

Operation and Maintenance Instructions

Axial Fan





Axial Fan

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1 General Safety Instructions

1.1 Introduction to General Safety Instructions

Apart from an economically sensible and ecologically suitable application, it is most important for the operation of a machine that any danger to the life and limb of people is excluded.

In order to ensure this, please observe the safety instructions given in this manual. In addition to these instructions, the generally applicable Safety and Accident Prevention Regulations must be complied with.

The fan you have purchased is a the state-of-the-art product and operates reliably and safely if this operation manual is observed. Inexpert use can cause both malfunctions and danger to people.

Therefore, this operation manual is binding for any person in charge of installation, start-up, operation and maintenance at the purchaser's works.

The fan must be used for the purpose defined in the contract only. Any use deviating herefrom does not comply with the contract. The manufacturer does not provide any warranty for damage resulting from this. It is not allowed to make the fan available to a third party if this includes additional risks.

The fan must be used, maintained and repaired by authorized and well-trained personnel only. The operating personnel must be informed about possible dangers by reading this operation manual.

It is necessary to observe the shut-off procedures described in the operation manual of the system into which the fan is integrated.

It is not allowed to carry out any work which impairs the reliability of the fan and associated system components. The operator has to make sure that no unauthorized person works at the machine. He is also obliged to immediately inform the purchaser about changes of the fan which reduce operating safety and reliability. The purchaser, for his part, is obliged to inform the manufacturer in writing about all defects without any delay, however 14 days after the defect has been detected at the latest.

The purchaser is obliged to run the fan always in perfect condition. The manufacturer declines liability for unauthorized changes which impair the function and safety of the fan.

Work on the fan must always be carried out during shutdowns. This applies especially to the removal of safety guards. In this case the drive must be secured against being switched on inadvertently.

It is not allowed to remove information, mandatory, and prohibitive signs.

If the fan is started up again after a shutdown, make sure that all safety guards have been mounted properly.

Any safety guards which are not in compliance with VDMA 24617 must be considered dangerous. The purchaser has to fix corresponding screens.

These safety instructions correspond to the following regulations:

- Worker health and safety regulation
- Occupational health and safety in metal processing sectors
- EC-directive on product liability dtd. 7/25/85
- EC-machine directive 89/392/EWG, annex IIa
- Product liability under the laws of Turkish Commerce
- Installation of the electrical and mechanical protection devices should be taken in accordance with DIN EN 60204-1, DIN EN 294 ve DIN EN 349
- Static grounding should be done in accordance with DIN EN 61000-6-3 ve EN 61000-6-4 ve VDMA 24169 part 1 and 2

Axial Fan**1.2 General Notices and Warning Signs**

GENERAL NOTICES and WARNING SIGNS	
	Fan is made according to the level of technical safety rules. However, life-threatening danger may occur to user as well as to a third party during use of fan or other damage may occur.
	Ventilator is a tool of dynamic high upper level current. This machine can only be used by authorized personnel.
	Do not operate this fan without reading the instructions. If there are any unclear parts in this instruction manual, it is absolutely necessary to contact authorised personnel of İNCİRCİOĞLU VANTİLATÖR, KLİMA İMALAT SANAYİ VE TİC. LTD. ŞTİ.
	This product should be used for the intended use. If used otherwise İNCİRCİOĞLU VANTİLATÖR, KLİMA İMALAT SANAYİ VE TİC. LTD. ŞTİ. is not responsible for the risks that might occur.
	All the safety protection devices and parts such as emergency stop button, shaft cover, coupling cover etc. must be installed.
	Sudden temperature changes may cause physical deformation. The fan must not be used at different temperatures other than the design temperature.
	Ear protection must be used at sound level which is over 82dB.
	Indicates the direction of the impeller rotation of the fan.



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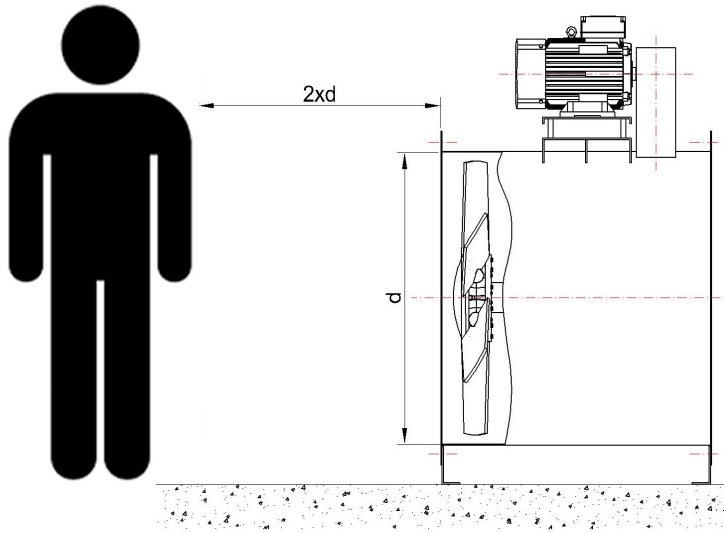
1.3 Special Safety Instructions

The purchaser has to take measures against the following dangers:

If the temperature of the housing exceeds 50° C, the purchaser has to provide protection against inadvertent contact.

