

**SIEMENS**

For employment in zone 1 or zone 2 (IEC/EN 60079-10-1)

CE<sup>0102</sup> Ex II 2G Ex d IIC/IIB T. Gb

# LOHER CHEMSTAR

Induction motor

Type 1PS5

Operating Instructions / Installation Instructions N-R 601d

Edition

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**Answers for industry.**



## Induction motor

### LOHER CHEMSTAR 1PS5

Operating Instructions  
Installation Instructions




For employment in zone 1 or zone 2 (IEC/EN  
60079-10-1)  
**CE**<sup>0102</sup> II 2G Ex d IIC/IIB T. Gb

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## Legal information

### Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

 <b>DANGER</b>
indicates that death or severe personal injury <b>will</b> result if proper precautions are not taken.
 <b>WARNING</b>
indicates that death or severe personal injury <b>may</b> result if proper precautions are not taken.
 <b>CAUTION</b>
indicates that minor personal injury can result if proper precautions are not taken.
<b>NOTICE</b>
indicates that property damage can result if proper precautions are not taken.


If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

### Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

### Proper use of Siemens products

Note the following:

 <b>WARNING</b>
Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

### Trademarks

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### Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

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# Introduction

These instructions describe the machine and explain how to handle it, from initial delivery to final disposal of the equipment. Keep these instructions for later use.

Read these operating instructions before you handle the machine and follow the instructions to become familiar with its design and operating principles and thus ensure safe, problem-free machine operation and long service life.

If you have suggestions for improving the document, please contact the Service Center (Page 125).

## Text format features

The warning notice system is explained on the rear of the inside front. Always follow the safety instructions and notices in these instructions.

In addition to the safety-related warning notices which you must read, you will find the text in these instructions is formatted in the following way:

1. Handling instructions are always formatted as a numbered list. Always perform the steps in the order given.
- Lists are formatted as bulleted lists.
  - Lists on the second level are hyphenated.

---

### Note

A Note is an important item of information about the product, handling of the product or the relevant section of the document. Notes provide you with help or further suggestions/ideas.

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## Safety notes

### 2.1 Information for the nominated person in control of the electrical installation

This machine has been designed and built in accordance with Directive 94/9/EC ("Explosion Protection Directive") and is intended for use in industrial plants with potentially explosive atmosphere. Commissioning in the European Community is forbidden until the plant into which the machine will be installed has been shown to conform with this directive. Please observe the country-specific regulations when using the machine outside the European Community.



#### **WARNING**

##### **Commissioning prior to determining the conformance**

If the machine is commissioned prior to determining the plant conformance, the explosion protection of the plant is not guaranteed. An explosion can result. This can result in death, serious injury or material damage.

Commission the machine only when the plant conformance with the explosion protection directive has been confirmed.

### 2.2 The five safety rules

For your personal safety and to prevent material damage when carrying out any work, always observe the safety instructions and the following five safety rules, according to EN 50110-1 "Dead working". Apply the five safety rules in the sequence stated before starting work.

#### **Five safety rules**

1. Disconnect completely.  
Disconnect the auxiliary circuits, for example anti-condensation heating.
2. Secure against reconnection.
3. Verify absence of operating voltage.
4. Carry out earthing and short-short-circuiting.
5. Provide protection against adjacent live parts.

To energize the system, apply the measures in reverse order.

## 2.3 Qualified personnel

All work at the machine must be carried out by qualified personnel only. For the purpose of this documentation, qualified personnel is taken to mean people who fulfill the following requirements:

- Through appropriate training and experience, they are able to recognize and avoid risks and potential dangers in their particular field of activity.
- They have been instructed to carry out work on the machine by the appropriate person responsible.

## 2.4 Safe handling

Workplace safety depends on the attentiveness, care, and common sense of the personnel who install, operate, and maintain the machine. In addition to the safety measures cited, as a matter of principle, the use of caution is necessary when you are near the machine. Always pay attention to your safety.

Also observe the following to prevent accidents:

- General safety regulations applicable in the country where the machine is deployed.
- Manufacturer-specific and application-specific regulations
- Special agreements made with the operator
- Separate safety instructions supplied with the machine
- Safety symbols and instructions on the machine and its packaging



### **WARNING**

#### **Live parts**

Electric machines contain live parts.

Fatal or severe injuries and substantial material damage can occur if the covers are removed or if the machine is not handled, operated, or maintained properly.

- Always observe the "five safety rules (Page 13)" when carrying out any work on the machine.
- Only remove the covers using the methods described by these operating instructions.
- Operate the machine properly.
- Regularly and correctly maintain the machine.



**WARNING**

**Rotating components**

Electric machines contain dangerous rotating parts.

Fatal or severe injuries and substantial material damage can occur if the covers are removed or if the machine is not handled, operated, or maintained properly.

- Only remove the covers using the methods described by these operating instructions.
- Operate the machine properly.
- Perform regular maintenance on the machine.
- Secure free-standing shaft ends.



**WARNING**

**Hot surfaces**

Electric machines have hot surfaces. Do not touch these surfaces. They could cause burns.

- Allow the machine to cool before starting work on the machine.
- Only remove the covers using the methods described by these operating instructions.
- Operate the machine properly.



**CAUTION**

**Hazardous substances**

Chemical substances required for the setup, operation and maintenance of machines can present a health risk.

Poisoning, skin damage, cauterization of the respiratory tract, and other health damage may result.

- Read the information in these operating instructions and the product information supplied by the manufacturer.
- Observe the relevant safety regulations and wear the personal protective equipment specified.




**CAUTION**

**Flammable substances**

Chemical substances required for the setup, operation and maintenance of machines may be flammable.

Burns and other damage to health and material may result.

- Read the information in these operating instructions and the product information supplied by the manufacturer.
- Observe the relevant safety regulations and wear the personal protective equipment specified.

 <b>WARNING</b>
<b>Noise emissions</b> <p>During operation, the machine's noise emission levels can exceed those permitted at the workplace, which can cause hearing damage.</p> <p>Take steps to reduce noise, such as introducing covers and protective insulation or adopting hearing protection measures, so that the machine can be operated safely within your system.</p>

## 2.5 Use in hazardous areas

Electrical systems in hazardous zones must be assembled, installed, and operated by the applicable responsible persons in accordance with the applicable rules and regulations.

---

### Note

The basic requirements relating to electrical systems and their operation in hazardous areas are described, for instance, in EU Directive 1999/92/EC as well as in IEC / EN 60079-14.

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### Ignition hazards

The assessment of operating risks and local operating conditions and the necessary monitoring methods must be clarified and made binding by the system operator in consultation with the responsible supervisory authority. The required measures must be adhered to at all times. The machine manufacturer cannot provide any generally applicable recommendations. Please observe the information in these operating instructions.

---

### Note

The basic requirements relating to the assessment of ignition hazards arising from electrical equipment and their operation in hazardous zones are specified, for instance, in 94/9/EC and 1999/92/EC directives as well as in the IEC / EN 60079 series of standards.

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If a third-party certification is available for the machine, then carefully comply with the technical data defined in it and any special conditions.

The certificate must be available before commissioning.



## 2.6 Electrostatic sensitive devices

### ESD protective measures



#### NOTICE

##### Electrostatic discharge

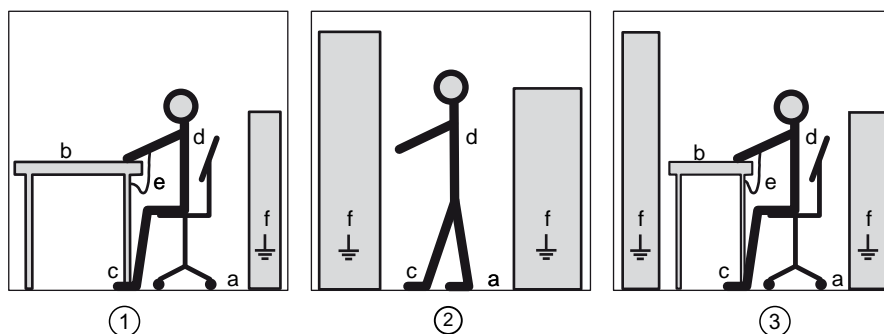
Electronic modules contain components that can be destroyed by electrostatic discharge.

These modules can be easily destroyed by improper handling.

To protect your equipment against damage, follow the instructions given below.

- Never touch electronic modules unless absolutely necessary in the course of maintenance and repair procedures.
- If the modules have to be touched, the body of the person concerned must be electrostatically discharged immediately beforehand and be grounded.
- Electronic modules should not be brought into contact with electrically insulating materials such as plastic film, plastic parts, insulating table supports or clothing made of synthetic fibers.
- Always place electrostatic sensitive devices on conductive bases.
- Always pack, store and transport electronic modules or components in conductive packaging, e.g. metallized plastic or metal containers, conductive foam material or domestic aluminum foil.

The necessary ESD protective measures for electrostatic sensitive devices are illustrated once again in the following drawings:



(1) Sitting

a = conductive floor surface

d = ESD overall

(2) Standing

b = ESD table

e = ESD wristband

(3) Standing/sitting

c = ESD shoes

f = cabinet ground connection

## 2.7 Electromagnetic compatibility

This machine is designed in accordance with IEC/EN 60034 and when used as prescribed it satisfies the requirements of European Directive 2004/108/EC on Electromagnetic Compatibility.

## 2.8 Interference immunity

The machine fulfills the requirements regarding interference immunity in accordance with IEC/EN 61000-6-2.

For machines with integrated sensors (e.g. PTC thermistors), the manufacturer of the complete system must ensure sufficient interference immunity by selecting suitable sensor signal leads and evaluation units.

## 2.9 Interference voltages when operating the converter




### **WARNING**

#### **Interference voltages when operating the converter**

When a converter is in operation, the emitted interference varies in strength depending on the converter (manufacturer, type, interference suppression measures undertaken). On machines with integrated sensors (e.g. PTC thermistors), interference voltages caused by the converter may occur on the sensor lead. This can cause faults which can result in eventual or immediate death, serious injury or material damage.

In order to avoid exceeding the limit values set for the drive system (machine and converter) in IEC/EN 61000-6-3, the EMC information provided by the converter manufacturer must be observed. You must put appropriate EMC measures in place.

## 2.10 Electromagnetic fields when operating electrical power engineering installations

 <b>WARNING</b>
<b>Interference to electronic devices caused by electrical power equipment</b> Electrical power equipment generate electric fields during operation. Potentially lethal malfunctions can occur in medical implants, e.g. pacemakers, in the vicinity of electrical power equipment. Data may be lost on magnetic or electronic data carriers. <ul style="list-style-type: none"><li>• It is forbidden for people with pacemakers to enter the vicinity of the machine.</li><li>• Protect the personnel working in the plant by taking appropriate measures, such as erecting identifying markings, safety barriers and warning signs and giving safety talks.</li><li>• Observe the nationally applicable health and safety regulations.</li><li>• Do not carry any magnetic or electronic data media.</li></ul>

## 2.11 Ventilation

<b>NOTICE</b>
<b>Ventilation</b> <ul style="list-style-type: none"><li>• Do not obstruct ventilation.</li><li>• Prevent the air expelled by neighboring equipment from being immediately drawn in again.</li><li>• On the vertical type of machine construction with air intake from above, protect the air inlets from the ingress of foreign bodies and water.</li><li>• If the shaft extension is facing upwards, liquid must be prevented from entering by moving along the shaft.</li></ul>



## Description

### Applications

This electrical machine is designed for driving rotating machines in industrial environments and also for energy conversion. It is characterized by a high level of safety, long lifetime, and overall reliability.

The machine was designed in accordance with the ordering party's specification and may only be used for the contractually agreed purpose.

### Type of protection

This machine is constructed in the "explosion proof" type of protection (Ex d) in accordance with IEC / EN 60079-1. Therefore, it may be operated in hazardous areas of **Zone 1** according to IEC / EN 60079-10-1.

This machine is optionally available with type of protection "Protection through enclosure" (Ex tc) according to IEC / EN 60079-0 and IEC / EN 60079-31.

This electrical machine corresponds to standards of the IEC / EN 60034, IEC / EN 60079-0 and IEC / EN 60079-31 series. Only operate the machine in hazardous areas, strictly complying with the specifications of the responsible supervisory authorities. The relevant supervisory authority is responsible for determining the hazard level of each area and classifying the zones.

The type of protection as well as special regulations are stamped on the rating plate or in the test certificate.

If the certificate number is supplemented by an X, to safely operate the machine observe the special notes in the operating instructions or if available in the EC type examination certificate or in the IECEx certificate of conformity.

Operation with a converter must be certified. It is essential that you observe the separate manufacturer's information and instructions.

**! DANGER**

## Explosion hazard from hybrid mixtures

Hybrid mixtures are mixtures of flammable dusts with explosive gas/air atmospheres which can together create a dangerous explosive atmosphere if they occur at the same time. Changes can arise in the safety characteristics here, such as a change in the zonal classification, increase in the explosion pressure, reduction in the minimum ignition energy and a reduction in the maximum temperatures to be observed.

An explosion can result. This can result in death, serious injury or material damage.

- For this reason, the relative characteristics must be considered both for gas (zones 0, 1 and 2) and for dust (zones 20, 21 and 22) where hybrid mixtures arise. It is necessary for a competent assessor to determine in the individual case whether the parameters determining ignition are unfavorably affected in a particular hybrid mixture.
- Motors with dual plates for G ("Gas") andD ("Dust") may only be used where these two simultaneously occur after the user has first analyzed the properties of the hybrid mixture.









## NOTICE

### Use of machines without CE marking

Machines without CE marking are intended for operation outside the European Economic Area (EEA). Do not use any machines without a CE marking in the EEA!

The roller bearing machines with Ex d type of protection can have the following Ex marking:

Table 3-1 Marking for machines with type of protection Ex d for Zone 1

Directive	Ex marking			
Directive 94/9/EC with EC type-examination certificate	 II 2G Ex d IIC T3 to T6 Gb	or	 II 2G Ex d IIB T3 to T6 Gb	
	 II 2G Ex d e IIC T3 to T6 Gb		 II 2G Ex d e IIB T3 to T6 Gb	
	 II 2G Ex d ib IIC T3 to T6 Gb		 II 2G Ex d ib IIB T3 to T6 Gb	
	 II 2G Ex d e ib IIC T3 to T6 Gb		 II 2G Ex d e ib IIB T3 to T6 Gb	
IECEx-Scheme with Certificate of Conformity	Ex d IIC T3 to T6 Gb		Ex d IIB T3 to T6 Gb	
	Ex d e IIC T3 to T6 Gb	Ex d e IIB T3 to T6 Gb		
	Ex d ib IIC T3 to T6 Gb	Ex d ib IIB T3 to T6 Gb		
	Ex d e ib IIC T3 to T6 Gb	Ex d e ib IIB T3 to T6 Gb		

Machines with Ex t type of protection can be marked as follows:

Table 3-2 Marking for machines with Ex tb type of protection for zone 21




Directive	Ex marking
Directive 94/9/EC with EC type-examination certificate	 2D Ex tb IIIC T... °C Db
IECEX-Scheme with Certificate of Conformity	Ex tb IIIC T... °C Db

Table 3-3 Marking for machines with Ex tc type of protection for Zone 22 without certificate

Directive	Ex marking
Directive 94/9/EC	 3D Ex tc IIIC T... °C Dc
	 3D Ex tc IIIB T... °C Dc
IECEX-Scheme with Certificate of Conformity	Ex tc IIIC T... °C Dc
	Ex tc IIIB T... °C Dc

## Machine design

The regulations and standards used as the basis to design and test this machine are stamped on the rating plate.

The machine design basically complies with the subsequent standards. Please refer to the EC Declaration of Conformity for the versions of the harmonized standards referenced.

Table 3-4 Machine design

Feature	Standard
Rating and performance	IEC/EN 60034-1
Degree of protection	IEC/EN 60034-5
Cooling	IEC/EN 60034-6
Type of construction	IEC/EN 60034-7
Terminal markings and direction of rotation	IEC/EN 60034-8
Noise emission	IEC/EN 60034-9
Starting characteristics, rotating electrical machines	IEC/EN 60034-12*
Vibration severity grades	IEC/EN 60034-14
Vibration limits	DIN ISO 10816-3

\* For machines in line operation only

## See also

Quality documents (Page 129)

The following standards additionally apply for explosion-proof motors:

Table 3-5 Motor version with type of explosion protection Ex t

Feature	Standard
Type of protection Ex t <sup>①</sup>	IEC / EN 60079-0 IEC / EN 60079-31

<sup>①</sup> Optional (depending on order)

The following standards additionally apply for explosion-proof machines:

Table 3-6 Machine version with type of explosion protection Ex d

Characteristic	Standard
Type of protection Ex d	IEC / EN 60079-0 IEC / EN 60079-1

## Rating plate

The rating plate shows the identification data and the most important technical data. The data on the rating plate and the contractual agreements define the limits of proper usage.

## Motor enclosure with water-jacket cooling

Stator frame and bearing shields are from cast iron or steel. The stator jacket is formed as a double jacket through which the coolant is fed. The frame is equipped with a cooling water inlet and outlet.

## Motor enclosure with surface, hollow-fin or tube cooling

Depending on their size, the stator frame and bearing shields are from cast iron or steel. The fan cover is made of sheet steel. The stator frame surface has cooling ribs, hollow ribs, or tubes and mounted terminal box.

## Cooling for machines with water-jacket cooling

The stator frame has a double jacket that is split and through which the cooling water flows. As a consequence, there is a good heat dissipation and there is less risk of the suspended solids in the water being deposited.



### **Cooling for machines with surface cooling, hollow rib cooling or tube cooling**

For machines with rib, hollow rib or tube cooling, the cooling air is drawn in through openings in the fan cover. The air is blown over the surface or through the cooling tubes of the stator frame. With hollow-fin or tube cooling, a closed cooling air circuit inside the motor assists with heat dissipation.

### **Stator winding**

The stator winding has a temperature class according to EN 60034-1, see rating plate. High-quality enameled wires, suitable surface insulating materials, and the type of impregnation guarantee great mechanical and electrical stability together with a high utility value and a long service life.

### **Rotor**

The rotor has a squirrel cage rotor manufactured out of die-cast aluminum or a brazed copper rotor. The rotor is dynamically balanced. The balance condition is stated on the shaft end face or rating plate.

### **Bearings**

The motors are equipped with grease-lubricated roller bearings.

- The bearings of the standard version motors (up to size 280) are permanently lubricated.
- The bearings of motors from size 315 upwards have a relubrication facility and automatic grease quantity control.

### **Terminal boxes**

In the motor terminal box, additional connecting terminals are available if required for monitoring equipment. For larger machines, an additional terminal box can be optionally mounted. You can see the number of available terminals in the circuit diagrams.

### **Paint finish**

The machine is painted according to the instructions in your order.

## Monitoring equipment

Monitoring equipment is provided corresponding to what has been ordered. KTY83 and KTY84 semiconductor sensors are electrostatic sensitive devices (ESD). These elements can be damaged by electrostatic discharge. Observe the ESD protective measures (Page 17).



### **DANGER**

#### **Risk of explosion when used in Zone 21 or 22 as a result of the high surface temperature**

Death, serious injury or material damage will result.

Please note that the optionally integrated PTC thermistors are only intended as additional protection for the winding. They are not used to limit the maximum surface temperature of the frame (see the data stamped on the rating plate). Prevent the maximum surface temperature from being exceeded by maintaining the specified operating conditions.

## External fan

The machine can be fitted with an external fan. For IC 666, there are two external fans. The electrical connection data are stamped on the rating plate of the external fan.

## Anti-condensation heating

The machine can be fitted with anti-condensation heating. The connection data is listed on an additional plate on the machine.

## Preparations for use

Good planning and preparation of machine applications are essential in terms of keeping installation simple and avoiding errors, ensuring safe operation, and allowing access to the machine for servicing and corrective maintenance.

This chapter outlines what you need to consider when configuring your plant in relation to this machine and the preparations you need to make before the machine is delivered.

### 4.1 Safety-related aspects to consider when configuring the plant

A number of residual risks are associated with the machine. These are described in the chapter titled "Safety information" and in related sections.

Take appropriate safety precautions (covers, barriers, markings, etc.) to ensure the machine is operated safely within your plant.

#### **Observing the operating mode**

Observe the machine's operating mode. Use a suitable control system to prevent overspeeds, thus protecting the machine from damage.

### 4.2 Motors without final paint coating

Motors, which are only delivered with primer, must be painted to comply with the applicable guidelines for the specific application. The primer does not provide adequate corrosion protection.

The paint used must fully comply with the requirements to avoid electrostatic charging (refer to DIN EN 60079-0).

---

#### **Note**

The Service Center can provide recommendations for painting.

---

Please note that the lower side of the machine mounting feet is bare metal. Ensure that there is adequate corrosion protection, e.g. using grease, sealing paste or a similar product. The terminal box cover also has bare metal surfaces. Here, only use a suitable grease to guarantee protection against corrosion.

### 4.3 Ensuring adequate cooling


Ensure that the machine is sufficiently cooled by the cooling air flow at the installation site:

#### 4.6 Interlock circuit for the external fan motor

- The cooling air can flow in and out freely.  
The full air flow provided by the fan is only achieved if air can freely enter the impeller. A clearance of at least 1 times the air intake diameter must therefore be provided in the axial direction.
- Hot discharged air must not be drawn in again.
- If there is no protective canopy, then for vertical types of construction where the air enters from the top, the air entry openings must be protected against the ingress of foreign bodies and water.

## 4.4 Thermal motor protection

Thermal motor protection by directly monitoring the winding temperature is permissible if this is certified and stamped on the rating plate. The temperature sensors used must comply with DIN 44081/44082 .

PTC thermistors as sole protection guarantee explosion protection in conjunction with function tested tripping devices with type of protection marking  II (2) G. No voltage > 2.5 V may be applied for any continuity test required on the temperature sensor.

For each speed range of pole-changing motors, use only isolated, interlocked protective devices that have been tested and certified by an approved test center.

## 4.5 Interlock circuit for anti-condensation heating


If the anti-condensation heating is operated while the machine is running, this can increase the temperatures inside the machine.

- Install an interlock circuit that switches off the anti-condensation heating once the main machine is switched on.
- Only operate anti-condensation heating when the machine is switched off.

## 4.6 Interlock circuit for the external fan motor

For machines with external fans, install an interlock circuit that prevents the main machine being switched on if the external fan is not operational.

## 4.7 Noise emissions

	<b>WARNING</b>
<b>Noise emissions</b>	
During operation, the machine's noise emission levels can exceed those permitted at the workplace, which can cause hearing damage.	
Take steps to reduce noise, such as introducing covers and protective insulation or adopting hearing protection measures, so that the machine can be operated safely within your system.	

## 4.8 Voltage and frequency fluctuations during line operation

Unless stated otherwise on the rating plate, the permissible voltage fluctuation is  $\pm 10\%$  and the permissible frequency fluctuation is  $\pm 2\%$  in accordance with range B in IEC / EN 60034 1. The following always applies. Under practical operating conditions a machine may sometimes have to be operated outside the limits of Range B. Exceptions of this sort should be limited with regard to the values that arise, how often and for how long they occur. Where possible and within a reasonable time take corrective actions such as reducing the power. Such actions can avoid thermal ageing leading to a reduction in the service life of the machine.

<b>NOTICE</b>
<b>Overheating of the winding</b>
Exceeding the permissible tolerances for voltage and frequency can lead to an impermissibly high temperature rise in the windings and thus cause long-term damage to the machine.

Be aware that every machine must be protected against unpermitted heating. The following notes apply here:

Every machine must be protected against an inadmissible temperature rise according to IEC / EN 60079-14 using a current-dependent delayed circuit breaker with phase failure protection conforming to IEC / EN 60947 or an equivalent device in all phases. The protective equipment is to be configured to the rated current (the value is on the rating plate). Furthermore, it is to be selected so that the motor is thermally protected even with a blocked rotor. Windings in a delta connection are to be protected in such a way that the trip unit or relay is connected in series with the winding phases. When selecting and configuring the trip unit, the nominal value of the phase current (i.e. 0.58 times the rated motor current) is to be taken as a basis. If such a circuit is not possible, then additional protective measures are required (e.g. thermal motor protection).

