SIEMENS

Operating instructions

Low-voltage motors

SIMOTICS SD

1LE5 - frame size 400/450

Edition 03/2018

www.siemens.com/drives

SIEMENS

Low-voltage motors

SIMOTICS SD
1LE5 AH400/450

Operating Instructions

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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.

Proper use of Siemens products

Note the following:

⚠ WARNING

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

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

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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Table of contents

Introduction 1

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.

Please contact the service center (Page 135) if you have any suggestions on how to improve this document.

In the following text, the motor is referred to as "electrical machine" – or abbreviated, just "machine".

These operating instructions do not cover all of the order-specific versions of the product range. Additional information on this can be found in the Catalog.

Text format features

The warning notice system is explained on the rear of the inside front. Carefully comply with all of the safety-relevant information in these instructions and attached to the product itself.

In addition, you will find the following text format features in these instructions:

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

The note provides you with additional information about the product itself, handling the product - and the relevant documentation.

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.

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.

Safety information 2

2.1 Information for those responsible for the plant or system

This electric machine has been designed and built in accordance with the specifications contained in 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 local service center (Page 135) for planning, installation, commissioning and service 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 11) when carrying out any work on the machine.
- Only remove covers in the manner described in the operating instructions.
- Operate the machine properly.
- Regularly and professionally maintain the machine according to the instructions provided in the "Maintenance" (Page 91) chapter of the operating instructions.

⚠ WARNING

Rotating parts

Electric machines contain dangerous rotating parts.

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

- Only remove the covers using the methods described by these operating instructions.
- Operate the machine properly.
- Regularly and correctly maintain the machine.
- Secure free shaft extensions and other rotating part such as couplings and pulley belts so that they cannot be touched.

⚠ WARNING

Hot surfaces

Electric machines have hot surfaces. Touching hot surfaces can result in severe burns.

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

⚠ CAUTION

Hazardous substances

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

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

⚠ CAUTION

Flammable substances

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

Burns and other damage to health and material may result.

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

2.5 Electromagnetic fields when operating electrical power engineering installations

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.

2.6 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.

- Comply with the EMC information provided by the manufacturer of the converter. This is how you prevent the limit values stipulated by IEC/EN 61000-6-3 for the drive system (consisting of the machine and converter) from being exceeded.
- You must put appropriate EMC measures in place.

2.7 Special designs and construction versions

Note

Before carry out any work on the machine, determine the machine version.

If there are any deviations or uncertainty, contact the manufacturer, specifying the type designation and serial number (see the rating plate), or contact the Service Center (Page 135).

Description 3

3.1 Area of application

The three-phase machines of this series are used as industrial drives. They are designed for a wide range of drive applications both for line operation as well as in conjunction with frequency converters.
They are characterized by their high power density, extreme robustness, long service life and outstanding reliability.

Intended use of the machines

These machines are intended for industrial installations. They comply with the harmonized standards of the series EN / IEC 60034 (VDE 0530). It is prohibited to use these motors in hazardous zones if the marking on the rating plate does not explicitly permit line or converter operation. If other/more wide-ranging demands (e.g. protection so that they cannot be touched by children) are made in special cases – i.e. use in non-industrial installations – these conditions must be ensured by the customer.

Note

Machine directive

Low-voltage motors are components designed for installation in machines in accordance with the current Machinery Directive. Commissioning is prohibited until it has been absolutely identified that the end product is in conformance with this Directive. Please observe the EN / IEC 60204-1 standard.

⚠ WARNING

Risk of explosion

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.

3.1.1 CE marking

CE

Use of machines without CE marking

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

3.1.2 EAC marking

Use of machines without EAC marking

EAC machines are appropriately marked on the rating plate, and are intended for operation within the Eurasian customs union.
Within the Eurasian customs union, do not use machines without the appropriate EAC marking.

3.1.3 Operating UL-certified machines with a converter

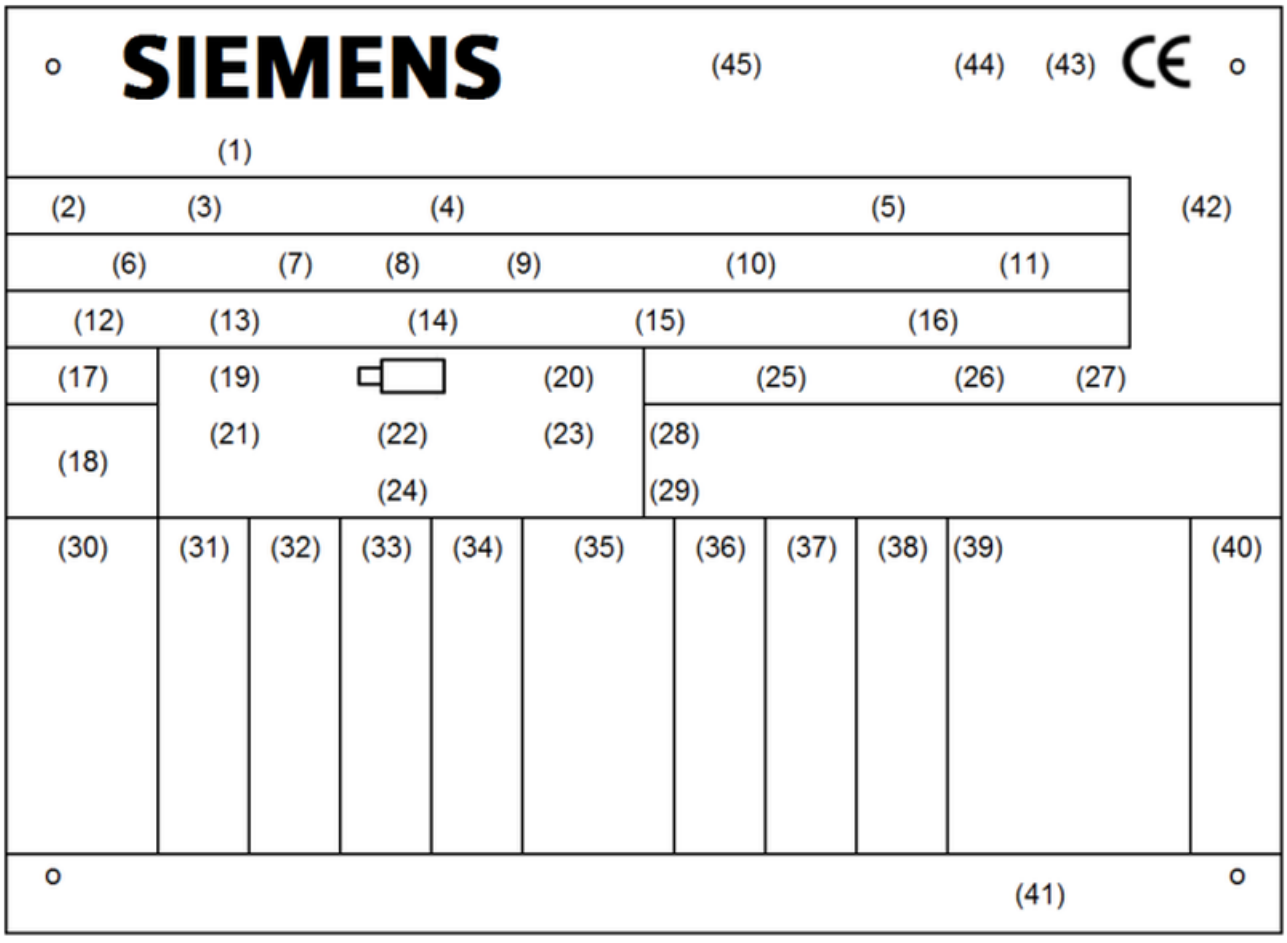
Operating a machine with a converter

Implement all machines of the overall machine-converter system according to UL-File E227215 assuming that the machines are only to be operated with a converter and are supplied with UL certificate.
The company operating the equipment is responsible for implementing this in the actual application.

3.2 Rating plate

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.



Data on the rating plate

(1)	Production location	(23)	Relubrication quantity NDE
(2)	Type of motor	(24)	Grease type
(3)	Motor type	(25)	NEMA standard
(4)	Order number	(26)	Cooling method according to NEMA MG1
(5)	Serial number/ year of manufacture	(27)	Operating mode/duty type according to NEMA MG1
(6)	IEC/EN standard	(28)	Supplementary data, e.g. option Y84
(7)	Frame size	(29)	Motor design: only for line operation or capable of converter operation
(8)	Type of construction	(30)	Rated voltage and connection
(9)	Weight	(31)	Rated frequency
(10)	Thermal class of the insulation system/utilization	(32)	Rated current
(11)	Permissible ambient temperature range	(33)	Rated power in kW
(12)	Vibration severity grade	(34)	Rated power factor
(13)	Degree of protection	(35)	Efficiency according to IEC/EN 60034-2-1
(14)	Maximum speed	(36)	Rated speed
(15)	Maximum permissible installation altitude	(37)	Efficiency class according to IEC/EN 60034-30-1

(16)	Voltage/power of the anti-condensation heating	(38)	Rated power in HP
(17)	Cooling method	(39)	Code letter according to NEMA MG 1
(18)	Direction of rotation	(40)	Country of production
(19)	Bearing type DE	(41)	Classification society
(20)	Bearing type NDE	(42)	Balancing code
(21)	Relubrication quantity DE	(43)	Efficiency class code
(22)	Regreasing interval	(44)	Country-specific marking, e.g. CSA mark

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.

3.3 Installation

3.3.1 Machine design

Machines of this series are low-voltage three-phase induction drives with a cylindrical shaft extension and keyway.

They can be supplied as single-speed machines with different efficiency classes or as pole changing machines for several speeds.

The regulations and standards used as the basis for designing and testing this machine are stamped on the rating plate. The machine design basically complies with the following standards:

Table 3-1 Applicable general regulations

Feature	Standard	EAC
Dimensioning and operating behavior	EN / IEC 60034-1	GOST R IEC 60034-1
Procedure for determining the losses and the efficiency of rotating electrical machines and inspections	EN / IEC 60034-2-1 EN / IEC 60034-2-2 EN / IEC 60034-2-3	GOST R IEC 60034-2-1 GOST R IEC 60034-2-2 GOST RIEC 60034-2-3
Degree of protection	EN / IEC 60034-5	GOST R IEC 60034-5
Cooling	EN / IEC 60034-6	GOST R IEC 60034-6
Type of construction	EN / IEC 60034-7	GOST R IEC 60034-7

Feature	Standard	EAC
Terminal designations and direction of rotation	EN / IEC 60034-8	GOST R IEC 60034-8
Noise emission	EN / IEC 60034-9	GOST R IEC 60034-9
Starting characteristics of rotating electrical machines	EN / IEC 60034-12	GOST R IEC 60034-12
Vibration severity grades	EN / IEC 60034-14	GOST R IEC 60034-14
Efficiency classification of three-phase squirrel-cage induction motors	EN / IEC 60034-30-1	GOST R IEC 60034-30-1
IEC standard voltages	IEC 60038	GOST R IEC 60038

3.3.2 Cooling and ventilation

The surface cooling varies depending on the version.

Self-ventilation (standard): Cooling method IC 411 according to EN / IEC 60034-6

Located at the ND end of the stator housing is an air intake cowl that guides the external air on its way to the motor. The external air is drawn in through openings in the air intake cowl and flows axially across the outer cooling ribs of the motor frame. The fan wheel for the external flow of cooling air is attached to the machine shaft.
The fan wheels are bidirectional.
Check the cooling effect below rated speed in the case of frequent switching or braking – or if the speed is controlled continually below the rated speed.

Surface cooling by relative movement of cooling air (option): Cooling method IC 418 according to EN / IEC 60034-6

Enclosed machine, no fan, enclosure surface is cooled using an external cooling air flow. The required air flow is available on request.

Forced ventilation (optional): Type of cooling IC 416 in accordance with EN / IEC 60034-6

Cooling that does not depend on the speed is achieved by means of a unit that is independent of the motor operating state (forced ventilation). This unit is closed to the outside by a fan cover. It has its own main drive with fan impeller which creates the cooling air flow required for cooling the motor.

3.3.3 Bearings

In order to support the machine shaft and maintain its position in the non-moving part of the machine, only 2 rolling bearings are used. One rolling bearing performs the function of a location bearing that transfers axial and radial forces from the rotating machine shaft to the non-moving part of the machine. The second rolling bearing is implemented as floating and support bearing in order to allow thermal expansion inside the machine and transfer radial forces.
The nominal (calculated) useful life of the bearings according to ISO 281 is at least 20,000 hours with utilization of the permissible radial/axial forces. However, the achievable useful life of the bearings can be significantly longer in the case of lower forces (e.g. operation with self-aligning couplings).

Rolling bearings with permanent lubrication are maintenance-free.

The machines are equipped with different types of rolling bearings depending on the version and the operating conditions described in the order.

Table 3-2 Rolling bearing versions

Horizontal type of construction, coupling output	• DE: Deep-groove ball bearing as fixed bearing • NDE: Deep-groove ball bearing as floating bearing with axial springs
Horizontal type of construction, for increased transverse forces e.g. in the case of belt coupling	• DE: Cylindrical rolling bearing as floating bearing • NDE: Deep-groove ball bearing as fixed bearing
Vertical type of construction	• DE: Pairing of angular-contact ball bearing / deep-groove ball bearing as fixed bearing • NDE: Deep-groove ball bearing as floating bearing with axial springs

The type of construction of the machine is stated on the rating plate.

The machine has a type of protection as stamped on the rating plate, and can be installed in dusty or humid environments.

3.3.4 Environmental conditions

Table 3-3 Limit values for the ambient conditions for standard motors

Ambient temperature	-20 °C ... +40 °C
Installation altitude	≤1000 m above sea level

If the environmental conditions are different from the details listed here, then the values on the rating plate or in the catalog will apply.

3.3.5 Optional built-on and built-in accessories

Machines can be equipped with the following integrated components/devices:

- Temperature sensors integrated in the stator winding in order to monitor the temperature and protect the stator winding from overheating.
- Anti-condensation heating for machines whose windings are subject to a risk of condensation due to the climatic conditions.

Machines can be equipped with the following mounted components/devices:

- Brake
- Rotary pulse encoder
- External fan (forced ventilation)
- Measuring nipple for SPM shock pulse measurement for bearing monitoring

Preparing for use

4

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 11) 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 Ensuring cooling

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

- Ensure that the cooling air can flow in and out unobstructed. The full air flow provided by the fan is only possible if air can freely enter the impeller. In the axial direction, ensure a clearance of at least 1 x air intake diameter.
- Make sure that the machine does not draw in the hot discharged air again.
- For machines with a vertical type construction with an air intake from above, ensure that the air inlets are protected against the ingress of foreign bodies and water.

4.4 Thermal motor protection (depending on the particular version)

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

Setpoint values for monitoring the bearing temperature (Page 80)

4.5 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 machine has been switched off.

4.6 External fan cooling air quality

The cooling air is only permitted to have weak chemically aggressive properties and must only have low levels of oil or dust.

4.7 Interlock circuit for the external fan motor

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

4.8 Support base for IM B5 construction type

- For machines, type of construction IM B5, provide an additional support foot at the NDE. The support foot is not included in the scope of supply.
- Use an appropriately sized support foot with the appropriate rigidity. The support foot must be able to support the total weight of the machine.
  The weight of the machine is stated on the rating plate, data on geometry is shown in the dimension drawing.
- There is a threaded hole M36 at the bottom of the machine where you can attach the support foot.

⚠ WARNING

Missing support at the NDE

If the machine has no support at the NDE, the flange cannot hold the weight of the machine. The machine or machine parts may loosen.

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

- Use an appropriately sized support base.

4.9 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.

4.10 Voltage and frequency fluctuations during line operation

Unless stated otherwise on the rating plate, the permissible voltage fluctuation is ±10 % and the permissible frequency fluctuation is ±2 % in accordance with range B in IEC / EN 60034-1. Permissible fluctuations that go beyond this are stamped on the rating plate.

Under operating conditions a machine may sometimes have to be operated outside the limits of range A.

- Exceeding the permissible tolerances for voltage and frequency can lead to an impermissibly high temperature rise of the winding. This can result in long-term damage to the machine.
- Limit exceptions of this sort 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. In this way you can avoid that the service life of the machine is reduced as a result of thermal aging.

4.11 System-inherent frequencies

Excessively high vibration levels and system resonances can damage the machine set.

- Configure and match the system consisting of the foundation and machine set in such a way that no system resonances can arise and result in the permissible vibration levels being exceeded.
- The vibration limit values according to DIN ISO 10816-3 must not be exceeded.

4.12 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.

⚠ WARNING

Risk of torsional stress on the drive train

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.

- When planning the system, consider the configuration data.

4.13 Delivery

Checking the delivery for completeness

The drive systems are put together on an individual basis. When you take receipt of the delivery, please check immediately whether the items delivered are in accordance with the accompanying documents. Siemens will not accept any claims relating to items missing from the delivery and which are submitted at a later date.

- Report any apparent transport damage to the delivery agent immediately.
- Report any apparent defects/missing components to the appropriate SIEMENS office immediately.

Archive the safety and commissioning notes provided in the scope of delivery as well as the optionally available operating instructions so that these documents are always easily accessible.

The rating plate optionally enclosed as a loose item with the delivery is provided to enable the motor data to be attached on or near the machine or installation.

4.14 Transport and storage

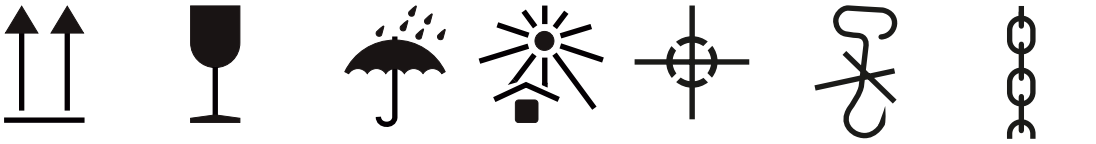
Observe the following when carrying out any work on the machine:

- Comply with the general safety instructions (Page 11)
- Comply with the applicable national and sector-specific regulations.
- When using the machine within the European Union, comply with the specifications laid down in EN 50110-1 regarding safe operation of electrical equipment.

4.14.1 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

WARNING

Risk of dropping and swinging when transported suspended

If you transport the motor suspended from cables or ropes, the cables or ropes can break, e.g. as a result of damage. Further, if not adequately attached, the motor can swing. This can result in death, serious injury, or material damage.

- Use additional, suitable lifting equipment for transport and during installation.
- Two cables alone must be able to carry the complete load.
- Prevent the lifting equipment from sliding by appropriately securing it.
- When using 2-cable lifting equipment, ensure that the maximum angle of inclination is ≤45° according to ISO 3266 (DIN 580).
- Align the eyebolts so that the cables used for lifting are aligned with the planes of the eyebolts.