If the fan is equipped with a heating system, protective measures must be taken against inadvertent contact with the immersion heater.

If the fan is equipped with vane control, an overload of the fan motor might occur in the the adjusting range of >90°. It is therefore necessary to check the nominal current.

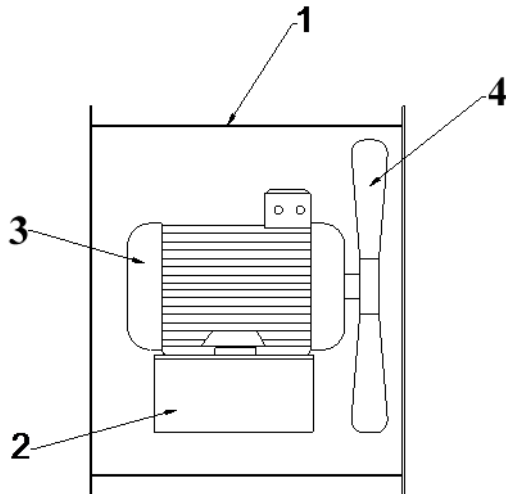


Keep out of the suction range of fans with free air intake within a distance of $L < 2 \times \text{nominal diameter}$ under any condition!

Ventilator must be used, maintained and repaired by authorised personnel only. This personnel must read this manuel for the dangers and7or unsafe situations that might occur.

Picture 1 : Minimum approach distance to free intake axial ventilator.

2 Introduction to Product and Ventilator Parts

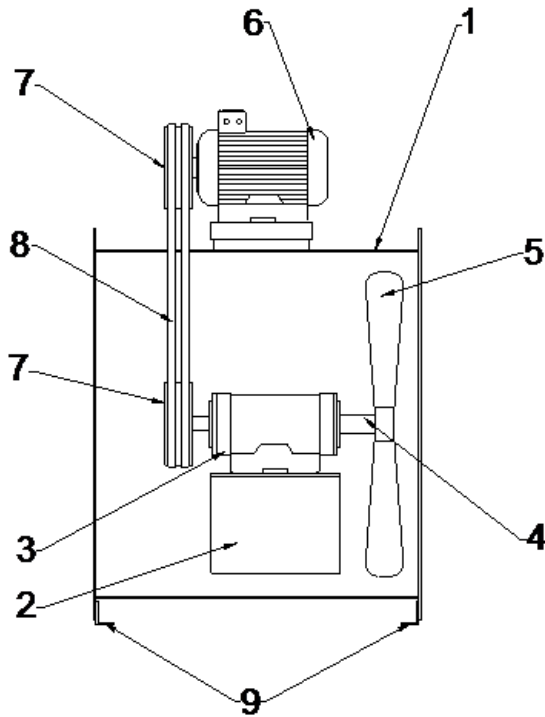


1. Casing
2. Base Frame
3. Impeller
4. Electric Motor

Picture 2 : Direct drive axial ventilator.



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1. Casing
2. Base Frame
3. Housing
4. Shaft
5. Impeller
6. Electric Motor
7. Pulley
8. V-Belt
9. Bracket

Picture 3 : Belt drive axial ventilator.

3 TRANSPORTATION AND STORAGE

3.1 Packing

Depending on type and size, the fans are delivered without packing, partly packed or completely packed. Decisive for the type of packing is the way of transport. The corresponding regulations of the contract are valid here as well. The type of packing is marked according to DIN 55 402 Part 1 and must be considered when it is handled.

3.2 Dismounting Degree

The dismounting degree depends on the conditions of transport, the local conditions and the hoist available. However, in order to make the assembly on site as easy as possible, we try to deliver fans as completely mounted as possible.

3.3 Handling

During transport the fan and fan components must be handled with care in order to avoid damage due to harsh treatment or uncaredful loading and unloading.



The fan must be attached only at the intended points (attaching eyes or openings).

For loading and transport it is prohibited to use motor mounting eyes in any case!

