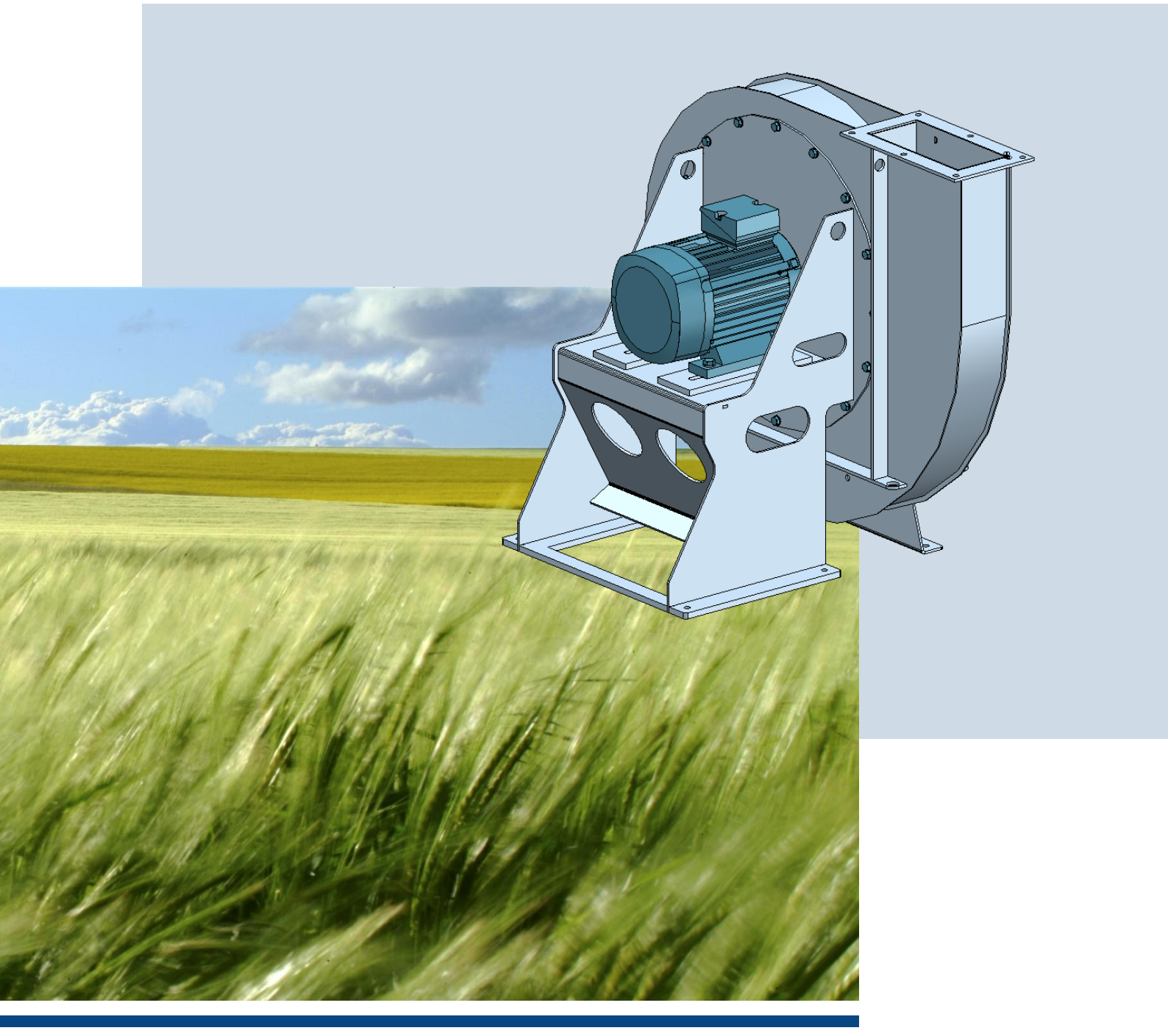
ZENNER VENTILATOREN



Operating and Servicing Instructions

Manual at Zenner Radial Fans (original)

Contents

1 General

Please read this operating manual carefully. In case of doubts or if uncertain points occur, please clarify them with Zenner Ventilatoren GmbH first.

This present technical documentation advises you how competent personnel can properly operate and maintain this equipment. It is applicable in conjunction with the technical findings and experience in the operation of turbo machinery and assumes that the generally applicable and local rules for the prevention of accidents and this documentation be known. Any damage resulting from non-observance of this Operating Instructions Manual or from improper usage will not be covered by the warranty obligations of Zenner Ventilatoren GmbH.

This documentation should be made accessible to any persons responsible for this fan. Knowledge of it can avoid fan malfunctioning and guarantee trouble-free operation.

2 Fields and limits of application

Zenner radial fans have been built according to the state of the art and are operationally reliable. They undergo quality inspection at the factory and leave the latter in an unobjectionable condition.

Zenner radial fans are used in installations, on machines and in equipment in numerous fields of industries for the conveyance of air and air/gas mixtures. They are suitable for any processes where heat, humidity as well as solid matter such as dust, grains, flakes, chips, clippings, fibres, grit, pieces of threads, etc. are to be conveyed. Such solid matter can be of various materials such as wood, wool, glass, plastics, sand, flour, ash, coal, metal, ceramics, paper, cardboard, straw, hay, salt, cement, etc. The fans can be used in installations, equipment and on machines for:
ventilation, air-conditioning, extraction, dedusting, heating, cooling, drying, fresh-air supply, flue-gas extraction, solid-matter conveyance, producing hot-air curtains, air jets and insulating air cushions, for example, in the following facilities, industries and processes: workshops, workshop halls, warehouse rooms, paint shops and

spray booths, laboratories, office rooms, dining and meeting rooms, cinemas, restaurants, club rooms, halls, telecom installations, heating systems, textile machinery, paper machinery, drying systems, horticulture, hot-air curtain systems, byres, garages, boiler houses, hospitals, shops, department stores, joiner's workshops, foundries, timber processing, plastics processing, metal industry, textile industry, ceramics industry, timber drying, shipbuilding, air-conditioners, cement industry, chip extraction systems, chemical processes and in many more fields.

Application limits:

The fans can be designed for the following ranges:

- Volume flow: from 0,02 to 15 m³/s
- Overall pressure increase: from 50 to 15000 Pa
- conveying medium Temperature: from - 20 to + 800 °C
- Type of conveying medium: any gases and gas mixtures with the exception of some toxic, chemically aggressive and explosive gases which belong to extreme explosion groups and temperature classes
- Ambient temperature: from - 20 to + 40 °C
- Vibratory stress: For the contractually agreed fields of application such as shipbuilding, railway earthquake-proof installations or similar.
- Solid matter admixture: normally, up to 20 g dust per m³ of air, and up to a concentration of 200 g/m³ for chip conveyance.
- Mode of operation: continuous operation, unless otherwise agreed.

