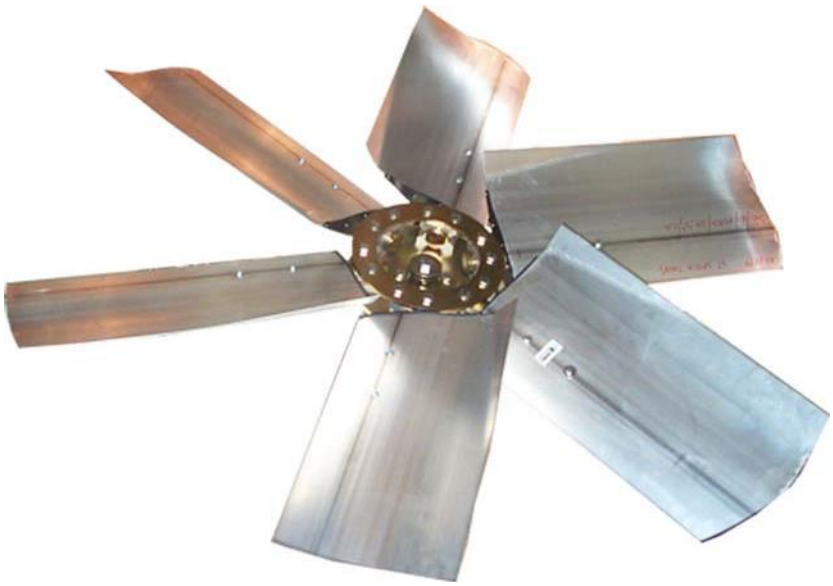
INSTALLATION, USE AND MAINTENANCE MANUAL

ilmed
VENTILAZIONE INDUSTRIALE

STANDSTILL ADJUSTABLE BLADE IMPELLERS

AP/EL SERIES



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1. INTRODUCTION

1.1. OVERVIEW

The purpose of this handbook is to assist owners and operators in maintaining and operating the industrial impellers of the Ilmed Ventilazione Industriale Srl (hereinafter IVI). You can install it in a ventilation assembly manufactured by IVI or, as an alternative, on systems at customer's premises.
Information contained in this handbook is property of IVI; copying and disclosure, even partly, is forbidden without authorization.
Equipment is designed in compliance with the Machinery Directive issued by EC Council (directive 2006/42/EEC as amended) to assure a safe intended use when directions contained in this handbook are always abode by. If required, equipment may be manufactured in compliance to directive ATEX 2014/34/EU for use in environments at danger of explosion.
Please read it carefully; information and instructions furnished can help you achieve years of dependable performance. This handbook provides indications and directions to install and operate equipment in safety condition for operator.
In compliance with Machinery Directive it reports all general information for safe assembly and installation of the impeller in a ventilation system; it also contains all routine service and maintenance actions operator directly can carry out.
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 understanding of given information.

1.2. REFERENCE

Separate manuals are included for auxiliary equipment; they contain additional information that may not be repeated in this manual. You are urged to read all manuals before attempting any operation or repair of the equipment in the system. If these manuals are not included in your owner’s packet, contact the IVI for further information.
Reference publications are divided in two separated groups:

- Applicable diagrams: this group collects all diagrams applicable to the equipment (e.g. Data Sheets).
- External auxiliary systems handbooks: This group collects all publications relevant to auxiliary groups not part of the equipment but essential for proper operation of the same (e.g. ventilation assembly handbook or electric engine handbook).

1.3. HANDBOOK USE WARNINGS

1.3.1. PURPOSE AND LIMITS OF THIS HANDBOOK

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

- All technical specifications about the impeller series AP or EL and the IVI ventilation system the impeller is installed in.
- Working place arrangement as regards the environmental features and supply sources.
- Accident-prevention regulations and information relevant to safety devices installed on equipment.
- Expected use of equipment.

Handbook cannot replace the specific training operators shall have achieved previously on similar equipment or they have to achieve on this equipment under the guide of trained staff. This manual is outlined for owners and operators of the IVI Company. Operating conditions vary considerably and cannot be addressed individually. Through experience, however, operators should have no difficulty in developing good operating, safety and monitoring skills.

1.3.2. HANDBOOK CONSERVATION

Installation, use and maintenance handbook is an integral part to this machinery; store it for future reference until equipment final dismantling. Keep it with the utmost care in a safe place, and protect it from dust and moisture. In case of damage or impairing reference, even partly, users must request a new copy to manufacturer.

1.3.3. HANDBOOK UPDATE

Photographs and illustrations were current at the time of printing, but subsequent production changes may cause your IVI's impeller to vary slightly in detail. IVI reserves the right to redesign and change the equipment as deemed necessary, without notification. If a change has been made to your impeller that is not reflected in this owner's manual or the illustrated parts list, please contact IVI for current information and parts.
This manual has been prepared when manufacturing the equipment it is referred to. It can be regarded as unfit only due to later updates (also for similar equipment) according to new experiences.
IVI reserves the right to change its production along with the relevant handbooks without being compelled to update what delivered previously. Any integration sent to user shall be kept along with the handbook.

1.3.4. COOPERATION WITH USER

IVI is at your disposal for any further information you may need concerning equipment use and maintenance. We will take into consideration handbook improvement suggestions in order to make it clearer and it fit for the needs of our customer.

1.3.5. SYMBOLS USED IN THIS HANDBOOK

⚠ *CAUTION*	This term and the relevant symbol pinpoint a situation where non-compliance with the stated regulations may jeopardize operator or exposed individuals resulting in injury or death.
⚠ *WARNING*	This term and the relevant symbol pinpoint a situation where non-compliance with the stated regulations may damage equipment or equipment parts.
NOTE	This term recalls the attention of reader on special aspects of the described procedure
	This term recalls the attention of reader on special aspects of the described procedure. This symbol identifies a prohibition or an important indication concerning operator or exposed persons safety, specific to the ATEX directive. Special directions for safe use of fans in compliance with directive ATEX 2014/34/EU directive are provided.

1.3.6. GENERAL SAFETY DEFINITIONS

OPERATOR
The operator is the individual authorized by plant safety manager to perform actions in his competence relevant to equipment management; operator shall identify any risk 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 special fields, e.g. aeraulic 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 one or more elements are linked to, that may result in death or severe injuries to operator or exposed persons.

RISK
Defines, in this handbook, a possible danger, therefore, a possible damage to operator or exposed persons.

1.3.7. EQUIPMENT TECHNICAL DEFINITIONS

AUXILIARY DEVICES
Defines any device not manufactured by IVI, fit, due to its own shape, specifications and size to perform a side action in equipment operation.

FIRST START UP
Post-installation start up, including running tests.

SERVICE ACTIONS
Refill or restore actions to perform from time to time or at scheduled time not requiring skilled personnel action. Operator may perform operation service.

SERIES
The term series identifies a line of similar equipment that can perform their action, with specific features and modes.

TYPICAL INFORMATION
"TYPICAL" refers to features or operations that are valid for base equipment in standard configuration. Features may differ according to the single equipment configuration.

1.4. EQUIPMENT INTENDED USE

In this handbook, equipment refers to impeller that has been designed to be placed inside a full ventilation assembly or for autonomous use (e.g. input and integration in ventilation towers or air coolers).

Installation in classified areas (ATEX/2014/34/EU)

- Fans to be used in dangerous areas are designed to meet official regulations requirements relevant to environment at risk of explosion. If such fans are installed or used improperly or even slightly changed, their safety and reliability may be impaired creating a grave danger to operator and exposed persons.
- Any device, equipment o additional parts used on fans o related to fans, shall be compliant with the ATEX directive and compatible with data reported on ID tag of the fan itself.

Impeller is an axial type impeller with direct or belt (V or direct) transmission, driven by an electric engine. It is fit for industrial tasks where high flow rates at medium or low pressure are required.
Do not use equipment for a task different than the one it has been designed for. The impeller must be installed inside fixed carters and grids that contain the moving parts and isolate them to the access of all operators. It is forbidden to install impellers NOT ATEX marked in potentially explosive areas.

1.4.1. CUSTOMER SERVICE

This handbook gives all required information for using and managing the equipment it refers to. All required servicing is ruled by system use conditions and warranty.
Address any further request for information or service to IVI Customer Service.

NOTE

To require service or order spare parts always state equipment ID data as per the following paragraph.

1.4.2. CUSTOMER SERVICE

ILMED VENTILAZIONE INDUSTRIALE s.r.l.
Viale dei Mareschi, 15
10051 Avigliana (TO) - Italy
Phone +39 – 011. 93.25.555
Telefax +39 – 011. 93.67.289 / +39 – 011.93.25.579
E-mail: ivisales@ilmed.it

1.4.3. EQUIPMENT ID

Main equipment ID data are printed in the tag installed on the equipment itself (refer to Figure 1-1).
Tag reports data of operator's interest:
Equipment type
Model
Year of production
Serial #
Electrical data

1.4.3.1. IMPELLER ID

The impeller model ID is encoded as follows in Table 1-1 and Table 1-2:

AAA / BBx / CCy / DDDD / EEEEE / FFFF

AAA	It states the material impeller is made of: ALU means extruded aluminium with no surface treatments FRP means pultruded plastic reinforced by fibre glass and carbon fibres
BBn	States the model of used impeller (chord size in cm) without winglet type tip plugs
BBw	States the model of used impeller (chord size in cm) with winglet type tip plugs
CCn	States the number of blades without reinforced leading edge
CCr	States the number of blades with reinforced leading edge
CCR	States the number of reversible type blades
DDDD	States the hub type
EEEEE	State the diameter in mm (or in feet when followed by ft.) without leading zeros.
FFFF	States the blades connection or pitch adjustment type: standstill manual AP moving automatic AV moving automatic controlled under AVCS elastomeric joint EL

Table 1-1: Impeller identification.

