

SIEMENS

Operating Instructions
Installation Instructions

Low-voltage motor

SIMOTICS TN Series N-compact

Type 1PQ8

Edition

11/2018

www.siemens.com/drives

SIEMENS

Low-voltage motor

SIMOTICS TN Series N-compact Type 1PQ8


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Installation 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

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Disclaimer of Liability

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

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Introduction

1.1 About these instructions

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

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

Please contact the Service Center if you have any suggestions on how to improve this document.

See also

Service and Support (Page 147)

Text format features

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

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

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

Note

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

1.2 Compiling personal documents

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

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

1.2 Compiling personal documents

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

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

This electric machine has been designed and built in accordance with the specifications contained in Directive 2014/35/EU ("Low-Voltage Directive") and is intended for use in industrial plants. Please observe the country-specific regulations when using the electric machine outside the European Community. Follow the local and industry-specific safety and setup regulations.

The persons responsible for the plant must ensure the following:

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

Note

Use the services and support provided by the appropriate Service Center (Page 147) for planning, installation, commissioning, and servicing work.

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

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

2.2 The five safety rules

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

Five safety rules

1. Disconnect the system.
Also disconnect the auxiliary circuits, for example, anti-condensation heating.
2. Secure against reconnection.
3. Verify absence of operating voltage.

2.3 Qualified personnel

- 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. <ul style="list-style-type: none">• Always observe the "five safety rules" (Page 15) when carrying out any work on the machine.• Only remove the covers using the methods described by these operating instructions.• Operate the machine properly.• Regularly and professionally maintain the machine according to the instructions provided in Chapter "Maintenance".

**! 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.

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


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

! CAUTION**Flammable substances**

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

Burns and other damage to health and material may result.

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

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

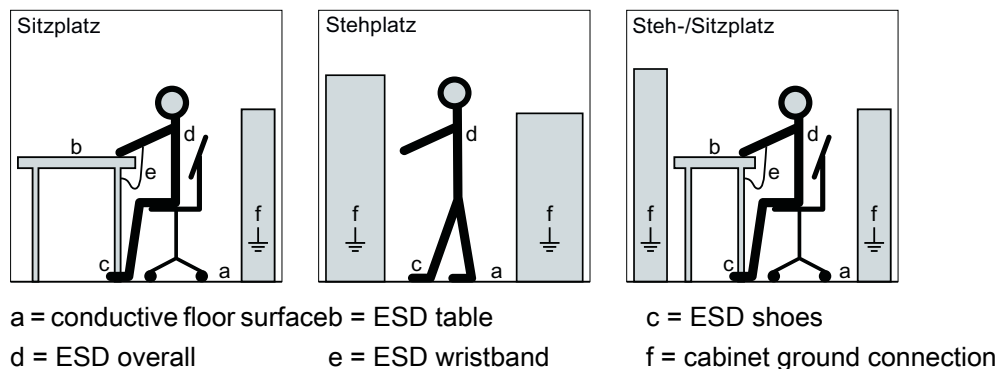
2.5 Electrostatic sensitive devices

ESD protective measures



NOTICE
Electrostatic discharge Electronic modules contain components that can be destroyed by electrostatic discharge. These components can be damaged or destroyed if they are not handled correctly. To protect equipment against damage, follow the instructions given below. <ul style="list-style-type: none">● Only touch electronic modules if you absolutely have to work on them.● The body of the person concerned must have been electrostatically discharged and grounded immediately before any electronic modules are touched.● Electronic modules should not be brought into contact with electrically insulating materials, such as:<ul style="list-style-type: none">– Plastic film– Plastic parts– Insulating table supports– Clothing made of synthetic fibers● Always place electrostatic sensitive devices on conductive bases.● Always pack, store and transport electronic modules or components in conductive packaging, such as:<ul style="list-style-type: none">– Metallized plastic or metal containers– Conductive foam material– Domestic aluminum foil

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




2.6 Interference immunity

By selecting suitable signal cables and evaluation units, companies operating complete plants and systems must ensure that the interference immunity of the machine is not diminished.

2.7 Influence on the line power supply through a strongly irregular torque

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

2.8 Interference voltages when operating the converter

 WARNING
<p>Interference voltages when operating the converter</p> <p>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.</p> <ul style="list-style-type: none"> • 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.

2.9 Electromagnetic fields when operating electrical power engineering installations

 **WARNING**

Interference to electronic devices caused by electrical power equipment

Electrical power equipment generate electric fields during operation. Potentially lethal malfunctions can occur in medical implants, e.g. pacemakers, in the vicinity of electrical power equipment. Data may be lost on magnetic or electronic data carriers.

- It is forbidden for people with pacemakers to enter the vicinity of the machine.
- Protect the personnel working in the plant by taking appropriate measures, such as erecting identifying markings, safety barriers and warning signs and giving safety talks.
- Observe the nationally applicable health and safety regulations.
- Do not carry any magnetic or electronic data media.


Description

Applications

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

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

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

 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.
<ul style="list-style-type: none"> • Never operate this machine in hazardous areas.

Machine design

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

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

Table 3-1 Machine design

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

* For machines in line operation only

See also

Quality documents (Page 151)

Comparison of IEC and GOST standards

The IEC/EN standards correspond to the following GOST standards.

