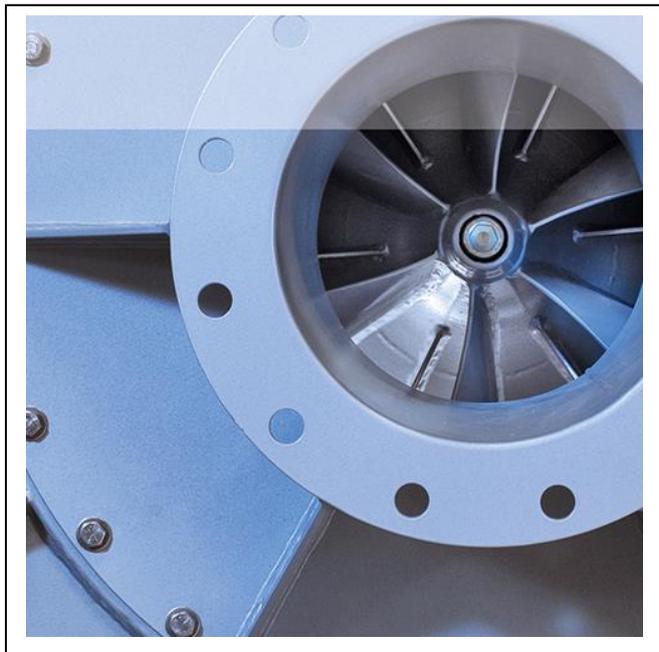

Installation instructions / Operating instructions for incomplete machine



Original operating instructions in German

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Product and performance specific data

The technical data of the fan, consisting of a motor data sheet, characteristics with fan performance data and an associated dimension sheet, are separate documents.

1. Safety information

This product represents an incomplete machine within the meaning of the Machinery Directive. Basic functional, safety and health protection requirements cannot yet be met in full, as certain risks only arise from the fact that the machine is still incomplete. The client assumes the obligation to produce the industry and application-specific functional safety and to prove compliance of the fan with the provisions of Directive 2006/42/EC.

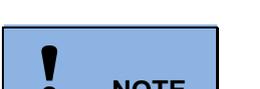
1.1. Definition

The following signal words and symbols are used in these installation instructions to indicate dangers and important information:

1.2. Warning symbol

In the safety instructions, the **warning symbol**  is positioned to the left of the actual signal word (DANGER, WARNING, CAUTION...) in the colour highlighted field. Safety instructions **with** a warning symbol indicate a danger of **personal injury**. Adhere to these safety instructions at all times to provide protection against **injuries or death!** Safety instructions without a warning symbol indicate a danger of damage to property.

1.3. Signal words

	<p>Indicates a potentially hazardous situation that could result in death, serious injury or damage to property if proper precautions are not taken.</p>
	<p>Indicates a potentially hazardous situation that could result in death, serious injury or damage to property.</p>
	<p>Indicates a potentially hazardous situation that could result in injury or damage to property.</p>
	<p>Indicates correct use or intended use of the product.</p>

The German acronym "SAFE" stands for

Schwere (severity of the danger indicated by a signal word and symbol)
Art (type and source of danger)
Folgen (consequences of the danger)
Entkommen (escape the danger)

Warning signs pursuant to DIN EN ISO 7010

	<p>W001 General warning sign</p>
	<p>W012 Electricity hazard</p>
	<p>W015 Overhead or suspended load</p>
	<p>W017 Hot surface</p>
	<p>W024 Crushing of hands</p>
	<p>W023 Corrosive substance</p>
	<p>W022 Sharp element</p>

Mandatory signs in accordance with the Technical Rules for Workplaces; "Safety and Health Signs"; ASR A1.3 (DIN EN ISO 7010:2020-07)

	M003 Wear ear protection
	M004 Wear eye protection
	M005 Connect an earth terminal to the ground
	M008 Wear foot protection
	M010 Wear protective clothing
	M014 Wear head protection
	D-M018 Read instruction manual
	D-M009 Wear hand protection
	Lifting point

(Source: German Federal Institute for Occupational Safety and Health;

Symbol explanation

	The use of this crossed out wheeled bin logo indicates environmental requirements. Environmental requirements are references to government requirements for the disposal of substances.
---	--

1.4. Warning notices


DANGER

Danger due to high voltages!

High voltages are applied to electrical machines. Improper use may result in death or serious injury.

Take the following measures prior to working on/at the fan:

- Disconnect completely
- Secure against reconnection
- Verify disconnection
- Only open the motor connection box after it has been verified that the machine is disconnected completely!
- Carry out earthing and short circuiting
- Cover or shield against adjacent live parts.

Upon completion of the work, undo the taken measures in the reverse order.

Work on electrical equipment may only be completed by fully qualified and authorised electricians!

Further protective measures against electric shock pursuant to VDE 0100-410

<p>Precaution for basic protection</p> <p>It prevents direct contact with live (active) parts of electrical systems, e.g. using insulation</p>	(+)	<p>Precaution for fault protection</p> <p>It provides some additional protection if the basic protection fails and / or</p> <ul style="list-style-type: none"> • if the precaution for fault protection fails or • in case of carelessness of the user of the electrical system or • in case of a particular danger to persons due to special conditions caused by external influences, e.g. due to the use of residual current devices with $I \leq 30$ mA.
<p>Precaution for fault protection</p> <p>It prevents hazardous touch voltages from occurring or remaining in the event of a fault, e.g. by switching off the power supply.</p>	(+)	

Protective measures against electric shock pursuant to VDE 0100-410

Section 411: Automatic shutdown of the power supply

Section 412: Double or reinforced insulation

Section 413: Protective separation

Section 414: Low voltage SELV or PELV

Source: Concept of personal protection pursuant to DIN VDE 0100-410 | DKE



DANGER

Danger due to missing guards

Fans must be **equipped with protection against contact** in accordance with the relevant regulations. (See DIN EN ISO 13857)

If protective devices are not ordered with the fan, protection against contact during operation must be ensured by the design of the system in which the fan is installed.

When installing the protection against contact, the user must always observe the valid industrial health and safety and accident prevention regulations. Covers that prevent direct contact with live or rotating parts or that are necessary to ensure a correct flow of air and thus proper operation must not be opened or removed during operation. Non-observance may result in death, serious injury or substantial damage to property.



WARNING

Improper use of the fan may result in serious injury or even death!

All activities such as transport, installation, commissioning, decommissioning, maintenance or disposal work on and with the fan may only be completed by **fully trained, qualified and reliable specialist personnel!**



WARNING

Improper use of the fan may result in serious injury or even death!

These operating instructions must be read and understood in full before completing any activities with or on the fan. The requirements and specifications set out herein must be followed at all times.



WARNING

Warning on burst safety

Since mdexx fan systems GmbH shall not be responsible for any external influences, e.g. resulting from the use of speed-controlled drivers, the system manufacturer must take suitable measures to protect against resonance. Within this context, the recommendations stipulated in E DIN EN 17170 (Fans – Safety requirements) in conjunction with ISO 14694 (Industrial fans – Specifications for balance quality and vibration levels) must be observed.

The most likely way to prevent fan impellers breaking in accordance with the aforesaid standard is to shut down the main motor by means of vibration monitoring. The necessity of these safety measures or other monitoring mechanisms must be checked by the system manufacturer or the end user for the respective application and implemented accordingly, if necessary.

Non-observance may result in death, serious injury or substantial damage to property.



CAUTION

Danger of a chain reaction of malfunctions

Repairs to the impeller are not permitted. Improper repairs can cause a chain reaction of malfunctions and damage that could result in both a danger of injury and damage to property.



CAUTION

Trial run without protection in the workshop or at unsecured machines

The fan must not be started up when carrying out repairs in the workshop or on incomplete systems whose safety equipment has been temporarily disabled as a result of maintenance or commissioning work.

! Note

Intended use

This device is designed exclusively for conveying air in the ambient conditions stipulated in the agreed specification and for installation in machines supplied by the customer. Any other use is considered improper and constitutes misuse of this device.