EXAMPLES

ALU/20n/05n/BA1/01000/AP	standstill adjustable pitch impeller with 5 type 20 aluminium blades (chord 200 mm) impeller diameter 1000 mm, type BA1 hub
FRP/59n/07n/F2-D/05000/AV	moving adjustable pitch impeller with 7 type 59 FRP blades (chord 590 mm) impeller diameter 5,000 mm, type F2D hub
ALU/36w/06n/D2-F/14Ft/EL	Impeller with elastomeric joint between blades and hub, 6 type 36 aluminium blades (chord 360 mm) impeller diameter 4267 mm, type D2-F hub with winglet type plugs

Table 1-2: Impeller ID examples.

1.4.4. SPARE PARTS

We recommend using only IVI genuine spare parts. You could order spare parts to IVI Customer Service. In your request, please always state:
1. All equipment ID data (refer to the ID tag) in Figure 1-1
2. Code, name and technical description of the part to be replaced
3. Destination of the requested parts.

Figure 1-1: ***Impeller identification.***

1.4.5. EC MARK

The impeller itself can't be EC marked, as equipment not usable by itself, in compliance with enclosure IIIb of the European Community Machinery Directive as amended by directives 91/368/EEC, 98/68/EEC and 2006/42/EEC relevant to equipment or equipment part that can't operate autonomously.
This information is contained in a proper certificate that also reports Customer name, order number and tag number of the equipment. This certificate is attached with the product and shall not be operated until equipment is it part of is declared compliant with Machinery Directive.
This certificate is integral part to the equipment; it must be given to the new owner if the equipment is sold.

1.4.6. ATEX MARK

ATEX mark is a code including the following items.

	II	2	G	c	T3	X
A symbol that identifies 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	Special directions for safe use (refer in handbook where the EX symbol is present)

Table 1-3: ATEX mark

For further information, refer to ATEX 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 evaluation of risks arising from equipment use and use environmental conditions.
Non-compliance with indication contained in this section and further directions contained on this handbook may impair design safety condition and result in accidents to operators.

1.5.1. REGULATIONS

The impeller with standstill adjustable blades AP series or in alternative, the whole IVI ventilation group and the single parts it is made of have been designed keeping in mind the harmonized EC regulations, other local and European rules, enforceable by the Machinery Directive issued from the EC Council (89/392/EEC as amended). The main harmonized regulations considered are:

- EN 292-1 (1992) - Equipment safety - Basics, design general principles. Part 1: terminology, base methods.
- EN 292-2 (1992) - Equipment safety - Basics, design general principles. Part 2: specifications and technical principles.
- EN 60204-1 (1992) / CEI 44-5 (1993) - Equipment safety - Equipment electric devices. Part 1: general rules.
- EN 50081-2 (1995) - EMC - Emission general regulations - Industrial environment.
- EN 50082-2 (1995) - EMC - Immunity general regulations - Industrial environment.
- CE 2014/34/EU (2014) – ATEX – Rules relevant to products used in potentially explosive atmosphere.

1.5.2. ENVIRONMENTAL USE CONDITIONS

1.5.2.1. TEMPERATURE AND HUMIDITY

You can use equipment under the following conditions:

- Minimum temperature – 20 °C (-40°C in case of supplies with low temperature steels)
- Maximum temperature +120 °C

NOTE

Different operating ranges are available. In case of doubt, call IVI Customer Service.

1.5.2.2. FREQUENCY AND RESONANCE

All fans and impellers, no matter the manufacturer, have natural frequencies that shall be as far as possible from system energizing frequencies.
Operation in resonance or near resonance conditions might highly stress structure elements and fan, causing risk of breakage. For further information call IVI.

1.5.2.3. OPERATION ENVIRONMENT CORROSION

Environmental conditions may deteriorate support structures and fan components. During scheduled inspections, check all fasteners and replace them as necessary.
When you use equipment in corrosive environment, adapt maintenance modes and times in order to avoid excessive wear and tear of components. Where severe corrosion conditions are expected, use inhibitors or special protection treatments. For help or advice call IVI.

1.5.2.4. LIGHTING

Equipment operating place shall be lighted in order to easily find, control and stop devices. Lighting shall allow to safely perform routine maintenance. Compliance with regulations as regards lighting modes is user's liability.

1.5.2.5. VIBRATIONS

In cooling systems, the impeller is usually the only high mass rotating element. Therefore, it usually points out installation anomalies. As a result, the fan is often considered a source of vibrations, due to poor balancing. All IVI fans and/or their main parts are dynamically balanced (hubs, impellers up to a diameter of 1800 mm, grade Q 6.3) or statically balanced (blades grade Q 16) as required by API STANDARD 661 (Seventh Edition, July 2013) regulations.
A scheduled system control may point out in advance system parts deterioration, e.g.: bearings, structure stanchions, bolted connections, etc., that may result in operation anomalies. Vibrations measurement may warn about deterioration of a fan part or a transmission part. Forces causing vibrations are always the same, regardless of structure stanchions. Operational conditions stated in below shown diagrams provide data about fan vibration status. To detect vibrations we recommend using magnetic head vibration sensors located, according to installation type, on supports, as near to fan as possible.
Sensors (refer to Figure 1-2) shall be installed to measure vibrations in the three directions: vertical, longitudinal and transverse. During measuring, it can be detected vibration amplitude and frequencies. The analysis of collected data, according to vibration axis, indicates vibration causes. Amplitudes state whether maintenance is needed.
Diagram in Figure 1-3 highlights different limits or acceptance levels of vibration according the ISO 10816-3, referring the evaluation of machine vibration by measurements on non-rotating parts. It is possible to find the allowable value of vibration analysing the different types of impeller.
First, it is necessary to identify the type of foundation where the machine is placed: it can be rigid or flexible. Later, the electric power absorbed by the machine: there are four different groups:

1. Large machine rated above 300 Kw, with an electric motor with a shaft height usually greater than 315 mm
2. Medium machines with a rated power above 15 kW up to and including 300 kW, with an electric motor with a shaft height between 160 and 315 mm
3. Pumps with multi vane impellers with separate driver, rated above 15 kW capacity
4. Pumps with multi vane impeller and integrated driver, rated above 15 kW capacity

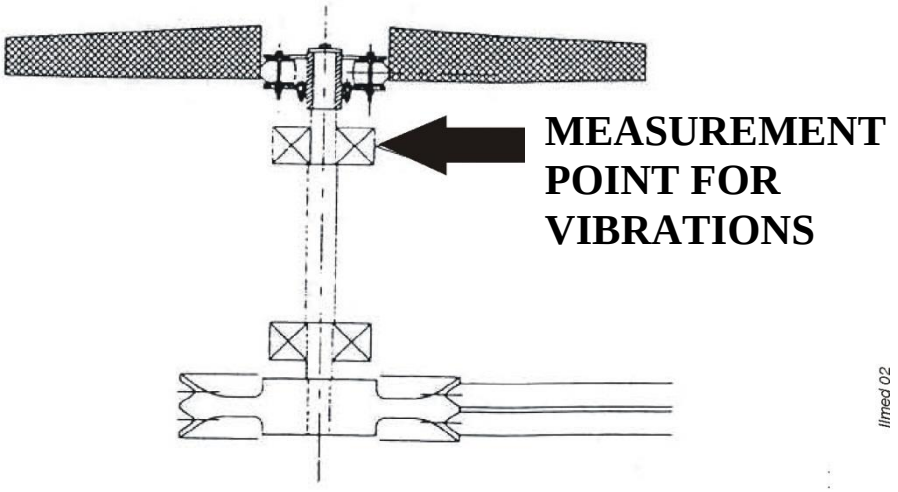


Figure 1-2 Measurement point for vibration test.

Once located the right column, the level of vibration are identify with difference colours:

Blue: “GOOD” for safe vibration conditions.

Green: “ACCEPTABLE” are acceptable conditions for a safe operation, also for new fans; this area is considered a standard for long-time service fans.

Yellow: “IMPROVEMENT NEEDED” refers to fans that should be stopped as soon as possible to perform the needed operations (cleaning, balancing, repair etc.).

Red: “NON ACCEPTABLE” refers to fans that must be immediately stopped for setting up. Operation of such machinery may be dangerous for equipment and staff.

