vibrations at their first startup generally levels remaining within this zone.
- Zone B (Green): Machines with vibrations within this zone are considered generally acceptable for long-term service without restrictions.
- Zone C (Yellow): Machines with vibrations within this zone are generally considered unsuitable for long-term continuous service. Generally, the machine can be operated under these conditions for a limited period, until there is a favourable opportunity for corrective action.
- Zone D (Red): vibration values within this zone are generally considered as severe as to cause damage to the machine.

								V.I.M.S. mm/s	V.I.M.S. m/s	Vibration velocity 10 - 1000 Hz n > 600 1/min (2 - 1000 Hz n > 120 1/min)
								11	0.433	
								7.1	0.280	
								4.5	0.177	
								3.5	0.138	
								2.8	0.110	
								2.3	0.091	
								1.4	0.055	
								0.71	0.028	
rigid	elastic	rigid	elastic	rigid	elastic	rigid	elastic	Foundation		
Pumps > 15 kW radial, axial, diagonal				Medium-size machines 15 kW < P ≤ 300 kW		Large machines 300 kW < P < 50 MW		Machine type		
Direct drive		Intermediate shaft/ Belt drive		Motors 160 mm ≤ H < 315 mm		Motors 315 mm ≤ H				
Group 4		Group 3		Group 2		Group 1		Group		

Figure 1-3: Evaluation criteria for vibrations according to ISO 10816.

The numerical values assigned to the zone limits are not intended to serve as acceptance specifications, which are subject to agreement between the manufacturer of the machine and the customer. However, these values are guidelines that allow avoiding big dysfunctions or placing unrealistic requirements.

For a long-term exercise, it is common practice to set limits on running vibrations. These limitations take the form of ALARMS and BLOCKS. IVI suggests the application of international standards such as ISO 10816-3, ISO 14694, or equivalent, for the most suitable identification of thresholds. Although beyond the scope of supply, if in doubt, contact the IVI Customer Service.

1.5.2.6. MAXIMUM TIP SPEED FOR IMPELLERS

DIAMETER (mm)	TIP SPEED (m/sec)
500 - 1000	130
1000 - 1600	130

1601 - 3000	75
3001 - 6000	65
6001 - 15000	55

Table 1-4: Maximum tip speed according to the diameter of the impeller.



Continuous operation at speeds above the maximum allowed must be authorized in writing by IVI, which declines any liability for damage to persons and / or things resulting from the use of impellers outside the permitted procedures.

1.5.3. GENERAL SAFETY RULES

The machine configuration and the respective accident prevention devices correspond to the requirements of the machinery directive issued by the Council of the European Communities (2006/42 / EC and subsequent amendments).

Section 2 of this manual describes accident prevention devices; all the safety rules that must be observed during the installation and operation phases of the machine are reported in detail in the other sections.

Failure to apply these rules could make the safety conditions foreseen in the project phase ineffective. The personnel in charge of the use and surveillance of the machine must be instructed by their employer on the risks of accidents, on the safety devices installed on the machine and on the general accident prevention rules provided for by the community directives and by the legislation of the destination country of the machine.

IVI declines all responsibility for damage to the machine or for the physical safety of the operator or third parties deriving from the non-observance of the safety regulations indicated in the technical documentation supplied with the machine itself.



Before any action, the operator must be perfectly aware of the characteristics of the machines, of the position and functioning of all the controls; he must have read the operating manual in full and read the attached drawings and diagrams.



Only skilled operators must use the machine.



The instructions, warnings and general accident prevention rules contained in the manuals must be fully observed.



Tampering or unauthorized replacement of one or more parts of the machines, the use of accessories, tools, and expendable materials other than those recommended by the manufacturer can be a danger of accident and release the manufacturer from any civil or criminal liability.

1.5.3.1. CLOTHING

The clothing of those who work or maintain the machine must comply with the essential safety requirements applicable in their country.

In general, the operator must wear safety shoes with non-slip soles and the use of moccasins, clogs, slippers or other types of footwear that may compromise the person's mobility is not permitted.

The clothes worn must be suitable for the work to be done: the suit or the apron must be in natural fibre (cotton for example), slightly flammable and clean from traces of lubricants.

It is mandatory to use protective eyewear operating in areas where there is a risk of splintering or spillage of material.

During installation operations, the operator must always be equipped with headphones or earplugs and a protective helmet.



Working on the machine, it is forbidden to wear bracelets, watches, rings or chains that can dangle or hinder movements. Likewise, the utmost care must be taken, working in close proximity to the moving parts of the machines, so that their clothing is suitable to avoid hooking with these devices (sleeves, shirts, hair and so on).

1.5.3.2. ACCESS TO WORKAREA

The work area, especially in the control area, should never be occupied. Nothing must interfere with the operator's freedom of movement. In the event of an emergency, immediate access to the equipment must be ensured for the appropriate personnel.

It must be prescribed the prohibition of access, by adequate means and signals, to the work area for persons not necessary for the operation of the machines.



During service, in particular when operating with open guards or disconnected safety devices, pay the utmost attention to forbid access to people not necessarily involved in such actions.



At the end of the control and maintenance operations, check that no instruments have been left inside the work area or inside accident prevention protections.

1.5.4. RISK ASSESSMENT

1.5.4.1. FOREWORD

Assessment of risks arising from machine use has been carried out according to 2006/42/EC: results of such analysis and safety measures taken to eliminate or reduce user risk are reported in this section for general aspects and in Section 2 for a detailed description.

1.5.4.2. INSTALLATION ENVIRONMENT RELATED RISKS

Environment where the machine is installed may present risk issues impairing proper operation of the machine.

FLOOR

The surface on which the machine rests must be such as to guarantee its correct support and levelling over time.

TEMPERATURE

The prescribed ambient temperature must be ensured; high peaks, both positive and negative, of temperature or humidity may cause components malfunctions (for example, engine cooling problems or ice formation on blades).

POLLUTANTS

Evaluate in advance any potential environmental damage arising from use of pollutants such as DUST, SAND OR HEAVY DUST PARTICLES within the operating environment: the use of such pollutants may accelerate blade wear and tear.

It is the user's responsibility to ensure the suitability of the place where the machine is installed, in order to safeguard its integrity over time.

1.5.4.3. EQUIPMENT FEATURES RELATED RISK

In compliance with 2006/42/CE directive, all machine areas involving work process or machine structure-related risk have been analysed.

Where possible, action has been taken to lower or eliminate all possible risks for exposed persons. Each machine is provided with standard fixed and movable guards that prevent access to its dangerous areas during operation.

Always keep in mind that the best safeguard for operator is a constant use of caution and common sense. Experience gained using equipment over time may improve safety margins in one's own work.

1.5.4.4. RESIDUAL RISK

The expression "residual risk" identifies all machine areas or procedures which, notwithstanding taken actions, are still highly dangerous, e.g. due to the presence of high tension, high temperatures or moving parts. Proper tags, as per ISO standards, mark the presence of residual risk areas on the machine.

1.5.4.5. PROTECTIVE EQUIPMENTS

Before operating with the machine, it shall equip themselves with the following protective devices:

- gloves against mechanical hazards
- Safety shoes against the danger of falling objects
- Helmet in case of lifting.
- Earmuffs when operating the system, with an exposure level above 75 dB(A).



2. INSTALLATION AND ASSEMBLY

2.1. INSTALLATION

Tampering or unauthorized replacement

Any unauthorized modification, tampering and / or replacement, same as the use of unapproved accessories or drive units will void the warranty and release IVI from any liability arising from the subsequent use of this equipment. Each type of industrial fan and impeller is designed to be used in a specific type of system. Using IVI products for a purpose other than that for which it was designed may result in personal injury, as well as damage to the product or property, although IVI equipment has been designed and constructed to ensure years of operation. As with all equipment, the following rules are essential for trouble-free operation:

- • Correct installation
- • Regular maintenance
- • Operation within the original design parameters
- • The prescribed application within a process

Bad assembly, poor maintenance or improper use of IVI equipment can cause a variety of problems, including but not limited to: poor equipment performance, decreased equipment life, failures or hazardous operating conditions. The IVI catalogue includes a multitude of products, each of which can be tailored to suit each specific application. IVI fans were chosen based on specific process specifications, product specifications, and application requirements for capacity, operating conditions, operating parameters. It is essential that IVI products are installed, maintained and used under the same conditions for which they were originally designed. In case it is necessary to change the original project, please consult the IVI before using the equipment in different conditions.

2.1.1. GENERAL INFORMATION

The fan is shipped packed, already assembled (if the diameter allows the standard transport) or decomposed in its main groups, according to the dimensions:

- Duct casing with installed engine (if possible)
- Impeller
- Protection grid
- Attachments and small metal parts (screw, nut and so on)
- Use and maintenance handbook.

Upon goods reception, it is necessary to check visually the integrity of the packaging, where applicable. In the event that damage is found due to shipping or missing parts, please contact the IVI Customer Service promptly, IVI will not be held responsible for any defects found after two months from receipt of its products.

Qualified personnel must carry out installation, testing and initial start-up of the impeller within a ventilation system. User shall prepare a suitable place for machine installation, hosting and handling devices and all material needed for installation as described in the following paragraphs.

2.1.2. HANDLING AND UNPACKING

First, make sure that the lifting systems and hooks set up for the operation are suitable for the weight to be lifted. For lifting, use appropriate belts taking into account the total weight to be lifted, shown on the fan plate, on the technical sheet or on the assembly drawing. During lifting, do not rotate the impeller on itself and take care not to damage the blades.

Use personal protective equipment such as gloves, safety shoes and protective helmet. Refer to the photos or drawings provided for the lifting mode, using the appropriate holes / hooks / lifting points. Use a transport mode that does not cause unwanted displacements (such as impeller rotation).

The fan or the components making it up are shipped using suitable packaging or means of protection according to the type of transport requested during the quotation process. Care should be taken when unpacking to avoid personal injury or damage to the machine and to dispose of packaging materials in accordance with the regulations of the country where the assembly work takes place.

NOTE

For lifting, do not use the anchor points on the engine, nor the impeller or the protection grid but the special anchor points on the casing, as shown in Figure 2-1.