## 4.9 System-inherent frequencies

### NOTICE

#### Machine damage caused by system resonances

The system consisting of the foundation and machine set must be configured and matched in such a way that no system resonances can arise and result in the permissible vibration levels being exceeded. Excessive vibrations can damage the machine set.

- Observe DIN 4024 when designing the machine foundation.
- The limit values according to DIN ISO 10816-3 must not be exceeded.

## 4.10 Transport and storage

### 4.10.1 Transport markings

The packing differs depending on the transport type and size. If not otherwise contractually agreed, the packaging corresponds to the packing guidelines for International Standards for Phytosanitary Measures (ISPM).

Comply with the images shown on the packaging. Their meaning is as follows:



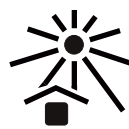
This way up



Fragile goods



Keep dry



Keep cool



Center of gravity



Do not use hand hook



Attach here

When carrying out any work on the machine, observe the general safety instructions and the specifications contained in EN 50110-1 regarding safe operation on electrical equipment.

### 4.10.2 Checking the delivery

The components are assembled on an individual basis. When you take receipt of the delivery, please check immediately whether the scope of the delivery matches up with the accompanying documents. No claims relating to defects/items missing from the delivery will be accepted if they are submitted at a later date.

- Report any apparent transport damage to the delivery agent immediately.
- Immediately report any apparent defects/missing components to your contact partner.

These Operating Instructions are part of the scope of delivery; keep them in a location where they can be easily accessed.

### 4.10.3 Lifting and transportation

- Persons driving cranes and fork lift trucks must hold appropriate qualifications.
- When lifting the machine, use only approved and undamaged sling guides and spreaders of sufficient rated capacity. Check these before using them. The weight of the machine is stated on the rating plate.
- When lifting the machine, refer to the information on the lifting plate:
  - Comply with the specified spreading angles.
  - Lift the machine without jerking it.
- When lifting, use only the load handling attachments on the stator casing, such as lifting eyes or eye bolts.



#### **WARNING**

##### **Transporting or lifting the machine**

The machine or the machine set may be transported and lifted only using the load handling attachments.

Otherwise, death, serious injury, or material damage may result.

1. Only use the load handling attachments on the stator frame to lift the motor.
2. Use suitable rope guidance or spreading devices. The weight of the machine is stated on the rating plate.



#### **WARNING**

##### **Center of gravity when transporting or lifting the motor**

If the center of gravity of a load is not located centrally between the attachment points, the motor can tip over or slip out of the lifting gear when it is being transported or lifted.

This can result in death, serious injury, or material damage.

1. Always take account of the center of gravity when transporting or lifting the machine. The machine's center of gravity is indicated in the relevant dimension diagram.
2. Observe the handling instructions on the motor when transporting it. If the center of gravity is not located centrally between the attachment points, then position the hoisting hook above it.
3. Be aware of the possibility of different loads on the sling ropes or lifting straps and the carrying capacity of the lifting equipment.

#### **Note**

##### **Store the rotor locking device**

Be sure to store the rotor locking device. It must be remounted for possible disassembly and transport.

**Note**

**Place the machine in a secure and raised position**

In order to obtain easy and safe access to the underside of the machine, place it in a secure and raised position.



**DANGER**

**Standing under suspended loads**

If the lifting gear or load handling attachments were to fail, the machine could fall. This can result in death, serious injury or material damage.

Never remain under or in the immediate vicinity of the machine when it is raised.

#### 4.10.4 Attaching the rotor shipping brace prior to storage

**NOTICE**

**Bearing damage caused by vibration**

If storage conditions are inappropriate there is a risk of bearing seizure damage. This can result in material damage, such as damage to bearings caused by vibration.

- On machines that have been supplied with a rotor shipping brace, secure the rotor as per the notes on transportation.
- Protect the machine against strong radial vibrations, since the rotor shipping brace might not absorb these completely.

**NOTICE**

**Bearing damage when being transported**

If the customer has already mounted parts, for example coupling, belt pulley, etc., the bearing can be damaged during transport.


- In this case, make sure that the customer uses a rotor shipping brace.



## **4.10.5 Storage for up to two years**

### **4.10.5.1 Storage conditions**

- Store the machines in a dry, dust-free room where the temperature is controlled. Special packing is therefore not necessary. In all other cases, pack the machines in a plastic film with a substance that absorbs moisture, e.g. Branogel, or in hermetically sealed welded foil. Use a protective cover to protect against sun and rain.
- Store the machines only in vibration-free rooms in order to avoid consequential damage to the bearings due to vibration at standstill.

 <b>WARNING</b>
<b>Risk of explosion due to damaged sealing materials</b> Storing the machine at temperatures that do not fall within the specified limits can damage the material of the seals and cause them to fail. As a result, a potentially explosive gaseous atmosphere can enter the machine and be ignited during commissioning. Explosions can occur. This can result in death, serious injury or material damage.  The materials used are specially designed for the temperature range required by the customer. Do not store the motor in conditions that lie outside the specified temperature limits. The relevant temperature limits are specified on the rating plate.

### **4.10.5.2 Storing motors with water cooling down to -20 °C**

If a water-cooled machine is stored at temperatures down to -20 °C, then also please note the following:

- Completely drain the coolers.
- Completely dry the coolers with warm air up to a max. 60 °C.
- After drying, seal off the coolers.
- Store machines with coolers in a dry and dust-free room.

## **4.10.6 Storage for between two and four years**

If machines are to be stored for between 2 and 4 years, then also observe the following:

When ordering, the manufacturer must know the storage time.

Grease caps must be available at the shaft outlet and at the terminal box cover. Do not rotate the motor shaft before commissioning as the protective grease coating will be destroyed. If rotating parts have to be turned, then apply a new protective coating of grease.

#### 4.10.7 Storage at low temperatures

If machines are stored at temperatures of down to -50° C, then also take into account the following:

- The normal roller bearing grease of machines is suitable for operating temperatures of between -30 °C and +130° C. Temperatures down to -50° C are harmless for the roller bearing grease if the machine is non operational or is in storage.  
For operation at -50 °C, the bearings have a special grease, e.g. Shell Aero Grease 7.
- Machines with regreasing system must be regreased when commissioning. Double the amount of grease that is specified on the lubricant plate.

#### 4.10.8 Storing motors together with the driven machine

- Before mounting the motors, grease the free parts of the shaft extension, as well as all other bare metal parts, such as mounting foot surfaces, flange surfaces, terminal box and cover contact surfaces. Attach caps filled with roller bearing grease to the shaft output gland to provide protection against dust and humidity.
- Fill the terminal boxes of the machines with a substance that will absorb moisture, e.g. Branogel.
- Store the machines in a dry, dust-free room where the temperature is controlled.

#### 4.10.9 Storage outdoors

If the machine is stored outdoors, then the following should additionally be observed:

- Provide protective cover against the effects of sun and rain. Air must freely circulate to avoid condensation forming.
- Every two months check the following:
  - Free parts of the shaft extension and other bare metal parts, e.g. mounting foot surfaces or the flange faces, terminal box and cover contact surfaces must be greased.
  - Caps filled with grease attached to the shaft output gland to provide protection against the ingress of dust and moisture are still effective.

## **4.10.10 Commissioning after storage**

### **4.10.10.1 Insulation resistance and polarization index**

Measuring the insulation resistance and polarization index (PI) provides information on the condition of the machine. It is therefore important to check the insulation resistance and the polarization index at the following times:

- Before starting up a machine for the first time
- After an extended period in storage or downtime
- Within the scope of maintenance work

The following information is provided regarding the state of the winding insulation:

- Is the winding head insulation conductively contaminated?
- Has the winding insulation absorbed moisture?

As such, you can determine whether the machine needs commissioning or any necessary measures such as cleaning and/or drying the winding:

- Can the machine be put into operation?
- Must the windings be cleaned or dried?

Detailed information on testing and the limit values can be found here:

"Testing the insulation resistance and polarization index" (Page 70)

### **4.10.10.2 Lubricating the roller bearings**

If you correctly store the machine for a longer period of time, it can be assumed that within a period of two years, the grease in the bearings will not deteriorate.

- For motors with thermal class 155, for normal ambient temperatures, use a lithium-soap roller bearing grease with a melting point of at least 180° C.
- For machines with thermal class 180, and for certain special machines, use the special grease specified on the machine lubricant plate.

### **4.10.10.3 Regreasing roller bearings after storage periods of up to 2 years**

- For machines with regreasing systems, briefly lubricate both bearings after commissioning with the motor running as a precautionary measure.
- Grease type, grease quantity and relubrication intervals for the regreasing system are stamped on a supplementary plate attached to the machine.

#### **4.10.10.4 Regreasing roller bearings after storage periods of between 2 and 4 years**

- For machines with regreasing system, lubricate machines immediately after commissioning while the machine is running with approximately twice the grease quantity. This causes the old grease to be spun out.
- Then regrease the bearings with the amount of bearing grease specified on the lubricant plate.

---

##### **Note**

##### **Increased bearing noise**

Increased bearing noise can occur while the bearings are being run in. The bearing noise is not dangerous, if the operating temperature has not yet been reached and the noise is caused by the viscosity and the dynamic viscosity of the bearing grease.

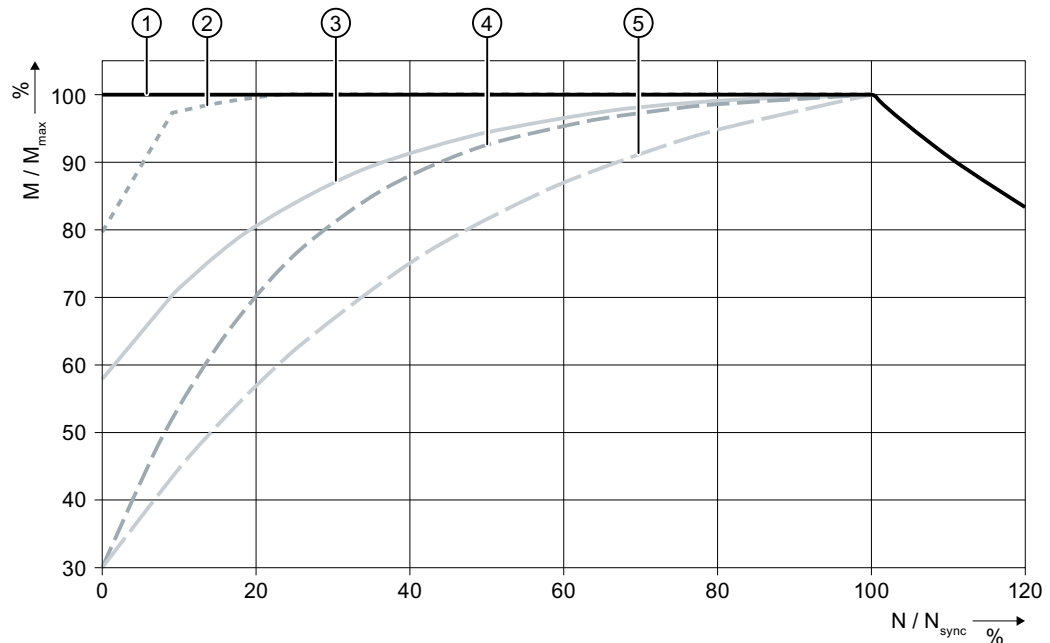
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## **4.11 Converter operation**

When controlling explosion-protected machines from a converter, carefully observe R-No. 20000 (Page 135)

### Speed/torque characteristic for operation with a Sinamics converter

The load characteristics show the permanent permissible load torque as a function of the speed and the cooling method. The load torque is specified as a percentage referred to the maximum torque according to the supplementary plate for converter operation.



1. IC666 – air-air heat exchanger, force ventilated externally and internally  
IC86W – air-water heat exchanger, force ventilated
2. IC416 – surface cooled, force ventilated and  
IC71W – water-jacket cooled
3. IC411 – surface cooled, self-ventilated
4. IC516 – tube cooled, force ventilated  
IC616 – air-air heat exchanger, force ventilated externally  
IC81W – air-water heat exchanger, self-ventilated
5. IC511 – tube cooled, self-ventilated  
IC611 – air-air heat exchanger, self-ventilated

#### Converter operation:

- If the motor design requires a special converter assignment, you can find the appropriate additional data stamped on the rating plate.
- Correctly parameterize the converter. The parameterization data is specified on the rating

plate of the machine. Information about the parameters is available in the operating instructions for the converter.



**WARNING**

**Exceeding limit values**

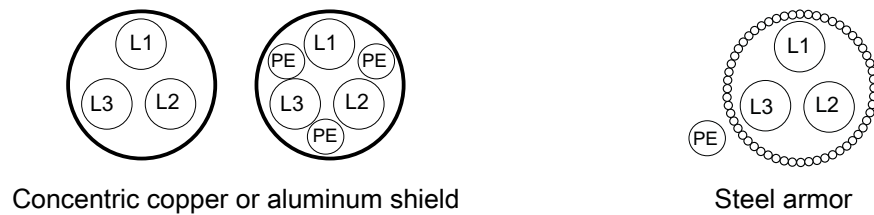
It is not permissible that the maximum speed and torque values stamped on the supplementary plate for converter operation are exceeded.

This can result in death, serious injury or material damage.

### 4.11.1 Reducing bearing currents during operation on the converter

Taking the following actions will reduce the bearing currents:

- **Grounding:**
  - In addition to grounding the machines via the solid protective ground conductor, supplement the high frequency grounding using braided flat copper straps or high frequency stranded conductors.
  - Ensure that the contacts cover a large area. Solid copper cables are not suitable for high frequency grounding because of the skin effect.
- Use **equipotential bonding conductors**:
  - Between motor and driven machine
  - Between motor and converter
  - Between terminal box and RF grounding point at the motor enclosure
- Use a **separate RF equipotential bonding conductor**:
  - Between motor enclosure and protective ground rail of the converter
  - Between motor enclosure and driven machine
- **Selecting and connecting the cable:** As far as possible, use symmetrically arranged, shielded connection cables. The cable shielding, made up of as many strands as possible, must have good electrical conductivity. Braided shields made of copper or aluminum are very suitable.
  - The shield must be connected at both ends to the motor and the converter; unshielded cable ends must be kept as short as possible.
  - To ensure good discharging of high-frequency currents, provide contacting over a large surface area: with 360° contacting at the converter, at the motor for instance with EMC screw fastenings at the cable entries.



### Measures to further reduce bearing currents

To specifically reduce and prevent damage caused by bearing currents, you must consider the system as a whole, which comprises the motor, converter, and driven machine. The following precautions help to reduce bearing currents:

- In the overall system, set up a properly meshed grounding system with low impedance for high-frequency currents.
- Use the common-mode filter (damping cores) at the converter output. The Siemens sales representative is responsible for selection and dimensioning.
- Limit the rise in voltage by using output filters. This dampens the harmonic content in the output voltage.

#### Note

#### Converter documentation

The operating instructions for the converter are not part of this documentation. Refer also to the configuration information for the converter.

### 4.11.2 Insulated bearings when operating the converter

Depending on the machine's size and design, an insulated bearing and an insulated tachometer can be fitted at the non-drive end.

Comply with the plates on the machine relating to bearing insulation and possible bridges.

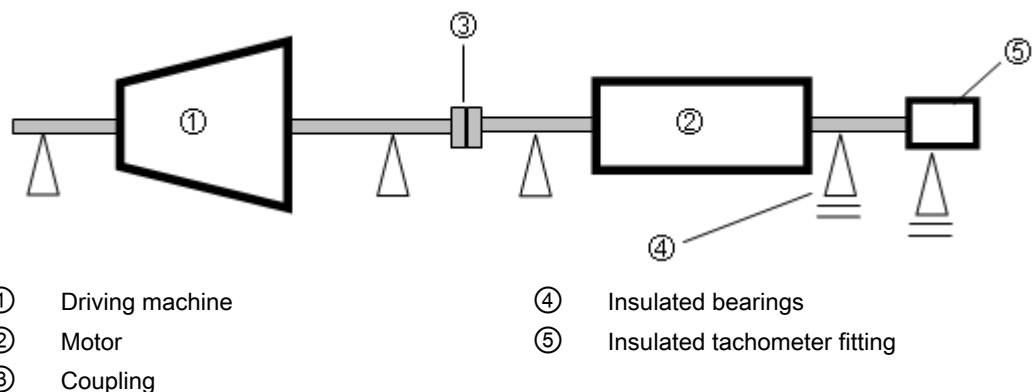


Figure 4-1 Schematic representation of a single drive

**NOTICE**

**Bearing damage**

The bearing insulation must not be bridged.

Damage may be caused to the bearings if there is a flow of current.

**Tandem operation**

If you connect two motors in series in "tandem operation", install an insulated coupling between the motors.

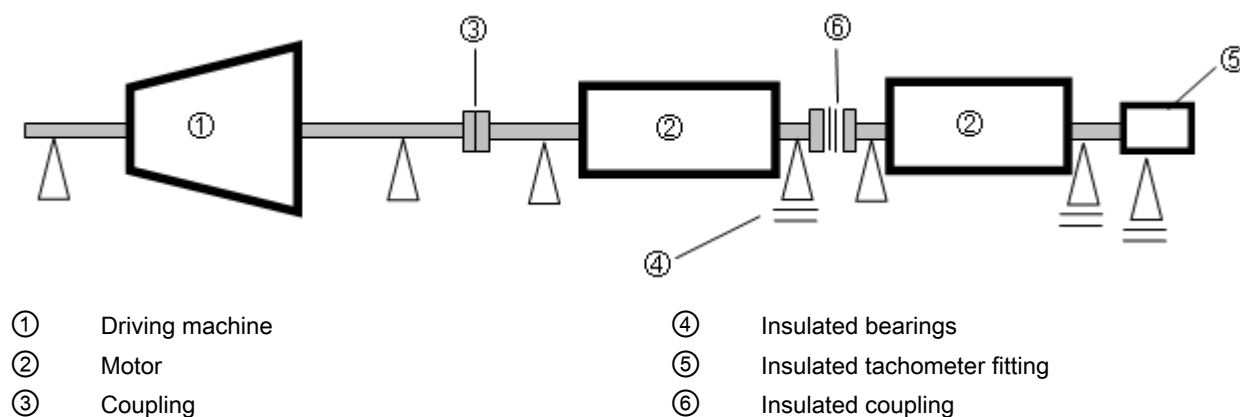


Figure 4-2 Schematic representation of a tandem drive

**NOTICE**

**Bearing damage**

If the coupling between the motors of the tandem drive is not insulated, bearing currents can cause damage to the drive-end bearings of both motors.

Use an insulated coupling to link the motors.





**WARNING**

**Dangerous voltage via the converter**

As long as the feeding converter is switched on, or the DC link of the converter is not discharged, there can be a voltage at the motor terminals even when the rotor is not moving. The voltage is up to 1000 V, depending on the converter type.

Ensure that the five safety rules are followed before working on the motor.



## Assembling

When carrying out any work on the machine, observe the general safety instructions (Page 13) and the specifications contained in EN 50110-1 regarding safe operation on electrical equipment.

### 5.1 Preparations for installation

#### 5.1.1 Safety instructions for installation



##### **WARNING**

##### **Danger caused by inappropriate fastening material**

If screws of an incorrect property class have been selected or if they have been fastened to an incorrect tightening torque, they may break or become loose. This will cause the machine to move, which could damage the bearings. The rotor could smash into the machine enclosure and machine parts could be flung out of place. This can result in death, serious injury or material damage.

- Comply with the required property classes for screwed connections.
- Tighten the screwed connections to the specified tightening torques.



##### **WARNING**

##### **Tensions on the fastening parts**

If the machine has not been properly aligned, this will mean the fastening parts are subjected to stress/distortion. Screws may become loose or break, the machine will move, machine parts could be flung out of place. This can result in death, serious injury or material damage.

- Carefully align the machine to the driven machine.

##### **NOTICE**

##### **Damage to the mounted parts**

Mounting parts such as temperature sensors or speed sensors are attached to the machine and could be ripped off or destroyed as a result of improper handling. This could lead to machine malfunctions, extending even to total loss of the machine.

- Where necessary, use suitable steps when performing installation work on the machine.
- Do not stand on cables or attachments during installation. Do not use attachments as steps.

---

**Note**

**Loss of conformity with European directives**

In the delivery state, the machine corresponds to the requirements of the European directives. Unauthorized changes or modifications to the machine lead to the loss of conformity with European directives and the loss of warranty.

---

### 5.1.2 Requirements for installation

The following requirements must be satisfied prior to starting installation work:

- Staff have access to the operating and installation instructions.
- The machine is unpacked and ready for mounting at the installation location.

---

**Note**

**Measure the insulation resistance of the winding before starting installation work**

Wherever possible, measure the insulation resistance of the winding before starting installation work. If the insulation resistance lies below the specified value, take appropriate remedial measures. These remedial measures may necessitate the machine being removed again and transported.

---

<b>NOTICE</b>
<b>High temperatures</b> The motor components get very hot during operation. High temperatures can damage mounting parts such as the cable insulation. <ul style="list-style-type: none"><li>• Temperature-sensitive parts such as normal cables or electronic components must not rest against or be attached to mounted machine parts.</li><li>• Only use heat-resistant mounting parts. The connecting cables and cable entries must be suitable for the ambient temperature.</li></ul>

## 5.2 Lift the machine to where it will be installed, and position it

### 5.2.1 Preconditions for correct alignment and secure attachment

Detailed specialist knowledge of the following measures is required in order to correctly align and securely fit the equipment.

- Preparing the foundation
- Selecting and mounting the coupling
- Measuring the concentricity and axial eccentricity tolerances
- Positioning the machine

If you are not familiar with the prescribed measures and procedures, then you can make use of the services offered by the local Service Center.

### 5.2.2 Checking the load handling attachments

Inspect the load handling attachments such as the load stands, lifting eyes and ring bolts and also the lifting gear, before lifting the machine:

- Inspect the load handling attachments on the machine for possible damage. Replace any load handling attachments that are found to be damaged.
- Check before use that the load handling attachments are correctly secured.
- When lifting the machine, use only approved and undamaged lifting gear of sufficient rated capacity. Check these before using them.



#### **WARNING**

##### **The machine can be dropped**

If the load handling attachments and lifting gear are damaged or not correctly secured, the machine may be dropped during lifting. This can result in death, serious injury or material damage. Inspect the load handling attachments and lifting gear before use.

### 5.2.3 Removing the rotor shipping brace

If a rotor shipping brace is attached to the machine, remove it at the last possible moment, for example, when you are ready to push on the output or drive element.

---

#### **Note**

##### **Store the rotor locking device**

Be sure to store the rotor locking device. It must be remounted for possible disassembly and transport.

---

## 5.2.4 Mounting the output elements

### Balance quality

The rotor is dynamically balanced. For shaft extensions with featherkeys, the balancing type is specified using the following coding on the face of the drive end of the shaft:

- "H" means balancing with a half feather key
- "F" means balancing with a whole feather key.

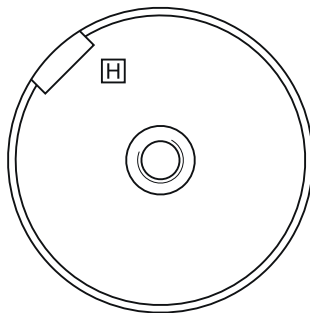


Figure 5-1 Balancing type on the drive-end side

### Pushing on the power output elements

- Prerequisites:
  - The coupling and/or the output element must be appropriately dimensioned for the operating case at hand. The balance quality must satisfy the following requirements.
  - Comply with the coupling manufacturer's instructions.
  - Make sure that the balancing type of the transmission element correctly matches the type of balance of the rotor.
  - Use only ready drilled and balanced transmission elements. Check the hole diameters and the balancing status before pulling them on. Thoroughly clean the shaft extension.
- Pulling on:
  - Warm up the transmission elements to expand them before pulling them on. Select the temperature difference for the heating process to suit the coupling diameter, fit and material. See the coupling manufacturer's instructions.
  - Power output elements may only be pushed on or pulled off with the correct equipment. The transmission element must be pulled on in one continuous operation via the front thread holes in the shaft or pushed on by hand.
  - Do not strike it with a hammer, as this would damage the bearings.