WARNING

Toppling over or slipping of the motor

The motor can slide or topple over if it is not correctly lifted or transported. This can result in death, serious injury, or material damage.

- Use all the lifting eyes on the machine.
- When using the lifting eyes on the machine, do not attach any additional loads or weight. The lifting eyes are only designed for the weight of the machine itself.
- Any eyes that are screwed in must be tightly fastened.
- Eyebolts must be screwed in right up to their supporting surface.
- Comply with the permissible eyebolt loads.
- When necessary, use suitably dimensioned lifting equipment, for example hoisting straps (EN1492-1) and load restraints (EN12195-2).

Note

When lifting the machines for transport, only lift them in a position that corresponds to their basic construction type.

4.14.2 Types of construction on the rating plate

The type of construction of the machine is stated on the rating plate.

4.14.3 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 machine 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.
- 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 ≤ 0.4 g (≈ 4 m/s^2)
    Velocity v ≤ 20 m/min

⚠ WARNING

Transport for a different type of construction

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.
- Only use suitable rope guiding or spreading devices.

⚠ WARNING

Center of gravity not centered

If the center of gravity of a load is not located centrally between the attachment points, the machine 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 machine. If the center of gravity is not located centrally between the attachment points, then position the hoisting hook above the center of gravity.

4.14.4 Securing the rotor

Depending on the version, the machine is fitted with a rotor shipping brace. This protects the bearings against damage due to shock and vibration during transport or storage.

NOTICE

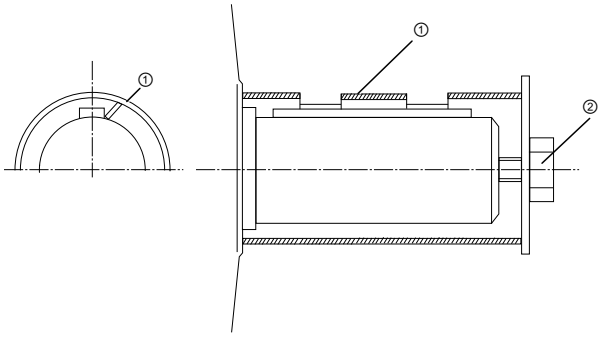
Motor damage due to vibrations

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

- If the machine is fitted with a rotor shipping brace, this should always be used when transporting the machine. The rotor shipping brace must be attached during the transport.
- Protect the motor against strong radial shocks and vibration when storing, as the rotor shipping brace cannot completely absorb these forces.
- Do not remove the rotor shipping brace until you are ready to push on the output element.
- If the customer already has mounted parts, such as a coupling or belt pulley, the bearings can be damaged during transport. In this case, make sure that the customer uses a rotor shipping brace.
- For machines with a vertical type of construction:
  - Do not remove the rotor shipping brace until the machine is in a vertical position.
  - If a machine has to be transported in a horizontal position, the rotor must be fixed in position before the machine is turned onto its side. Vertical machines can be supplied in the horizontal position from the manufacturing plant.

Alternative rotor bracing

- If you transport the machine after the output element has been pulled on, then you must axially fix the rotor in another way.



① Sleeve ② Shaft screw and washer

Figure 4-1 Axial fastening of the rotor

Thread in the shaft extension	Tightening torque
M20	80 Nm
M24	150 Nm
M30	230 Nm

Tightening torques for other rotor shipping brace types

- The thread in the shaft extension indicates the rotor weight. This indirectly specifies the required preload force when axially fastening the rotor.

Thread in the shaft extension	Preload
M20	20 kN
M24	30 kN
M30	40 kN

Axial preload force for other rotor shipping brace types

4.14.5 Storage

Storing outdoors

NOTICE
Damage to the motor
Damage can occur if incorrectly stored.
Take all precautions to protect the motor under extreme climatic conditions, e.g. salt-laden and/or dusty, moist/humid atmospheres.

Choose a dry storage location which is safe from flooding and free from vibration. Repair any damage to the packaging before putting the equipment into storage if this is necessary to

ensure proper storage conditions. In order to ensure protection against ground moisture, locate machines, equipment and crates on pallets, wooden beams or foundations. Prevent equipment from sinking into the ground. Do not impede air circulation under the stored items.

Covers or tarpaulins used to protect the equipment against the weather must not come into contact with the surfaces of the equipment. Use wooden spacer elements to ensure that air can circulate freely around the equipment.

Storing indoors

The storage rooms must provide protection against extreme weather conditions. They must be dry, free from dust, frost and vibration and well ventilated.

Bare metal surfaces

For transport, the bare surfaces (shaft ends, flange surfaces, centering edges) should be coated with an anti-corrosion agent which will last for a limited amount of time (<6 months). Apply suitable anti-corrosion measures for longer storage times.

Condensation drain hole

Open any condensation drain holes to drain the condensation depending on the environmental conditions, every six months at the latest.

Storage temperature

Permissible temperature range: -20 °C to +50 °C

Maximum permissible air humidity: 60%

For machines that have a special design regarding the ambient temperature in the operating state or the installation altitude, other conditions could apply regarding the storage temperature. In this case, refer to the machine rating plate for data on the ambient temperature and installation altitude.

Storage time

Turn the shaft once every year to avoid bearing brinelling. Prolonged storage periods reduce the useful life of the bearing grease (aging).

Open bearings

- For open bearings, e.g. 1Z, check the status of the grease when stored for longer than 12 months.
- Replace the grease if it is identified that the grease has lost its lubricating properties or is polluted. The consistency of the grease will change if condensation is allowed to enter.

Closed bearings

- For closed bearings, replace the DE and NDE bearings after a storage time of 48 months.

NOTICE
Storage The motor can be damaged if you use it or store it unprotected outdoors. • Protect the motor against intensive solar radiation, rain, snow, ice and dust. Use a superstructure or additional cover, for example. • If required, contact the service center, or technically coordinate outdoors use.

4.15 Electromagnetic compatibility

Note

If the torque levels are very unequal (e.g. when a reciprocating compressor is being driven), a non-sinusoidal machine current will be induced whose harmonics can have an impermissible effect on the supply system and cause impermissible interference emissions as a result.

Note

Converter

- If operated with a frequency converter, the emitted interference varies in strength, depending on the design of the converter (type, interference suppression measures, manufacturer).
- Avoid that the specified limit values stipulated for the drive system (consisting of the motor and converter) are exceeded.
- You must observe the EMC information from the manufacturer of the converter.
- The most effective method of shielding is to conductively connect a shielded machine supply cable to the metal terminal box of the machine (with a metal screw connection) over a large surface area.
- On machines with integrated sensors (e.g. PTC thermistors), disturbance voltages caused by the converter may occur on the sensor cable.

When used in accordance with their intended purpose and operated on an electrical supply system with characteristics according to EN 50160, the enclosed machines comply with the requirements of the EC Directive concerning electromagnetic compatibility.

Immunity to interference

The machines fulfill the requirements of interference immunity in conformity with EN / IEC 61000-6-2. If machines with integrated sensors (e.g. PTC thermistors) are used, the operating company must ensure sufficient interference immunity by selecting a suitable sensor signal lead (possibly with shielding, connected in the same way as the machine feeder cable) and a suitable evaluation unit.
When operating the machines from a converter at speeds higher than the rated speed, then the mechanical speed limits must be carefully observed (safe operating speed EN / IEC 60034-1).

4.16 Converter operation

The following chapter is relevant only if the machine is suitable for converter operation. Whether the motor is only suitable for line operation or also for converter operation - with or without filter - is stamped on the rating plate.

4.16.1 Converter parameterization

- If the design of the motor requires connection to a particular converter type, the rating plate will contain corresponding additional information.
- Correctly parameterize the converter. Parameterizing data can be taken from the machine rating plates.
  You can find parameter data here:
  - In the operating instructions for the converter.
  - In the SIZER engineering tool
  - In the SINAMICS Configuration Manuals.
- Do not exceed the specified maximum speed limit n_{max}. You can either find this on the rating plate n_{max} - or on the supplementary plate for converter operation as the highest speed.
- Check that the machine is cooled sufficiently for commissioning purposes.

4.16.2 Converter input voltage

The insulation system of SIMOTICS machines significantly exceeds the requirements of stress category C (IVIC C = high stress). If voltage peaks higher than those specified according to IVIC C can occur, then observe the data in the respective Catalog (http://w3app.siemens.com/mcms/infocenter/content/en/Pages/order_form.aspx):

- For a line voltage (converter input voltage) up to max. 480 V and operation connected to a SINAMICS G / SINAMICS S converter with uncontrolled/controlled infeed: Comply with the guidelines for configuring motor and converter.
- For line voltages (converter input voltages) higher than 480 V, motors, which are ordered for converter operation, have an appropriate insulation system.
- Operation with a converter from another manufacturer: Comply with the permissible voltage peaks according to IEC 60034-18-41 in accordance with stress category C, dependent on the particular line voltage (converter input voltage) and the motor insulation system.

NOTICE
Material damage caused by an excessively high supply voltage The insulation system will be damaged if the supply voltage is too high for the insulation system. This can completely destroy the machine. • Comply with the peak voltages as laid down in the guidelines above.

4.16.3 Reducing bearing currents when operated with a converter

Taking the following actions will reduce the bearing currents:

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

Equipotential bonding conductors:

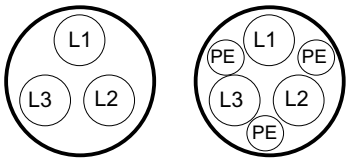
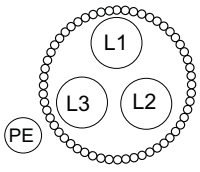
Use equipotential bonding conductors:

- 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.

	
Concentric copper or aluminum shield	Steel armor

- 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.
  - Ensure that the contacts are made over a large area.

Measures to reduce bearing currents

To specifically reduce bearing currents, you must consider the system as a whole, which comprises the motor, converter, and driven machine. The following measures support you when reducing bearing currents and help to avoid damage:

- 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. Output filters dampen the harmonic content in the output voltage.
- The operating instructions for the converter are not part of this documentation. Refer to the configuration information for the converter.

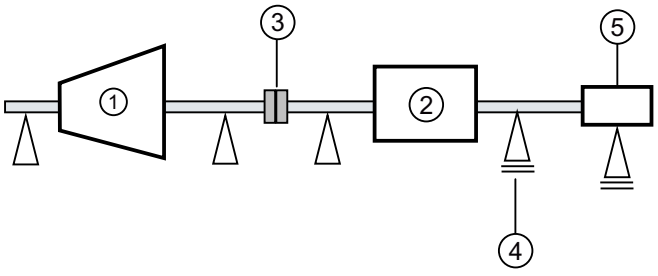
4.16.4 Insulated bearings when operating the converter

If the machine is operated with a low-voltage converter, then as a minimum, one bearing must be insulated (option) - and a speed encoder with insulated bearings (option) mounted.

Motor bearings can be insulated in the following ways:

- NDE bearing insulation (option): The DE bearing is not insulated. No additional measures are required.
- DE bearing insulation (option): The NDE bearing is not insulated. The coupling must be insulated.
- DE and NDE bearing insulation (option): Both bearings are insulated. The shaft must be continually grounded using a grounding brush (option).

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



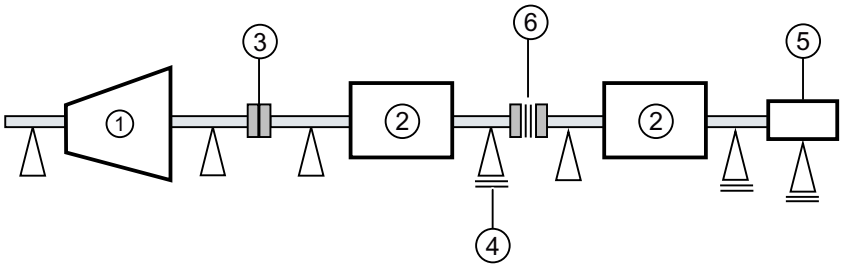
① Driving machine
② Motor
③ Coupling
④ Insulated bearings
⑤ Insulated tachometer fitting

Figure 4-2 Schematic representation of a single drive

NOTICE
Bearing damage due to bearing currents 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. • Please 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.



①	Driving machine	④	Insulated bearings
②	Motor	⑤	Insulated tachometer fitting
③	Coupling	⑥	Insulated coupling

Figure 4-3 Schematic representation of a tandem drive

NOTICE
Rolling bearing damage due to bearing currents 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.

Assembly 5

5.1 Safety instructions for mounting

Observe the following when carrying out any work on the machine:

- Comply with the general safety instructions (Page 11)
- Comply with the applicable national and sector-specific regulations.
- When using the machine within the European Union, comply with the specifications laid down in EN 50110-1 regarding safe operation of electrical equipment.

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.

Note

Note also the technical data on the rating plates on the motor enclosure.

NOTICE
Damage to the motor To avoid material damage, before commissioning, check whether the correct direction of rotation of the machine has been set on the customer side, e.g. by decoupling from the driven load.

5.2 Preparing for installation

5.2.1 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

Measure the insulation resistance of the winding before starting any 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.

5.2.2 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 39)

5.2.3 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. Short-circuit the ends of the temperature sensor cables before applying the test voltage. If the test voltage is connected to only one temperature sensor terminal, the temperature sensor will be destroyed.
3. Make sure that no power cables are connected.
4. 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.
5. 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 5-1 Stator winding insulation resistance at 40° C

U_N V	U_{meas} V	R_C MΩ
U ≤ 1000	500	≥ 5
1000 ≤ U ≤ 2500	500 (max. 1000)	100
2500 < U ≤ 5000	1000 (max. 2500)	
5000 < U ≤ 12000	2500 (max. 5000)	
U > 12000	5000 (max. 10000)	

U_{rated} = rated voltage, see the rating plate

U_{meas} = DC measuring voltage

R_C = minimum insulation resistance at a 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.

(1) $R_C = K_T \cdot R_T$	R_C	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
(2) $K_T = (0.5)^{(40-T)/10}$	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:
   PI = $R_{\text{insul 10 min}}$ / $R_{\text{insul 1 min}}$
   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.

$R_{(10\ min)}$ / $R_{(1\ min)}$	Assessment
≥ 2	Insulation in good condition
< 2	Dependent on the complete diagnosis of the insulation

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 135).
- 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.

5.2.4 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.
- Flange connection
  - Clean the flange before installation. Ensure that the flange surfaces are flat and perfectly clean.
  - Check the geometry of the flange.
- Wall mounting
  - Ensure that the wall faces are flat and free of contaminations.
  - Check the dimensions of the mounting-foot holes.
  - Support the machine from below, e.g. using a wall bracket or by bolting it.

5.3 Lift the machine to where it will be mounted and position it

5.3.1 Installing the machine

- For vertical installation, use all of the eyebolts provided and when necessary, hoisting straps (DIN EN 1492-1) and/or lashing straps (DIN EN 12195-2) to stabilize the position of the motor.
- Prevent foreign bodies from falling into the fan cover. For vertical machine installation with the shaft end facing downwards, attach a protective canopy.
- If the shaft extension is facing upwards, the user must prevent liquid from moving along the shaft and entering the motor.
- Clean bare metal surfaces with anti-corrosion agent using white spirit to ensure proper installation and / or machine mounting.
- Do not obstruct the ventilation! Do not draw in the discharged air directly – also from adjacent equipment.
- Avoid exposing them to direct, intense solar radiation, rain, snow, ice, or also dust for extended periods. Attach a covering structure or an additional cover when using or storing outdoors.
- Do not exceed the permissible axial and radial forces.

Note

In order to prevent the eyebolts loosening, after mounting, tighten these or remove them.

NOTICE
Damage to the mounted parts
To avoid material damage and injury, do not damage the mounted parts.
Only lift the motor at the lifting eyes provided for the purpose.

5.3.2 Checking the load handling attachments

Inspect the load handling attachments such as the load trestles, 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 suspension equipment that is found to be damaged.
- Before use, check that the load suspension equipment is correctly attached.
- When lifting the machine, use only approved and undamaged lifting gear of sufficient rated capacity. Check the lifting gear prior to its use.

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

5.3.3 Ensure adequate cooling

⚠ WARNING
Overheating and failure of the motor
Death, severe injury or material damage can occur if you do not carefully observe the following points. • Do not obstruct ventilation. • Prevent the air expelled by neighboring equipment from being immediately sucked in again. • For machines with a vertical type construction with air entry from above, prevent the ingress of foreign bodies and water in the air entry openings (standard IEC / EN 60079-0). • If the shaft extension is facing upwards, liquid must be prevented from entering by moving along the shaft.

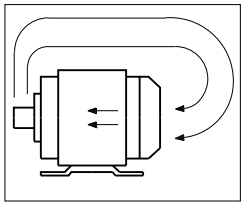
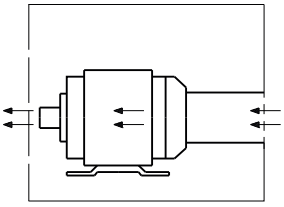
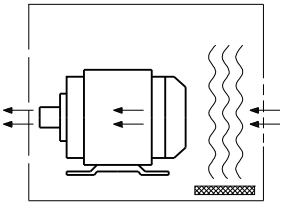
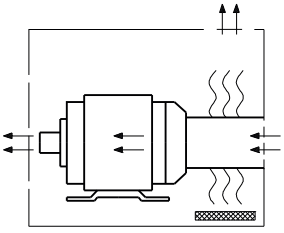
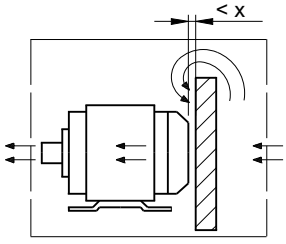
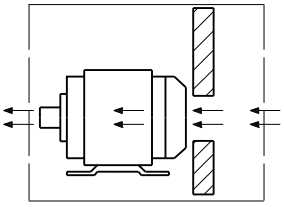
WARNING

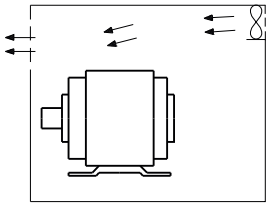
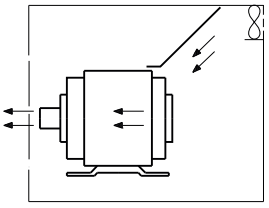
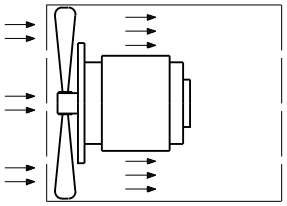
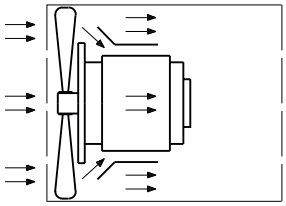
Damage caused by small parts falling in

Material damage and injury can occur if the fan is destroyed and therefore the motor overheats.

