

## INDEX

SIMBOLS	Page 22
INSTALLATION	Page 23
START-UP	Page 24
MAINTENANCE	Page 26
GENERAL OPERATION RULES	Page 29
DISASSEMBLY AND ASSEMBLY	Page 31
BALANCING	Page 33
PUTTING THE FAN OUT OF SERVICE	Page 33
REGOLATIONS TO ADOPT IN THE PRESENCE OF ATEX RATED FANS	Page 33

## SYMBOLS FOR THE SAFETY OF PERSONS AND THINGS



### **DANGER**

RISKS OF ELECTRICITY DISCHARGE SHOCKS

GB



The sign warns that non observance of the instructions prescribed leads to electric discharges



The sign warns that non observance of the instructions prescribed leads to a risk of damage to persons and things



The sign warns that non observance of the instructions prescribed leads to a risk of damage to the machine, the plant and things

## FANS

### USE AND MAINTENANCE MANUAL

## 1- INSTALLATION



### 1-1 RECEPTION

Examine the supply and immediately refer any defect or anything that is missing. If the machine has suffered damage during transport immediately lodge a complaint with the transporters/shippers

### 1-2 TRANSPORT

The fan is composed of rotating components which may undergo damage following transport carried out incorrectly, use only the lifting points provided, distributing the weight of the load uniformly to avoid deformation.

The TRA-BO does not respond if transport is carried out under particularly unfavourable environmental conditions (sea voyages, rough and uneven roads, loading enormous weights on top of the fan); in these cases all moving parts must be blocked and transmissions disassembled.

### 1-3 STORAGE

Protect the fans from bad weather conditions. In particular cover the electric motors, shafts, bearings, check that no parts have been corroded.

Above all, verify the bearings, the lubrication grease, and that there is no condensation present.

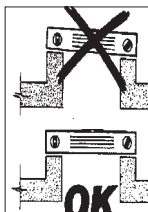
Periodically turn the impeller by hand (at least once a month) and check that no foreign bodies have entered.

**Do not store near machines that vibrate very much since they could cause damage to the balance of the fan.**

### 1-4 FOUNDATIONS

For heavy and high speed fans it is advisable to use well-levelled armoured cement foundations.

For installation on steel structures it is important that the structure is made adequately rigid so that the minimum natural frequency of the structure is greater than 50% of the fan and motor speeds, by inserting also, shock absorbers between the fan and structure.



### 1-5 FASTENING POINTS

Use all the prepared fastening points on the fan to ensure that in tightening the bolts the structure has not undergone deformations. It is a good rule to place vibration damping supports under the base.

## 2- START-UP



### 2-1 GENERAL CHECK

Before starting the fan check the lubrication of the bearings and that all the bolts are screwed down tight. Particularly check the bolts that block the impeller onto the shaft, those of the monoblock, of the control motor supports.

Turn the transmission shaft by hand to make sure that all the parts turn freely.

Check that there are no deformations or breakages

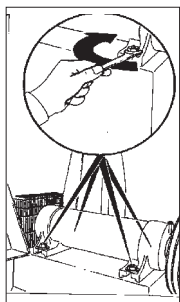
Check the direction of rotation of the impeller which must correspond to the direction indicated on the plate with the arrow (in case of anomalies contact TRA-BO)

Check that the inspection hatch, if present, is perfectly closed.

Check that all the protections are fastened or have not been removed

Make sure that all around the machine there is enough free space of at least 1 m for maintenance work.

**Check that the fan r.p.m. are not greater than that of the contract or indicated in the catalogue**



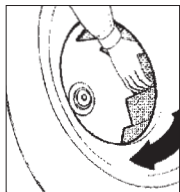
For installation in ATEX definition zones check that the fan is appropriate for the classification of the place where it is inserted,

verify that the temperature class of the fan is appropriate for the gases or inflammable vapours present and that the surface temperature is appropriate for the combustible dusts present.

Verify that the safety appliance has been assigned the service for which it has been built.