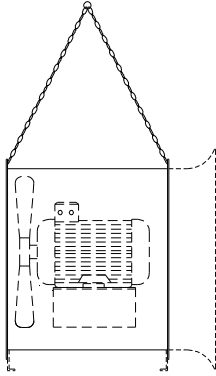
All hoists and means of transport used must be suitable for size and weight of the parts to be conveyed. For weights please refer to the technical data sheet. Transport frames must comply with the usual regulations.

Complete fans must be loaded in such a way that their position corresponds to their installation position. Inclined positions or similar deviations must be avoided at any rate. The only exceptions are small axial fans. The devices have to be loaded in such a way that they cannot move, tilt or get in contact with each other. The transporting agent and his loading expert are responsible for transport safety devices which are suitable for the duration of the transport.

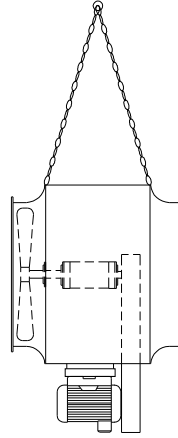
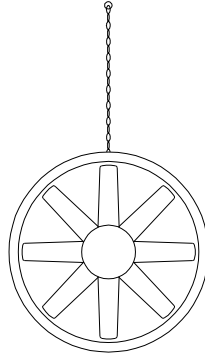


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* Example of lifting centrifugal fans in arrangement are shown in figures 4, 5.



Picture 4 : Direct drive axial ventilator.



Picture 5 : Belt drive axial ventilator.



The examples given above are generic examples, as it is impossible to know in advance every possible configuration for lifting an İNCİRCİOĞLU VANTİLATÖR LTD. ŞTİ.



Any other lifting point not shown above is indicated by this symbol.

3.4 Storage

The fans should be stored in roofed rooms.

Close openings in the housing of the fan which are not shut with covers in order to prevent water from penetrating.

During the storage period a minimum amount of maintenance work is necessary to maintain operativeness.

- The impeller must be spun in regular intervals (once per month). For this purpose the impeller or the shaft should be marked in such a way that the runner's idle position is offset by 90°. If the bearings are relieved it is not required to spin the impeller.
- If storage last for more than 3 months, the bearings must be opened before start-up and checked for corrosion damage caused by condensate. If required, the old grease has to be removed, the bearings must be cleaned and provided with new grease.

The storage of the motors must not affect their operativeness. Therefore, they should not be subjected to moisture or heat. In this connection, please refer to the operating instructions of the motor manufacturer.

Depending on the order, fans are primed, and then coated with a basic or covering varnish or galvanized. Bright parts are treated with rust preventing grease or preservative oil. If the fan is stored for longer than 9 months it must be preserved once more.

3.5 Scope of Supply

The scope of supply is listed in the shipping documents and has to be checked for completeness on receipt.

The forwarding agent or the manufacturer must be informed immediately about any transport damage or missing item noticed on delivery.

If a damage is found after acceptance of delivery, the purchaser must inform the manufacturer in writing about this damage without any delay, however 14 days after the damage has been noticed at the latest.

Axial Fan**4 ASSEMBLY****4.1 Conditions for Assembly**

With regard to plant engineering, make sure that the fan is freely accessible for installation and maintenance work. Adjacent plant sections or machines have to be arranged correspondingly.



Ventilator must be leveled with water gauge before the initial start up.

Otherwise, İNCİRCİOĞLU VANTİLATÖR LTD. ŞTİ. can not be held responsible for any damages.

4.2 Dimensions and Weights

The fan dimensions are given in the dimensional sheet and in the main drawing.
The total weight of the fan is also given in the main drawing.

4.3 Hoists

The lifting capacity must correspond at least to the weight of the complete fan or the heaviest component of the disassembled fan.

4.4 Assembly

The fan must be assembled according to the manufacturer's technical documents (operating manual and main drawing).

Assembly requires the following:

- Set and clean foundations which are capable of bearing or stable framings with plane horizontal surfaces corresponding to the dimensions of the fan to be installed.
- Free access and local freedom of motion in the area of assembly
- Mobile or stationary hoists
- Workside current 10 A/220 V for manual electric devices

Assemble the fan with the usual tools and measuring instruments such as mason's level, feeler gauge, straight-edge and graduated metal rule.

4.4.1 Preparation

The following conditions must be fulfilled before you start assembly:

- the foundations/frames must be checked,
- the alignments and heights must be measured,
- the fan must be transported to the place of assembly

4.4.2 Assembly

The fan has to be suspended by the suspension eyes and lifted in such a way that the vibration dampers (if there are any) can be placed underneath the fan and screwed to the base. Afterwards the machine is placed on the foundation/frame and aligned. Only after exact alignment by means of a water level or a similar measuring instrument the vibration dampers are screwed down.