### Shaft extensions with feather key

To maintain the balancing quality, you have the following options:

- If the transmission element is shorter than the feather key with balancing type "H", then you must machine off the section of feather key protruding from the shaft contour and transmission element in order to maintain the balance quality.
- If the transmission element is drawn up on to the shoulder of the shaft, you must ensure that the part of the coupling groove where the feather key is not inserted is taken into consideration when balancing the coupling.

The following applies for all 2-pole machines and 4-pole machines with a frequency  $\geq 60$  Hz:

- The feather key must be shortened if the coupling hub is shorter than the feather key.
- The center of gravity of the coupling half should be within the length of the shaft end.
- The coupling used must be prepared for system balancing.  
The number of poles of the machine is specified on the rating plate (in the designation of the motor type).



#### **WARNING**

##### **The feather key can fall out**

The feather keys are only locked against falling out during shipping. If a machine with two shaft extensions does not have an output element on one shaft extension, the feather key can fall out during operation.

Death or serious injury can result.

- Do not operate the machine unless the transmission elements have been pulled on.
- On shaft extensions without output element, make sure that the feather key cannot fall out and shorten it by approximately half for balance type "H".

### 5.2.5 Lifting and transportation

- Persons driving cranes and fork lift trucks must hold appropriate qualifications.
- When lifting the machine, use only approved and undamaged sling guides and spreaders of sufficient rated capacity. Check these before using them. The weight of the machine is stated on the rating plate.

5.2 Lift the machine to where it will be installed, and position it

- When lifting the machine, refer to the information on the lifting plate:
  - Comply with the specified spreading angles.
  - Lift the machine without jerking it.
- When lifting, use only the load handling attachments on the stator casing, such as lifting eyes or eye bolts.



**WARNING**

**Transporting or lifting the machine**

The machine or the machine set may be transported and lifted only using the load handling attachments.

Otherwise, death, serious injury, or material damage may result.

1. Only use the load handling attachments on the stator frame to lift the motor.
2. Use suitable rope guidance or spreading devices. The weight of the machine is stated on the rating plate.



**WARNING**

**Center of gravity when transporting or lifting the motor**

If the center of gravity of a load is not located centrally between the attachment points, the motor can tip over or slip out of the lifting gear when it is being transported or lifted.

This can result in death, serious injury, or material damage.

1. Always take account of the center of gravity when transporting or lifting the machine. The machine's center of gravity is indicated in the relevant dimension diagram.
2. Observe the handling instructions on the motor when transporting it. If the center of gravity is not located centrally between the attachment points, then position the hoisting hook above it.
3. Be aware of the possibility of different loads on the sling ropes or lifting straps and the carrying capacity of the lifting equipment.

**Note**

**Place the machine in a secure and raised position**

In order to obtain easy and safe access to the underside of the machine, place it in a secure and raised position.



**DANGER**

**Standing under suspended loads**

If the lifting gear or load handling attachments were to fail, the machine could fall. This can result in death, serious injury or material damage.

Never remain under or in the immediate vicinity of the machine when it is raised.



## 5.2.6 Setting down the machine

### Requirements

The following preconditions must be satisfied before setting down the machine at the installation location:

- The mating faces must be clean.
- The anti-corrosion protection paint has been removed from the mating faces, such as the machine mounting feet, flange, ...

### Setting down the machine

Set down the machine slowly and carefully at the installation location to avoid any impact.

## 5.2.7 Roughly aligning the machine

### Requirement

The transmission element such as a coupling half has already been pulled on.

### Roughly aligning the machine

- For horizontal positioning, push the motor sideways across the foundation. When doing so, ensure that the axial position is maintained.

## 5.3 Installing the machine

### 5.3.1 Preconditions for smooth, vibration-free operation

Preconditions for smooth, vibration-free operation:

- Stable foundation design as per DIN 4024
- Precise alignment of the machine
- Correct balancing of parts to be fitted to the shaft end.
- Maintaining the vibration velocity according to ISO 10816-3

## 5.3.2 Aligning the machine to the driven machine and mounting

### 5.3.2.1 Horizontal types of construction with mounting feet

1. Refer to any instructions for aligning the driven machine and those of the coupling manufacturer.
2. Align the machines with coupling output to the driven machine in such a manner that the center lines of the shafts are parallel with no offset. This ensures that no additional forces affect their bearings during operation.
3. For the vertical positioning ( $x \rightarrow 0$ ) place thin shims under the machine feet. The number of shims should be kept as low as possible, i.e. stack as few as possible. This also prevents the machine being subjected to any stress/distortion. If available, use the existing tapped holes for the forcing-off bolts to somewhat raise the machine.
4. When positioning the machine, ensure that a uniform axial gap ( $y \rightarrow 0$ ) is maintained around the coupling.
5. Fix the machine to the foundation. The choice of fixing elements depends on the foundation and is the plant operator's responsibility.

---

#### Note

##### Machine expansion

When aligning, make allowance for the thermal expansion of the machine when the temperature increases.

---

### 5.3.2.2 Horizontal types of construction with flange

The standard flange is provided with a centering. The choice of fit for the mating flange on the driven machine is the system manufacturer's or the plant operator's responsibility.

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#### Note

If the machine is not fitted with a standard flange, align the machine to suit the driven machine.

---

## Procedure

The machine axis must be horizontal when it is lifted and the flange must be parallel to the mating flange, so as to avoid seizing and stressing. Otherwise damage to the centering will result.

1. Grease the centering flange with assembly paste to make the process easier.
2. Screw three studs into tapped holes spaced about  $120^\circ$  apart around the driven machine flange. The studs act as positioning aids.
3. Position the machine so that its axis is aligned with that of the driven machine, but not yet quite touching. Advance the machine slowly towards the driven machine; advancing too quickly risks damaging the centering.

4. If necessary, rotate the machine into the right position so that the clearance holes in the flange are central to the tapped holes.
5. Move the machine fully up against the mating flange so that it is fully in contact.
6. Fix the machine using the flange fixing bolts, finishing by replacing the studs.

### 5.3.2.3 Vertical types of construction with flange

The standard flange is provided with a centering. The choice of fit for the mating flange on the driven machine is the system manufacturer's or the plant operator's responsibility.

---

#### Note

If the machine is not fitted with a standard flange, align the machine to suit the driven machine.

---

### Procedure

The machine axis must be vertical when it is lifted and the flange must be parallel to the mating flange, so as to avoid seizing and stressing. Otherwise damage to the centering will result.

1. Grease the centering flange with assembly paste to make the process easier.
2. Screw in two studs into tapped holes on opposite sides of the driven machine flange. The studs act as positioning aids.
3. Lower the machine slowly toward the driven machine and into the centering, so that the flanges do not quite touch. Lowering too quickly risks damaging the centering.
4. If necessary, rotate the machine into the right position so that the clearance holes in the flange are central to the tapped holes.
5. Lower the machine completely onto the mating flange so that it is fully in contact; then remove the studs.
6. Fix the machine using the flange fixing bolts.

### 5.3.3 Alignment accuracy

The alignment accuracy required depends essentially on the configuration of the overall machine train. Observe the required alignment accuracy of the coupling manufacturer in all cases when aligning the machine.

Table 5-1 Recommended alignment accuracy

Speed [rpm]	Parallel offset [mm]	Angular offset [mm per 100 mm coupling diameter]
750	0.09	0.09
1500	0.06	0.05
3000	0.03	0.025

### 5.3.4 Axial and radial forces

You can obtain the permissible values for axial and radial forces by contacting the Siemens Service Center or referring to the machine catalog.

<b>NOTICE</b>
<b>Damage to bearings or the shaft</b>
Large output masses and their centers of gravity outside the shaft extensions can lead to resonance in operation. This can result in damage to the bearings and shaft.
Ensure that the permissible loads for the forces on the shaft extension are adhered to in accordance with the catalog data or configuration data.

## 5.4 Cooling water supply for machines with water cooling

Seen from the shaft extension, connection of the water is possible from the right and from the left.

<b>NOTICE</b>
<b>Cooling water connection pipe</b>
If the cooling water cannot flow freely, the machine will not be cooled properly. The machine will overheat, which could result in material damage or even a write-off.
<ul style="list-style-type: none"><li>• Remove the flange cover plate.</li><li>• Insert the gaskets correctly.</li></ul>

- Remove the flange cover plate.
- Insert the gaskets correctly.

1. For the pipes, select materials with the required chemical composition in accordance with the water conditions. Also consider the pressure load and compatibility with the materials from which the cooler is made.
2. Route and support the water pipes so that the connecting flanges are not exposed to excessive stress or strain or vibration loads.
3. Rinse out the water circuit before you connect the cooling water supply to the motor. This removes deposits and foreign bodies so that they cannot make their way into the cooling circuit.
4. Should there be a possibility of the cooling water containing dirt and foreign bodies, install suitable filters in the cooling-water feed pipe.
5. Connect the cooling circuit to the machine.

**Filling the cooling circuit**

1. Fill the cooling circuit with water until the air is completely forced out of the cooling circuit.
2. Perform a pressure check to see whether the cooling water supply is airtight. In doing so, do not exceed the maximum test pressure. The maximum permissible pressure can be found on the rating plate.

If you do not then put the machine into operation, you must implement the measures necessary during stoppages.

**NOTICE****Bleed air from the cooling ducts**

If the cooling ducts are not completely filled with water, sufficient machine cooling cannot be guaranteed and the machine may overheat.

Ensure that the air is bled from the cooling ducts during filling and that the cooling ducts are completely filled with water.



## Electrical connection

When carrying out any work on the machine, observe the general safety instructions (Page 13) and the specifications contained in EN 50110-1 regarding safe operation on electrical equipment.

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### Note

#### Service Center

If you require support when electrically connecting up the machine, please contact the Service Center (Page 125).

---



### WARNING

#### Connected parts can loosen

If you use fixing elements made from the wrong material or apply the wrong tightening torque, this could impair current transfer or cause connecting parts to become loose. Fastening elements can work loosely, so that the minimum air clearances are no longer maintained. Sparking formation may occur, in an explosive atmosphere it can lead to an explosion. This could result in death, serious injury or material damage to the machine or even in failure, which could in turn lead indirectly to material failure of the system.

- Tighten the screwed connections to the specified tightening torques.
- Observe any specifications regarding the materials from which fixing elements must be made.
- When performing servicing, check the fastenings.

## 6.1 Preparation

### 6.1.1 Selecting cables

Take the following criteria into account when selecting the connecting cables:

- Rated current
- Rated voltage
- If required, service factor
- System-dependent conditions, such as ambient temperature, routing type, cable cross-section as defined by required length of cable, etc.

## 6.2 Connecting

- Requirements according to IEC/EN 60204-1
- Requirements according to IEC/EN 60079-14 when used in Zones 1, 2 or 21, 22
- Configuration notes

## 6.2 Connecting

### 6.2.1 Installing intrinsically safe circuits

Make sure that there is potential equalization along the entire length of the intrinsically safe power circuit when intrinsically safe circuits are set up.

A stranded wire is used as the potential equalizing cable. A copper braided strip is used to ensure potential equalization between the cable entry plate and the terminal box enclosure.

Table 6-1 **Electrical data**

Non-intrinsically safe power circuit $U_m = 700$ V alternating voltage		
Intrinsically safe power circuit in "fail-safe" type of protection		
	Ex ib IIB/IIC, only connected to certified intrinsically safe circuits that are galvanically isolated from ground. Maximum values for total:	
	<b>IIB</b>	<b>IIC</b>
e.g. at T4:	$U_i = 28$ V	$U_i = 24$ V
	$I_i = 300$ mA	$I_i = 170$ mA
	$P_i = 1,3$ W	$P_i = 1,3$ W
	The effective internal inductance and capacitance are negligibly small.	

The intrinsically safe circuits are safely galvanically isolated from all non-intrinsically safe circuits up to a peak value for the rated voltage of 1000 V. Please refer to the additional plate on the machine for the maximum values for "intrinsically safe power circuits".



### 6.2.2 Terminal boxes with type of protection "Ex d"

With terminal boxes of protection type "Ex d", the type and size of the cable entry threads and the type of protection are specified on the terminal box.



#### WARNING

**No cable or line entries, piping systems, or simple designs of sealing plug may be used on terminal boxes with the "Ex d" type of protection as the explosion protection type is no longer guaranteed.**

An explosion can result. This can result in death, serious injury or material damage.

Use only cable entries with type of protection "Ex d", that have been tested and certified in accordance with IEC / EN 60079-1 .



#### WARNING

**Special threads are closed with non-certified closures on delivery; this means that the type of protection is no longer guaranteed.**

An explosion may occur during operation. This can result in death, serious injury or material damage.

Replace the closures with cable entries that have been tested and certified in accordance with IEC / EN 60079-1.

### 6.2.3 Terminal boxes with type of protection "Ex e"



#### WARNING

**If the seal of the pressure relief flap (preset breaking point) in the lower section of the terminal box is damaged, then the explosion type of protection is no longer guaranteed.**

An explosion may occur during operation. This can result in death, serious injury or material damage.

The damaged seal may only be repaired with original sealing material.

**WARNING**

**No cable or line entries or simple designs of sealing plug may be used on terminal boxes with the "Ex e" type of protection.**

An explosion may occur during operation. This can result in death, serious injury or material damage.

- Use only cable entries that have been tested and certified in accordance with IEC / EN 60079-7 .
- Use only sealing plugs that have been tested and certified in accordance with IEC / EN 60079-7 to close openings that are not to be used.

**CAUTION**

**Working on terminal boxes of the "Ex e" type of protection with undrilled cable entry plate**

This can result in death, serious injury or material damage.

Ensure that the cable entry plate is still strong enough after drilling the threads.

### 6.2.4 Connecting the grounding conductor

The cross-section of the machine grounding conductor must comply with the installation regulations and also with IEC / EN 60204-1.

Table 6-2 Determining the cross-section of the grounding conductor

External cable cross-section S	Cross-section of the grounding conductor [mm <sup>2</sup> ]
$S \leq 16 \text{ mm}^2$	S
$16 \text{ mm}^2 < S \leq 35 \text{ mm}^2$	16 mm <sup>2</sup>
$S > 35 \text{ mm}^2$	S/2

A terminal strip for grounding is fitted either on the stator casing or on the flanged endshield, depending on the frame size. The grounding point is marked.

The terminal strip is suitable for connecting stranded cables with cable lugs or connecting flat straps. In addition, all motors have a PE terminal within the terminal box.

When connecting up the grounding conductor, ensure that the contact surface of the connection is bare and protected against corrosion using a suitable agent, e.g. with acid-free Vaseline.

### 6.2.5 Circuit diagram in the terminal box cover

Data on the connection and connecting the motor winding can be found in the circuit diagram in the cover of the terminal box.

## 6.2.6 Terminal designation

According to IEC / EN 60034-8, the following basic definitions apply to the terminal designations for 3-phase machines:

Table 6-3 Terminal designations using the 1U1-1 as an example

1	U	1	-	1	Designation
x					Index for pole assignment for pole-changing machines where applicable. A lower index signifies a lower speed. Special case for split winding.
	x				Phase designation U, V, W
		x			Index for winding start (1) or end (2) or if there is more than one connection per winding
				x	Additional indices for cases in which it is obligatory to connect parallel power feed cables to several terminals with otherwise identical designations

## 6.2.7 Connecting the machine for a specific direction of rotation

If the machine has one shaft extension or two shaft extensions with different diameters, the direction of rotation when looking at the front of the single or the thicker shaft extension is defined as follows:

- If you are connecting power supply cords with a phase sequence of L1, L2, L3 at U, V, W, the resulting rotation will be clockwise.
- If you transpose two connections, e.g. L1, L2, L3 at V, U, W, the resulting rotation will be counter-clockwise.

Machines which must run only in one specific direction of rotation are marked with a direction of rotation arrow.

## 6.2.8 Terminal box

- The number and size of the cable entry tapped holes can be found in the machine dimension drawing.
- Only use cable entries that are suitable for the cable.
- Only use suitable cable entries and cables for the prevailing ambient temperature.
- Check the cable glands and cables to ensure that they are correctly sealed and firmly seated.
- Correctly close and seal threads or holes that are not being used ensuring that the IP degree of protection is maintained. The IP degree of protection is specified on the rating plate.

**Please note the following points for explosion-protected machines:**

- Replace the cable glands that are not being used by appropriately certified screw plugs.
- If you are using cable glands, use only appropriately certified cable glands with strain relief. Comply with the installation and operation conditions specified in the certificate for these cable glands and check that they have been fully complied with.

**Note****Undrilled entry plate**

If the entry plate is undrilled, you should match the number and size of the cable glands to the operating conditions. Not applicable for terminal boxes of the Ex d type of protection.

1. Unscrew the cable entry plate.
2. Drill the required number of holes or threads in the required size into the cable entry plate. The thickness of the plate is selected in such a way as to give a sufficient number of turns when the holes are tapped.  
Please note that you are responsible for ensuring that the entry plate still has sufficient strength after the holes have been drilled and tapped.
3. Mount the cable entry plate and the cables with the cable glands onto the terminal box.  
**After the cables have been inserted** into the terminal box, tighten the cable glands and parts for strain relief to the torque specified by the manufacturer.
4. Seal the screwed sockets on the cable glands in accordance with the degree of protection.

Use only sealing plugs, cable entries and conductor entries, that are certified and marked for use in the respective hazardous area (the zone).

### 6.2.9 Minimum air clearances

After proper installation, verify that the minimum air clearances between non-insulated parts are maintained. Be aware of any protruding wire ends.

Table 6-4 Minimum air clearance dependent on rms value of the alternating voltage  $U_{rms}$

Rms value of the alternating voltage $V_{rms}$	Minimum air clearance
$\leq 500 \text{ V}$	8 mm
$\leq 630 \text{ V}$	10 mm
$\leq 800 \text{ V}$	12 mm
$\leq 1000 \text{ V}$	14 mm

Values apply at an installation altitude of up to 2000 m.

When determining the required minimum air clearance, the voltage value in the table may be increased by a factor of 1.1, so that the rated input voltage range is taken into account during general use.

### 6.2.10 Cable ends with wire end sleeves

Preferably use end sleeves instead of soldering cable ends. Before connecting, correctly clamp the end sleeve onto the cable to establish a connection capable of conducting current.



#### WARNING

##### Securely and reliably clamping and enclosing the end of the conductor

If the end of the conductor is not correctly enclosed by the end sleeve, but is clamped together with it, then this can lead to overheating. The temperature class of the machine can be exceeded. This can trigger ignition of an explosive mixture. This can result in death, serious injury or material damage.

- Insert only one conductor end into each end sleeve. Attach the end sleeve correctly.

### 6.2.11 Connection with terminal board

Note that for terminal boards with U-shaped terminal clamps, the conductors to be connected must be placed under the terminal clamps in a U shape. Alternatively, with multi-stranded and finely-stranded conductors, evenly divide the conductor (into two parts) and lay in a straight line under the U-shaped terminal clamps. See sketch!

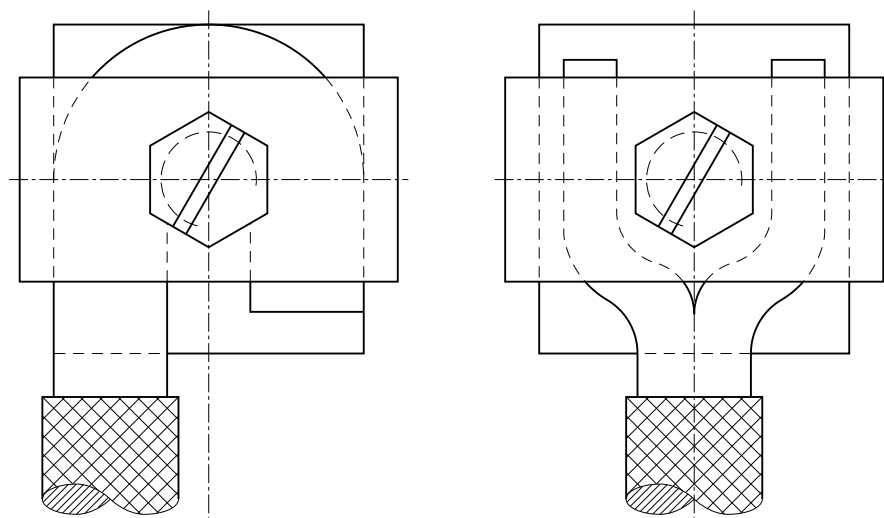
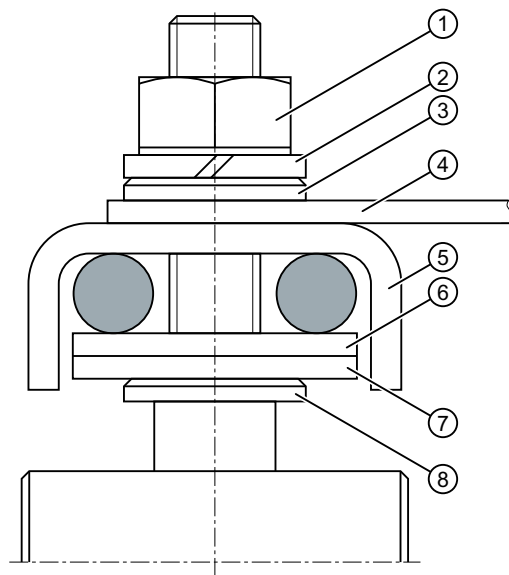


Figure 6-1 Conductor connection

## 6.2 Connecting



- 1 Hexagonal nut – DIN934
- 2 Spring washer – DIN128
- 3 or alternatively a spacer washer – DIN125 Cu (for a star connection)
- 4 alternatively a circuit connection
- 5 Terminal clamp
- 6 alternatively a spacer washer Cu
- 7 Angled cable lug
- 8 Washer – DIN125 St

Figure 6-2 Conductor connection

### 6.2.12 Tightening torques for cable glands

- Tighten the cable gland and the parts of terminal box intended to act as a strain relief to the appropriate torque as specified by the manufacturer after inserting the feeder cables. The tightening torques depend on the cable gland used and the cable or wire used.
- Tighten the standard cable glands supplied with the motor in accordance with the following table.

Table 6-5 Tightening torques for standard cable glands [Nm]

Nominal size	Cable gland for Ex e II Type HSK-M		Cable gland for Ex e / Ex d IIC Type ADE 1F, ADE 4F R... / B...	
	Union nut	Connection thread	Union nut / connection thread	Union nut / connection thread
M12 x 1.5	5	7	7.5	-
M16 x 1.5	5	7	12.5	17

Nominal size	Cable gland for Ex e II Type HSK-M		Cable gland for Ex e / Ex d IIC Type ADE 1F, ADE 4F R... / B...	
	Union nut	Connection thread	Union nut / connection thread	Union nut / connection thread
M20 x 1.5	5	7	20	23
M25 x 1.5	7	10	30	29
M32 x 1.5	7	10	55	33
M40 x 1.5	7	10	75	41
M50 x 1.5	7	10	100	50
M63 x 1.5	7	10	135	75
M75 x 1.5	-	-	175	100

### 6.2.13 Connecting aluminum conductors

If you are using aluminum conductors, comply in addition with the following:

- Use only cable lugs that are suitable for connecting aluminum conductors.
- Immediately before inserting the aluminum conductor, remove the oxide layer from the contact areas on the conductor and/or the mating piece, by brushing or filing.
- Then grease the contact areas immediately using neutral vaseline in order to avoid re-oxidation.