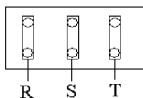
Verify that the safety apparatus unit is appropriate for the gases, vapours, dusts present; in particular, for the choice of the apparatuses consider the conductivity level of the dusts and the electrostatic risks connected with the characteristics of the plant in which the fan is installed.

### CONNECTION TO THE MOTOR TERMINAL BLOCK

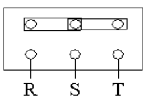


#### THREE-PHASE MOTOR

Volt 220/50 Hz

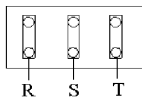


Volt 400/50 Hz

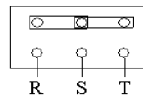


#### THREE-PHASE MOTOR

Volt 400/50 Hz



Volt 660/50 Hz



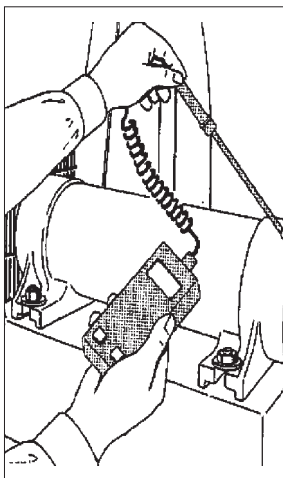
## 2-2 AFTER START-UP, CHECK...

2.2.1 that the temperature of the bearings is regular (for the first few hours there will be an increase in temperature followed by a subsequent decrease and stabilisation, in this case everything is to be considered regular) the maximum surface temperature of the bearings must be under 90°C.

2.2.2 the current absorbed by the motor – it must not be greater than that found on the rating plate (otherwise stop the machine and contact TRA-BO); **it is advisable to start with the air lock or delivery adjuster completely closed.** The application of this precaution reduces the time and the overload of the motor at start-up.

**Several successive start-ups must be avoided because the motor would not be able to deal with the overheating accumulated, resulting in serious damage to the bearings and coil, with a fire or explosion hazard.**

ALL THE ASSEMBLY AND INSTALLATION OPERATIONS MUST BE CARRIED OUT BY QUALIFIED PERSONNEL THAT MUST BE INFORMED ON THE GENERIC HAZARDS CONNECTED WITH THIS WORK. THIS IS NECESSARY TO AVOID HAZARDOUS SITUATIONS DURING THE FAN START-UP PHASE.



### 3- MAINTENANCE



#### GENERAL WARNINGS

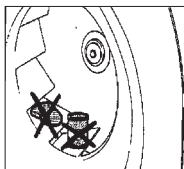
The maintenance personnel, besides having to observe the dispositions of the law in force concerning prevention, must respect the instructions that follow: they must wear adequate accident prevention clothing. The clothes must not have flapping parts or that might get caught in/on parts of the fans.

The use of headphones or protection inserts is obligatory when the noise exceeds the admissible limits.

Check the existence of an interlock that prevents other people from starting the machine.

**In ATEX environments use only instruments suitable for such operations.**

#### 3-1 CASING AND NOZZLES



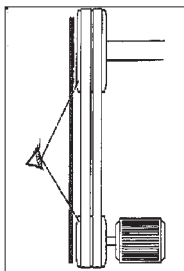
Periodically clean the internal parts from dirt residues and remove any foreign bodies. Check the paint and remove all rust scale.

#### 3-2 IMPELLER

Remove all traces of dirt or scale that may upset its balance. If abrasive dust has been sucked up check the impeller wear and if necessary replace it immediately.

Check the state of the welding.

Avoid unscrewing the hub from the impeller because there is no sense in doing so and it upsets the balance of the impeller.



#### 3-3 PULLEYS

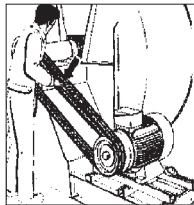
Make sure the alignment is still correct otherwise correct it, carefully clean the race from scale and incrustation and dirt and if worn replace it.

#### 3-4 BELTS

Carefully clean them, check that there it is not frayed or cracked (replace immediately) check the exact tension, prevent it from slipping.