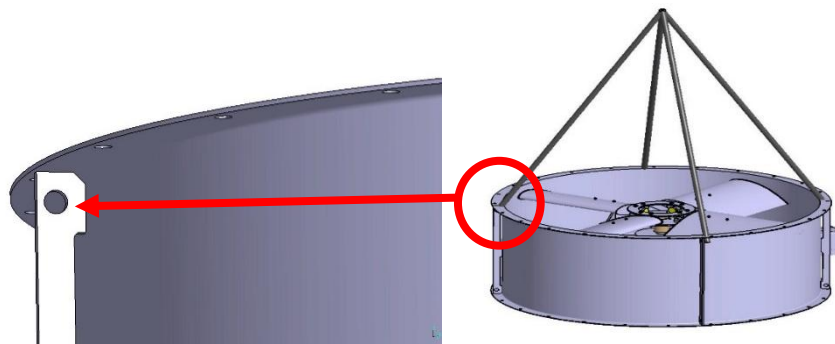


Figure 2-1: Handling anchoring points of the fans.

2.1.3. EQUIPMENT INSTALLATION PREARRANGEMENTS

2.1.3.1. INSTALLATION AREA REQUIREMENTS

Fans to be installed in potentially dangerous areas are supplied in compliance with end user specifications. The user is responsible for the certified classification level and fan safety, in compliance with local laws and regulations. In particular, make sure that:

- Engine and fan tag information and the used protection type are compatible with the area classification and with the operating atmosphere.
- The area and electrical system are complied with the EN 1127-1 regulation (Explosive atmospheres. Explosion prevention and protection. Basic concepts and methodology) and EN 50281-1-2 (Electrical apparatus for use in the presence of combustible dust. Electrical apparatus protected by enclosures. Selection, installation and maintenance).
- The ignition temperature of the gases or powders is compatible with the temperature class indicated on the electric motor and on the fan.



IVI fans, if supplied in accordance with the ATEX directive 2014/34 / EU, are valid for group II only and can be installed in areas corresponding to the following classification in:

Zone	1	2	21	22
Fan category	2G	3G/2G	2D	3D/2D

Table 2-1: ATEX zones.

Atmospheres:

G: explosive atmosphere caused by gas

D: explosive atmosphere caused by dust

Temperature class	T1	T2	T3	T4	T5	T6
Max. surface temperature [C°]	450	300	200	135	100	85

Table 2-2: Classes and relative ignition temperature ATEX.

The standard environmental conditions are the following (Different operating ranges are possible, for which contact the IVI Customer Service):

- Absolute pressure range: 0.9 to 1.1 bar
- Operating temperature range: referred to data sheet of project.
- Altitude: below 1000 meters above sea level
- Maximum oxygen content in the atmosphere: 20%

For further information, please refer to the “Operating restrictions” paragraph.

Electric boxes, terminal boards and other components supplied together with the fan are covered by fan certification. If electrical motor or these components are not supplied by IVI, Customer is responsible for their compliance to the relevant regulations and directives and with the classification of the fan installation area

2.1.3.2. . FAN ELIGIBILITY FOR THE INSTALLATION AREA

Install the fan within plants equipped with lightning protection devices, with no stray currents, cathode protection systems or radiofrequency electromagnetic waves.

Avoid exposure to electromagnetic waves or concentrated sunlight, which may result in the heating of the fan surface, moreover, it is necessary to avoid exposure to ultrasound with a frequency above 10MHz or, if of a lower frequency, with intensity above 1mW / mm².

Using fan must be avoided in processes that may cause adiabatic compressions, shock waves, or that use fluids with highly oxidizing gases.

2.1.3.3. FOUNDATIONS

Foundations must be built under the end user direct liability. Foundations must be rigid enough as to bear any vibrations or disturbances connected to fan operation, taking into account the possible presence of other devices installed in the operating area of the machine. To avoid vibration propagation through the base, the installation of anti-vibration supports is recommended. Please contact the IVI Customer Service for this purpose.

2.1.3.4. FIXING SYSTEMS

The IVI supply limit is defined in the coupling flange present on the fan casing: the relative fixing systems are at the complete Customer’s charge and responsibility.

2.1.4. ELECTRICAL SYSTEM

2.1.4.1. CONTROL PANEL AND EMERGENCY STOP

The electrical system must comply with the applicable laws. The electric starter equipment must include fuses and protections against overload or voltage drops, sized at start-up times and at full-load current absorption.



CAUTION 1

If the fan is far from the control panel and/or the control room, service omnipolar switch must be installed near the fan. Refer to the data displayed on the engine tag to make the most suitable choice in terms of protection system and power cable characteristics, considering that the tension drop during the starting phase must not exceed 3%.



CAUTION 2

If the fan is part of an automated process system which may be subject to the variation of operating conditions of the same fan, it is recommended to arrange a manual stop device for the fan (e.g. an emergency switch).

2.1.4.2. ELECTRICAL CONNECTIONS



ATTENTION

The execution of power connections or interventions on wiring by non-qualified personnel is forbidden.

Before any operation, it is necessary to check that the data of the electric line to which the connection will be made correspond to the voltage data reported on the electric motor nameplate and the earth connection is made before any other connection because the electrostatic charges are a possible cause of explosion risk.

Power cables, cable glands and switches must be chosen according to engine data and in compliance with local regulations. To connect cables to the terminal board, follow the diagram stamped on the electric motor manual provided as attachment.

Cables must be properly secured to avoid displacements caused by vibration and air moved by the fan, their path must maintain the maximum possible distance from the moving parts of the fan.



ATTENTION

All electrical components (cables, cable glands, terminal boards and so on) and control devices (such as switches, inverters, temperature and vibration sensors) must have suitable characteristics and certifications for the installation area and must be installed in such a way as not to alter the fan operating characteristics. All devices, equipment and components used with fans or related to them, must be compliant to the ATEX directive and compatible with data stamped on the fan ID tag.

2.1.4.3. GROUNDING

Both the fan and the electric engine must be grounded using the grounding points prepared and recommended. All accessories connected to the fan must be grounded as well, and connected to each other to assure the necessary electrical continuity.

2.1.4.4. ELECTRICAL MOTOR

Connect the electrical motor according to the connection diagram and to the instructions provided in the relative use and maintenance manual, provided in the annex. Tighten the terminal nuts, the cable terminals and the power cables to the torque indicated in Table 2-3.

Terminal diameter [mm]	4	5	6	8	10	12	14	16
Steel torque [Nm]	2	3,2	5	10	20	35	50	65
Copper torque [Nm]	1	2	3	6	12	20	35	50

Table 2-3: Driving torques for terminal bolts.

The connection diagrams typical for three-phase, single or double speed electric motors are shown in Table 2-4, for illustrative purposes only:

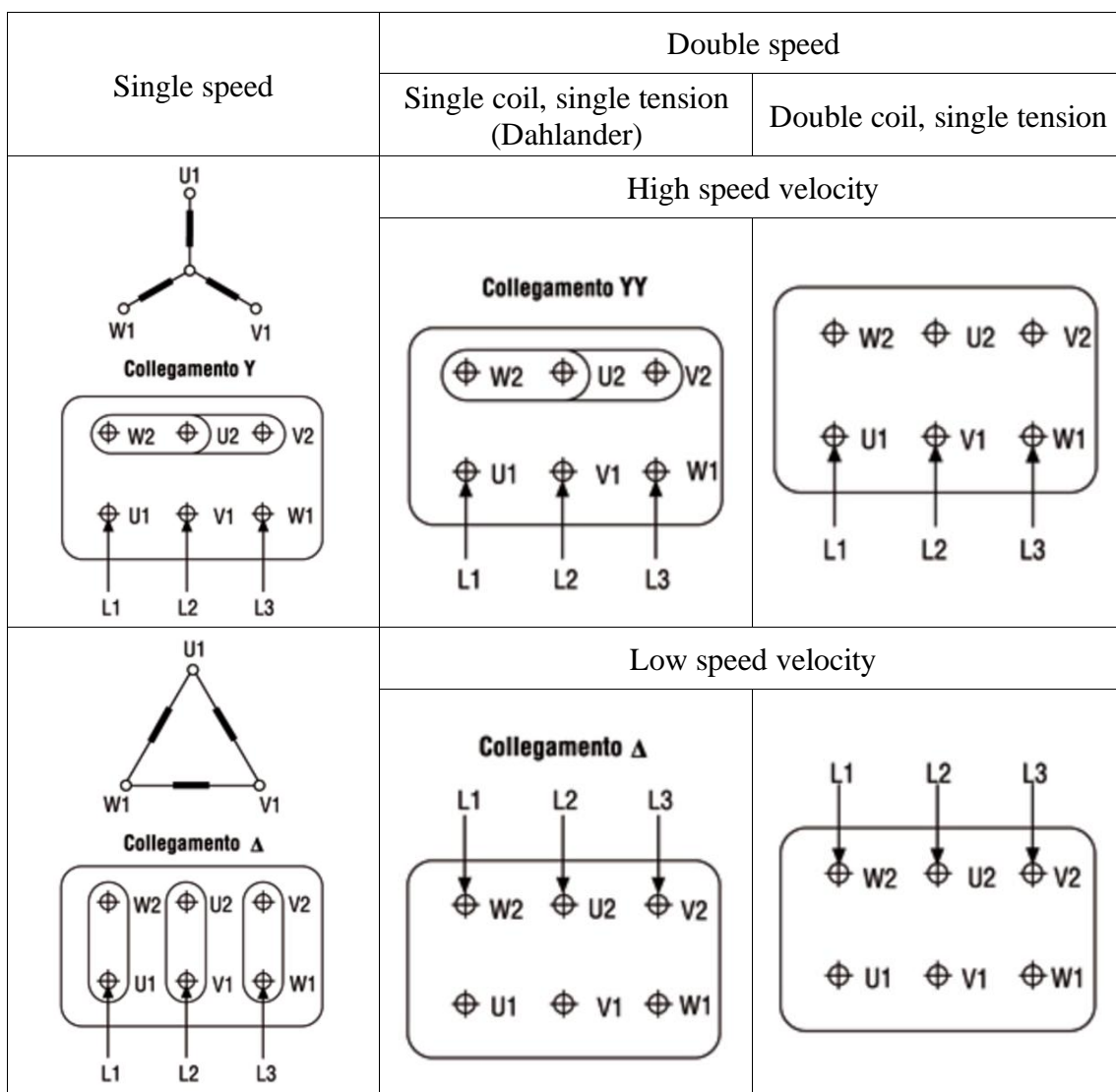


Table 2-4: Typical connection diagrams for electric motor.