Intended use also includes:

- Professional and qualified use of the device, including maintenance work.
- Operation of the device in compliance with the relevant safety regulations.
- Correct transport and storage conditions

! Note

Improper use

Improper use includes:

- Operating conditions that do not comply with the agreed specification requirements stipulated in the data sheet.
- Conveying media containing abrasive particles or corrosive components.
- Conveying air with a high dust content.
- Operation with dirt deposits on the impeller that could result in unbalances.
- Operation within or adjacent to potentially explosive atmospheres unless the fan has been subjected to a conformity assessment with the entire device independently of mdexx fan systems GmbH.
- Operation with a dismantled or manipulated safety device or unapproved attachments that bypass safety measures. Failure to comply with quality assurance measures
- Use of non-original spare parts

Claims for defects or liability or other consequential losses cannot be asserted in the event of improper use or unapproved device modifications.

! Note

These operating/installation instructions ...

- do not contain detailed information on all product types due to reasons of clarity, nor can they take into account every conceivable method of installation or operation.
- contain instructions on transport, storage, installation and commissioning
- must be read and understood in full before completing any activities on the fan.
- must be strictly adhered to

If any questions are not answered by these operating/installation instructions or the maintenance/repair instructions, please contact the fan manufacturer.
For supplementary information on safe operation, please refer to the additional document: "Technical Terms and Conditions of Delivery mdexx fan systems GmbH"

! Note

The maximum flow rate is only achieved when the impeller is free flowing.

In axial direction, a clearance equal to at least one impeller diameter must be maintained.

Further, an inlet nozzle or a cylindrical air duct whose length is equal to at least one impeller diameter must always be fitted at the fan inlet.

An additional inlet nozzle is not required at fan casings with an integrated inlet nozzle. This is a prerequisite for achieving the full flow rate and avoiding vibrations due to an uneven flow of air.

In general terms, fans must never be operated in the unstable range of their characteristic. In case of doubt, this must be ensured by suitable measures, e.g. volume flow monitoring.

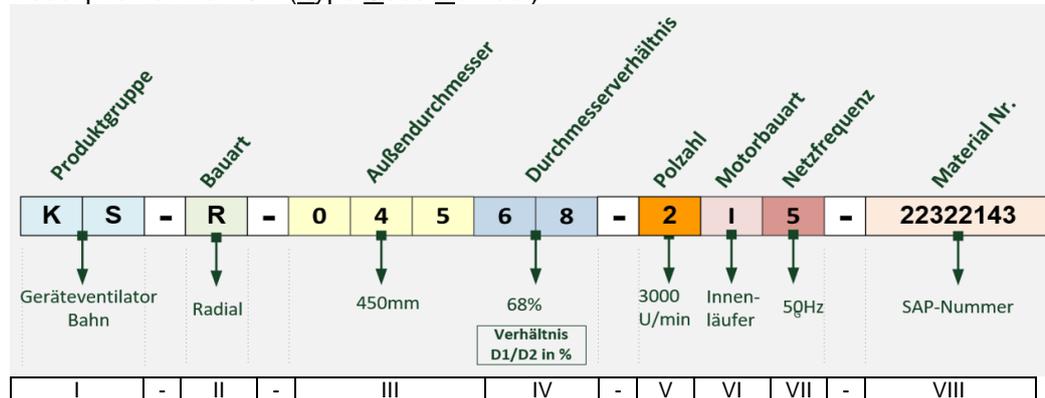
If a fan is operated in the unstable range of its characteristic for a longer period of time, the impeller may – depending on its design – be damaged or even destroyed.

1.5. General description of the machine

mdexx fan systems GmbH designs customised fans to achieve the best possible efficiency solutions for a wide range of applications such as rail vehicles, compressors, power transformers, wind turbines, car washes, industrial drying systems and many others. Different basic types, determined by a specific type code, form the foundation for this purpose. The general description therefore refers to the essential positions of the fan types. The terminology and classification for fans is in line with EN ISO 13349:2010.

1.6. Description of the type designation

Description of the **TCN** (**T**ype **C**ode **N**umber)



I. Product group:

The product group describes the intended application of the fan. This is defined by a letter combination.

BS	Railway technology
CS	Chemical industry (Safe Area)
CX	Chemical industry (ATEX-compliant fan with ATEX-certified motor)
Cy	Chemical industry (fan without ATEX declaration of conformity for the non-electrical part. End customers have to carry out the overall conformity assessment for use in a potentially explosive atmosphere on their own responsibility).
FS	Food technology
HS	Wood drying
IS	Industry (Safe Area)
IX	Industry (ATEX-compliant fan with ATEX-certified motor)
IY	Industry (fan without ATEX declaration of conformity for the non-electrical part. End customers have to carry out the overall conformity assessment for use in a potentially explosive atmosphere on their own responsibility).
KS	Compressor technology (Safe Area)
KX	Compressor technology (ATEX-compliant fan with ATEX-certified motor)
KY	Compressor technology (fan without ATEX declaration of conformity for the non-electrical part. End customers have to carry out the overall conformity assessment for use in a potentially explosive atmosphere on their own responsibility).
LS	Subcontracting
MS	Medical technology

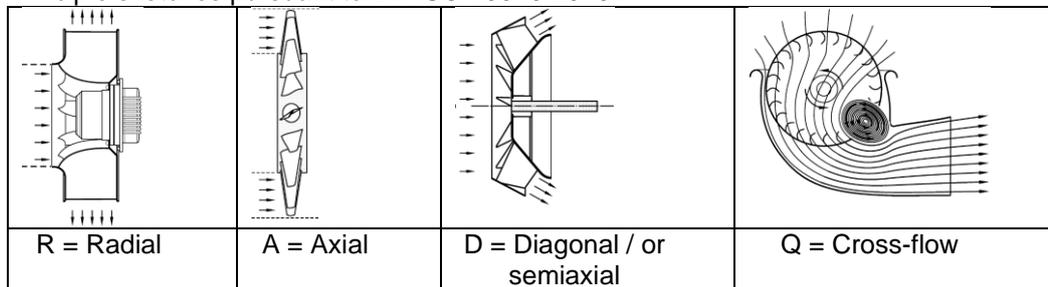
SS	Spinning technology
TS	Transformer cooling (Safe Area)
TX	Transformer cooling (ATEX-compliant fan with ATEX-certified motor)
TY	Transformer technology (fan without ATEX declaration of conformity for the non-electrical part. End customers have to carry out the overall conformity assessment for use in a potentially explosive atmosphere on their own responsibility).
WS	Laundry technology

II. Design:

R	Radial
A	Axial
D	Diagonal
Q	Cross-flow
E	Spare part for fan (e.g. motor or impeller)

The direction of flow determines the design of the fan.

Principle sketches pursuant to EN ISO 13349:2010

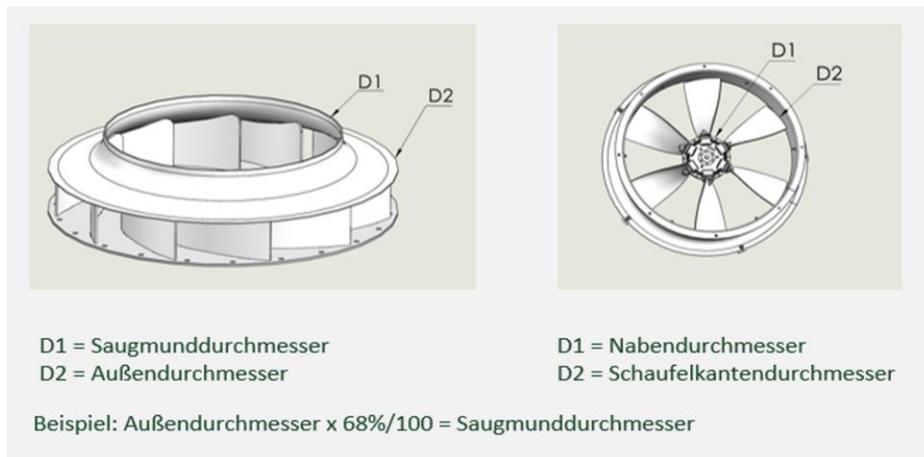


III. Impeller diameter

Adding a "0" to the specified 3 digits results in the rotation diameter of the impeller through which the flow passes.