- For types of construction with the shaft extension facing downwards, prevent small parts from falling into the fan cover by providing suitable covers (standard IEC / EN 60079-0).
- Ensure that the cooling air flow is not reduced as a result of covers and that the minimum air clearances are maintained.

Table 5-2 Air guidance

Incorrect	Correct
	
	
	

Incorrect	Correct
	
	

Minimum dimension "x" for the distance between neighboring modules and the air intake of the machine

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

Table 5-3 Minimum dimension "X" for the distance between adjacent modules and the air intake of the machine

Frame size	X [mm]
400	150
450	160

5.3.4 Balancing

The rotor is dynamically balanced. For shaft extensions with feather keys, 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 (standard)
- "F" means balancing with a whole feather key

⚠ CAUTION

Risk of injury due to Incorrect installation or removal

If the required touch protection measures for drive output elements are not observed this can result in physical injury and material damage.

- The general touch protection measures for drive output elements must be observed.
- Drive output elements may only be pushed on or pulled off with the correct equipment.
- The feather keys are only locked against falling out during shipping. If you commission a machine without a drive output element, the feather keys must be secured to prevent them from being thrown out.

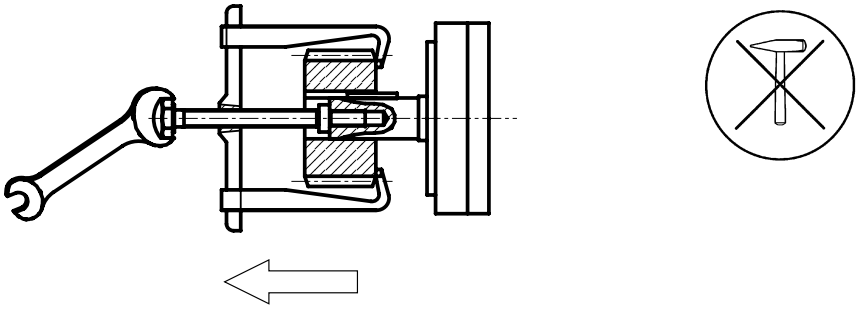
Shaft extensions with feather key

- If the output element is shorter than the feather key for balancing type "H": Machine off the section of feather key protruding from the shaft contour and output element. Alternatively, ensure that the weights are compensated to achieve the appropriate balance quality.
- If the output element is pulled on up to the shaft shoulder: When balancing the coupling, take into account that the feather key does not take up all of the coupling slot.
- The following applies for all two-pole machines and four-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.

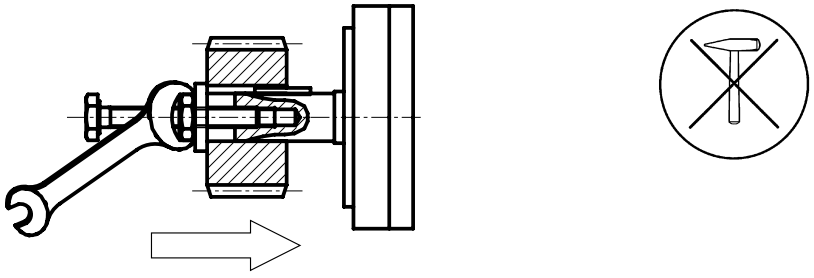
The number of poles of the machine is specified on the rating plate (in the designation of the motor type).

Align the offset at the coupling between electrical machines and the driven machines so that the maximum permissible vibration values according to ISO 10816 are not exceeded.

5.3.4.1 Mounting and withdrawing output transmission elements



Withdrawing output transmission elements



Mounting output transmission elements

- When mounting output transmission elements (coupling, gear wheel, belt pulley etc.) use the thread at the shaft end.
  If possible, heat up the output transmission elements as required.
- Use a suitable device when withdrawing output elements.

- When mounting or withdrawing, do not apply any blows, for example with a hammer or similar tool, to the parts to be mounted or withdrawn.
- Only transfer radial or axial forces specified in the catalog to the motor bearings via the shaft extension.

5.3.5 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.

5.3.6 Removing the rotor shipping brace from machines with vertical type of construction

- Only remove the rotor shipping brace when the machine is in a vertical position. Dismantling the rotor shipping brace when the machine is in a horizontal position could damage the bearings.
- Fix the rotor in place before you turn the machine into a horizontal position. Failure to fit the rotor shipping brace can result in damage to the bearings while the machine is being turned onto its side.

Store the rotor locking device

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

5.3.7 Removing anti-corrosion protection

Machined, bare metallic surfaces of the motor, such as the shaft end, fitted key, foot and flange surfaces, are treated with an anti-corrosion agent.

1. Remove this layer of anti-corrosion agent from the mounting surfaces of the motor by wiping it away with an absorbent cloth or paper sheet.

NOTICE
Damage to the machine surface Using metal objects such as scrapers, spatulas, or plates to remove the anti-corrosion protection could result in damage to the surfaces of the machine parts.

2. Then lightly oil the bare surfaces again.

5.3.8 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

NOTICE
Damage due to condensate 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. Ensure that condensate can drain away.

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.

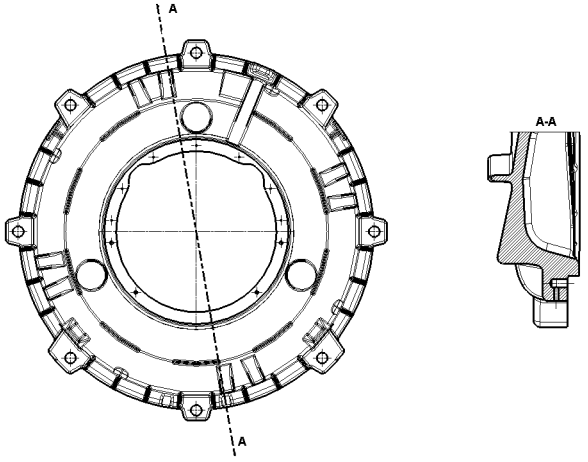


Figure 5-1 Schematic diagram of the water drain holes

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

5.4 Aligning and fixing the machine

5.4.1 Preconditions for correct alignment and secure attachment

To align the machine correctly and fasten it securely, you require detailed specialist knowledge of the following necessary measures:

- Preparing the foundation
- Select and mount the coupling
- Measure the radial and axial eccentricity
- Position the machine

If you are not familiar with the prescribed measures and procedures, make use of the services offered by the Service Center (Page 135).

Observe the following when aligning and mounting:

- Ensure a flat and uniform contact surface for foot and flange mounting.
- When mounting on the wall, support the machine from below, e.g. using a bracket, or bolt it.
- Precisely align the machine when couplings are used.
- Ensure that the mounting surfaces are clean and free of any dirt.
- Remove any anti-corrosion protection using white spirit.
- Avoid installation-related resonances with the rotating frequency and twice the line frequency.
- Note any unusual noise when the rotor is manually turned.
- Check the direction of rotation with the motor uncoupled.
- Avoid rigid couplings.
- Repair any damage to the paint, this must be done immediately and correctly.

5.4.2 Positioning the motor vertically and horizontally

The following measures are required in order to compensate any radial offset at the coupling and to horizontally adjust the electrical machine with respect to the driven load:

- **Vertical positioning**
  For vertical mounting positions, avoid deforming the machines by placing shims under the mounting feet. Keep the number of shims low; only use a few stacked shims.
- **Horizontal positioning**
  To position the machine horizontally, shift it sideways on the foundation and ensure that the axial position is maintained (angularity error).
- When positioning the motor, ensure that a uniform axial gap is maintained around the coupling.

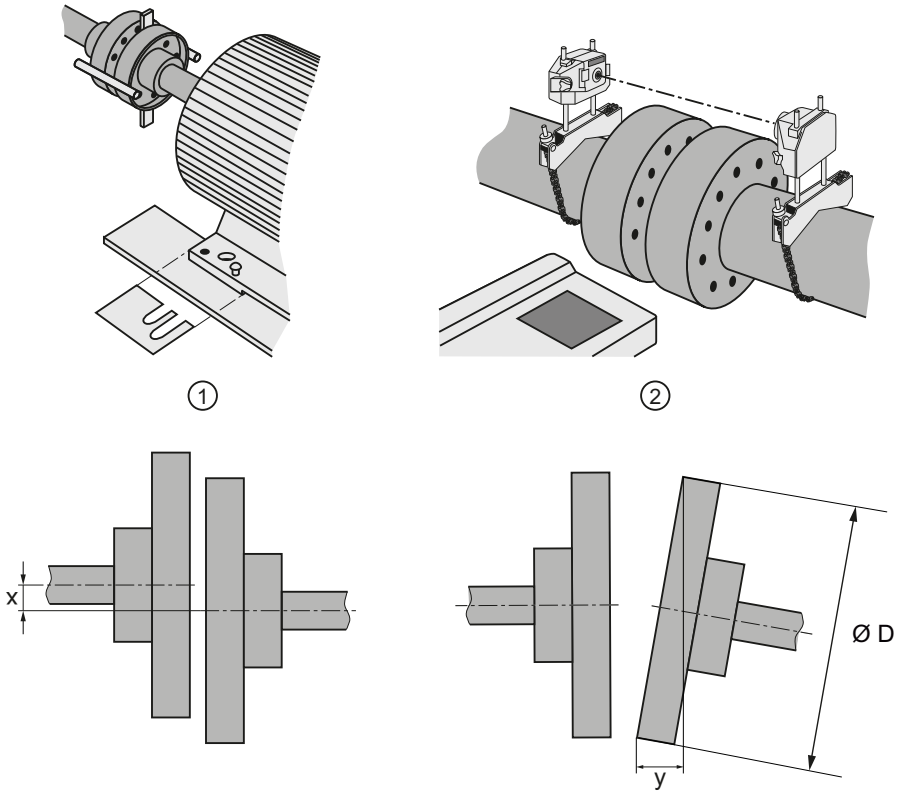
- **Smooth running**
  Preconditions for smooth, vibration-free operation according to DIN 4024 include:
  - Stable foundation design free of any shock or vibration.
  - A precisely aligned coupling.
  - A well-balanced drive output element (coupling, belt pulleys, fans, ...)

  Maintain the maximum permissible vibration levels in operation according to ISO 10816-3. Avoid inadmissible vibration levels caused by imbalance, for example (drive output element), external vibration or any resonance over the complete speed range.
  It may be necessary to completely balance the machine with the output element - or it may be necessary to shift the system resonance point.
- **Foot mounting/flange mounting**
  - When flanging the machine to a foundation or a machine flange, use the specified thread size for the foot and flange mounting corresponding to EN 50347 or IEC 60072-1 or IEC 60072-2.
  - Mount the machine at four foot or flanged holes that are at right angles to one another. The customer is responsible for selecting the strength (property class) of the mounting elements.
    Property class 8.8 or higher is recommended for the mounting elements.
  - Select the correct screw length for IM B14 flanges.
  - Ensure that the screw heads are in full contact with the flange surface. Use additional flat washers (ISO 7093), especially for elongated foot mounting holes.

5.4.3 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.



① Plates placed under the motor for alignment

② Laser alignment

Figure 5-2 Schematic diagram: Aligning the machine to the driven machine

Table 5-4 Permissible deviations for aligning the machine with flexible coupling

Max. speed n_{max}	Max. parallel offset x	Max. angular offset y
n_{max} ≤ 1500 rpm	x_{max} = 0.08 mm	y_{max} = 0.08 mm / 100 mm ∅ D
1500 rpm < n_{max} ≤ 3600 rpm	x_{max} = 0.05 mm	y_{max} = 0.05 mm / 100 mm ∅ D

Machine expansion

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

5.4.4 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.

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.

There is a threaded hole M36 at the bottom of the machine where you can fasten the support base.

- Mount the support base so that no additional mechanical tensions can occur in the housing.

⚠ WARNING

Mechanical tensions

The machine may be damaged by additional mechanical tensions in the housing caused by incorrect mounting of the support base. The machine or machine parts may loosen during operation.

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

- Mount the support base so that no additional mechanical tensions can occur in the housing.

See also

Tightening torques for screw and bolt connections (Page 137)

5.4.5 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.

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 137)

Alignment accuracy

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

Electrical connection 6

6.1 Safety instructions relating to the electrical connection

Observe the following when carrying out any work on the machine:

- Comply with the general safety instructions (Page 11)
- Comply with the applicable national and sector-specific regulations.
- When using the machine within the European Union, comply with the specifications laid down in EN 50110-1 regarding safe operation of electrical equipment.

⚠ DANGER

Hazardous voltages

Death, injury or material damage can occur. Note the following safety information before connecting-up the machine:

- Only qualified and trained personnel should carry out work on the machine while it is stationary.
- Disconnect the machine from the power supply and take measures to prevent it being reconnected. This also applies to auxiliary circuits.
- Check that the machine really is in a no-voltage condition.
- Establish a safe protective conductor connection before starting any work.
- If the incoming power supply system displays any deviations from the rated values in terms of voltage, frequency, curve form or symmetry, such deviations will increase the temperature and influence electromagnetic compatibility.
- Operating the machine on a line supply system with a non-grounded neutral point is only permitted over short time intervals that occur rarely, e.g. the time leading to a fault being eliminated (ground fault of a cable, EN 60034-1).

⚠ DANGER

Hazardous voltage

Electric motors have high voltages. When incorrectly handled, this can result in death or severe injury.

Switch off the machine so that it is in a no-voltage condition before you open the terminal box.

NOTICE
Damage to the terminal box If you incorrectly carry out work on or in the terminal box, this can result in material damage. You must observe the following to avoid damaging the terminal box: • Ensure that the components inside the terminal box are not damaged. • It must be ensured that there are no foreign bodies, dirt or moisture in the terminal box. • Close the terminal box using the original seal so that it is dust tight and water tight. • Use O-rings or suitable flat gaskets to seal entries in the terminal box (DIN 42925) and other open entries. • Please observe the tightening torques for cable entries and other screws.

Note

Service Center

If you require support when electrically connecting up the machine, please contact the Service Center (Page 135).

6.2 Basic rules

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 6-1 Connection technology (with cable lug / connection without cable lug)

Terminal box	Connection	
TB3R61	With cable lug (Page 68)	Without cable lug (Page 69)
1XB1631		
1XB7750		

- In case of high humidity or when installed outside, water drops can move along the cable jacket and enter the motor through the cable entry and cable gland.
  If you route the cable with an appropriate loop then water doesn't enter the terminal box, but simply drips off.

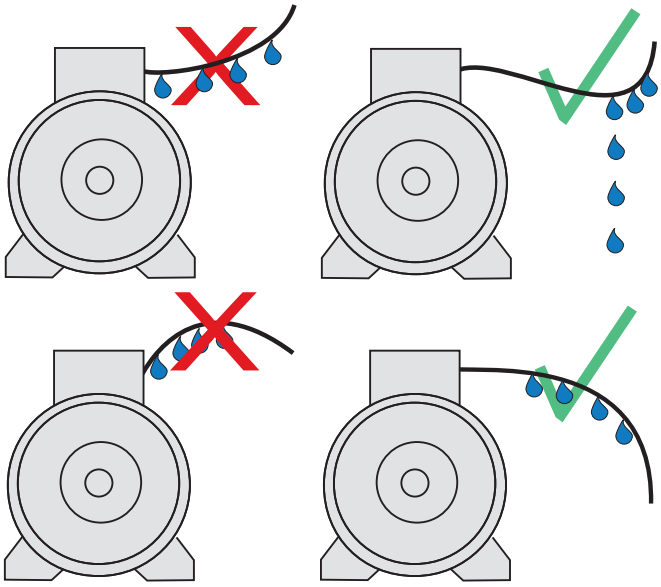


Figure 6-1 Water drip loop

6.3 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.

6.3.1 TB3R61 terminal box

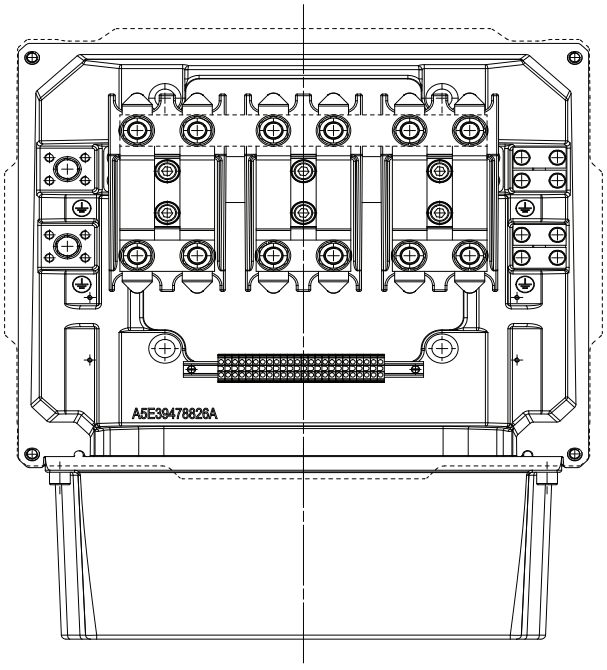


Figure 6-2 TB3R61 terminal box

The connecting cables are introduced into the terminal box through the 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.

You can find additional information here:

- Inserting the cable into the terminal box (Page 67)
- Laying cables (Page 70)
- Connecting cables with cable lugs (Page 68)
- Connecting cables without cable lugs (Page 69)

6.3.2 Terminal box 1XB1631

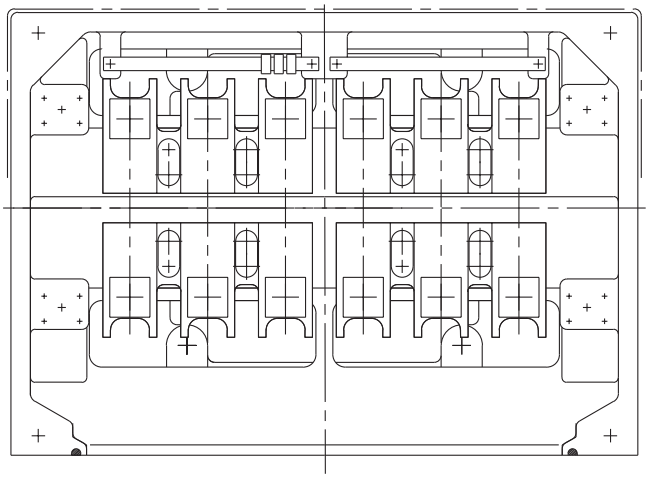


Figure 6-3 Terminal box 1XB1631

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.