If vibration dampers are used, ensure free motion and uniform spring deflection. Without vibration dampers stress-free installation must be guaranteed. Unevenness must be compensated by shims.

The electric installations must correspond to the VDE-regulations (regulations of the Association of German Engineers).

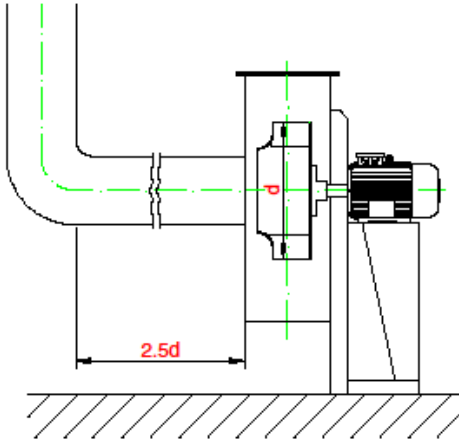
Connect the piping on plant side with elastic expansion joints, considering the intended flanges.

A non-uniform reduction of the intake cross section at the protective grating or the intake opening must be prevented. Otherwise, this may cause power loss and/or malfunctions.

If possible in the available space, to guarantee correct entry of the fluid in to the intake opening it is advisable on fans connected to ducting to leave a straight section of duct with length about 2.5 times impeller dimension. The result of this calculation divided by 1000 gives the recommended length (in metres).

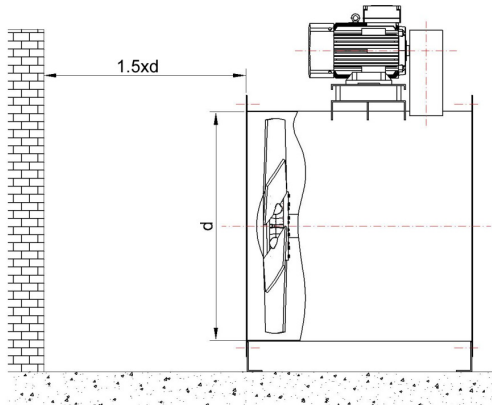


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Picture 6 : Minimum intallation distances with intake pipe.

If the fan is installed with a free intake opening, it must be positioned at a minimum distance from walls or other machinery of 1.5 times the impeller dimension. The result of this calculation divided by 1000 gives the recommended minimum distance (in metres).



Picture 7 : Minimum intallation distances with open intake.

4.5 Disassembly

If the fan is no longer required it is disassembled in reverse order. Here, too, the safety instructions must be observed!

5 TRIAL RUN and START-UP

Before the fan is started up, the following steps must be implemented:

5.1 Checks

5.1.1 Mechanical System

Check all visible screwed unions for tightness and retighten them, if necessary. For the tightening torques of the coupling screws (if there are any) please refer to the manufacturer's instructions.

All lubricating points must be provided with grease. Regrease, if required.

Check the fastening elements of the safety devices for correct installation. The cleaning opening(s) and the condensate nozzles must be firmly shut.



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Remove all foreign matters (parts for assembly, tools) from the fan housing. The same applies to connecting ducts. The fan must not be subjected to static stress caused by connected pipings. Check attached compensators/elastic expansion joints for function and correct installation.

Also check attached accessories such as vane controllers, rectifiers or similar devices. Shut vane controllers before start-up to such an extent that only 10 % of the cross section are still open.

When using explosion-proof motors measure the gap between impeller and inlet nozzle and record it.

5.1.2 Electric System

Check the electric systems for compliance with the VDE-regulations.

When the motor is selected according to power, make sure that the on-load torque has a square characteristic.

When selecting the connecting type consider the moment of inertia which must be overcome when the motor is started.

Apply the moments of inertia due to the gear ratio to the motor, when calculating the starting times of belt-driven machines.

Check and adjust the protective devices (protective relays for motors, protective relay in the power switch cell, counters, grounding, etc.).

Check possible control and measuring instruments.

Before starting the motor, check its insulating resistance. Furthermore, observe the instructions of the motor manufacturer.

Under normal conditions, the ambient temperature of the motor must not exceed 45 °C.

If motors are run above the admissible ambient temperatures, the admissible motor power is reduced in contrast to the nominal rated output. The same applies to installation heights above 1000 m NN. In this case contact the manufacturer.

Check the direction of rotation of the motor.

For explosion-proof motors special conditions are valid: short starting time $\leq t_e$. For this purpose we recommend direct connection of the motor.

When using pole changing motors, gradually change from high to low speeds. Delayed switching must be free of jerks.

Check the insulating resistance if the motor is started after a long shutdown. Dry moist coils with warm air.