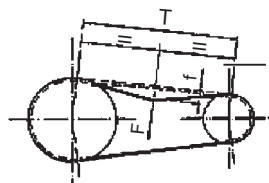
### TENSIONING METHOD

For a belt transmission to operate well the assembly belt tension must be correct. To do this act on the saddle tensioner, as follows:



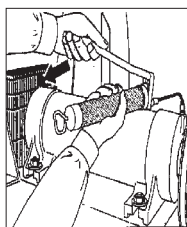
1. measure the free section T;
2. using a dynamometer, for each belt, halfway along T, apply a perpendicular force F capable of causing a 1.5 mm arrow f for each 100mm of T.
3. Compare the value of F supplied by the dynamometer with the values of F' and F'' found in the Table.  
(see drawing)

es:  
T=1300 mm  
 $f = \frac{1300}{100} \cdot 1,5 = 19,5$  mm



Belt Section	Ext. Diameter of the smaller pulley (mm)	r.p.m. smaller pulley	F' minimum Newton	F'' minimum Newton
SPZ	50 ÷ 90	1200 ÷ 5000	10	15
	100 ÷ 150	900 ÷ 1800	20	30
	155 ÷ 180	600 ÷ 1200	25	35
SPA	90 ÷ 145	900 ÷ 1800	25	35
	150 ÷ 195	600 ÷ 1200	30	45
	200 ÷ 250	400 ÷ 900	35	50
SPB	170 ÷ 235	900 ÷ 1800	35	45
	250 ÷ 320	600 ÷ 1500	40	60
	330 ÷ 400	400 ÷ 900	45	65
SPC	250 ÷ 320	900 ÷ 1800	70	100
	330 ÷ 400	600 ÷ 1200	80	115
	440 ÷ 520	400 ÷ 900	90	130

### 3-5 LUBRICATION



The TRA-BO fans are fitted with sealed life-long lubricated bearings inside their monoblocks.

The fans fitted with upright supports with radial ball bearings and roller bearings are greased before delivery. Lubrication must be done in the time intervals and with the quantities of grease found in the diagram below, for the ring temperatures external to the bearing between 70°C and 110°C for each  $\Delta T = 15^\circ\text{C}$  the lubrication interval is halved.

Even in dusty, damp, corrosive environments, the aforesaid time interval must be reduced accordingly.

Type of grease recommended MOBIL XHP 222.

NAME TYPE OF BEARINGS: tfa for the radial ball bearings, tfb for the roller bearings and tfc swivel roller bearings

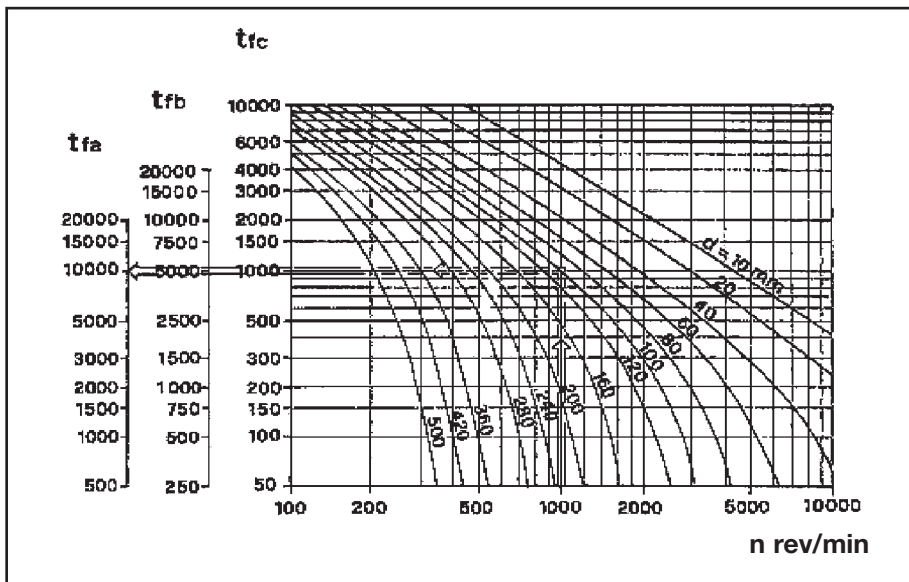
## GRAPH 1

Lubrication intervals, hours of work.