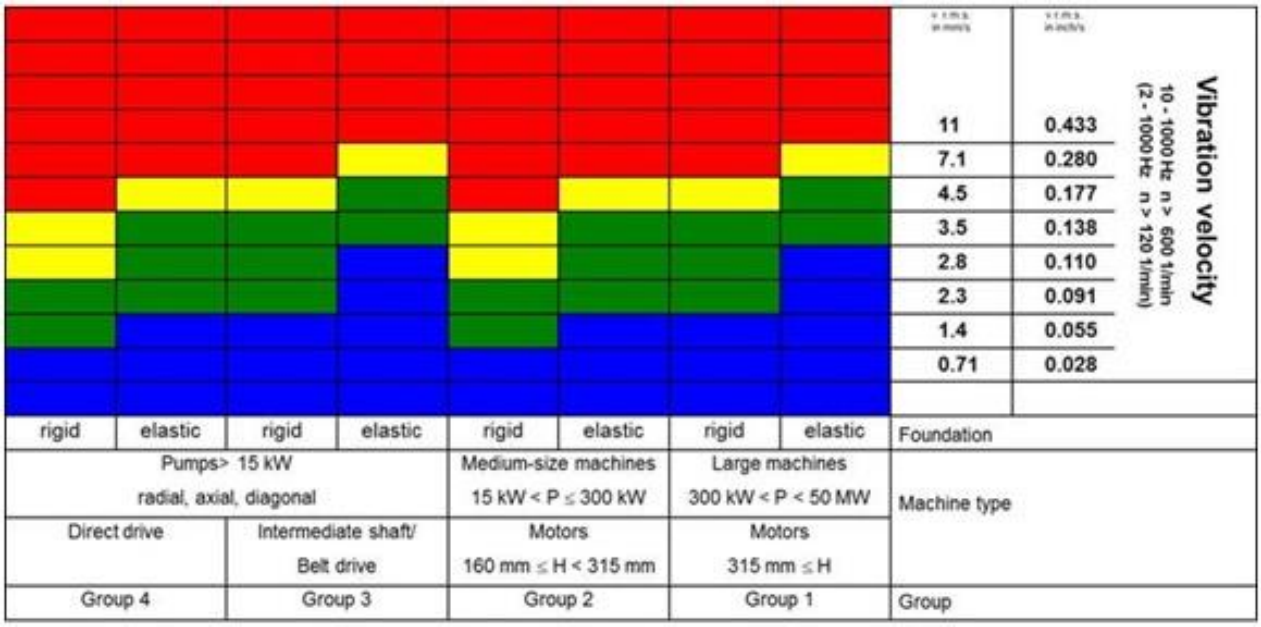


Figure 1-3: ISO 10816 vibration evaluation criteria.

NOTE

Different balancing grades are available. Contact the I.V.I. Customer Service for further information.

1.5.2.6. IMPELLER MAX TIP SPEED

DIAMETER (mm)	MAX TIP SPEED (m/sec)
500 - 1000	130
1001 - 1600	130
1601 - 3000	75
3001 - 6000	65
6001 - 15000	55

Table 1-4: Impeller max tip speed.

Continuous running at higher than allowed speed must be authorized in written by IVI. IVI declines all responsibility for damage to person and/or things arising from use of impeller out of allowed speed.

1.5.3. GENERAL SAFETY RULES

Equipment configuration and its accident prevention devices are compliant with requirements of the Machinery Directive issued by EEC Council (89/392 EEC as amended).
In Section 2 this handbook reports all accident prevention devices; all other sections report in detail all safety rules to abide by during installation and operation of equipment.
Lack to enforce these regulations may impair design safety conditions.
Staff using and monitoring equipment must be trained by employer about accident risks, safety devices installed on equipment and about accident prevention rules provided by EC regulations and by laws of the country equipment is delivered to.
IVI declines all liability for damage to equipment or for operator or third parties safety arising from non-abiding by safety rules reported in technical documents provided with equipment itself.

WARNING 1

Before starting, operator shall have perfect knowledge of equipment features, position and operation of all controls. Moreover, operator shall have fully read operation handbook and drawings and diagrams enclosed.

WARNING 2

Equipment shall be only used by skilled operators.

WARNING 3

Fully abide by directions, warnings and accident prevention general rules contained in handbooks.

WARNING 4

Tampering or non-authorized replacement of one or more equipment parts, use of accessories, tools, consumables other than the ones recommended by manufacturer may represent an injury risk and release manufacturer from tort and criminal liability

1.5.3.1. CLOTHING

Clothing of equipment operators or servicemen shall be compliant with local basic safety requirements.
Operator shall wear non-skid sole accident prevention shoes. Use of moccasins, sabots, slippers or other shoes that may impair personal movability is forbidden.
Clothes shall be fit for the work to carry out: overall or apron shall be made in natural fibre (e.g. cotton), non-flammable and clean from lubricant spots.
If operating in area at risk of splinter throwing o material outcome, use of goggles is compulsory.
During installation operator shall always wear headphones or ear caps and helmet.

During equipment use do not wear bracelets, watches, rings or chains that hang loose or hamper movements. Pay the utmost attention when working near equipment live parts not to wear clothes that might get caught inside equipment e.g. sleeves, tails, hairs etc.

1.5.3.2. ACCESS TO WORKING AREA

Working area, in particular control area, shall never be busy. Nothing shall interfere with operator freedom of movement. In case of emergency assure proper staff immediate access to equipment.
Forbid, using proper signs, access to working area to people not directly operating equipment.

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

At the end of service check no tools to be still inside accident prevention guards or inside working area.

1.5.4. RISK ASSESSMENT

1.5.4.1. FOREWORD

Assessment of risks arising from equipment use has been carried out according to methods stated in EN 292 and EN 60204-1 harmonized standards: results of such analysis and safety measures taken to eliminate or reduce user risks are reported in this section in general and in section 2 in detail

1.5.4.2. INSTALLATION ENVIRONMENT RELATED RISKS

Environment where equipment is installed may have risk issues impairing equipment proper operation.
TEMPERATURE
You shall assure the requested environmental temperature; high peaks - whether positive or negative - of temperature or humidity may cause operating issues in machines equipment is made of, e.g. engine cooling problems or ice formation on blades.

POLLUTANTS
Evaluate in advance any potential environmental damage arising from use in operating environment of pollutants such as DUST, SAND and/or HEAVY DUST PARTICLES that may accelerate blades wear and tear.
User shall guarantee suitability of equipment installation place in order to protect equipment integrity over time.

1.5.4.3. EQUIPMENT FEATURES RELATED RISKS

In compliance with directive 89/392 EEC, all equipment areas featuring risk related to work process nature o related to equipment structure itself have been analysed.
Where possible action has been taken to lower or remove all risks to exposed persons. Each equipment is provided with standard fixed and movable guards that prevent access to equipment dangerous areas during operation.
Always keep in mind that the best safeguard for operator is a constant use of caution and good sense. Experience gained using equipment over time may improve safety margins in one's own work.

1.5.4.4. RESIDUAL RISK

Residual risk are all such equipment areas or procedures that, notwithstanding taken actions, are still highly dangerous, e.g. for they are live, hot or with moving parts. On equipment all residual risk areas are marked by proper tags as per ISO standards.

1.5.4.5. PERSONAL PROTECTIVE EQUIPMENT PROVIDED

The following protective equipment must be provided before operating the equipment:

- Gloves against mechanical hazards
- Safety shoes against the danger of falling objects
- Helmet in case of lifting.

2. INSTALLATION AND ASSEMBLY

2.1. INSTALLATION

Any unauthorized modification, alteration, or use of non-approved attachments or drive units voids the warranty and releases IVI from any liability arising from subsequent use of this equipment. Each type of industrial fan and impeller is designed to be used in a specific type of system. Using the IVI's products for a purpose other than that for which it was designed could result in personal injury, as well as product or property damage. IVI's equipment is designed and built to provide years of operation. As with any equipment, the following rules are essential for trouble-free operation:

- Proper installation
- Regular maintenance
- Correct operation within original design parameters
- Proper application within a process

Failure to properly install, maintain or operate IVI equipment can result in a variety of problems, including but not limited to: poor equipment performance, decreased equipment life, equipment failure or dangerous operating conditions. The IVI product line includes a variety of equipment, all of which can be custom-made to suit your application. Your IVI equipment has been chosen based on your specification of process, product, and your application requirements for capacity, operating conditions, operating parameters, etc. It is essential that your IVI equipment be installed, maintained and operated under the conditions for which it was originally designed and specified. Should your process needs change, please consult with IVI prior to utilizing the equipment under different conditions.

2.1.1. GENERAL INFORMATION

Impeller is shipped packed, already assembled or split in its main parts:

- Lower hub disc with preassembled blade seating blocks and hub.
- Blades
- Upper hub disc with preassembled blade seating blocks and hub
- Gap optional adjustment rings
- Fixtures (screws, nuts, safety rings)
- Use and maintenance handbook

At reception visually check packing integrity, where packed. In case of damage arising from shipment or missing parts call IVI customer service.
Installation, test and first start of impeller inside a ventilation system shall be performed by skilled personnel. User shall prepare equipment installation place, hoisting and handling devices and all material needed for installation as described in the following paragraphs.

2.1.2. UNPACKING

Impeller or impeller parts are shipped properly packed and protected according to shipment means. Pay the maximum care when unpacking to avoid damage to people or equipment. Dispose of packing materials according to local regulations.