IV. Diameter ratio

The following two numbers form a ratio between the inner suction mouth diameter and the outer diameter as well as the hub diameter and blade edge diameter.



V. Number of poles

The digit at position "V" stands for the number of poles and thus for the maximum speed of the asynchronous motor.

Number of poles	Mains frequency	Max. speed
2	50 Hz	1500
2	60 Hz	1800
4	50 Hz	3000
4	60 Hz	3600

VI. Motor design

In an internal rotor, the stator is firmly connected to the outer motor casing. In an external rotor, the stator is located inside the motor. The motor casing (left) with cupped magnets is the stator.

I = Internal rotor motor
A = External rotor motor
E = Electrically commutated motors (EC motors)

VII. Mains frequency

The mains frequency of 50 Hz is described by a "5" and the mains frequency of 60 Hz is described by a "6".

VIII. SAP material number

The end of the type code number is followed by the internal material number, which is automatically assigned by the SAP system as a sequential number for each new fan type. This number uniquely specifies each fan.

1.7. Qualified personnel

The term "qualified personnel" defines persons who, due to their training, experience and skills as well as their knowledge of relevant standards, regulations, accident prevention rules and operating conditions, have been authorised by the person responsible for the safety of the component / system to perform necessary activities and are able to identify and avoid existing and predictable dangers (for a definition of a specialist, see also IEC 364).

Further, qualified personnel must also be knowledgeable of first aid measures and local rescue facilities.

1.8. Protective equipment

The following protective equipment is required when performing installation work:

- Protective gloves
- Safety shoes S3
- Protective goggles
- Tight-fitting work clothes

Always observe ESD protection pursuant to DIN EN 61340.

Welding work is not permitted on the fan.

2. Description

2.1. General

The unit is delivered complete with motor.

Quality assurance pursuant to DIN ISO 9001 ensures consistent manufacturing quality.

2.2. Direction of flow and rotation

The following applies to radial fans:

The fan draws in air axially and blows it out radially.

The following applies to axial fans:

The fan draws in air axially and blows it out axially.

The actual installation position is specified in the product-specific data sheets.

The correct direction of rotation is indicated by an arrow on each impeller and fan.

If the direction of rotation is incorrect, check the wiring and replace it, if necessary.



WARNING

Warning: Danger of impeller breakage

Notice! Fans must not be operated in the incorrect direction of rotation. There is a danger of impeller breakage due to impermissible vibrations. Moreover, in this case, the increased current consumption can lead to electrical and thermal overload of the motor.

3. Transport / Long-term storage

3.1. Transport

As soon as it is received, inspect the product for completeness and any damage in accordance with the scope of the order and the delivery note.

If the casing or the impeller has been damaged, inform the carrier and write a damage report.



WARNING

**Tipping or falling down can lead to crushing, broken bones or similar injuries!
Sharp edges can cause cuts!**

Wear personal protective equipment during transport! (For example, protective gloves, safety shoes, work clothes and safety helmet)



WARNING

Danger due to tipping or falling loads!

Prior to transport, make sure that all the components are mounted securely and that all detachable components have either been secured or removed!



WARNING

Danger due to tipping or falling loads!

When transporting the product with lifting gear, always observe the following basic rules:

- The load-carrying capacity of the lifting gear and load-carrying equipment must at least correspond to the weight of the fan.
- Do not walk, work or stand under suspended loads!



WARNING

Danger when lifting heavy loads!

Observe the following weight limits when performing manual handling tasks.

- max. 30 kg [max. 66 lbs] for men
- max. 10 kg [max. 22 lbs] for women
- max. 5 kg [max. 11 lbs] for pregnant persons

Suitable lifting gear or conveyors must be used to handle products above these weight limits.

Depending on the type of fan, transport at the customer facility takes place in various ways: If the transport is handled manually, always observe the aforesaid weight limits.

When using a crane, please pay attention to the specially marked attachment points.



Lifting eye bolts on the motor, eyelets on the casing, on the motor bracket, or straps looped around the fan casing are suitable attachment points for lifting the fan. Never use the impeller to lift or support the fan.

Use a touch-up pen to fix any minor scratches caused during transport. Please refer to the fan drawing or the order confirmation for the respective colour code.

When unloading the fan and during on-site transport, take great care to avoid any damage to the impeller and the casing. If slinging gear is used for unloading, make sure it does not come into contact with the impeller. This could otherwise lead to the impeller becoming unbalanced.



WARNING

Danger due to uneven lifting

When lifting, it is particularly important that the attachment points are loaded evenly, by vertical tensile forces. If not all the lifting eye bolts are involved in the lifting process, this could lead to a lifting point being overloaded. This could cause serious injury to anyone close by at that moment.

3.2. Long-term storage

Ambient conditions for storage:
Storage at: -20° to + 40°C

To ensure that storage for periods > 4 years in favourable storage conditions (i.e. storage in dry, dust and vibration-free rooms) or more than 2 years in unfavourable conditions does not result in storage damage, perform regular commissioning activities (for at least 30 minutes every 6 months). Otherwise, replace the motor bearings before commissioning to avoid any further damage. In case of longer storage, we recommend storing the fan in the installation position. Please refer to the fan-specific information for relevant details.

4. Installation

Refer to the dimension sheet or the specific data sheet for the correct installation position of the fan. Only operate the fan in this position.
Install the fan free of stress and on a level support (evenness <1mm).



DANGER

Danger of death due to electric shock!

If cables or electrical components are damaged, exposure to fault currents can cause death or serious personal injury.

When installing the fan, make sure electrical equipment cannot be damaged by external influences! Supply lines, in particular, must be routed safely, e.g. using cable ducts or similar.



WARNING

Danger due to incorrect installation or connection to a machine casing. This could result in increased vibrations, excessive noise development, bearing damage and bursting of the impeller. **There is a real danger of death or serious injury to anyone close by.**

An installation situation that deviates from the following information in this chapter and the respective instructions must always be agreed in advance with mdexx service staff!



WARNING

Improper use of the fan may result in serious injury or even death!

Always read and fully understand all the instructions in the Safety information chapter before working on the fan.

4.1. Tightening torques

The system operator must ensure that the fan is installed using correctly dimensioned bolts and the corresponding tightening torques.

If no other values are available, the following tables apply. For non-electrical connections, strength class 8.8 pursuant to DIN 25201 is assumed. Furthermore, the following tightening torques apply to DIN EN ISO 898-1 without the use of lubricants. The addition of lubricants changes the coefficient of friction considerably and leads to undefined tightening torques.

With stainless steel threaded connections (A2-70 / A4-70), individual threads (approx. 5 threads) can be lightly coated with copper paste to prevent the threaded connections "seizing up". However, make sure that the engaging surfaces for the bolt head and nut are not coated with lubricant. Especially with stainless steel threaded connections, do not use impact wrenches, as the increased frictional heat may cause the bolts to seize up.

Tightening torques (pursuant to DIN EN ISO 898-1) for 8.8 threaded connections and steel connections, not suitable for electrical connections.

Thread	[Nm]	[ft lbs]
M4	2.7	1.99
M5	5.3	3.91
M6	9.1	6.71
M8	22.5	16.60
M10	45	33.19
M12	79	58.27
M16	193	142.35

Tightening torques for stainless steel connections, A2-70/A4-70 (DIN ISO 3506) not suitable for electrical connections.

Thread	[Nm]	[ft lbs]
M4	2.6	1.92
M5	5.1	3.76
M6	8.0	5.9
M8	19.8	14.6
M10	41	30.24
M12	70	51.63
M16	172	126.86

The following specifications for electrical connections apply to all terminal board connections with the exception of terminal strips.