#### NOTICE

##### Aluminum flow due to contact pressure

Aluminum flows following installation due to the contact pressure. The connection with the clamping nuts can loosen as a result. The contact resistance would increase and the current-carrying impeded; as a consequence the terminal box and the surrounding components could burn. This could result in material damage to the machine or even in total failure, which could in turn lead to indirect material damage to the system.

Retighten the clamping nuts after approximately 24 hours and then again after approximately four weeks. Make sure that the terminals are de-energized before you tighten the nuts.

### 6.2.14 O-ring seal

If O-ring seals are present, you should check that they are in perfect condition and that the O-ring seals are properly seated in the grooves between the components. Replace any damaged O-ring seals.

O-ring seals can be present on the following components, for instance:

- Tapers
- Cable glands
- Bearing seals

## 6.2 Connecting

- Bearing plate seals
- Terminal box seals
- Cable glands
- etc.

### 6.2.15 Finishing connection work

1. Before closing the terminal box, please check that:
  - The electrical connections in the terminal box are tight and in full compliance with the specifications above
  - The motor is connected so that it rotates in the direction specified
  - The inside of the terminal box is clean and free of any cable debris
  - All gaskets and seals are intact
  - Unused **cable glands** must be replaced with certified closures or closed with other suitable closure types. Comply with the installation and operation conditions specified in the certificate for these plug elements and check that they have been complied with.
  - The pressure relief device is intact Depending on the type of terminal box being used, the pressure relief device can be implemented either by sealing the slots or by using a pressure relief diaphragm.



#### **WARNING**

##### **Damaged pressure relief device**

Water and foreign bodies can penetrate the enclosure if the pressure relief device is damaged: The degree of protection of the terminal box is no longer guaranteed, a short-circuit can occur, which can result in death, serious injury or material damage.

- Do not operate the machine with a damaged pressure relief device.
- Any damage may only be repaired after prior discussion with the person responsible for the safety of the plant or system and only using original parts. Any damage may only be repaired after prior discussion with the person responsible for the safety of the installation and only by using original parts.

2. Close the terminal box.  
See section "Tightening torques for screw and bolt connections (Page 127)" for the tightening torque of the fixing bolts for the cover.

### 6.2.16 Internal equipotential bonding

The equipotential bonding between the ground terminal in the terminal box enclosure and the motor frame is established via the terminal box metallic contact faces. The contact faces are protected against corrosion.



The equipotential bonding is achieved by means of a stranded wire. A copper braided strip, a stranded wire or a metal contact is used to ensure potential equalization between the cable entry plate and the terminal box enclosure.



# Commissioning

When carrying out any work on the machine, observe the general safety instructions (Page 13) and the specifications contained in EN 50110-1 regarding safe operation on electrical equipment.

## 7.1 Checks to be carried out prior to commissioning

Once the system has been correctly installed, you should check the following prior to commissioning:

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### Note

#### Checks to be carried out prior to commissioning

The following list of checks to be performed prior to commissioning does not claim to be complete. It may be necessary to perform further checks and tests in accordance with the specific situation on-site.

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- The machine is undamaged.
- The machine has been correctly installed and aligned, the transmission elements are correctly balanced and adjusted.
- All fixing screws, connection elements, and electrical connections have been tightened to the specified tightening torques.
- The operating conditions match the data provided in accordance with the technical documentation, such as degree of protection, ambient temperature, etc..
- Moving parts such as the coupling move freely.
- If the second shaft extension is not in use, its feather key is secured to prevent it from being thrown out, and cut back to roughly half its length if the rotor has balancing type "H" (standard type).
- All touch protection measures for moving and live parts have been taken.



### WARNING

**If the openly accessible shaft sealing rings are damaged, the degree of protection is at risk.**  
This can result in death, serious injury, or material damage.  
Replace damaged components immediately.

*7.1 Checks to be carried out prior to commissioning*

- The rotor can spin without coming into contact with the stator.
- The bearing insulation is not bridged.
- Appropriately configured control and speed monitoring functions ensure that the permissible speeds specified on the rating plate cannot be exceeded.
- Any supplementary motor monitoring devices and equipment have been correctly connected and are fully functional.

**Force-ventilated motors**

- All external fans fitted are ready for operation and have been connected so that they rotate in the direction specified.
- The flow of cooling air is not impeded.

**Motors with water jacket cooling**

- Make sure that the cooling-water circuit functions correctly before you commission the water-cooled machine.
- Do not switch the machine on until the cooling-water circuit is in operation. Ensure that the cooling-water circuit remains in operation until the machine has come to a complete standstill.
- Optionally, depending on the order, the motor has PTC thermistors that switch off the motor when the cooling-water circuit fails.
- The openings for the inlet and outlet are at the motor enclosure.
- Vent plugs are optionally provided for the water chamber at the frame. Vent the water chamber when filling for the first time and at regular intervals.
- Use only clean, non-aggressive cooling water with a maximum sediment content of 10 mg/l.
- In order to avoid the increased formation of condensation, make sure that the inlet temperature of the cooling water is at least 20° C.
- Refer to the plates on the machine for the permissible inlet and outlet temperatures, the maximum pressure and the required amount of cooling water.
- If you operate the machine with a cooling-water temperature below 0° C, antifreeze must be added to the water because of the reduced cooling effect. You must contact the Service Center.

**Electrical connection**

- The grounding and equipotential bonding connections have been made correctly.
- The machine is connected so that it rotates in the direction specified.

- Appropriately configured control and speed monitoring functions ensure that the motor cannot exceed the permissible speeds specified in the technical data. For this purpose, compare the data on the rating plate or, if necessary, the system-specific documentation.
- The minimum insulation resistance values are within tolerance.
- Minimum air clearances have been maintained.
- Any supplementary motor monitoring devices and equipment have been correctly connected and are functioning correctly.
- All brakes and backstops are operating correctly.
- At the monitoring devices, the values for "Warning" and "Shutdown" are set.

#### Converter operation

- If the design of the motor requires connection to a particular converter type, the rating plate will contain corresponding additional information.
- The converter is correctly parameterized. The parameterization data is specified on the rating plate of the machine. Information about the parameters is available in the operating instructions for the converter.
- The specified limit speed  $n_{\max}$  is not exceeded. Limit speed  $n_{\min}$  is not fallen below.

## 7.2 Insulation resistance and polarization index

Measuring the insulation resistance and polarization index (PI) provides information on the condition of the machine. It is therefore important to check the insulation resistance and the polarization index at the following times:

- Before starting up a machine for the first time
- After an extended period in storage or downtime
- Within the scope of maintenance work

The following information is provided regarding the state of the winding insulation:

- Is the winding head insulation conductively contaminated?
- Has the winding insulation absorbed moisture?

As such, you can determine whether the machine needs commissioning or any necessary measures such as cleaning and/or drying the winding:

- Can the machine be put into operation?
- Must the windings be cleaned or dried?

Detailed information on testing and the limit values can be found here:

"Testing the insulation resistance and polarization index"

## 7.3 Testing the insulation resistance and polarization index



### WARNING

#### Hazardous voltage at the terminals

During and immediately after measuring the insulation resistance or the polarization index (PI) of the stator winding, hazardous voltages may be present at some of the terminals. Contact with these can result in death, serious injury or material damage.

- If any power cables are connected, check to make sure line supply voltage cannot be delivered.
- Discharge the winding after measurement until the risk is eliminated, e.g. using the following measures:
  - Connecting the terminals with ground potential until the recharge voltage drops to a non-hazardous level
  - Connecting the connecting cable

### Measure the insulation resistance

1. Before you begin measuring the insulation resistance, please read the manual for the insulation resistance meter you are going to use.
2. Make sure that no power cables are connected.
3. Measure the insulation resistance of the winding in relation to the machine enclosure and the winding temperature. The winding temperature should not exceed 40° C during the measurement. Convert the measured insulation resistances to the reference temperature of 40° C according to the formula in the following table. This thereby ensures that the minimum values specified can be compared.
4. Read out the insulation resistance one minute after applying the measuring voltage.

### Measuring the polarization index

1. To determine the polarization index, measure the insulation resistances after one minute and ten minutes.
2. Express the measured values as a ratio:  

$$PI = R_{\text{insul } 10 \text{ min}} / R_{\text{insul } 1 \text{ min}}$$
 Modern measuring devices display these values automatically following the measurement.

### Limit values for insulation resistance and polarization index of the stator winding

The following table shows the measuring voltage and limit values for the insulation resistance and polarization index. These values correspond to the recommendations of IEEE 43-2000.

## 7.3 Testing the insulation resistance and polarization index

In addition, a critical insulation resistance is specified for the stator winding, which is the minimum requirement for further operation, e.g. following longer machine downtimes.

Table 7-1 Stator winding insulation resistance at 40° C

$U_{\text{rated}}$ [V]	$U_{\text{meas}}$ [V]	$R_C$ [MΩ]	$R_{C, \text{operation}}$ [MΩ]	$R_T$ [MΩ]	PI
$U \leq 1000$	500	$\geq 5$	0.2 MΩ/kV ( $\approx 0.5$ MΩ/kV at 25° C)	$R_T = \frac{R_C}{0,5^{(40-T)/10}}$	$> 2,0$
$1000 \leq U \leq 2500$	500 (max. 1000)	100	1.8 MΩ/kV ( $\approx 5$ MΩ/kV at 25° C)		
$2500 < U \leq 5000$	1000 (max. 2500)				
$5000 < U \leq 12000$	2500 (max. 5000)				
$U > 12000$	5000 (max. 10000)				

$U_{\text{rated}}$  = rated voltage, see the rating plate

$U_{\text{meas}}$  = DC measuring voltage

$R_C$  = critical or minimum insulation resistance at reference temperature of 40° C

$R_C$  = minimum insulation resistance after cleaning/repair at 40° C

$R_{C, \text{operation}}$  = critical insulation resistance during operation at 40° C

$R_T$  = insulation resistance converted to current measuring/winding temperature

PI = polarization index  $R_{\text{insul } 10 \text{ min}} / R_{\text{insul } 1 \text{ min.}}$  ( $T \leq 40^\circ \text{ C}$ )

T = current measuring/winding temperature

**Note the following:**

- When making measurements at winding temperatures other than 40 °C, the measured value must be converted to the reference temperature of 40 °C. The conversion is made using the formula from IEEE 43-2000 specified in the table. In so doing, doubling or halving the insulation resistance for a temperature change of 10 K is used as basis.
  - The insulation resistance halves every time the temperature rises by 10 K.
  - The resistance doubles every time the temperature falls by 10 K.
- Dry, new windings have insulation resistance of between 100 and 2000 MΩ, or possibly even higher values. Insulation resistance close to the minimum value could be due to humidity and/or dirt accumulation. However, the size of the winding, the rated voltage and other characteristics affect the insulation resistance and may need to be taken into account when determining measures.
- Over its operating lifetime, the motor winding insulation resistance can drop due to ambient and operational influences. Depending on the rated voltage, the critical insulation resistance value is to be calculated by multiplying the rated voltage (kV) by the specific critical resistance value and then converted to the current winding temperature at the time of the measurement, see previous table.

**Example calculation**

Critical resistance for a rated voltage ( $V_N$ ) of 3.3 kV:

$$3.3 \text{ kV} \times 1.8 \text{ M}\Omega / \text{kV} = 6 \text{ M}\Omega \text{ at } 40^\circ \text{ C}$$

### 7.3 Testing the insulation resistance and polarization index

A winding temperature of  $T = 25^{\circ}\text{C}$  during the measurement, results in a critical insulation resistance of  $16.5\text{ M}\Omega$ .

<b>NOTICE</b>
<b>Damage to insulation</b> If the critical insulation resistance is reached or undershot, this can damage the insulation and cause voltage flashovers. <ul style="list-style-type: none"><li>• Contact the Service Center.</li><li>• If the measured value is close to the critical value, you must subsequently check the insulation resistance at shorter intervals.</li></ul>



### See also

Insulation resistance and polarization index (Page 35)

### Limit values of the anti-condensation heating insulation resistance

The insulation resistance of the anti-condensation heating with respect to the machine housing should not be lower than  $1\text{ M}\Omega$  when measured at  $500\text{ V DC}$ .



When carrying out any work on the machine, observe the general safety instructions (Page 13) and the specifications contained in EN 50110-1 regarding safe operation on electrical equipment.

## 8.1 Safety instructions during operation



### WARNING

#### All terminal boxes must be closed

Terminal boxes contain live electrical parts. Death, serious injury or material damage can result if terminal box covers are removed.

When the machine is in operation, the terminal boxes must remain closed at all times. Terminal boxes may be opened only when the machine is stopped and de-energized.



### WARNING

#### Do not remove covers when the motor is running

Rotating or live parts are dangerous. Death, serious injury or material damage can result if the required covers are removed.

Any covers that prevent live electrical or rotating parts from being touched, or that ensure compliance with a particular degree of protection or are required for ensuring proper air flows, and hence effective cooling, must not be opened during operation.



### WARNING

#### Faults in operation

Deviations from normal operation such as increased power consumption, temperatures or vibrations, unusual noises or odors, tripping of monitoring devices, etc., indicate that the machine is not functioning properly. This can cause faults which can result in eventual or immediate death, serious injury or material damage.

- Immediately inform the maintenance personnel.
- If you are in doubt, immediately switch off the motor, being sure to observe the system-specific safety conditions!



**CAUTION**

**Fire hazard**

Certain parts of the motor may reach temperatures above 50° C. Touching them can result in burns.

- Check the temperature of the parts before touching them and take appropriate protective measures if necessary.



**CAUTION**

**Terminal boxes with current transformers**

If you are using current transformers, make sure that the secondary circuit from the current transformer is protected against unintentional opening while the equipment is in use.



**DANGER**

**Explosion hazard if the bridging is removed from the insulated bearing**

Removing the factory-fitted bridging of the insulated bearing leads to potential differences between the rotor and the grounded motor. This can cause the generation of sparks, which especially in an explosive atmosphere can ignite surrounding dust or combustible gases. Explosions can occur. There is also a risk of an electric shock. Death, serious injury, or material damage will result.

Do not open the bridging of the bearing insulation during operation.

**NOTICE**

**Excessive machine temperature**

If the anti-condensation heating is operated while the machine is running, this can increase the temperatures inside the machine. This can result in material damage.

- Make sure that the anti-condensation heating is switched off before the machine is switched on.
- Only operate anti-condensation heating when the machine is switched off.

## **8.2 Switching on the machine**

1. If at all possible, run the machine without load and check that it is running smoothly.  
Maximum number of permissible consecutive starts for machines on the power supply:  
Three cold / two warm  
The start conditions for converter machines can be found in the catalog.
2. If it runs perfectly, connect a load.
3. If this is possible using the available measuring equipment, check the bearing and stator winding temperatures.

## **8.3 Switching off the external fan**

If the controller does not switch off the external fan automatically, switch it off when the machine is stopped.

## **8.4 Switching off the water-cooling system**

If the controller does not switch off the air-to-water heat exchanger automatically, switch it off when the machine is stopped.

## **8.5 Switching on again after an emergency switching-off**

- Check the motor before restarting the driven machine after an emergency off.
- Eliminate all the causes that have led to the emergency off

## **8.6 Stoppages**

The stoppage is a shutdown for a period of time, during which the machine is stopped but remains at the location of use.

Under normal ambient conditions, e. g. the stopped machine is not exposed to any vibration, no increased level of corrosion, etc. in general, the following measures are necessary during stoppages.

### **8.6.1 Switching on the anti-condensation heater**

If the machine has anti-condensation heating, then switch it on when the machine is not in operation.

**WARNING****Explosion hazard**

If the anti-condensation heating is switched on directly after the machine is switched off, the temperature class or the maximum surface temperature of the machine can be exceeded.

In an explosive atmosphere, there is a risk of an explosion. This can result in death, serious injury or material damage.

Do not switch on the anti-condensation heating for at least one hour after the motor has been switched off.

### 8.6.2 Avoidance of frost and corrosion damage in the cooling system

- For avoidance of frost and corrosion damage, completely drain the water from the cooling system. Then blow air through the cooling system to dry it.  
If the cooling system cannot be drained because standby capability is required at short notice, protect the cooling circuit against frost and corrosion damage. To do this, add suitable additives to the cooling water.

**NOTICE****Impairment of the heat transport**

Additives such as anti-freeze and corrosive inhibitor can impair the heat transport.

Operate the motor only with the contractually agreed water quality.

For avoidance of deposits, the cooling water circuit must then be kept running. So as to be certain of excluding the possibility of formation of condensation within the machine, the anti-condensation heating should also remain switched on (if fitted).

### 8.6.3 Avoidance of damage to roller bearings during stoppages

Extended stoppages at the identical or almost identical resting position of the roller bearings can lead to damage such as brinelling or formation of corrosion.

- During stoppages, regularly start the machine up for a brief period once a month, or at least turn the rotor over several times.  
If you have uncoupled the machine from the driven machine and secured the rotor with a rotor shipping brace, then remove this before turning the rotor over or starting the machine up.  
Make sure that the resting position of the roller bearings after the rotor has been turned over is different from what it previously had been. Use the fitted key or the coupling halves as reference markers.
- During re-commissioning, refer to the information in the "Commissioning" section.

## 8.7 Decommissioning the machine

<b>NOTICE</b>
<b>Damage as a result of an extended period out of service</b>
If the machine is going to be out of service for longer than six months, then take the necessary measures for preservation and storing. Otherwise damage to the machine will result.

Record the decommissioning steps. This log will be useful upon recommissioning.

## 8.8 Re-commissioning the machine

When you re-commission the machine, proceed as follows:

- Study the record made when the machine was decommissioned, and reverse the measures that were taken for conservation and storage.
- Perform the measures listed in the "Commissioning" section.

## 8.9 Faults

### 8.9.1 Inspections in the event of faults

Natural disasters or unusual operating conditions, such as overloading or short circuit, are faults that overload the machine electrically or mechanically.

Immediately perform an inspection after such faults.

Correct the cause of the fault as described in the respective remedial measures section. Repair any damage to the machine.

### 8.9.2 Electrical faults

<b>Note</b>
If you are operating the motor with a converter, the operating instructions of the converter must also be observed if electrical faults occur.

Table 8-1 Electrical faults

↓ Motor fails to start								
↓ Motor accelerates sluggishly								
↓ Rumbling noise during startup								
↓ Rumbling noise during operation								
↓ High temperature rise during no-load operation								
↓ High temperature rise with load								
↓ High temperature rise of individual winding sections								
						Possible causes of faults	Remedial measures	
X	X		X		X	Overload		Reduce the load.
X						Interrupted phase in the supply cable		Check the switches and cables.
	X	X	X		X	Interrupted phase in the feeder cable after switching on		Check the switches and cables.
	X					Mains voltage too low, frequency too high		Check the power supply conditions.
				X		Mains voltage too high, frequency too low		Check the power supply conditions.
X	X	X	X			X	Stator winding incorrectly connected	Check the winding connection in the terminal box.
	X	X	X			X	Winding short circuit or phase short circuit in stator winding	Determine the winding resistances and insulation resistances. Carry out repair work <b>after consultation with the manufacturer</b> .
					X		Incorrect direction of rotation	Check the connection.

### 8.9.3 Mechanical faults

Table 8-2 Mechanical faults

↓ Grinding noise				
↓ Radial vibrations				
↓ Axial vibrations				
Possible causes of faults				Remedial measures
X			Rotating parts grind	Establish the cause and realign the parts.
	X		Stator or coupling not balanced.	Disconnect the stator or coupling and rebalance.  If the machine has two shaft ends, and a transmission element is only fitted to one end, secure the fitted key at the other end to prevent it from being thrown out. If the rotor has balance type "H" (standard type), the fitted key must be cut back to roughly half of its length.
	X		Rotor out of true, shaft bent	Consult the manufacturing plant.
	X	X	Poor alignment	Align the machine set; check the coupling. <sup>(1)</sup>
	X		Coupled machine not balanced	Rebalance the coupled machine.
		X	Shocks from coupled machine	Investigate the coupled machine.
	X	X	Uneven running of gear unit	Fix the gearing.
	X	X	Resonance of the overall system comprising motor and foundation	Stabilize the foundation following consultation.

↓ Grinding noise				
	↓ Radial vibrations			
		↓ Axial vibrations		
		Possible causes of faults	Remedial measures	
	X	X	Changes in foundation	Establish the cause of the changes and eliminate them if necessary; realign the machine.
<sup>(1)</sup> Take any changes into account when warming up the machine.				

### 8.9.4 Roller bearing faults

#### Note

Damage to roller bearings can be difficult to detect in some cases. If in doubt, replace the bearing. Use other bearing designs only **after consulting the manufacturer**.

Table 8-3 Roller bearing faults

↓ Bearing overheats				
	↓ Bearing "whistles"			
		↓ Bearing "knocks"		
		Possible causes of faults	Remedial measures	
X			High coupling pressure	Align the machine more accurately.
X			Belt tension too high	Reduce the drive belt tension.
X			Bearing contaminated	Clean the bearing or replace it. Check the seals.
X			High ambient temperature	Use a suitable high-temperature grease.
X	X		Insufficient lubrication	Grease the bearings as instructed.
X	X		Bearing canted	Properly install the bearing.
X	X		Insufficient bearing play	<b>Only after consultation with the manufacturer:</b> Fit a bearing with greater play.
		X	Excessive bearing play	<b>Only after consultation with the manufacturer:</b> Fit a bearing with lower play.
X	X		Bearing corroded	Replace the bearing. Check the seals.
X			Too much grease in bearing	Remove surplus grease.
X			Wrong grease in the bearing	Use the correct grease.
		X	Friction marks on raceway	Replace the bearing.
		X	Scoring (brinelling)	Replace the bearing. Avoid any vibration at standstill

### 8.9.5 Faults at the external fan

The following table shows the possible causes of and remedial measures for faults on forced-ventilated machines.

Table 8-4 Cooling system faults

↓ High temperature rise with load		
	Possible causes of faults	Remedial measures
X	Wrong direction of rotation of the external fan	Check the electrical connections to the external fan.
X	External fan is not running	Check the external fan and its connections.
X	Reduced air flow	Check the air ducts; clean the machine.

### 8.9.6 Cooling system faults (water jacket cooling)

The following table shows the possible causes of and remedial measures for faults on water-cooled machines.

Table 8-5 Cooling system faults

↓ Overheating		
↓ Water leaking		
	Possible causes of faults	Remedial measures
X	Reduced cooling	Check the cooling water flow, increase the amount of cooling water if necessary.
X	Cooling water flow rate too low	<b>Consult the manufacturer.</b> If the specified cooling water quality is observed, the cooling system is maintenance-free.
X	Inlet temperature too high	Set the correct upstream temperature.
X	Cooling water supply switched off	Switch on the cooling water supply.
X	Cooling water contains frost or anti-corrosion additives	Use cooling water of the agreed quality.
	X <b>Leaks in the cooling system</b>	<b>Consult the manufacturer.</b>
	X Defective cooling water connection	Find the leak and seal it.



# Maintenance

Through careful and regular maintenance, inspections, and overhauls you can detect faults at an early stage and resolve them. This means that you can avoid consequential damage.

Operating conditions and characteristics can vary widely. For this reason, only general maintenance intervals can be specified here. Maintenance intervals should therefore be scheduled to suit the local conditions (dirt, starting frequency, load, etc.).

When carrying out any work on the machine, observe the general safety instructions (Page 13) and the specifications contained in EN 50110-1 regarding safe operation on electrical equipment.

Comply with the IEC / EN 60079-17 standard during all servicing and maintenance work on the machine.

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## Note

### Service Center

Please contact the Service Center, if you require support with servicing, maintenance or repair.

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## 9.1 Inspection and maintenance

	<p><b>WARNING</b></p> <p><b>Rotating and live parts</b></p> <p>Electric machines contain live and rotating parts. Fatal or serious injuries and substantial material damage can occur if maintenance work is performed on the machine when it is not stopped or not de-energized.</p> <ul style="list-style-type: none"> <li>• Perform maintenance work on the machine only when it is stopped. The only operation permissible while the machine is rotating is regreasing the roller bearings.</li> <li>• When performing maintenance work, comply with the five safety rules.</li> </ul>
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**WARNING**

**Machine damage**

If the machine is not maintained it can suffer damage. This can cause faults which can result in eventual or immediate death, serious injury or material damage.