However, not any fan can be used for every requirement as the variety of external conditions may require a specific design.

Despite the high safety in its constructional design, it must be pointed out that a fan may only be used for its contractually agreed application. In particular, ensure that the fan is not exposed to any higher external stress as can, for example,
be caused by:

- static or dynamic forces (vibration; if elastic air-duct connection elements, also referred to as compensators, and vibration absorbers between the frame and the base of the fan are intended for installation they must not be omitted or be ineffective).
- higher ambient temperatures (bearing lubricants).
- higher conveying medium temperatures.
- any speeds changed without any authorization which can lead to resonance vibration of some components, higher stress on stability or to excessive driving power.
- higher solids contents in the conveying medium which can lead to excessive wear or higher dust deposits and to impermissible unbalance.
- excessively high system resistance which, above all, adversely affects the performance parameters, the power consumption, the sound power level and the behaviour with respect to dust.
- any disturbances within the inlet area in front of the fan.
- excessively frequent switching OFF and ON.

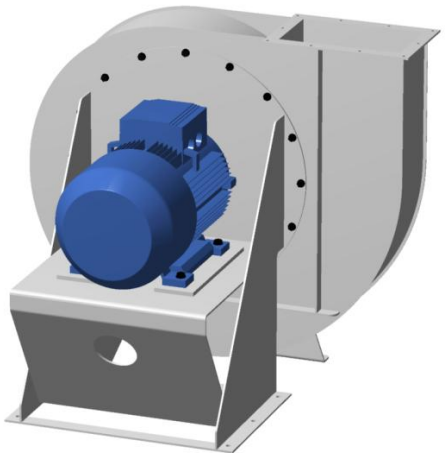
3 Fan design

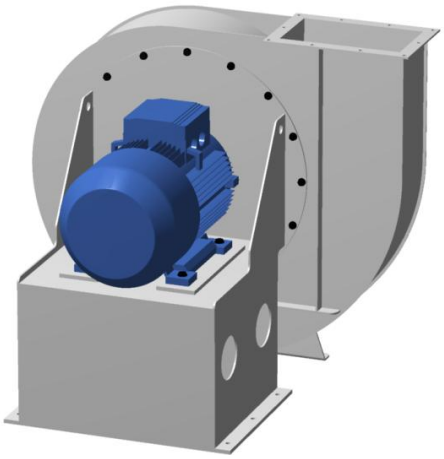
Our radial fans can be designed with three different drive types:

- W-type design: Direct drive, with the impeller on the shaft end of the electric motor.
- Z-type design: Driven via a coupling and an intermediate shaft.
- F-type design: Driven by a V-belt via an intermediate shaft.

3.1 W-type design

For the W-type design, the power is directly transferred from the electric motor to the impeller, as the latter has been directly fitted to the motor shaft end.





The fan consists of the following assemblies:

Impeller

A sheet steel weldment, dynamically balanced for quality class 6.3 according to VDI 2060, with a stability rated for the contractually agreed speed only, consisting of moving vanes as well as of a bottom and a cover plate, fixed to the shaft by a hub.

Spiral housing

A sheet steel weldment, bolted to the motor frame, rotating housing position; if required, provided with a labyrinth gland at the shaft exit; if required, split horizontally or in any other way; if required, provided with a peephole; pipeline connection flanges as per dimension sheet according to DIN 24154.

The housing must not be statically loaded by subsequent ducts; normally, elastic connection elements (available as accessories) should be used.

Motor frame

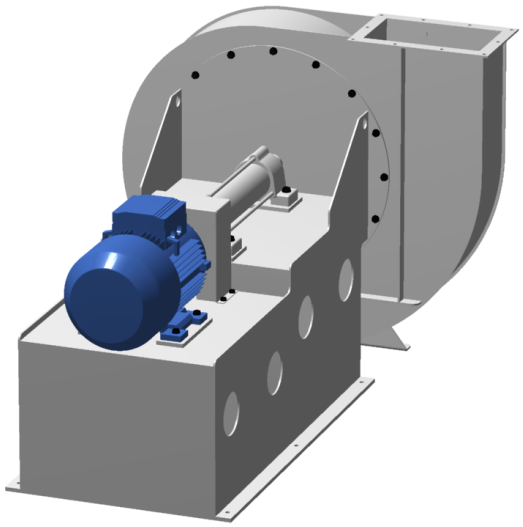
A sheet steel weldment to take up the electric motor and the spiral housing; anchoring can be made either directly between the motor frame and the foundation or indirectly between the motor frame and the foundation via a base frame, or between the motor frame and the foundation via a vibration-absorbing frame and vibration absorber elements (frame and absorbers available as accessories), respectively.

Electric motor

Normally, an asynchronous squirrel-cage motor, with the impeller being fixed to the motor shaft end and the normal scope of supplies ending at the terminal box.

3.2 Z-type design

For the Z-type design, the power is transferred from the motor to the impeller through a coupling and an intermediate shaft which has separate bearings. As far as vibration and stability are concerned, this design has only been rated to the contractually agreed speed range. Such intermediate suspension will be necessary if the temperature of the conveying medium is higher than 80 °C, or if the impeller weight is too high for the motor shaft end.



The fan consists of the following assemblies:

Impeller

Same as above.

Spiral housing

Same as above.

Bearing block

A sheet steel weldment which serves to take up

- the bearings of the intermediate shaft which holds the impeller and one coupling half,
- the electric motor with the other coupling half, and
- the spiral housing.

Anchoring is the same as for the W-type design (base frame or vibration-absorbing frame and vibration absorber elements available as accessories).

Intermediate suspension

Consisting of a movable and a fixed bearing (on the coupling side), either two bearing housings, or designed as a double bearing, normally of antifriction-type with grease slingers.

Intermediate shaft

A steel shaft suspended by intermediate bearings and to take up the impeller and one coupling half, designed so that its operating speed is at least 20 % below the critical speed of the rotor.

Coupling

An elastic pin or denture coupling.

Coupling guard

To serve as protection against accidental contact.