Example: A rigid radial ball bearing, having a hole with diameter (d) of 100mm, rotates at 1000 rpm. The working temperature varies from 60-70°C. What can be expected as a lubrication interval?

Trace a vertical line starting from the value 1000 on the

X-axis to the curve d = 100mm. From the intersection trace a horizontal line till it intersects the Y-axis corresponding to the radial ball bearings; here we find the value 10,000 which represents the lubrication interval in hours.



tfa = Radial ball bearings

tfb = cylindrical roller and roller bearings.

tfc = swivel roller bearings, conical roller bearings, ball thrust block

## 4- GENERAL OPERATION RULES



### 4.1 INFORMATION ON THE OPERATION OF THE RADIAL FANS

The radial fans with radial blade or front-curved impellers must always operate connected to pipes or appliances that, with their resistance, limit the flow rate. If the fan should operate without any resistance (open inlet/outlet) the motor could burn out because the fan in this case gives the maximum flow rate and overloads the motor.

A) if the circuit offers the calculated resistance, the fan flow rate is that provided for and the motor absorbs the power indicated in the data table.

B) if the circuit resistance is greater than that calculated, the fan flow rate is less than that foreseen and the motor normally absorbs less power.

C) if the resistance is less than that calculated the fan flow rate is greater than that foreseen and the motor absorbs more power.

**It is advisable for this type of fan to install a regulator air lock on the circuit to adjust the fan when the plant is started.**



### 4-2 REVERSE CURVED IMPELLER FANS

These fans can also operate with circuits that offer a lower resistance than that calculated without the danger of burning the motor, because these fans are characterised by a greater power curve at any point of the capacity curve. These fans absorb maximum power near the point of maximum efficiency.

### 4-3 GENERAL INFORMATION

#### A) INFORMATION ON NOISINESS

##### A) INFORMATION ON NOISINESS

The noisiness of the fan depends on its anchorage to the supporting plane and the connections to the suction and delivery piping.

It is advisable to install the fan on vibration damping supports in order to limit the transmission of the vibrations and to place canvas vibration damping joints between the fan inlets/outlets and the piping.

##### B) PROTECTION OF THE ELECTRIC MOTOR

The intensity of the current absorbed by the motor at full blast must never exceed the value on the rating plate.

If the current should exceed the rating plate value, the current absorbed must be adjusted by reducing the fan flow rate with the partial closure of the regulator air lock.

To protect the motor an automatic cut-out switch, complete with magneto-thermal elements, must be installed. It is a good rule to check the state of the contacts of the switch periodically.

##### C) PROTECTION AGAINST RISK OF ACCIDENTAL CONTACT

All the fans are supplied complete with protections against risk of accidental contact, in conformity with UNI EN 953 regulations and standards

- 1) the protection netting on the suction inlets and delivery outlets (to be requested when making out the order if the outlets and inlets are not channelled)
- 2) protection guard over the cooling fan
- 3) protection guards for the pulleys, belts, and shafts of the transmission equipped fans

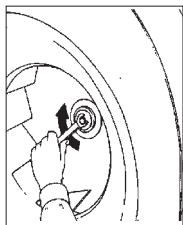
**It is absolutely prohibited to start the fan if even one of these protections are lacking, and also the cleaning hatch must not be opened when the fan is in operation nor must any of the above mentioned protections be removed with the fan in operation.**

TRA-BO is not liable for any damage to things or persons caused by the absence of accident prevention devices listed above, or by the non observance of the prescribed rules.

**N.B. When using the fan the risk deriving from the entry of foreign bodies, the risk of conveying dangerous gases (explosives, inflammable, etc) must be considered**  
Even the risks inherent to cleaning operations, balancing, repainting, welding, drilling must be done under maximum safety conditions. All operations aimed at modifying the initial state of the fan (if not agreed upon before with TRA-BO) are done at the risk and danger of whoever carries them out.



