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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.

⚠️ DANGER
indicates that death or severe personal injury will result if proper precautions are not taken.

⚠️ WARNING
indicates that death or severe personal injury may result if proper precautions are not taken.

⚠️ CAUTION
indicates that minor personal injury can result if proper precautions are not taken.

NOTICE
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.

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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

1.1 About these instructions

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 137).

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.

1.2 Compiling personal documents

On the Internet pages in Industry Online Support you have the possibility of compiling personal documents using the function Documentation (https://support.industry.siemens.com/My/ww/en/documentation)

Using the "Documentation" function, from Product Support manuals, you can compile your own "Documentation". However, you can also include other Product Support content such as FAQs or characteristics in the documentation that you compile.

In the "Documentation" function, you have the option of creating your own compiled documents in your own structure and managing them. You can delete or shift individual chapters or topics. Further, using the note function you can import your own content. The compiled "documentation" can be exported as PDF, for example.
Introduction

1.2 Compiling personal documents

Using the "Documentation" function, you can efficiently compile your own plant or system documentation. The "Documentation" compiled in a specific language can also be automatically exported in one of the other available languages.

The full functionality is only available for registered users.
2.1 Information for the nominated person in control of the electrical installation

This electric machine has been designed and built in accordance with the specifications contained in Directive 2006/95/EC up to April 19, 2016 - and from April 20, 2016 according to Directive 2014/35/EU ("Low-Voltage Directive") and is intended for use in industrial plants. Please observe the country-specific regulations when using the electric machine outside the European Community. Follow the local and industry-specific safety and setup regulations.

The persons responsible for the plant must ensure the following:

- Planning and configuration work and all work carried out on and with the machine is only to be done by qualified personnel.
- The operating instructions must always be available for all work.
- The technical data as well as the specifications relating to the permissible installation, connection, ambient and operating conditions are taken into account at all times.
- The specific setup and safety regulations as well as regulations on the use of personal protective equipment are observed.

Note

Use the services and support provided by the appropriate Service Center (Page 137) for planning, installation, commissioning, and servicing work.

You will find safety instructions in the individual sections of this document. Follow the safety instructions for your own safety, to protect other people and to avoid damage to property.

Observe the following safety instructions for all activities on and with the machine.

2.2 The five safety rules

For your own personal safety and to prevent material damage when carrying out any work, always observe the safety-relevant instructions and the following five safety rules according to EN 50110-1 "Working in a voltage-free state". Apply the five safety rules in the sequence stated before starting work.

Five safety rules

1. Disconnect the system.
   Also disconnect the auxiliary circuits, for example, anti-condensation heating.
2. Secure against reconnection.
3. Verify absence of operating voltage.
4. Ground and short-circuit.
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 15) 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.
<table>
<thead>
<tr>
<th><strong>WARNING</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rotating parts</strong></td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>● Only remove the covers using the methods described by these operating instructions.</td>
<td></td>
</tr>
<tr>
<td>● Operate the machine properly.</td>
<td></td>
</tr>
<tr>
<td>● Regularly and correctly maintain the machine.</td>
<td></td>
</tr>
<tr>
<td>● Secure free-standing shaft ends and other rotating parts such as couplings, belt pulleys etc. against touch.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>WARNING</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hot surfaces</strong></td>
<td></td>
</tr>
<tr>
<td>Electric machines have hot surfaces. Do not touch these surfaces. They could cause burns.</td>
<td></td>
</tr>
<tr>
<td>● Allow the machine to cool before starting work on the machine.</td>
<td></td>
</tr>
<tr>
<td>● Only remove the covers using the methods described by these operating instructions.</td>
<td></td>
</tr>
<tr>
<td>● Operate the machine properly.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CAUTION</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Hazardous substances</strong></td>
<td></td>
</tr>
<tr>
<td>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.</td>
<td></td>
</tr>
<tr>
<td>● Read the information in these operating instructions and the product information supplied by the manufacturer.</td>
<td></td>
</tr>
<tr>
<td>● Observe the relevant safety regulations and wear the personal protective equipment specified.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>CAUTION</strong></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flammable substances</strong></td>
<td></td>
</tr>
<tr>
<td>Chemical substances required for the setup, operation and maintenance of machines may be flammable. Burns and other damage to health and material may result.</td>
<td></td>
</tr>
<tr>
<td>● Read the information in these operating instructions and the product information supplied by the manufacturer.</td>
<td></td>
</tr>
<tr>
<td>● Observe the relevant safety regulations and wear the personal protective equipment specified.</td>
<td></td>
</tr>
</tbody>
</table>
**WARNING**

Noise emissions

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.

---

### 2.5 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

2.6 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 - from April 20, 2016 of the European directive 2014/30/EU on Electromagnetic Compatibility.

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

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

2.8 Influence on the line power supply through a strongly irregular torque
A strongly irregular torque, for example with the drive of a reciprocating motor, forces a non-sinusoidal motor current. The emerging harmonics can have an impermissible influence on the line power supply via the connection lines.
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.

Observe the EMC instructions of the converter manufacturer in order to avoid exceeding the limit values according to IEC/EN 61000-6-3 for drive systems comprising machine and converter. You must put appropriate EMC measures in place.

2.10 Electromagnetic fields when operating electrical power engineering installations

⚠️ WARNING

Interference to electronic devices caused by electrical power equipment

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.

- It is forbidden for people with pacemakers to enter the vicinity of the machine.
- 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.
- Observe the nationally applicable health and safety regulations.
- Do not carry any magnetic or electronic data media.
Description

Applications

This electrical machine has been designed for a wide range of drive and energy conversion applications. The machines are characterized by extreme ruggedness, long service life, and overall reliability. They are also highly versatile, allowing them to be tailored to specific functions.

Details of the supplied machine and permissible operating conditions can be found in this documentation.

The machine was designed in accordance with the ordering party's specification and may only be used for the contractually agreed purpose. The permissible operating conditions are specified on the rating plate. The technical data are described in the catalog.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of explosion</td>
</tr>
</tbody>
</table>

This machine is not designed for use in hazardous areas. An explosion can occur if the machine is operated in these areas. This can result in death, serious injury or material damage. **Never** operate this machine in hazardous areas.

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 or EU Declarations of Conformity for the versions of the harmonized standards referenced.

Table 3-1 Machine design

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

* For machines in line operation only
See also

Quality documents (Page 141)

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.

Table 3-2 Data on the rating plate

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1)</td>
<td>Type of motor</td>
<td>(12)</td>
<td>Rated speed [rpm]</td>
</tr>
<tr>
<td>(2)</td>
<td>Motor type</td>
<td>(13)</td>
<td>Starting current ratio</td>
</tr>
<tr>
<td>(3)</td>
<td>Serial number</td>
<td>(14)</td>
<td>(empty)</td>
</tr>
<tr>
<td>(4)</td>
<td>Type of construction</td>
<td>(15)</td>
<td>Certificate number</td>
</tr>
<tr>
<td>(5)</td>
<td>Temperature class</td>
<td>(16)</td>
<td>Degree of protection</td>
</tr>
<tr>
<td>(6)</td>
<td>Rated voltage [V] and connections</td>
<td>(17)</td>
<td>Rotor class</td>
</tr>
<tr>
<td>(7)</td>
<td>Rated frequency [Hz]</td>
<td>(18)</td>
<td>Motor weight [kg]</td>
</tr>
<tr>
<td>(8)</td>
<td>(Content depending on the version)</td>
<td>(19)</td>
<td>Additional information (optional)</td>
</tr>
<tr>
<td>(9)</td>
<td>Rated current [A]</td>
<td>(20)</td>
<td>Maximum speed [rpm]</td>
</tr>
<tr>
<td>(10)</td>
<td>Rated power [kW]</td>
<td>(21)</td>
<td>Country of manufacture / City</td>
</tr>
<tr>
<td>(11)</td>
<td>Power factor [cos φ]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**Efficiency requirement**

According to EU Regulation (EC) No. 640/2009, the IE3 efficiency requirement for low-voltage motors with a power of 7.5 kW to 375 kW for line operation has been in force since January 01, 2015.

From January 1, 2017, the IE3 efficiency requirement for motors with a power of 0.75 kW to 375 kW applies for line operation.

Efficiency IE2 still applies for motors that are operated from a converter.

Please note the applicable country-specific rules and regulations.

**Rotors**

The rotor assembly is pressed onto the shaft together with the cage winding. The drive end of the shaft usually has a cylindrical shaft end. Dependent on the design, a second shaft end may be located at the non-drive end.

**Cooling**

The cooling system is designed as a closed, internal cooling circuit. The heat lost from the machine is dissipated to the ambient air via the machine’s surface. A shaft-mounted fan moves the cooling air in the primary circuit. Movement of the cooling air in the secondary circuit is driven by a shaft-mounted fan.

**Fan**

- The internal fans are bidirectional.
- External fan:
  - Machines with four poles and more as well as 1L.831.-2: The external fans are bidirectional.
  - Two-pole machines except 1L.831.-2: The external fans are unidirectional. The machines have an additional label on the end shield and on the rating plate with an arrow indicating the direction of rotation. The 1L.831.-2 can optionally also be equipped with a unidirectional external fan.
Rolling-contact bearings

The machines are equipped with different types of rolling-contact bearings depending on the version and the operating conditions described in the order. The different types are listed on the lubricant plate of the machine. In converter operation an insulated bearing is usually installed on the non-drive end. The following rolling-contact bearing variants are available:

Table 3-3 Rolling-contact bearing variants

<table>
<thead>
<tr>
<th>Version</th>
<th>Rolling-contact bearing</th>
</tr>
</thead>
</table>
| Horizontal type of construction, coupling output | • Drive end: Deep-groove ball bearing as a fixed bearing  
• Non-drive end: Deep-groove ball bearing as a floating bearing with axial compression springs |
| Horizontal type of construction, for increased transverse forces e.g. in the case of belt coupling | • Drive end: Cylindrical-roller bearing as a floating bearing  
• Non-drive end: Deep-groove ball bearing as a fixed bearing |
| Vertical type of construction, shaft height 315, coupling output | • Drive end: Deep-groove ball bearing as a fixed bearing  
• Non-drive end: Deep-groove ball bearing as a floating bearing with axial compression springs |
| Vertical type of construction, shaft height 355 ... 450 | • Drive end: Pairing of angular-contact ball bearing / deep-groove ball bearing as a fixed bearing  
• Non-drive end: Deep-groove ball bearing as a floating bearing with axial compression springs |

Rolling-contact bearing design for "Increased degree of protection" (option)

Improved sealing of the bearing units to prevent dust and water from getting in can be achieved by positioning a grease chamber ahead of the actual bearing unit. Although the same grease is used in both cases for reasons of convenience, a distinction is made here between "lubricating grease" and "sealing grease" because of their different functions.

Layout

The spent lubricating grease collects in the space between the bearing housing and the outer bearing cap. The latter also forms the sealing grease chamber with the labyrinth sealing ring (optional). The second lubricating nipple containing the grease duct for pressing in the sealing grease is also located in the outer bearing cap. The chamber is sealed off from the space where the lubricating grease collects by a V-ring or a V-ring and felt ring combination which prevents the sealing grease in the chamber from penetrating into the lubricating grease collecting space. During operation, the sealing grease in the chamber slowly runs out via the labyrinth and seals it, additionally removing dust from inside and around the outside of the labyrinth ring.

Terminal box

The terminal box can be arranged either on the left or right of the machine. It is not possible to change the position to the other side of the machine at a later date.
If you wish to upgrade to the next largest terminal box at a later date, please contact the manufacturer. Depending on the shaft height, the following terminal boxes are used for connecting the cables:

Table 3-4 Assignment of shaft heights to terminal boxes

<table>
<thead>
<tr>
<th>Shaft height</th>
<th>Terminal box</th>
</tr>
</thead>
<tbody>
<tr>
<td>315</td>
<td>GT640 ¤</td>
</tr>
<tr>
<td>315 ... 355</td>
<td>1XB1621</td>
</tr>
<tr>
<td>315 ... 450</td>
<td>1XB1631</td>
</tr>
<tr>
<td>315 ... 450</td>
<td>1XB1634</td>
</tr>
<tr>
<td>315 ... 450</td>
<td>1XB9600 ¤</td>
</tr>
</tbody>
</table>

¤ Not for explosion-proof versions

**Note**

**Rotating the terminal box**

Depending on the version, the terminal box can be rotated. It can then be rotated through increments of 90° corresponding to the connection direction.

If required, contact your Service Center (Page 137).

**Supplementary devices**

Depending on the order, various supplementary devices can be installed or mounted. These include sensors for bearing temperature monitoring or winding monitoring, for example.

**Anti-condensation heating (option)**

The machine is 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" (Page 15) and in related sections.

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

4.2 Observing the operating mode

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

4.3 Thermal motor protection

The machine is equipped with PTC thermistors for direct monitoring of the motor temperature to protect the machine against overheating during operation. Plan a corresponding circuit for monitoring.

See also

Set values for monitoring the winding temperature (Page 84)
Setpoint values for monitoring the bearing temperature (Page 84)

4.4 Interlock circuit for anti-condensation heating (option)

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 switch on the anti-condensation heating after the motor has been switched off. Carefully comply with the data on the anti-condensation heating plate.
See also
Switching off the anti-condensation heating (Page 88)

4.5 Noise emissions

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise emissions</td>
</tr>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

4.6 Rotational speed limit values

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excessively high speeds</td>
</tr>
<tr>
<td>Excessive rotational speed can lead to serious damage to the machine. This can result in death, serious injury, or material damage.</td>
</tr>
<tr>
<td>• Avoid operation above the permissible speed by using the appropriate control function.</td>
</tr>
<tr>
<td>• Observe the speeds stamped on the rating plate.</td>
</tr>
</tbody>
</table>

4.7 Phase synchronization during supply system switching

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply system switching</td>
</tr>
<tr>
<td>Damage to the machine may be caused when switching to another supply system with different phasing.</td>
</tr>
<tr>
<td>• The phasing must be synchronized during switching. Use appropriate means to synchronize the phasing.</td>
</tr>
</tbody>
</table>
4.8 Space requirements

Observe the minimum dimension for the air inlet at the machine site:

Table 4-1 Minimum dimensions for air intake

<table>
<thead>
<tr>
<th>Shaft height</th>
<th>31.</th>
<th>35.</th>
<th>40.</th>
<th>45.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>130 mm</td>
<td>140 mm</td>
<td>150 mm</td>
<td>160 mm</td>
</tr>
</tbody>
</table>

4.9 Voltage and frequency fluctuations during line operation

If nothing else is stamped on the nameplate, then the permissible voltage fluctuation is ±5 % and the permissible frequency fluctuation is ±2 %, corresponding to range A in IEC / EN 60034-1. Permissible fluctuations that go beyond this are specified on the nameplate, e.g. voltage fluctuation of ±10 % corresponding to range B in IEC / EN 60034-1.