Cooling vanes

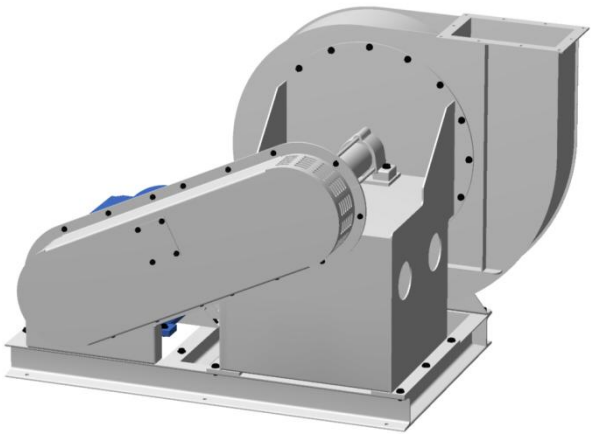
To avoid heat transfer to the bearings if the temperature of the conveying medium is above 80 °C. The material normally used is aluminium.

Electric motor

Same as above.

3.3 F-type design

For the F-type design, the power is transferred from the motor to the impeller through v-belts and an intermediate shaft which has separate bearings. As far as vibration and stability are concerned, this design has only been rated to the contractually agreed speed range. Such intermediate suspension will be necessary if the temperature of the conveying medium is higher than 80 °C, or if the impeller weight is too high for the motor shaft end.



The fan consists of the following assemblies:

Impeller

Same as above.

Spiral housing

Same as above.

Bearing block

A sheet steel weldment which serves to take up

- the bearings with the intermediate shaft which holds the impeller and a V-belt pulley,
- and the spiral housing.

Intermediate suspension

Consisting of a movable and a fixed bearing (on the V-belt pulley side), either two bearing housings, or designed as a double bearing, normally of antifriction-type with grease slingers.

Intermediate shaft

A steel shaft suspended by intermediate bearings and to take up the impeller and a V-belt pulley, designed so that its operating speed is at least 20 % below the critical speed of the rotor.

V-belt pulleys

One, in each case, on the intermediate shaft and on the motor shaft.

V-belts

For the power transfer from the motor to the intermediate shaft, their number and dimensions depending on the power and the speed.

V-belt guard

As protection against accidental contact.

Electric motor

Bolted to the base or vibration-absorbing frame and shifting to tension the V-belts after you have slackened the bolts.

Base of vibration-absorbing frame with vibration absorbers

To take up the electric motor, the bearing block and the spiral housing.

4 Handling instructions

Our fans are shipped as complete units either unpacked on skids or packed in boxes. The vehicles, lifting tackles and other auxiliary means intended for handling must be adequate the size and the weight of the fan.

Lifting is only allowed by the eyelets provided for this purpose.
Suspending the entire fan by the motor eyelets is not allowed.

Do not transport the fan in any way other than in its installation position. Observe any corresponding instructions given on the packing.

On the handling means, protect the fans from slipping, canting and grinding both against one another and against any other objects and side panels. For each transport and storage, make sure that no water can penetrate into the motor, the bearings or into other sensitive components.

Detect and repair any possible transport damage prior to the installation.

5 Storage of fans and replacement parts/storage rules

Store the fans so that no deterioration of their serviceability by the influence of moisture and dust will be possible. Avoid high temperature fluctuations. If this is partly disregarded damage to electric motors, cable terminal boxes, bearings, paint coats and seals can be the result. Please note that not all types of paint coats are weatherproof. So rust can easily develop under a single prime coat.

For longer storage periods, rotate the impeller once a month. Make a mark on the shaft or on the impeller to ensure that the bearings will get a another new position after you have rotated the impeller.

After very long storage periods (> 1 year), it will be necessary that the old grease be removed, the bearings washed out and fresh grease be refilled before you restart the fan.

Store replacement parts in a room with a suitable temperature of 15 °C to 25 °C.

- antifriction bearings
  The maximum storage period for in their original packing is two years. After that, such parts must be replaced.
- rubbery materials
  Store any parts of rubbery materials such as shaft seals, O-rings, flexible connection pieces, vibration absorbers and V-belts in places where they are protected from light. Such parts should be checked for elasticity and brittleness once a year. Their maximum storage period is five years, unless otherwise advised by their manufacturers.
- metallic parts
- Any metallic parts such as impellers, shafts, shaft bushings, V-belt pulleys and bearing housings should be inspected once per year. Repair the preservative coat of machined surfaces, if necessary. Apply some grease to all bare, metallic surfaces.

6 Installation of radial fans

6.1 Installation of fans

When installing fans, follow the instructions as given in DIN 4024 (Machine foundations; flexible structures that support machines with rotating elements).

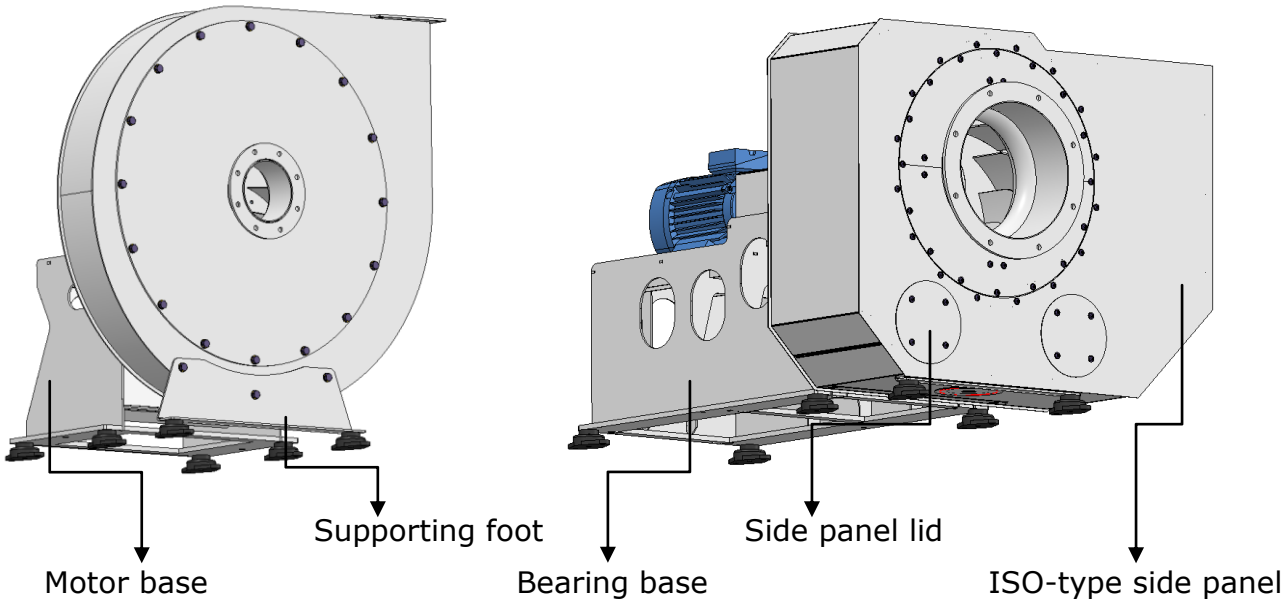
The fans may only be fitted in their installation position (vertical, horizontal) for which they have been ordered and designed.