You can find additional information here:

- Inserting the cable into the terminal box (Page 67)
- Laying cables (Page 70)
- Connecting cables without cable lugs (Page 69)
- Connecting cables with cable lugs (Page 68)

6.3.3 Terminal box 1XB7750

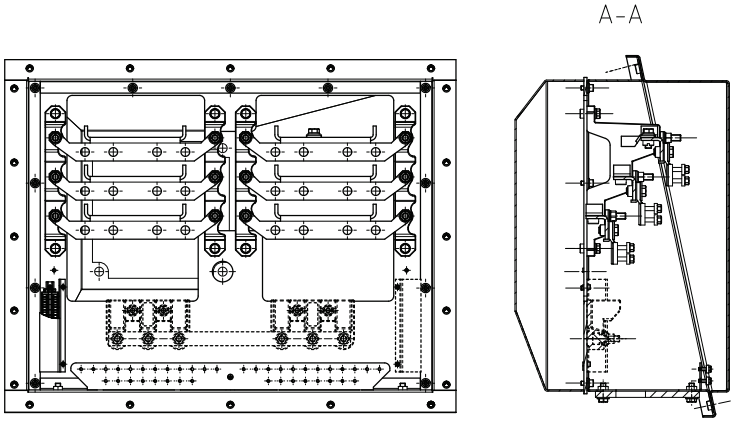


Figure 6-4 Terminal box 1XB7750

The connecting cables are introduced into the 1XB7750 terminal box through the cable glands with threaded holes 8 x M72 x 2 and 3 x M25 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 terminal box (Page 67)
- Connecting cables with cable lugs (Page 68)
- Connecting cables without cable lugs (Page 69)

See also

Laying cables (Page 70)

6.3.4 Rotating the terminal box (option)

Optionally, depending on the terminal box and version, you can rotate the terminal box through ±90° in accordance with the connection direction. Switching over to the other motor side is only possible with support from the Service Center (Page 135).

Rotating the terminal box

If necessary, remove the internal stator cables.

1. Ensure that the motor is disconnected from the power supply.
2. Release two diagonally opposed screws for the cover, and secure the cover using two M10 threaded bars screwed in diagonally opposing one another.
   Release the two other screws and lift the cover off the terminal box. The terminal box cover is very heavy. Especially when in a lateral position, ensure that the terminal box does not fall down.
3. If the motor is already connected:
   – Remove the cables of the power supply.
   – Release the screw connection of the cable entry. Remove the cables through the opening.
4. Release the screwed connections of the internal stator cables.
5. Release the screwed connections of the lower section with the console; if present, release the high-frequency grounding to the motor enclosure.
6. Screw in two eye-bolts diagonally in the M10 thread at the corners. Slightly raise the terminal box housing using a crane.
7. Rotate the terminal box through ±90° in the desired direction. Carefully place the terminal box down. Take care not to damage the seal.
8. Screw the terminal box to the console (4 x M16, tightening torque 170 Nm).
9. If present: Reconnect the high-frequency grounding.
10. Connect the cables in accordance with the circuit diagram on the inside of the cover. Ensure that the minimum air clearances are observed. More on this (Page 71)

11. Reconnect the power supply cables. More information:
    - Connect (Page 64) the grounding conductor
    - Introduce and route the cable... / connect (Page 67) the cable ...
12. Screw in the two diagonally arranged threaded bars and slide the cover onto these bars. Take care not to damage the seal.
13. Fix the two free screw connections and tighten by hand.
14. Remove the threaded bars and screw in the two other screws.
15. Tighten all the screws with 40 Nm (4 x M10).

See also

Finishing connection work (Page 72)

6.3.5 Removing/attaching the terminal box cover

When removing or installing the terminal box cover, secure it using diagonally arranged M10 threaded bars to prevent it falling.

Removing the terminal box cover

1. Release 2 diagonally opposing screws at the terminal box cover and replace them by threaded bars.
2. Release the two other screws.
3. Carefully pull the terminal box cover over the threaded bars.

Attaching the terminal box cover

1. Screw in the 2 threaded bars diagonally at the lower section of the terminal box.
2. Slide the terminal box cover over the threaded bars onto the lower section of the terminal box.
3. Screw the screws into the free holes and tighten by hand.
4. Release the threaded bars.
5. Tighten all 4 M10 screws, tightening torque 40 Nm.

6.4 Connecting the machine

6.4.1 Selecting cables

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

- Rated current
- Rated voltage
- If required, service factor
- System-dependent conditions, such as ambient temperature, routing type, cable cross-section as defined by required length of cable, etc.
- Configuration notes
- Requirements according to IEC/EN 60204-1
- Dimensioning for bundled cable routing, e.g. according to DIN VDE 0298 Part 4 or IEC 60364-5-52

Observe the information in EN / IEC 60034-1 (VDE 0530-1) regarding operation at the limits of the A zones (±5 % voltage difference and ±2 % frequency difference) and the B zones, especially in respect of temperature increase and deviation of the operating data from the rated data on the rating plate. Never exceed the specified limits!

Connect up so that a permanently safe electrical connection is guaranteed (no protruding wire ends); use the assigned cable-end fittings (e.g. cable lugs, end sleeves).
Connect up the line supply voltage and arranged the disconnecting link in accordance with the circuit diagram provided in the terminal box.

Select the connecting cables in accordance with DIN VDE 0100 and in accordance with the rated current and the installation-specific conditions (e.g. ambient temperature, routing method etc. according to DIN VDE 0298 and/or EN / IEC 60204-1).

The technical specifications stipulate the following that have to be taken into account with respect to the motor connection:

- Direction of rotation.
- The number and arrangement of the terminal boxes.
- The circuit and connection of the machine winding.

6.4.2 Terminal designations

The following definitions apply in principle to the terminal designations of three-phase motors in accordance with DIN VDE 0530 Part 8 or EN / IEC 60034-8:

Table 6-2 Terminal designations (with the 1U1-1 as an example)

1	U	1	-	1	Designation
x					Index showing the pole assignment for pole-changing machines (where applicable, a lower number indicates a lower speed) or, in special cases, for a subdivided winding.
	x				Phase designation (U, V, W)
		x			Index showing the start (1) / end (2) or tapping point of the winding (if there is more than one connection per winding)
				x	Additional indices for cases in which it is obligatory to connect parallel power feed cables to several terminals with otherwise identical designations

6.4.3 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 line cables with phase sequence L1, L2, L3 to U, V, W or according to NEMA at T_1 T_2 T_3, then a clockwise phase sequence is obtained.
- If you interchange two connections, e.g. L1, L2, L3 at V, U, W or according to NEMA at T_2 T_1 T_3, then a counterclockwise phase sequence is obtained.
- 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.

Check the appropriate data before connecting the line feeder cables.

NOTICE

Machine damage due to 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.

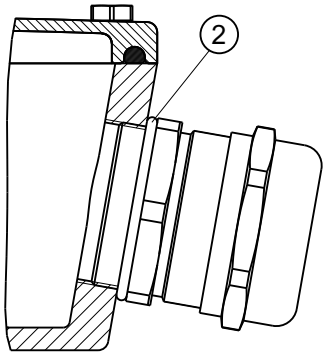
- Observe the direction of rotation data on the nameplate.

6.4.4 Connecting protruding cables

In the case of connection cables brought out of the machine, no terminal board is installed on the terminal base of the machine housing. The connection cables are directly connected to stator winding terminals at the factory.

The connection cables are color-coded or labeled. The customer directly connects individual cables in the control cabinet for their system in accordance with the labeling.

Cable glands with connecting thread in the terminal box (EN 50262)



② O ring

6.5 Connecting the grounding conductor

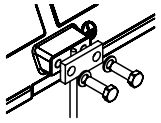
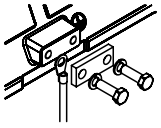
The machine's grounding conductor cross-section must comply with EN / IEC 60034-1.

Please also observe installation regulations such as those specified in EN / IEC 60204-1.

Basically, there are two ways of connecting a grounding conductor to the machine.

- Internal grounding with a connection in terminal box at the location intended for this purpose and marked accordingly.
- External grounding with connection at the stator housing at the locations intended for this purpose and marked accordingly.

6.5.1 Grounding connection type

Enclosure grounding method			Cable cross-section [mm²]
Connection of an individual conductor under the external grounding bracket.		M8	120
		M12	150
Connection is made using a DIN cable lug under the external grounding bracket. DIN 46 234		M8	120
		M12	150

6.5.2 Connecting the grounding conductor

The grounding conductor cross-section of the motor must be in full conformance with the installation specifications, e.g. in accordance with IEC 60034-1.

External conductor cross-section S mm²	Grounding conductor cross-section mm²
35	25
50	25
70	35
95	50
120	70
150	70
185	95
240	120
300	150
400	185

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

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

	Screw	Screw-in depth	Tightening torque
When using cable lugs	M6	> 6 mm	8 Nm
	M8	> 8 mm	20 Nm
	M12 x 25	> 16 mm	38 Nm
	M16 x 35	> 20 mm	92 Nm
When using grounding terminals	M6	> 9 mm	8 Nm
	M8	> 12 mm	20 Nm
	M10	> 15 mm	40 Nm
	M12	> 18 mm	70 Nm
	M16	> 20 mm	170 Nm

The thread size for the grounding conductor is 2x M12.

Internal ground terminal

When making connections, ensure the following:

- 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.
- Locate the cable lug under the clamping bracket.
- Use the terminals designated for the grounding conductor in the terminal box.
- Observe the tightening torque (Page 137) for the locking screw.

External ground terminal

When making connections, ensure the following:

- Ensure that the connecting surface is bare and is protected against corrosion using a suitable substance, e.g. acid-free Vaseline.
- Position the cable lug between the contact bracket and the grounding bracket; do not remove the contact bracket pressed into the enclosure!
- Arrange the flat washer and spring washer under the bolt head.
- Use the marked connection location for the grounding conductor on the stator housing.
- Observe the tightening torque (Page 137) for the locking screw.

The tightening torques for the electrical connections of the terminal board and grounding are listed in the Table (Page 137) under case A.

6.6 Conductor connection

The maximum conductor cross-section that can be connected is 300 mm².

6.6.1 Inserting the cable into the terminal box

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.

Table 6-3 Cable entry plate versions

Terminal box	Standard Cable entry plate with boreholes	Option R53
TB3R61	4 x M80 x 2 + 2 x M25 x 1.5	Undrilled
1XB1631	4 x M80 x 2 + 2 x M25 x 1.5	
1XB7750	8 x M72 x 2 + 3 x M25 x 1.5	

Insert the cable into the terminal box

1. Unscrew the cable entry plate.
2. When required, drill the required number of holes or threads in the required size into the cable entry plate. Ensure that the cable entry plate can be assembled after drilling and that it features sufficient stiffness.
3. Install the cable glands required, taking into account the manufacturers data relating to installation steps - including tightening torques and the suitability for the ambient conditions.
4. Route the cables through the cable glands - and carefully ensure that the cables and conductors are strain relieved.
5. Fit the cable entry plate to the terminal box with the assembled cables.
   For the TB3R61 and 1XB1631 terminal boxes, ensure a perfectly flat contact surface for the cover, to ensure that the IP degree of protection is complied with.
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.
7. Check that the cable glands are sealed and securely fixed. Correctly close and seal threads and holes that are not being used ensuring that the IP degree of protection is maintained. The IP degree of protection is specified on the rating plate.

See also

Connecting cables with cable lugs (Page 68)

Connecting cables without cable lugs (Page 69)

Note

Avoid damaging the cable jacket.

Adapt the tightening torques to the cable jacket materials.

You should refer to the table in order to find the correct tightening torque for any metal and plastic cable glands that are to be mounted directly on the machine, as well as for any other screw-type connections (such as adapters).

Table 6-4 Tightening torques for cable glands

	Metal ± 10% [Nm]	Plastic ± 10% [Nm]	Clamping range [mm] Standard -30 °C ... 100 °C	O ring Cord dia. [mm]
M 12 x 1.5	8	1.5	3.0 ... 7.0	2
M 16 x 1.5	10	2	4.5 ... 10.0	
M 20 x 1.5	12	4	7.0 ... 13.0	
M 25 x 1.5			9.0 ... 17.0	
M 32 x 1.5	18	6	11.0 ... 21.0	
M 40 x 1.5			19.0 ... 28.0	
M 50 x 1.5	20		26.0 ... 35.0	
M 63 x 1.5			34.0 ... 45.0	
M 63 x 1.5			42.0 ... 54.0	
M 75 x 1.5	80		54.0 ... 58.0	
M 75 x 1.5			59.0 … 63.0	
M 80 x 2.0			58.0 ... 64.0	
M 80 x 2.0			63.0 ... 70.0	

6.6.2 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.

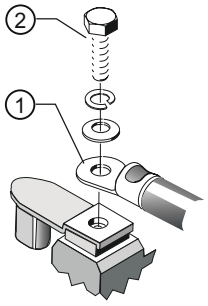


Figure 6-5 Connection with cable lug and fixing screw (schematic diagram)

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 1XB7750 terminal boxes, place the cable lug on the busbar.
6. Tighten the fixing element ② with the corresponding tightening torque:

Fixing element	Tightening torque
Fastening screw M12	20 Nm
Fixing screws M16	40 Nm
Fixing nuts M12	20 Nm

6.6.3 Connecting cables 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 and the creepage distance 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 with 8 Nm.

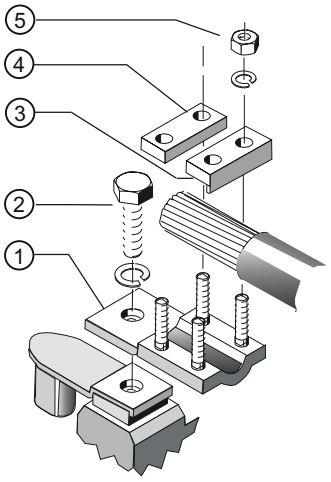


Figure 6-6 Connection using terminal clamps (schematic diagram)

5. If you have loosened the terminal body clamping bolts ②, then retighten them with the following torque:

Terminal box	Tightening torque
TB3R61 / 1XB1631	40 Nm
1XB7750	20 Nm

6.6.4 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.

The tightening torques for the electrical connections of the terminal board and grounding are listed in the Table (Page 137) under case A.

6.6.5 Minimum air clearances

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

Table 6-5 Minimum air clearance dependent on rms value of the alternating voltage U_{rms}

Rms value of the alternating voltage V_{rms}	Minimum air clearance
≤ 500 V	8 mm
≤ 630 V	10 mm
≤ 800 V	12 mm
≤ 1000 V	14 mm
≤ 1250 V	18 mm

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

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

6.6.6 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.

6.6.7 Use of aluminum conductors

If you are using aluminum conductors, then comply 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. Do this using a brush or file.
- Then grease the contact areas immediately using neutral Vaseline. This prevents a new oxide layer from forming.

NOTICE
Aluminum flow due to contact pressure Aluminum flows following installation due to the contact pressure. The connection using clamping nuts can loosen as a result. The contact resistance increases, obstructing the current from being conducted. This can result in fire and material damage to the machine – or even in total failure, as well as material damage to the plant or system due to machine failure. • 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.

6.7 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.
     Remove the used bolts and fastening elements.
   - 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.
   - Unused cable entries are closed and their plugs are tightly screwed in place, i.e. they can only be released using a tool.
   - The connecting cables are freely routed. The cable insulation cannot be damaged in operation.
2. Close the terminal box using the cover fixing screws, see Chapter Tightening torques for screw connections. (Page 137)

The tightening torques for the screw connections of the terminal box and grounding conductor are in Table (Page 137) under case C.

6.8 Connecting the auxiliary circuits

6.8.1 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

6.8.2 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 137)

In addition to the current-dependent overload protective device located in the connecting cables, use the optionally available integrated devices and equipment, for example, temperature sensor, anti-condensation heating.

6.8.3 Connecting temperature monitoring for the stator winding (depending on the particular version)

The stator winding is monitored for thermal loading by temperature sensors embedded in the stator winding.

The connecting cables of the temperature sensors are routed to the main or auxiliary terminal box, depending on the version. The connection and assignment of the terminals is specified in the circuit diagram.

⚠ 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 requirements set out in IEC 60664-1 or IEC 61800-5-1 "Hazard due to electric shock”.

6.8.4 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 137)" for the tightening torque of the fixing bolts for the cover.

6.9 Connecting converters

NOTICE
Excessively high supply voltage Material damage can occur if the supply voltage is too high for the insulation system. SIMOTICS machines can be operated with SINAMICS G converters and SINAMICS S converters (uncontrolled and controlled infeed) when maintaining the permissible peak voltages. Carefully observe the values in the following tables. Rise times t_r > 0.1 µs. The insulation system of SIMOTICS machines corresponds to the specifications laid down in IEC 60034-18-41 according to voltage stress category C (IVIC C = high stress).

Table 6-6 Maximum voltage peaks at the motor terminals for line (DOL) motors, converter operation possible

Rated motor voltage [V]	Maximum peak voltage at the motor terminals $\hat{U}_{max}$ dependent on the rise time t_r			
	$\hat{U}_{phase\text{-}to\text{-}phase}$ [V_{pk}]	$\hat{U}_{phase\text{-}to\text{-}ground}$ [V_{pk}]	Rise time t_r [µs]	DC link U_{DC} [V]

≤ 500 V	1500	1100	0.5	750
	900	900	0.1	

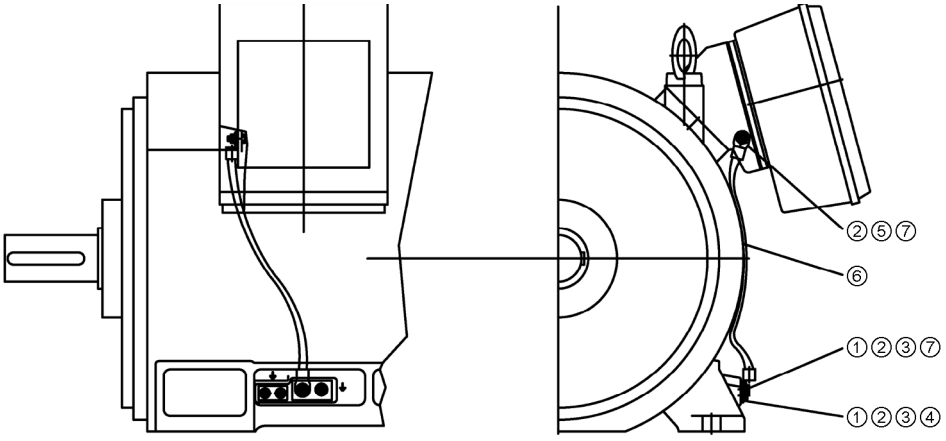
Table 6-7 Maximum voltage peaks at the motor terminals for motors specifically designed for converter operation (e.g. VSD 10)

Rated motor voltage [V]	Maximum peak voltage at the motor terminals $\hat{U}_{max}$ dependent on the rise time t_r			
	$\hat{U}_{phase\text{-}to\text{-}phase}$ [V_{pk}]	$\hat{U}_{phase\text{-}to\text{-}ground}$ [V_{pk}]	Rise time t_r [µs]	DC link U_{DC} [V]
≤ 500 V	1600	1400	0.5	750
	1000	1000	0.1	
≥ 500 V to 690 V	2200	1800	0.5	1080
	1000	1000	0.1	

6.9.1 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.