The following applies: Under practical operating conditions a machine may sometimes have to be operated outside the limits of Range A. 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.

**NOTICE**

**Overheating of the winding**

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.

4.10 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. The vibration limit values according to DIN ISO 10816-3 must not be exceeded.
4.11 Torsional loading of the drive train due to faults in the electrical supply

In the event of faults in the electrical connection during operation, excessive air gap torques can lead to additional mechanical torsional load on the line shaft.

Note

The system planner is responsible for the entire drive train.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serious damage to the machine</td>
</tr>
<tr>
<td>If the configuration does not correctly recognize the mechanical torsional loadings of the shaft assembly, this can lead to serious damage to the machine. This can result in death, serious injury or material damage.</td>
</tr>
<tr>
<td>When planning the system, consider the configuration data.</td>
</tr>
</tbody>
</table>

Note

More information about this may be found in the catalog.

4.12 Transport and storage

When carrying out any work on the machine, observe the general safety instructions (Page 15) and the specifications contained in EN 50110-1 regarding safe operation on electrical equipment.

4.12.1 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).

Note the symbols which appear on the packing. These have the following meanings:

- Top
- Fragile material
- Keep dry
- Keep cool
- Center of gravity
- Do not use hand hook
- Attach here
4.12.2 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.

4.12.3 Requirements for safe lifting and transporting

To safely lift and transport the machine, the following requirements must be met:

- Personnel operating cranes and fork-lift trucks must be appropriately qualified.
- If the motor is packed, depending on the weight, size and on-site conditions, lift crates and transport frames using a fork-lift truck or a crane with slings.
  - Use a crane or fork-lift truck suitable for the load.
  - The center of gravity of the goods and the positions of the hoisting points are indicated on the packaging. Do not hoist any goods with damaged packaging.
- When lifting the machine, use only approved and undamaged sling guides and spreaders of sufficient rated capacity. Check the lifting equipment prior to its use. The weight of the machine is shown on the rating plate.
- When lifting the machine, refer to the information on the lifting plate.
  - Comply with the specified spreading angles.
  - Do not exceed the maximum lifting acceleration and lifting speed specified on the lifting plate. Lift the machine without jerking it.
    Acceleration \( a \leq 0.4 \text{ g (} \approx 4 \text{ m/s}^2 \) 
    Velocity \( v \leq 20 \text{ m/min} \)
- Use only the load carrying device on the stator frame for lifting.

⚠️ WARNING
The machine can tip over, slip or fall down during transport if a different construction is used

If you do not transport or lift the machine in a position appropriate for its construction, the machine can tip, slip into the lifting equipment or fall down. This can result in death, serious injury or material damage.

- Use only the load carrying device on the stator frame for lifting.
- Use the load carrying device appropriate for the machine position.
- Use suitable rope guiding or spreading devices. The weight of the machine is shown on the rating plate.
**4.12 Transport and storage**

### 4.12.4 Securing the rotor

Depending on the version, the machine is fitted with a rotor shipping brace.

**NOTICE**

**Damage during transport**

Not using the rotor shipping brace can cause damage to the machine if it is jolted during transport. Material damage can result.

- If the machine is fitted with a rotor shipping brace, this should always be used when transporting the machine. It must be securely attached during transportation.
- Only remove it before pushing on the output element. If you transport the machine after the output element has been pushed on you must take other appropriate measures to fix the axial position of the rotor. Please refer to the illustration below.
- In the case of vertical design motors, disassemble the rotor shipping brace in the vertical position only. Fix the rotor in position before the machine is turned onto its side if a machine has to be transported in a horizontal position. Vertical motors are supplied from the manufacturing plant in the horizontal position.

---

**Image 4-1  Axial location of the rotor**

- **Sleeve**
- **Screw and washer**
Table 4-2  Tightening torque for the shaft screw on the rotor shipping brace

<table>
<thead>
<tr>
<th>Thread in the shaft end</th>
<th>Tightening torque</th>
<th>Preload</th>
</tr>
</thead>
<tbody>
<tr>
<td>M20</td>
<td>80 Nm</td>
<td>20 kN</td>
</tr>
<tr>
<td>M24</td>
<td>150 Nm</td>
<td>30 kN</td>
</tr>
<tr>
<td>M30</td>
<td>230 Nm</td>
<td>40 kN</td>
</tr>
</tbody>
</table>

**Note**

*Store the rotor locking device*

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

---

4.12.5  Transporting the machine set

⚠️ **WARNING**

**Falling down of the machine**

The lifting lugs on the machine are designed only for the weight of the machine. If a machine set is lifted and transported on a single machine, this can lead to mechanical failure of the lifting lug. The machine or machine set may fall. This can result in death, serious injury or material damage.

- Do not lift machine sets by attaching lifting tackle to the individual machines.
- Use only the equipment provided, e.g. the openings or lugs on the base plates, for transporting machine sets. Note the maximum capacity of the lifting lug.

---

**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.
4.12.6 Storage

If the machine is not going to be commissioned soon after delivery, ensure that it is stored correctly.

**NOTICE**

**Seizure damage to bearings**

If the machine is stored incorrectly there is a risk that the bearings will suffer damage while out of use. Examples of resulting damage can include scoring and corrosion.

Read the following storage instructions.

**Preconditions and preparations**

- Only store goods in undamaged packaging. If goods are delivered in damaged packaging, unpack them and store appropriately according to the nature of the goods.
- Repair any damage to the packaging before putting the equipment into storage insofar as this is necessary to ensure proper storage conditions.

**General instructions for storage**

Wherever possible, store the machine in a storage room. The place of storage must satisfy the following general conditions:

- Select a sufficiently sized dry and horizontal place of storage that is above flood level and free of vibration ($v_{eff} \leq 0.2 \text{ mm/s}$).
  - The place of storage must be well ventilated as well as free of dust and frost. Provide protection against extreme weather conditions. Ensure that the temperature remains stable in the range from 10°C (50°F) to 50°C (120°F). The room temperature should be approx. 10 K above the outside temperature. The temperature should not fall below -20°C.
  - The relative humidity of the air should be less than 60%.
  - The floor of the place of storage must be sufficiently strong. The maximum permissible floor loading or storage compartment loading may not be exceeded.
  - The ambient air must not contain any harmful gases.
- Protect the motor from shocks and humidity.
- Position machines, devices and crates on pallets, wooden beams or foundations that protect them against rising damp and water.
- Ensure that the air circulation under the equipment is not impeded.
  - Place wooden spacer blocks between the covers and the motor.
  - Covers or tarpaulins must not trail on the floor around the machine.
Storing outdoors

For outdoor storage, the following additional conditions must be satisfied:

- The ground must be sufficiently strong. Prevent the motor from sinking into the ground.
- Covers or tarpaulins used to protect the equipment against the weather must not make contact with the surfaces of the equipment. Otherwise air circulation under the stored items will be prevented.

Protection against humidity

If a dry storage space is not available, protect the machine as follows against humidity:

- Wrap the machine in humidity-absorbent material.
- Wrap the machine in plastic film:
  - Place a humidity meter inside the plastic film.
  - Place desiccant within the plastic film.
  - Pack the machine air-tight.
- Inspect the machine regularly.

NOTICE

Damage to the roller bearings

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 (Page 32). Protect the machine against strong radial vibrations, since the rotor shipping brace might not absorb these completely.

NOTICE

Bearing damage

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 locking device.

Long-term storage

If you are storing a machine for more than six months, you must check its condition every six months. Store the machine in accordance with the specifications in Section "Storage (Page 34)", and if possible, packed.

- Check the motor for damage.
- Carry out any necessary maintenance work.
• Make sure that the storage conditions are such that condensation cannot form in the motor.
• If the machine is not sealed in plastic film, continually and slightly heat the machine, e.g. with anti-condensation heating (if available), and ensure that the air circulates in the storage room.

Storage for longer than three months

Lubricate the machine after every two years of storage.
1. Unpack the machine.
2. Remove the rotor shipping brace, if one is being used.
3. When stored for longer than two years, lubricate with twice the grease quantity in accordance with the lubricant plate. This ensures that the grease is evenly distributed and covers all surfaces. Corrosion damage is avoided.

| NOTICE |
| Damage to roller bearings |
| Roller bearings can be damaged when kept in the same or almost the same position. |
| Every three months, manually rotate the rotor through five revolutions. Make sure that the resting position of the roller bearings after the rotor has been turned is different from what it previously had been. Use the feather key as a reference point, if present. |

4. Replace the corrosion protection.
5. Reattach the rotor shipping brace, if present.
6. Pack the machine again.

4.12.7 Protection against corrosion

If the machine is stored in dry conditions, then apply the subsequently listed anti-corrosion measures:
• Storage up to six months: Apply a coat of corrosion protective compound to all accessible bare metal parts such as the exposed shaft extension, flange or machine feet.
• Storage for longer than six months: Apply a coat of anti-corrosion compound which provides long-term protection, e.g. Tectyl 506.
• Inspect the machine regularly and apply an additional coating of corrosion protection if necessary.

Document all preservation measures taken so that they can be reversed before the machines are put back into service.
4.13 Converter operation

The following chapter is relevant only to machines of series 1PQ8 or if the machine was ordered for operation on the rectifier.

Note

The order number shows whether the machine was ordered for operation with converter: the 9th digit of the order number features the letter "P" or "Q".

4.13.1 Supply line configuration

NOTICE

Asymmetric voltage load during operation on a TN system in delta connection

An asymmetric voltage load of the machine winding can occur during operation on a TN system in delta connection with a grounded line conductor. Winding damage can result.

● Do not operate the machine on a TN system with a grounded line conductor.

NOTICE

Ground fault during operation on an IT system

If a ground fault occurs when connected to an IT supply system, the insulation is excessively stressed. Winding damage can result.

● If possible, complete the process within two hours.
● Rectify the fault cause.
● Deploy a ground fault monitoring.

4.13.2 Reducing bearing currents

Taking the following actions will reduce the bearing currents:

● Ensure that the contacts are established over a large area. Solid copper cables are not suitable for high frequency grounding because of the skin effect.

Equipotential bonding conductors:

Use equipotential bonding conductors:

● Between motor and driven machine
● Between motor and converter
● Between the terminal box and the RF grounding point at the motor enclosure.
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 is connected at both ends, at the motor and converter.
- To ensure good discharging of high-frequency currents, provide contacting over a large surface area:
  - as contact established through 360° at the converter
  - at the motor, for instance with EMC glands at the cable entries
- If the cable shield is connected as described, then it ensures the specified equipotential bonding between the motor enclosure and converter. A separate RF equipotential bonding conductor is then not necessary.

![Diagram](image)

- If the cable shield is not connected due to special secondary conditions, or not adequately connected, then the specified equipotential bonding is not provided. In this particular case, use a separate RF equipotential bonding conductor:
  - Between the motor enclosure and protective ground rail of the converter.
  - Between motor enclosure and driven machine
  - Use braided flat copper straps or high-frequency cables with finely-stranded conductors for the separate RF equipotential bonding cable. Solid copper cables are not suitable for high frequency grounding because of the skin effect.
  - Ensure that the contacts are established over a large area.

Overall system design

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.
- 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.
4.13.3 Insulated bearings when operating the converter

If the machine is operated from a low-voltage converter, insulated bearings are fitted at the NDE and an insulated encoder with insulated bearings (option).

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

![Schematic representation of a single drive](image)

- 1 Driving machine
- 2 Motor
- 3 Coupling
- 4 Insulated bearings
- 5 Insulated tachometer fitting

**NOTICE**

**Bearing damage**

The bearing insulation must not be bridged. Bearing currents can damage bearings.

- Also for subsequent installation work, such as the installation of an automatic lubrication system or a non-insulated vibration sensor, make sure that the bearing insulation cannot be bridged.
- Contact the Service Center, if necessary.
Tandem operation

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

![Image 4-3 Schematic representation of a tandem drive]

**NOTICE**

**Bearing damage**

Bearing currents can flow if the coupling between the motors of the tandem drive is not insulated. This can damage the DE bearings of both motors.

- Use an insulated coupling to link the motors.

**See also**

Service and Support (Page 137)
When carrying out any work on the machine, observe the general safety instructions (Page 15) and the specifications contained in EN 50110-1 regarding safe operation on electrical equipment.

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 Preparations for installation

5.1.1 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.

NOTICE

High temperatures

The motor components get very hot during operation. High temperatures can damage mounting parts such as the cable insulation.

- Temperature-sensitive parts such as normal cables or electronic components must not rest against or be attached to mounted machine parts.
- Only use heat-resistant mounting parts. The connecting cables and cable entries must be suitable for the ambient temperature.
5.1.2  **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” (Page 42)

5.1.3  **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:
  - Connect the terminals with the ground potential until the recharge voltage drops to a non-hazardous level
  - Attach the connection cable.

**Measure the insulation resistance**

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

4. Read out the insulation resistance one minute after applying the measuring voltage.

**Limit values for the stator winding insulation resistance**

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

<table>
<thead>
<tr>
<th>V_N [V]</th>
<th>V_Meas [V]</th>
<th>R_C [MΩ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>U ≤ 1000</td>
<td>500</td>
<td>≥ 5</td>
</tr>
<tr>
<td>1000 ≤ U ≤ 2500</td>
<td>500 (max. 1000)</td>
<td>100</td>
</tr>
<tr>
<td>2500 &lt; U ≤ 5000</td>
<td>1000 (max. 2500)</td>
<td></td>
</tr>
<tr>
<td>5000 &lt; U ≤ 12000</td>
<td>2500 (max. 5000)</td>
<td></td>
</tr>
<tr>
<td>U &gt; 12000</td>
<td>5000 (max. 10000)</td>
<td></td>
</tr>
</tbody>
</table>

U_{rated} = rated voltage, see the rating plate  
U_{meas} = DC measuring voltage  
R_C = minimum insulation resistance at reference temperature of 40° C

**Conversion to the reference temperature**

When measuring with winding temperatures other than 40° C, convert the measuring value to the reference temperature of 40° C according to the following equations from IEEE 43-2000.

\[
R_C = K_T \cdot R_T
\]

- Insulation resistance converted to 40° C reference temperature
- \(K_T\) = Temperature coefficient according to equation (2)
- \(R_T\) = Measured insulation resistance for measuring/winding temperature \(T\) in °C

\[
K_T = (0.5)^{(40-T)/10}
\]

- \(40\) = Reference temperature in °C
- \(10\) = Halving/doubling of the insulation resistance with 10 K
- \(T\) = Measuring/winding temperature in °C

In this case, doubling or halving the insulation resistance at a temperature change of 10 K is used as the basis.

- The insulation resistance halves every time the temperature rises by 10 K.
- The resistance doubles every time the temperature falls by 10 K.
For a winding temperature of approx. 25° C, the minimum insulation resistances are 20 MΩ (U ≤ 1000 V) or 300 MΩ (U > 1000 V). The values apply for the complete winding to ground. Twice the minimum values apply to the measurement of individual assemblies.