## 5- DISASSEMBLY AND ASSEMBLY



### 5-1 SUCTION NOZZLE

Remove the nuts that hold it to the side of the fan

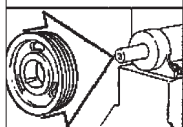
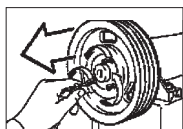
### 5-2 CASING

On the swivel fans the casing is bolted to the seat disk, so to disassemble unscrew these nuts

### 5-2 IMPELLER

Disassembly – Remove the suction nozzle, and if possible, the casing also, unscrew the screw that locks the impeller to the shaft, interpose a washer on the extremity of the shaft to protect it, then use an extractor to slip the impeller off the shaft; for particularly heavy impellers suspend with a hoist until extraction is completed

Assembly – Set the impeller in front of the shaft and guide it for a few centimetres, finish the operation with a threaded bar and a nut that, while it is screwed down, will push the impeller until it strikes the end

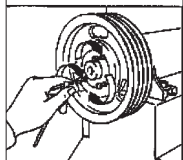
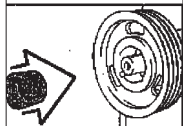


### 5-3 PULLEYS

To disassemble the pulleys (almost always with a conical bushing):

- Remove the two screws blocking it, slide a screw into the extraction hole and screw down until the pulley is released.

- When assembling, first place the pulley on the shaft, then insert the conical bushing, screw the two screws into the two holes, one opposite the other and screw down



IT IS ADVISABLE TO DO THIS WITH A TORQUE WRENCH

### 5-4.1 UPRIGHT SUPPORTS

Unscrew the upper part of the supports, remove the stop rings of the bearings, unscrew the ring nut after having straightened the safety washer tab. Remove the traction bushing and slip the bearing off the shaft.

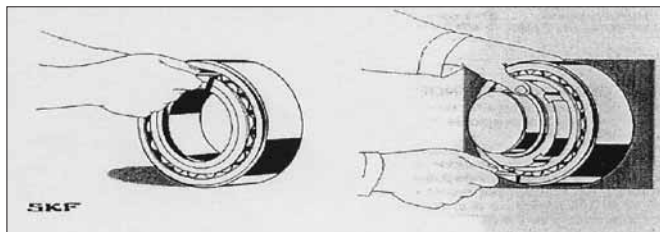
During assembly block the traction bushing with the appropriate ring nut, using a spanner for ring nuts

#### ASSEMBLY INSTRUCTIONS FOR CONICAL ROLLER BEARINGS ON THE FANS

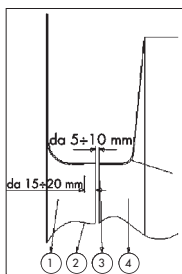
Before assembling the bearings check the radial play measured between the external ring (placed higher up) and a discharged roll, getting the bearing to turn a few times, before measuring, so that the rolls take up the correct position. N.B. use feeler gauges from 0.03 mm upwards.

During assembly check the reduction of the internal play under the roll placed lowest.

Correct assembly is obtained with a reduction of the internal play as shown in the table below



BEARING	REDUCTION OF THE RADIAL PLAY (MM)	RESIDUAL MINIMUM PLAY AFTER ASSEMBLY (MM)
22215 EK	from 0.040 to 0.050	0,025
22216 EK	from 0.040 to 0.050	0,025
22217 EK	from 0.045 to 0.060	0,035
22218 EK	from 0.045 to 0.060	0,035
22220 EK	from 0.045 to 0.060	0,035
22222 EK	from 0.050 to 0.070	0,050
22224 EK	from 0.050 to 0.070	0,050



- 1 - Nozzle
- 2 - Brass Part
- 3 - Space between nozzle and impeller
- 4 - Impeller

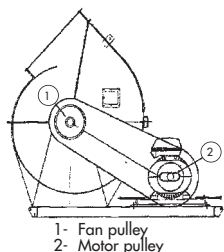
## 6- BALANCING

Before assembly all the TRA-BO impellers are balanced statically and dynamically in conformity with the ISO 1940/1 regulations, with a minimum degree of balancing of 6.3.