IEC/EN	GOST
IEC/EN 60034-1	GOST R IEC 60034-1
IEC/EN 60034-5	GOST R IEC 60034-5
IEC/EN 60034-6	GOST R IEC 60034-6
IEC/EN 60034-7	GOST R IEC 60034-7
IEC/EN 60034-8	GOST R IEC 60034-8
IEC/EN 60034-9	GOST R IEC 60034-9
IEC/EN 60034-12	GOST R IEC 60034-12
IEC/EN 60034-14	GOST R IEC 60034-14

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.

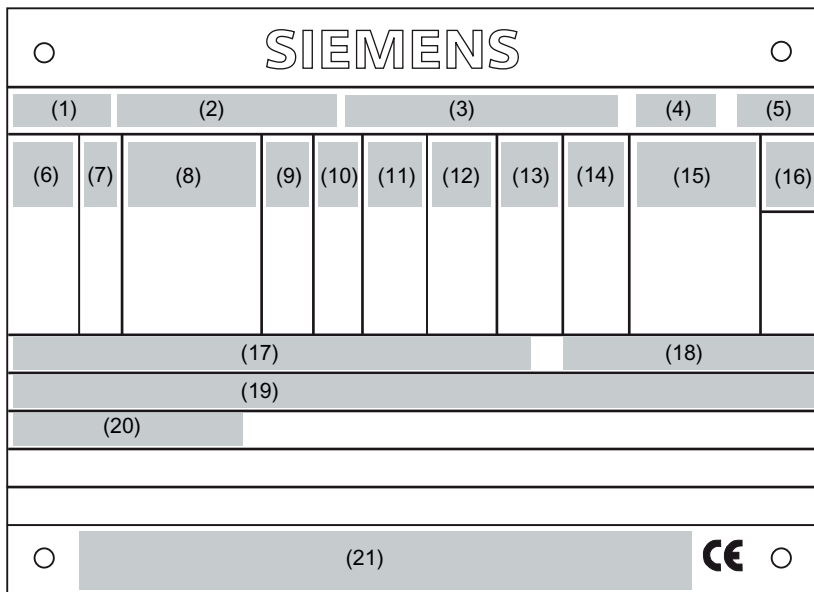


Figure 3-1 Schematic diagram of rating plate

Table 3-2 Data on the rating plate

Item	Description	Item	Description
(1)	Type of motor	(12)	Rated speed [rpm]
(2)	Motor type	(13)	Starting current ratio
(3)	Serial number	(14)	(empty)

Item	Description	Item	Description
(4)	Type of construction	(15)	Certificate number
(5)	Temperature class	(16)	Degree of protection
(6)	Rated voltage [V] and connections	(17)	Rotor class
(7)	Rated frequency [Hz]	(18)	Motor weight [kg]
(8)	(Content depending on the version)	(19)	Additional information (optional)
(9)	Rated current [A]	(20)	Maximum speed [rpm]
(10)	Rated power [kW]	(21)	Country of manufacture / City
(11)	Power factor [cos ϕ]		

Efficiency requirement

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

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

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

Please note the applicable country-specific rules and regulations.

Rotors

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

Cooling

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

External fan

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

Roller-contact bearings

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

Table 3-3 Roller-contact bearing variants

Version	Roller-contact bearings
Horizontal type of construction, coupling output	<ul style="list-style-type: none"> • Drive end: Deep-groove ball bearing as a fixed bearing • Non-drive end: Deep-groove ball bearing as a floating bearing with axial compression springs
Horizontal type of construction, increased transverse forces e.g. in the case of belt coupling	<ul style="list-style-type: none"> • Drive end: Cylindrical-roller bearing as a floating bearing • Non-drive end: Deep-groove ball bearing as a fixed bearing
Vertical type of construction, shaft height 315	<ul style="list-style-type: none"> • Drive end: Deep-groove ball bearing as a fixed bearing • Non-drive end: Deep-groove ball bearing as a floating bearing with axial compression springs
Vertical type of construction, shaft height 355 ... 450	<ul style="list-style-type: none"> • Drive end: Pairing of angular-contact ball bearing / deep-groove ball bearing as a fixed bearing • Non-drive end: Deep-groove ball bearing as a floating bearing with axial compression springs

Roller bearings for high-speed version

For high-speed versions, the roller bearing is designed as follows:

Table 3-4 Roller bearings designs for high-speed version

Version	Roller bearings
Horizontal type, elastic power output via coupling	<ul style="list-style-type: none"> • Drive end: Deep-groove ball bearing as a fixed bearing • Non-drive end: Deep-groove ball bearing as a floating bearing with axial compression springs

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

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

Layout

The spent lubricating grease collects in the space between the bearing housing and the outer bearing cap. The latter also forms the sealing grease chamber with the labyrinth sealing ring (optional). The second lubricating nipple containing the grease duct for pressing in the sealing

grease is also located in the outer bearing cap. The chamber is sealed off from the space where the lubricating grease collects by a V-ring or a V-ring and felt ring combination which prevents the sealing grease in the chamber from penetrating into the lubricating grease collecting space. During operation, the sealing grease in the chamber slowly runs out via the labyrinth and seals it, additionally removing dust from inside and around the outside of the labyrinth ring.

Terminal box

The terminal box can be arranged either on the left or right of the machine. It is not possible to change the position to the other side of the machine at a later date.

If you wish to upgrade to the next largest terminal box at a later date, please contact the manufacturer.