Perform regular maintenance on the machine.



**CAUTION**

**Dust disturbances when working with compressed air**

When cleaning with compressed air, dust, metal chips, or cleaning agents can be whirled up. Injuries can result.

When cleaning using compressed air, make sure you use suitable extraction equipment and wear protective equipment (safety goggles, protective suit, etc.).

**NOTICE**

**Damage to insulation**

If metal swarf enters the winding head when cleaning with compressed air, this can damage the insulation. Clearance and creepage distances can be undershot. This may cause damage to the machine extending to total failure.

When cleaning with compressed air, ensure there is adequate extraction.

**NOTICE**

**Machine damage caused by foreign bodies**

Foreign bodies such as dirt, tools or loose components, such as screws etc., can be left by accident inside the machine after maintenance is performed. These can cause short circuits, reduce the performance of the cooling system or increase noise in operation. They can also damage the machine.

- When carrying out maintenance work, make sure that no foreign bodies are left in or on the machine.
- Securely attach all loose parts again once you have completed the maintenance procedures.
- Carefully remove any dirt.

**Note**

Operating conditions and characteristics can vary widely. For this reason, only general intervals for inspection and maintenance measures can be specified here.

**WARNING****Explosion hazard**

Components within the machine may be hotter than the maximum permissible surface temperature of the enclosure. In an explosive atmosphere, dust can ignite and an explosion occur. This can result in death, serious injury or material damage.

- Do not open the machine in an explosive and dusty atmosphere when it is still at normal operating temperature.
- Allow the machine to cool down before opening it.
- When disassembling, ensure that the parts necessary to seal the enclosure are not damaged, for example seals, face/plane mating surfaces. Perform a new routine test for the parts that have been repaired if these parts are crucial to ensure dust protection.

**WARNING****Explosion hazard due to overheating of the machine caused by a layer of dust**

Layers of dust thicker than 5mm can insulate the machine, resulting in overheating. The maximum surface temperature of the machine cannot be adhered to. The dust can ignite, resulting in an explosion. This can result in death, serious injury or material damage.

Dust the machine regularly. Do not allow dust layers thicker than 5 mm to build up on the machine surface. Do not switch the machine on until the dust has been removed.

**WARNING****Risk of explosion due to excessive bearing temperature**

The surface temperature cannot be maintained within maximum permissible limits if the bearing becomes too hot. The dust can ignite, resulting in an explosion. This can result in death, serious injury or material damage.

- Always check the bearing temperature.
- In addition to the current-dependent overload protection device located in the three phases of the connecting cable, we recommend that you also monitor the temperature rise in the motor with the aid of the temperature sensors built into the stator winding.

**WARNING****Risk of explosion when cleaning with compressed air**

If you clean the machine with compressed air, plastic components may become statically charged and ignite a potentially explosive atmosphere; an explosion can occur. This can result in death, serious injury or material damage.

Do not use compressed air to clean plastic parts in an explosive atmosphere. When cleaning the machine, make sure that the air in the vicinity of the motor is free of gas and dust.

### 9.1.1 Inspections in the event of faults

Natural disasters or unusual operating conditions, such as overloading or short circuit, are faults that overload the machine electrically or mechanically.

Immediately perform an inspection after such faults.

### 9.1.2 First inspection

Perform the following checks after approximately 500 operating hours or one year, whichever comes first:

Table 9-1 Checks after installation or repair

Check	When the motor is running	At standstill
The electrical parameters are maintained.	X	
The permissible bearing temperatures are not exceeded.	X	
The smooth running characteristics and machine running noise have not deteriorated.	X	
The motor foundation has no cracks and indentations. (*)	X	X

(\*) You can perform these checks while the motor is at standstill or, if required, while running.

#### Further checks

Further checks may be required if so specified in supplementary instructions or in accordance with the plant-specific conditions.

#### NOTICE

If you detect any deviations during the inspection, you must rectify them immediately. They may otherwise damage the motor.

### 9.1.3 General inspection

Check that the installation conditions are observed. We recommend that the following checks are performed after approx. 16 000 operating hours or at the latest after two years:

Table 9-2 Checks that have to be performed during the general inspection

Checking	When the motor is running	At standstill
The electrical parameters are maintained	X	
The permissible bearing temperatures are not exceeded	X	

Checking	When the motor is running	At standstill
The smooth running characteristics and machine running noise have not deteriorated	X	
The motor foundation has no cracks and indentations (*)	X	X
The machine is aligned within the permissible tolerance ranges		X
All the fixing bolts/screws for the mechanical and electrical connections have been securely tightened		X
All the potential connections, grounding connections and shield supports are correctly seated and properly bonded		X
The winding insulation resistances are sufficiently high		X
Any bearing insulation is fitted as shown on the plates and labels		X
The CABLES and insulating parts and components are in good condition and there is no evidence of discoloring		X

(\*) You can perform these checks while the motor is at standstill or, if required, while running.

#### NOTICE

##### Machine damage

When carrying out the inspection, if you detect any impermissible deviations from the normal state, you must rectify them immediately. They may otherwise cause damage to the machine.

### 9.1.4 Servicing the roller bearings

When inspecting rolling-contact bearings, it is generally not necessary to dismantle the machines. The motor only has to be dismantled if the bearings are to be replaced.

### 9.1.5 Bolt grade

Check that all the bolts for attaching the bearing shields, bearing cover, gland plates, and terminal boxes are present and properly tightened. Replace damaged bolts with identical bolts of a perfect quality.

Depending on the ambient temperature, only bolts with the bolt grade according to the following table are permissible for motors without heating.

Table 9-3 Bolt grade BG071 to BG315

Type/size	Bolt grade for ambient temperature $T_u$		
	$\geq -40\text{ °C}$		$-55\text{ °C} \leq T_u < -40\text{ °C}$
	Standard	Stainless steel bolts	Standard
071, 080, 090, 100, 112, 132, 160, 180, 200, 225, 250, 280, 315	8.8	A4-70	A4-70
180.B	8.8	A4-80	A4-80

Table 9-4 Bolt grade BG315 to BG910

Type/size	Bolt grade for ambient temperature $T_u$			
	$\geq -20\text{ }^{\circ}\text{C}$		$-40\text{ }^{\circ}\text{C} \leq T_u < -20\text{ }^{\circ}\text{C}$	
	Standard	Stainless steel bolts	Standard	Stainless steel bolts
315.B, 315.C, 315.D, 315.E	8.8	A4-70	8.8	A4-70
355.K, 355.L, 355.M, 355.N, 355.X	8.8	A4-70	8.8	A4-70
355.A, 355.B, 355.C, 355.D	8.8	A4-70	8.8	A4-80
400.K, 400.L, 400.M, 400.N, 400.X	8.8	A4-70	8.8	A4-70
450.K, 450.L, 450.M, 450.N, 450.X	8.8	A4-70	8.8	A4-80
500.K, 500.L, 500.M, 500.N, 500.X				
560.K, 560.L, 560.M, 560.N, 560.X				
630.K, 630.L, 630.M, 630.N, 630.X	8.8	A4-80	8.8	A4-80
710.A, 710.B, 710.C, 710.X	8.8	A4-70	8.8	A4-80
800.A, 800.B, 800.C, 800.D type of protection IIB / IIC	8.8	A4-70 / A4-80	8.8	A4-80
910.A, 910.B, 910.C,	8.8	A4-70	8.8	A4-80

### 9.1.6 Mechanical explosion protection for roller bearings

All machines marked in accordance with directive 94/9/EG must be regularly inspected for mechanical damage that could constitute a risk of ignition in accordance with IEC / EN 60079-17.

- Comply with the following intervals:
  - Bearing replacement intervals
  - Relubrication intervals
  - Grease replacement intervals
  - Oil change intervals
- Roller bearing service life
  - Replace the roller bearings once the nominal service life is reached. Alternatively, you can verify they are free of mechanical damage as part of an inspection.
  - In the case of roller bearings without a regreasing system, it is ensured that the nominal service life will only be achieved clearly after achievement of the service life of the grease in the bearings.
  - The roller bearing service life under full specified load is at least 20 000 hours for machines subject to radial or axial forces.
  - The nominal roller bearing service life of machines which are not subject to any forces is at least 40 000 hours.
- For roller bearings with external oil supply, monitor that lubrication is maintained.

## 9.1.7 Maintenance

### 9.1.7.1 Explosion protection for machines with type of protection "Ex d"


For explosion-protected motors with type of protection "flameproof enclosure" according to IEC / EN 60079-0 and IEC / EN 60079-1, observe the following:

It is not permissible to subsequently machine or paint contact and mating surfaces of the parts listed below:

- Stator frame
- End shields
- Bearing covers
- Motor shaft
- Gland plate
- Terminal box base
- Terminal box cover
- Gland plates for additional terminal boxes, where present

Keep these surfaces clean and protect them against corrosion by applying a thin coating of grease. It is not permissible that any seals are fitted between the surfaces that guarantee that flame is not transmitted.

### 9.1.7.2 Explosion hazard due to increased surface temperature

 <b>WARNING</b>
<b>Explosion hazard</b> Components within the motor may be hotter than the maximum permissible surface temperature for the enclosure. In an explosive atmosphere, dust can ignite and an explosion occur. This can result in death, serious injury or material damage. <ul style="list-style-type: none"><li>• Do not open the motor in an explosive and dusty atmosphere when it is still at normal operating temperature.</li><li>• Allow the machine to cool down before opening it.</li></ul>

### 9.1.7.3 Insulation resistance and polarization index

Measuring the insulation resistance and polarization index (PI) provides information on the condition of the machine. It is therefore important to check the insulation resistance and the polarization index at the following times:

- Before starting up a machine for the first time
- After an extended period in storage or downtime
- Within the scope of maintenance work

*9.1 Inspection and maintenance*

The following information is provided regarding the state of the winding insulation:

- Is the winding head insulation conductively contaminated?
- Has the winding insulation absorbed moisture?

As such, you can determine whether the machine needs commissioning or any necessary measures such as cleaning and/or drying the winding:

- Can the machine be put into operation?
- Must the windings be cleaned or dried?

Detailed information on testing and the limit values can be found here:

"Testing the insulation resistance and polarization index"



## 9.1.7.4 Grease service life and fill quantities

## Standard roller bearings

Size	Grease stability time for permanent lubrication or relubrication interval for a regreasing system in operating hours at rated speed						Grease filling quantity for permanent lubrication or grease quantity for relubrication in g per bearing			
	Horizontal type of construction (B)			Vertical type of construction (V)			Permanent lubrication		Relubrication	
	3000 rpm	1500 rpm	≤1000 rpm	3000 rpm	1500 rpm	≤1000 rpm	3000 rpm	≤1500 rpm	3000 rpm	≤1500 rpm
71	33000			33000	40000		9	9	-	-
80							9	9	-	-
90							11	11	-	-
100							25	25	-	-
112							25	25	-	-
132	24000	40000	40000	16000	26000	40000	50	50	-	-
160							80	80	-	-
180							100	100	-	-
200							130	130	-	-
225							190	190	-	-
250							190	190	-	-
280							190	260	-	-
315	4000	8000	11000	2800	5600	8000	-	-	35	25
355							-	-	35	50

The specified grease service lives or relubrication intervals are valid for a maximum ambient temperature of 40° C. For every 10° C increase in temperature, reduce the lubrication interval specified in the table by a factor of 0.7 (max. 20° C = factor 0.5). With an ambient temperature ≤ 25° C, twice the grease stability time can be expected; but a maximum of 40000 hours. Times for operation on 60 Hz systems on request. With pure coupling operation with flexible coupling, the calculated bearing life is L10h greater than 50000 hours. Comply with the grease service life and relubrication intervals.

## Reinforced roller bearings

Size	Grease stability time for permanent lubrication or relubrication interval for a regreasing system in operating hours at rated speed						Grease filling quantity for permanent lubrication or grease quantity for relubrication in g per bearing	
	Horizontal type of construction (B)			Vertical type of construction (V)			Permanent lubrication	Relubrication
	3000 rpm	1500 rpm	≤1000 rpm	3000 rpm	1500 rpm	≤1000 rpm		
180	2800	5600	8000	2000			-	17
200							-	20
225					4000	5600	-	25

## 9.1 Inspection and maintenance

Size	Grease stability time for permanent lubrication or relubrication interval for a regreasing system in operating hours at rated speed						Grease filling quantity for permanent lubrication or grease quantity for relubrication in g per bearing	
	Horizontal type of construction (B)			Vertical type of construction (V)			Permanent lubrication	Relubrication
	3000 rpm	1500 rpm	≤1000 rpm	3000 rpm	1500 rpm	≤1000 rpm		
250	2000			1400	2800	4000	-	25
280		-			-	-	-	25
280	-	4000	5600	-	2800	4000	-	25
315	2000	-	-	1400	-	-	-	35
315	-	4000	5600	-	2800	4000	-	25

The specified relubrication intervals are valid for maximum ambient temperatures of 40 °C. Reduce the relubrication intervals for

10°C increase in temperature, by a factor of 0.7 of the value listed in the table (max. 20 °C = factor 0.5). Times for operation on 60 Hz systems on request.

## 9.1.7.5 Regreasing intervals and types of grease for operating rolling-contact bearings

## Regreasing intervals

The regreasing intervals for roller bearings in operating hours and the grease types are stated on the machine's lubricant plate. Regardless of the actual number of operating hours reached, the machine must be regreased at least once a year. The lubrication information can be found on the lubricant plate.

**Note****Observe the regreasing intervals for the roller bearings**

The regreasing intervals for roller bearings are different from the service/inspection intervals for the machine. Failure to regrease the roller bearings at the specified intervals can result in bearing damage.

## Regreasing

The spent grease chamber is designed to accommodate the spent grease for a computed, rated service life of 40000 operating hours.

- Clean the grease nipples before regreasing and then gradually press in an appropriate type and amount of grease, as described on the lubricant plate. The shaft must then be rotated so that the new grease can be distributed throughout the roller bearing. The roller bearing temperature rises sharply at first, then drops to the normal value again after the excess grease has been displaced out of the bearing.
  - If the machine is fitted with **grease removal sliders** :  
After the bearings have been regreased, with the motor running, the used grease should be removed by pulling the slider fitted to the bearing to its stop several times.
  - If the machine is fitted with **grease collection chambers** :  
Unbolt the grease collection chambers at the intervals shown on the notice plate with the motor stopped, and remove the used bearing grease. If this is not done, the grease will clog and the bearings will overheat.



### WARNING

#### Rotor can fall out

If the machine is in a vertical position, the rotor can fall out while work is being performed on the locating bearing. This can result in death, serious injury or material damage.

Support or relieve the rotor when carrying out work with the machine in a vertical position.

## Grease types

For the standard operating range, a grease for temperatures down to -20 °C is normally used for the initial greasing of roller bearings. If the machine has been ordered for use in the extended temperature range of below -20 °C, the permissible type of grease is indicated on the lubricant plate.

### Note

#### Grease quantity control

The grease quantity control only operates correctly if the specified greases are used. This is specified on plates attached to the machine.

## 9.1.7.6 Alternative types of grease for the operation of roller bearings

In the following table, you will find a list of approved alternative types of grease.

Filling with oil for the first time	Alternative permissible greases
Shell Gadus S2 V100 3	Aral Aralub HL3 BP Energrelub LS3 Castrol Optimol Olista Longtime 3 Exxon Mobil Beacon EP3 Mobilux EP3 OMV Signum L3 SKF LGMT 3
Shell Gadurail S4 HS EUDB (dt. Bezeichnung) Shell Gadus S5 V42P 2.5(int. Bezeichnung)	Currently no comparable grease with $Dm \cdot n \geq 1,000,000$ is known.
Shell Gadus S5 V100 2	Exxon Mobil Mobilith SHC 100
Esso Unirex N3	Exxon Mobil Mobilgrease XHP 103 Shell Gadus S5 V100 2
Shell Gadus S3 T100 2	BP Energrelub SY2202 Castrol Firetemp XT2 Chevron Grease SRI2 Klüber Petamo GHY 133N SKF LGHP 2 Exxon Mobil Polyrex EM

Observe the following when changing over to an alternative type of grease that is permitted according to the table:

**Bearings with permanent lubrication:**

- Completely remove the old grease from the bearing before regreasing it.
- Fill roller bearings completely with grease and cavities in the bearing cover only up to one third.

**Bearings with regreasing:**

If complete replacement of grease and cleaning of the bearing is not possible, keep the operating time to a minimum when different greases are mixed. To do this, thoroughly grease the bearing when the machine is running with about twice the amount of grease until spent grease has been removed from the greasing ducts. Then regrease 4x at intervals of  $\frac{1}{4}$  of the

normal greasing interval. During this time, very carefully monitor the bearing locations involved. Then resume the normal greasing intervals.

#### NOTICE

##### Damage due to mixing grease types

If you mix greases and oils with different soap or oil bases, then the lubricating properties may no longer be guaranteed.

Mixing low-temperature grease with normal temperature grease can cause lumps to form in the lubricant. The consequence can be damage to the roller bearings due to overheating.

Never mix greases that have different thickening agents and different base oils.

### 9.1.7.7 Cleaning the cooling air passages

- Regularly clean the cooling air passages through which the ambient air flows, e.g. using dry compressed air.

#### NOTICE

##### Cleaning intervals depend on the degree of fouling

The frequency of the cleaning intervals depends on the local degree of fouling. The machine will overheat if the cooling air ducts are polluted and the cooling air cannot flow without obstruction.

Regularly check for pollution, and clean the cooling air ducts through which the ambient air flows.

### 9.1.7.8 Maintenance and repair for machines of protection type "Ex d"

The machine marking based on IEC / EN 60079-0 was added with the "X" symbol.

Maintain the special conditions for repairs. The gap dimensions for the electric machine **do not** comply with the standardized values in IEC / EN 60079-1. For repair work, obtain the gap dimensions of the electrical machine from the manufacturer.

Perform maintenance, repair and modification work on explosion-protected machines in strict compliance with the corresponding national health and safety legislation, the safety instructions and descriptions in the general maintenance instructions.

Work influencing explosion protection must be carried out by the manufacturer or by a specialist workshop for electrical machinery authorized by the manufacturer. This includes the following operations, for example:

- Repairs to the stator or rotor windings and to the terminals
- Repairs to the ventilation system
- Repairs to the bearings

- Dismantling machines with flameproof enclosures
- Connection work carried out in the terminal box

The operations must be identified by an additional repair plate carrying the following information:

- Date
- Company carrying out repair
- Type of repair
- Reference number of the repair technician regarding repair work

Testing after repair shall be carried out in accordance with EU directives.



**DANGER**

**Gap dimensions**

Changing ignition gap geometries (gap dimensions) as part of repair work according to the minimum specifications of IEC / EN 60079–1 is not permissible.

This can result in death, serious injury or material damage.

Obtain the gap dimensions of the electrical machine from the manufacturer for the repair or restoration of ignition gap geometries.



**WARNING**

**Rotating or live parts**

Live electrical parts are dangerous. Contact with them can cause death, serious injury or material damage.

Before carrying out any maintenance work on the external fan, disconnect it from the mains, particularly before opening the terminal box. Make sure that the device cannot be switched back on.

### Servicing the external fan

The external fan is essentially maintenance-free. However, dirt and dust deposits on the impeller and the motor, particularly in the gap between the impeller and the inlet nozzle can impair its function.

- Remove the dirt and dust deposits regularly; the intervals depend on how dirty the surrounding area is.
- Make sure that the impeller is evenly cleaned, as irregular deposits can lead to an imbalance.

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#### Note

##### Flowrate

The full flowrate is only achieved if the inward flow of air to the impeller is unrestricted.

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### Servicing the external fan motor

- Perform an occasional visual inspection of the external fan motor and check it electrically and mechanically every time the roller bearings are replaced.
- Replace permanently lubricated roller bearings in the external fan motor as specified in the operating instructions for the external fan motor.

#### 9.1.7.9 Maintaining terminal boxes

##### Requirement

The machine is de-energized.

##### Checking the terminal box

- Terminal boxes must be regularly checked for tightness, undamaged insulation, and tight terminal connections.
- If dust or humidity have infiltrated the terminal box, this should be cleaned and dried (particularly the insulators).  
Check all the seals and sealing surfaces and address the cause of the leakiness.
- Check the insulators, connectors and cable connections in the terminal box.
- Replace the damaged components if necessary.



#### WARNING

##### Short-circuit hazard

Damaged components can cause short circuits, possibly resulting in death, serious injuries and property damage.

Replace damaged components.

#### 9.1.7.10 Touch up any damaged paintwork

If the paint is damaged, it must be repaired in order to protect the unit against corrosion.

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##### Note

##### Paint system

Contact the Service Center before you repair any paint damage. They will provide you with more information about the correct paint system and methods of repairing paint damage.

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##### Complete overpainting

The paint applied must conform to the requirements to avoid electrostatic charging. See DIN EN 60079-0. The repair of painted surfaces of the **non**-conductive paint coating up to a nominal coating thickness of 350 µm was investigated and is acceptable.

#### 9.1.7.11 Repainting



##### WARNING

##### Repainting explosion-proof motors

The paint coat can become electrostatically charged where there is a thick coat. Electrostatic discharges can occur. There is a risk of explosion if potentially explosive mixtures are also present at this moment. This can result in death, serious injury or material damage.

You must comply with one of the following requirements when you repaint painted surfaces:

- Limit the total paint coating thickness according to the explosion protection group:
  - IIB: Total paint coating thickness  $\leq 2$  mm
  - IIC: Total paint coating thickness  $\leq 0.75$  mm for motors of group II (gas)
  - III: Total paint coating thickness  $\leq 0.45$  mm for group III motors (dust)  
According to tests, paint repair work up to the total paint coating thickness of the non-conductive paint coating listed has also been examined and is harmless.
- Limit the surface resistance of the paint used:
  - IIB, IIC, III: Surface resistance  $\leq 1$  GΩ for motors of groups II and III (gas and dust)
- Breakdown voltage  $\leq 4$  kV for explosion group III (dust only)



- Charge transfer limit:
  - IIB: Limit value for the largest transferred charge < 30 nC
  - IIC: Limit value for the largest transferred charge < 10 nC for group II motors (gas)
  - III: Limit value for the largest transferred charge < 200 nC for group III motors (dust)
- Incapability, dangerous charge to be saved:
  - IIB: Limit value for the maximum capacity  $\leq 15$  pF
  - IIC: Limit value for the maximum capacity  $\leq 5$  pF for group II motors (gas)
  - III: Limit value for the maximum capacity  $\leq 10$  pF for group III motors (dust)

## 9.2 Repair

When carrying out any work on the machine, observe the general safety instructions (Page 13) and the specifications contained in EN 50110-1 regarding safe operation on electrical equipment.

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### Note

If the motor has to be transported, please observe the information and instructions in the "Transport" section.

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### Note

#### Service Center

Please contact the Service Center, if you require support with servicing, maintenance or repair.

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### 9.2.1 Anti-condensation heating spare parts

 <b>WARNING</b>
<b>Risk of explosion</b> If repairs to the anti-condensation heating are not carried out correctly, e.g. if unauthorized or untested spare parts are used, this can result in explosions during operation in a potentially explosive gaseous atmosphere. This can result in death, serious injury or material damage.  Repairing and mounting the anti-condensation heating and the subsequent routine testing must always be undertaken by experts from the Service Center, because this work requires extensive specialist knowledge. Only authorized and tested spare parts may be used.

### 9.2.2 Insulated roller bearings

If roller-contact bearings with an insulated design are installed, use roller bearings of the same type as spare parts. This will prevent any bearing damage being caused by bearing currents.