## 7- PUTTING THE FAN OUT OF SERVICE

Disposal of the fan and its components must be by "DEMOLITION" according to the local regulations in force where the fan is installed, by taking it to the municipal refuse disposal yards or licensed refuse disposal companies

## 8- REGULATIONS TO ADOPT IN THE PRESENCE OF ATEX RATED FANS



- 1 - Fan pulley
- 2 - Motor pulley

**8-1** All the operations concerning assembly, installation, disassembly, maintenance must be carried out by qualified personnel informed on the dangers connected with these operations

**8-2** Before starting up, the installer or user must check that the distance between the fixed and mobile parts fall within those indicated in the typical cross section of the fan (an example is shown in the figure). For the fans complete with elastic joint or belt transmission the typical cross section will be supplied for the assembly of the protection guard

**8-3** The installer or user should check that there has not been any tampering of modifications and above all that the fan corresponds to the classification of the dangerous

**8-4** Only use ATEX certified tools, equipment, clothing

**8-5** Verify that the electrical connections are perfectly tightened, the integrity and continuity of the protection or equipollent grounding conductors

**8-6** Before carrying up any speed variation of the fan compared to what is foreseen in the supply phase, written approval must first be requested and obtained from TRA-BO, this is especially important if the electric motor is interlocked with an inverter

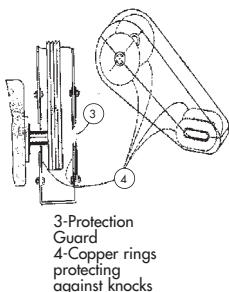
**8-7** If the transmission belts must be replaced, purchase anti-static belts complete with antistatic certification of authenticity and with dimension and material characteristics equal to those supplied originally

**8-8** Periodically check the vibrations on the bearings, this check permits verifying if the machine is working correctly (at least every 300 hours of operation). It would be a good rule to install vibration sensors that would intervene to stop the fan if any anomalies are detected. Working with unbalanced machines is very dangerous since they may cause breakages

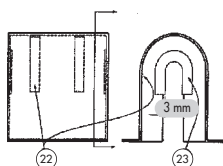
**8-9** Check that the rotating parts are clean to avoid deposits that could cause unbalancing

(this must be done at least every 300 hours of operation)

**8-10** Check that the surfaces of the fan and motor are clean - **Attention: dust deposits must not exceed 3 mm** (operation to be done at least every 300 hours of operation)



- 3- Protection Guard
- 4- Copper rings protecting against knocks



- 23-23 Copper protection
- Small fan protection guards

**8-11** Check the environmental data and in particular the operating temperature, which must not be below  $-20^{\circ}\text{C}$  and must never exceed  $+60^{\circ}\text{C}$ , so it is a good rule to install sensors that will stop the machine when the temperatures do not fall within this range. (these temperature readings must be taken at least at start up and then every 300 hours of work)

**8-12** Check the total pressure before and after the fan. The suction pressure (upstream of the fan) must not be greater than 20KPa and the delivery pressure (downstream of the fan) must not be greater than 10 KPa (operation to be done during the start up phase and every 300 hours of work)

**8-13** Check the voltage and current values of the motor, to be done continuously to avoid damage to the motor and that may be a symptom of anomalies in the correct operation of the fan

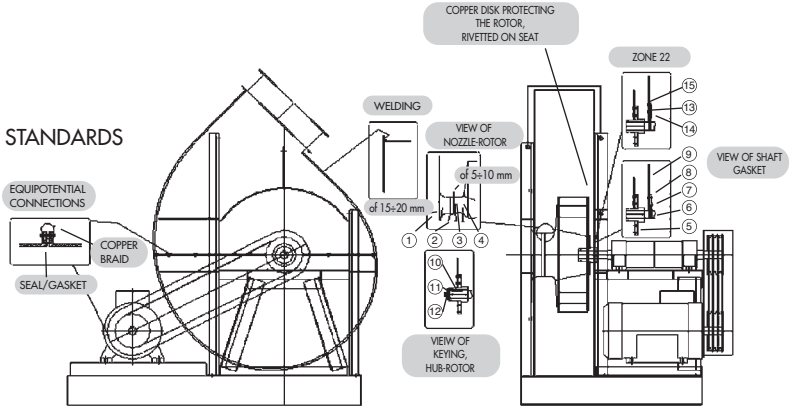
**8-14** Check the state of lubrication of the bearings (refer to point 3-5, it would be advisable to install time programmable greasing machines)