Tightening torques for electrical connections		
Thread	[Nm]	[ft lbs]
M4	0.8 ... 1.2	0.59 ... 0.89
M5	1.8 ... 2.5	1.33 ... 1.84
M6	7.7 ... 4	1.99 ... 2.95

The following tightening torques apply to threaded earth conductor connections

Tightening torques for electrical connections		
Thread	[Nm]	[ft lbs]
M4	2 ... 3	1.48 ... 2.21
M5	3.5 .. 5	1.58 ... 3.68
M6	6 ... 9	4.43 ... 6.64

The following values apply to cable glands:

Tightening torques for threaded connections				
Thread	[Nm]		[ft lbs]	
	Min.	Max.	Min.	Max.
M12x1.5	4	6	2.95	4.43
M16x1.5	5	7.5	3.69	5.53
M20x1.5	6	9	4.43	6.64
M32x1.5	8	12	5.9	8.85
M40x1.5				

5. Commissioning



WARNING

Improper use of the fan may result in serious injury or even death!

Have you read and understood the instructions in the "Safety information" chapter?
Otherwise, you are not permitted to carry out any work with or on the fan!

Before commissioning, check the motor, the impeller and the casing for external damage. If damaged, do not put the fan into operation. In the event of damage, it cannot be ruled out that the balance condition of the impeller has changed.

5.1. Electrical connection

When working on electrical machines, please observe the warning notices in chapter 1.1.3

5.2. Electric power supply

Pay attention to the **rating plate**.

The conditions at the place of use must match the information on the rating plate.

Connect cable glands and protective earthing to the terminal box, if not already included in the scope of delivery.

Proceed as follows:

- Select a cable gland that fits the cable diameter in each case.
- Insert this cable gland into the opening of the terminal box, if necessary use a reducer.
- Screw on the cable gland, making sure no moisture, dirt, etc. can enter the terminal box. Connect and arrange the terminal strip according to the **circuit diagram in the terminal box**.

Connect the protective earthing conductor  to the terminal displaying the following symbol:



M005

Connect an earth terminal to the ground!

(exemplary view of an earthing connection)

Checking the direction of rotation:

- The intended direction of rotation of the motor shaft and the impeller is indicated by arrows on the fan.
- The direction of rotation of the motor might have to be reversed.
- An incorrect direction of rotation can lead to the impeller being destroyed.

Note

Make the electrical connection as follows:

- In accordance with the corresponding VDE or national regulations of the respective place of use,
- In accordance with the respective applicable national, local and system-specific regulations and requirements,
- In accordance with the regulations of the utility company responsible for the installation site.

Before commissioning, check the fan for external damage. Factory settings may have changed, for example, due to improper transport up to the time of commissioning, due to transport, installation or for other reasons.

In this context, please observe the correct gap settings and the instructions in chapter "Checking the gap between impeller and inlet nozzle".

6. Decommissioning

When decommissioning, observe exactly the same safety regulations as for commissioning.

- Isolate the fan from all possible sources of supply and check isolation using a suitable measuring device.
- Take suitable measures to protect against contact with moving or live parts.
- Attach written information to the fan about why it has been shut down.

7. Operation



WARNING

Improper use of the fan may result in serious injury or even death!

Have you read and understood the instructions in the "Safety information" chapter? Otherwise, you are not permitted to carry out any work with or on the fan!

Also pay attention to standard E DIN EN 17170.

! Note

Notes on a range of safety requirements for fans.

Also pay attention to standard E DIN EN 17170.

The focus here is on the significant hazards, hazardous situations and events relevant to fans during transport, assembly and installation, commissioning and use, as defined in DIN EN ISO 12100:2010, Annex B, when used as intended and under conditions of misuse which are reasonably foreseeable by the manufacturer.

The safety devices and, if applicable, the alarm logs must be checked for proper functioning at regular intervals. As with commissioning or the trial run, the limit values of the alarm message and those of the safety shutdown depend on the application in question and must be determined by the system manufacturer in cooperation with the operator.

Pay attention to the standards of ISO 14694 in conjunction with ISO 10816-3.

Prior to commissioning, the system operator must ensure that the flange surface or the floor for the fan is level (<1mm) and that the fan is mounted free of stress within the machine. Further, the fan must not be negatively impacted during operation by impermissible vibrations resulting from the overall process or from neighbouring components that in total exceed the permitted limit values pursuant to ISO 14694. If exceedance of the limit value cannot be ruled out, the system manufacturer must ensure that a vibration sensor pursuant to DIN EN 17170 guarantees emergency shutdown in such cases.

8. Vibrations

One of the main reasons for fan failure is resonance, which can lead to material fatigue of the rotating impellers. These vibrations and unbalances cause increased wear of the motor bearings, rotating elements and machine frame right down to the foundations in the immediate vicinity. In the case of permanent and impermissibly high vibrations, there is a real risk of health hazards due to increased noise emissions, vibrations or bursting.

Agreed vibration limits pursuant to ISO 14694 are documented prior to delivery and guaranteed up to the time of delivery in accordance with Incoterms EXW or DAP. mdexx fan systems GmbH cannot be held responsible for subsequent changes to the vibration limits, as the causes are extremely diverse and very difficult to determine. Please also observe the notes in the "Repairs" chapter.

Alternatively, sensors with magnetic holders can be positioned as close as possible to the motor bearing. If no threaded holes are available, steel plates can be affixed to the cast iron casing for the magnetic sensors.

Sensors designed to measure vibration velocity are very sensitive to external influences, e.g. due to a strained structure, additional natural resonances from the installation environment of the overall system, repeatability of the measuring positions, stability of the power supply, contact between sensor and surface, correct measuring positions, etc.

Please also observe the notes in the "Repairs" chapter.

Vibration sensors should never be placed on the sheet metal cover hood, but always directly on the cast iron casing of the bearing shield. The soft cover plate would provide incorrect results.

Vibration measurements may only be carried out by experienced and trained experts who are familiar with the highly specialised measuring equipment. Such measurements are not required during maintenance. However, they must be scheduled after each installation / replacement and before each recommissioning.

Fan application category

Anwendung Application	Beispiel Example	Antriebsleistung Driver power (kW)	Ventilator Kategorie Fan category (BV)
Wohnraum Residential	Deckenventilatoren Ceiling fans	≤ 0.15	BV-1
		> 0.15	BV-2
HVAC und Agrar HVAC and agriculture	Gebäude Air conditioning	≤ 3.7	BV-2
		> 3.7	BV-3
Transport und Marine	Bahn, LKW, Auto Locomotive, trucks, automotive	≤ 15 > 15	BV-3 BV-4
Transit / Tunnel	Untergrundventilat. Subway emergency fans, tunnel jet fans	≤ 75 > 75 None	BV-3 BV-4 BV-4
Petrochemie Petrochemical	Gefährliche Gase Hazardous gases	≤ 37	BV-3
		> 37	BV-4
Computer Chip Fertigung / Computer chip manufacture	Hygieneräume Clean rooms	None	BV-5

Condition	Application category	Rigid installation	Flexible installation
		r.m.s	r.m.s
Start-up	BV-1	10	11.2
	BV-2	5.6	9.0
	BV-3	4.5	6.3
	BV-4	2.8	4.5
	BV-5	1.8	2.8
Alarm	BV-1	10.6	14.0
	BV-2	9.0	14.0
	BV-3	7.1	11.8
	BV-4	4.5	7.1
	BV-5	4.0	5.6
Emergency shutdown	BV-1	Notice 1	Notice 1
	BV-2	Notice 1	Notice 1
	BV-3	9.0	12.5
	BV-4	7.1	11.2
	BV-5	5.6	7.1

Notice 1: The shutdown stages for fans in the fan application classes above should be determined using historical data.

(Source of the values: ISO 14694:2003-03)

When installed, the limit values stated in the tables above must not be exceeded. Contractually defined limits take precedence.