Depending on the shaft height, the following terminal boxes are used for connecting the cables:

Table 3-5 Assignment of shaft heights to terminal boxes

Shaft height	Terminal box
315	GT640 [⊙]
315 ... 355	1XB1621
315 ... 450	1XB1631
315 ... 450	1XB1634
315 ... 450	1XB9600 [⊙]

[⊙] Not for explosion-proof versions

Supplementary devices

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

Anti-condensation heating (option)

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

Preparations for use

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

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

4.1 Safety-related aspects to consider when configuring the plant

A number of residual risks are associated with the machine. These are described in the chapter titled "Safety information" (Page 15) and in related sections.

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

4.2 Observing the operating mode

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

4.3 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.

4.4 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.

See also

Connecting an external fan motor (Page 82)

4.5 Thermal motor protection

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

4.6 Interlock circuit for anti-condensation heating (option)

See also

Set values for monitoring the winding temperature (Page 90)

Setpoint values for monitoring the bearing temperature (Page 90)

4.6 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.

See also


Switching off the anti-condensation heating (Page 94)

4.7 IM B5 type of construction with support foot


- 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
Danger if there is no 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. <ul style="list-style-type: none">• Use an appropriately sized support base.

4.8 Noise emissions

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

4.9 Rotational speed limit values

 WARNING
Excessively high speeds Excessive rotational speed can lead to serious damage to the machine. This can result in death, serious injury, or material damage. <ul style="list-style-type: none">• Avoid operation above the permissible speed by using the appropriate control function.• Observe the speeds stamped on the rating plate.

4.10 Phase synchronization during supply system switching

NOTICE
Supply system switching Damage to the machine may be caused when switching to another supply system with different phasing. <ul style="list-style-type: none">• The phasing must be synchronized during switching. Use appropriate means to synchronize the phasing.

4.11 Space requirements

Plan sufficient space on site for the machine so that the third-party fan can be disassembled and assembled as required. The necessary space requirements are listed in the following table:

Table 4-1 Space required for removing/fitting the external fan

Shaft height			
31.	35.	40.	45.
345 mm	345 mm	360 mm	365 mm

4.12 Voltage and frequency fluctuations during line operation

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

The following applies: Under practical operating conditions a machine may sometimes have to be operated outside the limits of Range A. Exceptions of this sort should be limited with regard to the values that arise, how often and for how long they occur. Where possible and within a reasonable time take corrective actions such as reducing the power. Such actions can avoid thermal ageing leading to a reduction in the service life of the machine.

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

4.13 System-inherent frequencies

NOTICE
System resonances
Excessive vibrations and system resonances can damage the machine set.
<ul style="list-style-type: none"> • 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.

4.14 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

Serious damage to the machine

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.

Note

More information about this may be found in the catalog.

4.15 Transport and storage

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

4.15.1 Transport markings

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

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



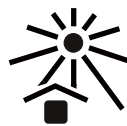
Top



Fragile material



Keep dry



Keep cool



Center of gravity



Do not use hand hook



Attach here

4.15.2 Checking the delivery

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

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

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

4.15.3 Lifting and transportation

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 $a \leq 0.4 \text{ g} (\approx 4 \text{ m/s}^2)$
Velocity $v \leq 20 \text{ m/min}$



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.

4.15.4 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.

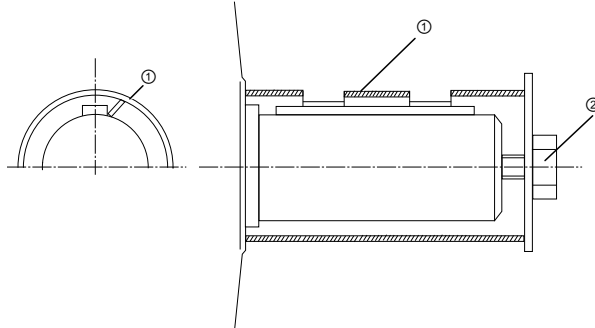
NOTICE**Vibration and shock during transport**

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

- If the machine is fitted with a rotor shipping brace, this should always be used when transporting the machine. The rotor shipping brace must be attached during the transport.
- Only remove it before pulling on the output element.
- 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

Note

Store the rotor locking device

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


4.15.5 Transporting the machine set

 WARNING
Falling down of the machine
The lifting lugs on the machine are designed only for the weight of the machine. If a machine set is lifted and transported on a single machine, this can lead to mechanical failure of the lifting lug. The machine or machine set may fall. This can result in death, serious injury or material damage.
<ul style="list-style-type: none">• Do not lift machine sets by attaching lifting tackle to the individual machines.• Use only the equipment provided, e.g. the openings or lugs on the base plates, for transporting machine sets. Note the maximum capacity of the lifting lug.

Note

Place the machine in a secure and raised position

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

 DANGER
Standing under suspended loads
If the lifting gear or load handling attachments were to fail, the machine could fall. This can result in death, serious injury or material damage.
<ul style="list-style-type: none">• Never remain under or in the immediate vicinity of the machine when it is raised.

4.15.6 Storage

You must correctly store the machine if you do not install and use it after it has been delivered.

NOTICE
Bearing seizure damage if incorrectly stored
If storage conditions are inappropriate there is a risk of bearing seizure damage. Resulting damage can include scoring (brinelling) and corrosion.
<ul style="list-style-type: none">• Follow the storage guidelines.