The fans must be installed on a level foundation in a firm and vibration-free manner. When installing a fan, ensure that it will not be mechanically deformed or distorted to avoid jamming or grinding of its impeller.

6.2 Vibration absorbers

To reduce any vibration effects that Zenner fans can impose on foundations and structures vibration absorbers must be fitted to both the motor base and the fan frame foot. The size, number and hardness of the vibration absorbers are subject to the fan manufacturer's decision (as to the weight, natural frequency and the design of the fan(s) in question). Zenner Ventilatoren GmbH will not accept any warranty claims for damages as a result of unauthorized modifications of vibration absorber configurations.

Vibration absorber configuration and installation



Depending on the given number of vibration absorbers, screw the latter to the tapped holes provided for this purpose.

If only four vibration absorbers are sufficient fit two of them to the end of the base and the other two to the frame supporting foot. (To these two positions, vibration absorbers must always be fitted!) For fans that have insulated housings, there are two different ways of fitting the vibration absorbers to the supporting foot. One the one

hand, the side panel of the insulation has some lids. These should be removed so that

you can screw the vibration absorbers to the supporting foot from above, right through the insulation. On the other hand, some side panels have no lids. For this design, just screw the vibration absorbers to the supporting foot from below. In this case, Zenner Ventilatoren GmbH uses vibration absorbers that have no own threads. The vibration absorbers to be used for the motor base, however, are still the same.

6.3 Compensators

By the installation of elastic air-duct connection elements (compensators), vibration and noise transmissions to the plant as may come from the fan will be avoided. These elastic connection elements must be fitted in such a way as to allow the fan enough freedom of movement, especially when it is starting up. On the other hand, they must not be compressed or offset to such an extent as to form wrinkles resulting in obstruction of the air flow.

Compensators serve for decoupling the air handling system from the vibration caused by the fan. They are no spacers!

Depending on their intended purpose, compensators come as fabric or elastomer elements and may only be used in combination with their associated fans. In addition, it must be ensured that a compensator is firmly connected between the fan and the plant.

Each compensator supplied has been matched to the geometric dimensions, the medium to be conveyed and to the customer-specific place of installation of the fan unit concerned. This is why the proper compensator should be used, rather than any other one.

In the following, the conditions of proper and improper usage are briefly listed below.

Proper usage:

- The compensator is firmly connected between the Zenner fan and the plant.
- The compensator may only be used in combination with its appropriate Zenner fan matched to it.
- The compensator must not be exposed to tension or pressure.
- The ducts between which the fan is to be installed must not show any angular offset and should be precisely aligned to one another.
- The temperature of the medium to be conveyed must agree with the temperatures allowed for the respective compensator.
- The medium to be conveyed corresponds to that as agreed upon with Zenner Ventilatoren GmbH.

Improper usage:

- There are ambient conditions that have not been agreed upon, such as an excessively high ambient temperature at the place of installation/operation.
- The compensator does not make up for length differences or angular offset between the ducts connected.
- The compensator is exposed to tension or pressure.
- The fan is used for a medium that has not been agreed upon.
- The temperature of the medium to be conveyed deviates from the allowed limits.
- The compensator is used within the system with its shipping bracket (threaded rod) not having been removed.

For further information on how to use Zenner compensators, please refer to our **"Operating Instructions Manual for Compensators"**

6.4 Electrical connection

Do not connect the motor to the mains supply before you have installed the fan. The electrical connection of the fan motor must be established as shown on the circuit dia

gram in the terminal box or in accordance with the manufacturer's instructions, respectively. Unobstructed cooling air supply to the motor must be guaranteed. To ensure this, follow the motor manufacturer's instructions.

Such work may only be performed by authorized experts in accordance with the relevant protective and safety regulations.

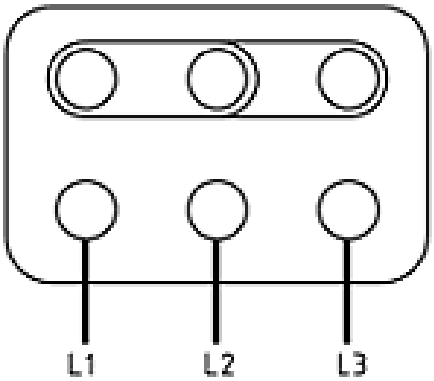
Terminal board connections

For single-speed three-phase current motors, distinction is made between two different connection methods. In addition, it is important to know what kind of mains supply and what voltage is provided at the place of operation.

If the motor is supplied with too low an input voltage its current consumption will rise, and its winding can burn while the fan is being started up or operated.

Star connection – motor voltage 230/400 V

This suggested connection is only applicable to a 400 V mains supply. For a 230 V mains supply, the following delta connection must be established.

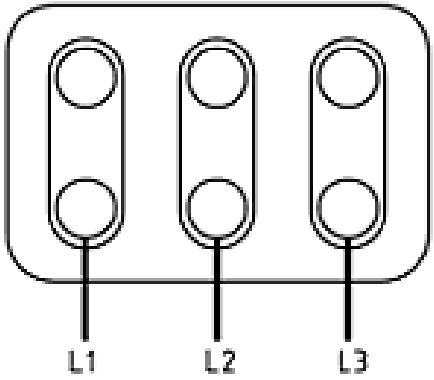


If the motor winding has six taps fit a star jumper (W2-U2-V2) to the terminal board.

In motors that have three taps, the star point is already connected within the winding. In such case, you can omit the star jumper.

Delta connection – motor voltage 400/690 V

This suggested connection is only applicable to a 400 V mains supply. For a 690 V mains supply, the following star connection must be established.



Motors that are intended for delta connection always have six taps.

For the direct startup mode, install three delta jumpers (U1-W2, V1-U2, W1-V2) that connect the ends of the phases.

For the star-delta startup mode, omit the jumpers. Changeover can be effected manually by means of a star-delta switch, or automatically by contactor circuits.

If you want to run the fan in combination with a frequency inverter the output voltage of the latter will be decisive for what kind of jumpers to use for the motor (star or delta connection).

Prior to starting up the fan, check the running direction of the motor or of the impeller, respectively. The sense of rotation must agree with the directional arrow you find on the fan. Otherwise, interchange phase connection wires L1 and L2.

Such work may only be performed by authorized experts in accordance with the relevant protective and safety regulations.

7 Startup

Prior to starting up the fan, remove any foreign bodies from the interior spaces of the fan and of the upstream and downstream machines, ducts and pipe lines. Attention of suction effect.