2.1.3. EQUIPMENT INSTALLATION PREARRANGEMENTS

2.1.3.1. INSTALLATION PLACE REQUIREMENTS CAUTION

Refer to “Limits relevant to installation area” in Use and Maintenance handbook of the ventilation assembly.

2.1.3.2. INSTALLATION AREA IMPELLER SUITABILITY

Refer to “Installation area impeller suitability” in Use and Maintenance handbook of the ventilation assembly.

2.1.3.3. FOUNDATIONS

Refer to “Foundations” in Use and Maintenance handbook of the ventilation assembly.

2.2. IMPELLER ASSEMBLY

2.2.1. TOOLS NEEDED FOR IMPELLER ASSEMBLY

To properly assembly impeller you need the following tools:

- Goniometric level, used to measure blades keying
- Torque wrench to tighten hub bolts according to table shown in paragraph 2.2.11.

2.2.2. SINGLE DISC IMPELLER MAIN PARTS

The single disc impeller is made of the following parts (refer to Figure 2-1):

BLADE ASSEMBLY 1. Blade 2. Safety ring 3. Root plug 4. Tip plug 5. Gap optional adjustment rings 6. Blade shaft	**HUB ASSEMBLY** 7. Disc - ring - blocks securing parts (screws, washers, nuts) 8. Hub disc 9. Upper hub ring 10. Lower block 11. Upper block 12. Bush 13. Bushed disc securing parts (screws, washers) 14. Elastic pins

2.2.3. SINGLE DISC IMPELLER DESCRIPTION (Figure 2-1)

Impeller (refer Figure 2-1) is made of a blade holder hub, a coupling bush, a support disc, a ring and a series of blades.
A bush (12) seats in its upper (or lower) part the hub disc (8). Disc (8) is secured to bush using screws and washers (13) while ring (9) is secured to disc (8) using a set of screws, two sets of washers and a set of nuts (7), putting in between a lower block (10) and an upper block (11) that support each blade. Lower block (10) is positioned accurately on disc (8) using two elastic pins (14).

NOTE

The number of screws that secure the hub disc (8) to the bush (12) may change according to impeller size.

Each blade (1) is seated in its seat through a steel shaft (6), kept in position by a safety ring (2). Achieve proper position of blades inside ventilation duct installing on shaft up to three shimming rings (optional gap adjustment rings) (5), between block and safety rings. Blades are closed at both tips by plugs (3 and 4). In ATEX versions blades plugs are TIG welded.

NOTE

Gap is the space between blade tip and inner wall of duct (refer to the applicable standards in use).

NOTE

In 20 cm chord blades impeller and in special applications such as naval applications, safety ring does not keep blade in place. Instead you use a specific ring acting as shimming of blade against hub. Also in this case you can install shims to adjust impeller position inside fan.

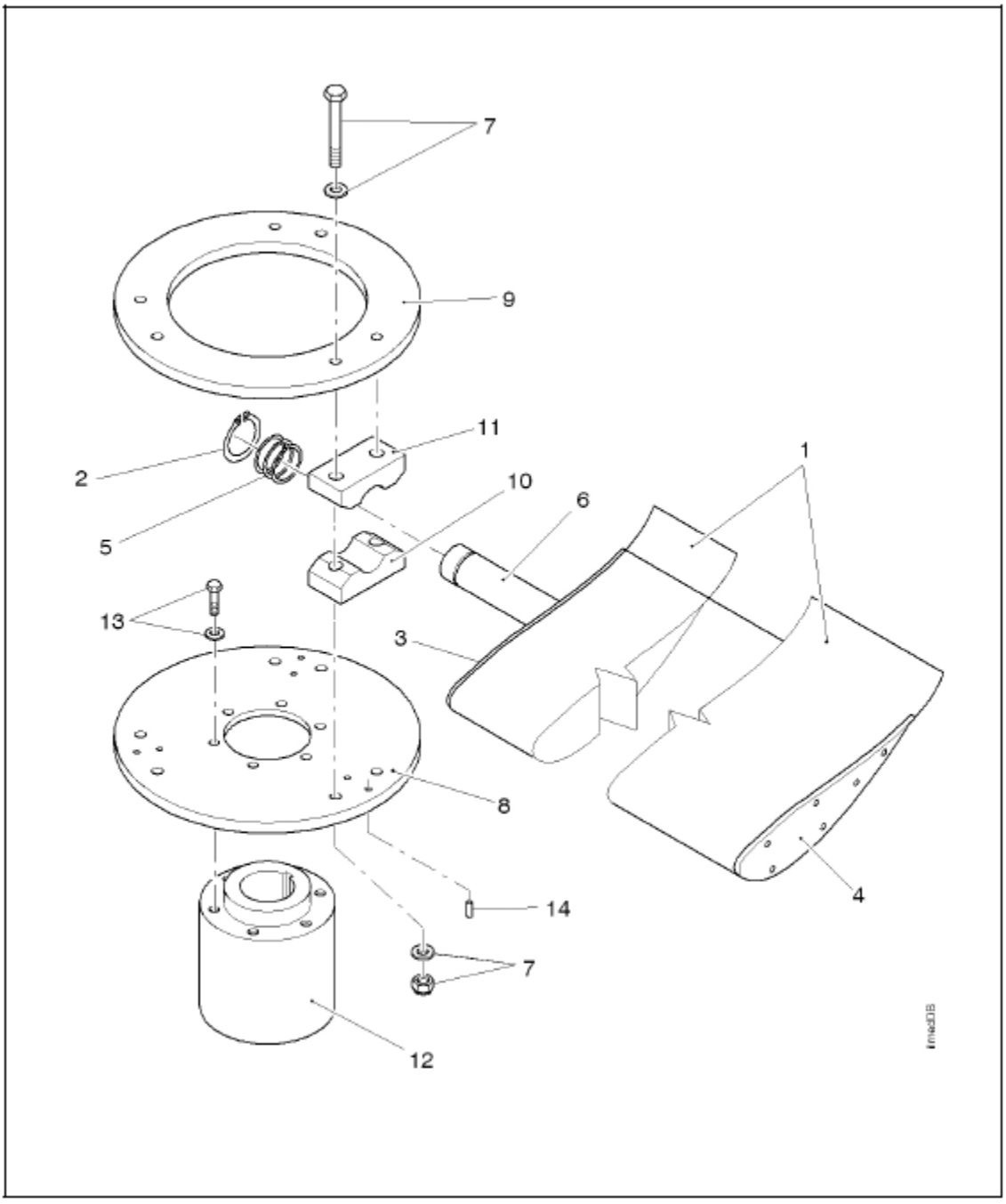


Figure 2-1: Main components of single disc impeller.

2.2.4. DOUBLE DISC IMPELLER MAIN PARTS

The double disc impeller is made of the following parts (refer to Figure 2-2):

BLADE ASSEMBLY 1. Blade 2. Safety ring 3. Root plug 4. Tip plug 5. Gap optional adjustment rings 6. Blade shaft	**HUB ASSEMBLY** 7. Upper disc securing parts (screws, washers) 8. Lower hub disc 9. Upper hub disc 10. Lower block 11. Upper block 12. Bush 13. Blade holder block fixtures 14. Lower disc securing parts (screws, washers) 15. Spacer 16. Pins 17. Pins

2.2.5. DOUBLE DISC IMPELLER DESCRIPTION (Figure 2-2)

Impeller (refer to Figure 2-2) is made of a blade holder hub, a coupling bush, two support discs, a ring and a series of blades.
A coupling bush (12) seats in its upper part the upper (or lower) hub disc (9) and in its lower part the lower (or upper) hub disc (8). Bush (10) is secured to the two discs (8) and (9) through one set of screws and washers (5 and 14) while the upper hub disc (9) is secured to lower hub disc (8) using one set of screws, two sets of washers and a set of nuts (13) putting in between the lower block (10) and the upper block (11). The two blocks are accurately positioned using a pair of elastic pins (16) and (17). The blocks, once secured, support each blade (1).
Each blade is seated in its seat through a steel shaft (6), kept in position by a safety ring (2). Achieve proper position of blades inside ventilation duct installing on shaft up to three shimming rings (optional gap adjustment rings) (5), between block and ring. Blades are closed at both tips by plugs (3 and 4). In ATEX versions blades plugs are TIG welded.