## Spare parts

### 10.1 Ordering data

When ordering spare parts, in addition to the precise designation of the spare part, specify the motor type and the serial number of the motor. Ensure that the spare part designation matches the designation in the spare part lists and add the associated part number.

Example:

Bearing shield, drive end (Part 105)

Machine type DNGW-315ML-04A

Serial number 3424606

The machine type and serial number can be found on the rating plate data and in the technical data. The serial number is also stamped on the end face of the shaft extension at the drive end.

### 10.2 Replacing roller bearings

#### Rolling-contact bearings

When ordering roller bearings, in addition to the bearing identification code, the supplementary specifying code is also necessary for the bearing version. Both of these codes are stamped on the lubricant plate and specified in the motor documentation, or can also be taken from the installed bearings.

If roller-contact bearings with an insulated design are installed, use roller bearings of the same type as spare parts. This will prevent any bearing damage being caused by bearing currents.

## 10.3 Using commercially available spare parts

### **WARNING**

#### **Risk of explosion**

If you use parts other than the original spare parts, the type of protection can no longer be guaranteed. This can result in an explosion during operation in a potentially explosive gaseous atmosphere. This can result in death, serious injury or material damage.

- Use only original spare parts for explosion-proof machines; this also applies to components such as seals, terminals, cables and cable entries. Should you have any questions, please contact the Service Center .
- Commercially available equivalent standard parts such as screws may be used.

## 10.4 Anti-condensation heating spare parts

### **WARNING**

#### **Risk of explosion**

If repairs to the anti-condensation heating are not carried out correctly, e.g. if unauthorized or untested spare parts are used, this can result in explosions during operation in a potentially explosive gaseous atmosphere. This can result in death, serious injury or material damage.

Repairing and mounting the anti-condensation heating and the subsequent routine testing must always be undertaken by experts from the Service Center (Page 125), because this work requires extensive specialist knowledge. Only authorized and tested spare parts may be used.

## 10.5 Spare parts list, frame sizes 071 to 132

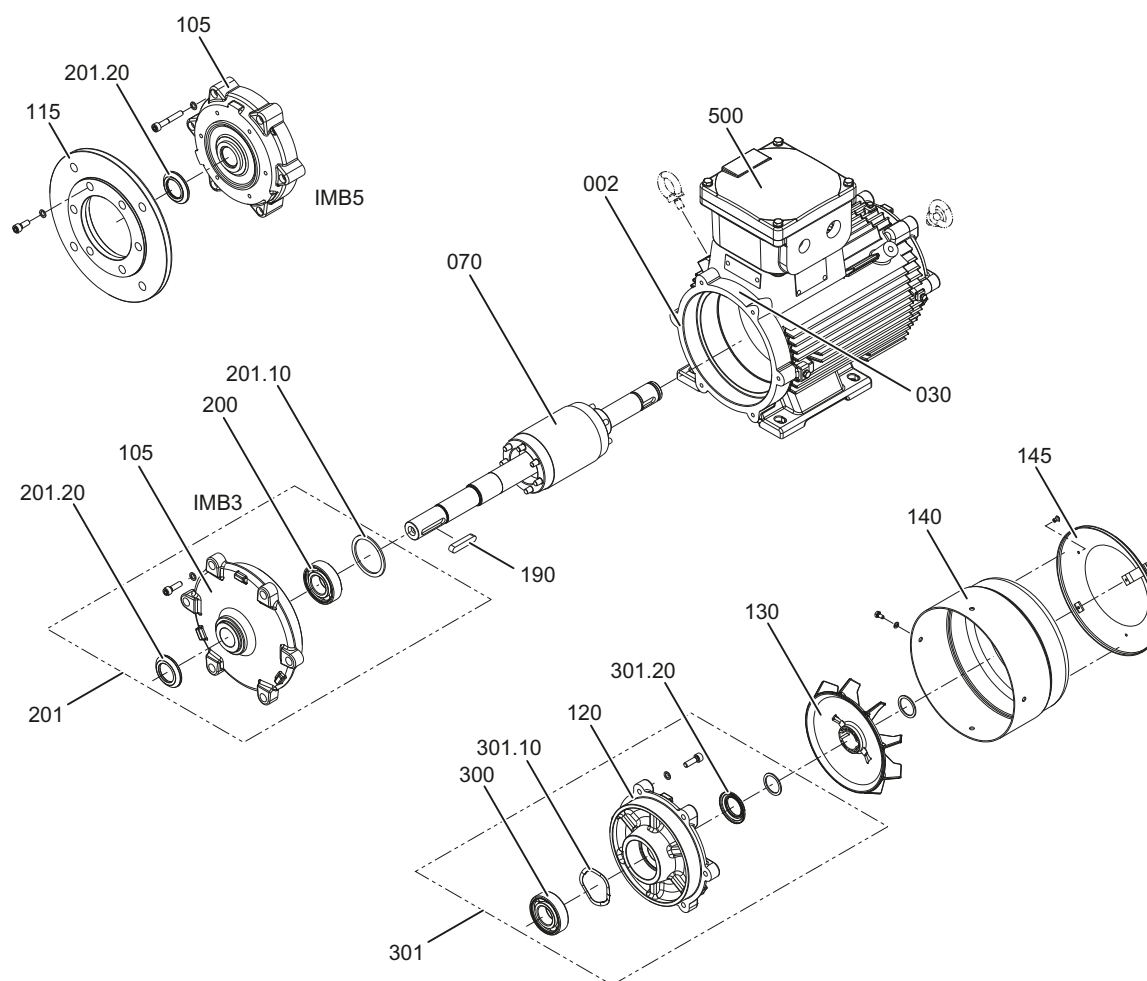


Figure 10-1 E-AN000-0007

Parts Number	Designation	Parts Number	Designation
002	Stator laminated core with winding	190	Feather key
030	Stator frame	200	Roller bearing, DE
031	Housing foot, right	201	Bearings, DE
032	Housing foot, left	201.10	Spacer washer
070	Shaft with rotor	201.20	Gamma ring
105	End shield, drive end	300	Roller bearings, NDE
115	Flange plate	301	Bearings, NDE
120	End shield, non-drive end	301.10	Spacer washers
130	Fan	301.20	Gamma ring
140	Fan cover	500	Terminal box
145	Protective cover		

## 10.6 Spare parts list, frame sizes 160 to 280

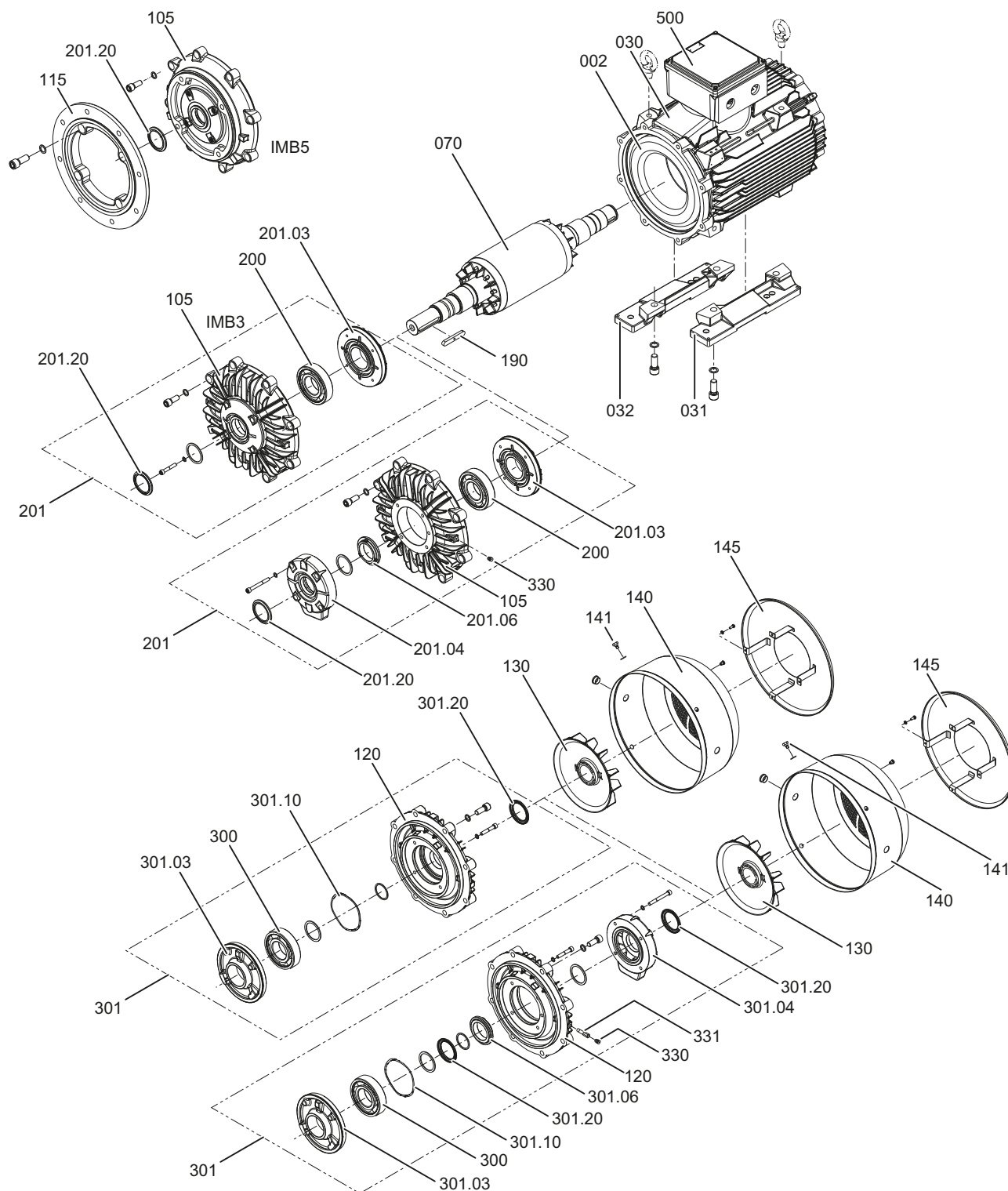


Figure 10-2 E-AN000-0008

## 10.6 Spare parts list, frame sizes 160 to 280

Parts Number	Designation	Parts Number	Designation
002	Stator laminated core with winding	201.03	Inner grease chamber cover
030	Stator frame	201.04	Outer grease chamber cover
031	Housing foot, right	201.06	Grease slinger
032	Housing foot, left	201.20	Gamma ring
070	Shaft with rotor	300	Roller bearings, NDE
105	End shield, drive end	301	Bearings, NDE
115	Flange plate	301.03	Inner grease chamber cover
120	End shield, non-drive end	301.04	Outer grease chamber cover
130	Fan	301.06	Grease slinger
140	Fan cover	301.10	Spacer washers
141	Adapter screw	301.20	Gamma ring
145	Protective cover	330	Grease nipple
190	Feather key	331	Regreasing assembly
200	Roller bearing, DE	500	Terminal box
201	Bearings, DE		

## 10.7 Spare parts list, frame size 315

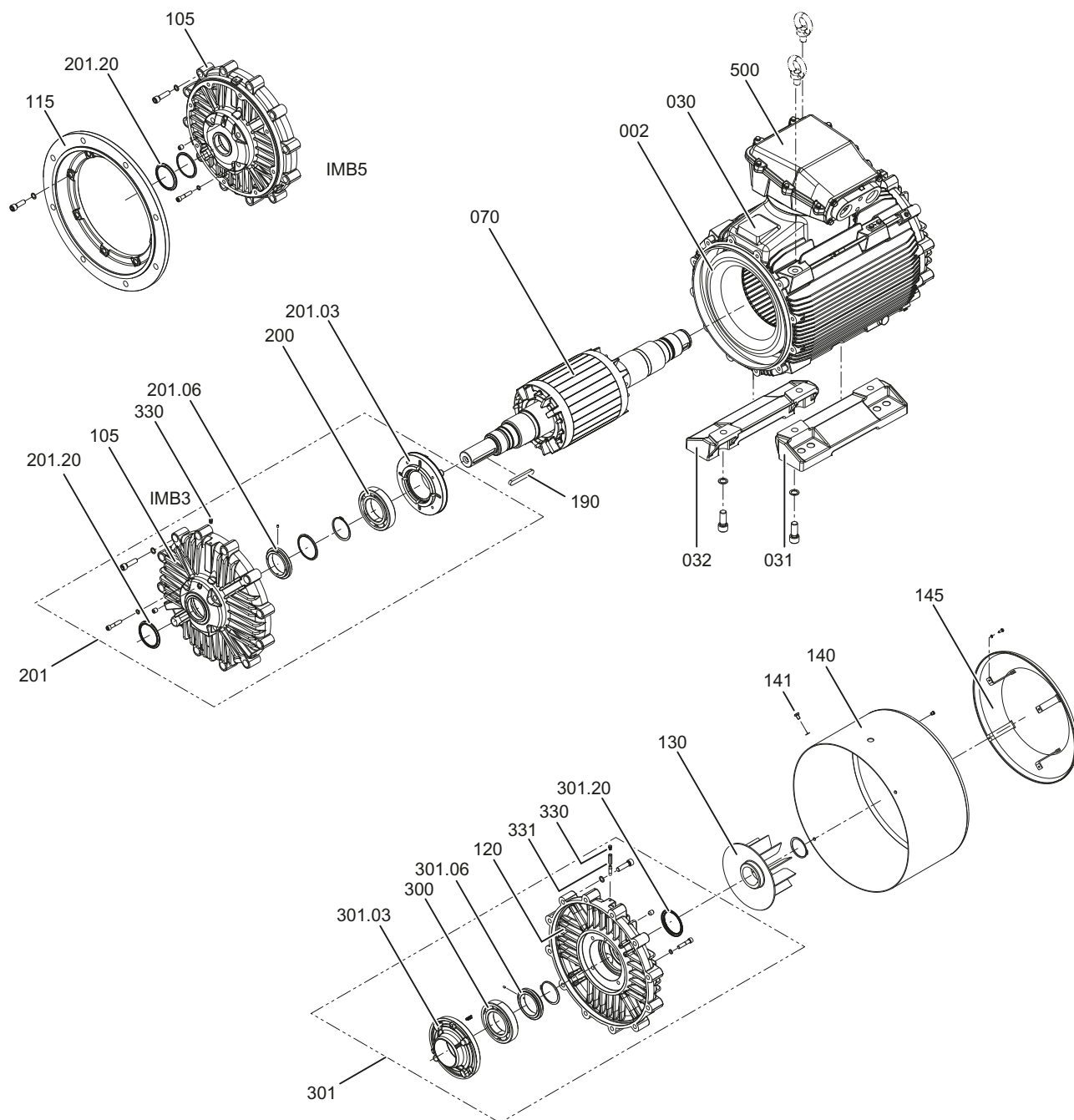


Figure 10-3 E-AN000-0009



Parts Number	Designation	Parts Number	Designation
002	Stator laminated core with winding	200	Roller bearing, DE
030	Stator frame	201	Bearings, DE
031	Housing foot, right	201.03	Grease chamber cover
032	Housing foot, left	201.06	Grease slinger
070	Shaft with rotor	201.20	Gamma ring
105	End shield, drive end	300	Roller bearings, NDE
115	Flange plate	301	Bearings, NDE
120	End shield, non-drive end	301.03	Grease chamber cover
130	Fan	301.06	Grease slinger
140	Fan cover	301.20	Gamma ring
141	Adapter screw	330	Grease nipple
145	Protective cover	331	Regreasing assembly
190	Feather key	500	Terminal box

## 10.8 Spare parts list, frame size 355

## 10.8 Spare parts list, frame size 355

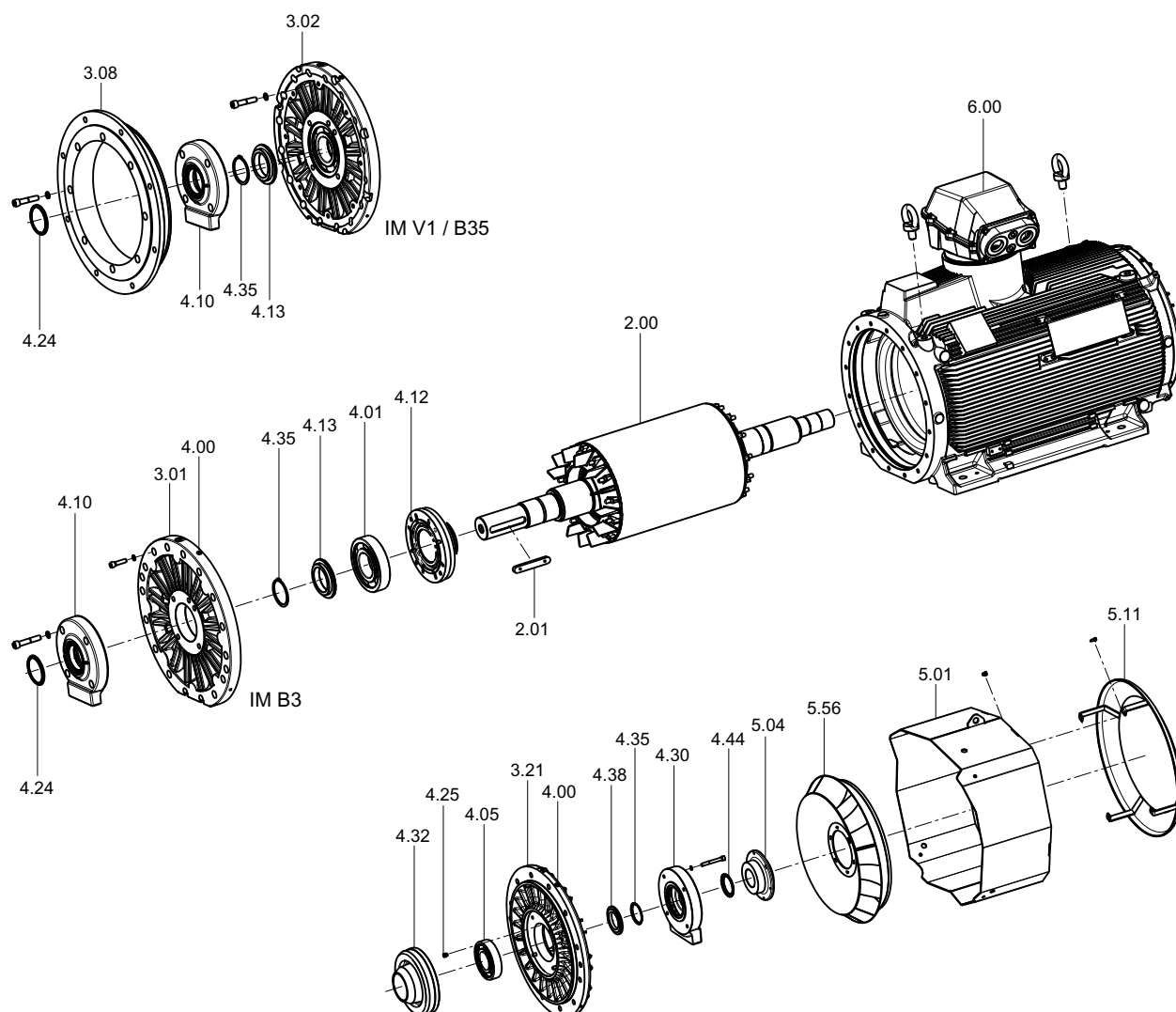


Figure 10-4 E-DN000-0010

Parts Number	Designation	Parts Number	Designation
2.00	Rotor, complete (balanced)	4.25	Compression spring
2.01	Keyway	4.30	Grease chamber cover NDE, outer
3.01	Bearing shield DE	4.32	Grease chamber cover NDE, inner
3.02	Flange bearing shield DE	4.35	Snap ring
3.08	Flange plate DE	4.38	Grease slinger NDE
3.21	Bearing shield NDE	4.44	Sealing ring NDE, outer
4.00	Grease nipple	5.01	Fan cowl, complete
4.01	Bearing DE	5.04	Fan hub NDE
4.05	Bearing NDE	5.11	Protective cover
4.10	Grease chamber cover DE, outer	5.56	Fan, complete
4.12	Grease chamber cover DE, inner	6.00	Terminal box, complete

Parts Number	Designation	Parts Number	Designation
4.13	Grease slinger DE		
4.24	Sealing ring DE, outer		

## 10.9 Spare parts list for terminal boxes with type of protection "Ex e", frame sizes 071-160

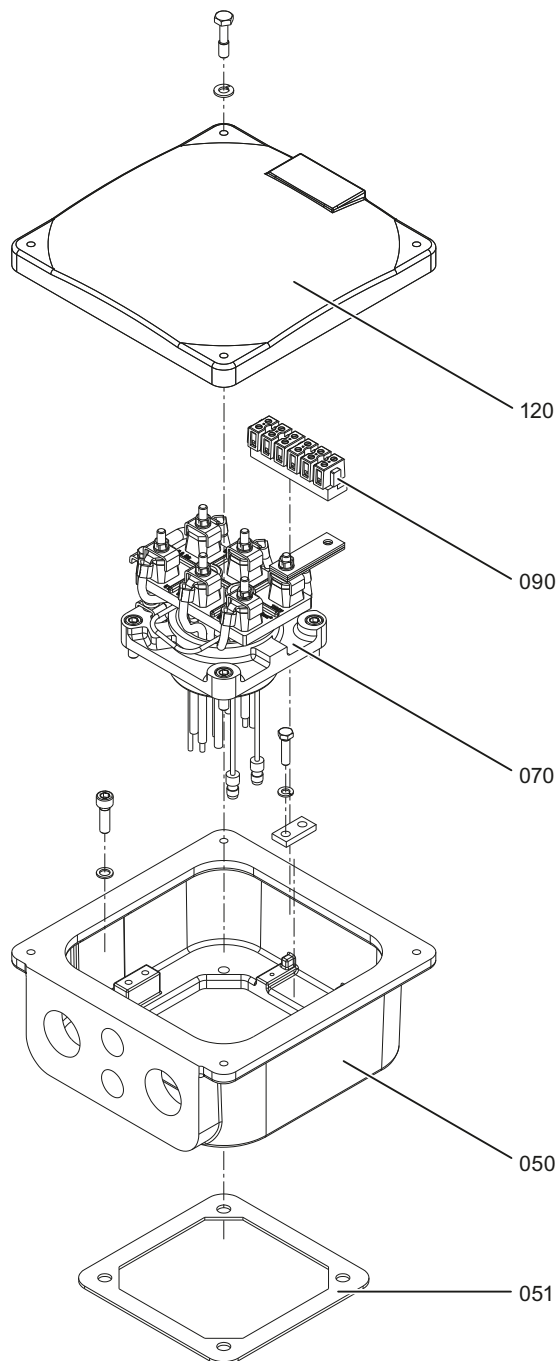


Figure 10-5 E-9-101\_162-0002

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*10.9 Spare parts list for terminal boxes with type of protection "Ex e", frame sizes 071-160*

<b>Parts Number</b>	<b>Designation</b>	<b>Parts Number</b>	<b>Designation</b>
050	Terminal box base	090	Additional terminals
070	Terminal board	120	Terminal box cover