① Hexagon bolt
② Spring washer
③ Terminal Board
④ Grounding conductor
⑤ Hexagon nut
⑥ Radio-frequency grounding cable
⑦ Cable lug

Figure 6-7 High-frequency grounding

You find further information in the "Operation with converter (Page 33)" section.

Commissioning

7

Observe the following when carrying out any work on the machine:

- Comply with the general safety instructions (Page 11)
- Comply with the applicable national and sector-specific regulations.
- When using the machine within the European Union, comply with the specifications laid down in EN 50110-1 regarding safe operation of electrical equipment.

NOTICE
Damage to the machine In order to avoid material damage, check the following points before commissioning the motor: • Using appropriate measures, check whether the correct direction of rotation of the motor has been set by the customer, e.g. by decoupling from the driven load. • Ensure that temperature-sensitive parts (cables, etc.) are not in contact with the machine enclosure. • Ensure that the condensation drain holes are always located at the lowest part of the motor.

NOTICE
Damage caused by insufficient cooling Effective cooling is no longer possible if air guidance of the machine is not provided as intended. This can damage the machine. • Before commissioning, attach the covers to guarantee the intended air guidance.

Measures

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

- Ensure that the machine has been correctly installed and aligned.
- Connect the machine corresponding to the specified direction of rotation.
- Ensure that the operating conditions match the data specified on the rating plate.
- Lubricate the bearings, depending on the version. Ensure that machines with rolling bearings, which have been stored for longer than 12 months, are relubricated.
  Also observe the notes in Chapter Preparation for use.
- Ensure that any optional supplementary machine monitoring equipment has been connected correctly and is functioning as it should.
- For versions with bearing thermometers, check the bearing temperatures when the machine starts to run for the first time. Set the values for alarm and shutdown at the monitoring device. Also observe the notes in Chapter Setting values for monitoring the bearing temperature.

- Corresponding to the control and speed monitoring functions implemented, ensure that the machine cannot exceed the permissible speeds specified on the rating plate.
- Ensure the correct setting conditions of the drive output elements depending on the type (e.g. alignment and balancing of couplings, belt forces in the case of a belt drive, tooth forces and tooth flank backlash/play in the case of gear wheel output, radial and axial clearance in the case of coupled shafts).
- Comply with the minimum insulation resistances and minimum air clearances.
- Ensure correct grounding and potential bonding connection of the protective conductor.
- Tighten all mounting bolts, connection elements and electrical connections to the specified torques.
- Remove any lifting eyes that were screwed after installation – or secure them to prevent them becoming loose.
- Rotate the rotor to ensure that it does not touch the stator.
- Implement all touch protection measures for both moving and live parts.
- Ensure that free shaft extensions cannot be touched, e.g. by attaching covers.
- Secure any featherkeys so that they cannot be flung out.
- Ensure that the optional external fan is ready for operation and connected so that it rotates in the specified direction.
- Ensure that the cooling airflow is not obstructed or diminished in any way.
- If an optional brake is being used, ensure that it is functioning perfectly.
- Comply with the specified mechanical limit speed n_{max}, and ensure that it is not exceeded.

If the design of the machine requires the converter to be assigned in a particular way, the relevant information will be provided on the rating plate or an additional label.

Note

It may be necessary to perform additional checks and tests in accordance with the specific situation on site.

See also

Observing the operating mode (Page 23)

- The bearing insulation should be implemented as shown on the plates.

Second shaft extension

If the second shaft extension is not used:

- The feather key is secured to prevent it from being thrown out, and for balancing type "H" (standard type), its weight is reduced to 60 % of the original weight.
- The unused shaft extension is covered and protected against accidental contact.

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.
- Any supplementary motor monitoring devices and equipment have been correctly connected and are functioning correctly.
- In continuous operation, the motor cannot exceed the specified upper speed limit n_{max} or undershoot the lower speed limit n_{min}.
  The permissible acceleration time to the limit speed n_{min} depends on the parameter assignment.

⚠ WARNING

Dangerous voltage via the converter

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

Ensure that the five safety rules (Page 11) are followed before working on the motor.

7.1 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 39)

7.2 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

Set value	Temperature
Alarm	115 °C
Shutting down	120 °C

Normal operation

Determine the maximum operating temperature of the bearings $T_{operation}$ taking into account the temperature, bearing load and influences of the plant on the motor in °C. Set the values for shutdown and warning corresponding to the operating temperature T_{op}.

Table 7-2 Set values for monitoring the bearing temperatures

Set value	Temperature
Alarm	$T_{operation}$ + 5 K ≤ 115 °C
Shutting down	$T_{operation}$ + 10 K ≤ 120 °C

7.3 Commissioning an external fan

An external fan is suitable for use only in unidirectional operation; refer to the specification of the direction of rotation on the fan cowl or on the fan unit. The external fan ensures that the machine is cooled irrespective of the machine speed or direction of rotation.

If the cooling air is in open circulation, it must have only weak, chemically abrasive properties and only a low dust content.

Checks before the first test run

Before the first test run, carry out the following checks:

- The external fan is correctly fitted and aligned.
- The rotor runs freely.
- All of the retaining elements and electrical connections are securely tightened.
- The grounding and equipotential bonding connections to the mains have been correctly made.
- The air flow is not impeded or shut off by flaps, covers or similar.
- All protection measures have been taken to prevent accidental contact with moving or live parts.

Performing the test run

1. Switch the external fan motor on and off briefly.
2. Compare the the direction of rotation of the external fan with the arrow indicating the direction of rotation. If the direction of rotation and the arrow do not match, then switch two of the three phases of the external fan motor.

7.4 Switching on

Measures for start-up

After installation or inspections, the following measures are recommended for normal start-up of the machines:

- Start the machine without a load. To do this, close the circuit breaker and do not switch the machine off prematurely. 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 to a standstill before switching it back on again.
- Check mechanical operation for noise or vibration at the bearings or end shields.
- If the machine is not running smoothly or is emitting abnormal noises, switch it off, and determine the cause of the fault as it runs down.
- If mechanical operation improves immediately after the machine is switched off, then the cause is magnetic or electrical, e.g. voltage imbalance, magnetic imbalance. If mechanical operation does not improve immediately after switching the machine off, then the cause is mechanical, e.g. an imbalance in the electrical machines or in the driven machine, inadequate alignment of the machine set, operation of the machine with the system resonating (system = machine + base frame + foundations etc.).
- If the machine runs perfectly in terms of its mechanical operation, switch on any cooling devices present and continue to monitor the machine for a while as it idles.
- If it runs perfectly, connect a load. Check that it runs smoothly.
  Read off and document the values for voltage, current, and power.
  Where possible, read off corresponding values for the driven machine and document them as well.
- Monitor the bearing temperature, winding temperature, etc. until the system reaches a steady state.
  Document these, provided this is possible with existing measuring instruments.

NOTICE
Destruction of the machine The machine can be destroyed if the vibration values are not strictly complied with. • In operation, observe the vibration values in accordance with DIN ISO 10816- .

Operation

8

8.1 Safety instructions for operation

Observe the following when carrying out any work on the machine:

- Comply with the general safety instructions (Page 11)
- Comply with the applicable national and sector-specific regulations.
- When using the machine within the European Union, comply with the specifications laid down in EN 50110-1 regarding safe operation of electrical equipment.

Switching on the machine

⚠ DANGER

Hazardous voltages

Electrical machines are at hazardous voltage levels. Contact with these can result in death, serious injury or material damage.

Operating the machine on a line supply system with a non-grounded neutral point is only permitted for short periods of time that occur rarely, e.g. the time leading to a fault being eliminated. Cable ground fault EN / IEC 60034-1.

NOTICE

Damage to the machine or premature bearing failure

The bearings can be damaged if the following is not observed.

- It is absolutely crucial that you maintain the permissible vibration values to avoid damage to the machine or its destruction.
- In operation, observe the vibration values in accordance with ISO 10816.
- Under all circumstances maintain the minimum radial load of cylindrical roller bearings of 50% corresponding to what is specified in the catalog.
- Take the appropriate measures to reduce bearing currents. Observe the Chapter Converter operation.

⚠ WARNING

Faults in operation

Changes with respect to normal operation indicate that there is an impaired function. This can cause faults which can result in eventual or immediate death, severe injury or material damage.

For instance, observe the following signs that could indicate a malfunction:

- Higher power drawn than usual
- Higher temperatures than usual
- Unusual noises
- Unusual smells
- Response of monitoring equipment

Immediately contact the maintenance personnel if you identify any irregularities. If you are in doubt, immediately switch off the machine, being sure to observe the system-specific safety conditions.

NOTICE

Risk of corrosion due to condensation

If the machine and/or ambient temperatures fluctuate, this can result in condensation inside the machine.

- If available, remove the drain plugs or drain screws to drain the water depending on the ambient and operating conditions.
- If available, re-attach the drain plugs or drain screws.

If the motor is equipped with drain plugs, then the water can drain away by itself.

Switching on the machine with anti-condensation heating (optional)

⚠ CAUTION

Machine overheating

Minor injury or material damage can occur if you do not observe the following:

- If available, switch off the anti-condensation heating each time before switching on.

See also

Converter operation (Page 33)

8.1.1 Safety instructions when operating machines with fan

⚠ CAUTION

Risk of injury when touching the fan

There is a risk of injury at machines equipped with a fan cover (e.g. on machines in the textile industry), as the fan is not completely touch protected.

- Do not touch the rotating fan.
- Do not put your fingers into the larger air discharge openings.
- Prevent manual intervention by using suitable measures, e.g. appropriate housings or a protective grating.

Forced ventilation (optional): Type of cooling IC 416 in accordance with EN / IEC 60034-6

⚠ WARNING

Risk of burning

Operating the machine without external fan results in overheating. This may result in death, personal injury and material damage.

- Never commission the machine without an external fan.

8.1.2 Operating UL-certified machines with a converter

Operating a machine with a converter

Implement all machines of the overall machine-converter system according to UL-File E227215 assuming that the machines are only to be operated with a converter and are supplied with UL certificate.
The company operating the equipment is responsible for implementing this in the actual application.

8.2 Regreasing roller bearings

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

8.3 Avoidance of damage to rolling bearings during stoppages

Extended stoppages at the identical or almost identical resting position of the rotor in the rolling bearings can result in damage, such as brinelling or corrosion.

- During stoppages, regularly start up the machine for a brief period once a month. As a minimum, turn the rotor 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 up the machine.
  Make sure that the resting position of the rotor after the rotor has been turned over is different from its previous position. Use the fitted key or the coupling halves as reference markers.
- During recommissioning, refer to the information in Chapter "Commissioning".

See also

Commissioning (Page 77)

8.4 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

8.5 Electrical and mechanical faults

Note

Before resolving any faults, please read the information in Chapter Safety information (Page 11).

Note

If you operate the motor with a converter, and an electrical fault occurs, then also observe the information in the converter operating instructions.

The tables below list general faults caused by mechanical and electrical influences.

Table 8-1 Electrical influences

								Electrical fault characteristics	
↓								Machine will not start up	
	↓							Machine starts up reluctantly	
		↓						Rumbling noise during startup	
			↓					Rumbling noise during operation	
					↓			Overheating during no-load operation	
						↓		Overheating when under load	
							↓	Overheating of individual winding sections	
								Possible causes of faults	**Remedial measures**[1)]
X	X		X			X		Overload	Reduce load
X								Interruption of a phase in the supply line	Check switches and supply lines
	X	X	X			X	X	Interruption of a phase in the supply line after switching on	Check switches and supply lines
X	X							Supply voltage too low, frequency too high	Check power supply conditions
					X			Supply voltage too high, frequency too low	Check power supply conditions
X	X	X	X				X	Stator winding incorrectly connected	Check winding connections
	X	X	X				X	Winding short circuit or phase short circuit in stator winding	Measure the winding resistances and insulation resistances, repair after consultation with manufacturer
						X		Incorrect direction of rotation of axial fan	Check connections

[1)] In addition to the cause of the fault (according to remedial measures), also eliminate any machine damage that might have occurred.

Table 8-2 Mechanical effects

				Mechanical fault characteristics	
↓				Grinding noise	
	↓			Overheating	
		↓		Radial vibrations	
			↓	Axial vibrations	
				Possible causes of faults	**Remedial measures**[1)]
X				Rotating parts are grinding	Determine cause and adjust parts concerned
	X			Reduced air supply, fan possibly rotating in the wrong direction	Check airways, clean machine
		X		Rotor not balanced.	Check feather key declaration (H, F, N)
		X		Rotor out of true, shaft bent	Please consult the manufacturer.
		X	X	Poor alignment	Align machine set, check coupling. [2)]
		X		Coupled machine not balanced	Re-balance coupled machine

				Mechanical fault characteristics	
			X	Surges from coupled machine	Inspect coupled machine
		X	X	Imbalance originating from gearing	Adjust/repair gearing
		X	X	Resonance in the overall system (comprising machine and foundation)	Reinforce foundation following consultation
		X	X	Changes in foundation	Determine cause of changes; eliminate if necessary; realign machine

1) In addition to the cause of the fault (according to remedial measures), also eliminate any machine damage that might have occurred.

2) Note any changes that take place while the temperature is rising.

8.6 Rolling bearing faults

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

Table 8-3 Rolling bearing faults

↓ Bearing overheats				
	↓ Bearing "whistles"			
		↓ Bearing "knocks"		
			Possible causes of faults	**Remedial measures**
X			High coupling pressure	Align the machine more accurately.
X			Belt tension too high	Reduce the drive belt tension.
X			Bearing contaminated	Clean or replace the bearing. Check the seals.
X			High ambient temperature	Use a suitable high-temperature grease.
X	X		Insufficient lubrication	Grease the bearings as instructed.
X	X		Bearing canted	Contact the service center.
X	X		Insufficient bearing play	Contact the service center.
		X	Excessive bearing play	Contact the service center.
X	X		Bearing corroded	Replace the bearing. Check the seals.
X			Too much grease in bearing	Remove surplus grease.
X			Wrong grease in the bearing	Use the correct grease.
		X	Friction marks on raceway	Replace the bearing.
		X	Brinelling or scoring	Replace the bearing. Avoid any vibration at standstill

8.7 Deactivating

Commission any devices provided for protection against condensation after switching off 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.

8.8 Stoppages

Longer non-operational periods

Note

- For longer non-operational periods (> 1 month), either operate the machine or at least turn the rotor regularly, approximately once per month.
- Please refer to the section "Switching on" before switching on to recommission the motor.
- Remove any machine rotor locking devices before you turn the rotor.

NOTICE
Restricted motor function If not used for longer periods of time, material damage or complete motor failure can occur. If the motor is out of service for a period of more than 12 months, then environmental effects can damage the motor. • Apply suitable corrosion protection, preservation, packing and drying measures.

Switching on the anti-condensation heater

Switch on any anti-condensation heating while the machine is not being operated.

Taking the machine out of service

Details regarding the necessary measures, Chapter Preparing for use (Page 23).

Lubricating before recommissioning

NOTICE
Dry running bearings Bearings can be damaged if they do not have sufficient grease. • Re-grease the bearings if they have been out of service for more than one year. The shaft must rotate so that the grease can be distributed in the bearings. Observe the data on the lubricant plate. Chapter Regreasing roller bearings (Page 85).

Maintenance 9

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.).

9.1 Safety instructions for maintenance

Observe the following when carrying out any work on the machine:

- Comply with the general safety instructions (Page 11)
- Comply with the applicable national and sector-specific regulations.
- When using the machine within the European Union, comply with the specifications laid down in EN 50110-1 regarding safe operation of electrical equipment.

Note

Please contact the service center (Page 135), if you require support with service, maintenance or repair.

9.2 Inspection and maintenance

⚠ WARNING

Rotating and live parts

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.

- Perform maintenance work on the machine only when it is stopped. The only operation permissible while the machine is rotating is regreasing the rolling bearings.
- When performing maintenance work, comply with the five safety rules (Page 11).

⚠ WARNING

Machine damage

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

Perform regular maintenance on the machine.

⚠ CAUTION

Dust disturbances when working with compressed air

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

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

NOTICE

Damage to insulation

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

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

NOTICE

Machine damage caused by foreign bodies

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

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

Note

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

9.2.1 North American market (optional)

When making changes or repairs, maintain the corresponding design standards! These machines are labeled on the rating plate with the following markings.

Underwriters Laboratories

Canadian Standard Association

Canadian Standard Association Energy Efficiency Verification

9.2.2 Customs union Eurasia (optional)

When making changes or repairs, maintain the corresponding design standards! These machines are labeled on the rating plate with the following markings.

Customs union Eurasia

Eurasian customs union

Note

Pay particular attention to the relubrication intervals for rolling bearings that deviate from the inspection intervals.

Note

When servicing a three-phase machine, it is generally not necessary to dismantle it. The machine only has to be dismantled if the bearings are to be replaced.

9.2.3 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

Check	When the motor is running	At stand-still
The stated electrical characteristics are being observed.	X	
The permissible bearing temperatures are not exceeded (Page 80).	X	

Check	When the motor is running	At standstill
The smooth running characteristics and machine running noise have not deteriorated.	X	
The motor foundation has no cracks and indentations. (*)	X	X

(*) 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.

9.2.4 Main inspection

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

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

(*) This check can be made at standstill or when running.

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

9.2.5 Maintenance intervals

Please note the following in order to identify faults at an early stage, rectify them and avoid follow-on damage:

- Maintain the machine regularly and carefully.
- Inspect the machine.
- Motors must be allocated a revision/inspection number after inspection.

NOTICE
Motor failure Material damage can occur if the machine develops faults or is overloaded. • Immediately inspect the machine if faults occur. • An immediate inspection is necessary if the three-phase motor is excessively stressed, either electrically or mechanically (e.g. overload or short-circuit).

The machines are equipped with permanently lubricated rolling bearings. A regreasing device is provided as standard.

⚠ CAUTION
Skin irritations and eye inflammations caused by rolling bearing grease Many rolling bearing greases can cause skin irritations and eye inflammations. • Carefully follow all safety instructions provided by the manufacturer.

Measures and intervals

Measures after operating period intervals or deadlines have elapsed:

Operating situations and characteristics can vary widely. For this reason, only general maintenance intervals are specified here. Maintenance intervals should therefore be scheduled to suit the local conditions, such as dirt, number starting operations, load, etc.