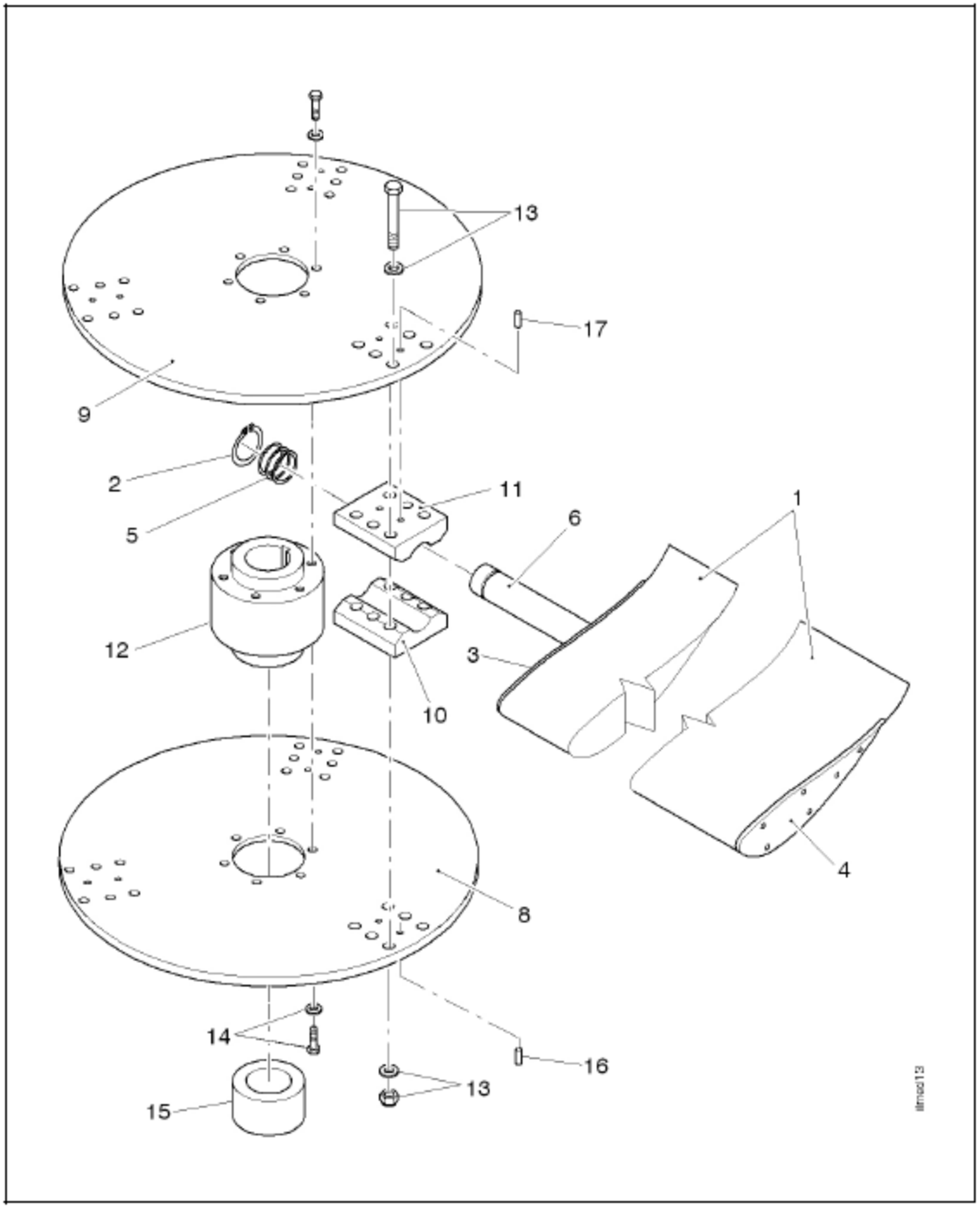


Figure 2-2: Main components of double disc impeller.

2.2.6. ELASTOFAN IMPELLER MAIN PARTS

The elastofan impeller is made of the following parts (refer to Figure 2-3):

BLADE ASSEMBLY 1. Blade 2. Safety ring 3. Root plug 4. Tip plug 6. Blade shaft	**HUB ASSEMBLY** 8. Lower bend plate 9. Upper bend plate 10. Lower block 11. Upper block 12. Disc impeller 13. Bush 14. Elastomeric joint holder block fixtures (bolts, nuts, washers) 15. Joint/blade connecting screws (bolts, nuts, washers) 16. Blade block fixtures (bolts, nuts, washers)

2.2.7. ELASTOFAN IMPELLER DESCRIPTION (Figure 2-3)

The elastofan impeller (refer to Figure 2-3) is composed by the coupling bushing, support disc and a series of blades mounted on flexible supports.
The coupling bushing (13) seats in its lower (upper) part in the support disc hub (12). The bushing is fixed at the disc through a series of screws, washers and nuts.
On the disc hub there are fixed elastomeric couplings through two series of screws, washers and nuts (14).
Each blade (1) is housed in its own place of the flexible coupling through two bend plates (8 and 9) with the use of two pillow block (10 and 11) and four screws (16). Each blade is seated in its seat through a steel shaft (6), kept in position by a safety ring (2). The both sides of each blade are closed with caps (3 and 4). In ATEX versions blades plugs are TIG welded.

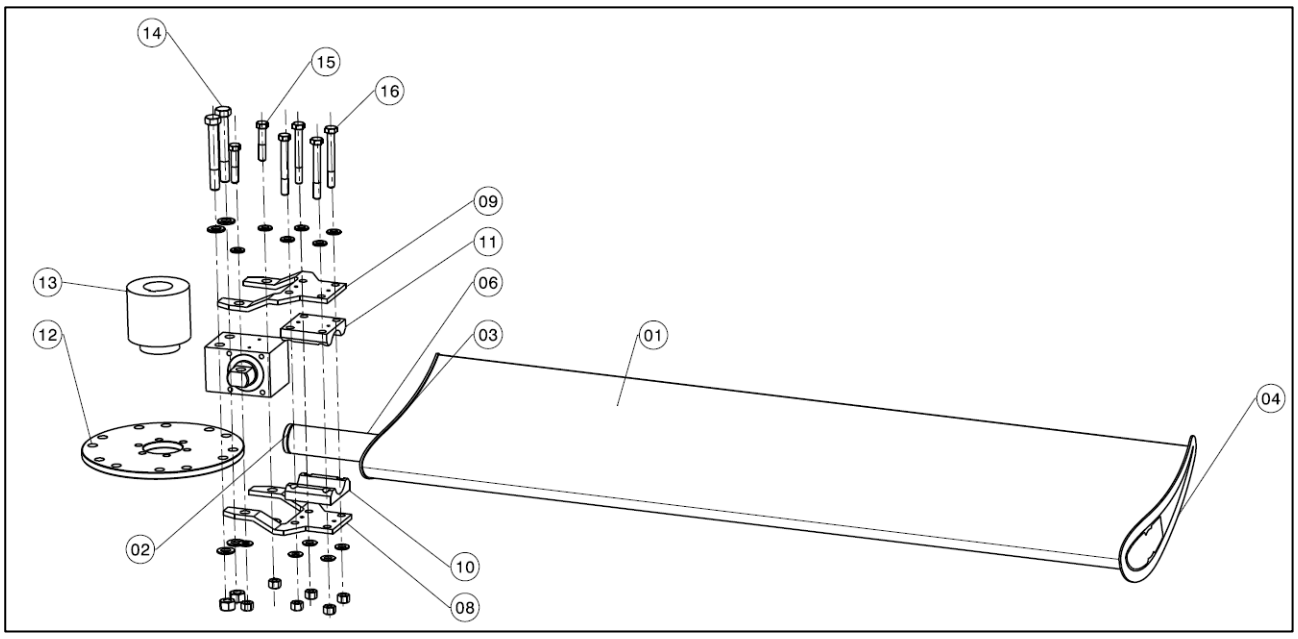


Figure 2-3: Details of the elastomeric joint of the elastofan impeller.

2.2.8. BLADE ASSEMBLY (FOR DISASSEMBLED AP IMPELLERS)

NOTE

Stated procedure applies to single disc impeller but is valid also for the double disc one.

1. Refer to Figure 2-4.
2. At reception, gather a lower disc-hub-block for blade seating group (1) and put it on a proper assembly stand.
3. Install an upper disc-upper block for blade seating group (2) on the lower disc-hub-lower block group (1) and secure it using provided screws and nuts (3). Do not tighten bolts now.
4. Carefully clean blade shaft (4).
5. Insert blades (5) in their seats on the hub between the two blade holder blocks.
6. In case, install up to 3 shimming rings (6) on blade shaft (4), until proper adjustment is achieved.
7. Insert safety ring (7) in its seat on blade shaft (4).
8. Tighten nuts alternatively, using the same torque increment, as per sequence shown in Figure 2-6 until applied pressure is enough to keep blade in position, though allowing it to turn around its longitudinal axis.