If nothing else has been agreed, observe the motor manufacturer's instructions for the connecting conditions..

Motor cooling must not be impaired by attachments or changes of design.

5.2 Start Up

Keep out of the fan's danger zone!

When the fans are started up, close the vane controller. Set the duct flaps to the intended position. When radial or axial fans are used without vane control, the on-load torque may be reduced by shutting the duct flaps only if they are equipped with stabilisers. Axial fans without vane controller and without rectifier always must be started up with open duct flaps.

A vane control may be opened to the nominal current of the fan at best.

- Switch on main switch
- Switch on motor

If the nominal speed has been reached, open the control devices of the duct until the required operating point has settled.

Special attention should be paid to the temperature of the bearings, the power consumption of the motor and the smooth running of the fan. For early detection of invisible damage due to transport or faults made during assembly we recommend carrying out vibration measurements.

Consider the connecting frequency of the motor specified by the manufacturer.

After 2 hours of operation check the tension of the V-belts and restretch them, if necessary.

Check all screws 12 hours after start-up for tightness and retighten them, if necessary.

6 Operating Instructions

6.1 Checks

Check all screwed unions, especially foundation bolts, at intervals of six months for tightness and retighten them, if required.

Also check the impeller every six months by a visual inspection. Pay special attention to the condition of the weld seams and irregular deposits of dirt. If fluids which contain dust are conveyed through the fan, monthly checks are necessary. The results of these visual inspections should be recorded.

The motor must be checked in accordance with the manufacturer's requirements.

The bearing temperatures must be permanently observed during start-up. They must not exceed 80°C. In case of hot gas fans they should not exceed 100 °C. The temperatures become stable after three hours of operation at the earliest.



Vibrations represent a very high stress to the entire mechanical system of the fan!

Therefore, measurements are required at regular intervals. Instructions for vibration measurements are given in the chapter "Vibration measurements". If the results of the measurements exceed the admissible values according to VDI 2056 although the fan has been maintained according to the instructions, please inform the manufacturer.

Schedule maintenance by the manufacturer every 8000 operating hours.

6.2 Shutdown

1. Switch off motor
2. Switch off main switch
3. Shut all control devices to prevent the impeller from running.

Before switching off hot-gas fans (conveying temperatures above 150 °C) the temperature in the fan should be reduced to approx. 100 °C first in order to avoid thermal stress.

Make sure that the motor cannot be switched on again by unauthorized persons. The valid regulations for prevention of accidents must be observed.



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6.3 Malfunctions

This sections list possible malfunctions and recommendations on their elimination in a table.

Malfunction	Cause	Remedy
Fan output and total pressure are too low.	Speed too low.	Compare type of motor with specifications of the technical data sheet; complain about fan, if required.
	Wrong direction of rotation.	Connect motor correctly.
	Fan output is subjected to prerotation.	Check position of baffle plates. If their position cannot be changed, mount rectifiers on the fan.
	Plant resistances larger than calculated.	Check position of flaps; inform manufacturer of plant.
	Vane controller cannot be opened completely.	Loosen stoppers and readjust them. Check adjustment of the angles of the pre-guide vane; change length of adjusting rods if necessary.
Unusual noise		
- at the impeller	Cover disc of impeller touches the inlet nozzle.	Realign nozzle; check compensators for static load.
- whistling sound	Lubrication fault Different types of grease have been mixed.	Relubricate according to instructions.
- irregular, rolling sound in connection with a high bearing temperature	Defective antifriction bearing Belt tension too low	Exchange bearing. Increase tension of belt again.
Vane controller cannot be adjusted.	Vane bearings are corroded or dirty.	Clean, lubricate, and possibly exchange bearing.
	Adjusting lever of a guide vane unhinged - vane is jammed	Align, clamp and pin guide vane.
	Defective servo motor	Detach drive from vane controller - if the vane controller can be adjusted manually, the servomotor is defective.
Cracks in the weld seams of the housing	Strong vibrations at the fan (Veff > 11-14 mm/s)	see "Vibrations".
Fan vibrates strongly	Fastening bolts in frame/foundations have loosened	Tighten bolts
	Screwed unions of base frame are not stress-free	Compensate irregularities and check the alignment of the coupling
	Seat of shaft is worn out	Exchange shaft and hub
	Impeller distorted due to inexpert transport	Balance or exchange impeller
	Vibration damper is damaged	Exchange damper
	Compensators not correctly installed	Mount compensators free of stresses
Impeller does not move although motor is running	Fracture of the impeller key	Withdraw impeller, exchange key, check shaft and hub
	Hub detached from impeller	Exchange impeller completely
Motor protection fails in the starting stage (radial fan)	Direction of rotation of the fan is wrong	Determine direction of rotation; sense of rotation must correspond to the course of an opening spiral. Change poles of motor.
	Run-up time too long	Check whether throttle valves are open too far.
	Motor protection too low, motor rating too low	Connect motor correctly - direct connection
Motor too hot	Cooling air temperature above 40°C	Improve supply of fresh air, install forced-air cooling system.
	Flow of cooling air is impeded	Improve air supply
	Motor overloaded	Slightly close vane controller or duct flaps.
Bearing temperature too high	Cooling wheel not installed	Install cooling wheel
	Belts heat up	Balance and adjust belt pulleys.
	Unacceptable operating temperature	Change operating mode
	Wrong lubricant	Lubrication as per instructions.