2.1.4.5. ISOLATION RESISTOR

Before operation, check the engine's isolation resistor. If values are $\leq 1k \Omega$ per Volt of normal nominal voltage, dry the winding.

The reference value is >10 Mega Ohm, measured with a 500-Vcc device. This value is halved every 20 °C increase in room temperature. In case of failure to reach the reference value, the winding is moist and must be dried in an oven. For this purpose, refer to the attached electric engine use and maintenance handbook.

Anti-condensation heaters must be supplied with a single line, separate from the engine line, using the relevant terminals. Check voltage values on the relevant tag. Resistors must work only when power is not supplied to the engine.



Before any intervention, disconnect the engine from the network and make sure there are no explosive gases.



Discharge the windings immediately after measurement, to avoid the risk of electric shock.

2.1.4.6. VIBRATION AND TEMPERATURE MONITORING DEVICES

In order to improve operational safety, the Customer should perform the following:

- Provide continuous vibration monitoring (see paragraph 1.5.2.5) with alarm threshold and stop device in accordance with the applied reference standard.
- For transmission fans only, arrange for a constant monitoring of bearing temperature and transmission, with a fan operating alarm and interruption when temperature exceeds 10 °C of the operating temperature value.

NOTE

The fan stop should be evaluated in compliance with the plant's general safety. Before restarting the machine, it is necessary to identify and solve the problem that brought to the overcoming of the acceptable vibration and/or temperature threshold. The actual need to install vibration and temperature monitoring devices must be evaluate according to fan service conditions.



Vibration monitoring is prescribed for fans with 2D category, as well as for 2G fans, in case it is not possible to avoid the formation of dust deposits on the blades.

2.2. IMPELLER ASSEMBLY

For impeller assembly, if it is supplied disassembled, it is necessary to refer to the relative installation, use and maintenance handbook.

2.3. FAN ASSEMBLY

2.3.1. FAN SERIES “CFF”, “GFF-08” E “LFF”: IMPELLER INSTALLATION

The impeller installation on a fan is a potentially dangerous operation because it is often necessary to work in difficult conditions, on scaffolding or scaffolding. Always pay close attention.

To assemble the impeller on the fan, proceed as follows:

1. Place the fan within the installation area and secure it according to the chosen method (refer to general drawings).
2. Clean the drive shaft (of the electric motor or geared electric motor) accurately with diluent or with extra-fine emery cloth.
3. Grease the drive shaft with synthetic grease with graphite or equivalent.
4. Clean the hub hole accurately with solvent; make sure to remove completely the anti-rust protection.
5. Lift the impeller (5, Figure 2-2) and insert it on the driveshaft.
6. Insert the drive shaft key (1).
7. Secure the impeller on the driveshaft using the large washer (2), the small washer (3) and the screw (4).

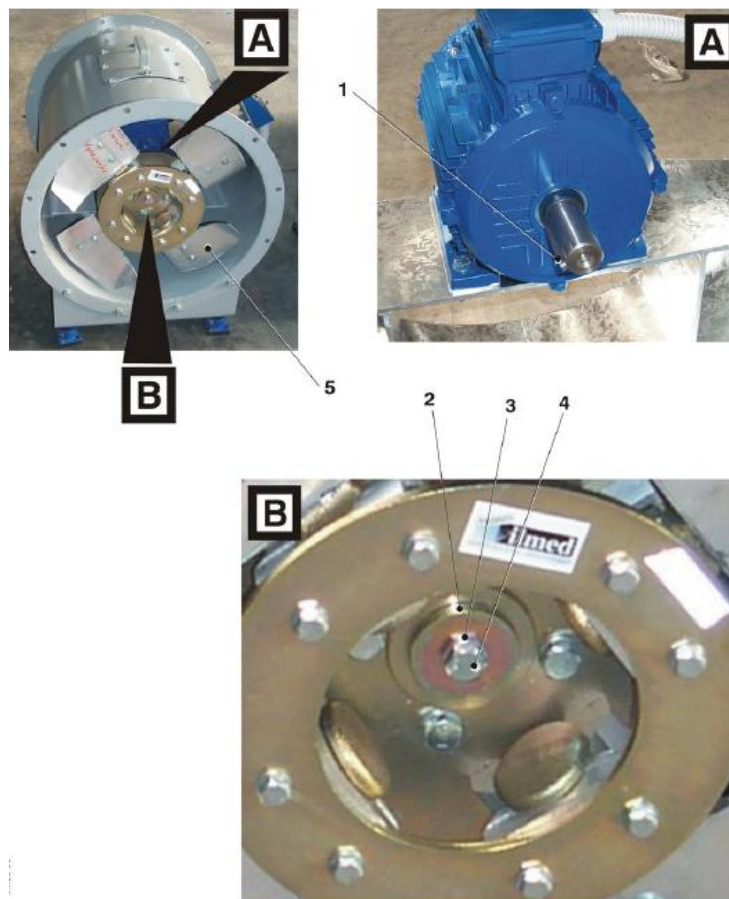


Figure 2-2: Impeller installation for CFF / GFF-08 / LFF fans.

2.3.2. SERIES “CFF”, “GFF-08” E “LFF”: FINAL OPERATIONS

1. Remove all scaffoldings, assembly tools used for the assembly and other foreign bodies from the installation area that may interfere with the fan when operating.

2. Rotate the impeller manually for at least one full rotation and make sure there is no interference between the blade and structure, or between the blade and casing.
3. Check the gap, i.e. the distance between the blade and the ring in which it rotates. The gap value must correspond to the one in the data sheet.
4. In case there is a junction box for the electrical connection outside the casing, install the safety grid (usually in the groups of the TFF type or with external terminal box)



Before performing step 5, make sure the system is not under tension.

5. Connect all power contacts.
6. Install the protection grid if it has not been done previously (usually in CFF and GFF fans without external junction box)
7. Operate the fan for a few seconds and, when it is still moving, check the rotation direction and airflow (please refer to Section 3).
8. If no anomalies are detected, restart the impeller and let it rotate for at least 1 h, checking:
 - The absorbed power (if exceeding, reduce blade keying as explained in the applicable impeller manual)
 - Vibrations (refer to paragraph 1.5.2.5)
9. Stop the fan and check nuts are tightened correctly. The torque value must correspond to the value inside the impeller use and maintenance handbook.
10. Check nuts are tightened correctly after 100 h and after 200 h operation.

2.3.3. FAN SERIES GFF-01”, “GFF-04”, “TFF-09” E “TFF-12”: IMPELLER INSTALLATION



The impeller installation in a fan is a potentially dangerous operation because it is often necessary to work in difficult conditions, on scaffolding or scaffolding. Always pay close attention.



The fans in this paragraph have belts from the motor to the impeller. During the assembly, pay attention to the risk of shock or dragging with moving parts (such as pulleys, belts, etc.)



It is very important that the belt is mounted with the correct tension and that the pulleys are aligned, in order to optimize its performance and durability. A lower than recommended tension leads to excessive belt oscillations. High tension causes premature belt wear and increases the level of noise produced. The belt must be assembled by hand, without the use of tools (such as keys or levers) that can cut or damage the belt or the pulleys. Refer to Section 4 of the manual.

To assemble the impeller on the fan, proceed as follows:

1. Install the transmission shaft (1, Figure 2-3) inside the two bearing supports (2), securing both with the respective couple of screws and washers (3). If the unit has been supplied with "MONOBLOCK", install the same, taking care to respect the indications given on it with regard to the indications of "pulley side" and "impeller side".

NOTE

For ATEX version of the bearing block, install the temperature sensors, if planned.

2. Secure the pulley pack in position (4) on the transmission shaft (1) inserting the conical bush (5) then securing it with the two screws (6).
3. Secure the pulley pack (4) to the transmission shaft (1) with washer (7) and screw (8).
4. Put the electric engine in place (9), mounted on its support (10) and secure it to the fan base (11) using the four transmission belt tension rods.

NOTE

The distance between the electric engine and the base should allow installing transmission belts without forcing.

5. Install the pulley pack (12) on the engine side, on the electric engine output shaft (9).
6. Secure the pulley pack in place (12) on the electric engine output shaft, by inserting the conical bushing (13) and securing it with the two screws (14).
7. Perform an alignment check on the two pulley packs (see Section 4).
8. Install transmission belts (15) between the two pulley packs.
9. Perform a tension check on the two belts (see Section 4).
10. Place the fan within the installation area and secure it according to the chosen method (refer to general drawings).
11. Clean the drive shaft accurately with diluent or with extra-fine emery cloth.
12. Grease the drive shaft with synthetic grease with graphite or equivalent.
13. Clean the hub hole accurately with solvent; make sure to remove completely the anti-rust protection.
14. Lift the impeller (5, Figure 2-2) and insert it on the driveshaft.
15. Insert the drive shaft key (1, Figure 2-2).
16. Secure the impeller on the driveshaft using the large washer (2, Figure 2-2), the small washer (3, Figure 2-2) and the screw (4, Figure 2-2).
17. Install the driver pulley protection (16, Figure 2-4) on the screw base, using the pre-arranged screws on the structure, the nut and the washer (17).