WARNING 1

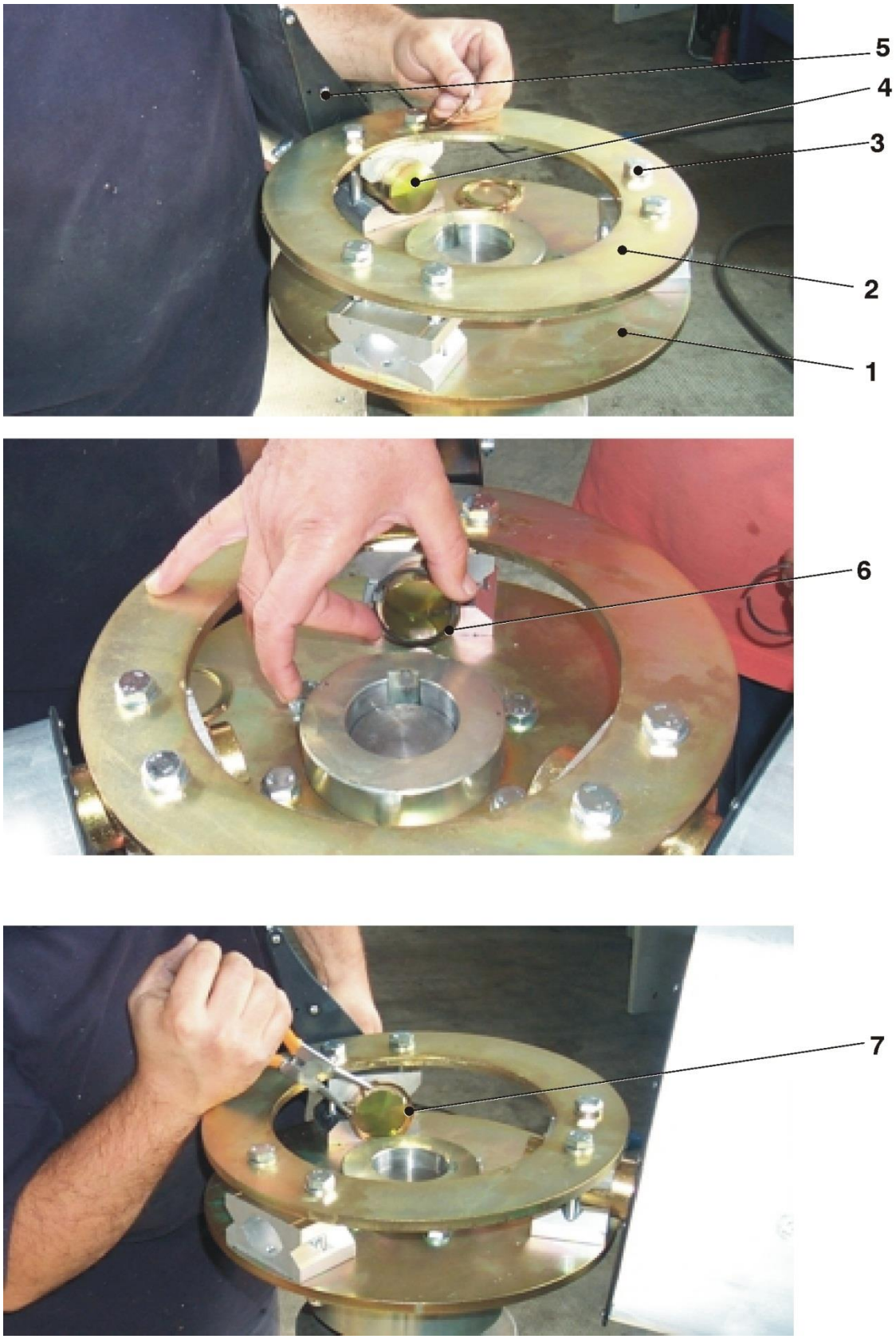
At the end of procedure always check safety ring to be against the blade holders.

WARNING 2

If you have to remove blades from impeller, assign each blade a number corresponding to the hub position the blade was in. When reassembling comply with such numbers.

WARNING 3

The wrong assembly of the blades can cause projection of the blades with relative displacement of the impeller!!



ilmed 03

Figure 2-4: Blade assembly for blades of AP impellers.

2.2.9. BLADE ASSEMBLY (FOR DISASSEMBLED EL IMPELLERS)

1. Refer to Figure 2-3.
2. At reception, gather support disc-hub-block (12 and 13) for blade seating group and put it on a proper assembly stand.
3. Loosen the two screws (15) that link the elastomeric joint and the blade with the two bend plates with the pillow blocks. Loosen, if necessary, the four screws (16) that link the bend plates and the pillow blocks.
4. Carefully clean blade shaft (6).
5. Insert blade in it seats on the hub between the two blade holder blocks (10 and 11).
6. In case, install up to 3 shimming rings on blade shaft, until proper adjustment is achieved.
7. Insert safety ring (2) in its seat on blade shaft.
8. Tighten nuts (16) alternatively, using the same torque increment, as per sequence shown in Figure 2-6 until applied pressure is enough to keep blade in position, though allowing it to turn around its longitudinal axis.

WARNING 1

At the end of procedure always check safety ring to be against the blade holders.

9. Tighten the two bolts (15) between the elastomeric joint and the bend plates using the same torque increment, until applied pressure is enough to keep blade in position.

WARNING 2

If you have to remove blades from impeller, assign each blade a number corresponding to the hub position the blade was in. When reassembling comply with such numbers.

WARNING 3

The wrong assembly of the blades can cause projection of the blades with relative displacement of the impeller.

WARNING 4

Due the nature of the elastomeric joint, please be careful to do not apply static loads on blades once mounted. The resilient material has been designed to carry on the lift force during normal operation and any other

NOTE

Due the nature of the elastomeric joint and the hysteresis of any rubber component, it is possible the blades are not on the same level; this condition will not invalidate the performances. During the normal operation, the centrifugal force will stretch the blades to work on the same level.

2.2.10. BLADES KEYING

1. To key blades proceed as follows (refer to Figure 2-5).
2. Put on blade external tip (1) a bubble protractor (2) and tilt it to required operational conditions.
3. By hand or using a gummy mallet (3), turn blade to put it at desired angle (tolerance ± 0,5°).
4. Alternatively tighten bolts (4), using the same torque increment, acting as per sequence shown in Figure 2-6. Comply with values reported in Table 2-1, Table 2-2 or Table 2-3, according to bolt type.

WARNING 1

Pay attention not to vary blade tilt during bolt tightening. Safety ring must remain in proper position.

WARNING 2

Increment in blade keying results in more power consumption by electric engine. Pay attention to limits reported on engine tag.

WARNING 2

It is strictly necessary that the keying of the blades is done according to the values indicated on the data sheet (tolerances included). A different keying from the one on the data sheet may cause serious damage to the impeller. In that case, IVI declines all responsibility.

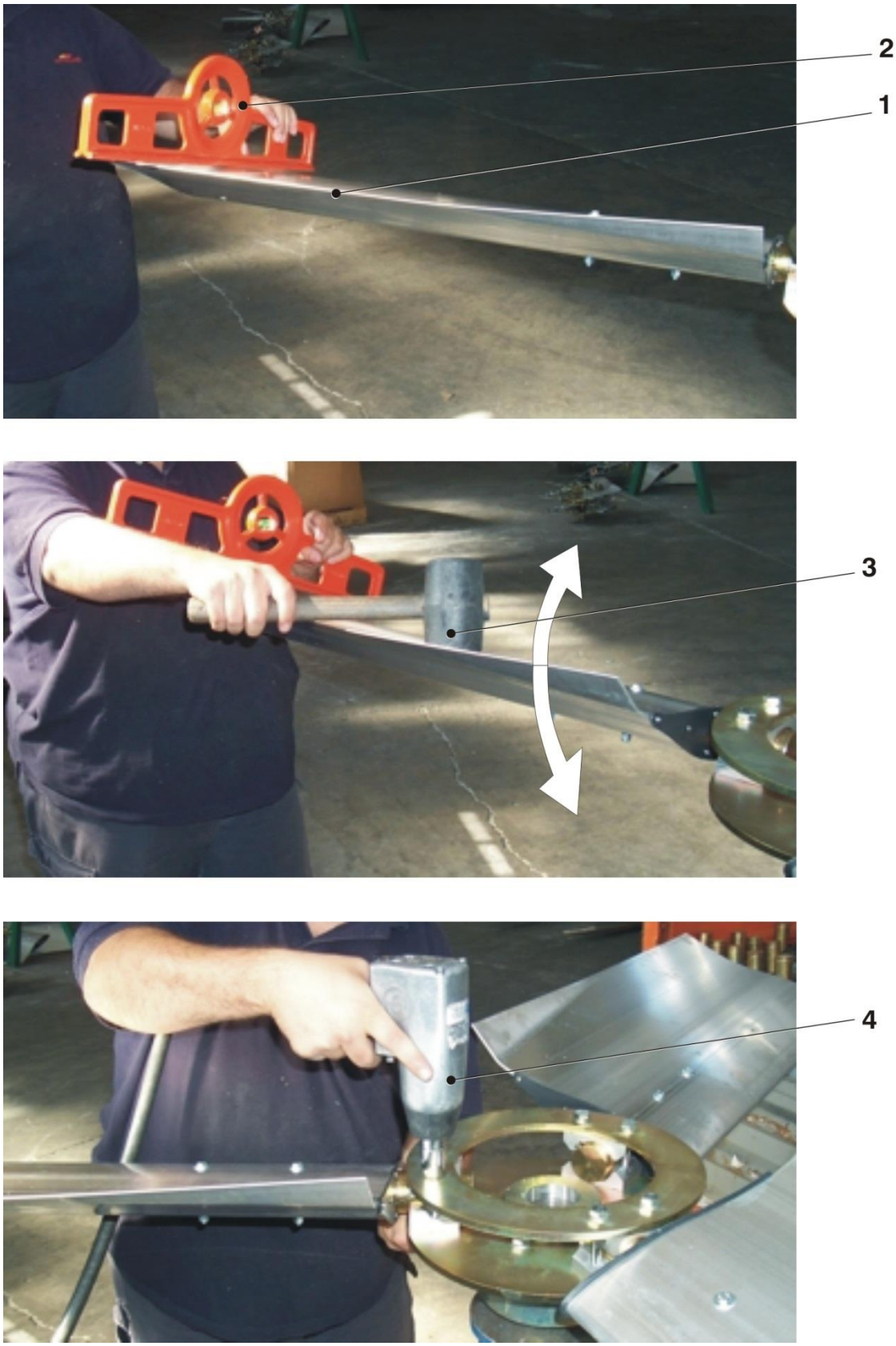


Figure 2-5: ***Blade keying.***

2.2.11. BOLTS DRIVING TORQUE

STANDARD BOLTS AND SCREWS

Bolt diameter (mm)	Driving torque (Nm)	Preloading (kN)
M4	3,04	3,93
M5	5,58	6,36
M6	9,81	9,00
M8	24,52	16,40
M10	49,05	26,00
M12	84,36	37,80
M14	134,39	51,50
M16	204,04	70,30
M18	282,52	86,00
M20	399,26	110,00
M22	533,66	136,00
M24	591,60	158,00

Table 2-1: Bolts driving torque for Class 8.8 bolts and nuts (steel).