**8-15** Spare parts – always use original parts and ask explanations of TRA-BO

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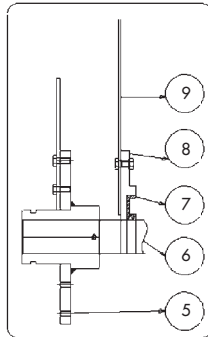
**Considering the importance of the ATEX machine it would be a good rule to keep a spare fan to avoid machine stoppage.**

OVERALL  
 CONSTRUCTION  
 FAN  
 ACCORDING TO STANDARDS  
 ATEX

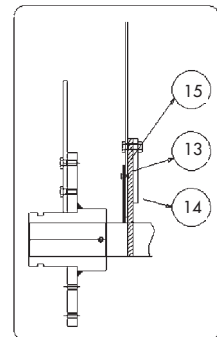


VIEW ON SHAFT SEAL ACCORDING TO ZONE

- 5- Impeller hub
- 6- Shaft
- 7- Vaiton seal
- 8- Seal holder
- 9- Fan casing



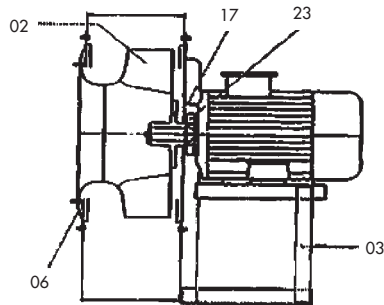
ZONE 1 OR ZONE 21



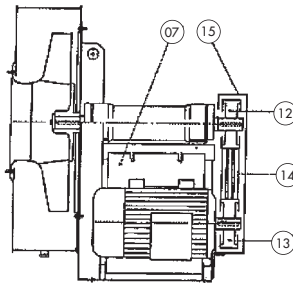
ZONE 2 OR ZONE 22

- 13- Felt seal
- 14- Seal holder
- 15- Copper disk

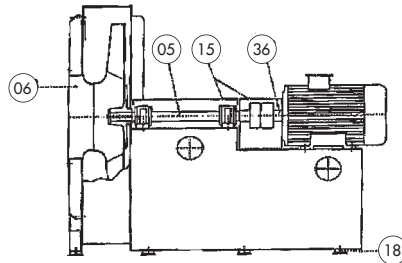
- 02-Impeller
- 03-Seat
- 06-Nozzle
- 17-Small fan protection guard
- 23-Small cooling fan



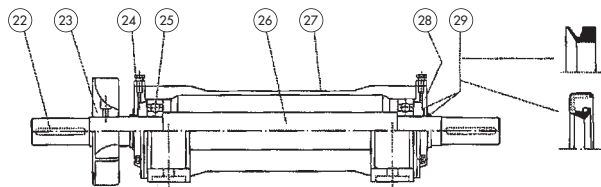
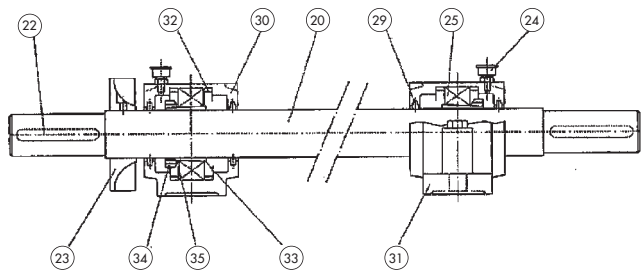
- 07-Motor bearing lug
- 12-Fan pulley
- 13- Motor pulley
- 14-Belts



- 05-Transmission shaft
- 06-Suction nozzle
- 15-Protection guard
- 18-Vibration damping shock absorbers