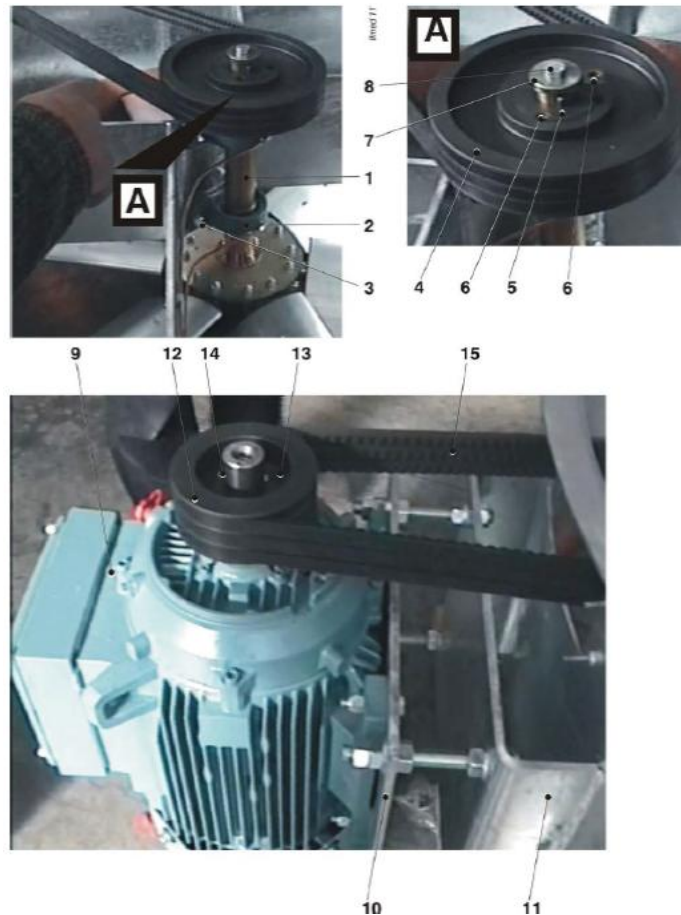


Figure 2-3: Impeller installation of the GFF-01 / GFF-04 / TFF-09 / TFF-12 fan series.

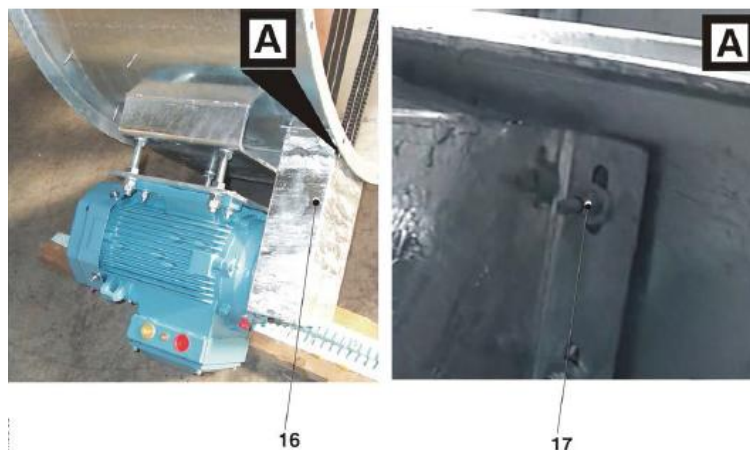


Figure 2-4: Driver pulley protection installation of the GFF-01 / GFF-04 / TFF-09 / TFF-12 fan series.

2.3.4. FAN SERIES GFF-01”, “GFF-04”, “TFF-09” E “TFF-12”: FINAL OPERATIONS

1. Remove all scaffoldings, assembly tools used for the assembly and other foreign bodies from the installation area that may interfere with the fan when operating.
2. Rotate the impeller manually for at least one full rotation and make sure there is no interference between the blade and structure, or between the blade and casing.
3. Check the gap, i.e. the distance between the blade and the ring in which it rotates. The gap value must correspond to the one in the data sheet.
4. Install the protection grid.



ATTENTION

Before performing step 5, make sure the system is not under tension.

5. Connect all power contacts.
6. Operate the fan for a few seconds and, when it is still moving, check the rotation direction and airflow (please refer to Section 3).
7. If no anomalies are detected, restart the impeller and let it rotate for at least 1 h, checking:
 - The absorbed power (if exceeding, reduce blade keying as explained in the applicable impeller manual)
 - Vibrations (refer to paragraph 1.5.2.5)
8. Stop the fan and check nuts are tightened correctly. The torque value must correspond to the value inside the impeller use and maintenance handbook.
9. Check nuts are tightened correctly after 100 h and after 200 h operation.

2.3.5. FAN SERIES “TFF-01”: IMPELLER INSTALLATION



ATTENTION 1

The impeller installation is a fan is a potentially dangerous operation because it is often necessary to work in difficult conditions, on scaffolding or scaffolding. Always pay close attention.



ATTENTION 2

The fans in this paragraph have belts from the motor to the impeller. During the assembly, pay attention to the risk of shock or dragging with moving parts (such as pulleys, belts, etc.)



CAUTION

It is very important that the belt is mounted with the correct tension and that the pulleys are aligned, in order to optimize its performance and durability. A lower than recommended tension leads to excessive belt oscillations. High tension cause premature belt wear and increase the level of noise produced. The belt must be assembled by hand, without the use of tools (such as key or levers) that can cut or damage the belt or the pulleys. Refer to Section 4 of the manual.

To assemble the impeller on the fan, proceed as follows:

1. Assemble the two half casing using the side bolts (1, Figure 2-5).
2. Install the transmission shaft (2, Figure 2-3) inside the two bearing supports (3), securing both with the respective couple of screws and washers (4). If the unit has been supplied with “MONOBLOCK”, install the same, taking care to respect the indications given on it with regard to the indications of "pulley side" and "impeller side".

NOTE

For ATEX version of the bearing block, install the temperature sensors, if planned.

3. Secure the pulley pack in position (5) on the transmission shaft (2) inserting the conical bush (6) then securing it with the two screws (7).
4. Secure the pulley pack (5) to the transmission shaft (2) with washer and screw (8).
5. Put the electric engine in place (9), mounted on its support (10) and secure it to the fan base (11) using the four nuts (12).

NOTE

The distance between the electric engine and the base should allow installing transmission belts without forcing.

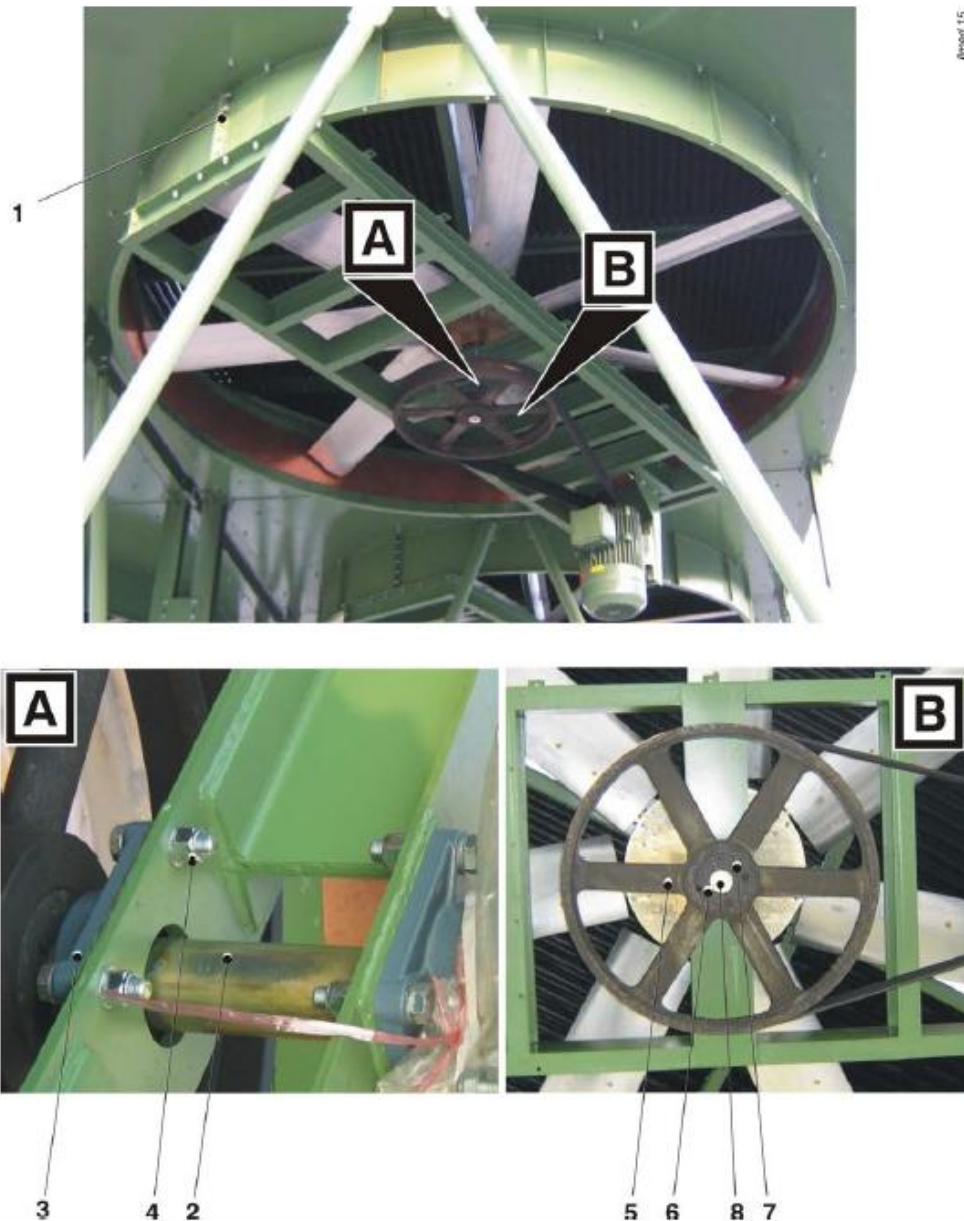


Figure 2-5: Driven pulley installation of the TFF-01 fan series.

6. Install the pulley pack (13) on the engine side, on the electric engine output shaft (9).
7. Secure the pulley pack in place (13) on the electric engine output shaft, by inserting the conical bushing (14) and securing it with the two screws (15).
8. Perform an alignment check on the two pulley packs (see Section 4).
9. Install transmission belts (16) between the two pulley packs.
10. Perform a tension check on the two belts (see Section 4).

11. Place the fan within the installation area and secure it according to the chosen method (refer to general drawings).
12. Clean the drive shaft accurately with diluent or with extra-fine emery cloth.
13. Grease the drive shaft with synthetic grease with graphite grease or equivalent.
14. Clean the hub hole accurately with solvent; make sure to remove completely the anti-rust protection.
15. Lift the impeller (5, Figure 2-2) and insert it on the driveshaft.
16. Insert the drive shaft key (1, Figure 2-2).
17. Secure the impeller on the driveshaft using the large washer (2, Figure 2-2), the small washer (3, Figure 2-2) and the screw (4, Figure 2-2).