- Dry, new windings have an insulation resistance of between 100 and 2000 MΩ, or possibly even higher values. An insulation resistance value close to the minimum value could be due to moisture and/or dirt accumulation. 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. Calculate the critical insulation resistance value depending on the rated voltage by multiplying the rated voltage (kV) by the specific critical resistance value. Convert the value for the current winding temperature at the time of measurement, see above table.

### 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:
   \[ \text{PI} = \frac{R_{\text{insul}, 10 \text{ min}}}{R_{\text{insul}, 1 \text{ min}}} \]
   Many measuring devices display these values automatically following the measurement.

   For insulation resistances > 5000 MΩ, the measurement of the PI is no longer meaningful and consequently not included in the assessment.

<table>
<thead>
<tr>
<th>( \frac{R_{\text{10 min}}}{R_{\text{1 min}}} )</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 2</td>
<td>Insulation in good condition</td>
</tr>
<tr>
<td>&lt; 2</td>
<td>Dependent on the complete diagnosis of the insulation</td>
</tr>
</tbody>
</table>

### NOTICE

**Damage to insulation**

If the critical insulation resistance is reached or undershot, this can damage the insulation and cause voltage flashovers.

- Contact the Service Center (Page 137).
- If the measured value is close to the critical value, you must subsequently check the insulation resistance at shorter intervals.

### 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 MΩ when measured at 500 V DC.
5.1.4 Preparing the mating faces

Prepare the foundation faces dependent on the machine type:

- Mounting on a foundation
  - Ensure that the foundation faces are flat and free of contaminations.
  - Check the dimensions of the mounting-foot holes, if necessary.
- Flange connection
  - Clean the flange before installation, and make sure that the flange faces are flat and free of contaminations.
  - Check the dimensions of the flange geometry, if necessary.
- Wall mounting
  - Ensure that the wall faces are flat and free of contaminations.
  - Check the dimensions of the mounting-foot holes, if necessary.

Note

Wall mounting

Machines that are attached to the wall by their mounting feet because of their type must be supported from below by a wall strip, for example, or pinned.

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 (Page 137).
### 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.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>The machine can be dropped</td>
</tr>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

### 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.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damage to the bearing</td>
</tr>
<tr>
<td>Dismantling the rotor shipping brace when the machine is in a horizontal position could damage the bearings.</td>
</tr>
<tr>
<td>Only remove the rotor shipping brace when the machine is in a vertical position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damage to the bearing</td>
</tr>
<tr>
<td>Failure to fit the rotor shipping brace can result in damage to the bearings while the machine is being turned onto its side.</td>
</tr>
<tr>
<td>Fix the rotor in place before you turn the machine into a horizontal position.</td>
</tr>
</tbody>
</table>
5.2.4 Removing anti-corrosion protection

Machined, bright surfaces of machine parts and small components such as screws, bolts, wedges, feather keys and dowel pins, are treated with an anti-corrosion agent.

Carefully remove the anti-corrosion agent just before starting the installation work.

Bright surfaces on machine parts

- Remove the anti-corrosion coating from the machined surfaces of machine parts and from small components. To do this, use petroleum, petroleum ether - or a similar solvent or cleaning agent.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paintwork damage</td>
</tr>
<tr>
<td>Painted surfaces can be damaged if they come into contact with detergents or solvents.</td>
</tr>
</tbody>
</table>

- Use a suitable solvent to soften thick layers of anti-corrosion agent. Then push off the softened layers using a piece of hardwood (approximately 10 x 10 x 1 cm). Do not sand the protective coating down or scrape it off.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damage to the machine surface</td>
</tr>
<tr>
<td>Metal objects, such as scrapers, spatulas or pieces of metal, are not suitable to remove the anti-corrosion protection.</td>
</tr>
<tr>
<td>These could damage the surfaces of the machine parts.</td>
</tr>
</tbody>
</table>

- Lightly oil the depreserved surfaces.
5.2.5 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.

![Image 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 ≥ 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).

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>The feather key can fall out</td>
</tr>
</tbody>
</table>

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".

5.2.6 Lifting and transporting the machine

To safely lift and transport the machine, the following requirements must be met:

- Personnel operating cranes and fork-lift trucks must be appropriately qualified.
- If the motor is packed, depending on the weight, size and on-site conditions, lift crates and transport frames using a fork-lift truck or a crane with slings.
  - Use a crane or fork-lift truck suitable for the load.
  - The center of gravity of the goods and the positions of the hoisting points are indicated on the packaging. Do not hoist any goods with damaged packaging.
- When lifting the machine, use only approved and undamaged sling guides and spreaders of sufficient rated capacity. Check the lifting equipment prior to its use. The weight of the machine is shown on the rating plate.
Assembly

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.
  - Do not exceed the maximum lifting acceleration and lifting speed specified on the lifting plate. Lift the machine without jerking it. Acceleration $a \leq 0.4$ g ($= 4 \text{ m/s}^2$) Velocity $v \leq 20$ m/min
- Use only the load carrying device on the stator frame for lifting.

⚠️ WARNING

The machine can tip over, slip or fall down during transport if a different construction is used

If you do not transport or lift the machine in a position appropriate for its construction, the machine can tip, slip into the lifting equipment or fall down. This can result in death, serious injury or material damage.
- Use only the load carrying device on the stator frame for lifting.
- Use the load carrying device appropriate for the machine position.
- Use suitable rope guiding or spreading devices. The weight of the machine is shown on the rating plate.

⚠️ WARNING

The machine can fall over, shift or fall down during transport if the center of gravity is not symmetrical

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 equipment and fall when it is being transported or lifted. This can result in death, serious injury or material damage.
- Comply with the handling instructions on the machine when transporting it.
- Be aware of the possibility of different loads on the sling ropes or lifting straps and the carrying capacity of the lifting equipment.
- Always take account of the center of gravity when transporting or lifting the motor. If the center of gravity is not located centrally between the attachment points, then position the hoisting hook above the center of gravity.

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.
5.2.7 Draining condensation

Under the following conditions it is possible that condensation may accumulate within the machine:

- Wide fluctuations in the ambient temperature, such as direct sunlight combined with high atmospheric humidity
- Intermittent operation or load fluctuations during operation

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damage due to condensate</td>
</tr>
<tr>
<td>If the stator winding is damp, its insulation resistance will be reduced. This can result in voltage flashovers that can seriously damage the windings. Condensate can also cause rust to form within the machine.</td>
</tr>
<tr>
<td>Ensure that condensate can drain away.</td>
</tr>
</tbody>
</table>

Ensure that condensate can drain away

In the bearing shields on the DE and NDE, water drainage holes are situated below or opposite the regreasing devices. They are sealed with screw plugs. Depending on the type of installation, the water drainage holes are located at the bottom.

1. Regularly remove the screw plugs to allow the condensate to drain away.
2. Replace them when you have finished.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The degree of protection is reduced</td>
</tr>
<tr>
<td>Nominally the degree of protection of the machine is reduced to IP44 when the screw plug is removed.</td>
</tr>
</tbody>
</table>
5.2.8 Putting the machine down

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, ...
- There is no condensation present within the machine.

Setting down the machine

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

See also

Draining condensation (Page 51)

5.2.9 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 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.

5.3.2 Selecting fixing screws

- Unless specified otherwise, use mounting bolts with at least strength class 8.8 to ISO 898-1. In this way you guarantee that the machine is securely mounted and the forces can be transferred through the torque.

- Take into account the maximum forces occurring in the case of a fault such as short circuit or system transfers in phase opposition.
  
  - When selecting the bolts
  
  - When designing the foundation
5.3 Installing the machine

See also

Tightening torques for screw and bolt connections (Page 139)

5.3.3 Preconditions for smooth, vibration-free operation

Preconditions for smooth, vibration-free operation:

- Stable foundation design
- 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

5.3.4 Aligning the machine to the driven machine and attaching it to it (IM B3 / IM B35)

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 at the operating temperature do not have any parallel or angular offset. This ensures that no additional forces affect their bearings during operation. If the thermal change of the motor and the driven machine is different, couple in the cold state with an appropriate alignment offset. The alignment offset to be set in the cold state must be determined and specified by the system specialist.

3. For the vertical positioning (x→0), place thin shims over a large surface area 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. Use the existing tapped holes for the forcing-off bolts to raise the machine. The balance state of the shaft (full-key or half-key balancing) and alignment errors primarily influence the service life of the bearing, especially for high motor speeds or when using rigid couplings.
4. When positioning the machine, ensure that a uniform axial gap (y→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.

![Image 5-3 Schematic diagram: Aligning the machine to the driven machine]

Table 5-2 Permissible deviations for aligning the machine with flexible coupling

<table>
<thead>
<tr>
<th>Max. speed $n_{\text{max}}$</th>
<th>Max. parallel offset $x$</th>
<th>Max. angular offset $y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n_{\text{max}} \leq 1500$ rpm</td>
<td>$x_{\text{max}} = 0.08$ mm</td>
<td>$y_{\text{max}} = 0.08$ mm / $100$ mm $\Theta$ $D$</td>
</tr>
<tr>
<td>$1500$ rpm &lt; $n_{\text{max}} \leq 3600$ rpm</td>
<td>$x_{\text{max}} = 0.05$ mm</td>
<td>$y_{\text{max}} = 0.05$ mm / $100$ mm $\Theta$ $D$</td>
</tr>
</tbody>
</table>

**Note**

**Machine expansion**

When performing alignment, make allowance for the thermal expansion of the machine due to rising temperature.
Assembly

5.3 Installing the machine

5.3.5 Aligning the machine to the driven machine and attaching it to it (IM B5)

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 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° 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.

See also

Tightening torques for screw and bolt connections (Page 139)

5.3.6 Aligning the machine to the driven machine and attaching it to it (IM V1, IM V10)

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.

See also

Tightening torques for screw and bolt connections (Page 139)

Alignment accuracy

The coaxial characteristic of the shafts of electrical machines and driven machine may not exceed 0.05 mm in diameter.

5.3.7 Axial and radial forces

You can obtain the permissible values for axial and radial forces by contacting the Siemens Service Center (Page 137) or referring to the machine catalog.

| NOTICE |
| Damage to bearings or the shaft |
| 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. |
Assembly

5.3 Installing the machine
Electrical connection

When carrying out any work on the machine, observe the general safety instructions (Page 15) and the specifications contained in EN 50110-1 regarding safe operation on electrical equipment.

Note
Service Center
If you require support when electrically connecting up the machine, please contact the Service Center (Page 137).

6.1 Safety instructions relating to the electrical connection

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected parts can loosen</td>
</tr>
</tbody>
</table>

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. This could result in material damage to the machine or even in total failure, which could in turn lead indirectly to material damage to 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.

See also
Tightening torques for screw and bolt connections (Page 139)

6.2 Terminal box

Depending on the version, different terminal boxes may be installed on the machine. Depending on the terminal box, different cable entries and options for the cable connection are possible. You can identify the terminal box installed on the machine via the illustrations in the following chapters.

- Terminal box GT640 (Page 60)
- Terminal box 1XB1621 (Page 60)
6.2.1 Terminal box GT640

The GT640 terminal box is used only for machines with shaft height 315.

![Image 6-1 Terminal box GT640](image)

The connecting cables are introduced into the GT640 terminal box through the cable glands with threaded holes 2 x M72 x 2 and 2 x M20 x 1.5. The cable glands are not included in the standard scope of supply.

You can find additional information here:

- Inserting the cable into the GT640 terminal box (Page 68)
- Connecting cables with cable lugs (Page 71)
- Connection without cable lugs (Page 71)

6.2.2 Terminal box 1XB1621

![Image 6-2 Terminal box 1XB1621](image)
The connecting cables are introduced into the 1XB1621 terminal box through the cable glands with threaded holes 2 x M80 x 2 and 2 x M25 x 1.5. The cable glands are not included in the standard scope of supply. The version with sealing insert with break-off ring is optional.

You can find additional information here:
- Inserting the cable into the 1XB16... terminal box with cable gland (Page 68)
- Inserting the cable into the 1XB.. terminal box with ring seal (Page 69)
- Connecting cables with cable lugs (Page 71)

6.2.3 Terminal box 1XB1631

The connecting cables are introduced into the 1XB1631 terminal box through cable glands with threaded holes 4 x M80 x 2 and 2 x M25 x 1.5. The cable glands are not included in the standard scope of supply. The version with onion sealing ring is optional.

You can find additional information here:
- Inserting the cable into the 1XB16... terminal box with cable gland (Page 68)
- Inserting the cable into the 1XB.. terminal box with ring seal (Page 69)
- Connecting cables with cable lugs (Page 71)
The connecting cables are introduced into the terminal box 1XB1634 through cable glands with threaded holes 4 x M80 x 2 and 2 x M25 x 1.5. The cable glands are not included in the standard scope of supply. The version with onion sealing ring is optional.

For more information, see:

- Inserting the cable into the 1XB16... terminal box with cable gland (Page 68)
- Inserting the cable into the 1XB.. terminal box with ring seal (Page 69)
- Connecting cables with cable lugs (Page 71)
- Connection without cable lugs (Page 71)
6.2.5 Terminal box 1XB9600

The connection cables are inserted into the 1XB9600 terminal box through an onion sealing ring in a three-part cable entry plate.

You can find additional information here:
- Inserting the cable into the 1XB.. terminal box with ring seal (Page 69)
- Connecting cables with cable lugs (Page 71)

6.3 Preparation

6.3.1 Checking winding connections

With an open winding design, i.e. when the windings start and end directly at the terminal box (see the “Terminal marking” (Page 64) section), the connections are made using jumpers in the terminal box. The jumpers for the open connection must not be removed when testing the winding; refer to the relevant circuit diagram.

- Check that the connections (star or delta) comply with the specifications on the rating plate.
- Ensure that the connection values correspond to the information on the rating plate.
6.3.2 Terminal designation

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

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

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

6.3.3 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.
- Configuration notes
- Requirements according to IEC/EN 60204-1

6.3.4 Connecting the grounding conductor

The grounding conductor cross-section of the machine must be in full conformance with the installation specifications, e.g. according to IEC / EN 60204-1.

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

<table>
<thead>
<tr>
<th>Phase conductor cross-section S [mm²]</th>
<th>Cross-section of grounding conductor [mm²]</th>
</tr>
</thead>
<tbody>
<tr>
<td>S &gt; 35</td>
<td>S/2</td>
</tr>
</tbody>
</table>

There is a hexagon bolt with a flat washer and a spring washer on the stator frame at the designated connecting point for the grounding conductor. The grounding conductor can be connected as follows:

- With stranded cables with cable lugs
- With flat cables with cable end designed accordingly
As an alternative, you can connect the grounding conductor without cable lugs using a terminal plate at the marked connection point.