Make sure that all guards (protective grating, V-belt guard, coupling guard, etc.) have been properly fitted. Improper handling life-threatening danger from rotating parts.

Through increased noise when the fan start hearing protection should be worn!

For hot gas fan, fan throttled operation as well as camps may lead to hot surfaces. Danger of burns!

The safety regulations for electrical equipment and systems and the electricity companies are to be observed.

Also notice

Check all controls such as louvers, slide gates and swirl controllers installed before and behind the fan for their adjustability. Shut such controls before starting up the fan to ensure that this process is executed as quickly as possible.

Check the sense of rotation of the drive motor (shortly switch it on and off). It must coincide with the direction arrow shown on the fan housing.

After you have started the motor and the rated speed has been attained, you can slowly open the controls while permanently checking the current consumption of the motor. Also pay attention to the bearing and motor winding temperatures.

Unless any other switching frequency has been agreed upon, the S1 mode (continuous operation) shall apply. According to DIN VDE 0530, Part 12, Sections 6 and 7 (starting characteristic), a maximum of two successive starts is allowed.

After the rated speed has been attained and you have opened the upstream or downstream controls, make a balance quality test. The running smoothness must not exceed a value of 2.8 mm/s (RMS) on the bearings.

For fans driven by V-belts, make sure the belts are running smoothly. After a maximum of five hours of continuous operation, check the belt tension and correct it, if necessary.

Monitor the temperature of the bearings. The normal temperature range is around 50 °C to 70 °C. If the temperature climbs to higher values repeat the start after a cooling-down period and then locate and repair the possible fault.

Do not run the fan at any speed higher than indicated in the specification sheet. The speed may only be reduced after you have consulted Zenner Ventilatoren GmbH. It must be checked whether the fan will thus be run at a speed where a resonance frequency of a harmful extent is incited. When speed control is used it must be expected that the resonant frequencies of various fan components will be attained within the range from the lowest to the highest speed. At such points, no continuous operation must take place. When you are running in the installation adjust the speed governor so that such number of revolutions is passed through quickly.

Throttle slides which can entirely stop the air flow must be actuated so that the fan will be immediately stopped after the closing of the slide. Otherwise, impermissible heating up of the fan and impermissible vibration as a result of burbling can be caused.

For parallel connection of fans, make sure before starting that fans which are not started will not run into the opposite direction. Otherwise, starting can lead to mains overloading, motor overloading and to impeller vane damage as a result of such direction reversal.

8 Maintenance and upkeep

8.1 General

The safety instructions given in the "Startup" section shall also apply to restarting after any maintenance work has been done.

The maintenance frequency essentially depends on the mode of operation, the ambi-

ent conditions and on the required availability. The latter must be determined by the user of the installation in connection with the installation concept and with the details given by Zenner Ventilatoren GmbH.

You should keep in your stock any replacement an wearing parts which are not available at short notice.

Check all screw and bolt connections for tightness at regular intervals and retighten them, if necessary, in accordance with the following table.

Tightness Class 8.8 Screw	Tightening Torque [Nm]
M4	3
M5	6
M6	10
M8	25
M10	49
M12	85
M16	210
M20	425
M24	730

8.2 Impellers

All impellers have been statically and dynamically balanced at the factory in accordance with the balance quality specified in the fan data sheet.

For fans used to convey polluted gases, the impellers are subject to wear, or deposits build up on their vanes. Some unbalance occurring during the operation of the fan often is a clear sign of it. To guarantee the operational dependability of the fan unit inspection, cleaning and re-balancing the impellers at regular intervals will be necessary under such operating conditions. The times when to do this should be scheduled by the user.

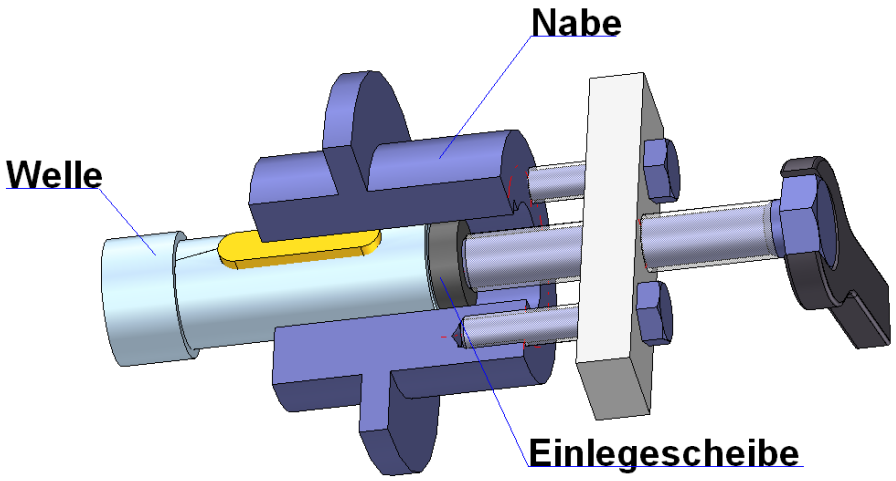
8.2.1 Assembly instructions for impellers using extractors

(The fitted impeller is clamped against the shaft shoulder by a screw and an end washer. It is protected against loosening by a locking plate and two fixing screws.)

Removal

(Do not use any hammers or crowbars!)

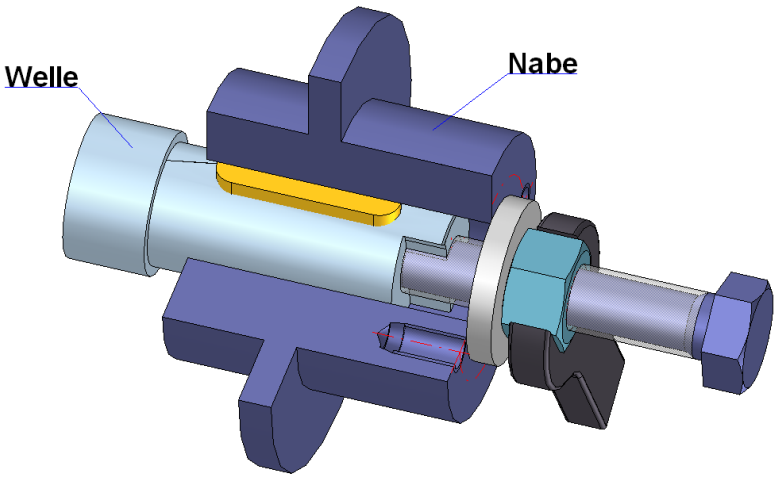
- Remove the clamping washer.
- Use a washer to cover the bore in the shaft.
- Apply the extractor as shown in the illustration below and turn in the screw until the impeller comes loose.
- Remove the impeller.