HIGH RESISTANCE BOLT AND NUTS

Bolt diameter (mm)	Driving torque (Nm)	Preloading (kN)
M4	4,22	5,52
M5	8,34	8,94
M6	13,73	12,65
M8	34,30	23,01
M10	68,67	36,56
M12	117,72	53,15
M14	186,39	72,41
M16	284,49	98,84
M18	397,30	120,91
M20	559,17	154,66
M22	745,56	191,21
M24	971,19	222,14

Table 2-2: Bolts driving torque for Class 10.9 bolts and nuts (steel).

CLASS AISI 304 OR AISI 316 BOLTS AND NUTS

NOTE

Use proper lubricant to prevent seizure

Bolt diameter (mm)	Driving torque (Nm)	Preloading (kN)
M4	1,47	0,9
M5	2,74	1,49
M6	4,70	2,09
M8	11,67	3,85
M10	23,54	6,14
M12	40,22	9,0
M14	64,74	12,3
M16	100,06	17,0
M18	141,26	21,1
M20	201,11	27,4
M22	273,69	34,3
M24	347,27	39,4

Table 2-3: Bolts driving torque for class AISI 304 or AISI 316 bolts and nuts.

WARNING

Due to the high self-weight of large fan blades, once the tightening of all impeller blades has been completed, the tightening torque of the retaining bolts should be checked again, applying the nominal values. It may be necessary to perform the operation more than once.
Below, Figure 2-8 shows the sequence of tightening the retaining bolts on the blocks, depending on the number of bolts present for each impeller blade.

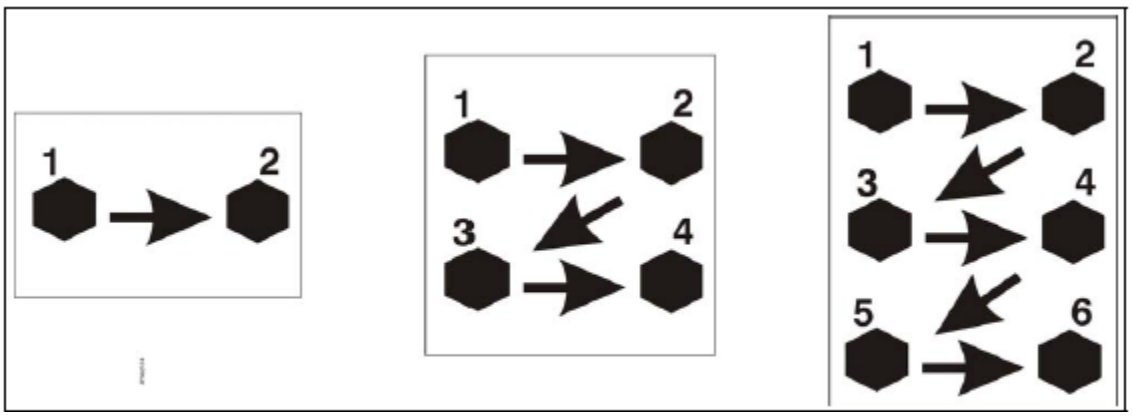


Figure 2-6: Blade securing bolts tightening sequence.

2.3 GAP ADJUSTMENT (OPTIONAL)

The clear span between the blade end and the duct (gap) has a non-negligible influence on the performance of an axial fan: as the gap decreases, the overall efficiency increases. Conversely, a very small gap can cause the blades to creep to the outer duct, possibly resulting in damage to the blades or the duct itself. The gap adjustment system is designed to optimize the blade/duct clearance at installation, and allows better fan utilization and lower power consumption.

In case the system is required in bidding, it consists of one or more shim rings that must be placed or removed in equal numbers for all fan blades between the blade retaining ring and the positioning blocks in order to reduce or increase the fan diameter.

Before making this adjustment, measure the minimum diameter of the duct or the nominal diameter in case it has a perfectly circular shape. This numerical value should be compared with the nominal diameter of the impeller and the difference between the two compared with the values recommended by international reference standards and/or experience with similar machines.
In the case of wanting to increase the impeller diameter, in order to reduce the gap with the duct, it is necessary to remove, in equal numbers on each individual blade, one or more of the shim rings.
If, on the other hand, the impeller diameter is to be decreased, one or more shim rings must be inserted between the blade support blocks and the shim ring, as shown in Figure 2-7. Should it be necessary to adjust the diameter beyond the physical possibilities of the impeller, contact IVI customer service.

WARNING

At the end of this procedure always check the safety ring to be against the blade supports, as shown in figure 2-7.

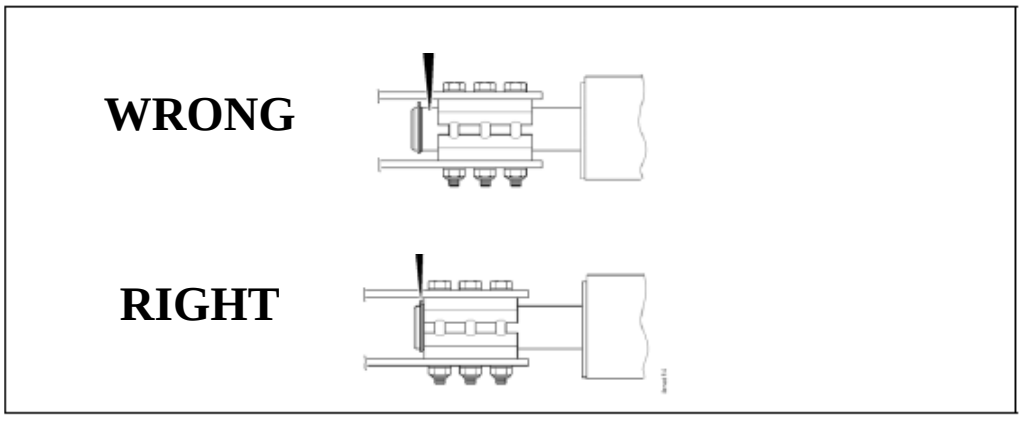


Figure 2-7: Wrong and right position of the relative position of the safety ring.

2.4. MOUNTING OF THE IMPELLER TO THE SUPPORT STRUCTURE

Unless otherwise requested, the impeller is equipped with a bush with a diameter hole agreed upon with the customer that allows it to be mounted directly on a shaft (of a motor or gearbox at the customer's expense) and secured by a bolt plus washer screwed directly onto the shaft (at the customer's expense).

WARNING

Improper installation leads to the risk of vibration resulting in instability and the possibility of the impeller becoming detached from the support with the following danger of the impeller falling off.

2.5. THE IMPELLER PROTECTION

Si raccomanda di installare la girante in un luogo inaccessibile e di evitare ogni contatto con le pale installando reti di protezione o carter di protezione all'interno del sistema, una volta che la girante è stata montata.
Si vieta l'installazione della girante in un luogo accessibile senza sistemi di protezione che dovranno essere installati secondo la norma ISO 13857:2008: Sicurezza del macchinario. Distanze di sicurezza per impedire il raggiungimento di zone pericolose con gli arti superiori e inferiori.
E' vietato l'avviamento della girante in presenza di persone esposte al flusso di aria generata.

2.6. PRECAUTIONS IN THE USE OF THE IMPELLER

The impeller is constructed, unless otherwise required, to work in the clockwise direction of rotation, and it is therefore forbidden to start the impeller in counter-rotation to the direction of the fluid. This could cause vibration problems, excessive noise or even breakage of the impeller itself.
It is also forbidden to use the impeller in environments where fluids contain components that could become permanently fixed on the blades (e.g., paint), unbalancing their structure.

2.7. CLEANING

After installation is complete, carry out a thorough cleaning of the impeller; remove any dust and debris present, with special attention to the blades. For cleaning, use a blast of compressed air and a dry cloth for the purpose of removing dust and a nonaggressive solvent to remove any traces of dirt.