Measures	Operating period interval	Intervals
Initial inspection	After 500 operating hours	After 1/2 year at the latest
Regreasing	See the lubricant plate	
Clean	Depending on the degree of pollution	
Main inspection	Approximately every 16000 operating hours	After 2 years at the latest
Drain condensate	Depending on the climatic conditions	

9.2.6 Servicing and maintaining the anti-condensation heating

The anti-condensation heating is maintenance-free. If it is defective, then contact the Service Center (Page 135).

9.2.7 Assessing the rolling bearings

To assess the rolling bearings, it is generally not necessary to dismantle the machines. The motor only has to be dismantled if the bearings are to be replaced.

The state of a rolling bearing can be assessed by analyzing the bearing vibration. The measured values provide an indication and can be assessed by specialists. In this case, please contact the Service Center.

9.2.8 Re-greasing

For machines with regreasing system, relubrication intervals, grease quantity and grease grade are provided on the lubricant plate. Additional data can be taken from the main machine rating plate.

Grade of grease for standard motors (IP55) UNIREX N3 - ESSO.

Note

It is not permissible to mix different types of grease.

Prolonged storage periods reduce the useful lifetime of the bearing grease. Check the condition of the grease if the equipment has been in storage for more than 12 months. If the grease is found to have lost oil content or to be contaminated, the machine must be immediately relubricated before commissioning. For information on permanently-greased bearings, please refer to the section titled Regreasing intervals and types of grease for operating roller bearings (Page 97).

Procedure

To relubricate the rolling bearings, proceed as follows:

1. Clean the grease nipples at the drive end and non-drive end.
2. Press-in the specified grease and amount of grease according to the data stamped on the lubrication plate.
   - Please observe the information on the rating and lubricant plates.
   - Regreasing should be carried out when the motor is running (max. 3600 rpm).

The bearing temperature can rise significantly at first, and then drops to the normal value again when the excess grease is displaced out of the bearing.

Table 9-2 Capacity of the spent grease chamber in cm³

Type	Type of construction IM B3, IM B5, IM B35	Type of construction IM V1
1LE5...-4AA	560	760
1LE5...-4AB 1LE5...-4AC 1LE5...-4AD	1320	980

1LE5...-4BA	690	780
1LE5...-4BB 1LE5...-4BC 1LE5...-4BD	1800	1430

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

Table 9-3 Criteria for selecting roller bearing greases

Criteria	Standard	Property, characteristic value	Unit
Type of base oil	-	Mineral oil	-
Thickener	-	Lithium	-
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 • Alternatively: Extreme-pressure (EP) only after prior consultation with grease and bearing manufacturers	-

Criteria	Standard	Property, characteristic value	Unit
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	Korr.°
Corrosion resistance (EMCOR)	DIN 51802 / ISO 11007	0 - 0	Korr.°
Solid matter content, particle sizes > 25 µm	DIN 51813	<10 mg/kg	mg/kg
Suitability of bearings Speed parameter nxdm	-	Suitable for the built-in motor bearings, seals and these speeds	- mm/min

Note

Deviating operating conditions and characteristics

Only use the grease type that is specified on the lubricant plate.

- If the operating conditions differ from those mentioned, other greases may only be used after prior consultation with the manufacturer.

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 9-4 Roller bearing greases for vertical and horizontal types of construction

Manufacturer	Grease type
Shell	Gadus S2 V100 3
ExxonMobil	Unirex N3
Esso	
BP	Energrease LS3
Fuchs	Renolit H443 HD88
Lubcon	Turmoplex 3
Addinol	LM 3 EP
FAG	Arcanol Multi 3

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

Table 9-5 Alternative greases with NLGI class 2 for motors of horizontal construction

Manufacturer	Grease type
Shell	Gadus S2 V100 2
ExxonMobil	Unirex N2
Esso	
BP	Energrease LS2
Castrol	Longtime PD2
Lubcon	Turmogrease L 802 EP plus
Shell	Retinax LX2
FAG	Arcanol Multi 2

NOTICE

Diminished lubrication properties by mixing greases

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.

Lubrication data

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

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

Regrease the roller bearing at the latest every 12 months irrespective of the actual number of operating hours.

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, reduce the relubrication intervals after prior consultation with the manufacturer.

Regreasing roller bearings

Pay attention to the instructions on the lubricant plate.

1. Rotate the shaft when regreasing, so that the new grease can be distributed throughout the bearing.
   Motors that are operated with converters: Regrease the bearings at a low to medium speed (n_{min} = 250 rpm, n_{max} = 3600 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 nipple before regreasing. Gradually press in an appropriate type and amount of grease, as stamped on the lubricant plate and specified in these operating instructions.
   The roller bearing temperature rises sharply at first, then drops to the normal value again when the excess grease is 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.

9.2.10 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.

9.2.11 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.

9.2.12 Cleaning

Cleaning the grease ducts and spent grease chambers

The spent grease collects outside each bearing in the spent grease chamber of the outer bearing cap. When replacing bearings, remove the spent grease.

Note

Dismantle the bearing cartridges to replace the grease in the lubrication duct.

Cleaning the cooling air ducts

Regularly clean the cooling air ducts through which the ambient air flows.

The frequency of the cleaning intervals depends on the local degree of fouling.

NOTICE

Damage to the machine

Material damage can occur if you direct compressed air in the direction of the shaft outlet or machine openings.

- Avoid pointing compressed air directly onto shaft sealing rings or labyrinth seals of the machine.

9.2.13 Drain condensate

If there are condensation drain holes present, open these at regular intervals, depending on climatic conditions.

⚠ WARNING

Hazardous voltage

The winding can be damaged if objects are introduced into the condensation holes (optional). This can lead to death, serious injury or material damage.

Note the following to maintain the degree of protection:

- Switch off the machine so that it is in a no-voltage condition before you open the condensation drain holes.
- Close the condensation drain holes, e.g. using T-plugs, before commissioning the machine.

NOTICE

Reduction of the degree of protection

If condensation drain holes are not closed, then this can result in material damage to the motor. In order to maintain the degree of protection, after the condensation has been drained, you must close all of the drain holes.

9.2.14 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 135) before you repair any damage to paint. They will provide you with more information about the correct paint system and methods of repairing paint damage.

9.2.15 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 any damaged components.

⚠ WARNING

Short-circuit hazard

Short-circuits can occur as a result of damaged components. This can result in death, serious injury or material damage.

Replace damaged components.

9.3 Corrective maintenance

Observe the following when carrying out any work on the machine:

- Comply with the general safety instructions (Page 11)
- Comply with the applicable national and sector-specific regulations.
- When using the machine within the European Union, comply with the specifications laid down in EN 50110-1 regarding safe operation of electrical equipment.

9.3.1 Fundamentals

If possible, assemble the machine on and alignment plate. This ensures that the mounting feet surfaces are all on the same plane.

Note

Before commencing removal, you should mark how each of the fastening elements has been assigned, as well as how internal connections are arranged. This simplifies subsequent reassembly.

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.

9.3.1.1 Screws with preCOTE coating

The motor can partly be fitted with screws with preCOTE coating. To ensure screw locking, use new screws with preCOTE coating during assembly/repair. As an alternative, use normal screws with a threadlocker such as Loctite.

9.3.1.2 Screw lock washers

Nuts or bolts that are mounted together with locking, resilient and/or force-distributing elements (e.g., safety plates, spring-lock washers, etc.) must be refitted together with identical, fully functional elements.

Locking and sealing elements must always be replaced!

9.3.2 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.

9.3.3 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.

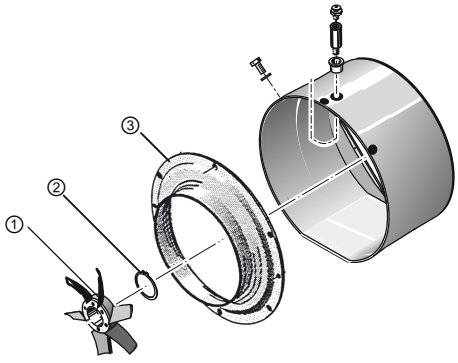


Figure 9-1 Ventilation (schematic diagram with axial fan)

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.

9.3.4 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.

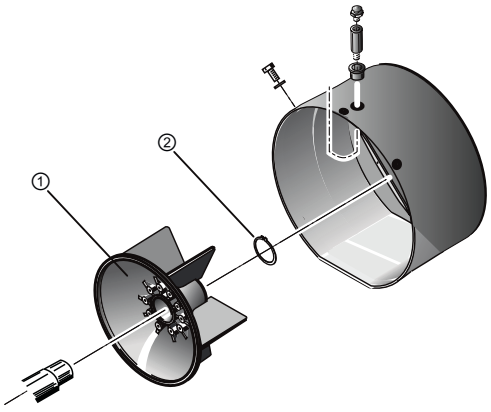


Figure 9-2 Ventilation (schematic diagram with radial fan)

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.

- Take care not to damage the snapping mechanisms on fans that are equipped with these.
- To ensure this, the fans should be heated to a temperature of approximately 50 °C around the area of the hub.
- If any damage is caused, request new parts.

9.3.5 External fan cover

The external fan is installed in the external fan cowl. To remove or replace it, the external fan cowl must be disassembled.

Disassembly

⚠ WARNING

Rotating or live parts

Live electrical parts at the external fan motor are dangerous. Contact with them can cause death, serious injury or material damage.

1. Before you start working on the fan, disconnect the fan motor from the supply system.
2. Make sure that the device cannot be switched back on.
3. Wait until the external fan has reached a standstill before you start work.

1. Secure the external fan cowl against falling before you start working.
2. If a speed sensor is installed, it is located inside the external fan cowl. Separate the brought-out cables of the speed sensor before removing the external fan cowl in the corresponding terminal box.
3. Loosen the fixing screws that secure the external fan cowl on the enclosure.
4. Observe existing retaining components and retain them for the reassembly.

Assembly

Proceed in the reverse order to assemble the external fan cowl.

1. If a speed sensor is installed:
   - Ensure that the cables of the speed sensor are not damaged during the assembly.
   - Before attaching the external fan cowl, route the cables of the speed sensor to the outside between two cooling ribs and affix them temporarily.
2. Position the external fan cowl and tighten the fixing screws.
3. When installing the external fan cowl, make sure that the retaining components are undamaged and correctly installed.
4. Connect the encoder cable.

9.3.6 Links

1. Replace any corroded screws.
2. Take care not to damage the insulation of live parts.
3. Document the position of any rating and supplementary plates that have been removed.
4. Avoid damaging the centering edges.

9.3.7 Canopy; mounting a rotary pulse encoder under the canopy

Guide the fixing screws through the holes on the external surface of the canopy and tighten to a torque of 3 Nm ±10%.

9.3.8 Brake mounting (option)

Table 9-6 Assignment of the brakes to the various frame sizes

Frame size	Brake type	Size assignment of the brakes
400	NFA 250/400	250/400
450	NFA 400/630	400/630

The tightening torques for the electrical connections of the terminal board and grounding are listed in the Table (Page 137) under case A.

See also

Inserting the cable into the terminal box (Page 67)

- Position all rating and supplementary plates as in the original state.
- Where relevant, fix electric cables.
- Check the tightening torques of all screws, as well as those of screws that have not been released.

Sealing measures

1. Apply the necessary liquid sealant, e.g. Fluid-D, Hylomar, to the centering edge.
2. Check the terminal box seals, and if required, replace these.
3. Repair any damage to the paint, also to screws/bolts.
4. Take the necessary measures to ensure compliance with the applicable degree of protection.
5. Do not forget the foam rubber cover in the cable entry. Completely seal the holes, and ensure that cables do not come into contact with sharp edges.

9.3.9 Roller-contact bearings

Protect the bearings against the ingress of dirt and moisture.

9.3.9.1 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 104)
    External fan cover (Page 106)
  - Remove the external fan.
    External fan made of metal (Page 105)
    External fan made of plastic (Page 105)

Note

For a schematic diagram of the respective component layout, see the chapter "Spare parts (Page 115)".

Procedure

1. Remove the bearing mounting components.
   - Remove the outer bearing cover if one is being used.
     Remove V ring (Page 109).
     Removing the labyrinth sealing ring (Page 110).
   - 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.

9.3.9.2 Remove V ring

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

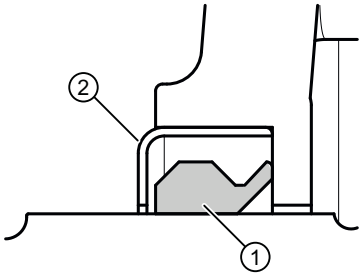


Figure 9-3 Remove the V ring

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 IP56 degree of protection

The V ring for the outer bearing seal is fitted with a protective ring ② for degree of protection IP56. 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 112)

9.3.9.3 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.

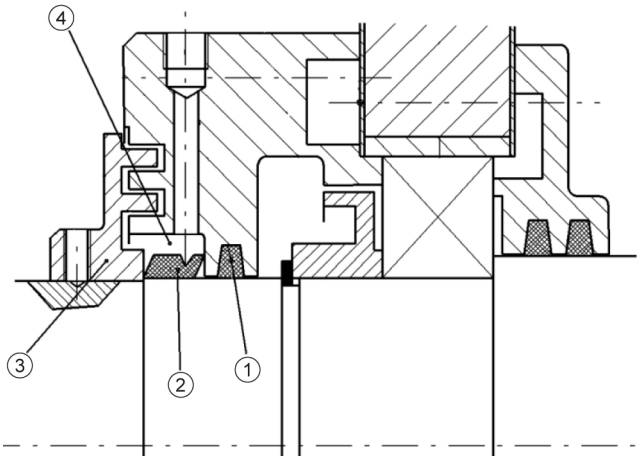


Figure 9-4 Disassembling the labyrinth sealing ring (schematic diagram)

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 113)

9.3.9.4 Installing rolling bearings

- Extreme caution and attention to cleanliness are vital when installing rolling bearings. Observe the correct assembly sequence of the components.
- Attach all components with the specified tightening torques (Page 137).

Note

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

Procedure

1. Replace the damaged components.
2. Remove any dirt from the components. Remove any grease and the remains of sealant or liquid threadlocker.
3. Prepare the bearing seats:
   – Lightly oil the inner ring seat.
   – Grease the outer ring seat with a solid lubricant such as Altemp Q NB 50.
   – Press the inner bearing cover onto the shaft.
4. Warm up the rolling bearing.
5. Push the inner ring of the warmed up rolling bearing onto the shaft. Avoid any blows that might damage the bearing.
6. Make sure that the rolling bearing is resting against the shaft shoulder or the second bearing.
7. Fill the bearing to the top with the specified lubricating grease as stamped on the lubricant plate.
8. Warm up the grease slinger and push it onto the shaft.
9. Depending on the particular version, fix the bearing with a locking ring or shaft nut.
10. Support the rotor when installing the bearing housing or bearing end shield.
11. Use a suitable sealant when assembling.
12. Assemble the bearing shield or bearing housing together with the bearing shield.
13. Install the outer bearing cover if one is being used.
14. Install the sealing elements:

When fitting the bearing cartridges, observe the specified screw tightening torques (Page 137).

- Shaft sealing rings are used to seal machines at the rotor shaft.
- Use the specified bearings.
- Ensure that the bearing sealing disks are in the correct position.
- Insert the elements for bearing preloading at the correct end.
- Fixed bearings can have a locking ring or bearing cover.

- Seal the bearing cap screws with the appropriate gaskets or with grease.
- Do not interchange the position of the bearing covers - DE and NDE or inner and outer.

Avoid damaging the windings protruding out of the stator enclosure when assembling the end shield.

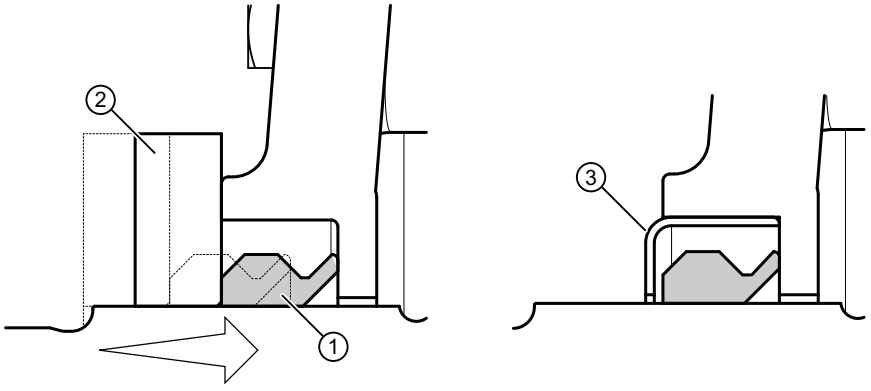
9.3.9.5 Install the V ring

Requirement

The roller bearing is already fitted.

Install the V ring

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



① V ring
② Mounting aid washer
③ Protective ring

Figure 9-5 Install the V ring

2. Push the V ring ① onto the shaft using an assembly disk 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 IP56 degree of protection

For degree of protection IP56, the V ring for the outer bearing seal is fitted with a sheet steel protective ring ③ in the bearing cover.

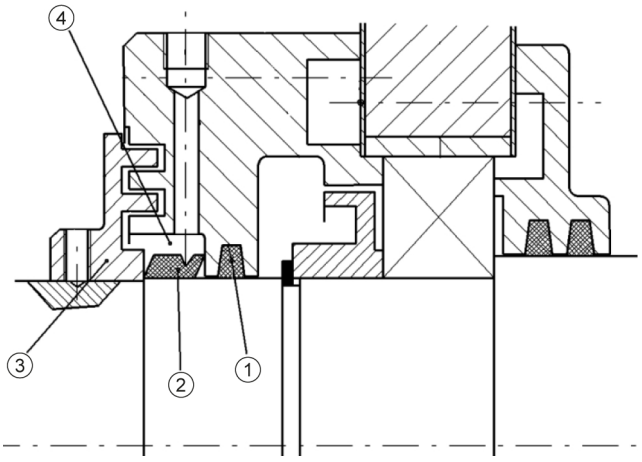
1. Push the protective ring onto the shaft.
2. Verify that the ring is sufficiently pretensioned. Replace the protective ring, if necessary.
3. Position the protective ring so that one of the longitudinal grooves meets the corresponding water separation groove at the bottom in the bearing cover flange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

9.3.9.6 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.



① Felt ring
② V ring
③ Labyrinth sealing ring
④ Grease chamber

Figure 9-6 Roller-contact bearing with grease chamber (schematic diagram)

See also

Install the V ring (Page 112)

9.3.9.7 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.