Alarm: A warning is output as soon as a set vibration limit has been reached or a significant change has occurred and remedial action is necessary. When an alarm situation occurs, operation may continue until the reasons for the change in vibration exposure are found and remedial action is determined.

Shutdown: Occurs if the vibration limit is above the value after which continued operation of the machine may cause damage. If the shutdown limit is exceeded, measures must be taken immediately to reduce the vibration exposure or the machine should be shut down.

Determining the alarm limit: The alarm limits can vary at different machines. Usually, the selected values are related to a base value that results from experience gained at the measuring locations and measuring directions of the respective machine.

Determining the shutdown limit: The shutdown limits generally result from the basic requirement that the machine must not encounter any mechanical damage. They also depend on specific design features that are intended to make the machine resistant to unusual changing forces.

In general, a fan mounted on a large rigid concrete foundation is classified as being rigid, while vibration dampers are seen as being flexible. Machine walls or steel frames, on the other hand, can be classified in any category.

The weight and rigidity of the overall system in which the fan is installed influence the vibration level in the fan environment. Pursuant to ISO 14694, pg.15, the fan manufacturer is not responsible for vibration behaviour in the overall system if the actual fan complies with the vibration limits stipulated in Table 5 of ISO 14694.

For the vibration values measured by mdexx, please refer to the enclosed measurement report of the laboratory.

The vibration level is expected to rise over time due to wear and other accumulated effects during operation.

In general, an increase in vibration levels is appropriate and safe as long as the alarm level of 11.8 mm/s for flexibly fixed fans and 7.1 mm/s for a rigid connection is not reached. Above this threshold, a prompt inspection should be carried out. Emergency shutdown must occur at 12.5 mm/s and at 9.0 mm/s for a flexible and a rigid attachment respectively.

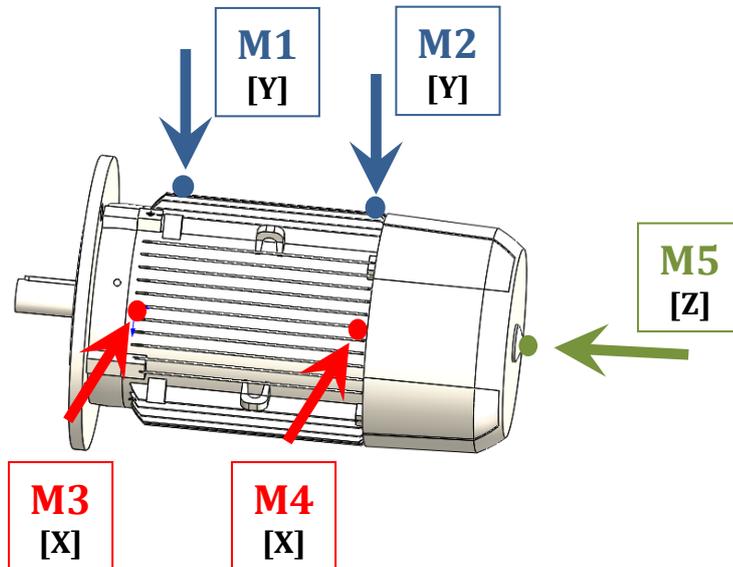
Due to the manufacturer's obligation to study the market and the experience of the end customer (user) the standard recommendations may be somewhat excessive in specific sectors or applications. In these cases, the limit values must be redefined individually.

When using frequency converters, individual resonance ranges may occur within the speed spectrum due to the influence of stiffness arising from the overall installation system or due to bearing wear during normal service life. The system manufacturer must ensure that the system control passes through these frequency ranges quickly with a safety margin of at least +/- 7 Hz.

Further, changes to the vibration behaviour may occur due to feedback from the flow behaviour. In this case, structural measures must be taken after prior system analysis.

Procedure:

The sensors must be fixed correctly to perform the measurements.



Measuring positions for vibration sensors

Note: Do not mount sensors on metal sheets, but on solid points of the casing, as close as possible to the motor bearing.

Protective measures and rules of conduct

- Cordon off the area in which work is being carried out to prevent unauthorised access. Use barrier tapes, for example.
- Cover live parts.
- Design a clearly arranged test set-up.
- Do not stand in the range of rotating parts, as there is always a risk of parts being ejected.

Balancing can be performed using the measuring device Vibroport 80 from Brüel & Kjaer, for example.





DANGER

Take special care with fans that are susceptible to vibrations, as there is a danger of bursting!

Depending on the degree of pre-existing damage, parts of the rotating impeller could, in exceptional cases, become loose during commissioning or during a damage analysis and lead to serious injuries or even death.

If in doubt, do not put these fans back into operation under any circumstances. Especially not in the immediate vicinity of maintenance and/or operating staff.

Further inspections should only be carried out by the manufacturer inside a special protective chamber.

Indications of pre-existing damage are:

- Loud noises (humming)
- Excessive vibrations (resonances)
- Drop in air flow rates
- Increased motor and fan temperatures
- High vibration velocities

! Note

Take special care with fans that are susceptible to vibrations!

Also during commissioning, trial runs and maintenance work, gradually increase speeds when starting up fans instead of simply switching straight to nominal speed. This is the only way to ensure rising resonance fields can be detected and the trial run can be stopped in time.

The safety devices and, if applicable, the alarm logs must be checked for proper functioning at regular intervals.

Vibration measurements or checks may only be carried out by specially trained personnel who have been instructed in a separate training course by the manufacturer and received a qualification certificate.

Without this qualification, vibration tests are prohibited.



Protective measures and rules of conduct

- Cordon off the work area to prevent unauthorised access. Use barrier tapes, for example.
- Cover live parts.
- Design a clearly arranged test set-up.

9. Repairs



DANGER

Repairs and maintenance work

Danger of death due to defective motors or cracked weld seams in the impeller section

Depending on the degree of pre-existing damage, parts of the rotating impeller could, in exceptional cases, become loose during commissioning or during a damage analysis and lead to serious injuries or even death.

If in doubt, do not put defective fans back into operation under any circumstances. Especially not in the immediate vicinity of maintenance and/or operating staff.

Defective fans are usually noticeable through untypical, particularly loud noises. The motor becomes significantly warmer than usual.

Further inspections should only be carried out by the manufacturer inside a special protective chamber.

Indications of pre-existing damage are:

- Loud noises (humming)
- Excessive vibrations (resonances)
- Drop in air flow rates
- Increased motor and fan temperatures
- High vibration velocities

! Note

Avoid impacts and collisions during transport!

This product is a fan designed for industrial purposes. On-site transport or maintenance work must be carried out very carefully. In particular, the fan must not be knocked or dropped when still in its packaging or during installation in the overall system, as this could negatively impact the quality of balance and smooth running during operation.

Visible damage to the casing or the impeller indicates a collision. Damaged fans must not be put into operation.

! Note

Repairs to the impeller or the motor are prohibited!

Repairs to the motor require special qualification and are only to be carried out by the motor manufacturer. **Attempts at independent repairs will lead to the expiry of the operating permit and any warranty claims.**

The same applies to repairs to the impeller, the casing or the inlet nozzle. These activities may only be carried out by the manufacturer or by suitable persons who have been qualified by the manufacturer to perform the relevant activities.

After a repair by the manufacturer, a proper trial run, including a balancing report, must generally be performed according to the procedure described above.

10. Maintenance



CAUTION

Danger of a chain reaction of malfunctions

Improper handling or use contrary to the intended use can result in a chain reaction of malfunctions.

Also pay attention to the motor operating instructions of the motor manufacturer.

It is strictly forbidden to insert a mechanical lever, such as a piece of pipe, between the impeller blades.

Once the fan has been installed, make sure that there is an even gap all round between the impeller and the inlet nozzle before commissioning.

Make sure the bearings are not stressed as a result of hard impacts on the impeller or motor shaft.

Pay attention to the instructions of the motor manufacturer.

If the fan is not used for more than six months, put it into operation briefly to prevent the balls of the rolling bearing being displaced and condensation forming in the motor and to ensure constant lubrication of the bearings.