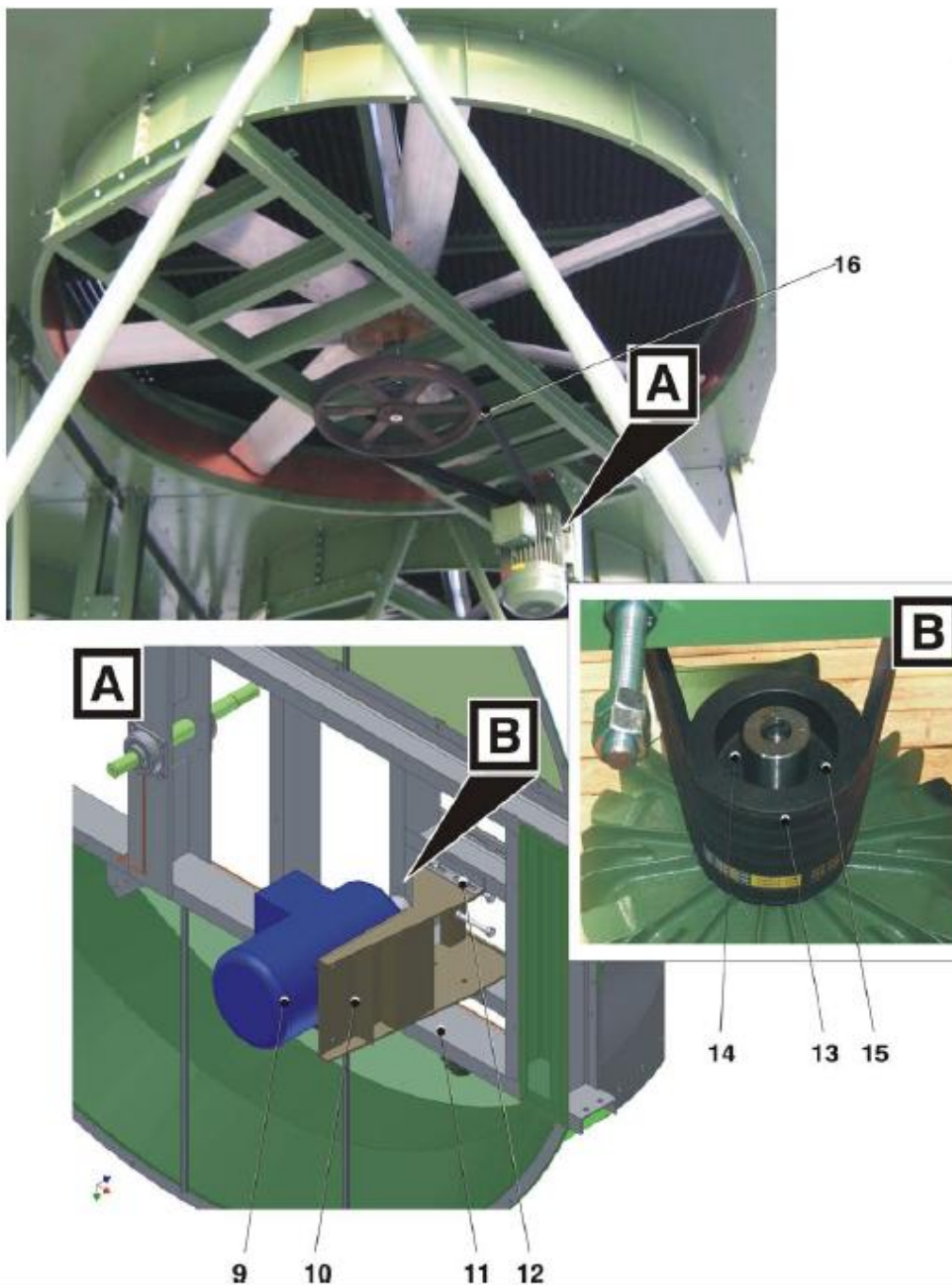


Figure 2-6: Transmission system installation of the TFF-01 fan series.

2.3.6. FAN SERIES “TFF-01”: FINAL OPERATIONS

1. Remove all scaffoldings, assembly tools used for the assembly and other foreign bodies from the installation area that may interfere with the fan when operating.
2. Rotate the impeller manually for at least one full rotation and make sure there is no interference between the blade and structure, or between the blade and casing.
3. Check the gap, i.e. the distance between the blade and the ring in which it rotates. The gap value must correspond to the one in the data sheet.
4. Install the protection grid.



Before performing step 5, make sure the system is not under tension.

5. Connect all power contacts.
6. Operate the fan for a few seconds and, when it is still moving, check the rotation direction and airflow (please refer to Section 3).
7. If no anomalies are detected, restart the impeller and let it rotate for at least 1 h, checking:
 - The absorbed power (if exceeding, reduce blade keying as explained in the applicable impeller manual)
 - Vibrations (refer to paragraph 1.5.2.5)
8. Stop the fan and check nuts are tightened correctly. The torque value must correspond to the value inside the impeller use and maintenance handbook.
9. Check nuts are tightened correctly after 100 h and after 200 h operation.

3. INSTRUCTIONS FOR USE

3.1. FAN STARTING

Specialized personnel must only carry out fan start-up operations. Failure to carry out the prescribed checks may be a serious source of risk.

It is forbidden to start the fan in counter rotation with respect to the fluid direction or in the case of a moving fan moving contrary to the normal direction of rotation. The contravention to these indications can lead to the breaking of the impeller blades with consequent damage to the other components.



It is forbidden to start the fan in the presence of people exposed to the flow of air generated due to possible debris.

3.2. OPERATING RESTRICTIONS



The use of the fan in conditions other than those prescribed is a source of danger and therefore it is expressly forbidden.

It is the customer's responsibility to declare the operator accessibility zones around the fan supplied. Based on this information, the IVI designs the fan in accordance with local laws for safety and provides adequate protection grids.



It is forbidden to install the fan without protection grids in a place where people are allowed to enter.

3.2.1. TREATED FLUID

IVI axial fans are suitable for the treatment of clean or slightly dusty and humid air. If the treated air contains corrosive elements, pay the utmost attention to material and coating suitability.

NOTE

It is the customer's responsibility to declare the operating conditions where the fan will be operating. IVI is not liable for any damage that occurred due to errors in the communication of the properties of the treated fluids. If, during the normal operation of the fan group, the working conditions undergo a variation, it is advisable to contact the IVI Customer Service.

It is forbidden to use the fan in environments containing particles that can settle permanently on the fan blades (as paints for example) that can alter its balance.



ATTENTION

It is forbidden the use of fans for the treatment of fluids containing rust particles or hot gases, as well as the use of ventilation units for the treatment of corrosive or abrasive fluids.

3.2.2. TEMPERATURE AND ALTITUDE

The IVI fans are suitable for the treatment of air with temperatures ranging : see data sheet of your project . IVI Customer Service must approve different operating conditions. In order to exceed the maximum temperature limit of the fluid, a temperature monitoring system must be provided to stop the operation of the fan.

In case of installation of the fan in cold climates, before starting, check that there are no ice deposits on the blades; in case of ice on blades, remove it using solvent or steam.

3.2.3. MAXIMUM TIP SPEED

DIAMETER (mm)	MAX. TIP SPEED (m/sec)
500 - 1000	130
1000 - 1600	130
1601 - 3000	75
3001 - 6000	65
6001 - 15000	55

Table 3-1: Maximum tip speed according to the diameter of the impeller.



ATTENTION

The maximum operating speeds of the impellers are linked to particular constructive devices that depend on the information supplied during the offer request phase. The operating speed cannot be increased, for any reason, beyond 5% of the value declared initially. If in doubt, contact the IVI Customer Service.

3.2.4. AIRFLOW

The nominal airflow of the fan is indicated on the identification plate and on the datasheet provided. It is prohibited to use the fan reducing the airflow below 20% of the nominal value; because an excessive reduction can cause the overheating of some components (Different ranges of use are possible; if in doubt, contact the IVI Customer Service).

3.2.5. REPETITIVE STARTING

The fans are suitable for continuous operation. The number of permitted subsequent starts is reported on the electric motor datasheet. In any case, it should be limited as follows:

- Four direct starts / hour.
- Two quick start sequences followed by 30 minutes of cooling achieved with continuous operation or shutdown.



CAUTION

Always avoid electric motor overheating. In case of doubts, please contact our Customer Service.

3.2.6. ELECTRICAL CONNECTION

In order to avoid excessive acceleration when starting the fan, an electric star-delta connection is mandatory for three-phase AC electric motors with power higher than 15 kW if the motor is connected directly to the fan or above 25 kW if the motor is connected to the fan by transmission, gearbox or geared motor. It is always recommended to use soft-starter or VSD for connection to the electricity line.

3.2.7. DOUBLE SPEED

If a double-polarity electric motor moves the impeller, we recommend stopping it for at least 30 seconds before operating it at a low speed. This will allow the impeller to slow down, avoiding damaging mechanical stress. It is suggested, however, to do not exceed four speed changes every hour.

3.2.8. REVERSE SPEED OF ROTATION

In some cases, it is possible to operate the fan with the rotation of the impeller in the opposite direction to the normal operation. In this working condition, in the majority of installations, airflow rates are reduced to 60% of the nominal ones. Special installations are possible to obtain 100% of airflow in both directions of rotation of the impeller. Contact the IVI Customer Service for more information.



CAUTION

When inverting rotation direction, make sure the impeller has stopped before restarting it. Generally, simply observing the motion is sufficient. We recommend waiting for 30-90 seconds, according to the machine's power and speed.

3.2.9. VARIABLE SPEED DRIVE (VSD)

The chosen VSD should be compatible with the used electric motor. Please refer to the inverter and the electric motor handbooks as regards connections, wiring and safety measures.



ATTENTION

Do not supply power to the electric engine with a frequency involving a higher speed compared to nominal one.

The expected starting ramp should neither overheat the engine nor cause any fan vibration. The VSD must be chosen bearing in mind that the engine must not be subject to tension peaks over 1000 V, which may reduce its duration.

In case the fan is expected to work at different speeds than ones specified in the tag, make sure that the intended speeds do not cause vibrations or resonance phenomena and that they do not cause

malfunctions or overheating of the electric motor. In any case, it is necessary to contact the IVI Customer Service to approve these changes under warranty.