**Connecting the grounding conductor**

- Ensure that the connecting surface is bare and is protected against corrosion using a suitable substance, e.g. acid-free vaseline.
- Arrange the flat washer and spring washer under the bolt head.
- Check that the maximum permissible clamping thickness of 10 mm for the cable lug or strap is not exceeded.
- Fasten the clamping screw according to the following table. Screw-in depth and tightening torque are different depending on whether cable lugs or ground terminals are used.

<table>
<thead>
<tr>
<th></th>
<th>Screw</th>
<th>Screw-in depth</th>
<th>Tightening torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>When using cable lugs</td>
<td>M6</td>
<td>&gt; 6 mm</td>
<td>8 Nm</td>
</tr>
<tr>
<td></td>
<td>M8</td>
<td>&gt; 8 mm</td>
<td>20 Nm</td>
</tr>
<tr>
<td></td>
<td>M12 x 25</td>
<td>&gt; 16 mm</td>
<td>38 Nm</td>
</tr>
<tr>
<td></td>
<td>M16 x 35</td>
<td>&gt; 20 mm</td>
<td>92 Nm</td>
</tr>
<tr>
<td>When using ground terminals</td>
<td>M6</td>
<td>&gt; 9 mm</td>
<td>8 Nm</td>
</tr>
<tr>
<td></td>
<td>M8</td>
<td>&gt; 12 mm</td>
<td>20 Nm</td>
</tr>
<tr>
<td></td>
<td>M10</td>
<td>&gt; 15 mm</td>
<td>40 Nm</td>
</tr>
<tr>
<td></td>
<td>M12</td>
<td>&gt; 18 mm</td>
<td>70 Nm</td>
</tr>
<tr>
<td></td>
<td>M16</td>
<td>&gt; 20 mm</td>
<td>170 Nm</td>
</tr>
</tbody>
</table>

- Use the connecting terminals designated for the grounding conductor in the terminal box.

**See also**

Converter operation (Page 77)

**6.3.5 Radio-frequency grounding for converter operation**

In converter operation, the converter emits RF alternating currents. To establish and RF-specific optimal connection between motor terminal box and motor enclosure, you can use flexible braided copper flat cables with low impedance and a broad frequency range.

Establish the radio-frequency ground connection with flat cables. Alternatively you can establish the radio-frequency ground connection with cable lugs.
6.3 Preparation

6.3.6 Connection without terminal box

If the machine was ordered with brought-out cables, i.e. without terminal box, then the proper connection must be made in an external terminal box.

Ensure that the external terminal box is dimensioned according to the data on the rating plate and is suitable for the respective use.

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
</table>

**Faults as a result of incorrect technical design**

Faults can occur if the appropriate technical data is not complied with when connecting up. For instance, degree of protection, minimum air and creepage distances. These faults can result in eventual or immediate death, serious injury or material damage.

Observe the data on the rating plate.

You find further information in the "Operation with converter (Page 77)" section.
6.3.7 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 connect the power cables in the phase sequence L1, L2, L3 to U, V, W, the resulting rotation will be clockwise.
- If you interchange two connections, e.g. L1, L2, L3 to W, V, U, the resulting rotation will be counter-clockwise.

**Note**

On machines which are only allowed to run in one direction, the rating plate shows an arrow which indicates the permitted direction of rotation, and it also specifies the terminal connections in the required phase sequence.

---

**NOTICE**

**Incorrect direction of rotation**

The machine will not be adequately cooled if it is operated other than how it was originally ordered or with the incorrect direction of rotation. This can result in machine damage.

Observe the direction of rotation data on the nameplate.

---

6.4 Connection

The following generally applies to electrical connections:

- Ensure that there is a safe and reliable PE ground connection before starting any work.
- The connecting cables can be sealed and secured at every cable entry point into the terminal box.
- Lay the connecting cables and in particular the PE conductor in the terminal box in an open arrangement so that chafing of the cable insulation is prevented.
- Connect the machine in such a way that a permanent, safe electrical connection is maintained. Avoid protruding wire ends.
- Lay and secure external auxiliary cables separately from the main cable. Elements with cable ties may be present for this purpose.
Table 6-3  Connection technology (with cable lug / connection without cable lug)

<table>
<thead>
<tr>
<th>Terminal box</th>
<th>Connection</th>
</tr>
</thead>
<tbody>
<tr>
<td>GT640</td>
<td>With cable lug (Page 71)</td>
</tr>
<tr>
<td>1XB1621</td>
<td>Without cable lug (Page 71)</td>
</tr>
<tr>
<td>1XB1631</td>
<td>Connection without cable lug not possible</td>
</tr>
</tbody>
</table>

6.4.1 Inserting the cable into the GT640 terminal box

1. If necessary, disassemble the screw caps of the threaded holes at the underside of the terminal box.
2. Screw in suitable cable glands for the respective cable into the threaded holes.
3. Route the cable properly through the cable gland dependent on supply system or converter operation.
4. Prepare the cable ends accordingly for connection to the terminals.
5. Connect the ends of the cables to the terminals in accordance with the circuit diagram. The circuit diagram is located in the cover of the terminal box. Refer to the "Connecting cables..." section for more information.

6.4.2 Inserting the cable into the 1XB16... terminal box with cable gland

The connection cables are inserted into the terminal box via an exchangeable cable entry plate or cable entry support. The cable entry plate is drilled by default. The cable glands are not included in the standard scope of supply.

You can rotate the cable entry through 180°.

Table 6-4  Cable entry plate versions

<table>
<thead>
<tr>
<th>Terminal box</th>
<th>Standard cable entry plate drilled with</th>
<th>Explosion-proof version</th>
</tr>
</thead>
<tbody>
<tr>
<td>1XB1621</td>
<td>2 x M80 x 2 + 2 x M25 x 1.5</td>
<td>Undrilled</td>
</tr>
<tr>
<td>1XB1631</td>
<td>4 x M80 x 2 + 2 x M25 x 1.5</td>
<td>-</td>
</tr>
<tr>
<td>1XB1634</td>
<td>Onion ring only</td>
<td>-</td>
</tr>
<tr>
<td>1XB9600</td>
<td>Onion ring only</td>
<td>-</td>
</tr>
</tbody>
</table>
Insert the cable into the terminal box

1. Unscrew the cable entry plate.
2. Drill the required number of holes or threads in the required size in the cable entry plate. Ensure that the cable entry plate can be assembled after drilling and that it features sufficient stiffness.
3. Fit the required cable glands.
4. Route the cables through the cable glands.
5. Fit the cable entry plate to the terminal box with the assembled cables.
6. Connect the ends of the cables to the terminals in accordance with the circuit diagram. The circuit diagram is located in the cover of the terminal box.

Refer to Chapter "Connecting cables ..." for more information.

6.4.3 Inserting the cable into the 1XB.. terminal box with ring seal

The following terminal boxes may be equipped with an onion sealing ring.

Table 6-5 Terminal boxes with onion sealing ring

<table>
<thead>
<tr>
<th>Terminal box</th>
<th>Onion sealing ring</th>
</tr>
</thead>
<tbody>
<tr>
<td>1XB9600</td>
<td>Standard design</td>
</tr>
<tr>
<td>1XB1621, 1XB1631, 1XB1634</td>
<td>Optional</td>
</tr>
</tbody>
</table>

The connecting cable is sealed at the cable entry location using a cut-out sealing insert and is fastened using a strain relief device.

Bringing cables into the terminal box and connecting them

The terminal box is opened, the cable cut to the correct length and stripped back. Make sure that no external forces are acting on the cable connection.
1. Remove the top part of the strain relief ③ and release the fixing screws for the bottom part of the strain relief ②. The strain relief device can be located either in the terminal box or externally. If necessary, switch the direction sense of the strain relief device.

2. Cut the seal insert ① so that its opening is 1 to 3 mm smaller than the diameter of the cable.

3. Pull the sealing insert over the end of the cable.

4. Prepare the end of the cable depending on the cable and its use, e.g. with a cable lug.

5. Connect the ends of the cables to the terminals in accordance with the circuit diagram. The circuit diagram is located in the cover of the terminal box. Refer to the "Connecting cables..." section for more information.

6. You might need to use a sleeve made of suitable sealing tape to modify the diameter where it passes through the sealing insert. Push the sealing insert onto the prepared sleeve.

7. Insert the cable with the seal insert in position into the gland opening. Screw the strain relief device together once the cable is in a concentric position in the gland opening.

8. Secure the strain relief device.

9. Tighten the clamping screws of the strain relief device so that the cable is clamped as necessary, but do not damage the cable insulation. We recommend a torque of 5 Nm.

10. Retighten the clamping screws after 24 hours.

### WARNING

<table>
<thead>
<tr>
<th>Clamping screws for the strain relief clip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tightening the strain relief clip clamping screws too tightly can damage the insulation. This can cause a voltage flashover. This can result in death, serious injury, or material damage. Tighten the strain relief clip clamping screws to the specified torque.</td>
</tr>
</tbody>
</table>

#### 6.4.4 Laying cables

- Lay the cables in accordance with IEC/EN 60364-5-52.
- Use EMC cable glands for fixed cables. Screw the EMC cable glands into the threaded holes in the entry plate, which can be unscrewed.
- Use shielded cables whose shields are conductively connected to a large area of the terminal box of the motor via EMC cable glands.
- In the case of aluminum connecting bars, insert a steel washer between the cable lug and the connecting bar. This prevents contact corrosion.
- Arrange the exposed connecting cables in the terminal box so that the PE conductor has excess length and the insulation of the cable strands cannot be damaged.
- Close off unused bushings with a metal threaded plug. This is the way to achieve a high frequency-proof shielding.
6.4.5 Connecting cables with cable lugs

1. Select the cable lugs according to the required cable cross-section and fixing screw or stud size. Information about the maximum cross-section for the respective standard terminal box design can be found in the catalog. A sloped/angular arrangement of the supply cables is only permitted provided the required minimum air clearances are met.

2. Remove the insulation from the conductor ends so that the remaining insulation reaches almost up to the cable lug ①. Connect only one conductor per cable lug.

3. Fasten the cable lug to the end of the conductor correctly, e.g. by squeezing.

4. Insulate the cable lug sleeves where necessary to ensure minimum air clearances and the creepage distance are maintained.

5. Place the cable lug on the terminal support. If you are using a disconnecting link, check its positioning. For terminal boxes 1XB7740 and 1XB7750, place the cable lug on the busbar.

6. Tighten the fixing element ② with the corresponding tightening torque:

<table>
<thead>
<tr>
<th>Fixing element</th>
<th>Tightening torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fastening screw M12</td>
<td>20 Nm</td>
</tr>
<tr>
<td>Fixing screws M16</td>
<td>40 Nm</td>
</tr>
<tr>
<td>Fixing nuts M12</td>
<td>20 Nm</td>
</tr>
</tbody>
</table>

6.4.6 Connection without cable lugs

Lug terminal connections - which are suitable for connecting flexible and stranded conductors without the use of wire end ferrules - may be installed if ordered accordingly. If you wish to
use wire end ferrules, then before connecting the cable, attach these so as to form a technically correct, current-carrying crimped joint at the end of the conductor.

**NOTICE**

**Overheating of the conductor ends**

If the end of the conductor is not correctly enclosed by the wire end ferrule, but is trapped by it, this can lead to overheating.

- Insert only one conductor end into each wire end ferrule, and attach the wire end ferrule correctly.
- Insert only one conductor end into each terminal.

**Procedure**

Ensure that the minimum air clearances of 10 mm and the creepage distance of 20 mm are maintained for the connection.

1. Open the terminal box and cut the cable to the correct length.

2. Prepare the end of the cable depending on the cable and its use. Make sure that no external forces are acting on the cable connection.

3. Insulate the conductor ends in such a way that the remaining insulation reaches almost up to the cable lug.

4. Make sure the terminal clamps ③, ④ are arranged correctly for the size of the conductor. Insert the cable into the terminal clamps. Tighten the clamping nuts ⑤ to a tightening torque of 8 Nm.

5. If you have loosened the terminal body clamping bolts ②, then retighten them to a torque of 40 Nm.

For terminal box GT640, the fixing of the terminal element ① is done using a terminal nut M12 on the threaded stud of the terminal support with a torque of 20 Nm.

![Connection using terminal clamps (schematic diagram)]
6.4.7 Use of 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.

6.4.8 Using single-stranded cables

**NOTICE**

**High temperatures from induced eddy currents**

With high currents and where several single-stranded cables are used instead of multiple-stranded cables, high temperatures can result in the cable entry area due to induced eddy currents. This can result in material damage or even a machine failure.

- After commissioning, ensure that the temperature limits of the connected power cables are not exceeded during operation. This temperature effect can be reduced by altering the conditions at the entry points or by using modified cable entry plates after consultation with the manufacturing plant.
- Use a cable entry plate made of non-ferrous metal.

6.4.9 Internal equipotential bonding

Between the ground terminal in the terminal box enclosure and the machine enclosure, the fixing screws of the terminal box serve as PE conductor connection.

Between terminal box cover and terminal box enclosure, the cover fixing screws serve as equipotential bonding.

A special external ground conductor is only installed if, for example, flat seals are mounted without additional support.
When performing any installation work, you must always take care to ensure that all equipotential bonding measures remain effective.

6.4.10 Stepless mating face for sealing in the terminal box cover (not for GT640)

The sealing face of the terminal box cover is formed by the terminal box enclosure and the cable entry element. Therefore make sure these parts are correctly aligned, so as to ensure the seal and hence the degree of protection.

Align the cable entry support and the cable entry plate to the terminal box enclosure so that the sealing surface between the terminal box and the terminal box cover form a flat face. There must be no steps in the sealing area.

6.4.11 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>
<thead>
<tr>
<th>Rms value of the alternating voltage $V_{\text{rms}}$</th>
<th>Minimum air clearance</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\leq 500$ V</td>
<td>8 mm</td>
</tr>
<tr>
<td>$\leq 630$ V</td>
<td>10 mm</td>
</tr>
<tr>
<td>$\leq 800$ V</td>
<td>12 mm</td>
</tr>
<tr>
<td>$\leq 1000$ V</td>
<td>14 mm</td>
</tr>
<tr>
<td>$\leq 1250$ V</td>
<td>18 mm</td>
</tr>
</tbody>
</table>

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.
6.4.12 Finishing connection work

1. Before closing the terminal box, please check that:
   – The electrical connections in the terminal box have been made in accordance with the specifications above and tightened with the correct tightening torque.
   – The machine is connected in such a way that it rotates in the direction specified.
   – The inside of the terminal box is clean and free of any cable debris, dirt and foreign bodies.
   – All of the seals and sealing surfaces of the terminal box are intact and in a good condition.
   – Any cable entries which are not used are sealed and the sealing elements are tightly screwed in (i.e. so that they can only be removed using suitable tools).
   – The connecting cables are laid in an open arrangement, so that the cable insulation cannot be damaged during operation.