Preconditions and preparations

- Only store goods in undamaged packaging. Unpack the goods if the packaging is damaged. Correctly store the goods corresponding to the type.
- Repair any damage to the packaging before putting the equipment into storage insofar as this is necessary to ensure proper storage conditions.

General instructions for storage

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

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

Storing outdoors

When storing the machines outside, the storage location must comply with the following conditions:

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

Protection against humidity

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

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

NOTICE

Improper storage or transport

Damage to bearings can result from improper storage or transport.

- On machines that have been supplied with a rotor shipping brace, secure the rotor as per the notes on transportation (Page 33).
- Protect the motor against strong radial shocks and vibration when storing, as the rotor shipping brace cannot completely absorb these forces.
- If the customer has already 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 locking device.

Long-term storage

If you are storing a machine for more than six months, you must check its condition every six months. Store the machine in accordance with the specifications in Section "Storage (Page 35)", and if possible, packed.

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

Storage for longer than three months

Lubricate the machine after every two years of storage.

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

NOTICE

Damage to roller bearings

Roller bearings can be damaged when kept in the same or almost the same position.

Every three months, manually rotate the rotor through five revolutions. Make sure that the resting position of the roller bearings after the rotor has been turned is different from what it previously had been. Use the feather key as a reference point, if present.

4. Replace the corrosion protection.

5. Reattach the rotor shipping brace, if present.
6. Pack the machine again.

4.15.7 Protection against corrosion

If the machine is stored in dry conditions, then apply the subsequently listed anti-corrosion measures:

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

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

4.16 Converter operation

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

Note

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

4.16.1 Supply line configuration

NOTICE
Asymmetric voltage load during operation on a TN system in delta connection
An asymmetric voltage load of the machine winding can occur during operation on a TN system in delta connection with a grounded line conductor. Winding damage can result.
<ul style="list-style-type: none">• Do not operate the machine on a TN system with a grounded line conductor.

NOTICE

Ground fault during operation on an IT system

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

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

4.16.2 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

Taking the following actions will reduce the bearing currents:

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

Equipotential bonding conductors:

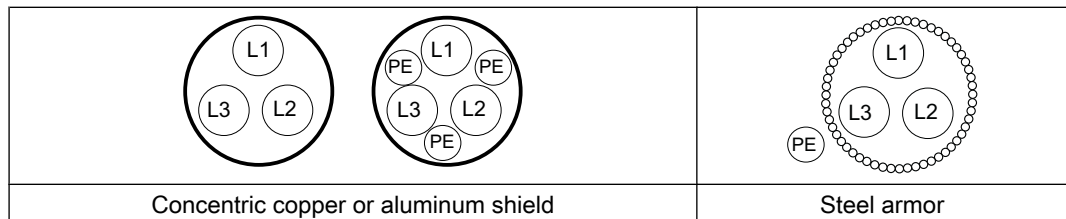
Use equipotential bonding conductors:

- Between motor and driven machine
- Between motor and converter
- Between the terminal box and the RF grounding point at the motor enclosure.

Selecting and connecting the cable:

As far as possible, use symmetrically arranged, shielded connection cables. The cable shielding, made up of as many strands as possible, must have good electrical conductivity. Braided shields made of copper or aluminum are very suitable.

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



- 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 established over a large area.

Overall system design

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.

Note

Converter documentation

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

4.16.4 Converter operation on a grounded network

NOTICE

Damage resulting from protective conductor currents
--

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

- | |
|---|
| <ul style="list-style-type: none">• Use an appropriately sized PE conductor.• Connect the PE conductor to the grounding terminal on the motor enclosure. |
|---|