- 22-Tab
- 23-Small cooling fan
- 24-Greaser
- 25-Bearing
- 26- Transmission shaft
- 27-Supporting casing
- 28-Cover
- 29-Protection seal
- 30-Support cover
- 31- Support Casing
- 33-Traction bushing
- 34-Ring nut
- 35-Safety washer



## CONTROLS AND MAINTENANCE TABLE

Pos.	Type of check	date	Value/outcome	checked by	notes
1	<b>CHECKS DURING START UP</b>				
1.1	Temperature of the bearings (C°)				
1.1.1	Fan: impeller side (if present)				
1.1.2	Fan: impeller side (if present)				
1.1.3	Motor: coupling side				
1.1.4	Motor: side opposite coupling				
1.2	Vibrations of the bearings (mm/s-RMS)				
1.2.1	Fan: impeller side (if present)				
1.2.2	Fan: side opposite impeller (if present)				
1.2.3	Motor: coupling side				
1.2.4	Motor: side opposite coupling				
1.3	Operating speed (r.p.m.)				
1.3.1	Motor				
1.3.2	Fan (if different from motor speed)				
1.4	Sound pressure level at 1.5 m distance form the side opposite the suction inlet (db/A)				
1.5	Check the assembly play, verify the correspondence with the data indicated in the typical cross section of the Fan and in the typical cross section of assembly of the transmission protection guard (if present). See the two typical cross sections attached to fan documentation..				
1.6	Check the spare parts supply according to the indications of TRA-BO (list on request)				
1.7	Check the environmental data				
1.7.1	Environmental temperature (°C)				
1.7.2	Fan inlet temperature (°C)				
1.7.3	Fan outlet Temperature (°C)				
1.8	Check the total pressures (Pa)				
1.8.1	Total suction pressure				
1.8.2	Total delivery pressure				
1.9	Motor voltage and current values				
1.9.1	Voltage (V)				
1.9.2	Current (A)				
2.0	<b>CHECK THE CORRECT CONNECTION OF THE GROUNDING POINTS</b>				
2.1	Check the state of the lubricant				
2.2	Check the state of the bearings				

Pos.	Type of check	date	Value/outcome	checked by	notes
	<b>Checking to carry out cyclically At least every 300 to 600 hours of operation</b>				
3.1	Temperature of the bearings (°C)				
3.1.1	Fan: impeller side (if present)				
3.1.2	Fan: side opposite impeller (if present)				
3.1.3	Motor: shaft side				
3.1.4	Motor: side opposite shaft				
3.2	Vibrations of the bearings (mm/s-RMS)				
3.2.1	Fan: impeller side (if present)				
3.2.2	Fan: side opposite impeller (if present)				
3.2.3	Motor: shaft side				
3.2.4	Motor: side opposite shaft				
3.3	Operating speed (r.p.m.)				
3.3.1	Motor				
3.3.2	Fan (if different from motor speed)				
3.4	Sound pressure level at 1.5 m distance from the side opposite the suction inlet (db/A)				
3.5	Check the assembly play, verify the correspondence with the data indicated in the typical cross section of the Fan and in the typical cross section of assembly of the transmission protection guard (if present). See the two typical cross sections attached to fan documentation.				
3.6	Check the spare parts supply according to the indications of TRA-BO (list on request)				
3.7	Check the environmental data				
3.7.1	Environmental temperature (°C)				
3.7.2	Fan inlet temperature (°C)				
3.7.3	Fan outlet Temperature (°C)				
3.8	Check the total pressures (Pa)				
3.8.1	Total suction pressure				
3.8.2	Total delivery pressure				
3.9	Motor voltage and current values				
3.9.1	Voltage (V)				
3.9.2	Current (A)				
3.10	Check the correct connection of the grounding points				
4.1	Check the state of cleaning of the rotating parts				
4.2	Check the state of cleaning of the fan surfaces, the motor, and all the electrical appliances and not, connected to the fan				
4.3	Check the state of the shock absorbers (if present)				
4.4	Check the tension of the belts				
4.5	Check the alignment of the flexible joints				
4.6	Check the state of the lubricant				
4.7	Check the state of the bearings				