Reassembly (fitting)

(Do not use any hammers or crowbars!)

- Clean the shaft and the impeller holes and apply some grease to them.
- Lift the impeller onto the shaft and slightly press it on.
- Put a screw with a washer into the shaft.
- Refit the locking elements.



8.2.2 Assembly instructions for impellers using taper lock bushings

(The hub has a tapered hole. A tapered bushing which is cylindrical inside is inserted into this hole. When the locking screws are tightened the bushing will be clamped between the shaft and the hub.)

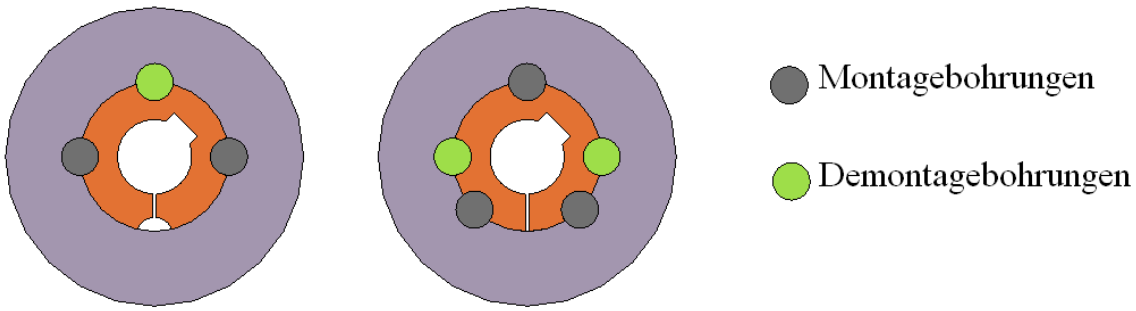
Removal

(Do not use any hammers or crowbars!)

- Loosen all locking screws. Depending on the bushing size, fully remove one or two screws, apply some oil and turn them into the extracting holes.
- Uniformly tighten the screw(s) in the extraction hole(s) until the bushing comes out of the hub and can be moved on the shaft.
- Remove the impeller and the bushing from the shaft.

Reassembly

- Clean all bare surfaces and the tapered hole in the hub and apply some grease. Insert the taper lock bushing into the hub and bring all connection holes to co-incidence (each half of a tapped hole must be opposite to half a plain hole).
- Apply some oil to the set screws (size 1008-3030) or cheese-head screws (size 3525-5050) and turn them in. Do not tighten the screws.
- Clean and degrease the shaft. Slide the washer with the taper lock bushing onto the shaft up to the desired position.
- When a feather key is used first insert the latter into its groove on the shaft. There must be some play between the feather key and the groove in the bore.
- Uniformly tighten the set screws or cheese-head screws at the torque values specified in the table.
- After a short time of operation (approx. 1 hour) check the tightening torque of the screws and correct it, if necessary.



1008 bis 3030 3525 bis 5050

Taper Lock Bushing	1008	1108	1210	1610	1615	2012	2517	3020	3030
Screw tight-ening torque [Nm]	5,6	5,6	20	20	20	30	50	90	90
Number of locking screws	2	2	2	2	2	2	2	2	2
Size	1/4"	1/4"	3/8"	3/8"	3/8"	7/16"	1/2"	5/8"	5/8"
Taper Lock Bushing	3525	3535	4030	4040	4535	4545	5040	5050	
Screw tight-ening torque [Nm]	115	115	170	170	190	190	270	270	
Number of locking screws	3	3	3	3	3	3	3	3	
Size	1/2"	1/2"	5/8"	5/8"	3/4"	3/4"	7/8"	7/8"	

Table: Tightening torques for taper lock bushings

8.3 Vibration monitoring

Increased vibration is always a sign of danger. Any changes in the balance quality are determined by measuring the mechanical vibration on the bearings and drive motors. By comparison of the measured values over a longer period, changes can be reliably detected. If these values change drastically examine their causes (e. g. soiling of the impeller) and clean or re-balance the impeller, if necessary.

8.4 Bearings/grease quality/lubrication intervals

The bearings must undergo inspection at regular intervals. To avoid premature failure of bearings no foreign bodies, dirt or moisture must penetrate into the bearings. Ensure high cleanliness when regreasing the bearings or changing the lubricant or bearings.

You will find the regreasing intervals and quantities as well as the refilling schedule in the Lubricating Instructions Manual. It also specifies the grease used. (You can use lubricant grades from any other manufacturers if they have the same chemical and physical properties (miscibility).

When regreasing the bearings, make sure that the grease has enough room to expand or will be allowed to emerge from the housing chamber. During regreasing, the temperature will increase due to accumulated grease. After the surplus grease quantity has been displaced, the temperature will fall back to its steady-state value.

Store the lubricants in clean and sealed containers to avoid penetration of dust and moisture, and to keep the oxidation effect of the air as low as possible. The place of storage should be dry and cool.

For the storage of the motor, please refer to the Lubricating Instructions contained in the motor manufacturer's documentation.

8.5 V-belt drive

Correct belt initial tension is of enormous significance for proper power transfer and for reaching usual belt life. Excessively low or high belt initial tension frequently leads to premature belt failure. In addition, excessively high initial tension often results in bearing defects on the driving motor or on the machine.

Therefore, it is recommended that the required static tensile pull be individually calculated for each drive.

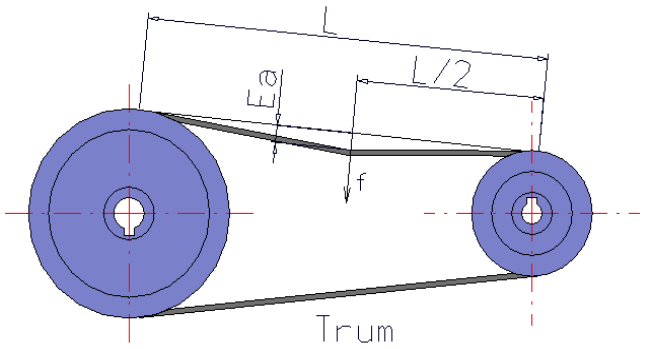
Section	Diameter of the Small Pulley [mm]	Static Tensile Pull – Initial Tension [N]	
		First Installation	Operation after Running in
SPZ	≤ 71	200	150
	> 71 ≤ 90	250	200
	> 90 ≤ 125	350	250
	> 125	Initial tension values must be calculated.	
SPA	≤ 100	350	250
	> 100 ≤ 140	400	300
	> 140 ≤ 200	500	400

	> 200	Initial tension values must be calculated.	
SPB	≤ 160	650	500
	> 160 ≤ 224	700	550
	> 224 ≤ 355	900	700
	> 355	Initial tension values must be calculated.	
SPC	≤ 250	1000	800
	> 250 ≤ 355	1400	1100
	> 355 ≤ 560	1800	1400
	> 560	Initial tension values must be calculated.	
XPZ	≤ 71	250	200
	> 71 ≤ 90	300	250
	> 90 ≤ 125	400	300
	> 125	Initial tension values must be calculated.	
XPA	≤ 100	400	300
	> 100 ≤ 140	500	400
	> 140 ≤ 200	600	450
	> 200	Initial tension values must be calculated.	
XPB	≤ 160	700	550
	> 160 ≤ 224	850	650
	> 224 ≤ 355	1000	800
	> 355	Initial tension values must be calculated.	
XPC	≤ 250	1400	1100
	> 250 ≤ 355	1600	1200
	> 355 ≤ 560	1900	1500
	> 560	Initial tension values must be calculated.	