2. Close the terminal box with the cover fixing screws, see chapter Tightening torques for screw and bolt connections (Page 139).

6.5 Connecting the auxiliary circuits

6.5.1 Selecting cables

Take the following criteria into account when selecting the connecting cables for the auxiliary circuits:

- Rated current
- Rated voltage
- System-dependent conditions, such as ambient temperature, routing type, cable cross-section as defined by required length of cable, etc.
- Requirements according to IEC/EN 60204-1

6.5.2 Bringing cables into the auxiliary terminal box and routing them

The required data for connecting the auxiliary circuits is located on the terminal diagram on the inside of the respective auxiliary terminal or terminal box cover.

- In some cases a terminal strip is installed in the main terminal box for the auxiliary circuit connections.
- The required stripped length on conductors for auxiliary terminals differs according to terminal type (6 to 9 mm). When the length is correct, the conductor should reach the stop in the terminal and at the same time the conductor insulation should reach the contact part of the terminal.
Adapting the cable glands

A plate is bolted to the terminal box enclosure via a rectangular cutout through which the connecting cables enter. The plate is generally delivered with threaded holes and cable glands.

1. Open the auxiliary terminal box and undo the cable entry plate screws. Depending on the terminal box version, the cable entry plate is below a steel screening plate.

2. For the undrilled version, drill the required number of holes or threads in the required size of the cable gland into the cable entry plate.

3. Mark the cables if necessary for subsequent assignment.

4. Pull the cables through the cable glands and the cable entry plate, and connect the cables.

5. Fit the cable entry plate.

6. Make sure that the seal on the screwed sockets for the cable glands satisfies the degree of protection.

See also

Tightening torques for screw and bolt connections (Page 139)
Spare parts (Page 117)

6.5.3 Connecting temperature monitoring for the stator winding

The stator winding is monitored for thermal loading by resistance thermometers embedded in the stator winding.

The connecting leads of the temperature sensors are routed to the main or auxiliary terminal box. The connection and assignment of the terminals is shown on the terminal diagram in the particular terminal box.

⚠️ WARNING

Hazard due to electric shock

The installation of the temperature sensors for the winding monitoring with respect to the winding is implemented according to the requirements for basic insulation. The temperature sensor connections are located in terminal boxes, safe to touch, and have no protective separation. This is the reason that in the case of a fault, a hazardous voltage can be present at the measuring sensor cable. When touched, this can result in death, severe bodily injury and material damage.

When connecting the temperature sensor to external temperature monitoring devices, when required, apply additional measures to fully comply with the requirement "Hazard due to electric shock", see IEC 60664-1 or IEC 61800-5-1.
6.5.4 Terminating the connection work (auxiliary circuit)

1. Before closing the auxiliary terminal box, please check that:
   – The cables are connected in accordance with the terminal diagram.
   – The cables are freely arranged so that they cannot come into contact with the machine, and the cable insulation cannot be damaged.
   – The inside of the terminal box is clean and free of any cable debris, dirt and foreign bodies.
   – The cable glands are firmly tightened, are suitable with respect to the degree of protection, type of cable routing, permissible cable diameter, etc., and have been mounted in full compliance with specifications and regulations.
   – The threads in the connection plate are sealed using cable and conductor entries, thread adapters or sealing plugs that achieve the respective degree of protection.
   – Unused cable entries are sealed. The sealing elements are firmly screwed in, and can only be released using a tool.
   – All of the seals/gaskets and sealing surfaces of the terminal box are in good condition.
   – The screws of all of the screw clamps are fully tightened, even if they are not being used.

2. Close the auxiliary terminal box using the cover supplied for this purpose. See section "Tightening torques for screw and bolt connections (Page 139)" for the tightening torque of the fixing bolts for the cover.

6.5.5 Converter operation

The following chapter is relevant only to machines of series 1PQ8 or if the machine was ordered for operation on the rectifier.

Note

The order number shows whether the machine was ordered for operation with converter: the 9th digit of the order number features the letter "P" or "Q".

6.5.5.1 Operation on a converter with a low pulse frequency

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Increased motor temperature</strong></td>
</tr>
<tr>
<td>If the pulse frequency is less than the rated pulse frequency, then increased motor losses occur. This results in a higher motor temperature.</td>
</tr>
<tr>
<td>• Reduce the power to prevent exceeding the temperature class and to avoid consequential premature thermal aging of the insulation.</td>
</tr>
<tr>
<td>• Contact the Service Center if necessary.</td>
</tr>
</tbody>
</table>
6.5.5.2 Maximum peak voltage at the motor terminals

The maximum peak voltage values at the motor terminals are listed in the table as limit values for the insulation system:

Table 6-7 Maximum peak voltage at the motor terminals

<table>
<thead>
<tr>
<th>Rated motor voltage [V]</th>
<th>Maximum peak voltage at the motor terminals $U_{\text{max}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Conductor - conductor</td>
</tr>
<tr>
<td>≤ 500 V</td>
<td>1500 V</td>
</tr>
<tr>
<td></td>
<td>Rise time 0.5 μs</td>
</tr>
<tr>
<td>&gt; 500 to 690 V</td>
<td>2250 V</td>
</tr>
<tr>
<td></td>
<td>Rise time 0.4 μs</td>
</tr>
</tbody>
</table>

6.5.5.3 Reducing bearing currents

Taking the following actions will reduce the bearing currents:

- Ensure that the contacts are established over a large area. Solid copper cables are not suitable for high frequency grounding because of the skin effect.

**Equipotential bonding conductors:**

Use equipotential bonding conductors:

- Between motor and driven machine
- Between motor and converter
- Between the terminal box and the RF grounding point at the motor enclosure.
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 is connected at both ends, at the motor and converter.
- To ensure good discharging of high-frequency currents, provide contacting over a large
  surface area:
  - as contact established through 360° at the converter
  - at the motor, for instance with EMC glands at the cable entries
- If the cable shield is connected as described, then it ensures the specified equipotential
  bonding between the motor enclosure and converter. A separate RF equipotential bonding
  conductor is then not necessary.

<table>
<thead>
<tr>
<th>Concentric copper or aluminum shield</th>
<th>Steel armor</th>
</tr>
</thead>
</table>

- If the cable shield is not connected due to special secondary conditions, or not adequately
  connected, then the specified equipotential bonding is not provided. In this particular case,
  use a separate RF equipotential bonding conductor:
  - Between the motor enclosure and protective ground rail of the converter.
  - Between motor enclosure and driven machine
  - Use braided flat copper straps or high-frequency cables with finely-stranded conductors
    for the separate RF equipotential bonding cable. Solid copper cables are not suitable
    for high frequency grounding because of the skin effect.
  - Ensure that the contacts are established over a large area.

Overall system design
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.
- 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.
6.5 Connecting the auxiliary circuits

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

6.5.5.4 Converter operation on a grounded network

NOTICE
Damage resulting from protective conductor currents
When the machine is operated on a converter with current limiter, but without ground-fault monitoring, protective conductor currents of up to 1.7 times the external conductor current can arise if there is a ground fault on the output side. Neither the PE conductors of normally rated multi-core connecting cables nor the PE connecting points of normal terminal boxes are suitable for this purpose. Material damage can result.

- Use an appropriately sized PE conductor.
- Connect the PE conductor to the grounding terminal on the motor enclosure.
When carrying out any work on the machine, observe the general safety instructions (Page 15) 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:

**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.

- 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.
- All touch protection measures for moving and live parts have been taken.
- 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). The unused shaft extension is covered and protected against accidental contact.

**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.
Start-up

7.2 Measuring the insulation resistance before commissioning

- 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.

See also

Set values for monitoring the winding temperature (Page 84)
Setpoint values for monitoring the bearing temperature (Page 84)

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 \( n_{\text{max}} \) is not exceeded. Limit speed \( n_{\text{min}} \) is not fallen below.

Cooling

- Check that the machine cooling is available for commissioning.
- The bearing insulation should be executed as shown on the plates.

7.2 Measuring the insulation resistance before commissioning

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 42)
7.3 Greasing the roller bearings prior to commissioning

The following information assumes that the specified storage conditions have been complied with.

**General specifications**
- Pay attention to the instructions on the lubricant plate.
- Regrease in portions. The shaft must rotate so that the new grease can be distributed in the bearings.

**Regreasing the roller bearings prior to commissioning**
- If the period between delivery and commissioning is more than a year and less than four years:
  - Re-grease the roller bearings with twice the amount of grease specified on the lubricant plate.
  - Check the bearing temperature, as far as possible.

**Regreasing roller bearings before commissioning**
You must regrease the roller bearings under the following conditions:
- If the machine has been in storage for more than four years.
- If the machine has not been stored in accordance with the specifications in the “Storage” section.

**Procedure**
1. Remove the bearing, regreasing pipes, grease nipples and the bearing cap.
2. Flush out the old grease.
3. Check the bearings before regreasing. If necessary, install new bearings.
4. Lubricate the bearings and reinstall the bearing components.

**See also**
- Regreasing intervals and types of grease for operating roller bearings (Page 101)
- Stoppages (Page 89)
- Transport and storage (Page 30)
7.4 Setpoint values for monitoring the bearing temperature

Prior to commissioning

If the machine is equipped with bearing thermometers, set the temperature value for disconnection on the monitoring equipment before the first machine run.

Table 7-1 Set values for monitoring the bearing temperatures before commissioning

<table>
<thead>
<tr>
<th>Set value</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disconnecting during commissioning</td>
<td>120 °C</td>
</tr>
</tbody>
</table>

Normal operation

Measure the normal operating temperature of the bearings $T_{op}$ at the installation site in °C. Set the values for shutdown and warning according to the operating temperature $T_{op}$.

Table 7-2 Set values for monitoring the bearing temperatures in normal operation

<table>
<thead>
<tr>
<th>Set value</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warning in normal operation</td>
<td>$T_{op} + 5 K \leq 115 °C$</td>
</tr>
<tr>
<td>Disconnection in normal operation</td>
<td>$T_{op} + 10 K \leq 120 °C$</td>
</tr>
</tbody>
</table>

See also

Thermal motor protection (Page 27)

7.5 Set values for monitoring the winding temperature

Prior to commissioning

Before running the machine for the first time, set the temperature value for shutdown on the monitoring device.

Table 7-3 Set values for monitoring the winding temperatures during commissioning

<table>
<thead>
<tr>
<th>Set value</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shutdown</td>
<td>145 °C</td>
</tr>
</tbody>
</table>
Normal operation

Measure the normal operating temperature $T_{\text{operation}}$ at the installation site in °C. Set the values for shutdown and warning according to the operating temperature $T_{\text{operation}}$. The set values depend on the design of the insulation system or the temperature class of the machine. The data can be found on the rating plate.

Table 7-4  Set values for monitoring the winding temperatures in normal operation

<table>
<thead>
<tr>
<th>Set value</th>
<th>Insulation class 155(F)</th>
<th>Insulation class 180(H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warning</td>
<td>$T_{\text{op}} + 10 \text{ K} \leq 145 \degree \text{C}$</td>
<td>$T_{\text{op}} + 10 \text{ K} \leq 170 \degree \text{C}$</td>
</tr>
<tr>
<td>Shutdown</td>
<td>$T_{\text{op}} + 15 \text{ K} \leq 155 \degree \text{C}$</td>
<td>$T_{\text{op}} + 15 \text{ K} \leq 180 \degree \text{C}$</td>
</tr>
</tbody>
</table>

7.6 Test run

After installation or inspection, carry out a test run:

1. Start up the machine without a load. To do this, close the circuit breaker and do not switch off prematurely. Check whether it is running smoothly. Switching the machine off again while it is starting up and still running at slow speed should be kept to a bare minimum, for example for checking the direction of rotation or for checking in general. Allow the machine to run down before switching it on again.

2. If the machine is running smoothly and evenly, switch on the cooling equipment. Continue to observe the machine for a while in no-load operation.

3. If it runs perfectly, connect a load.

**NOTICE**

Thermal overload of motors connected directly to the line supply

In addition to the load torque, the ramp-up (accelerating) time is essentially influenced by the moment of inertia to be accelerated. While ramping up when connected to the line supply, the inrush (starting) current is a multiple of the rated current. This can result in thermal overload. This can damage the motor.

As a consequence, when ramping up, observe the following:

- Monitor the ramp-up time and number of consecutive starts.
- Comply with the limit values and/or ramp-up conditions specified in the catalog or the order documentation.
4. During the test run, check and document the following:
   - Check whether it is running smoothly.
   - Document the voltage, current and power values. As far as possible, document the corresponding values of the driven machine.
   - If this is possible using the available measuring equipment, check the bearing and stator winding temperatures until they have reached steady-state values.
   - Check the machine for noise or vibrations on the bearings or bearing shields as it runs.

5. In case of uneven running or abnormal noise, switch off the machine. As the machine runs down, identify the cause.
   - If the mechanical operation improves immediately after the machine is switched off, then the cause is magnetic or electrical.
   - If the mechanical running does not improve immediately after switching the machine off, then the cause is mechanical.
     - Imbalance of the electrical machine or the driven machine
     - The machine set has not been adequately aligned
     - The machine is being operated at the system resonance point. System = motor, base frame, foundation, ...

NOTICE

Serious damage to the machine
If the vibration values in operation are not maintained in accordance with DIN ISO 10816-3, then the machine can be mechanically destroyed.
• During operation, observe the vibration values in accordance with DIN ISO 10816-3.

7.7 De-energizing

• If the controller does not do this automatically, switch on any anti-condensation heating during stoppages. This will avoid the formation of condensation.
• Do not switch on the anti-condensation heating for at least two hours after the motor has been switched off. This prevents damage to the winding insulation.
When carrying out any work on the machine, observe the general safety instructions (Page 15) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

### 8.1 Safety guidelines in operation

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Live parts</strong></td>
</tr>
<tr>
<td>Terminal boxes contain live electrical parts. If you open the terminal box cover, this can result in death, serious injury or material damage.</td>
</tr>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Rotating and live parts</strong></td>
</tr>
<tr>
<td>Rotating or live parts are dangerous. If you remove the required covers, this can result in death, serious injury or material damage.</td>
</tr>
<tr>
<td>Any covers that prevent live electrical or rotating parts from being touched, 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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fire hazard resulting from hot surfaces</strong></td>
</tr>
<tr>
<td>Certain parts of the machine become hot during operation. Severe burns can result from contact with these parts.</td>
</tr>
<tr>
<td>- Check the temperature of parts before touching them. If required, apply suitable protective measures.</td>
</tr>
<tr>
<td>- Allow the machine to cool before starting work on the machine.</td>
</tr>
</tbody>
</table>
**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.