The noise level may significantly increase with inverter power supply, even at network frequency.



- When fans are expected to be used in dangerous areas, please remember that nominal fan characteristics, related to network service, may be modified if power is supplied through a VSD.
- It is up to the installer to check and possibly intervene in order to comply with the limits imposed by the standards.

Never use the fan motor at speeds below 20% of the rating plate (Different ranges of use are possible; if in doubt, contact the IVI Customer Service).

3.3. FAN NOISE

Fans exceeding 75 dB(A) require the use of hearing protection systems. In any case, refer to the safety standards and tolerance limits for environmental pollution applicable where the fans are mounted.

3.4. OPERATING WAY IN CASE OF ACCIDENT OR DAMAGE

IVI is not responsible for the organization of an operating method for allow you to unlock the fan safely in case of accident or failure: this method must be described in the manual of the equipment on which the fan is installed.

4. TROUBLESHOOTING

PROBLEM	POSSIBLE CAUSES	SOLUTIONS
High vibration level on horizontal plan	Loss of fan balance	Balance the fan again
	High bearing clearance	Replace bearings
	Transmission disruption	Put the assembly back in place checking alignment
	Structure deterioration	Repair or replace
Low or medium vibration level on horizontal plan	Blades are not assembled properly	Assemble blades correctly (refer to the impeller manual)
	Blades are not assembled properly	Key blades correctly (refer to the impeller manual)
	Dirt residues on blades	Clean with solvent
	Ice on blades	Remove it
	Loose bolts	Tighten with correct torque (refer to the impeller manual)
	Worn or missing balancing weights	Balance the fan again (contact the IVI Customer Service)
High vibration level on vertical plan	Irregular aerodynamic loads	Contact structure manufacturer and the IVI Customer Service
	Structure in resonance with fan	DO NOT USE FAN Contact the IVI Customer Service
	Loose bolts on blade supports	Tighten with correct torque (refer to the impeller manual)
Low or medium vibration level on vertical plan	Blades not aligned	Check blade alignment
Corroded bolts and nuts	Corrosive atmosphere	Periodically replace with anti-corrosion protection bolts
Hub corrosion	Corrosive atmosphere	Disassemble hub and protect it. If corrosion traces are on 20% of hub surface and/or on 10% of disc thickness, contact IVI Customer Service.
Blade erosion	Atmosphere where soil, sand or heavy dust are present	Reduce erosive components if possible. Contact the IVI Customer Service if necessary for blade check and/or replacement

5. OPERATIONAL MAINTENANCE AND PERIODIC CONTROLS

5.1. INTRODUCTION

Fans require regular maintenance in order to preserve their efficiency, as well as to prevent any damage to people or things. The frequency of operational maintenance interventions will depend on actual operating conditions of the machine. In case of ideal operating conditions and continuous operation, we recommend controlling the machine:

- After the first 100 hours of operation
- After the first 200 hours of operation
- At 2500-hour intervals



Before performing any maintenance intervention, make sure the fan is not operating and the impeller is not moving. Make also sure that the fan cannot be accidentally started. Skilled personnel shall perform all maintenance intervention.



- Components resulting damaged or worn after inspection must be replaced.
- All maintenance involving modification of the product's original characteristics is forbidden.
- Repair interventions performed without an express written authorization by the manufacturer shall make product warranty and certification null and void.

It is suggested to use compressed air to clean the fan: it is better not use water, water jets and wet clothes to prevent electric shock or electric motor malfunction.

5.2. FAN CLEANING



Cleaning operations are particularly important for fans used in potentially explosive areas, and must be performed according to safety criteria suitable to the type of dust to be removed. In particular, periodically it is necessary to remove dust and debris at the end of blades or on the carpentry casing, to prevent any friction, and always keep the electric engine clean.

When cleaning the fan components, it is essential to remove the dust deposits inside interstices between fixed and removable parts (e.g. between impeller and casing, or impeller hub and driving shaft) and on the electric motor. It is also very important to remove any rust trace appearing in possible contact area, even accidental, between moving parts and to restore the protective coating.



Some fans are equipped with an impeller inspection door or hatch, it is forbidden to open the door when the machine is in operation for inspection and maintenance operations. There is a residual risk of shearing and impact with the fan blades. A warn has been affixed to the inspection hatch.

5.3. DUCT CASING AND PROTECTION GRID

- Check the integrity of the grounding connections.
- Clean parts periodically, removing all foreign bodies and dirt.
- Make sure the anti-spark band (if present) is secured properly and not deformed.
- Make sure the protection grid and carters are not deformed and the distance between them and moving parts is sufficient to avoid friction.
- Check the condition of surface coatings and the presence of rust, if so, remove the rust and restore the protection.

5.4. IMPELLER

- Accurately clean the blades and the hub, removing all dirt deposits.
- Make sure blades are free from any bend or scratch traces.
- Check the tightening of the bolts fixing the blades to the hub and of the ones fixing the impeller to the shaft is according to the tables in the provided impeller manual.
- Make sure the gap, which is the distance between the blades tip and the casing inner wall (or anti-spark, if present), is consistent with the value in the impeller datasheet, the provided impeller manual or the applicable reference standards.

5.5. ELECTRICAL MOTOR AND ELECTRICAL CONNECTION

- Make sure grounding connections are intact.
- Clean the electric engine accurately, paying the utmost attention to the two side extremities.
- Make sure the electric engine is operating properly, without any vibration or strange noise.
- Make sure the electric engine fixtures are tightened properly, according to electric motor manual.
- Please refer to the electric motor installation, use and maintenance handbook for any further information on maintenance procedures.

5.6. SUPPORTS AND TRANSMISSION SHAFT (OR MONOBLOCK)

- Clean supports accurately, making sure there are no corrosion or overheating traces.
- If applicable, check the condition of greasers and thermometric probes.
- Make sure support fixtures are tightened properly, according to the impeller handbook.

5.7. BEARINGS

For any maintenance operations or replacement of the motor bearings, monoblock or bearings of the drive shafts, it is necessary to refer to the manufacturers' manuals.



For Cat. 2 fans, the user shall install a temperature-monitoring device for bearings, connecting it to an alarm or switch activated by temperatures overcoming 10 °C the standard operating temperature. Devices shall be suitable to the installation area and properly certified.

5.7.1. ELECTRIC MOTOR OR TRANSMISSION SHAFT WITH BEARINGS LUBRICATED AT INTERVALL

Clean the grease nipples and introduce the grease with the special syringe, slowly rotating the shaft during the operation. For the lubrication intervals of the bearings refer to Table 5-1 and Table 5-2, it was prepared, just as reference, by mediating the values provided by the different manufacturers. For detailed information on the fan supplied, refer to the electric motor manual.

5.7.2. ELECTRIC MOTOR OR TRANSMISSION SHAFT WITH BEARINGS LUBRICATED LIFETIME

Most electric motors used on low-power fans involve the use of permanently lubricated sealed Z or RS bearings. Their duration varies according to environmental and operating conditions (temperature, presence of dust, number of starts, etc.). These bearings can guarantee an adequate greasing of about 25000 hours in Cat. 3D / 3G, or about 40,000 hours in Cat. 2D / 2G. For detailed information on the fan supplied, refer to the electric motor manual.

5.7.3. TYPES OF GREASE

Use only greases having the following characteristics:

- High quality, lithium-soap or mineral oil grease.
- Viscosity: 70-160 mm²/s at 40 °C.
- Temperature range: -30 / +140 °C (continuous operation).
- Recognition temperature higher of at least 50 °C than maximum overall temperature for the engine/fan class (e.g. over 250 °C for T3/T4 class).

Do not mix different types of grease. Their incompatibility may damage bearings.

5.7.4. LUBRICATION INTERVALS

IVI fan are equipped with components supplied by different manufacturers, choosing among many models to better adapt to working conditions. Regarding the lubrication intervals of electric motors and supports, Table 5-1 and Table 5-2 are intended to provide indications that may not be in line with the relevant component manuals. For detailed information on the fan supplied, refer to the electric motor manual.

Electrical motor size	Greasing interval in operating hours, according various velocity of rotation in RPM [x 1000h]						Lubricant [g]
	3600	3000	1800	1500	1000	<1000	
112	10	13	18	21	25	28	10
132	9	11	17	19	23	26	15
160	7	9	14	17	21	24	25
180	6	8	12	15	19	22	30
200	4	6	11	13	17	21	40
225	3	5	10	12	16	20	50
250	2.5	4	9	11	15	18	60
280	2	3.5	8	10	14	17	70

Table 5-1: Greasing intervals for electric motor with ball bearings lubricated at interval.

For roller bearings, the intervals are equal to 40% of those indicated in the table.

The table is applicable for horizontal shafts with normal loads and with an ambient temperature of 25 °C, corresponding to a bearing temperature of 70/80 ° C. For vertical shafts, the ranges shown in the table must be halved.

The intervals indicated in the table are to be halved every 15 ° C of temperature increase.

In case of use in a dusty, hot or corrosive environment, the lubrication intervals must be suitably reduced.

Transmission shaft or Monoblock size	Greasing interval in operating hours, according various velocity of rotation in RPM [x 1000h]						Lubricant [g]
	3000	1500	1000	750	500	<500	
50	6	12	15	18	21	25	20
60	5	11	14	17	20	24	25
70	4	10	13	16	19	23	30
80	3	9.5	12.5	15	18	22	40
90	2	9	12	14	17	21	50

Table 5-2: Greasing intervals for transmission shaft or monoblock with ball bearings lubricated at interval.

5.7.5. CONTROLLI

It is necessary to refer to the relative use and maintenance manuals for the control intervals to be performed on the bearings.

Resistors, gaskets and V-rings must be replaced, along with bearings, at least every three years, except for particular operating conditions

5.7.6. REPLACEMENT

To replace the bearings for drive shafts or monoblock, contact the IVI Customer Service.

For the replacement of bearings for electric motors, it is necessary to refer to the relative maintenance manual. If in doubt, contact the IVI Customer Service.

5.8. BELTS AND PULLEYS

It is essential that the belt is assembled with the correct tension, and that pulleys are aligned properly, in order to enhance their performance and duration.