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6.4 Start after Malfunctions

The procedure is the same as for start-up.

6.5 Stoppage

6.5.1 Preparations

Protect the motor against moisture, heat, dust and shocks.

Treat bright parts with means of preservation.

6.5.2 Restart

Remove auxiliary equipment of storage (covers etc.) and proceed as during initial start-up.

7 Maintenance

7.1 General

Expert and regular maintenance is a prerequisite for troublefree operation. To prevent long periods of repair and downtimes, the following recommendations should be strictly observed.

Purchased parts manufactured by subsuppliers have to be maintained according to their instructions.

7.2 Maintenance

7.2.1 Bearings and Lubricants

The antifriction bearings installed are subject to the manufacturer's lubrication instructions. They were originally filled with the lubricant Shell Alvania R3 for applications at normal temperatures. Other lubricants can also be used, of course, if they have comparable characteristics. Please find the corresponding overview in the annex. When cleaning the housing, completely remove old grease, possibly clean the bearing and fill with new grease. The lubricants must be stored in clean, closed containers to prevent dust and moisture from penetrating. The storing place should be dry and cool.

7.2.2 Impeller

In case of long shutdowns spin the impeller once per week. Here the final position should be offset by 90° compared to the previous idle position.

Apart from the regular visual inspections (at least once a year) the impeller must be cleaned whenever it is dirty. The cleaning intervals depend on the fluid conveyed.

7.2.3 Motor

Under standard conditions the motors used by RUWU are maintenance-free. Permanently lubricated bearings do not require regreasing.

Apart from this, the motor manufacturer's maintenance instructions are valid.

7.2.4 Belt Drive

The drive must be visually inspected after the first 24 hours of operation. Afterwards, it should be checked every three months.

Protect the belts against oil mist, dripping oil and other chemicals. Permanent exposure to these fluids causes early wear of the belts.

7.3 Repair Work

7.3.1 General

This chapter contains instructions for repair work which only includes the exchange of original components. In case of problems which are not mentioned in this chapter, please contact the manufacturer.

Make sure for every repair that the fan cannot be switched on inadvertently.

Axial Fan**7.3.2 Exchange of Impeller**

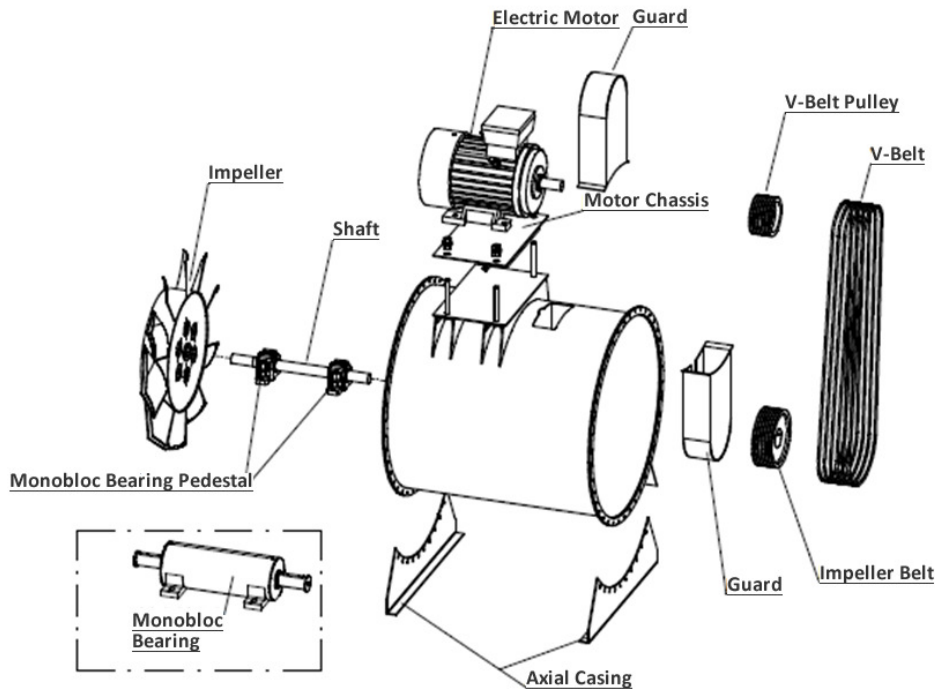
- Remove suction piping for free access to the impeller.
- Dismount belt guard.
- Open the slide rails of the motor and reduce the centre distance by shifting the motor until the belts can be removed.
- Dismount inlet nozzle.
- For radial fans with split housing: Dismount top half of housing.
- Strike impeller; loosen safety bolt and nut and withdraw impeller.