**NOTICE**

Risk of corrosion due to condensate

Humid air can condense inside the machine during operation as a result of intermittent duty or load fluctuations. Condensate can collect inside the motor. Damage such as rust can result.

Make sure that any condensation can drain away freely.

---

**8.2 Switching off the anti-condensation heating**

**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.

**See also**

Interlock circuit for anti-condensation heating (option) (Page 27)
De-energizing (Page 86)
8.3 Switching on the machine

1. If at all possible, run the machine without load and check that it is running smoothly.
2. If it runs perfectly, connect a load.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thermal overload of motors connected directly to the line supply</strong></td>
</tr>
<tr>
<td>In addition to the load torque, the ramp-up (accelerating) time is essentially influenced by the moment of inertia to be accelerated. While ramping up when connected to the line supply, the inrush (starting) current is a multiple of the rated current. This can result in thermal overload. This can damage the motor.</td>
</tr>
<tr>
<td>As a consequence, when ramping up, observe the following:</td>
</tr>
<tr>
<td>• Monitor the ramp-up time and number of consecutive starts.</td>
</tr>
<tr>
<td>• Comply with the limit values and/or ramp-up conditions specified in the catalog or the order documentation.</td>
</tr>
</tbody>
</table>

3. If this is possible using the available measuring equipment, check the bearing and stator winding temperatures.

8.4 Regreasing roller bearings

Refer to the regreasing instructions for the roller bearings on the lubricant plate.

8.5 Switching on again after an emergency switching-off

- Check the machine before recommissioning 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.

<table>
<thead>
<tr>
<th>NOTICE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Damage due to improper storage</strong></td>
</tr>
<tr>
<td>Damage may occur to the motor if it is not stored properly.</td>
</tr>
<tr>
<td>If the machine is to be taken out of operation for more than 12 months, suitable anti-corrosion, preservation, packaging, and drying measures must be taken.</td>
</tr>
</tbody>
</table>
8.6.1 Avoidance of condensation or formation of condensation within the machine

- If the controller does not do this automatically, switch on any anti-condensation heating during stoppages. This will avoid the formation of condensation.
- Do not switch on the anti-condensation heating for at least two hours after the motor has been switched off. This prevents damage to the winding insulation.

8.6.2 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.

See also

Transport and storage (Page 30)
Start-up (Page 81)
Greasing the roller bearings prior to commissioning (Page 83)
8.6.3 Shaft grounding brushes (option)

With non-encapsulated and non-sealed shaft grounding brushes, rust may form on the brushes' running surface on the shaft after extended breaks in operation.

⚠️ WARNING

Live parts

If the shaft grounding does not function correctly, the shaft can be at a high voltage level that does not decay quickly enough when the machine comes to a standstill. This can lead to death or serious injury as a result of electric shock, or bearing damage caused by current flowing through the bearing.

- Regularly inspect the shaft grounding brushes and replace them if necessary.
- Keep the brushes' running surface clean: Regularly inspect the brushes' running surface and remove any rust before starting the machine up.

8.6.4 Measurement of the insulation resistance after an extended stoppage

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 42)
8.7 Decommissioning the machine

**NOTICE**

<table>
<thead>
<tr>
<th>Damage as a result of an extended period out of service</th>
</tr>
</thead>
<tbody>
<tr>
<td>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.</td>
</tr>
</tbody>
</table>

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.

See also

Start-up (Page 81)

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

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

<table>
<thead>
<tr>
<th>Possible causes of faults</th>
<th>Remedial measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overload</td>
<td>Reduce the load.</td>
</tr>
<tr>
<td>Interrupted phase in the supply cable</td>
<td>Check the switches and cables.</td>
</tr>
<tr>
<td>Interrupted phase in the feeder cable after switching on</td>
<td>Check the switches and cables.</td>
</tr>
<tr>
<td>Mains voltage too low, frequency too high</td>
<td>Check the power supply conditions.</td>
</tr>
<tr>
<td>Mains voltage too high, frequency too low</td>
<td>Check the power supply conditions.</td>
</tr>
<tr>
<td>Stator winding incorrectly connected</td>
<td>Check the winding connection in the terminal box.</td>
</tr>
<tr>
<td>Winding short circuit or phase short circuit in stator winding</td>
<td>Determine the winding resistances and insulation resistances. Carry out repair work after consultation with the manufacturer.</td>
</tr>
<tr>
<td>Incorrect direction of rotation</td>
<td>Check the connection.</td>
</tr>
</tbody>
</table>
8.9.3 Mechanical faults

The following table shows the possible causes of and remedial measures for mechanical faults.

Table 8-2 Mechanical faults

<table>
<thead>
<tr>
<th>Possible causes of faults</th>
<th>Remedial measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>X Rotating parts are grinding</td>
<td>Establish the cause and realign the parts.</td>
</tr>
<tr>
<td>X Reduced air supply, direction of rotation of fan possibly incorrect</td>
<td>Check the air ducts; clean the machine.</td>
</tr>
<tr>
<td>X Rotor not balanced</td>
<td>Decouple the rotor and then rebalance it.</td>
</tr>
<tr>
<td>X Rotor out of true, shaft bent</td>
<td>Please consult the manufacturer.</td>
</tr>
<tr>
<td>X Poor alignment</td>
<td>Align the machine set and check the coupling.</td>
</tr>
<tr>
<td>X Coupled machine not balanced</td>
<td>Rebalance the coupled machine.</td>
</tr>
<tr>
<td>X Shocks from coupled machine</td>
<td>Investigate the coupled machine.</td>
</tr>
<tr>
<td>X Fault originating from gearing</td>
<td>Fix the gearing.</td>
</tr>
<tr>
<td>X X Resonance of the overall system comprising motor and foundation</td>
<td>Reinforce the foundation after consultation with the manufacturer.</td>
</tr>
<tr>
<td>X X Changes in foundation</td>
<td>Determine the cause and rectify it. Realign the machine.</td>
</tr>
</tbody>
</table>

© Note any changes taking place during warm up
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

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

8.9 faults
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 15) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

Note
Service Center

Please contact the Service Center (Page 137), if you require support with servicing, maintenance or repair.

9.1 Inspection and maintenance

9.1.1 Safety instructions for inspection and maintenance

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotating and live parts</td>
</tr>
<tr>
<td>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.</td>
</tr>
<tr>
<td>● 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.</td>
</tr>
<tr>
<td>● When performing maintenance work, comply with the five safety rules (Page 15).</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>WARNING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Machine damage</td>
</tr>
<tr>
<td>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.</td>
</tr>
<tr>
<td>Perform regular maintenance on the machine.</td>
</tr>
</tbody>
</table>
### 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.

### 9.1.2 Measurement of the insulation resistance and polarization index in the context of maintenance work

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 42)

9.1.3 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.

9.1.4 First inspection after installation or repair

Perform the following checks after approximately 500 operating hours or at the latest six months after commissioning:

Table 9-1 Checks after assembly or repair

<table>
<thead>
<tr>
<th>Check</th>
<th>When the motor is running</th>
<th>At standstill</th>
</tr>
</thead>
<tbody>
<tr>
<td>The stated electrical characteristics are being observed.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The permissible bearing temperatures are not exceeded.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The smooth running characteristics and machine running noise have not deteriorated.</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The motor foundation has no cracks and indentations. (*)</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

(*) You can perform these checks while the motor is running or at a standstill.

Additional tests may also be required according to the system-specific conditions.

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.
9.1.5 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>
<thead>
<tr>
<th>Checking</th>
<th>When the motor is running</th>
<th>At standstill</th>
</tr>
</thead>
<tbody>
<tr>
<td>The electrical parameters are maintained</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The permissible bearing temperatures are not exceeded</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The smooth running characteristics and machine running noise have not deteriorated</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The motor foundation has no cracks and indentations (*)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>The machine is aligned within the permissible tolerance ranges</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>All the fixing bolts/screws for the mechanical and electrical connections have been securely tightened</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>All the potential connections, grounding connections and shield supports are correctly seated and properly bonded</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The winding insulation resistances are sufficiently high (Page 84)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Any bearing insulation is fitted as shown on the plates and labels</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The CABLES and insulating parts and components are in good condition and there is no evidence of discoloring</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

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

**NOTICE**

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

**See also**

Setpoint values for monitoring the bearing temperature (Page 84)

9.1.6 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.

9.1.7 Servicing and maintaining the anti-condensation heating

The anti-condensation heating is maintenance-free. If it is defective, contact the Service Center (Page 137).
9.1.8 Regreasing intervals and types of grease for operating roller bearings

The specified grease data applies to the data specified on the rating plate and for high-quality grease in accordance with the specifications in these operating instructions. Because these greases exceed significantly the requirements according to DIN 51825 and ISO 6743-9, they permit the specified relubrication intervals.

Initial lubrication

The grease specified on the lubricant plate is selected according to the operating conditions known at the time of ordering and should be used for initial lubrication.

Grease selection criteria

High quality ISO-L-X BDEA3 lubricating grease according to ISO 6743-9 and K3K-20 lubricating grease according to DIN 51825 with lithium soap as a thickener and an upper service temperature of at least +130° C / +266° F are permissible for standard applications without special requirements.

When selecting the lubricating grease, ensure that the technical data of the grease is suitable for the application.

The lubricating grease must satisfy the criteria listed in the table below and must match the operating conditions.

<table>
<thead>
<tr>
<th>Table 9-3 Criteria for selecting roller bearing greases</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Criteria</strong></td>
</tr>
<tr>
<td>Type of base oil</td>
</tr>
<tr>
<td>Thickener</td>
</tr>
</tbody>
</table>
| Consistency in accordance with NLGI class | DIN 51818 | • "3" for vertical and horizontal types of construction  
• "2" alternatively for horizontal type of construction with reduced lubrication interval | |
| Operating temperature range | - | At least -20° C ... +130° C | °C |
| Dropping point | DIN ISO 2176 | At least +180° C | °C |
| Basic oil viscosity | DIN 51562-1 | • Approx. 100 mm²/s at 40° C  
• Approx. 10 mm²/s at 100° C | mm²/s |
| Additives | - | • Anti-Oxidation (AO), Anti-Wear (AW)  
• No solid lubricants  
• Alternative: Extreme-pressure (EP) only after consultation with grease and bearing manufacturers | |
| FE9 test: A/1500/6000 | DIN 51821-1/-2 | F10 ≥ 50 h at +130° C  
F50 ≥ 100 h at +130° C | H |
| Behavior in the presence of water | DIN 51807 | 0 or 1 at a test temperature of +90° C | - |
| Corrosive effect on copper | DIN 51811 | 0 or 1 at a test temperature of +120° C | Corr. ° |
| Resistance to corrosion (EMCOR) | DIN 51802 / ISO 11007 | 0 - 0 | Corr. ° |
### Maintenance

#### 9.1 Inspection and maintenance

If different special lubricating greases are stated on the lubricant plate, then different criteria apply.

**Note**

**Deviating operating conditions and characteristics**

Only those greases named on the lubricant plate may be used. If the operating conditions and characteristics differ from those mentioned, other greases may be used only after consultation with the manufacture.

**Note**

**Use of other greases**

If greases other than those named on the lubricant plate are used, it cannot be guaranteed that they are compatible with the complete system. If you use greases that satisfy only the minimum requirements of DIN 51825 or ISO 6743-9, then reduce the lubrication intervals by half or adapt them as appropriate. If in doubt, consult the manufacturer.

**Recommended greases for roller bearings**

For standard applications, the following high-quality greases are recommended for roller bearings for vertical and horizontal motor constructions due to their technical properties:

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Grease type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell</td>
<td>Gadus S2 V100 3</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>Unirex N3</td>
</tr>
<tr>
<td>Esso</td>
<td>Energrease LS3</td>
</tr>
<tr>
<td>BP</td>
<td></td>
</tr>
<tr>
<td>Fuchs</td>
<td>Renolit H443 HD88</td>
</tr>
<tr>
<td>Lubcon</td>
<td>Turmoplex 3</td>
</tr>
<tr>
<td>Addinol</td>
<td>LM 3 EP</td>
</tr>
<tr>
<td>FAG</td>
<td>Arcanol Multi 3</td>
</tr>
</tbody>
</table>

For motors of horizontal construction you can alternatively use greases with NLGI class 2. However, this reduces the lubrication interval by 20%.

---

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Standard</th>
<th>Property, characteristic value</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid matter content, particle sizes &gt; 25 µm</td>
<td>DIN 51813</td>
<td>&lt; 10 mg/kg</td>
<td>mg/kg</td>
</tr>
<tr>
<td>Suitability of bearings</td>
<td>-</td>
<td>Suitable for the built-in motor bearings, seals and these speeds</td>
<td>- mm/min</td>
</tr>
</tbody>
</table>
Table 9-5  Alternative greases with NLGI class 2 for motors of horizontal construction

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Grease type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shell</td>
<td>Gadus S2 V100 2</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>Unirex N2</td>
</tr>
<tr>
<td>Esso</td>
<td>Energrease LS2</td>
</tr>
<tr>
<td>BP</td>
<td>Longtime PD2</td>
</tr>
<tr>
<td>Castrol</td>
<td>Turmogrease L 802 EP plus</td>
</tr>
<tr>
<td>Lubcon</td>
<td>Retinax LX2</td>
</tr>
<tr>
<td>Shell</td>
<td>Arcanol Multi 2</td>
</tr>
</tbody>
</table>

NOTICE

Damage due to mixing grease types

The lubrication properties will be impaired if you mix different greases. This can result in material damage.

Avoid mixing greases. Only the manufacturer can provide a guarantee for the miscibility of particular greases.

Regreasing

Regreasing data are stated on the lubricant plate of the machine:

- Regreasing intervals in operating hours
- Regreasing amount in grams
- Grease type

Independent of the actual number of operating hours, the roller bearings must be regreased every 12 months at the latest.

NOTICE

Damage to roller bearings

The regreasing intervals for roller bearings are different from the servicing intervals for the machine. The roller bearings may be damaged if the relubrication intervals are not adhered to.

Pay attention to the instructions on the lubricant plate.

Grease replacement intervals

The grease replacement intervals in these operating instructions or the regreasing intervals indicated on the plate apply to the following conditions:

- Normal load
- Operation at speeds in accordance with rating plate
- Low-vibration operation
Neutral ambient air
High-quality roller bearing greases

In the case of unfavorable operating conditions, the regreasing intervals must be reduced after consultation with the manufacturer.

Regreasing

Pay attention to the instructions on the lubricant plate.

1. The shaft must rotate during regreasing, so that the new grease can be distributed throughout the bearing. For motors operated with a converter, regreasing should be carried out at low to medium speed where possible ($n_{\text{min}} = 250 \text{ rpm}, n_{\text{max}} = 3600 \text{ rpm}$) to ensure an even distribution of grease.

![WARNING]

Rotating components
The shaft must rotate to allow the grease to be distributed. This can result in death, serious injury or material damage.