4.16.5 Insulated bearings when operating the converter

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

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

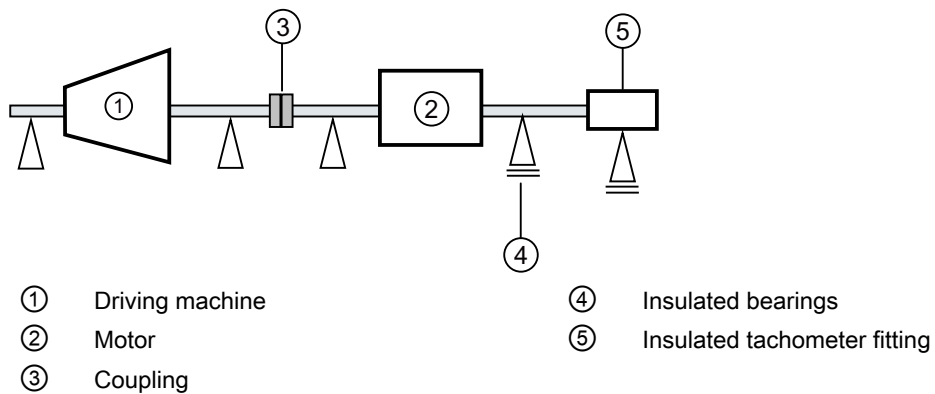


Figure 4-2 Schematic representation of a single drive

NOTICE

Bearing damage

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

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

Tandem operation

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

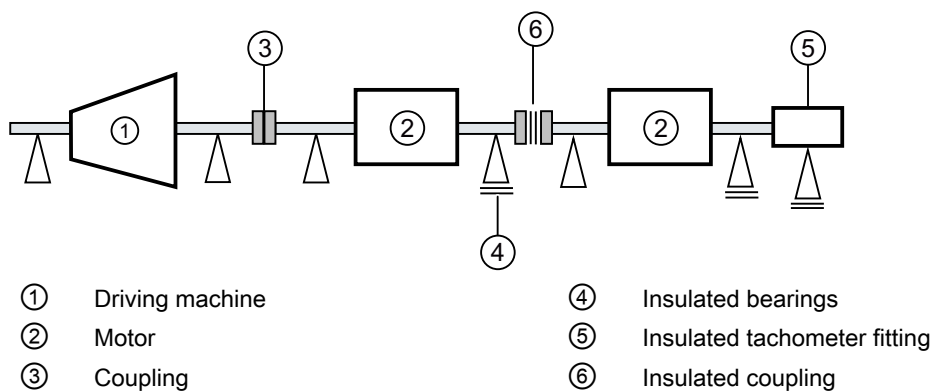


Figure 4-3 Schematic representation of a tandem drive

NOTICE

Bearing damage

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

- Use an insulated coupling to link the motors.

See also

Service and Support (Page 147)

Assembly

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

- Comply with the general safety instructions
- 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.

See also

Safety information (Page 15)

Note

Loss of conformity with European directives

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

5.1 Preparations for installation

5.1.1 Requirements for installation

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

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

Note

Measure the insulation resistance of the winding before starting installation work

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

NOTICE

High temperatures

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

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

5.1.2 Insulation resistance and polarization index

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

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

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

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

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

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

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

"Testing the insulation resistance and polarization index" (Page 47)

5.1.3 Testing the insulation resistance and polarization index



! WARNING

Hazardous voltage at the terminals

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

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

Measure the insulation resistance

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

Limit values for the stator winding insulation resistance

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

Table 5-1 Stator winding insulation resistance at 40° C

$V_N [V]$	$V_{Meas} [V]$	$R_C [M\Omega]$
$U \leq 1000$	500	≥ 5
$1000 \leq U \leq 2500$	500 (max. 1000)	100
$2500 < U \leq 5000$	1000 (max. 2500)	
$5000 < U \leq 12000$	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 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:

$$PI = R_{\text{insul } 10 \text{ min}} / R_{\text{insul } 1 \text{ min}}$$

Many measuring devices display these values automatically following the measurement.

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

$R_{(10 \text{ min})} / R_{(1 \text{ min})}$	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 147).
- 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 M Ω when measured at 500 V DC.

5.1.4 Preparing the mating faces

Prepare the foundation faces dependent on the machine type:

- Mounting on a foundation
 - Ensure that the foundation faces are flat and free of contaminations.
 - Check the dimensions of the mounting-foot holes.
- 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.

5.2 Lift the machine to where it will be installed, and position it**5.2.1 Preconditions for correct alignment and secure attachment**

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

- Preparing the foundation
- Selecting and mounting the coupling

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


- Measuring the concentricity and axial eccentricity tolerances
- Positioning the machine

If you are not familiar with the prescribed measures and procedures, then you can make use of the services offered by the local Service Center (Page 147).

5.2.2 Checking the load handling attachments

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

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

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

5.2.3 Removing the rotor shipping brace

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

Note

Store the rotor locking device

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

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

NOTICE
Removing the rotor shipping brace in the horizontal position. Dismantling the rotor shipping brace when the machine is in a horizontal position could damage the bearings. <ul style="list-style-type: none">• Only remove the rotor shipping brace when the machine is in a vertical position.

NOTICE
Turning the motor over without rotor shipping brace Failure to fit the rotor shipping brace can result in damage to the bearings while the machine is being turned onto its side. <ul style="list-style-type: none">• Fix the rotor in place before you turn the machine into a horizontal position.

5.2.5 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.

5.2.6 Mounting the output elements

Balance quality

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

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

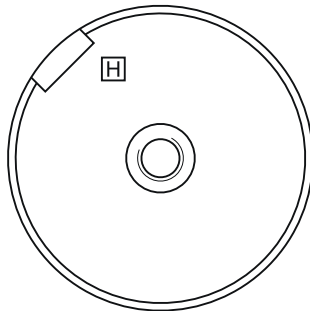


Figure 5-1 Balancing type on the drive-end side

Pushing on the power output elements

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


Shaft extensions with feather key

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

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

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

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

 WARNING
The feather key can fall out
The feather keys are only locked against falling out during shipping. If a machine with two shaft extensions does not have an output element on one shaft extension, the feather key can fall out during operation.
Death or serious injury can result.
<ul style="list-style-type: none">• If the machine is to be operated without output elements, secure the feather key on the free shaft extension so that it cannot be flung out.• To avoid imbalance, for balancing type "H", reduce the weight of the feather key to 60 % of the original weight.

5.2.7 Lifting and transporting the machine

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

- Personnel operating cranes and fork-lift trucks must be appropriately qualified.
- If the 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.