The new impeller must be treated carefully in order to prevent any unbalance caused by an impact.
The impeller is assembled in reverse order.

7.3.3 Exchange of Bearings

Fans with belt drive:

- Dismount belt guard.
- Open the slide rails of the motor and reduce the centre distance by shifting the motor until the belts can be removed.
- Withdraw the V-belt pulley, considering the manufacturer's instructions.
- Dismount the top halves of the bearing housings; consider manufacturer's instructions here as well.
- Lift shaft
- Detach bottom halves of bearing housings from bearing pedestals.
- Detach adapter sleeve and dismount antifriction bearing according to the manufacturer's instructions.



Picture 8 : Exchange of impeller, belt and bearing.

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Fans with direct drive without/with coupling:

- Dismount shaft guard.
- Dismount motor.
- Remove coupling, if one exists.
- Dismount top halves of bearing housings according to the manufacturer's instructions.
- Lift shaft.
- Detach bottom halves of bearing housings from bearings pedestals.
- Detach adapter sleeve and dismount antifriction bearing according to the manufacturer's instructions.

The bearings are mounted in reverse order.

7.3.4 Exchange of Cooling Disc

In case undivided cooling discs are used, contact RUWU. Split cooling discs can be exchanged by the purchaser himself as follows:

- Remove cooling disc guard.
- Loosen connecting bolts of the disc halves.
- Remove disc halves.
- Mount the new cooling disc in reverse order - make sure that they are mounted correctly (blades in direction of bearings)!

7.3.5 Exchange of Belt

A belt has to be exchanged if the admissible restretching length exceeds 3 % of the working length or if the profile of the belts is no longer in perfect condition.

- Dismount belt guard.
- Open the slide rails of the motor and reduce the centre distance by shifting the motor until the belts can be removed.
- Lay the new belts on the pulley without using force or tools.
- Stretch the belt uniformly.

Pay attention to the following:

The pulleys must be in true alignment and must run on the shaft free of vibrations. Furthermore, no grease or dirt must deposit on the pulley. The shafts of motor and impeller have to be exactly parallel.

The centre distance of the motor must be reduced so far that the belts can be mounted free of tension.

Slack belts flap and slide. If the V-belts are overstretched the belt is drawn too far into the pulleys. The driving end must run smoothly, the slacked end must not pulsate. Both slack and overstretched belts cause much flexing work which leading to high frictional heat which gives rise to the early destruction of the belts and an unnecessary strain of the bearings.

Subsequent elongation of the belts can be compensated by restretching.

With multiple groove pulleys always exchange the complete set of belts. For installation the first belt has to be inserted into the last groove of the pulley.

If belts are supplied in sets, they must not be mixed up with other sets of belts. Otherwise the different work tolerances affect the performance. Punched group numbers ensure that the set can be assembled without problems.

Carry out the first visual check after 24 hours. Further checks should be carried out in intervals of 3 months.

For flat belts special instructions are valid. Please refer to the manufacturer's instructions.

7.3.6 Other Components

Important components such as

- gear units
- labyrinth seals
- couplings

should not be exchanged by the customer. Exchange of these components is at his own risk. Please contact RUWU for the exchange of these parts.

Axial Fan**7.4 Spare Parts**

The type-specific spare parts list in the annex contains the exact designation of the single components. If a spare part is required, please refer to this list. In case of order, always specify order no., type of fan and the number of pieces you require.

If other than the original spare parts are installed we cannot assume any guarantee. The installation/use of such parts might have a negative effect on the operating characteristics of the fan and change the passive safety. For damage due to the use of other than the original spare parts and accessories, any liability or warranty on the part of RUWU Hochleistungs-Ventilatoren are excluded.

8 Vibration Measurement

A variety of mechanical defects can be traced back to one of the three main causes of increased machine vibrations: loose fastening elements, poor alignment and unbalances. Changes in the operating performance have a direct influence on the vibration behaviour of a fan. The measuring method recommended by the internationally accepted regulations (VDI 2056, ISO 2372) is so easy that it can be carried out by the maintenance personnel without special training in vibration measurement.