When regreasing, pay attention to all rotating components.

2. Clean the grease nipples before regreasing and then gradually press in an appropriate type and amount of grease, as described on the lubricant plate and by the specifications in these operating instructions.

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.

3. The used grease collects outside each bearing in a spent grease chamber.

Lubricating roller bearings prior to commissioning

When properly stored prior to commissioning for a longer period of time, normally the grease in the bearings does not deteriorate within two years. Please note the information regarding long-term storage.

When commissioning, the bearings must be relubricated with twice the amount of lubricating grease. When doing this, the shaft must rotate so that the grease is replaced in the bearings.

9.1.9 Sealing the rolling-contact bearings ("Increased degree of protection" option)

Relubricating the grease tank

In order to achieve optimum sealing of the rolling contact bearings and to reliably seal the labyrinth joints with grease, the chamber must be relubricated at regular intervals. The procedure is the same as that for lubricating grease. The sealing effect during operation is optimum as long as a small amount of relatively clean grease is forced out.
Regreasing intervals

The necessary relubrication intervals depend essentially on the level of dirt in the environment and on the ON time of the motor. For this reason, they can only be defined taking into account the respective operating conditions. Make sure that the groove in the seal is full of grease at all times.

9.1.10 Keeping the cooling air flow clean

The cooling ducts must be free of any pollution in order that the machine is adequately cooled. Regularly clean the grids, ducts, ribs, pipes etc. to remove dust and pollution.

9.1.11 Touch up any damaged paintwork

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

Note

Paint system

Contact the Service Center (Page 137) before you repair any paint damage. They will provide you with more information about the correct paint system and methods of repairing paint damage.

9.1.12 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.

---

### 9.2 Corrective Maintenance

When carrying out any work on the machine, observe the general safety instructions (Page 15) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

**Note**

If the motor has to be transported, please observe the information and instructions in the "Transport" (Page 31) section.

---

#### 9.2.1 Prepare servicing work

- The drawings and parts lists do not contain any detailed information about the type and dimensions of fixing elements and components. For this reason, you should establish this information when dismantling them and make a note of it for the purpose of reassembly.

- Document the type, dimensions and arrangement of the parts so that you will be able to reassemble the machine to its original state.

- Use suitable tools to disassemble the machine.

- Take measures to prevent parts from dropping down before you dismantle them, e.g. by replacing fastening elements with extra-long screws, threaded bolts or similar. This ensures that the part is supported after it is pulled off.

- The centerings in the shaft extensions have reset threads. Use lifting gear which is suitable for the rotor weight and direction of loading.

**WARNING**

**Rotor can fall down**

Eyebolts in accordance with DIN 580 are unsuitable for suspending the rotor. The rotor can fall off. This can result in death, serious injury or material damage.

Use lifting gear which is suitable for the rotor weight and direction of loading.
### WARNING

**Machine damage caused by improper repair work**

Improper servicing work can damage the machine. This can cause damages and/or faults which can result in eventual or immediate death, serious injury, or property damage.

- Properly assemble or disassemble the machine.
- Use only suitable tools and equipment.
- Immediately replace damaged components.
- Contact the Service Center (Page 137), if necessary.

### WARNING

**Rotor can fall out**

If the motor 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 damage.

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

### 9.2.2 Seal the motor

Extreme caution and attention to cleanliness are vital to installation.

- Clean all bare joints between parts such as housings, bearing shields and bearing bushes etc., and remove old sealant material.
- Smear bare joints between parts with non-hardening, permanently flexible sealant, such as "Hylomar M". Follow the manufacturer's application and safety instructions when doing this.
- Check all sealing elements, such as those on the terminal boxes, for elasticity, aging or damage, and renew them if they are no longer effective.

### 9.2.3 Fan cowl

To remove or replace the external fan, the fan cowl must be disassembled. The fan cowl is fixed on the machine enclosure with screws.

#### Disassembly

1. Secure the fan cowl against falling before you start working.
2. Loosen the fixing screws that secure the fan cowl on the enclosure.
3. Observe existing retaining components and retain them for the reassembly.
Assembly

Proceed in the reverse order to assemble the fan cowl.

1. Position the fan cowl and tighten the fixing screws.
2. Ensure that the retaining components are undamaged and correctly installed.

9.2.4 External fan made of metal

External metal fans have a keyway connection and are prevented from axially shifting using a locking ring.

Disassembly

1. The external fan ① is fixed on the shaft with a locking ring ②. Remove the locking ring. Pliers according to DIN 5254 should preferably be used for this purpose.
2. Use a suitable device to pull off the external fan.
3. Avoid using a hammer.
4. Secure the parallel key from falling out or remove it.

Assembly

1. Remove the parallel key lock or insert it in the keyway.
2. Check the correct seating.
3. Then push the external fan ① onto the shaft up to its stop. Use a suitable device for this purpose.
4. Insert the retaining ring ② into the corresponding groove and check its fit.

Air inlet nozzle

Two-pole machines are equipped with an air inlet nozzle ③. The spacing between external fan and air inlet nozzle must measure ≥ 2 mm evenly over the circumference.
9.2.5 External fan made of plastic

External fans made of plastic feature a cast-on driver similar to a parallel key. The external fan is secured using a retaining ring to prevent axial movement.

Disassembly

1. The external fan ① is fixed on the shaft with a retaining ring ②. Remove the retaining ring. Pliers according to DIN 5254 should preferably be used for this purpose.
2. Pull off the external fan by hand.

![Image 9-2 Ventilation (schematic diagram with radial fan)]

Assembly

1. Push the external fan ① up to the end stop on the shaft extension.
2. Insert the retaining ring ② into the corresponding groove and check its fit.

9.2.6 Internal fan

The internal fan is located on the rotor inside the machine. If the internal fan is defective or must be replaced, please contact the Service Center (Page 137).
9.2.7 Roller-contact bearings

9.2.7.1 Uninstalling roller-contact bearings

Preparation

- Remove any grease feeders, shock pulse measurement equipment and possibly mounted instrumentation at the DE and NDE.
- Remove the coupling on the drive end or make the shaft extension freely accessible.
- At the NDE, proceed as follows:
  - First, uninstall the fan cowl or external fan cowl.
    - Fan cowl (Page 107)
    - External fan cowl
  - Remove the external fan.
    - External fan made of metal (Page 108)
    - External fan made of plastic (Page 109)

Note

For a schematic diagram of the respective component layout, see the chapter "Spare parts (Page 117)".

Procedure

1. Remove the bearing mounting components.
   - Remove the outer bearing cover if one is being used.
     - Remove V ring (Page 111).
     - Removing the labyrinth sealing ring (Page 111).
   - Ensure that the inner bearing cover is no longer attached to the bearing housing or end shield.
   - Support the rotor for the removal of bearing housing or end shield.
   - If necessary, remove the bearing housing from the end shield.
   - Remove the end shield. Depending on the shaft height, roller bearing type and design, it is either a bearing head version or a bearing housing version.
   - Remove the locking ring from the shaft.
2. Pull off the roller bearing together with the grease slinger.
9.2.7.2 Remove V ring

 Depending on the particular version, there is a V ring. It must be replaced if unusual amounts of grease escape from the roller bearing or the V ring is visibly damaged.

![Image 9-3 Remove the V ring](image)

1. Mark the components so that they can be correctly assembled.
2. Remove the V ring ① with the bearing cap – or by using a suitable tool from the shaft.

Removing the protective ring for degree of protection IP56 (non-heavy-sea)

The V ring for the outer bearing seal is fitted with a protective ring ② for the degree of protection IP56 (non-heavy-sea). The protective ring does not have to be removed for disassembling the bearing bush.

Remove the protective ring together with the V ring and the outer bearing cover or end shield from the shaft.

See also

Install the V ring (Page 113)

9.2.7.3 Removing the labyrinth sealing ring

**Note**

For the "Increased degree of protection" option, the machine is equipped with a labyrinth sealing ring on the drive side and the non-drive side.

Before uninstalling the roller bearing, the labyrinth sealing ring must be removed.

The labyrinth sealing ring ③ is fixed with three grub screws that are separably secured with adhesive such as Loctite 243.
1. Mark the components of the bearing units so that they can be assembled correctly.
2. Remove the protective coating from the shaft in front of the labyrinth sealing ring.
3. Unscrew the three radially arranged set screws for fixing the ring axially.
4. Screw suitable bolts or screws into the radial threads for pulling off. Note the length of engagement to avoid clamping to the shaft or damaging the thread.
5. Warm the labyrinth sealing ring as you pull it off.

See also

Installing the labyrinth sealing ring (Page 115)

9.2.7.4 Assembling the rolling-contact bearings

- Extreme caution and attention to cleanliness are vital to installation. Observe the correct assembly sequence of the components.
- Attach all components with the specified tightening torques (Page 139).

Note

For further information about mounting the roller bearing, please refer to the catalog or the information provided by the roller bearing manufacturer.

Procedure

1. Remove the required components and replace damaged components.
2. Remove any dirt from the components. Remove any grease and the remains of sealant or liquid threadlocker.
3. Prepare the bearing journals:
   - Lightly oil the inner ring seat.
   - Grease the outer ring seat with solid lubricant such as the anti-fretting paste Altemp Q NP 50.

4. Warm up the roller bearing.

5. Push the inner ring of the warmed up roller bearing onto the shaft. Avoid any blows that might damage the bearing.

6. Make sure that the roller bearing is resting against the shaft shoulder or the second bearing. Otherwise, axial vibrations may occur.

7. Fill the bearing to the top with the specified lubricating grease.

8. Warm up the grease slinger and push it onto the shaft.

9. Locate the locking ring in the shaft groove or attach the bearing using the shaft nut or a set screw, depending on the particular version.

10. Support the rotor for the installation of bearing housing or end shield.

11. Grease the bearing locations (bearing shield/bearing cartridge) with solid lubricant such as the anti-fretting paste Altemp Q NP 50.

12. Use a suitable sealant when assembling.

13. Install the bearing shield or bearing housing together with the bearing shield.

14. Install the outer bearing cover if one is being used.

15. Install the sealing elements:
   - If present: V ring (Page 113)
   - Labyrinth sealing ring (special design) (Page 115)

### 9.2.7.5 Install the V ring

#### Requirement

The roller bearing is already fitted. The V ring can be installed for the bearing seal.
Install the V ring

1. Grease the axial sealing surface. The shaft seating remains ungreased.

2. Push the V ring \( \textcircled{1} \) onto the shaft using an assembly disk \( \textcircled{2} \). The V ring is in the correct axial position when the face surface is flush with the outer edge of the V ring.

Install the protective ring for degree of protection IP56 (non-heavy-sea)

For degree of protection IP56 (non-heavy-sea), the V ring for the outer bearing seal is fitted with a protective ring \( \textcircled{3} \) in the bearing cover made of sheet metal.

1. Push the protective ring onto the shaft.
2. Verify that the ring is sufficiently pretensioned. Replace the protective ring, if necessary.
3. Position the protective ring so that one of the longitudinal grooves meets the corresponding water separation groove at the bottom in the bearing cover flange or end shield.

9.2.7.6 Installing the V ring ("Increased degree of protection" option)

The grease chamber of the labyrinth sealing ring together with the V ring ensures compliance with degree of protection IP65.
When installing the V ring, proceed in the same way as when installing the labyrinth ring.

1. Grease the axial sealing surface. The shaft seating remains ungreased.

2. Push the V ring ② onto the shaft.
   
The correct axial position of the V ring for the design with grease chamber has been reached if the V ring sits approx. 0.2 mm behind the edge of the shaft heel. This position is the result of installing the labyrinth sealing ring.

See also

Install the V ring (Page 113)

9.2.7.7 Installing the labyrinth sealing ring

The labyrinth sealing ring is the last component to be fitted when fitting the roller-contact bearing. It ensures degree of protection IP65 and prevents the penetration of dirt and foreign bodies into the roller-contact bearing.

1. Apply a soluble adhesive to the three set screws such as Loctite 243) and screw them partially into the labyrinth sealing ring.

2. Apply an corrosion protection paint to the shaft in the area of the labyrinth sealing ring.
3. Warm up the labyrinth sealing ring. Push the labyrinth sealing ring to approx. 3 mm before the bearing cover before the paint or adhesive cures on the set screws.

![Image 9-7 Position the set screws for the labyrinth sealing ring on the outer bearing cover](image)

4. Locate the labyrinth sealing ring in position by screwing the set screws in. Check that the tips of the set screws engage with the keyway with a short axial movement. The correct axial position is obtained when the locating setscrews screwed into the keyway engage.
10.1 Ordering data

In addition to the exact part designation, please specify the machine type and serial number in all orders for spare parts. Ensure that the spare part designation matches that on the spare parts list and make sure you use the appropriate part number as well.

Example

- Bearing shield, drive end (Part 5.00)
- Machine type
- Serial number

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

Note

The graphical representations in this chapter show schematic diagrams of the basic versions. They are used for spare parts definitions. The supplied version may differ in details from these representations.

10.2 Using commercially available spare parts

You can use commercially available, standard components, but ensure that they have the same construction type, dimensions, strength class etc.

10.3 Ordering spare parts via the Internet

Spare parts can be ordered online from the spare parts service "Spares on Web":

You can use "Spares on Web" to determine the order numbers for motor spare parts quickly and easily.

A short description of how to use "Spares on Web" is available on the Internet.

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.