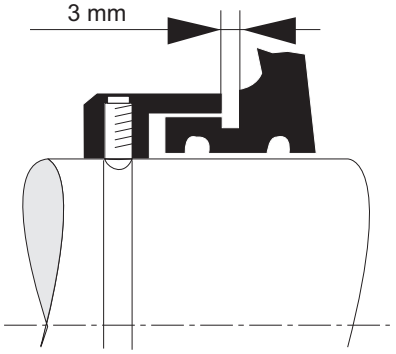


Figure 9-7 Position the set screws for the labyrinth sealing ring on the outer bearing cover

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.

Spare parts 10

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 Parts order

In addition to the exact part designation, please specify the machine type and the serial number of the machine in all orders for spare parts and repair parts. Ensure that the part designation is the same as that in the parts list, and make sure you also use the associated part number.

When spare and repair parts are ordered, the following details must be provided:

- Designation and part number
- Order number and serial number of the machine

The machine type and serial number can be found on the rating plate.

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.

10.3 Ordering spare parts via the Internet

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

Spares on Web (https://www.sow.siemens.com/?lang=en).

10.4 Groups of parts

A distinction is made between the following groups of parts:

Spare parts

Spare parts are machine parts that can be ordered during the production time - and for a further 5 years after discontinuation of production. These parts should only be replaced by authorized service or modification partners.

Repair parts

Repair parts are machine parts that can be supplied during the active production of the machine (until the product discontinuation).
Repair parts are parts used for the repair or modification of the current products. These parts should be replaced only by authorized service or modification partners.

Standardized parts

Standardized parts are machine parts obtained from free trade outlets in accordance with their necessary dimensions, materials and surface finish. A detailed list can be found in the "Standardized parts" section.

Other parts

Other parts are small parts required to complete the exploded drawing. However, these parts cannot be supplied as individual spare or repair parts. The delivery in assembly units (e.g. complete terminal box) is possible on request.

The following supply commitments apply to replacement machines and repair parts following delivery of the motor:

- For up to 3 years after the delivery of the original machine, in the event of total machine failure, Siemens will supply a comparable replacement machine with regard to the mounting dimensions and functions; it is possible that this will involve a new series.
- If a replacement machine is supplied within the 3 year period, this does not mean that the warranty restarts.
- Replacement machines delivered after the active production of the machine series are also identified as spare motors on the rating plate.
- Spare parts are offered only for these spare motors on request; repair and replacement are not possible.

- After a period of 3 years (after the delivery of the original machine), it is only possible to repair these machines (depending on the availability of the spare parts required).
- For up to 5 years after the delivery of the original motor, spare parts will be available and for a further 5 years, Siemens will provide information about spare parts and will supply documents when required.

10.5 Machine parts

10.5.1 Stator and rotor

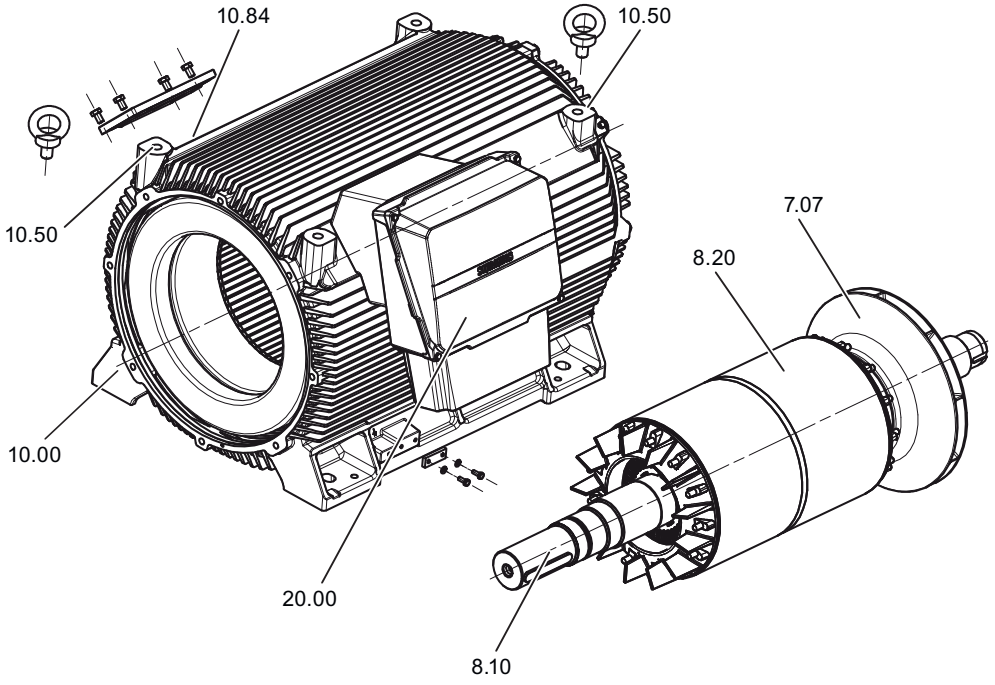
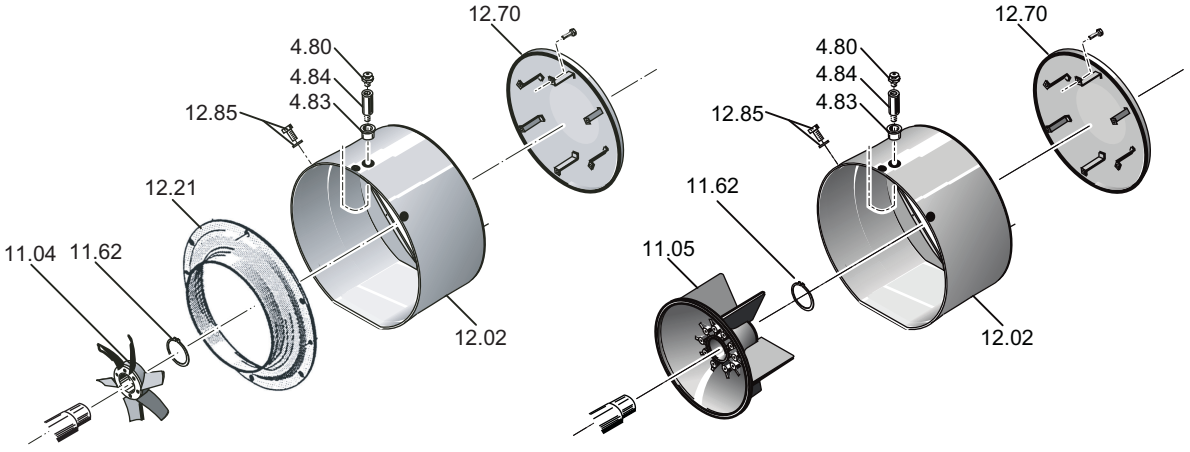


Figure 10-1 Stator and rotor

Table 10-1 Spare parts for stators and rotors

Part	Description	Part	Description
7.07	Internal fan	10.50	Lifting lug
8.10	Shaft	10.84	Cover with seal
8.20	Rotor core with winding	20.00	Terminal box
10.00	Stator frame with laminated core and winding		

10.5.2 Ventilation



Version for two-pole motors

Version for motors with four or more poles

Table 10-2 Spare parts for cooling components

Part	Description	Part	Description
4.80	Grease nipple	12.02	Fan cowl
4.83	Rubber bush	12.21	Air inlet nozzle
4.84	Grease supply extension tube	12.35	Protective grille
11.04	External fan, unidirectional	12.70	Protective cover, optional for design IM V1
11.05	External fan, bidirectional	12.85	Fixing elements
11.62	Locking ring		

10.5.3 External fan

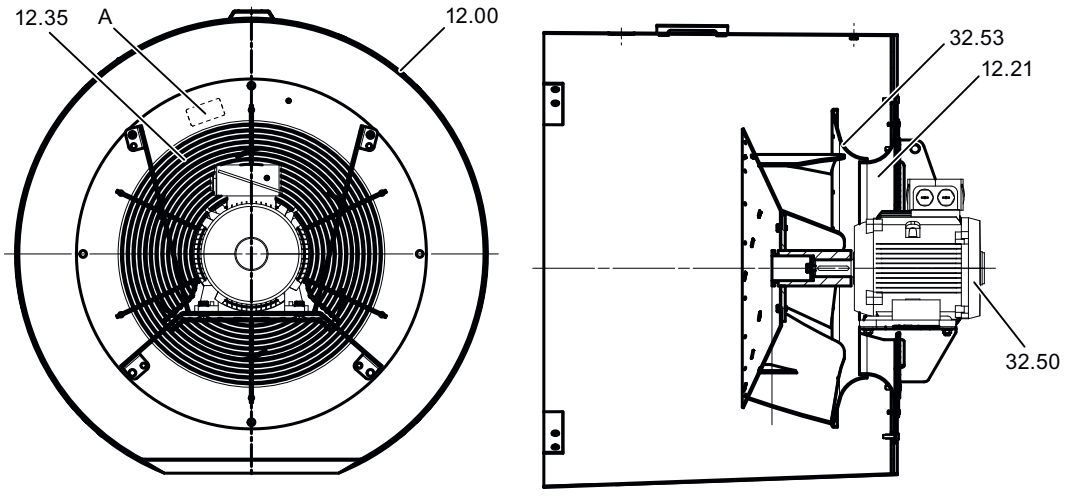


Figure 10-2 Fan cowl with external fan

Table 10-3 Spare parts for external fan

Part	Description	Part	Description
12.00	Complete fan cowl with external fan	32.50	Fan motor
12.21	Suction nozzle	32.53	Fan impeller
12.35	Protective grille	A	Rating plates for external fans, data for 50 Hz and 60 Hz

10.5.4 TB3R61 terminal box

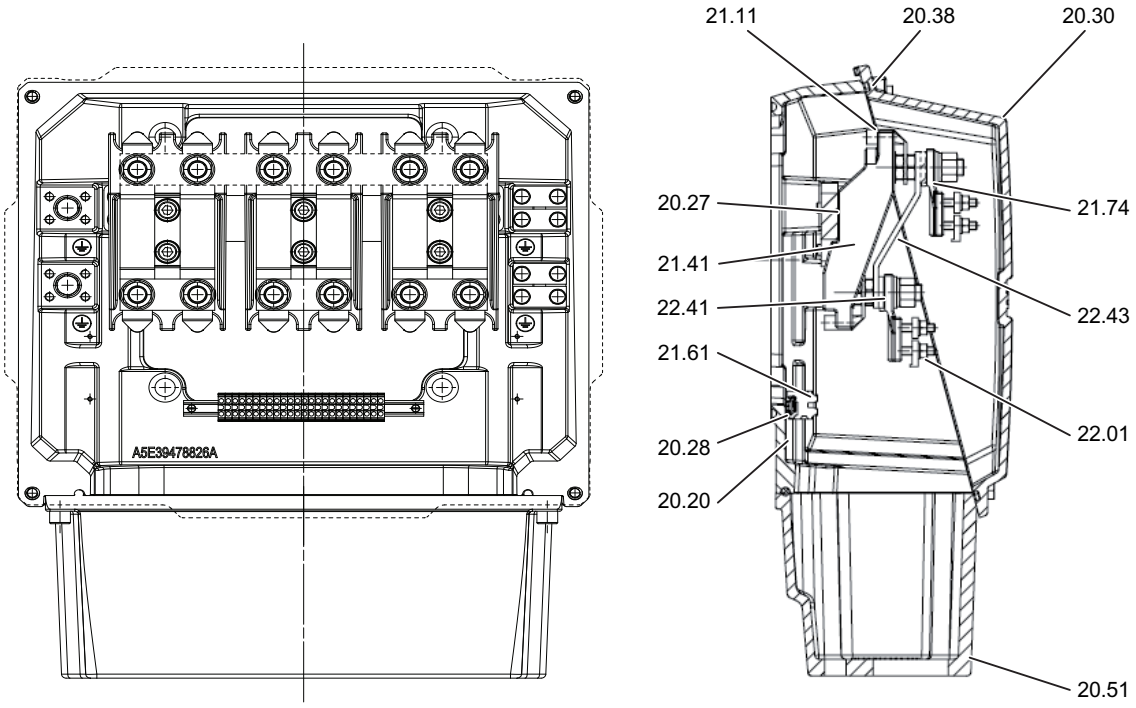


Figure 10-3 TB3R61 main terminal box

Table 10-4 Spare parts for the TB3R61 main terminal box

Part	Description	Part	Description
20.20	Terminal box housing	21.41	Terminal bushings
20.27	Mounting rail	21.61	Terminal strip for auxiliary circuit
20.28	Seal	21.74	Anti-rotation cartridge
20.30	Cover	22.01	Saddle terminal, complete
20.38	Seal	22.41	Terminal link, straight with 2 holes
21.11	Connecting plate with internal cable	22.43	Terminal link, stepped with 2 holes

Part	Description	Part	Description
20.51	Cable entry plate with seal		

10.5.5 1XB1631 terminal box

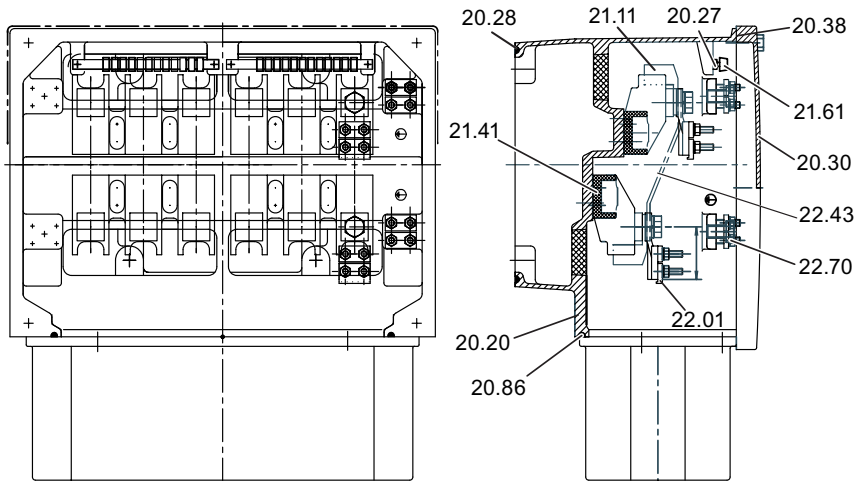


Figure 10-4 Terminal box 1XB1631

Part	Description	Part	Description
20.20	Terminal box housing	21.11	Connecting plate with internal cable
20.27	Mounting rail (depending on version)	21.41	Terminal bushings
20.28	Seal	21.61	Terminal strip for the auxiliary circuit (depending on version)
20.30	Cover	22.43	Terminal link, stepped with two holes
20.38	Cover seal	22.70	Fixing lug for PE conductor
20.86	Entry for auxiliary cable		

You can order the terminal box just as one component.

10.5.6 Terminal box 1XB7750

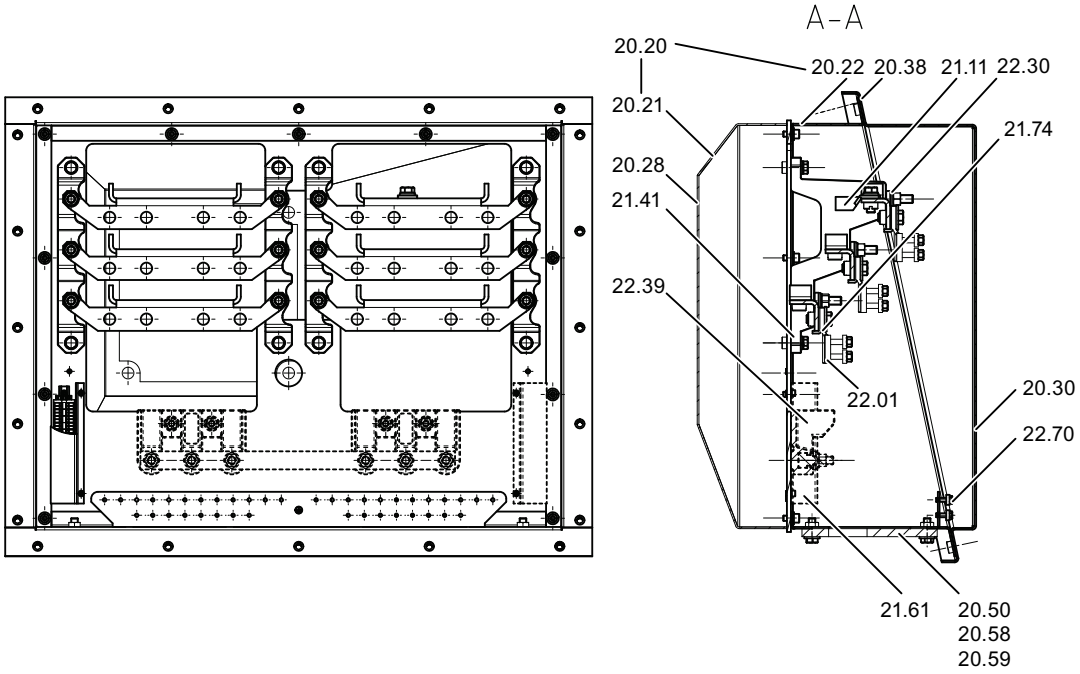


Figure 10-5 Main terminal box 1XB7750 with standard cable entry

Table 10-5 Spare parts main terminal box 1XB7750

Part	Description			Part	Description
20.20	Terminal box housing consisting of	20.21	Lower part of enclosure	21.41	Terminal bushings
		20.22	Upper part of enclosure		
20.28	Seal			21.61	Terminal strip for auxiliary circuit
20.30	Cover			21.74	Anti-rotation cartridge
20.38	Seal			22.01	Saddle terminal, complete
20.50	Cable entry plate			22.30	Connecting bar for main current
20.58	Seal			22.39	Neutral point connection
20.59	Spacer			22.70	Fixing lug for PE conductor
21.11	Connecting plate with internal cable				