The values listed in the table apply to the use of an Optibelt pretension meter.

If you use a different type of meter refer to the belt bend. You can find the required values (belt bend [Ea] and test force [f]) in the V-belt calculations attached to this documentation.

Only for the first installation, the value of the belt bend should be multiplied by 0.75.



Ea – bend per belt [mm]
f – test force per belt [N]
L – centre distance [mm]

The following retensioning intervals apply:

- check: 0.5 hours after startup.
- check: 10 hours after startup.
- check: 1 week after startup.

You can re-tension the V-belts by parallel sliding the motor on its tensioning guide rails. Ensure that the V-belt pulleys are in true alignment.

If it should become necessary to replace any V-belts change them as a whole set. It is not allowed to change individual belts only.

V-belt pulleys provided with taper lock bushings should be removed and re-fitted in the same way as described under "Assembly instructions for impellers using taper lock bushings".

8.6 Shaft seals

There is a variety of different sealing methods.

A diaphragm is standard. Its sealing effect is based on an annular gap between the fan housing and the hub or shaft of about 1 mm – 2 mm. Regarding tightness, there must be no special requirements. In addition to such diaphragm, it is possible to provide the impeller with back vanes, where the vacuum produced this way reduces the emergence of the medium.

For fans with higher tightness requirements, shaft seals using packing rings are available. There are various designs regarding the number of packing rings and their materials. In addition, there are designs with grease chambers and regreasing facilities, with grease overflow channels as well as with seal gas connections.

What kind of shaft seals with packing rings should be chosen depends on the respective requirements concerning the tightness of the fan.

8.7 Electric motors

For electric motors, please observe the manufacturer's rules and safety instructions. Any work regarding their electrical connection may only be performed by qualified and skilled personnel.

If motors are run above their allowed ambient temperature range the permissible motor output will reduce, compared with the rated output. The same applies to installation at 1000 m above sea level. In such case, please consult the fan manufacturer. If you use pole-changing motors ensure soft transfer from high to low speeds. Such delayed changeover must be free of any jerking. After longer periods of standstill of your installation, check the insulation resistance before starting it up. Use warm air to dry damp windings.

Unless otherwise agreed in the delivery contract, the manufacturer's rules for the switching conditions should be observed.

Motor cooling must not be obstructed by any attachments or modifications.

9 Special instructions

9.1 Gas-tightness

For gas-tight fans, tightness must be checked by measurements to be made at regular intervals.

If there is a hazard for the health of people after permissible limits have been exceeded the fan must be placed out of service. General room ventilation should always be provided so that no toxic or explosive gas concentrations will occur if any leakages are not detected.

During installation and maintenance work, the shaft seals in the gland must not be damaged. Ensure that any damage of the shaft surface (scratches, rust, etc.) on the places where the seals run will be avoided, as this will lead to leakage.

After reassembling, use new packing material and check again for tightness. Observe any additional measures prescribed by local or statutory regulations, standards or guidelines. In the event of unbalance and abnormal vibration and after removing and refitting the impeller, also perform a tightness check.

9.2 Increased temperatures

For fans intended for operation with hot media (temperatures > 80 °C), contact with hot surfaces must be excluded by insulation, protective grating or warning signs.

If the fan is started in its cold state its power consumption may possibly exceed its rated value, and current consumption may reach impermissibly high values. For this reason, an pressure-side throttle slide must be closed when the fan is being started from its cold state.

Before switching off the fan, keep it running at a lower temperature (< 100 °C) until its impeller, shaft and housing have cooled down. This is to prevent heat from adversely affecting the bearings or the bearing grease when the fan is at a standstill.

The cooling disks used at increased temperatures will only provide sufficient cooling when the speed is high enough. At slow speeds (e. g. when a frequency converter is used) or at a standstill (e. g. power failure), the user must externally cool the cooling disk (for example, a separate fan with a guaranteed power supply must blow on the cooling disk).

9.3 Frequency converter

The use of a frequency converter to be agreed in each case with the fan manufacturer. The unauthorized modification of the contractually agreed upon speed, eg for the purpose of power adjustment or regulation, is dangerous in itself and is not allowed.

For frequency converter operation or speed control, the following must be taken into consideration: The frequency converter should be adjusted so that heavy loading as a result of quick acceleration or deceleration will be avoided. This will normally be guaranteed if the run-up time is at least 30 seconds for impellers of up to 1000 mm in diameter and at least 60 seconds for impeller diameters between 1000 mm and 2000 mm.

The resonance frequencies must be disabled in the frequency converter. The number of how many times such frequencies are passed through must be reduced to a minimum.

Observe the frequency converter manufacturer's safety instructions before installing and starting up the fan.

10 Protection against explosion

10.1 General

The rules of EU Directives 94/9/EC (ATEX for Manufacturers) and 99/92/EC (ATEX for Users) as well as of VDMA 24169, Parts 1 and 2, and of DIN EN 1127 must be observed. They form the basis for the manufacture and the use of all potentially explosive installations.

10.2 Instructions for protection against explosion

For the maintenance and repair of fans, the following instructions should be followed:

- Adjust the radial and axial impeller gaps as indicated in the fan drawing and document these adjustments. Tighten the motor anchor bolts with the corresponding torque specified in the motor documentation and lock them. Improper installation will make the fan become an ignition source.
- Slipping V-belts are capable of producing hot surfaces which are above the maximum permissible temperature. For this reason, attach utmost importance to the mutual alignment of the pulleys and to the correct the belt tension. Record the values you have adjusted. V-belts for fans of explosion-proof design are electrostatically conductive and meet the requirements of EN 13463-5. Do not use any belts other than such certified ones. Otherwise, the fan can become an ignition source, due to electrostatic charging. The use of belt lubricants or similar means to alter the pull is not allowed.
- Dust caking can lead to a reduction of the gaps between rotating and stationary parts so that temperatures above the permissible surface temperature limit can be caused by frictional heat. This can make the fan become an ignition source. Dust caking can also occur on protective gratings or similar parts and change the pressure losses within the installation in such a way as to cause the fan to work in the instable range of its characteristic curve. Therefore, cleaning the complete fan at regular intervals is strictly necessary and must be done at least twice a year, or at shorter intervals if dirt accumulation is high.