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

- When lifting the machine, use only approved and undamaged sling guides and spreaders of sufficient rated capacity. Check the lifting equipment prior to its use. The weight of the machine is shown on the rating plate.
- When lifting the machine, refer to the information on the lifting plate.
 - Comply with the specified spreading angles.
 - Do not exceed the maximum lifting acceleration and lifting speed specified on the lifting plate. Lift the machine without jerking it.
Acceleration $a \leq 0.4 \text{ g}$ ($\approx 4 \text{ m/s}^2$)
Velocity $v \leq 20 \text{ m/min}$

 **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.

Note

Place the machine in a secure and raised position

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

 **DANGER**

Standing under suspended loads

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

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

5.2.8 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.

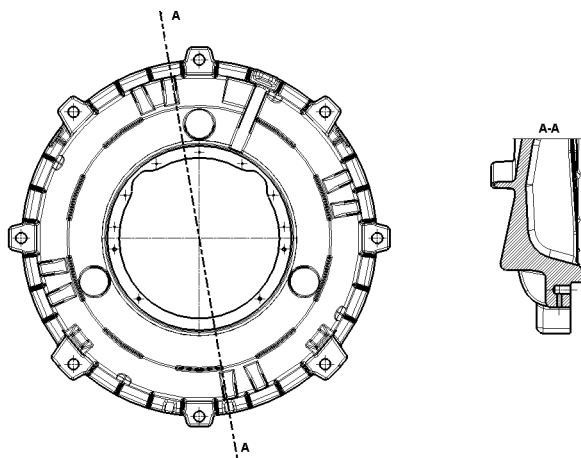


Figure 5-2 Schematic diagram of the water drain holes

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

NOTICE

The degree of protection is reduced

Nominally the degree of protection of the machine is reduced to IP44 when the screw plug is removed.

5.2.9 Putting the machine down

Requirements

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

- The mating faces must be clean.
- The anti-corrosion protection paint has been removed from the mating faces, such as the machine mounting feet, flange, ...
- There is no condensation present within the machine.

Setting down the machine

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

See also

Draining condensation (Page 55)

5.2.10 Roughly aligning the machine

Requirement


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


Roughly aligning the machine

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

5.3 Installing the machine

5.3.1 Safety instructions for installation

 WARNING
Inappropriate fastening material
<p>If screws of an incorrect property class have been selected or if they have been fastened to an incorrect tightening torque, they may break or become loose. This will cause the machine to move, which could damage the bearings. The rotor could smash into the machine enclosure and machine parts could be flung out of place. This can result in death, serious injury or material damage.</p>
<ul style="list-style-type: none">• Comply with the required property classes for screwed connections.• Tighten the screwed connections to the specified tightening torques.

 WARNING
Incorrect alignment
<p>If the machine has not been properly aligned, this will mean the fastening parts are subjected to stress/distortion. Screws may become loose or break, the machine will move, machine parts could be flung out of place. This can result in death, serious injury or material damage.</p>
<ul style="list-style-type: none">• Carefully align the machine to the driven machine.

NOTICE
Improper handling
<p>Mounting parts such as temperature sensors or speed sensors are attached to the machine and could be ripped off or destroyed as a result of improper handling. This could lead to machine malfunctions, extending even to total loss of the machine.</p>
<ul style="list-style-type: none">• Where necessary, use suitable steps when performing installation work on the machine.• Do not stand on cables or attachments during installation. Do not use attachments as steps.

5.3.2 Selecting fixing screws

- Unless specified otherwise, use mounting bolts with at least strength class 8.8 to ISO 898-1. In this way you guarantee that the machine is securely mounted and the forces can be transferred through the torque.
- Take into account the maximum forces occurring in the case of a fault such as short circuit or system transfers in phase opposition.
 - When selecting the bolts
 - When designing the foundation

See also

Tightening torques for screw and bolt connections (Page 149)

5.3.3 Preconditions for smooth, vibration-free operation

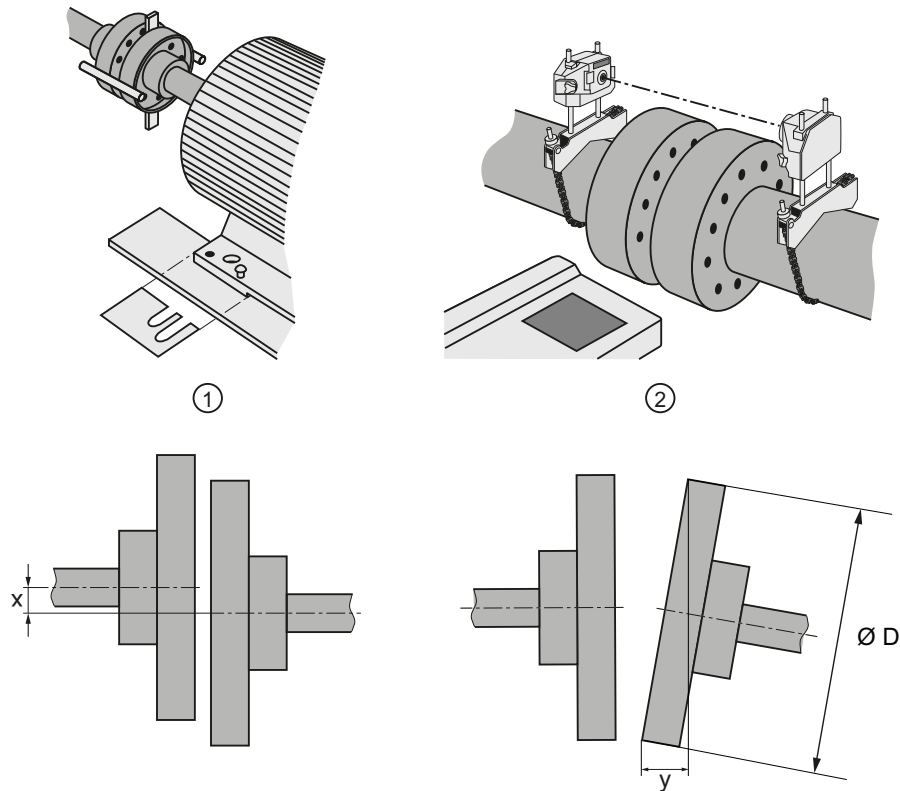
Preconditions for smooth, vibration-free operation:

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

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

1. Refer to any instructions for aligning the driven machine and those of the coupling manufacturer.
2. Align the machines with coupling output to the driven machine in such a manner that the center lines of the shafts at the operating temperature do not have any parallel or angular offset. This ensures that no additional forces affect their bearings during operation. If the thermal change of the motor and the driven machine is different, couple in the cold state with an appropriate alignment offset. The alignment offset to be set in the cold state must be determined and specified by the system specialist.
3. For the vertical positioning ($x \rightarrow 0$), 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 ($y \rightarrow 0$) is maintained around the coupling.
5. Fix the machine to the foundation. The choice of fixing elements depends on the foundation and is the plant operator's responsibility.



- ① Plates placed under the motor for alignment
- ② Laser alignment

Figure 5-3 Schematic diagram: Aligning the machine to the driven machine

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

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

Note

Machine expansion

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

5.3.5 Aligning the machine to the driven machine (high-speed version)

In the case of motors with high-speed design, the vertical positioning is achieved using the adjustment screws of the machine bearings. They can also be used to compensate for any settling that may take place. Please see the manufacturer's data sheet for information on tightening torque values.

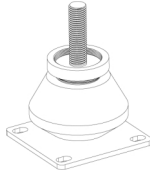


Figure 5-4 Machine bearing with adjustment screws

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

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

Note

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


Procedure

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

1. Grease the centering flange with assembly paste to make the process easier.
2. Screw three studs into tapped holes spaced about 120° apart around the driven machine flange. The studs act as positioning aids.
3. Position the machine so that its axis is aligned with that of the driven machine, but not yet quite touching. Advance the machine slowly towards the driven machine; advancing too quickly risks damaging the centering.
4. If necessary, rotate the machine into the right position so that the clearance holes in the flange are central to the tapped holes.
5. Move the machine fully up against the mating flange so that it is fully in contact.
6. Fix the machine using the flange fixing bolts, finishing by replacing the studs.

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
<p>Mechanical tensions</p> <p>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.</p> <p>This can result in death, serious injury or material damage.</p> <ul style="list-style-type: none"> • 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 149)

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

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

Note

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

Procedure

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

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

See also

Tightening torques for screw and bolt connections (Page 149)

Alignment accuracy

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

5.3.8 Axial and radial forces

You can obtain the permissible values for axial and radial forces by contacting the Siemens Service Center (Page 147) or referring to the machine catalog.

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

Electrical connection

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

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

See also

Safety information (Page 15)

Note

Service Center

If you require support when electrically connecting up the machine, please contact the Service Center (Page 147).

NOTICE

Connected parts can loosen

If you use fixing elements made from the wrong material or apply the wrong tightening torque, this could impair current transfer or cause connecting parts to become loose. This could result in material damage to the machine or even in total failure, which could in turn lead indirectly to material damage to the system.

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

See also

Tightening torques for screw and bolt connections (Page 149)

6.1 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.
- 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.

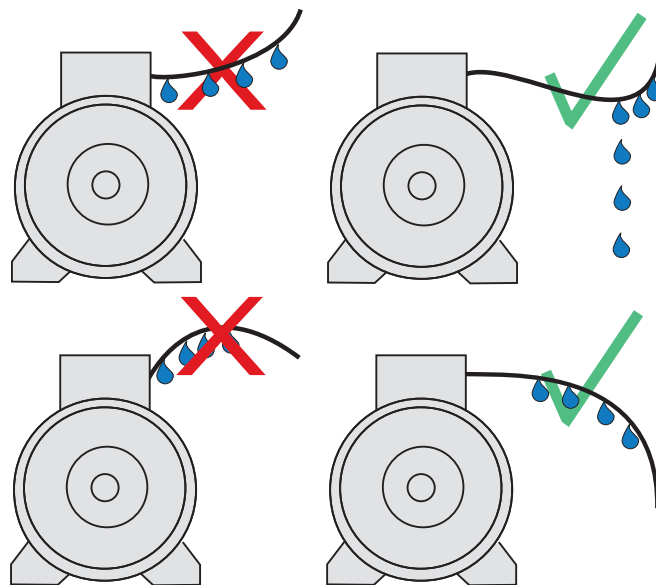


Figure 6-1 Water drip loop

6.2 Terminal box

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

Terminal box GT640 (Page 65)

Terminal box 1XB1621 (Page 65)

Terminal box 1XB1631 (Page 66)

Terminal box 1XB1634 (Page 67)

Terminal box 1XB9600 (Page 68)