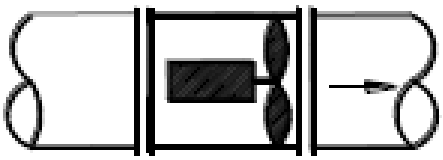
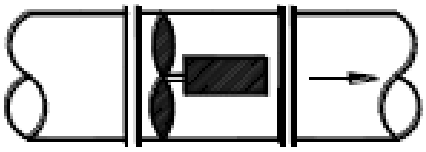
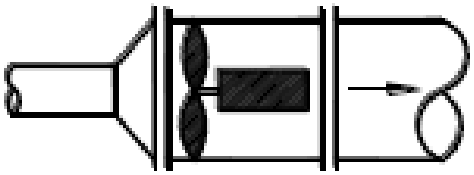
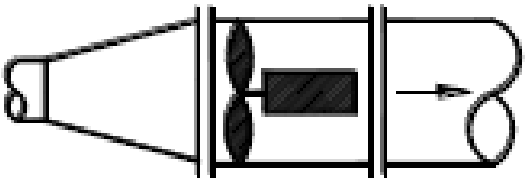
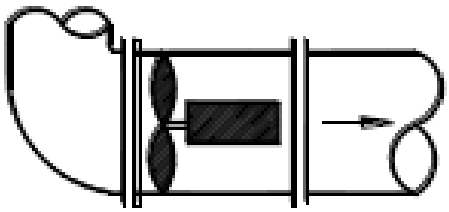
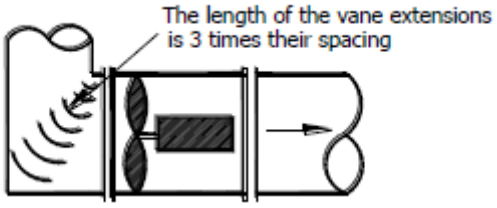
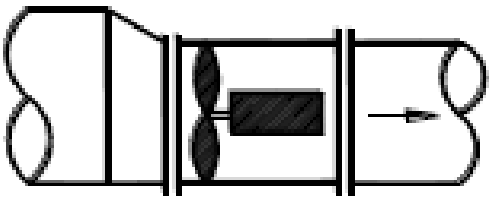
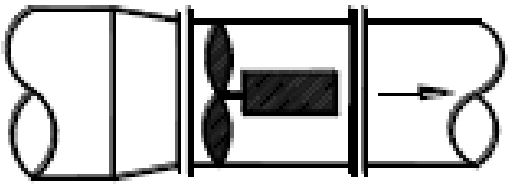
2.8. DEMOLITION OF THE MACHINE

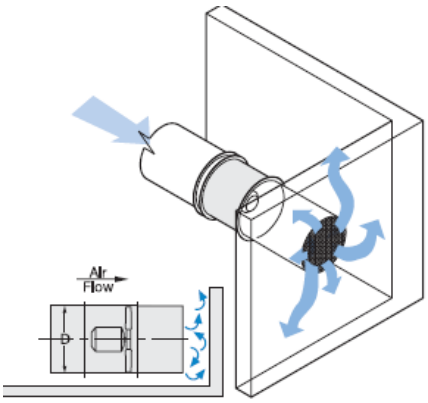
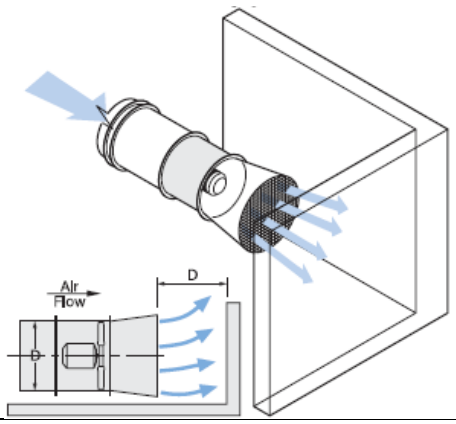
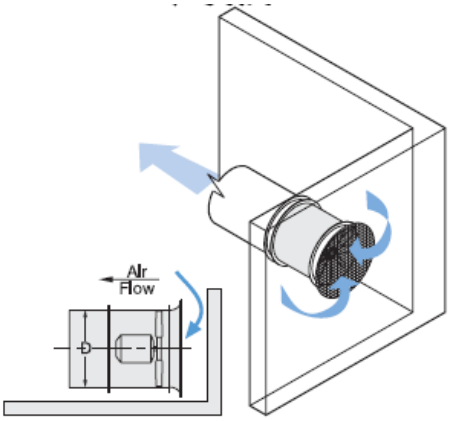
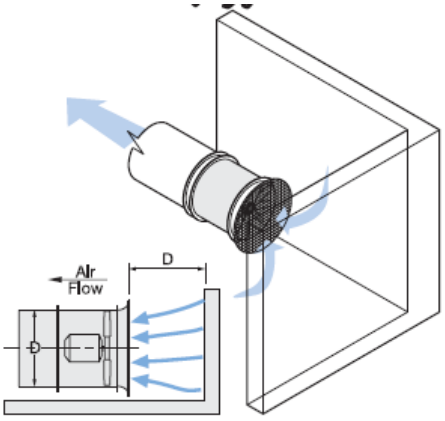
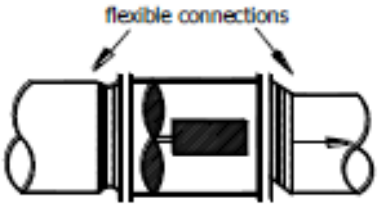
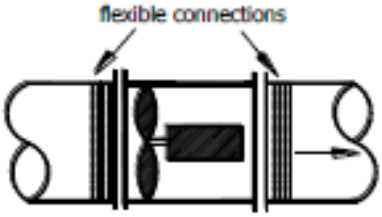
Demolition of the impeller must be carried out by specialized personnel.
In any case, the regulations in force in different countries regarding this kind of operation differ, so it is recommended that the requirements imposed by the laws be analyzed and implemented when the blower is to be dismantled.
The machine has been made using non-hazardous materials (steel, aluminum) that do not pose problems of recycling or disposal; however, a thorough knowledge of the machine's construction characteristics and precise technical knowledge for its dismantling is necessary, as well as specific equipment.
It is therefore recommended that the IVI technical service department be contacted to ensure that this work is carried out under completely safe conditions.

3. ATTACHMENTS

3.1. "GOOD ENGINEERING" ADVICES ON WAYS TO INSTALL THE INDUSTRIAL FANS & IMPELLERS

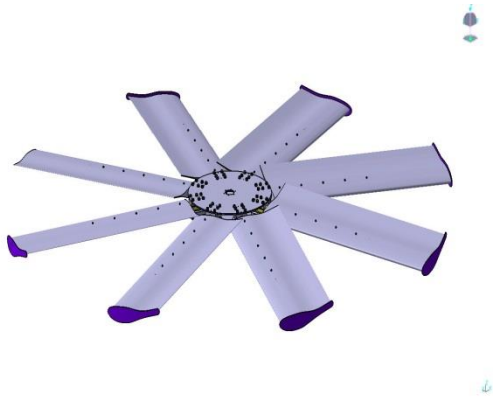
Guidelines for industrial fans installation to be evaluated according to the application

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

When the discharge is too close to an obstacle (wall, ceiling etc.) the obstruction* might generate noise and increase the discharge losses 	Allow a gap at least one fan diameter between the discharge and obstacle 
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**  A “partial obstructions” inlet and outlet side, beams closest of 1,5 times the chord of the used profile. The obstructions might affect the life of the impeller	Allow a gap at least equal to one fan diameter between the inlet and nearby obstruction, even then fan performance can be less that rated 
Slack or offset flexible connections causes turbulent air flow 	In-line flexible connections provide optional vibration isolation without creating turbulence 

3.2. TROUBLESHOOTING GUIDE

Problem	Probable Cause/Suggested Remedies
Excessive Vibration A common complaint regarding industrial fans is "excessive vibration". IVI is careful to ensure that each fan is precisely balanced prior to shipment; however, there are many other causes for fan vibration, including:	1. Inadequate structural support, mounting procedures or material 2. Externally transmitted vibration 3. Loose mounting bolts, setscrews, bearings or couplings 4. Misalignment or excessive wear of couplings or bearings 5. Misaligned or unbalanced motor 6. Bent shaft due to mishandling or material impact 7. Accumulation of foreign material on wheel 8. Excessive wear or erosion of the wheel 9. Excessive system pressure or restriction of airflow due to closed dampers
Inadequate Performance	1. Fan wheel rotating in the wrong direction or installed backwards on the shaft 2. Fan wheel running too slow (drive sheaves incorrectly mounted as a slowdown drive instead of speed up drive) 3. Damaged or incorrectly installed cut-off sheet or diverter 4. Poor system design, closed dampers, air leaks, clogged filters or coils 5. Obstructions or sharp elbows near the fan inlet 6. Sharp deflection of air stream at the fan outlet
Excessive Noise	1. Fan operating near "stall" condition due to incorrect system design or installation 2. Vibration originating elsewhere in the system 3. System resonance 4. Improper location or orientation of fan intake and discharge 5. Nearby sound reflecting off surfaces 6. Inadequate or faulty design of fan structural supports 7. Loose accessories or components 8. Worn bearings
Premature component failure	1. Prolonged or major vibration 2. Inadequate or improper maintenance 3. Abrasive or corrosive elements in the air stream or surrounding environment 4. Misalignment or physical damage to rotating components or bearings 5. Bearing failure from incorrect or contaminated lubricant or grounding through the bearing while arc welding 6. Excessive fan speed 7. Extreme ambient or air stream temperatures



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