## 10.10 Spare parts list for terminal boxes with type of protection "Ex d", frame sizes 071-160

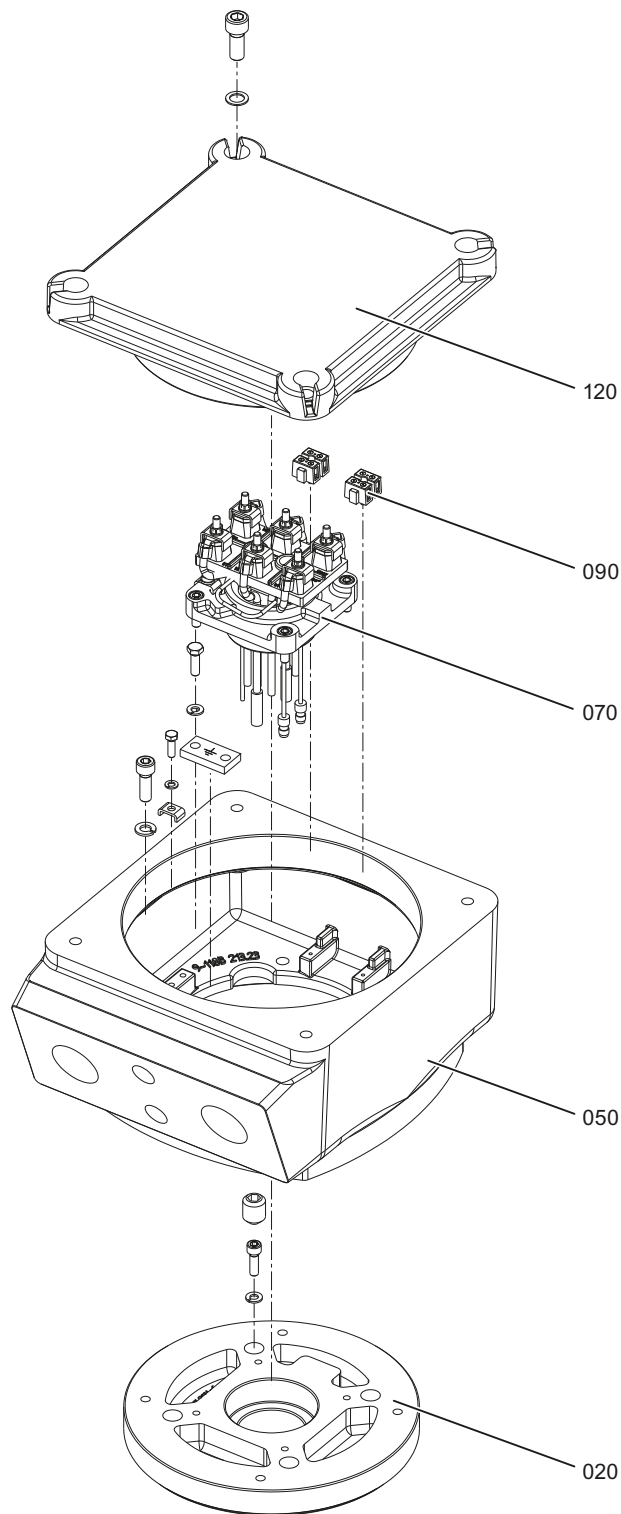


Figure 10-6 E-9-108\_213-0001

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*10.10 Spare parts list for terminal boxes with type of protection "Ex d", frame sizes 071-160*

Parts Number	Designation	Parts Number	Designation
020	Gland plate	090	Additional terminals
050	Terminal box base	120	Terminal box cover
070	Terminal board		

## 10.11 Spare parts list for terminal boxes with type of protection "Ex d", frame sizes 180-225

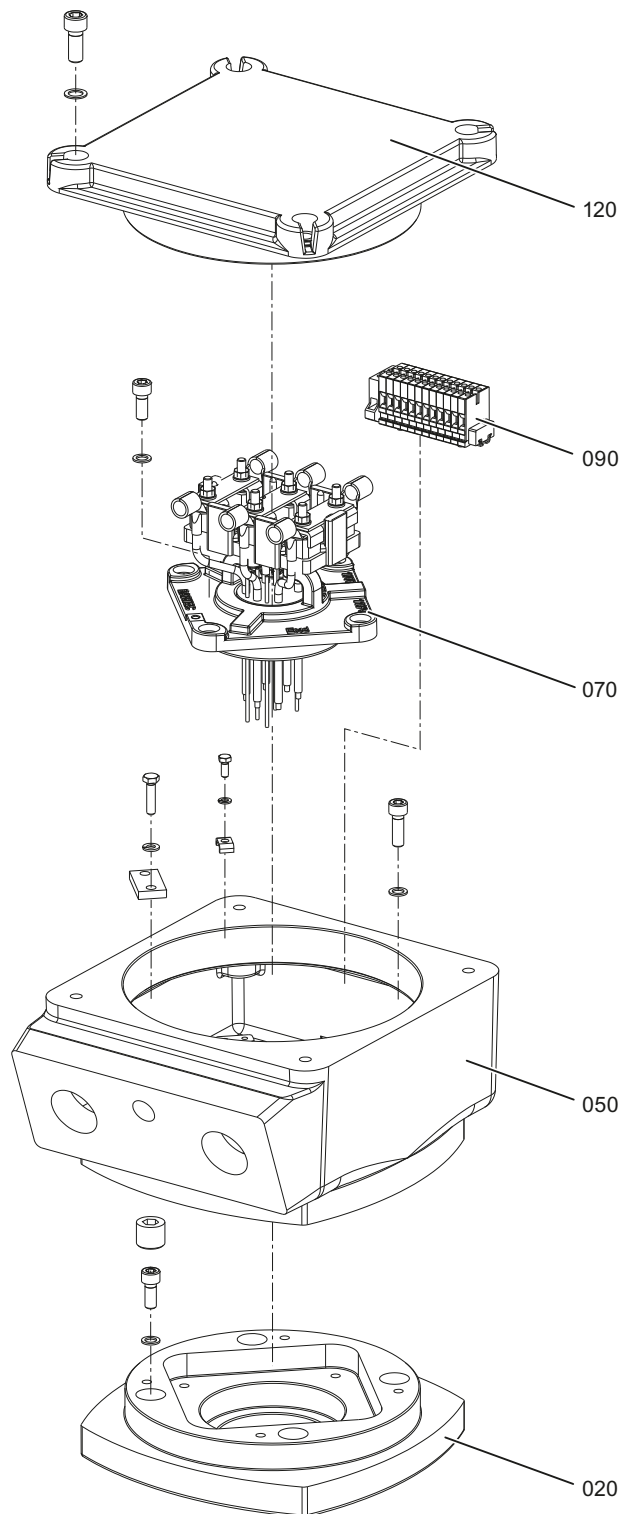


Figure 10-7 E-9-108\_213-0002



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*10.11 Spare parts list for terminal boxes with type of protection "Ex d", frame sizes 180-225*

Part number	Designation	Parts Number	Designation
020	Gland plate	090	Additional terminals
050	Terminal box base	120	Terminal box cover
070	Terminal board		

## 10.12 Spare parts list for terminal boxes with type of protection "Ex e", frame sizes 180-225

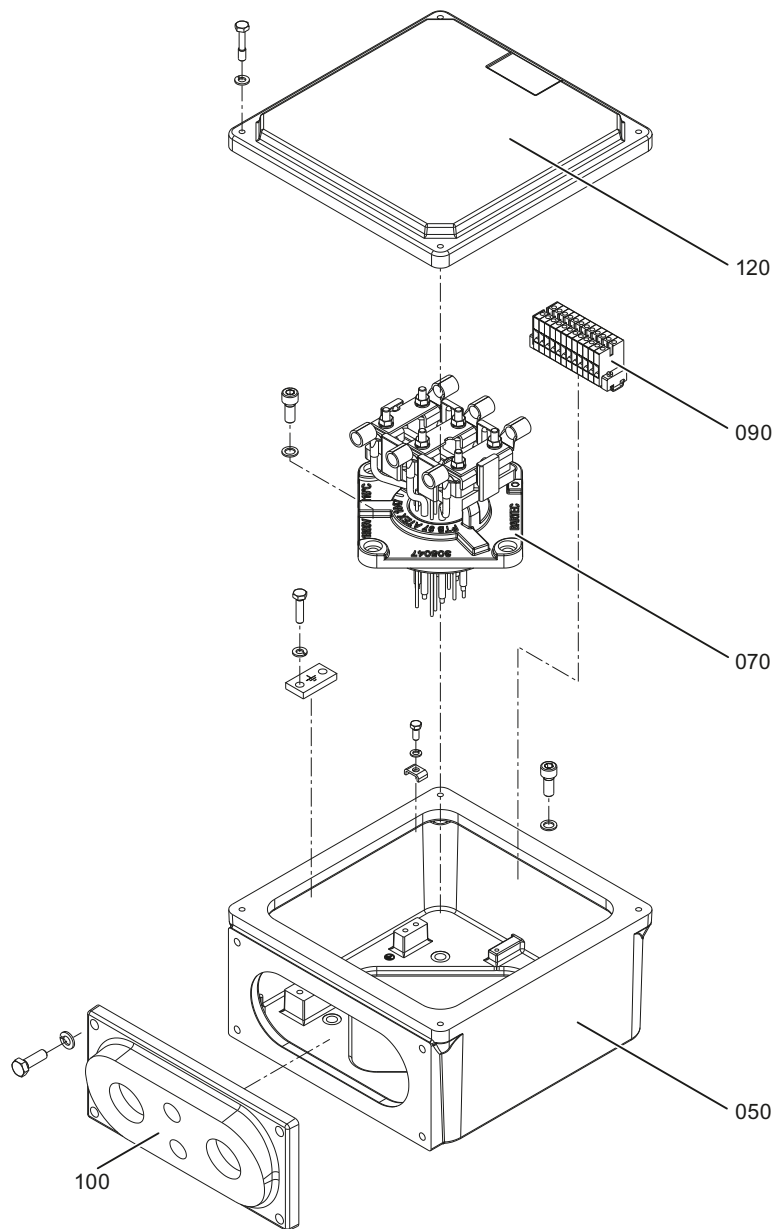


Figure 10-8 E-9-101\_208-0002

Part number	Designation	Parts Number	Designation
050	Terminal box base	090	Additional terminals
070	Terminal board	120	Terminal box cover

### 10.13 Spare parts list for terminal boxes with type of protection "Ex d", frame sizes 250 to 355

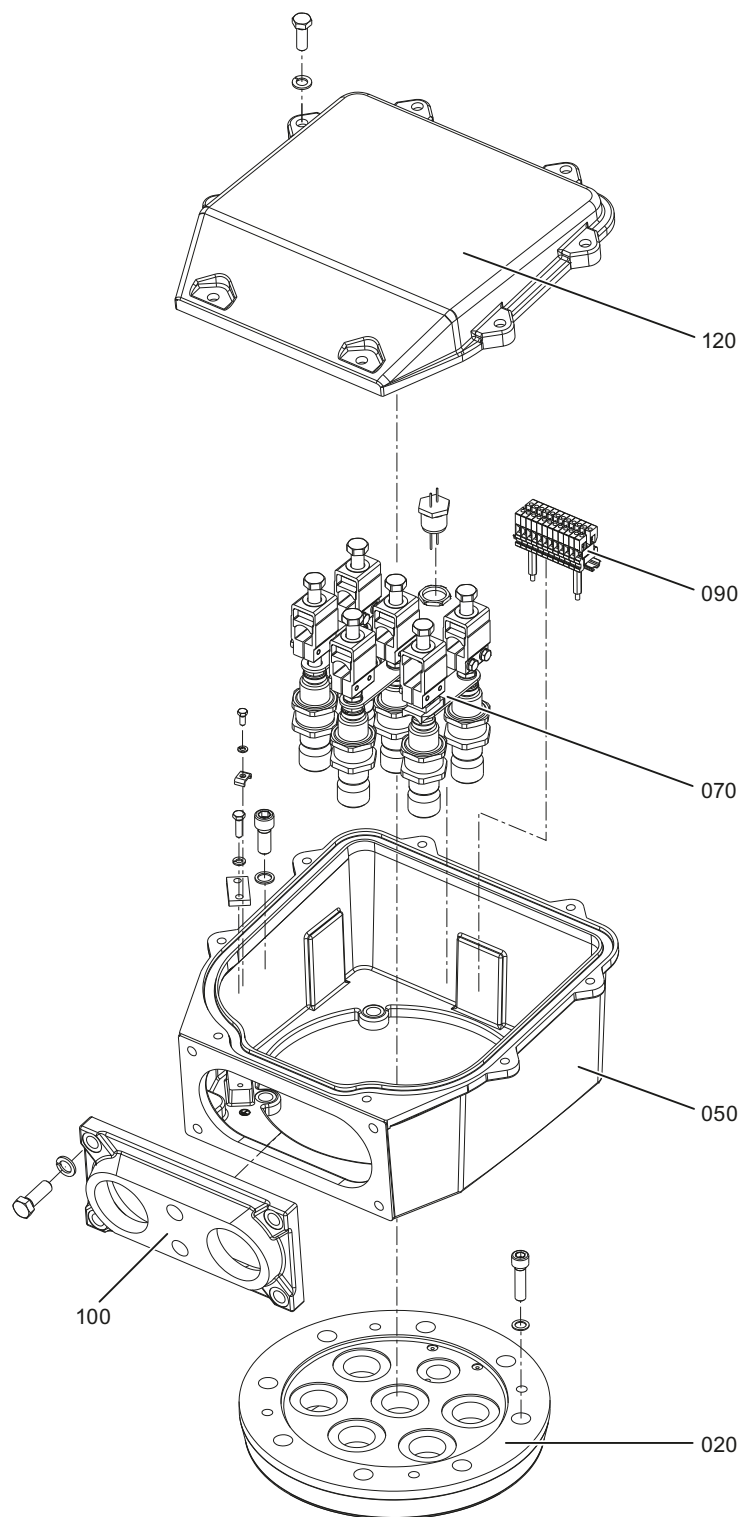


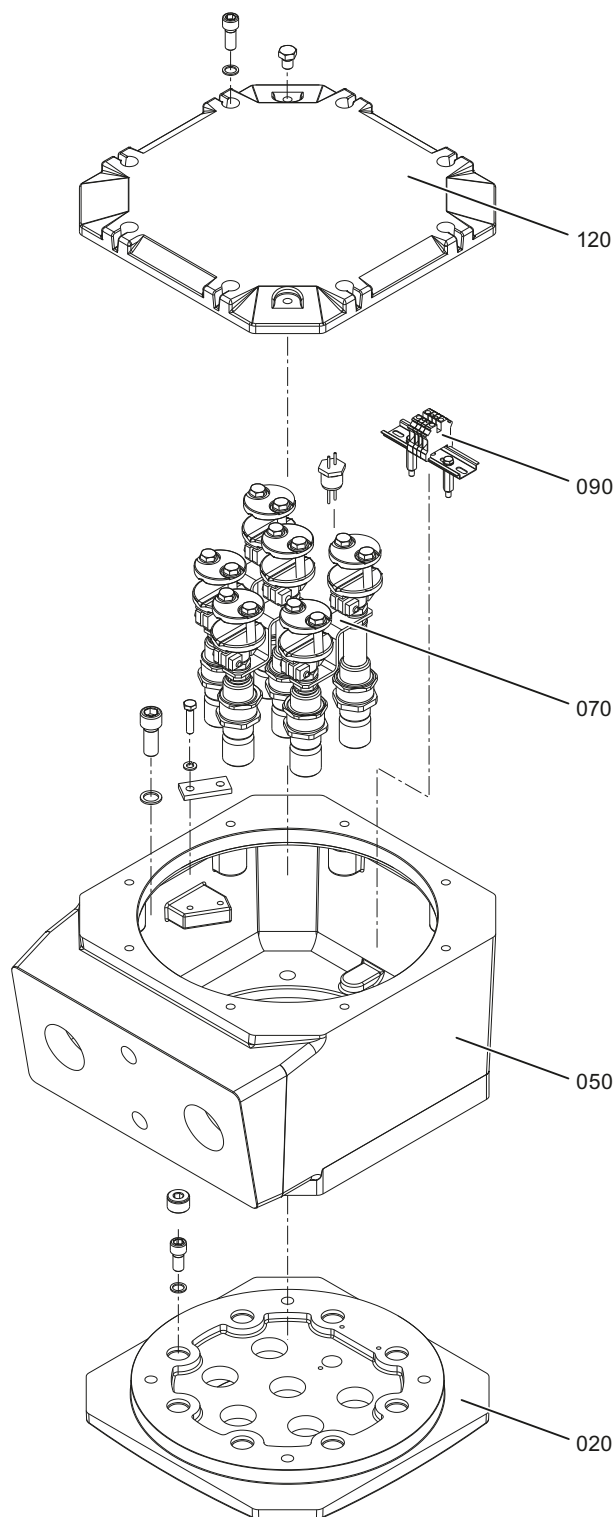
Figure 10-9 E-9-101\_285-0002

### *Spare parts*

#### *10.13 Spare parts list for terminal boxes with type of protection "Ex d", frame sizes 250 to 355*

<b>Part number</b>	<b>Designation</b>	<b>Parts Number</b>	<b>Designation</b>
020	Gland plate	090	Additional terminals
050	Terminal box base	100	Gland plate
070	Terminal board	120	Terminal box cover

## **10.14 Spare parts list for terminal boxes with type of protection "Ex d", frame sizes 250 to 355**



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*10.14 Spare parts list for terminal boxes with type of protection "Ex d", frame sizes 250 to 355*

<b>Parts Number</b>	<b>Designation</b>	<b>Parts Number</b>	<b>Designation</b>
050	Terminal box base	090	Additional terminals
051	Sealing washer	120	Terminal box cover
070	Terminal board		





## Disposal

### 11.1 Introduction

Protecting the environment and preserving its resources are corporate goals of the highest priority for us. Our worldwide environmental management system to ISO 14001 ensures compliance with legislation and sets high standards in this regard. Environmentally friendly design, technical safety and health protection are always firm goals even at the product development stage.

Recommendations for the environmentally friendly disposal of the machine and its components are given in the following section. Be sure to comply with local disposal regulations.

### 11.2 Preparing for disassembly

Disassembly of the machine must be carried out and/or supervised by qualified personnel with appropriate expert knowledge.

1. Contact a certified waste disposal organization in your vicinity. Clarify what is expected in terms of the quality of dismantling the machine and provision of the components.
2. Follow the five safety rules (Page 13).
3. Disconnect all electrical connections and remove all cables.
4. Remove all liquids such as oil and cooling liquids. Collect the liquids separately and dispose of them in a professional manner.
5. Detach the machine fixings.
6. Transport the machine to a suitable location for disassembly.

#### See also

Maintenance (Page 81)

## 11.3 Dismantling the machine

Dismantle the machine using the general procedures commonly used in mechanical engineering.



### **WARNING**

#### **Machine parts can fall**

The machine is made up of heavy parts. These parts are liable to fall during dismantling. This can result in death, serious injury or material damage.

Before you release any machine parts, secure them so that they cannot fall.

## 11.4 Disposal of components

### **Components**

The machines consist mainly of steel and various proportions of copper and aluminum. Metals are generally considered to be unlimitedly recyclable.

Sort the components for recycling according to whether they are:

- Iron and steel
- Aluminum
- Non-ferrous metal, e.g. windings  
The winding insulation is incinerated during copper recycling.
- Insulating materials
- Cables and wires
- Electronic waste

### **Process materials and chemicals**

Sort the process materials and chemicals for recycling according to whether they are for example:

- Oil
- Grease
- Cleaning substances and solvents
- Paint residues
- Anti-corrosion agent
- Coolant additives such as inhibitors, antifreeze or biocides

Dispose of the separated components according to local regulations or via a specialist disposal company. The same applies for cloths and cleaning substances which have been used while working on the machine.

**Packaging material**

- If necessary, contact a suitable specialist disposal company.
- Wooden packaging for sea transport consists of impregnated wood. Observe the local regulations.
- The foil used for water-proof packaging is an aluminum composite foil. It can be recycled thermally. Dirty foil must be disposed of via waste incineration.



# Service and Support

## A.1 Siemens Service Center

### Contact for further information

Details regarding the design of this electrical machine and the permissible operating conditions are described in these operating instructions.

#### Service numbers

If you wish to request local field service or order spare parts, or if you require answers to technical queries or any additional information, please contact the relevant service number below.

Please have the following machine data ready:

- Machine type
- Machine number

You can find this data on the rating plate of the machine.

Table A-1 Service numbers

Local field service	Phone	+49 (0)911 895 7444
	Fax	+49 (0)911 895 7445
Technical queries or additional information	Phone	+49 (0)911 895 7448
	Fax	+49 (0)911 895 7449
Spare parts and repairs	Phone	+49 (0)911 895 7222
	Fax	+49 (0)911 895 7223

Contact:

- <http://www.siemens.com/automation/support-request> (<http://www.siemens.com/automation/support-request>)
- [ld-service.i-cs@siemens.com](mailto:ld-service.i-cs@siemens.com) (<mailto:ld-service.i-cs@siemens.com>)



## Technical data and drawings

### B.1 Tightening torques for screw and bolt connections

#### Bolt locking devices

- Refit nuts or bolts that are mounted together with locking, resilient, and/or force-distributing elements with identical, fully-functional elements when re-assembling. Always renew keyed elements.
- When screwing together threads secured with a liquid adhesive, use a suitable medium such as Loctite 243.
- Always use suitable securing devices or removable adhesives (e.g., Loctite 243) when installing fixing bolts with a clamping length of less than 25 mm. The clamping length is taken as the distance between the head of the bolt and the point at which the bolt is screwed in.

#### Tightening torques

The bolted connections with metal contact surfaces, such as end shields, bearing cartridge parts, terminal box parts bolted onto the stator frame, should be tightened to the following torques, depending on the thread size:

Table B-1 Tightening torques for bolted connections with a tolerance of  $\pm 10\%$ .

Case	M4	M5	M6	M8	M10	M12	M16	M20	M24	M30	M36	M42	M48	M56	
A	1.2	2.5	4	8	13	20	40	52	80	150	-	-	-	-	Nm
B	1.3	2.6	4.5	11	22	38	92	180	310	620	1080	1700	2600	4200	Nm
C	3	5	8	20	40	70	170	340	600	1200	2000	3100	4700	7500	Nm

#### Applications

The above-mentioned tightening torques apply for the following applications:

*B.1 Tightening torques for screw and bolt connections*

- **Case A**  
Applies to electrical connections in which the permissible torque is normally limited by the bolt materials and/or the current carrying capacity of the insulators, with the exception of the busbar connections in case B.
- **Case B**  
Applies to bolts screwed into components made from materials with lower property class (e. g. aluminum) and to bolts with property class 8.8 according to ISO 898-1.
- **Case C**  
Applies to bolts with property class 8.8 or A4-70 according to ISO 898-1, however only to bolts screwed into components made from materials with higher property class, e.g. cast iron, steel or cast steel.

---

**Note**

**Non-standard tightening torques**

Different tightening torques for electrical connections and bolted connections for parts with flat seals or insulating parts are specified in the relevant sections and drawings.

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**See also**

Finishing connection work (Page 64)



## Quality documents

### C.1 IECEx certificate

If available, you can obtain the IECEx certificate on the Internet at the following address:

[Http://iecex.iec.ch/iecex/iecexweb.nsf/home?openform](http://iecex.iec.ch/iecex/iecexweb.nsf/home?openform)

**IECEx Certified Equipment** [PUBLIC AREA]

You are welcomed in as an **IECEx Guest User** [reader] and have full access to public information.

IECEx Certification Bodies please login to create or edit certificates [Password Protected] :

Quick access:    
Type in CoC ref. number (e.g.: "IECEx BAS 10.0001")

Free text search:    
You can use boolean operators "AND", "OR"

The IECEx Online Certified Equipment Scheme enables:

- IECEx Certification Bodies to issue new IECEx Certificates of Conformity "On-line"
- Full Public access to consult, view and print issued IECEx Certificates
- View Statistical information
- Export data to an Excel worksheet

For any questions, please contact Mr. Chris Agius , IECEx Secretary.

The IECEx ID for the IECEx certificate can be found on the rating plate of the machine or on the extra plate for explosion protection.

1. Enter the IECEx ID in the "Quick access" field.  
You then have access to the certificate.
2. If you scroll down completely to the bottom of the page shown, you can open the certificate as a PDF file and download it.