- Impermissibly high regreasing quantities or lack of regreasing will make the bearing temperature rise. If the permissible surface temperature is exceeded the fan can become an ignition source. The observance of the Lubricating Instructions Manual (regreasing intervals and grease change) attached to this documentation is mandatory. For the storage of the drive motors, the rules specified in the manufacturer's documentation shall apply.
- Storage temperatures of > 120 °C will considerably damage the antifriction bearings. Such bearings will have to be replaced. Otherwise, the fan can become an ignition source, due to bearing failure.
- The frequency converter and the drive motor form a tuned unit. Its explosion-proof design must be verified for the entire unit. Observe the manufacturer's instructions.
- The intrusion of foreign bodies during operation or a standstill of the fan can lead to the production of ignitable sparks. This will make the fan become an ignition source.
- The user should locally earth the entire fan unit. For this purpose, the motor frame or the base frame, respectively, has an earth connection terminal.
- The fan's minimum degree of protection must be IP 20. If you run the fan without an suction-side or pressure-side duct port you should provide protective grating for the suction and/or pressure side(s).
- For all applications, where it can be expected that dust deposits can build up on the surface of the fan and of its components, cleaning at suitable, regular intervals is mandatory.

10.3 Rating plates/identification

The suitability of the fan for use in potentially explosive areas is confirmed in its EC Conformity Certificate. The rating plate shows the machine group and machine category, together with the temperature class, separately for the fan inside and outside. The data indicated on the rating plate are important for proper usage. All plates must always be legible. Any illegible or missing rating plates and warning labels must be immediately replaced.

11 Fundamental safety instructions

The following general labour safety instructions should be paid particular attention to:

- This fan has been made according to the state of the art and to the established safety rules and will be operationally reliable if the Operating and Servicing Instructions Manual on hand is observed. Any improper usage or any application not in accordance with the requirements will make the installation inoperative and lead to danger to life and property.
- This present technical documentation shall be binding for anyone who is involved in the assembling, dismantling, reassembling, startup, operation, inspection, maintenance and repair of the fan at the user's premises. Such persons must have read the entire Operating and Servicing Instructions Manual.
- The product delivered should, on principle, only be used for the contractually agreed application. Any other usage will be considered improper. The manufacturer will not be liable for any damage resulting therefrom. The risk for this shall solely be borne by the user. Passing on this product to any third party shall not be allowed if this can result in any additional risks.
- Fans and associated components of the installation may only be operated, maintained and repaired by authorized, trained and instructed personnel. Such personnel must have been instructed on the basis of this Operating and Servicing Instructions Manual regarding the hazards which may occur. The responsibilities for assembling, dismantling, reassembling, startup, operation, and servicing of the fan must be clearly defined and kept so that no ambiguous competences can occur under the aspect of safety. Within the warranty period, the manufacturer's service personnel shall be responsible for any maintenance and repair work. As specified by the electrotechnical rules, any work on the electric equipment of the machine/installation may only be performed by a skilled electrician or by instructed persons who are under the supervision of a skilled electrician. During any work concerning assembling, dismantling, reassembling, startup and servicing, the shut-down procedures indicated in the Operating Instructions Manual of the entire installation should be observed.

- Any working method which adversely affects the safety of the fan and of the associated installation components should be refrained from.
- The user shall be obliged to operate the delivered product only in an unobjectionable condition. Any unauthorized modifications or adding of parts which adversely affect the function and/or safety of the fan and/or of associated components of the installation are not allowed.
- Removing any information, order-giving and prohibition labels from the fan is forbidden.
- All work on the fan should always be done when the machine is at a standstill. This especially applies to the removal of any guards.
- Prior to the beginning of any work on the fan, protect the drive against unintentional starting.
- Before the restarting of the fan after any maintenance work, it is imperative to make sure that all guards have been properly fitted.
- Any cleaning or inspection openings may only be opened when the fan is at a standstill.
- In the event of any malfunctioning, immediately shut-down the machine/installation. The malfunction should be immediately repaired.
- Any particular local safety and accident-prevention rules shall, in each case, also apply to the operation of the fan.

12 Troubleshooting

If any malfunction should occur while the fan is in operation you can find its cause on the basis of the following table. In addition, this table contains some measures which may lead to the elimination of a malfunction.

Trouble	Possible Cause	Remedy
Excessive vibration	Caking found on the impeller.	Clean impeller and measure vibration; re-balance, if necessary.
	Impeller is damaged.	Replace impeller.
	V-belt pulley not in alignment.	Align V-belt pulleys.
	Bearings worn out.	Replace bearings.
	Drive motor not running smoothly.	Measure vibration during operation; if values are too high uncouple motor and measure separately. Consult manufacturer and replace motor or motor bearing.
Bearing temperature > 80 °C	Vibration	Measure vibration; re-balance, if necessary.
	Bearings worn out.	Replace bearings.
	Too much/too little grease in bearing; grease used up.	Check grease quantity and reduce correspondingly, or regrease, respectively.
	Temperature monitoring device defective.	Check temperature sensor and evaluator, and replace defective device.

Noise	Impeller is grinding.	Inspect installation position; check screw connections and re-tighten, if necessary.
	Motor showing unbalance.	Measure vibration; consult manufacturer.
	Electrical problems on motor.	Consult manufacturer.
	V-belts are screeching or slipping.	Retension V-belts or replace complete set.
	Bearing damage.	Replace bearing.
Motor overloading; motor protection facility has tripped.	Impeller is grinding.	Inspect installation position; check screw connections and re-tighten, if necessary.
	Excessively high speed.	Correct speed limit to designed value.
	Wrong sense of rotation.	Change sense of rotation.
	Fuse defective.	Check fuse and motor protection facility.
Fan does not start.	Power supply has failed.	Restore power supply.
	Motor defective.	Consult manufacturer; replace motor, if necessary.
	Impeller seized due to caking.	Clean fan and re-align.
	V-belts loose or broken.	Retension V-belts or replace complete set.
Output and overall pressure too low.	Resistance within installation essentially higher than predicted.	Check whether all throttle slides are fully open.
	System components (filters, throttle slides, etc.) are not operational.	Check functions of system components.