10.5.7 Drive end rolling-contact bearings with bearing housing

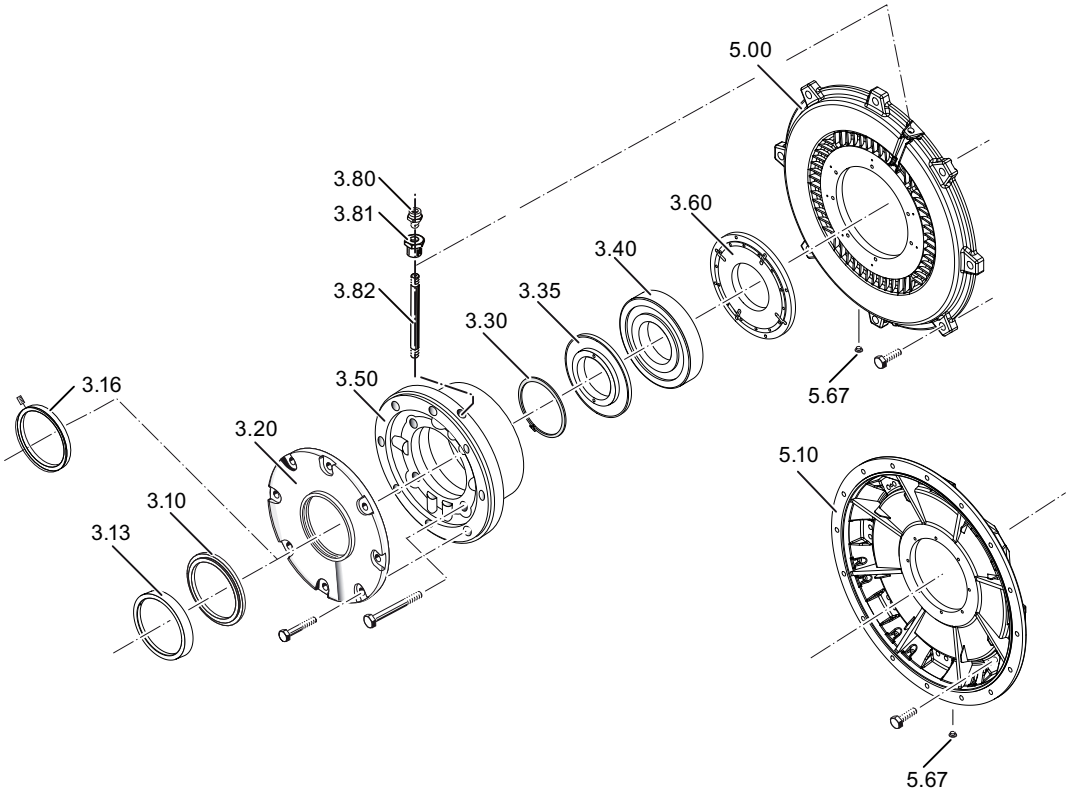


Figure 10-6 Drive end roller bearings with bearing housing

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

Part	Description	Part	Description
3.10	V ring	3.60	Inner bearing cover
3.13	Protective ring	3.80	Grease nipple
3.16	Labyrinth ring (optional)	3.81	Nut
3.20	Outer bearing cover	3.82	Grease tube
3.30	Locking ring	5.00	Type of construction IM B3
3.35	Grease slinger	5.10	Flanged end shield
3.40	Deep-groove ball bearing (locating bearing)	5.67	Sealing plugs
3.50	Bearing housing		

10.5.8 Non-drive end rolling-contact bearings with bearing housing

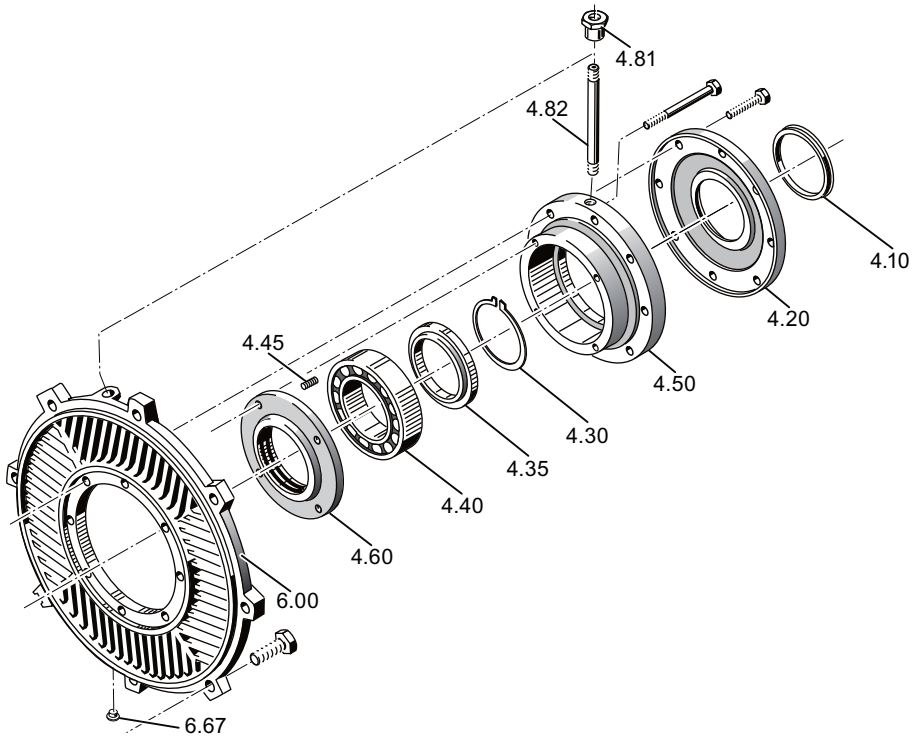


Figure 10-7 Non-drive end roller bearings with bearing housing

Table 10-7 Spare parts for non-drive end roller bearings with bearing housing

Part	Description	Part	Description
4.10	V ring	4.50	Bearing housing
4.20	Outer bearing cover	4.60	Inner bearing cover
4.30	Locking ring	4.81	Nut
4.35	Grease slinger	4.82	Grease tube
4.40	Deep-groove ball bearing	6.00	End shield
4.45	Compression spring	6.67	Sealing plugs

10.5.9 Drive end rolling-contact bearings without bearing housing

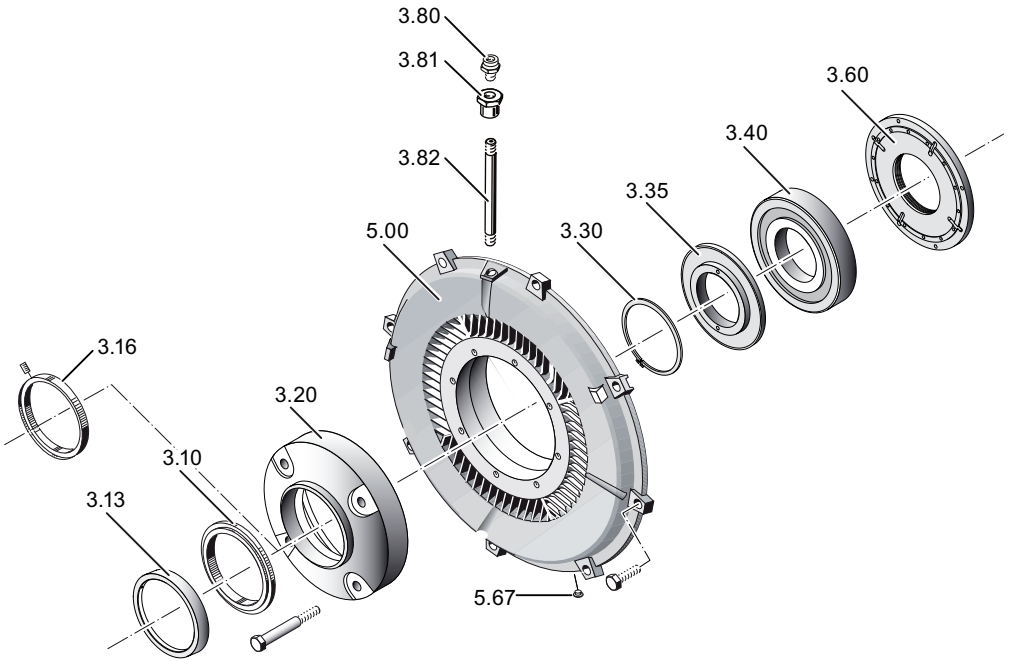


Figure 10-8 Drive end roller bearings without bearing housing

Table 10-8 Spare parts for drive end roller bearings without bearing housing

Part	Description	Part	Description
3.10	V ring	3.50	Bearing housing
3.13	Protective ring	3.60	Inner bearing cover
3.16	Labyrinth ring (optional)	3.80	Grease nipple
3.20	Outer bearing cover	3.81	Nut
3.30	Locking ring	3.82	Grease tube
3.35	Grease slinger	5.00	End shield
3.40	Deep-groove ball bearing (locating bearing)	5.67	Sealing plugs

10.5.10 Non-drive end rolling-contact bearings without bearing housing

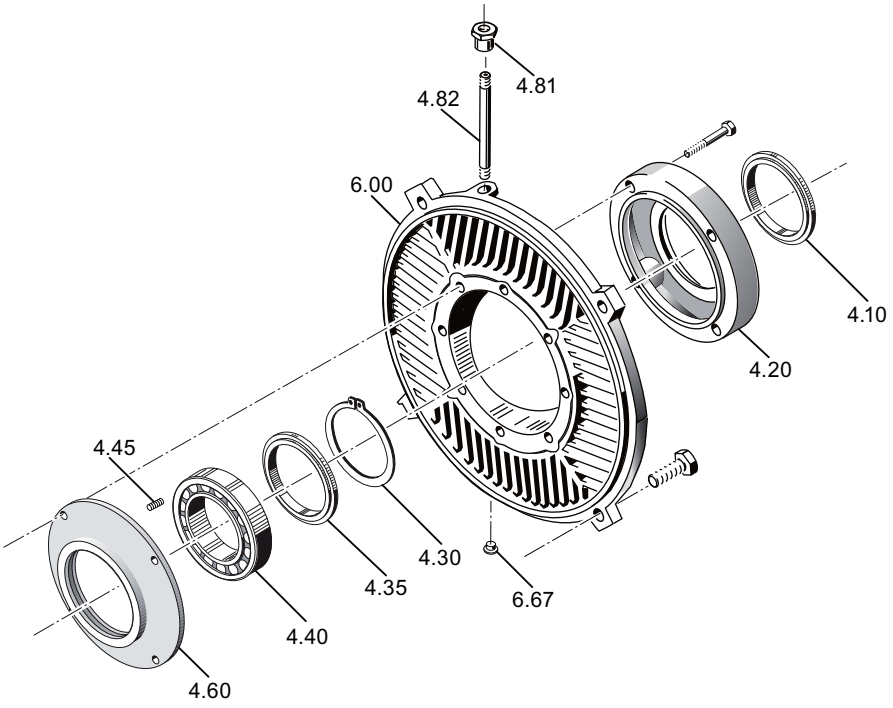


Figure 10-9 Non-drive end roller bearings without bearing housing

Table 10-9 Spare parts for non-drive end roller bearings without bearing housing

Part	Description	Part	Description
4.10	V ring	4.60	Inner bearing cover
4.20	Outer bearing cover	4.81	Nut
4.30	Locking ring	4.82	Grease tube
4.35	Grease slinger	6.00	End shield
4.40	Deep-groove ball bearing	6.67	Sealing plugs
4.45	Compression spring		

10.5.11 Roller bearings, DE - end shield with integrated bearing cover

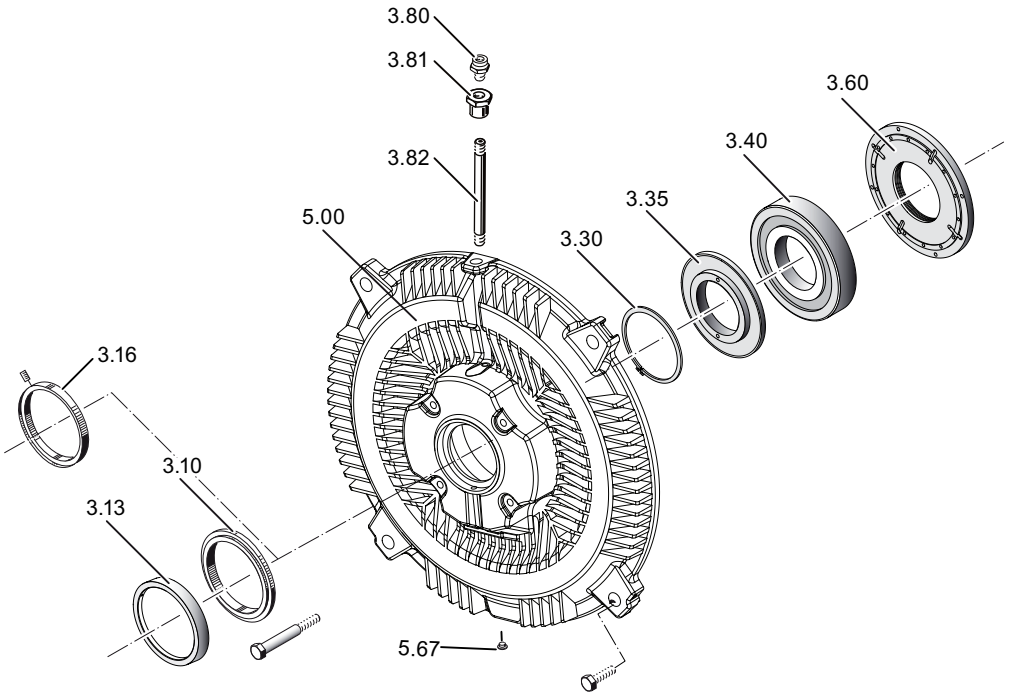


Figure 10-10 Roller bearings, DE - end shield with integrated bearing cover

Table 10-10 Spare parts for roller bearings, DE

Part	Description	Part	Description
3.10	V ring	3.60	Inner bearing cover
3.13	Protective ring	3.80	Grease nipple
3.16	Labyrinth ring (optional)	3.81	Nut
3.30	Locking ring	3.82	Grease tube
3.35	Grease slinger	5.00	End shield
3.40	Deep-groove ball bearing (locating bearing)	5.67	Sealing plugs
3.50	Bearing housing		

10.5.12 Roller bearings, NDE - end shield with integrated bearing cover

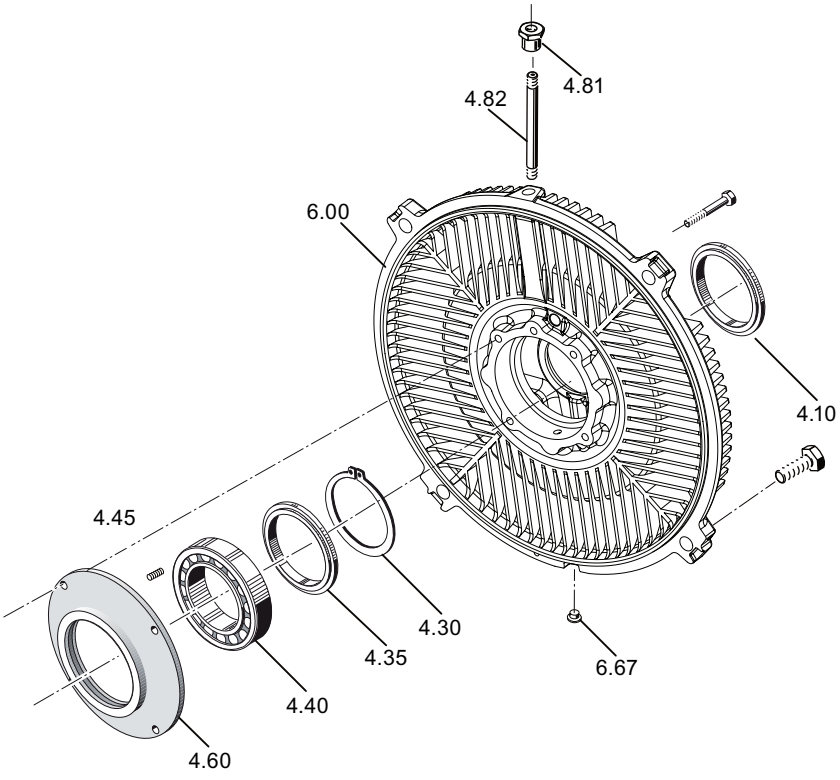


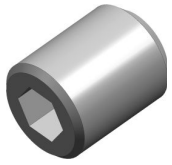
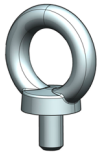
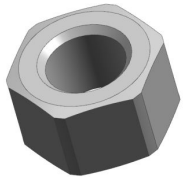
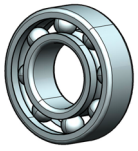
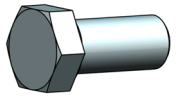
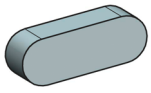
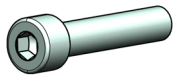
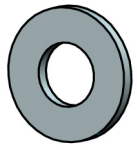
Figure 10-11 Roller bearings, NDE - end shield with integrated bearing cover

Table 10-11 Spare parts for roller bearings, NDE

Part	Description	Part	Description
4.10	V ring	4.60	Inner bearing cover
4.30	Locking ring	4.81	Nut
4.35	Grease slinger	4.82	Grease tube
4.40	Deep-groove ball bearing	6.00	End shield
4.45	Compression spring	6.67	Sealing plugs

10.6 Standardized parts

Table 10-12 Purchase standard parts according to dimensions, material and surface properties through normal commercial channels.

No	Standard	Picture	No	Standard	Picture
6.02	DIN 471		6.75	EN ISO 4026	
4.04	DIN 580		5.55	EN ISO 4032	
1.60 6.10	DIN 625		4.39 5.79 5.89	EN ISO 4017	
3.38	DIN 6885		1.30 1.49 5.46 5.49 5.60 6.29 7.49	EN ISO 4762	
			5.18 5.36	EN ISO 7089	

Disposal

11

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.

11.2 Country-specific legislation

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.

11.3 Preparing for disassembly

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

1. Contact a certified waste disposal organization in your vicinity. Clarify what is expected in terms of the quality of dismantling the machine and provision of the components.
2. Follow the five safety rules (Page 11).
3. Disconnect all electrical connections and remove all cables.
4. Remove all liquids such as oil and cooling liquids. Collect the liquids separately and dispose of them in a professional manner.
5. Detach the machine fixings.
6. Transport the machine to a suitable location for disassembly.

See also

Corrective maintenance (Page 103)

11.4 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.

11.5 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 & support

A

Technical questions or additional information

If you have any technical questions or require additional information, please contact Technical Support (https://support.industry.siemens.com/cs/ww/en/sc/2090).

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.

Technical data

B

B.1 Tightening torques for screw and bolt connections

Bolt locking devices

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

Tightening torques

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

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

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

Applications

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

- 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, A4-70 or A4-80 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.

If no other tightening torques are specified, then the values in the following table apply.

Table B-2 Tightening torques for screws on the terminal box, end shields, screw-type grounding conductor connections

Thread ∅		M 3.5	M 4	M 5	M 6	M 8	M 10	M 12	M 16	M20
Nm	min	0.8	2	3.5	6	16	28	46	110	225
	max	1.2	3	5	9	24	42	70	165	340

Quality documents

C

You can find the quality documents here:

https://support.industry.siemens.com/cs/ww/de/ps/13312/cert (https://support.industry.siemens.com/cs/ww/en/ps/13312/cert)

Index

G

H

I

L

M

N

O

P

Q

R

S

T

V

W

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