## C.2 EC Declaration of Conformity

**SIEMENS**

Industry

### EG Konformitätserklärung EC Declaration of Conformity

Hersteller: **Siemens AG**  
Manufacturer: **Hans-Loher-Straße 32  
94099 Ruhstorf/Rott, Germany**

Produktbezeichnung: **Drehstrom-Asynchronmaschinen der Zündschutzart**  
Product name: **Three phase asynchronous motors of the protection type  
Druckfeste Kapselung "d" / Flameproof Enclosure „d“**

Typ Type: **D ... 071 ... bis / to D ... 910 ...**  
Alternative Typenbezeichnung / alternative type  
**1PS.07. .... bis / to 1PS.91. ....**  
**1MD.07. .... bis / to 1MD.35. ....**

Das bezeichnete Produkt stimmt bei Ex-Kennzeichnung auf dem Typenschild mit den Vorschriften folgender  
Europäischer Richtlinien überein:  
*The indicated product with an adequate ex-marking on the rating plate is in conformity with the requirements of the  
following European Directives:*

<b>94/9/EG</b>	<b>Richtlinie des Europäischen Parlaments und des Rates zur Angleichung der Rechtsvorschriften der Mitgliedstaaten für Geräte und Schutzsysteme zur bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen</b>
<b>94/9/EC</b>	<b>Directive of the European Parliament and the council of the approximation of the Laws of the Member States concerning equipment and protective systems intended for use in potentially explosive atmospheres</b>


Die Übereinstimmung mit den Vorschriften dieser Richtlinien wird nachgewiesen durch die vollständige Einhaltung  
folgender Normen:  
*Conformity with the requirements of these directives is testified by complete adherence to the following standards:*

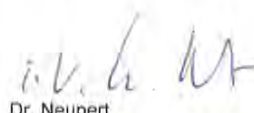
<b>EN 60079-0:2009</b>	<b>EN 60079-1:2007</b>	<b>EN 60079-7:2007</b>	<b>EN 60079-11:2012</b>
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Die EG-Baumusterprüfbescheinigungen für das bezeichnete Produkt sind in der Anlage angegeben.  
*The EC-Type Examination Certificates for the indicated product are specified in the appendix.*

Die Sicherheitshinweise der Produktdokumentation und die einschlägigen Errichtungsbestimmungen  
(z.B. EN 60204-1) sind zu beachten.  
*The safety notes in the product documentation and the relevant erection rules (e.g. EN 60204-1) must be  
observed.*

Ruhstorf/Rott, den 05. Dezember 2013

  
Hofbauer  
Leiter Qualitätssicherung  
Manager Quality assurance

  
Dr. Neupert  
Leiter Technik  
Manager Engineering

Diese Erklärung ist keine Zusicherung von Eigenschaften im Sinne der Produkthaftung.  
*This declaration is not a warranty of attributes within the meaning of the Law concerning product liability* Rev. Q

**Siemens AG**  
Industry Sector, Leitung: Siegfried Russwurm  
Drive Technologies Division, Leitung: Ralf-Michael Franke  
Large Drives, Leitung: Jürgen Amedick

Hans-Loher-Str. 32  
94099 Ruhstorf a. d. Rott  
Deutschland

Tel. +49 (8531) 39 0  
Fax: +49 (8531) 39 0

Siemens Aktiengesellschaft: Vorsitzender des Aufsichtsrats: Gerhard Cromme, Vorstand: Joe Kaeser, Vorsitzender:  
Roland Busch, Klaus Heinrich, Hermann Requardt, Siegfried Russwurm, Peter Y. Solmsen, Michael Suß, Ralf P. Thomas  
Sitz der Gesellschaft: Berlin und München, Deutschland, Registergericht: Berlin Charlottenburg, HRB 12300, München, HRB 6884  
WEEE-Reg.-Nr. DE 23691322

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**Anlage zur EG Konformitätserklärung**  
**Druckfeste Kapselung „d“**  
**Appendix to EC Declaration of Conformity**  
**Flameproof Enclosure “d”**

Gerät Equipment			EG-Baumusterprüf- bescheinigung EC-Type Examination Certificate	Gasgruppe gas group		Temperatur- klasse temperature class
Type type	Alternativer Typ alternative type	Lagerung bearing		IIB	IIC	
D***-071**.*	1PS*07*.*.*.*.*.* 1MD*07*.*.*.*.*.*	anti-friction	PTB 10 ATEX 1007 X		x	T3 - T6
			BVS 11 ATEX E 053 X	x	x	T3 - T6
			BVS 13 ATEX E 129 X	x	x	T3 - T6
D***-080**.*	1PS*08*.*.*.*.*.* 1MD*08*.*.*.*.*.*	anti-friction	PTB 09 ATEX 1091 X		x	T3 - T6
			BVS 11 ATEX E 027 X	x	x	T3 - T6
			BVS 13 ATEX E 128 X	x	x	T3 - T6
D***-090**.*	1PS*09*.*.*.*.*.* 1MD*09*.*.*.*.*.*	anti-friction	PTB 08 ATEX 1021 X		x	T3 - T6
			BVS 11 ATEX E 015 X	x	x	T3 - T6
			BVS 13 ATEX E 098 X	x	x	T3 - T6
D***-100**.*	1PS*10*.*.*.*.*.* 1MD*10*.*.*.*.*.*	anti-friction	PTB 09 ATEX 1087 X		x	T3 - T6
			BVS 10 ATEX E 155 X	x	x	T3 - T6
			BVS 13 ATEX E 127 X	x	x	T3 - T6
D***-112**.*	1PS*11*.*.*.*.*.* 1MD*11*.*.*.*.*.*	anti-friction	PTB 08 ATEX 1123 X		x	T3 - T6
			BVS 10 ATEX E 159 X	x	x	T3 - T6
			BVS 13 ATEX E 126 X	x	x	T3 - T6
D***-132**.*	1PS*13*.*.*.*.*.* 1MD*13*.*.*.*.*.*	anti-friction	PTB 08 ATEX 1119 X		x	T3 - T6
			BVS 10 ATEX E 123 X	x	x	T3 - T6
			BVS 13 ATEX E 099 X	x	x	T3 - T6
D***-160**.*	1PS*16*.*.*.*.*.* 1MD*16*.*.*.*.*.*	anti-friction	PTB 08 ATEX 1103 X		x	T3 - T6
			BVS 11 ATEX E 012 X	x	x	T3 - T6
			BVS 13 ATEX E 019 X	x	x	T3 - T6
D***-180**.*	1PS*18*.*.*.*.*.* 1MD*18*.*.*.*.*.*	anti-friction	PTB 09 ATEX 1044 X		x	T3 - T6
			BVS 11 ATEX E 047 X	x	x	T3 - T6
			BVS 13 ATEX E 017 X	x	x	T3 - T6
D***-200**.*	1PS*20*.*.*.*.*.* 1MD*20*.*.*.*.*.*	anti-friction	PTB 08 ATEX 1054 X		x	T3 - T6
			BVS 11 ATEX E 020 X	x	x	T3 - T6
			BVS 13 ATEX E 012 X	x	x	T3 - T6
D***-225**.*	1PS*22*.*.*.*.*.* 1MD*22*.*.*.*.*.*	anti-friction	PTB 08 ATEX 1107 X		x	T3 - T6
			BVS 11 ATEX E 046 X	x	x	T3 - T6
			BVS 12 ATEX E 103 X	x	x	T3 - T6
D***-250**.*	1PS*25*.*.*.*.*.* 1MD*25*.*.*.*.*.*	anti-friction	PTB 09 ATEX 1046 X		x	T3 - T6
			BVS 11 ATEX E 030 X	x	x	T3 - T6
			BVS 11 ATEX E 045 X	x	x	T3 - T6
D***-280**.*	1PS*28*.*.*.*.*.* 1MD*28*.*.*.*.*.*	anti-friction	PTB 09 ATEX 1070 X		x	T3 - T6
			BVS 11 ATEX E 051 X	x	x	T3 - T6
			BVS 12 ATEX E 029 X	x	x	T3 - T6
D***-315**.*	1PS*31*.*.*.*.*.* 1MD*31*.*.*.*.*.*	anti-friction	PTB 08 ATEX 1037 X		x	T3 - T6
			BVS 11 ATEX E 025 X	x	x	T3 - T6
			BVS 12 ATEX E 051 X	x	x	T3 - T6
DJS*-315**.*	1PS*31*.*.*.*.*.*	anti-friction	BVS 12 ATEX E 077 X	x	x	T3 - T6

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**Anlage zur EG Konformitätserklärung**  
**Druckfeste Kapselung „d“**  
**Appendix to EC Declaration of Conformity**  
**Flameproof Enclosure “d”**

Gerät Equipment			EG-Baumusterprüf- bescheinigung EC-Type Examination Certificate	Gasgruppe gas group		Temperatur- klasse temperature class
Typ type	Alternativer Typ alternative type	Lagerung bearing		IIB	IIC	
D***-355**.*	1PS*35*.*.*.*.*.*	anti-friction	PTB 08 ATEX 1077 X		x	T3 - T6
			PTB 08 ATEX 1078 X	x		T3 - T6
			PTB 08 ATEX 1079 X		x	T3 - T6
			BVS 11 ATEX E 003 X	x	x	T3 - T6
			BVS 13 ATEX E 120 X	x	x	T3 - T6
D***-400**.*	1PS*40*.*.*.*.*.*	anti-friction	PTB 07 ATEX 1060 X	x		T3 - T6
			PTB 07 ATEX 1047 X		x	T3 - T6
			BVS 11 ATEX E 162 X	x	x	T3 - T6
D*T*-400**.* D*V*-400**.*	1PS440*.*.*.*.*.*	sleeve	BVS 11 ATEX E 029 X	x		T3 - T6
D***-450**.*	1PS*45*.*.*.*.*.*	anti-friction	PTB 07 ATEX 1068 X		x	T3 - T6
			BVS 11 ATEX E 084 X	x	x	T3 - T6
D*T*-450**.* D*V*-450**.*	1PS445*.*.*.*.*.*	sleeve	BVS 11 ATEX E 067 X	x		T3 - T6
D***-500**.*	1PS*50*.*.*.*.*.*	anti-friction	PTB 08 ATEX 1035 X		x	T3 - T6
			PTB 08 ATEX 1036 X	x		T3 - T6
D*T*-500**.* D*V*-500**.*	1PS*50*.*.*.*.*.*	sleeve	PTB 07 ATEX 1074 X	x		T3 - T6
			BVS 10 ATEX E 142 X	x		T3 - T6
D*W*-500**.*	1PS*50*.*.*.*.*.*	anti-friction	BVS 09 ATEX E 159 X	x	x	T3 - T6
D***-560**.*	1PS*56*.*.*.*.*.*	anti-friction	PTB 07 ATEX 1042 X		x	T3 - T6
			PTB 07 ATEX 1043 X	x		T3 - T6
D*T*-560**.* D*V*-560**.*	1PS*56*.*.*.*.*.*	sleeve	PTB 07 ATEX 1046 X	x		T3 - T6
			BVS 12 ATEX E 092 X	x		T3 - T6
D***-630**.*	1PS*63*.*.*.*.*.*	anti-friction	PTB 06 ATEX 1028 X	x		T3 - T6
			PTB 06 ATEX 1022 X		x	T3 - T6
D*T*-630**.* D*V*-630**.*	1PS*63*.*.*.*.*.*	sleeve	PTB 07 ATEX 1075 X	x		T3 - T6
D***-710**.*	1PS*71*.*.*.*.*.*	anti-friction sleeve	PTB 09 ATEX 1009 X	x		T3 - T6
			BVS 13 ATEX E 045 X	x		T3 - T6
D***-800**.*	1PS*80*.*.*.*.*.*	anti-friction	PTB 09 ATEX 1078 X	x		T3 - T6
			BVS 11 ATEX E 170 X		x	T3 - T6
D*Q*-800**.*	1PS*80*.*.*.*.*.*	sleeve	PTB 06 ATEX 1049 X	x		T3 - T6
D*Q*-910**.*	1PS*91*.*.*.*.*.*	sleeve	BVS 10 ATEX E 103 X	x		T3 - T6

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## C.3 EC Declaration of Conformity, Zone 21 or 22

**SIEMENS**

Industry

**EG Konformitätserklärung  
EC Declaration of Conformity**

Hersteller: **Siemens AG**  
 Manufacturer: **Hans-Loher-Straße 32  
 94099 Ruhstorf/Rott, Germany**

Produktbezeichnung: **Drehstrom-Asynchronmaschinen der Zündschutzart**  
 Product name: **Three phase asynchronous motors of the protection type  
 Geräte-Staubexplosionsschutz durch Gehäuse "t"  
 Equipment dust ignition protection by enclosure "t"**

Typ Type: **A ... 071 ... bis / to A ... 800 ...  
 E ... 071 ... bis / to E ... 800 ...  
 D ... 071 ... bis / to D ... 910 ...**

Alternative Typenbezeichnung / alternative type  
**1PS.07. .... bis / to 1PS.91. ....  
 1MD.07. .... bis / to 1MD.35. ....**

Das bezeichnete Produkt stimmt bei Ex-Kennzeichnung auf dem Typenschild mit den Vorschriften folgender  
 Europäischer Richtlinien überein:

*The indicated product with an adequate ex-marking on the rating plate is in conformity with the requirements of the  
 following European Directives:*

**94/9/EG** **Richtlinie des Europäischen Parlaments und des Rates zur Angleichung der  
 Rechtsvorschriften der Mitgliedstaaten für Geräte und Schutzsysteme zur  
 bestimmungsgemäßen Verwendung in explosionsgefährdeten Bereichen**  
**94/9/EC** **Directive of the European Parliament and the council of the approximation of the  
 Laws of the Member States concerning equipment and protective systems intended  
 for use in potentially explosive atmospheres**

Die Übereinstimmung mit den Vorschriften dieser Richtlinien wird nachgewiesen durch die vollständige Einhaltung  
 folgender Normen:

*Conformity with the requirements of these directives is testified by complete adherence to the following standards:*

**EN 60079-0:2009****EN 60079-31:2009**


Die EG-Baumusterprüfbescheinigungen für das bezeichnete Produkt der Kategorie 2D sind in der Anlage  
 angegeben.

*The EC-Type Examination Certificates for the indicated product of the category 2D are specified in the appendix.*

Die Sicherheitshinweise der Produktdokumentation und die einschlägigen Errichtungsbestimmungen  
 (z.B. EN 60204-1) sind zu beachten.

*The safety notes in the product documentation and the relevant erection rules (e.g. EN 60204-1) must be  
 observed.*

Ruhstorf/Rott, den 05. Dezember 2013

  
 Hofbauer  
 Leiter Qualitätssicherung  
 Manager Quality assurance

  
 Dr. Neupert  
 Leiter Technik  
 Manager Engineering

Diese Erklärung ist keine Zusicherung von Eigenschaften im Sinne der Produkthaftung.

*This declaration is not a warranty of attributes within the meaning of the Law concerning product liability.*

Rev. N

**Siemens AG**  
 Industry Sector, Leitung: Siegfried Russwurm  
 Drive Technologies Division, Leitung: Ralf-Michael Franke  
 Large Drives, Leitung: Jürgen Amedick

Hans-Loher-Str. 32  
 94099 Ruhstorf a. d. Rott  
 Deutschland

Tel. +49 (8531) 39 0  
 Fax: +49 (8531) 39 0

Siemens Aktiengesellschaft, Vorsitzender des Aufsichtsrats: Gerhard Cromme, Vorstand: Joe Kaeser, Vorsitzender,  
 Roland Busch, Klaus Helmrich, Hermann Requardt, Siegfried Russwurm, Peter Y. Solmsen, Michael Süß, Ralf P. Thomas  
 Sitz der Gesellschaft: Berlin und München, Deutschland; Registergericht: Berlin Charlottenburg, HRB 12300, München, HRB 6684  
 WEEE-Reg.-Nr. DE 23691322

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**SIEMENS****Industry**

**Anlage zur EG Konformitätserklärung**  
**Geräte-Staubexplosionsschutz durch Gehäuse "t"**  
**Appendix to EC Declaration of Conformity**  
**Equipment dust ignition protection by enclosure "t"**

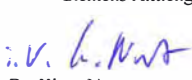

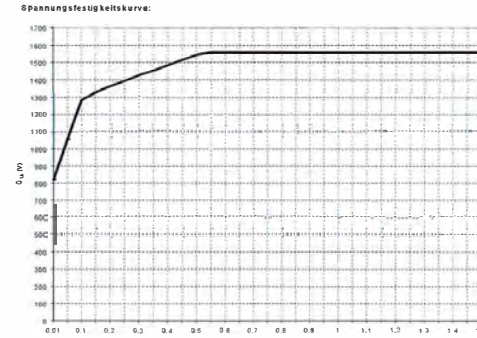
Gerät Equipment		EG-Baumusterprüf- bescheinigung
Type type	Alternativer Typ alternative type	EC-Type Examination Certificate
A***-071**.* E***-071**.*	1PS*07*-*****.*	BVS 11 ATEX E 006
D***-071**.*	1PS*07*-*****.* 1MD*07*-*****.*	BVS 11 ATEX E 053 X BVS 13 ATEX E 129 X
A***-080**.* E***-080**.*	1PS*08*-*****.*	BVS 11 ATEX E 014
D***-080**.*	1PS*08*-*****.* 1MD*08*-*****.*	BVS 11 ATEX E 027 X BVS 13 ATEX E 128 X
A***-090**.* E***-090**.*	1PS*09*-*****.*	BVS 11 ATEX E 092
D***-090**.*	1PS*09*-*****.* 1MD*09*-*****.*	BVS 11 ATEX E 015 X BVS 13 ATEX E 098 X
A***-100**.* E***-100**.*	1PS*10*-*****.*	BVS 11 ATEX E 105
D***-100**.*	1PS*10*-*****.* 1MD*10*-*****.*	BVS 10 ATEX E 155 X BVS 13 ATEX E 127 X
A***-112**.* E***-112**.*	1PS*11*-*****.*	BVS 11 ATEX E 112
D***-112**.*	1PS*11*-*****.* 1MD*11*-*****.*	BVS 10 ATEX E 159 X BVS 13 ATEX E 126 X
A***-132**.* E***-132**.*	1PS*13*-*****.*	BVS 11 ATEX E 118
D***-132**.*	1PS*13*-*****.* 1MD*13*-*****.*	BVS 10 ATEX E 123 X BVS 13 ATEX E 099 X
A***-160**.* E***-160**.*	1PS*16*-*****.*	BVS 11 ATEX E 126
D***-160**.*	1PS*16*-*****.* 1MD*16*-*****.*	BVS 11 ATEX E 012 X BVS 13 ATEX E 019 X
A***-180**.* E***-180**.*	1PS*18*-*****.*	BVS 11 ATEX E 010
D***-180**.*	1PS*18*-*****.* 1MD*18*-*****.*	BVS 11 ATEX E 047 X BVS 13 ATEX E 017 X
A***-200**.* E***-200**.*	1PS*20*-*****.*	BVS 11 ATEX E 005
D***-200**.*	1PS*20*-*****.* 1MD*20*-*****.*	BVS 11 ATEX E 020 X BVS 13 ATEX E 012 X
A***-225**.* E***-225**.*	1PS*22*-*****.*	BVS 11 ATEX E 017
D***-225**.*	1PS*22*-*****.* 1MD*22*-*****.*	BVS 11 ATEX E 046 X BVS 12 ATEX E 103 X
A***-250**.* E***-250**.*	1PS*25*-*****.*	BVS 11 ATEX E 034
D***-250**.*	1PS*25*-*****.* 1MD*25*-*****.*	BVS 11 ATEX E 030 X BVS 11 ATEX E 045 X

Gerät Equipment		EG-Baumusterprüf- bescheinigung
Type type	Alternativer Typ alternative type	EC-Type Examination Certificate
A***-280**.* E***-280**.*	1PS*28*-*****.*	BVS 11 ATEX E 125
D***-280**.*	1PS*28*-*****.* 1MD*28*-*****.*	BVS 11 ATEX E 051 X BVS 12 ATEX E 029 X
A***-315**.* E***-315**.*	1PS*31*-*****.*	BVS 11 ATEX E 123
D***-315**.*	1PS*31*-*****.* 1MD*31*-*****.*	BVS 11 ATEX E 025 X BVS 12 ATEX E 051 X
A***-355**.* E***-355**.*	1PS*35*-*****.*	BVS 10 ATEX E 077
D***-355**.*	1PS*35*-*****.* 1MD*35*-*****.*	BVS 11 ATEX E 003 X BVS 13 ATEX E 120 X
A***-400**.* E***-400**.*	1PS*40*-*****.*	BVS 10 ATEX E 078
D***-400**.*	1PS*40*-*****.*	BVS 11 ATEX E 162 X
D***-450**.*	1PS*45*-*****.*	BVS 11 ATEX E 084 X
A***-500**.* E***-500**.*	1PS*50*-*****.*	BVS 13 ATEX E 114
D***-*****.* A***-*****.* E***-*****.*	1PS*****.* 1MD*****.*	BVS 03 ATEX E 259

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## C.4 Data

<b>R-No. 20000h</b>	<b>Siemens Aktiengesellschaft</b> Postfach 1164 D-94095 Ruhstorf	<b>SIEMENS</b>
<p align="center"><b><u>INVERTER OPERATION OF EXPLOSION-PROTECTED LOW VOLTAGE THREE-PHASE MOTORS IN PROTECTION TYPE FLAMEPROOF ENCLOSURE AND PROTECTION TYPE N (NON-SPARKING) FOR THE TEMPERATURE CLASSES T1-T4</u></b></p> <p>Inverter operation of explosion-protected motors is allowed, when the following requirements are met:</p> <ol style="list-style-type: none"> <li>The output voltage of the inverter is to be adjusted in such a way that in the frequency range up to the rated frequency of the motor an almost linear relationship between the (fundamental) voltage and the (fundamental) frequency is kept, i.e. the practically constant motor flux must be kept in accordance with the rated data.  Motors operating above the 1.1 fold rated frequency are only permitted if a corresponding rating plate for inverter operation is fixed on the motor.</li> <li><math>I_{\text{contin}}</math> is the value to which the inverter management limits the current in continuous duty. <math>I_{\text{contin}}</math> is to be adjusted to the continually permitted motor rated current as a maximum in accordance with the rating plate for inverter operation attached to the motor or in conformity with the value determined in the describing documents for inverter operation (R-No.).</li> <li><math>I_{\text{short}}</math> is the value to which the inverter management limits the current in case of a short-time overload for a period of <math>\max. t_{\text{short}}</math>. <math>I_{\text{short}}</math> is to be adjusted to <math>1.5 \times I_{\text{contin}}</math> at a maximum.</li> <li><math>t_{\text{short}}</math> is the period for which the inverter allows an exceeding of <math>I_{\text{contin}}</math>. <math>t_{\text{short}}</math> is to be adjusted to 60 s at a maximum.</li> <li>The built-in temperature sensors (PTC thermistors) which must be suitable for sole protection are to be connected to a tripping device provided with the EC type examination certificate, like e.g. CK140: PTB 04 ATEX 3038 or CK144/145: PTB 02 ATEX 3059, according to Directive 94/9/EC.</li> <li>Voltage peaks (especially for PWM inverters with long motor cable)             <ol style="list-style-type: none"> <li>The design of the terminal box concerning the air and creepage distances allows the inverter operation with voltage peaks (<math>\hat{U}_{LL}</math> = Maximum value of the conductor-to-conductor voltage and <math>\hat{U}_{LE}</math> = Maximum value of the line-to-earth voltage) up to <math>\hat{U} = 1866 \text{ V}</math> which is not allowed to be exceeded for explosion protection reasons.</li> <li>To avoid the formation of partial discharges it is required for Ex nA machines that the voltage at the motor terminals is limited, depending on the rise time to values which are below the characteristic curve of the chart "Dielectric strength curve" (see diagram below). In order not to limit the service life this is recommended for Ex d motors.</li> </ol> </li> </ol> <p>Ruhstorf, 2012-09-10</p> <p align="right">Siemens Aktiengesellschaft            Dr. Klaus Neupert                Karl Hofbauer       </p> <p align="center">Spannungsfestigkeitskurve:</p> 		

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AC EC-Declaration of Conformity (U161)  
AB EC-Declaration of Conformity (U163)  
AA R-No.20000h (U165)

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