! Note

Danger of unbalance at the impeller

Do not use the impeller to lift or support the fan.

! Note

Danger of becoming unbalanced.

Make sure the bearings are not stressed as a result of impacts, as otherwise the motor bearings could be damaged.

 **Note****Danger of becoming unbalanced or bolts "seizing up"**

Never use impact wrenches. Especially not when stainless steel threaded connections are involved. Optionally, it is possible to order special tools from the manufacturer.

**WARNING****Risk of settling or creep damage in threaded connections**

When utilising soft material combinations, such as stainless steels or aluminium materials, the pre-load force can trigger flow processes in areas close to the surface. Vibrations, on the other hand, lead to settling of threaded connections. Both processes lead to a loss of pre-load force in threaded connections.

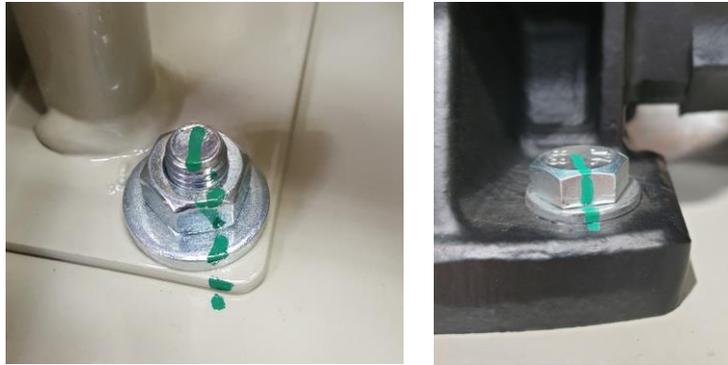
Therefore, after installation and commissioning, check bolts for correct tightness and mark them accordingly with a pen. Additionally use a thread-locking varnish or threadlocker.

**WARNING****Danger of injury / Danger of impact and crushing!**

When lifting and removing the fan from the fan casing, the fan could tip to one side or the other according to its centre of gravity position. There is a real danger of persons suffering impact and crushing injuries.

10.1. Threadlocker

To prevent threaded connections becoming loose, use spring washers and threadlocker. Replace these thread-locking agents and retainers each time a threaded connection is undone. They include spring washers, lock nuts, safety screws and suitable adhesives.



Basic principle: If the coloured line on the nut, washer and component does not line up, it is a good indication that the threaded connection has become loose.

Figure: Bolt markings, visual inspection



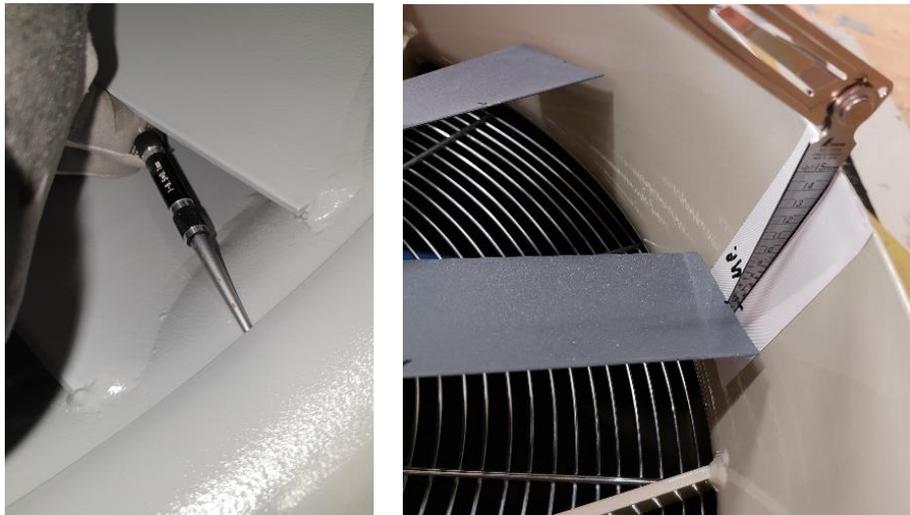
Figure: Basic principle: Secure the balancing weights with coloured marking ink (Loctite SF 7400, or SF 7240 thread-locking varnish).

10.2. Checking the gap between impeller and inlet nozzle



Tool for measuring the gap: Bore gauge or tapered measuring wedge; due to manufacturing inaccuracies, the gap may not be the same all the way around. Ensure there is no contact between the rotating impeller and the fixed inlet nozzle at any point.

For explosion-proof fans, the gap should be at least 2mm after deducting all tolerances. Alternatively: $0.005 \cdot \text{diameter of the suction mouth}$. (See following figure)



Example of checking the gap between the inlet nozzle and the radial impeller (left) or between the casing wall and the blade tip (right)

Lubrication

The fan motor is equipped with lifetime lubricated bearings or with a re-lubrication device depending on its actual design. The lifetime lubricated rolling bearings must be replaced after 40,000 operating hours at the latest, or after five years. At motors equipped with a re-lubrication device, remember to take the re-lubrication intervals into account. The re-lubrication intervals, quantities of grease and the types of grease are indicated on the motor type plate.

Longer periods of operation, special high-performance greases for extreme ambient temperatures or food applications, etc. must be agreed individually in the specification and are listed separately.

Optional use of rubber vibration dampers:

If rubber vibration dampers have been installed, we recommend inspecting them for ageing or brittleness at least twice a year and replacing them after every four years. If cracks appear in the rubber or there are visible signs of detachment, replace the vibration dampers immediately.

Secure the vibration dampers to the fan with new spring washers. When reconnecting to the vehicle, observe the thread-locking measures proposed by the vehicle manufacturer.

10.3. Impeller cleaning / Inspection

The impeller and casing are designed pursuant to EN 1127-1 to minimise the accumulation of dust deposits in normal operating conditions. (See also DIN EN 14986:2017-04; 4.13)

If the fan is disconnected from the rest of the system for maintenance work, always clean the impeller.

Extreme dirt and dust deposits on the impeller and motor can negatively impact correct functioning of the fan.

Take care to clean the impeller uniformly, since irregular deposits could lead to unbalances. Further, visually inspect the balancing weights. Use a coloured threadlocker to secure them. If the impeller is exposed to temperatures above 65°C, use the following threadlocker: (Resbond 907TS-1R / www.polytec-pt.com)

mdexx fan systems GmbH shall not be liable for any motor damage caused by dirt deposits on the impeller and motor.

10.4. Maintenance schedule / cycles

Inspect the motor in accordance with the separate documentation provided by the motor supplier, which is enclosed with these operating instructions.

The maintenance interval prescribed is **4000 operating hours**. After this period of time, perform the following maintenance activities:

- 1) Open the maintenance hatch and visually inspect the impeller for damage
- 2) Clean the impeller and inlet nozzle uniformly, removing all dirt and dust deposits
- 3) Check that the balancing weights are seated correctly
- 4) Perform a trial run according to the following instructions

10.5. Trial run

After each maintenance, a trial run must be performed, the measurement results of which must be documented in a report. An example is attached to the appendix.



WARNING

Danger of injury and damage to property

If, due to tight deadlines or other reasons, a documented trial run and commissioning are not carried out and measurement results are not recorded, defects may go undetected, which could eventually lead to personal injury or cause damage to property.

A documented trial run and commissioning are therefore mandatory. A sample maintenance and commissioning report can be found in the appendix of these installation instructions.

! Note

Inspections prior to commissioning

The following list of inspections prior to commissioning cannot be complete. Further inspections depend on special, system-specific conditions and are, therefore, additionally required. Since this product is an incomplete machine, the further, system-specific tests are to be performed by the respective system manufacturer.

Commissioning report as a supporting document for service requests from the manufacturer:

Maintenance and commissioning reports are indispensable tools when it comes to reconstructing changes that occurred during a process. If they are unavailable or incomplete, the causes of changes are difficult to comprehend and require a great deal of analysis.