It is very important that the belt is mounted with the correct tension and that the pulleys are aligned, in order to optimize its performance and durability. A lower than recommended tension leads to excessive belt oscillations. High tension cause premature belt wear and increase the level of noise produced. The belt must be assembled by hand, without the use of tools (such as key or levers) that can cut or damage the belt or the pulleys. Refer to Section 4 of the manual.

5.8.1. TRAPEZOIDAL AND TOOTHED BELT TENSION

Trapezoidal or toothed belt tension is essential for a correct operation of the fan's kinematic mechanism. The transmission datasheet is provided separately, referring to the tension for new and used belts. High tension reduces the life of the belt and bearings.

- Keep the belts free from foreign materials that may cause slippage.
- Check belt tension often during the first 24/48-hour run-in period.

The ideal tension is the lowest, at which the belt does not skid in maximum load conditions. If this definition is not enough to identify the best tension value for the application, it is possible to check the belt tension with two alternative approaches: the “flexion method” or the “vibration frequency” method.

Using the “flexion method”, it is necessary to measure the displacement (f) due to the application of a force (Q) in the middle of the free section of the belt (l) and perpendicular to it. Figure 5-1 can be used as reference. The displacement is usually about 1.5% of the free stretch applying a force. Both the arrow value and the force value are indicated in the datasheet of the transmission system.

For the vibration frequency method, it is necessary to have an instrument, an electronic belt gauge, able to measure the frequency at which the transmission belt vibrates because of an impact. For the use of this instrument, it is advisable to refer to the manual of the same.

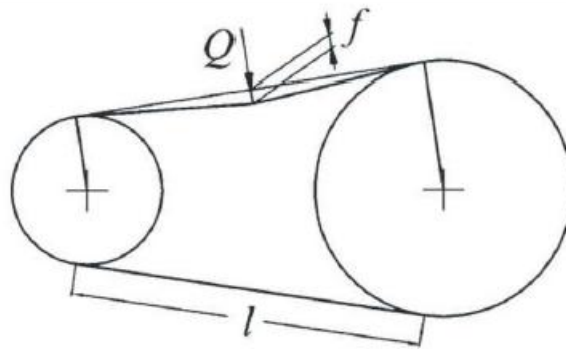


Figure 5-1: Reference diagram of the flexion method for trapezoidal or toothed belts.

Whatever the method used to measure the belt tension, to get the correct tension it is necessary to move away or bring closer the pulleys; according to the following instructions, depending on which group model is used.



On fans installed in areas classified as potentially explosive, the belts must be replaced with others of the same type, certified as suitable to avoid the accumulation of electrostatic charges.

IVI recommend replacing the belts every two years or 10,000 operating hours. For any other information, refer to the transmission system datasheet.

5.8.1.1. FAN SERIES “TFF-01”, “GFF-04”, “TFF-09” E “TFF-12”: BELT TENSION

1. Loosen the locknuts (1 and 3, Figure 5-2) at the four ends of the motor plate.
2. Tighten the nuts (2) to bring closer the two pulley packages or move away, in order to reduce or increase the belt tension.
3. Check the tensioning of the belts according one of the two methods described above.
4. Once the correct tension value is obtained, retighten the locknut (1 and 3).

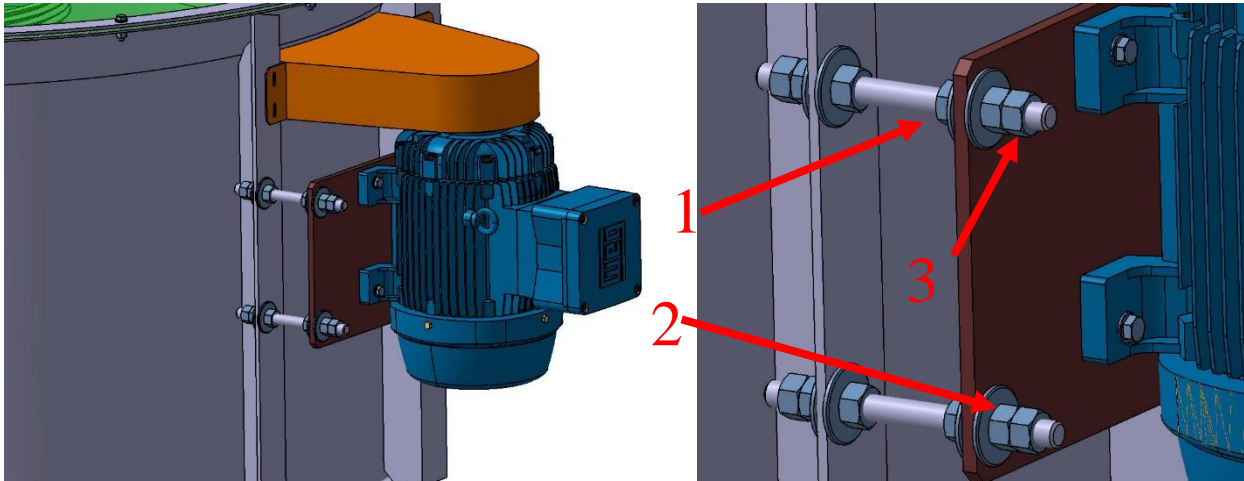


Figure 5-2: Tensioning for fan models “GFF-01”, “GFF-04”, “TFF-09” and “TFF-12”

5.8.1.2. FAN SERIE “TFF-01”: BELT TENSION

1. Loosen the locknuts (1 and 3, Figure 5-3) at the four ends of the motor plate.
2. Tighten the nuts (2) to bring closer the two pulley packages or move away, in order to reduce or increase the belt tension.
3. Check the tensioning of the belts according one of the two methods described above.
4. Once the correct tension value is obtained, retighten the locknuts (1 and 3).

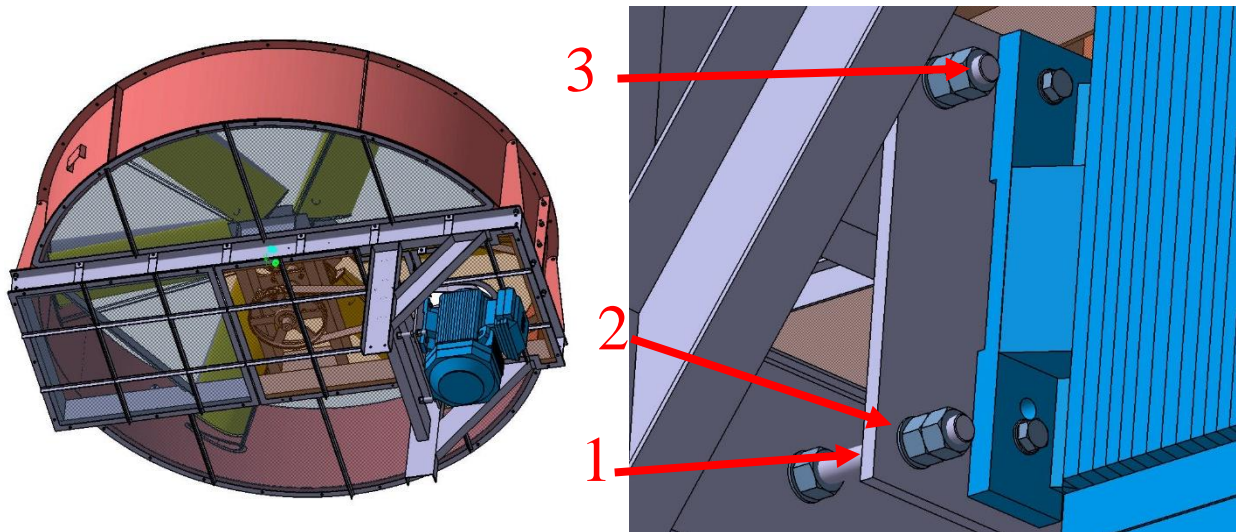


Figure 5-3: Tensioning for fan models “TFF-01”

5.8.2. PULLEY ALIGNMENT

After each belt adjustment intervention, it is necessary to check the alignment of the two pulleys, making sure there is no contact with other fan components. Misalignment can be parallel or angular as shown in Figure 5-4.

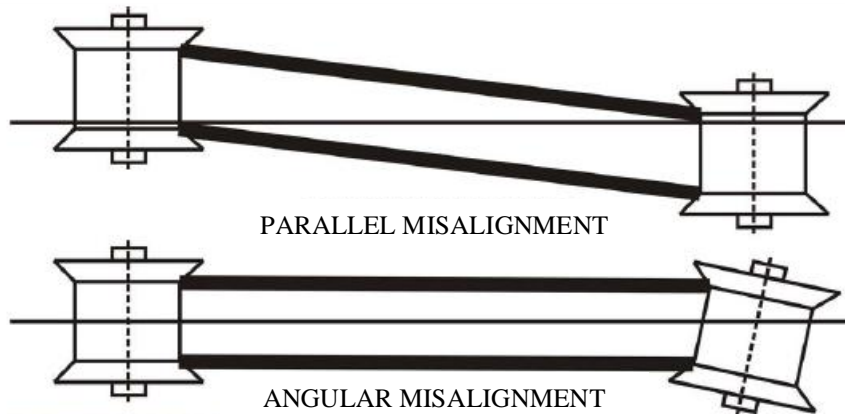


Figure 5-4: Typical misalignments for double pulley transmission systems.

In both cases, alignment must be checked with a pulleys alignment laser device, a laser lever or leaning a rectilinear bar on the two pulleys.

Please refer to the datasheet of the transmission system for the tolerance values; in any case, misalignment must never overcome 0.5° and 4 mm for each meter of center-to-center distance between the two pulleys.

1. Extract the conical bush securing the pulley, removing fixture screws.
2. Reinsert the fixture screws in the two unlock holes.
3. Tighten screws until the pulley is secured in place.
4. Align the other pulley.
5. Remove fixture screws from the unlock holes.
6. Secure the conical bush back in place, as well as fixture screws.