10.4 Anti-condensation heating

The anti-condensation heater is mounted directly on the winding. The anti-condensation heater cannot be removed without causing damage to the winding. A new anti-condensation heater may only be installed by Siemens Service Center (Page 137) specialists.
Table 10-1  Spare parts for stators and rotors

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.07</td>
<td>Internal fan</td>
<td>8.31</td>
<td>Non-drive end balancing ring</td>
</tr>
<tr>
<td>7.81</td>
<td>Air guide insert</td>
<td>10.00</td>
<td>Stator frame with laminated core and winding</td>
</tr>
<tr>
<td>8.00</td>
<td>Rotor, complete</td>
<td>10.50</td>
<td>Lifting lug</td>
</tr>
<tr>
<td>8.10</td>
<td>Shaft</td>
<td>10.84</td>
<td>Cover with seal</td>
</tr>
<tr>
<td>8.20</td>
<td>Rotor core with winding</td>
<td>20.00</td>
<td>Terminal box</td>
</tr>
<tr>
<td>8.30</td>
<td>Drive-end balancing ring</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10.6 Ventilation

### Table 10-2  Spare parts for cooling components

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.80</td>
<td>Grease nipple</td>
<td>12.02</td>
<td>Fan cowl</td>
</tr>
<tr>
<td>4.83</td>
<td>Rubber bush</td>
<td>12.21</td>
<td>Air inlet nozzle</td>
</tr>
<tr>
<td>4.84</td>
<td>Grease supply extension tube</td>
<td>12.35</td>
<td>Protective grille</td>
</tr>
<tr>
<td>11.04</td>
<td>External fan, unidirectional</td>
<td>12.70</td>
<td>Protective cover, optional for design IM V1</td>
</tr>
<tr>
<td>11.05</td>
<td>External fan, bidirectional</td>
<td>12.85</td>
<td>Fixing elements</td>
</tr>
<tr>
<td>11.62</td>
<td>Locking ring</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10.7 Drive end rolling-contact bearings with bearing housing

Table 10-3 Spare parts for drive end roller bearings with bearing housing

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.00</td>
<td>Roller bearing cartridge (locating</td>
<td>3.50</td>
<td>Bearing housing</td>
</tr>
<tr>
<td></td>
<td>bearing)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.10</td>
<td>V ring</td>
<td>3.60</td>
<td>Inner bearing cover</td>
</tr>
<tr>
<td>3.13</td>
<td>Protective ring</td>
<td>3.80</td>
<td>Grease nipple</td>
</tr>
<tr>
<td>3.16</td>
<td>Labyrinth ring (optional)</td>
<td>3.81</td>
<td>Nut</td>
</tr>
<tr>
<td>3.20</td>
<td>Outer bearing cover</td>
<td>3.82</td>
<td>Grease tube</td>
</tr>
<tr>
<td>3.30</td>
<td>Locking ring</td>
<td>5.00</td>
<td>End shield, design</td>
</tr>
<tr>
<td>3.35</td>
<td>Grease slinger</td>
<td>5.10</td>
<td>Flanged end shield</td>
</tr>
<tr>
<td>3.40</td>
<td>Deep-groove ball bearing (locating</td>
<td>5.67</td>
<td>Sealing plug</td>
</tr>
<tr>
<td></td>
<td>bearing)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10.8 Drive end rolling-contact bearings without bearing housing

Table 10-4 Spare parts for drive end roller bearings without bearing housing

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.00</td>
<td>Roller bearing cartridge (locating bearing)</td>
<td>3.50</td>
<td>Bearing housing</td>
</tr>
<tr>
<td>3.10</td>
<td>V ring</td>
<td>3.60</td>
<td>Inner bearing cover</td>
</tr>
<tr>
<td>3.13</td>
<td>Protective ring</td>
<td>3.80</td>
<td>Grease nipple</td>
</tr>
<tr>
<td>3.16</td>
<td>Labyrinth ring (optional)</td>
<td>3.81</td>
<td>Nut</td>
</tr>
<tr>
<td>3.20</td>
<td>Outer bearing cover</td>
<td>3.82</td>
<td>Grease tube</td>
</tr>
<tr>
<td>3.30</td>
<td>Locking ring</td>
<td>5.00</td>
<td>End shield</td>
</tr>
<tr>
<td>3.35</td>
<td>Grease slinger</td>
<td>5.67</td>
<td>Sealing plugs</td>
</tr>
<tr>
<td>3.40</td>
<td>Deep-groove ball bearing (locating bearing)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10.9 Roller bearings, DE - end shield with integrated bearing cover

Table 10-5  Spare parts for roller bearings, DE

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.00</td>
<td>Roller bearing cartridge (locating bearing)</td>
<td>3.50 Bearing housing</td>
</tr>
<tr>
<td>3.10</td>
<td>V ring</td>
<td>3.60 Inner bearing cover</td>
</tr>
<tr>
<td>3.13</td>
<td>Protective ring</td>
<td>3.80 Grease nipple</td>
</tr>
<tr>
<td>3.16</td>
<td>Labyrinth ring (optional)</td>
<td>3.81 Nut</td>
</tr>
<tr>
<td>3.30</td>
<td>Locking ring</td>
<td>3.82 Grease tube</td>
</tr>
<tr>
<td>3.35</td>
<td>Grease slinger</td>
<td>5.00 End shield</td>
</tr>
<tr>
<td>3.40</td>
<td>Deep-groove ball bearing (locating bearing)</td>
<td>5.67 Sealing plugs</td>
</tr>
</tbody>
</table>
10.10 Non-drive end rolling-contact bearings with bearing housing

Table 10-6  Spare parts for non-drive end roller bearings with bearing housing

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.00</td>
<td>Roller bearing cartridge (floating bearing)</td>
<td>4.50</td>
<td>Bearing housing</td>
</tr>
<tr>
<td>4.10</td>
<td>V ring</td>
<td>4.60</td>
<td>Inner bearing cover</td>
</tr>
<tr>
<td>4.20</td>
<td>Outer bearing cover</td>
<td>4.81</td>
<td>Nut</td>
</tr>
<tr>
<td>4.30</td>
<td>Locking ring</td>
<td>4.82</td>
<td>Grease tube</td>
</tr>
<tr>
<td>4.35</td>
<td>Grease slinger</td>
<td>6.00</td>
<td>End shield</td>
</tr>
<tr>
<td>4.40</td>
<td>Deep-groove ball bearing</td>
<td>6.67</td>
<td>Sealing plugs</td>
</tr>
<tr>
<td>4.45</td>
<td>Compression spring</td>
<td></td>
<td></td>
</tr>
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</table>
10.11 Non-drive end rolling-contact bearings without bearing housing

Table 10-7 Spare parts for non-drive end roller bearings without bearing housing

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.00</td>
<td>Roller bearing cartridge (floating bearing)</td>
<td>4.45</td>
<td>Compression spring</td>
</tr>
<tr>
<td>4.10</td>
<td>V ring</td>
<td>4.60</td>
<td>Inner bearing cover</td>
</tr>
<tr>
<td>4.20</td>
<td>Outer bearing cover</td>
<td>4.81</td>
<td>Nut</td>
</tr>
<tr>
<td>4.30</td>
<td>Locking ring</td>
<td>4.82</td>
<td>Grease tube</td>
</tr>
<tr>
<td>4.35</td>
<td>Grease slinger</td>
<td>6.00</td>
<td>End shield</td>
</tr>
<tr>
<td>4.40</td>
<td>Deep-groove ball bearing</td>
<td>6.67</td>
<td>Sealing plugs</td>
</tr>
</tbody>
</table>
### Table 10-8  
Spare parts for roller bearings, NDE

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
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<tbody>
<tr>
<td>4.00</td>
<td>Roller bearing cartridge (floating bearing)</td>
<td>4.60</td>
<td>Inner bearing cover</td>
</tr>
<tr>
<td>4.10</td>
<td>V ring</td>
<td>4.81</td>
<td>Nut</td>
</tr>
<tr>
<td>4.30</td>
<td>Locking ring</td>
<td>4.82</td>
<td>Grease tube</td>
</tr>
<tr>
<td>4.35</td>
<td>Grease slinger</td>
<td>6.00</td>
<td>End shield</td>
</tr>
<tr>
<td>4.40</td>
<td>Deep-groove ball bearing</td>
<td>6.67</td>
<td>Sealing plugs</td>
</tr>
<tr>
<td>4.45</td>
<td>Compression spring</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### 10.13 Terminal box GT640

The terminal box can only be ordered as one component.

The maximum connection cross-section for the main circuit is 240 mm².

---

**Table 10-9 Terminal box GT640**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.00</td>
<td>Terminal box without cable entry comprising the following components:</td>
<td>21.20</td>
<td>Bushing insulator</td>
</tr>
<tr>
<td>20.20</td>
<td>Housing</td>
<td>21.61</td>
<td>Terminals for auxiliary circuits, max. connection 2.5 mm²</td>
</tr>
<tr>
<td>20.27</td>
<td>Mounting rail</td>
<td>22.01</td>
<td>Saddle terminal, complete</td>
</tr>
<tr>
<td>20.28</td>
<td>Seal</td>
<td>22.11</td>
<td>Connecting plate with internal cable</td>
</tr>
<tr>
<td>20.30</td>
<td>Cover</td>
<td>22.40</td>
<td>Terminal link (two holes)</td>
</tr>
<tr>
<td>20.38</td>
<td>Seal</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10.14 Terminal box 1XB1621

Table 10-10 Terminal box 1XB1621 spare parts

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.00</td>
<td>Terminal box without cable entry comprising the following components:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20.20</td>
<td>Terminal box housing</td>
<td>21.41</td>
<td>Terminal supports</td>
</tr>
<tr>
<td>20.27</td>
<td>Mounting rail</td>
<td>21.61</td>
<td>Terminal strip for auxiliary circuit</td>
</tr>
</tbody>
</table>
Table 10-11  Additional spare parts

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.28</td>
<td>Seal</td>
<td>22.01</td>
<td>Saddle terminal, complete</td>
</tr>
<tr>
<td>20.30</td>
<td>Cover</td>
<td>22.43</td>
<td>Terminal link, stepped with two holes</td>
</tr>
<tr>
<td>20.38</td>
<td>Seal</td>
<td>22.70</td>
<td>Fixing lug for PE conductor</td>
</tr>
<tr>
<td>21.11</td>
<td>Connecting plate with internal cable</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.60</td>
<td>Cable gland</td>
<td>20.66</td>
<td>Strain relief - lower part</td>
</tr>
<tr>
<td>20.61</td>
<td>Cable gland - upper part</td>
<td>20.68</td>
<td>Seal</td>
</tr>
<tr>
<td>20.62</td>
<td>Cable gland - lower part</td>
<td>20.70</td>
<td>Sealing insert for cable entry</td>
</tr>
<tr>
<td>20.65</td>
<td>Strain relief - upper part</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Spare parts

10.15 Terminal box 1XB1631

Table 10-12 Additional spare parts for terminal box 1XB1631 with split cable entry

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.61</td>
<td>Cable gland - upper part</td>
<td>20.66</td>
<td>Strain relief - lower part</td>
</tr>
<tr>
<td>20.62</td>
<td>Cable gland - lower part</td>
<td>20.70</td>
<td>Sealing insert for cable entry</td>
</tr>
<tr>
<td>20.65</td>
<td>Strain relief - upper part</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10.16 Terminal box 1XB1634

Image 10-11 Terminal box 1XB1634 with standard cable entry

Image 10-12 Two-pane cable entry

Table 10-13 Spare parts for terminal box 1XB1634

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.20</td>
<td>Terminal box enclosure</td>
<td>20.65</td>
<td>Strain relief (upper part)</td>
</tr>
<tr>
<td>20.27</td>
<td>Mounting rail</td>
<td>20.66</td>
<td>Strain relief (lower part)</td>
</tr>
<tr>
<td>20.28</td>
<td>Seal</td>
<td>20.68</td>
<td>Seal</td>
</tr>
<tr>
<td>20.30</td>
<td>Cover</td>
<td>20.70</td>
<td>Sealing insert for cable entry</td>
</tr>
<tr>
<td>20.38</td>
<td>Seal</td>
<td>21.41</td>
<td>Terminal supports</td>
</tr>
<tr>
<td>20.60</td>
<td>Cable gland</td>
<td>21.61</td>
<td>Terminal strip for auxiliary circuit</td>
</tr>
</tbody>
</table>
### Spare parts

**10.16 Terminal box 1XB1634**

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.61</td>
<td>Cable gland (upper part)</td>
<td>22.70</td>
<td>Fixing lug for PE conductor</td>
</tr>
<tr>
<td>20.62</td>
<td>Cable gland (lower part)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10.17 Terminal box 1XB9600

Table 10-14  Spare parts for terminal box 1XB9600

<table>
<thead>
<tr>
<th>Part</th>
<th>Description</th>
<th>Part</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.20</td>
<td>Terminal box enclosure</td>
<td>20.63</td>
<td>Cable gland (center part)</td>
</tr>
<tr>
<td>20.27</td>
<td>Mounting rail</td>
<td>20.68</td>
<td>Seal</td>
</tr>
<tr>
<td>20.28</td>
<td>Seal</td>
<td>20.70</td>
<td>Sealing insert for cable entry</td>
</tr>
<tr>
<td>20.30</td>
<td>Cover</td>
<td>21.11</td>
<td>Connecting plate with internal cable</td>
</tr>
<tr>
<td>20.38</td>
<td>Seal</td>
<td>21.41</td>
<td>Terminal supports</td>
</tr>
<tr>
<td>20.61</td>
<td>Cable gland (upper part)</td>
<td>21.61</td>
<td>Terminal strip for auxiliary circuit</td>
</tr>
<tr>
<td>20.62</td>
<td>Cable gland (lower part)</td>
<td>22.70</td>
<td>Fixing lug for PE conductor</td>
</tr>
</tbody>
</table>
Spare parts

10.17 Terminal box 1XB9600
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.

11.1 RoHS - restricting the use of certain hazardous substances

In compliance with RoHS ("Restriction of certain Hazardous Substances") we replace substances that are damaging to the environment by those that are not based on state-of-the-art technology. In doing so, safety in operation and handling will take priority at all times.

Note

Country-specific legislation

When disposing of the machine or of waste that is created during the individual phases of its life cycle, please observe the statutory requirements applicable in the country of use.

11.2 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.
11.3 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

Technical queries or additional information

If you have any technical queries or you require additional information, please contact Technical Support (https://support.industry.siemens.com/cs/sc?nId=2090&lc=en-WW).

Please have the following data ready:

- Type
- Serial number

You can find this data on the rating plate.

Contact person

If you wish to request on-site service or order spare parts, please contact your local office. This office will contact the responsible service center on your behalf. You can find your contact person in the relevant contact database:

www.siemens.com/yourcontact (www.siemens.com/yourcontact)

Siemens Support for on the move

You can obtain optimum support anywhere you go using the "Siemens Industry Online Support" app. The app is available for Apple iOS, Android and Windows Phone.
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>
<thead>
<tr>
<th>Case</th>
<th>M4</th>
<th>M5</th>
<th>M6</th>
<th>M8</th>
<th>M10</th>
<th>M12</th>
<th>M16</th>
<th>M20</th>
<th>M24</th>
<th>M30</th>
<th>M36</th>
<th>M42</th>
<th>M48</th>
<th>M56</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>1.2</td>
<td>2.5</td>
<td>4</td>
<td>8</td>
<td>13</td>
<td>20</td>
<td>40</td>
<td>52</td>
<td>80</td>
<td>150</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Nm</td>
</tr>
<tr>
<td>B</td>
<td>1.3</td>
<td>2.6</td>
<td>4.5</td>
<td>11</td>
<td>22</td>
<td>38</td>
<td>92</td>
<td>180</td>
<td>310</td>
<td>620</td>
<td>1080</td>
<td>1700</td>
<td>2600</td>
<td>4200</td>
</tr>
<tr>
<td>C</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>20</td>
<td>40</td>
<td>70</td>
<td>170</td>
<td>340</td>
<td>600</td>
<td>1200</td>
<td>2000</td>
<td>3100</td>
<td>4700</td>
<td>7500</td>
</tr>
</tbody>
</table>
Applications

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

- **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.

See also

Securing the rotor (Page 32)
Quality documents

You can find the quality documents here:

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