This device was specially designed and manufactured to meet the technical specifications stipulated by the customer. To ensure safe operation for many years to come, special emphasis must, therefore, be placed on correct handling and professional maintenance and commissioning activities. Please note that only qualified personnel may be authorised to carry out measurements. The measurement and assessment of vibration values, in particular, require special qualifications.

! Note

Notice: Exclusion of warranty in case of non-observance of the operator's safety obligations.

Trial runs and commissioning activities are safety relevant. If they are not carried out and recorded properly, it may lead to the expiry of the operating permit and any warranty claims.

Fans must be equipped with protection against contact in accordance with the relevant regulations

In preparation for the trial run, observe the following points pursuant to "E DIN EN 17170":

- Any required setting checks must be indicated in a test report that has been prepared in advance. Record these checks and the actual measurements;
- Check mechanical and electrical guards for proper attachment and installation;
- Check the fan casing and connected lines for the presence of foreign bodies. No foreign bodies must enter the system, especially in the impeller area.
- Make sure the type, voltage and frequency of the power supply for the driver motor and control system comply fully with the relevant directives and standards;
- Check that the control device is in correct working order;
- Make sure sensory safety devices and alarm logs are fully functional.
- Ensure that the suction and pressure-side fan connections cannot be accessed during operation. If necessary, install guards as protection against contact.

- Assemble and align the fan correctly. In particular, ensure a uniform gap all the way round between the impeller and the inlet nozzle. Grinding noises must not be audible.
- Make sure all fastening elements and electrical connections have been tightened properly.
- Install proper earth and bonding leads to the mains system.
- Take suitable measures to protect against contact with moving or live parts.
- Eliminate any air flow problems caused by missing cover flaps, covers, etc.
- Align vibration dampers properly and check them for ageing.
- Perform a trial run to document the required checks for vibration velocity, power and current consumption, direction of rotation and speed, and enclose the respective verification with the machine documentation. Prepare written records of these checks, including actual settings and measurements.
- During production, the vibration level may change due to bearing wear or other negative system impacts. This is usually indicated by exceptionally loud noises coming from the fan. In this case, use a suitable measuring device to check the fan and document the measured values. If the values exceed the specified limits, take the system out of service and contact the manufacturer.
- The limit values of the alarm message as well as those of the safety shutdown depend on the respective application. Pay attention to the standards of ISO 14694 in conjunction with ISO 10816-3.
- Checking the direction of rotation
- Prior to initial start-up, rotate the impeller by hand to make sure it moves freely without colliding with the inlet nozzle. Switch the motor on and off briefly to compare the actual direction of rotation of the fan with the direction of rotation arrow on the fan.

Taking into account the relevant operating parameters (speed, mains frequencies, etc.) and the interconnection of several system components, changes in the vibration behaviour may occur. When using frequency converters, check, in particular, the resulting feedback. The system supplier must take suitable structural measures, if necessary.

11. Fan malfunctions

Extreme dirt and dust deposits on the impeller and motor can negatively impact correct functioning of the fan. Clean the fan at regular intervals in accordance with the degree of soiling.

If a fan fails to provide its usual operating characteristics, e.g. pressure or volume flow, or if loud humming noises or high vibration levels are detectable, the reasons can be extremely diverse and must be investigated **without delay** by a specialist. In fact, the overall installation system could be responsible for increased vibration values.

Typical causes could be, for example:

- Poor inflow to the fan.
- Operation with clogged up cooler and/or filter elements (this can lead to operation in an unstable characteristic range, especially with axial fans).
- Superposition of the natural resonances between the fan and the components in the immediate installation environment.
- Frequency-controlled behaviour of the overall system in conjunction with the fan. Periodic, wave-like flow conditions can additionally excite the natural resonances of the fan or the system, thereby leading to amplification of the vibration behaviour. This vibration behaviour can create undesirable pumping effects both inside and outside the blade channels. Further, instability of the air flow leads to dynamic loads and thus additional excitation of the vibration effects.

If necessary, record the vibration velocity and vibration acceleration over a certain period of operation. The limit values of the pre-message and emergency shutdown must be defined by the system manufacturer or system operator as part of the risk and hazard assessment. Also pay attention to standard ISO 14694 (Industrial fans - Specifications for balance quality and vibration levels).

If vibrations are the cause, a decision must be made on-site as to whether the fan should be replaced as a preventive measure.



DANGER

Burst process due to high vibration level or a defective impeller with cracked weld seams.

The burst process of a fan occurs in an uncontrolled manner, along with a high degree of energy, within a few seconds if the vibration level exceeds specified limits. This can lead to significant damage to property, personal injury or even death.

Ensure the impeller is inspected, maintained and cleaned properly and regularly, as irregular deposits could lead to unbalances and thus to bearing damage or vibrations.

11.1. Causes of vibrations

To avoid vibrations, observe the following points when performing maintenance work:

Possible causes of vibration due to incorrect maintenance work

- Damage to the impeller, driver shaft or bearings due to improper maintenance work
- Replacement of the motor or motor bearing without performing subsequent system balancing of the entire fan within the system
- Improper cleaning of the impeller resulting in irregular deposits on the impeller or blades
- Deformations caused by forbidden blows delivered with a hammer
- Bent shaft seat
- Incorrect blade installation
- Loose, tilted hub seat
- Local corrosion
- Thermal deformation
- Deformation due to incorrect transport
- Deformation of the impeller caused by using the impeller to lift the fan
- Wear caused by solids
- Fan not correctly bolted to the system or floor
- Incorrect direction of rotation of the fan
- Installation of the fan deviates from the planned method
- Fan unit exposed to constant stress due to incorrect installation

Possible causes of vibration due to operational reasons

- Missing balancing weights
- Missing, defective or worn vibration dampers beneath the fan casing
- Material fatigue cracks, especially in weld seams
- Thermal stress
- Deformation due to centrifugal force, blade deformation
- Changes to the original balance conditions due to grinding or wear effects
- Wear caused by solids
- Independent loosening of threaded connections
- System control or through speed-controlled drivers or system-related resonances
- Shifting unbalances¹⁾
- Local corrosion
- Peeling coatings
- Heavily stressed or deformed fan unit due to incorrect installation
- Uneven support surface for the fan (tilting effect)

Explanation:

¹⁾: Shifting unbalances: Shifting unbalances change their positions and cannot be balanced. The unbalance changes position during operation.

12. Corrosion

Despite taking the greatest possible care during the manufacturing process and using only recommended materials, corrosion formation cannot be completely ruled out. Unfortunately, 100% corrosion protection does not exist. The use of suitable materials can only influence the probability of corrosion, which in turn depends heavily on additional factors, such as the use of cleaning agents, humidity / salty atmosphere, constant exposure to water, etc.

- Corner thinning effect on coated round steel parts, purchased parts, metal sheets, motors as well as indentations of threaded elements in the coating surface or minor flaking of the coating cannot be avoided.
- Preparation grades pursuant to DIN EN ISO 8501-3 cannot be observed for thin metal sheets.
- Production-related limit values for weld seam imperfections (ISO 6520-1) correspond to evaluation group C pursuant to DIN EN ISO 5817.

The period of protection specified pursuant to ISO 12944-1 is therefore not to be understood as a warranty period. A guarantee for "absolute" corrosion protection cannot be given by mdexx.

The same applies to aluminium materials. Aluminium materials that are only exposed to splash water do not usually require corrosion protection if the smallest points of attack are approved.

Special corrosion protection and limits for off-shore applications

- Protective paint systems for sheet metal in offshore applications comply with DIN EN ISO 12944-5:2008 with the marking C5-M. They consist of a galvanised base coat followed by three top coats.
- The motor is supplied with a state-of-the-art CX finish, including a paint report, when ordered separately.
- Uncoated, stainless materials (e.g. fasteners / threaded fasteners or balancing stones) are made of 1.4301 or 1.4571.
- Materials with a higher corrosivity category are available on request.

13. Disposal

The issues of "health" and "safety" are just as important to us as the ecologically correct and rational disposal of valuable raw materials.