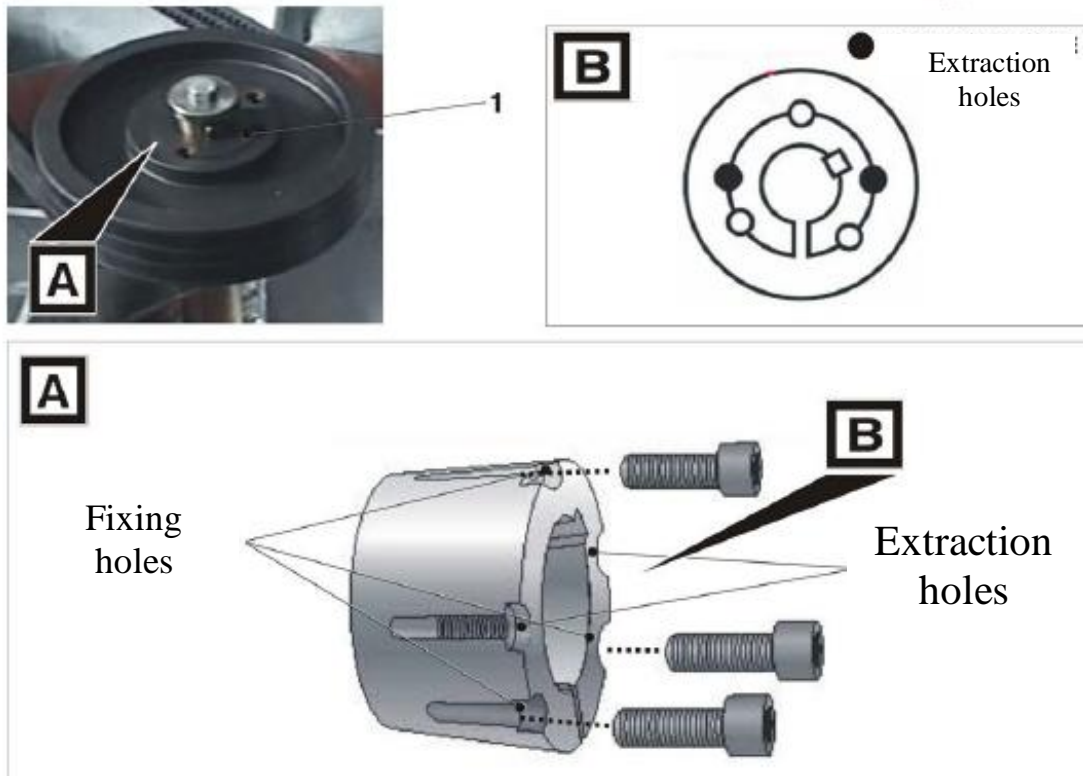


Figure 5-5: Detail of the conical bushing with indication of the bolt seats.



ATTENTION

Pulley misalignment may result in the reduction of pulley duration and in the presence of additional loads on bearings, reducing their duration as well. Moreover, misalignment can cause friction and, therefore, overheating. In case it is not possible to assure a correct pulley alignment constantly or to check pulley alignment regularly, user must install a temperature monitoring system, which is mandatory for cat. 2 fans.

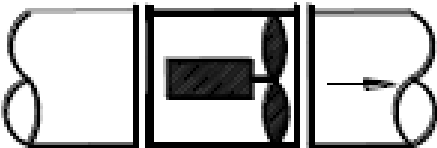
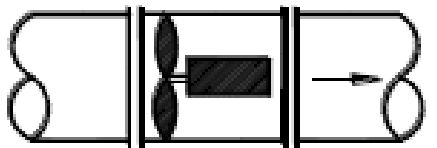
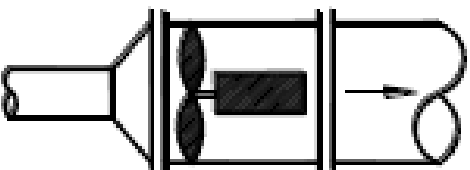
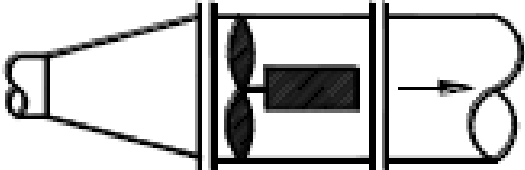
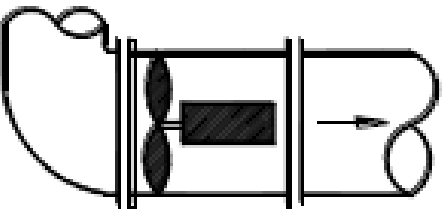
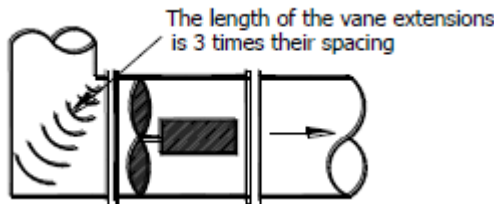
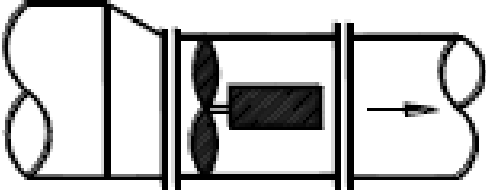
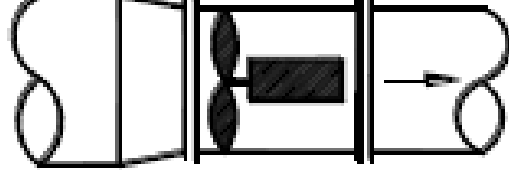
5.9. BOLTS AND NUTS

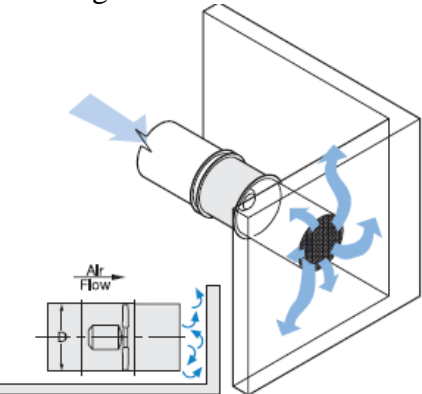
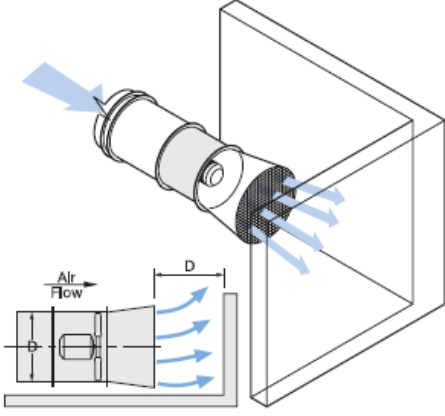
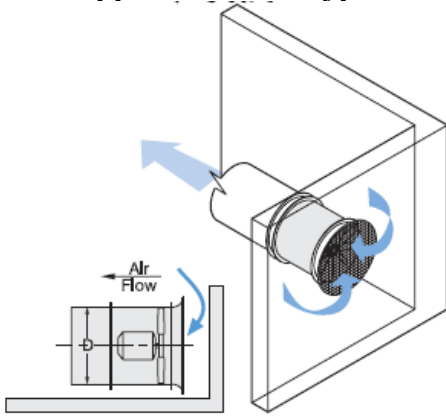
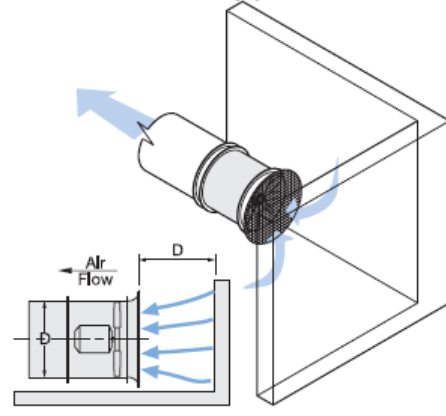
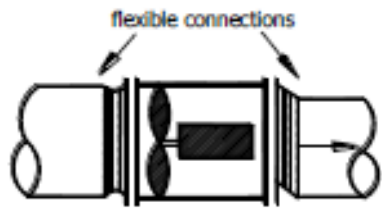
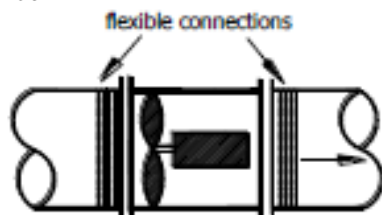
Periodically check there are no oxidation traces. In case of oxidation jeopardizing component performance, replace the component with a spare part having the same characteristics, tightening it according to torque values in the impeller handbook.

6. ATTACHMENTS

6.1. GUIDELINES FOR INDUSTRIAL FANS INSTALLATION

The following guidelines for industrial fans installation shall be evaluated according to the application.

INCORRECT	CORRECT
<p>Motor upstream of impeller causes turbulence and noise</p> 	<p>Motor downstream from impeller minimizes turbulence and noise</p> 
<p>Abrupt inlet transition causes turbulence and reduced aeraulic performances</p> 	<p>Gradual expansion of the inlet duct avoids impeller turbulence</p> 
<p>Upstream radius elbow creates imbalance at inlet</p> 	<p>Square inlet elbow with extended trailing edge vanes delivers less turbulent airflow to fan inlet</p> 
<p>Asymmetrical transition creates imbalanced load on fan, with excess turbulence and noise</p> 	<p>Symmetrical transition balances load on fan, which minimizes turbulence and noise</p> 

<p>When the discharge is too close to an obstacle (wall, ceiling etc.) the obstruction* might generate noise and increase the discharge losses</p> 	<p>Allow a gap at least 1.5 fan diameter between the discharge and obstacle</p> 
<p>The impeller might need air when the suction is obstructed*. This might increase the resistance of the system reducing the airflow handled by the impeller This is applicable on all type of fans</p> 	<p>Allow a gap at least 1.5 fan diameter between the inlet and nearby obstruction, to avoid that the fan performance will be less that rated</p> 
<p>Slack or offset flexible connections causes turbulent air flow</p> 	<p>In-line flexible connections provide optional vibration isolation without creating turbulence</p> 

NOTA

We define "partial obstructions" on the entry or exit side, beams nearest 1.5 times the rope of the wing profile used. Such obstructions can affect the impeller performance, as well as the life of the impeller due to resonance phenomena. It is always recommended to remove any obstructions, even partial, near the impeller.



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