The regulations subdivide industrial machines into six vibration classes. Only the effective value V_{eff} of the vibration speed is measured. By comparison with the specified limit values for the corresponding vibration class, the vibration behaviour of a fan can be immediately evaluated as good, acceptable, still acceptable or unacceptable. A certain amount of vibration is unavoidable and must be tolerated. Each fan has been designed for a certain vibration level. Only if this standard vibration level is exceeded, the conditions have deteriorated. The manufacturer's specifications in the inspection protocol serve as reference values.

Experience has shown that one gets the best idea of the vibration behaviour of a fan by measuring the vibration intensity. The vibration intensity is defined as the effective value of the vibration speed in the frequency range between 10 and 1000 Hz. The vibration intensity is measured in mm/s with the supplement V_{eff} . It is a direct measure for the energy content of the vibrations and therefore a good parameter for the destructive forces which possibly occur at a machine.

8.1 Selection of Measuring Point

The vibration at the selected measuring point should be representative for the vibration behaviour of the machine. The forces which occur are usually transmitted via the bearings and the bearing housings to the housing and the foundation of the fan. Therefore vibration should be measured at **bearing housings** or at a point immediately next to the bearings. Light attachment parts such as covers or duct connections as well as other components which are much less stiff than the fan are not suitable for the measurements.

The more measuring points, the easier mechanical disturbances can be located. The measuring results at the bearing on impeller side mainly provide information about unbalances of the impeller. To get an idea of the state of the complete fan, the bearings on the drive side of impeller and motor have to be measured.

The direction of vibration is important, too. Unbalances rotate with the shaft and cause radial vibrations, i.e. vibrations in all directions, at right angles of the shaft. Axial vibrations along the shaft are often caused by poor alignment, poor coupling or bent shafts. Therefore, at a measuring point measurements are usually taken in three directions: vertical, horizontal and axial. The two radial values permit an additional evaluation: Increased vertical values point to insufficient or damaged fixtures or foundations, whereas it is possible to draw conclusions from the horizontal measuring value to unbalances.

The exact measuring point at which the sensing element is fixed should be clearly marked and also used for future measurements. Otherwise, the measured values cannot be compared.

8.2 Evaluation of Vibration Behaviour

According to VDI 2056 the machines are subdivided into six groups, depending on

- machine size and mode of operation
- erection/foundation

(see table 1). For each group the limit values for good, acceptable, still acceptable and unacceptable vibrations have been defined to serve as a basis for comparing of the measured values.



Axial Fan

Most fans belong to groups M, G and T. Group K comprises smaller machines which are only rarely measured. Driving power, type of drive, machine size and stiffness of foundation are characteristics for assigning the individual fans to the machine groups. A fan with a driving power of approx. 100 kW on a concrete foundation belongs to group G. If mounted on another foundation, e.g. on the rather elastic deck of a ship, the same fan would however be allocated to group T.

Limit values	Group				mm/s RMS	
	M	G	T	D		
28					20	Unacceptable range
18						Still acceptable range
11						Acceptable range
7,1						Good
4,5					5	
2,8						
1,8						
1,1						
					1	

Picture 9 : Machine groups and limit values

Group M: Medium-size machines without special foundations; also firmly mounted driving mechanisms and machines (up to approx. 300 kW) with rotating parts on special foundations only.

Group G: Large machines on high-tuned, rigid or heavy foundations, large power engines and machines with circulating masses.

Group T: Large machines and power engines on low-tuned foundations with circulating masses, e.g. turbo groups.

Group D: High-tuned installed machines and driving mechanisms with mass effects which cannot be compensated.

For the application of the vibration measuring device the specifications of the respective manufacturer are valid.

Table of Lubricants

PRODUCT NAME	NLGI Class	Soap Type	Viscosity of basic oil cSt. ASTM D 445		Worked Penetration 25°C ASTM D 217	ASTM D 566 Dripping Point D 2265, °C IP132	Operating Temperature °C
			40°C	100°C			
Shell Alvania EP2	2	Li	189	15,6	265-295	180	-20°C, +120°C
Shell Retinax EP2	2	Li	188	15,5	265-295	184	-20°C, +120°C
Mobilux EP2	2	Li	160	-	280	190	-20°C, +130°C
Texaco Multifakt EP2	2	Li			265-295	190	-20°C, +130°C
Castrol SPHEEROL EPL-2	2	Li	150	-	265-295	180	-20°C, +120°C
Total MULTIS EP2	2	Li	150	-	265-295	>190	-25°C, +120°C

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