According to general understanding, recycling is only possible if mixed fractions are not formed and waste is recorded and collected separately. Therefore, in case of disposal, pay attention to pre-sorted components. Always dispose of these waste products in a responsible manner by hiring certified waste management companies, since they are subject to independent inspections and are generally licensed for the relevant types of waste. This helps to guarantee that important recycled raw materials can be returned to the market.

Disposal of old appliances in Germany: Appliances with the illustrated marking (crossed out wheeled bin logo) do not belong in household waste. The German Electrical and Electronic Equipment Act (ElektroG) guarantees the free return of electrical and electronic equipment to your local municipal collection point. For more information on this issue, please contact us. Disposal of old appliances outside Germany: Disposal must be carried out in accordance with the legal regulations of the respective country.



14. Standards / Safety requirements

Checks and measures pursuant to DIN EN 17170:2017-10; Table 2				
Safety requirements	Visual inspection	Functional test	Measurement	Reference to standards
Cutting, entanglement	x	x	x	EN 13857, EN 349, EN ISO 14120, EN ISO 12499
Inspection hatches	x	x		EN 349, EN ISO 13857, EN ISO 14120
Fluid jet	x	x		EN ISO 4413, EN ISO 12100
Ejection of parts	x			EN ISO 13849-1, EN 62061
Stability		x	x	EN ISO 12100
Slipping, tripping, falling	x			EN ISO 12100
Electrical safety	x	x	x	EN 60204-1, EN 61000-6-4
Control systems	x	x	x	EN 60204-1, EN ISO 4413, EN ISO 4414
Thermal safety		x	x	EN ISO 13732-1, EN ISO 13732-3, EN ISO 19353:2016
Noises		x	x	EN ISO 4871, EN ISO 5136, EN ISO 11688-1, EN ISO 11688-2, ISO 13347
Vibrations			x	EN 13849-1, EN 60204-1, EN 61511-1, ISO 21940-11, ISO 14694
Substances	x	x		EN 1672, ISO 13349
Ergonomics	x	x		EN 60204-1, EN 61310-1
Power supply		x		
Supplementary measures and equipment	x	x		EN 1037, EN 61310-1, EN ISO 13580, EN 60204-1

15. Example: Commissioning report

Betriebsdaten gemäß Typenschild		gemessene Prüfdaten während der Wartung																																																																	
<p>Inbetriebnahme-/ Wartungsprotokoll</p> <p>Betreiberangaben Werk / Standort: _____ Anlage: _____ Geräte-Nr.: _____</p> <p>Verantwortlicher Prüfdatum: _____ Schichtleiter / Meister: _____ Monteur: _____</p>	<p>Hersteller: mdexx-fan systems GmbH D-28844 Weyhe</p> <p style="text-align: right;"></p> <p>Herstellerrangaben: Ventilatorentyp / TSN: _____ Zeichnungsnummer: _____ SAP-Nr.: _____ Seriennummer: _____ Herstellungsjahr: _____</p> <p>Kontakt: info@mdexx.com / +49 421 - 5125 - 0</p>																																																																		
<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>01 Betriebsfrequenz</td><td>Hz</td></tr> <tr><td>02 Volumenstrom</td><td>m3/s</td></tr> <tr><td>03 Statischer Druck</td><td>Pa</td></tr> <tr><td>04 Totaldruckerhöhung</td><td>Pa</td></tr> <tr><td>05 zul. Schalleistungspegel</td><td>dB(A)</td></tr> <tr><td>06 Betriebsdrehzahl</td><td>rpm</td></tr> <tr><td>07 Leistungsbedarf</td><td>kW</td></tr> <tr><td>08 Isolationsklasse</td><td></td></tr> <tr><td>09 Schaltung</td><td>Δ Y</td></tr> <tr><td>10 Umgebungsluft</td><td>°C</td></tr> <tr><td>11 Nennstrom für Δ</td><td>A</td></tr> <tr><td>12 Nennstrom für Y</td><td>A</td></tr> <tr><td>13 Nennleistung</td><td>kW</td></tr> <tr><td>14 Motormoment</td><td>Nm</td></tr> <tr><td>15 Wirkungsgrad</td><td>%</td></tr> <tr><td>16 Leistungsfaktor cos phi</td><td></td></tr> <tr><td>17 Ia / In</td><td></td></tr> <tr><td>18 Effizienzklasse</td><td></td></tr> </table>	01 Betriebsfrequenz	Hz	02 Volumenstrom	m3/s	03 Statischer Druck	Pa	04 Totaldruckerhöhung	Pa	05 zul. Schalleistungspegel	dB(A)	06 Betriebsdrehzahl	rpm	07 Leistungsbedarf	kW	08 Isolationsklasse		09 Schaltung	Δ Y	10 Umgebungsluft	°C	11 Nennstrom für Δ	A	12 Nennstrom für Y	A	13 Nennleistung	kW	14 Motormoment	Nm	15 Wirkungsgrad	%	16 Leistungsfaktor cos phi		17 Ia / In		18 Effizienzklasse		<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>01 Betriebsdrehzahl</td><td></td></tr> <tr><td>02 Nennstrom</td><td>A</td></tr> <tr><td>03 Nennspannung</td><td>Δ Y V</td></tr> <tr><td>04 Wicklungswiderstand</td><td>Ω</td></tr> <tr><td>05 Motorentemperatur im vorderen Lagerbereich</td><td></td></tr> <tr><td>06 Motorentemperatur im hinteren Lagerbereich</td><td></td></tr> <tr><td>07 Schwinggeschwindigkeit bei Betriebsdrehzahl</td><td></td></tr> <tr><td>08 Schwinggeschwindigkeit bei halber Betriebsdrehzahl</td><td></td></tr> <tr><td>09 Schwinggeschwindigkeit bei unterster Betriebsdrehzahl</td><td></td></tr> <tr><td>10 Restunwucht</td><td></td></tr> <tr><td>11 Wie wurde die Schwinggeschwindigkeit gemessen?</td><td></td></tr> <tr><td>12 a) starr auf massiven Block angeschraubt (Limit: 4,5 mm/s)</td><td><input type="checkbox"/></td></tr> <tr><td>13 b) flexibel auf Schwingungspuffer (Limit: 6,3 mm/s)</td><td><input type="checkbox"/></td></tr> <tr><td>14 c) Anbindung an der Produktionsanlage</td><td><input type="checkbox"/></td></tr> <tr><td>15 elektrische Signale prüfen</td><td></td></tr> </table> <p><small>*Grenzwert gemäß ISO14694 Kategorie BV-3: Starre Anbindung: Peak = 6,4 Mittelwert = 4,5 mm/s Flexible / weiche Anbindung: Peak = 8,8 Mittelwert = 6,3 mm/s</small></p>	01 Betriebsdrehzahl		02 Nennstrom	A	03 Nennspannung	Δ Y V	04 Wicklungswiderstand	Ω	05 Motorentemperatur im vorderen Lagerbereich		06 Motorentemperatur im hinteren Lagerbereich		07 Schwinggeschwindigkeit bei Betriebsdrehzahl		08 Schwinggeschwindigkeit bei halber Betriebsdrehzahl		09 Schwinggeschwindigkeit bei unterster Betriebsdrehzahl		10 Restunwucht		11 Wie wurde die Schwinggeschwindigkeit gemessen?		12 a) starr auf massiven Block angeschraubt (Limit: 4,5 mm/s)	<input type="checkbox"/>	13 b) flexibel auf Schwingungspuffer (Limit: 6,3 mm/s)	<input type="checkbox"/>	14 c) Anbindung an der Produktionsanlage	<input type="checkbox"/>	15 elektrische Signale prüfen	
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<p>Bestätigung des Prüfers</p> <p><input type="checkbox"/> Der Ventilator ist mangelfrei und kann in Betrieb gehen.</p> <p>Folgende Punkte waren nicht in Ordnung und müssen ersetzt, repariert oder erneut überprüft werden.</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p> <p>_____</p>																																																																			
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