6.2.1 Terminal box GT640

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

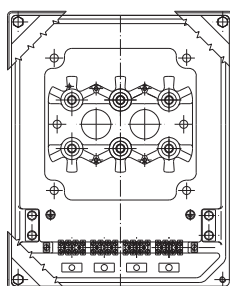


Figure 6-2 Terminal box GT640

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

You can find additional information here:

- Inserting the cable into the GT640 terminal box (Page 72)
- Connecting cables with cable lugs (Page 75)
- Connection without cable lugs (Page 76)

6.2.2 Terminal box 1XB1621

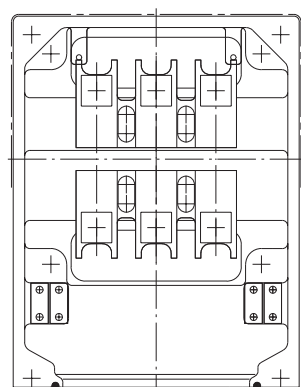


Figure 6-3 Terminal box 1XB1621

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

You can find additional information here:

- Inserting the cable into the 1XB16... terminal box with cable gland (Page 73)
- Inserting the cable into the 1XB.. terminal box with ring seal (Page 73)
- Connecting cables with cable lugs (Page 75)

6.2.3 Terminal box 1XB1631

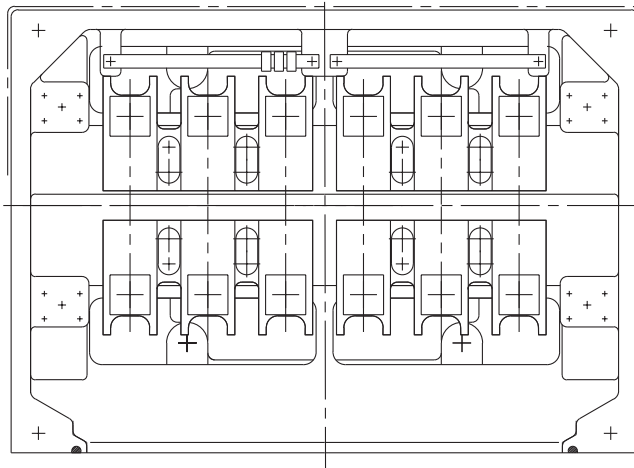


Figure 6-4 Terminal box 1XB1631

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

You can find additional information here:

- Inserting the cable into the 1XB16... terminal box with cable gland (Page 73)
- Inserting the cable into the 1XB.. terminal box with ring seal (Page 73)
- Connecting cables with cable lugs (Page 75)

6.2.4 Terminal box 1XB1634

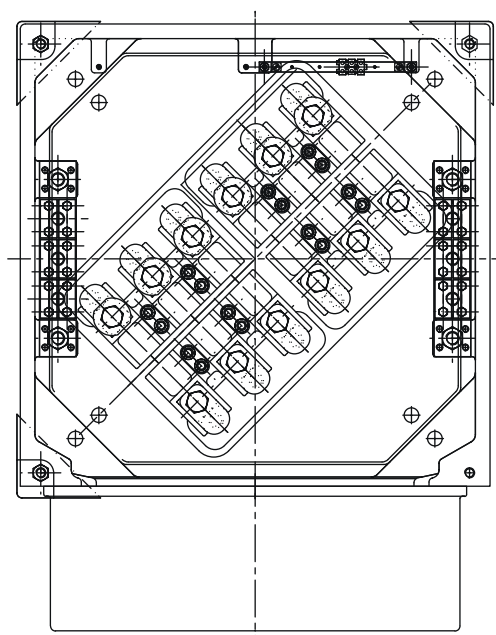


Figure 6-5 Terminal box 1XB1634

The connecting cables are introduced into the terminal box 1XB1634 through cable glands with threaded holes 4 x M80 x 2 and 2 x M25 x 1.5. The cable glands are not included in the standard scope of supply. The version with onion sealing ring is optional.

For more information, see:

- Inserting the cable into the 1XB16... terminal box with cable gland (Page 73)
- Inserting the cable into the 1XB.. terminal box with ring seal (Page 73)
- Connecting cables with cable lugs (Page 75)
- Connection without cable lugs (Page 76)

6.2.5 Terminal box 1XB9600

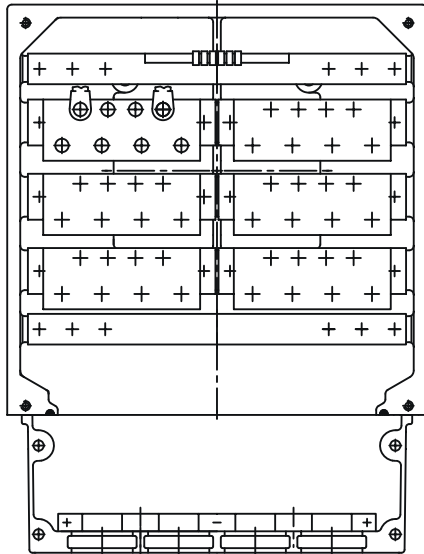


Figure 6-6 1XB9600 terminal box

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

You can find additional information here:

- Inserting the cable into the 1XB.. terminal box with ring seal (Page 73)
- Connecting cables with cable lugs (Page 75)

6.3 Preparation

6.3.1 Checking winding connections

With an open winding design, i.e. when the windings start and end directly at the terminal box (see the "Terminal marking" (Page 69) section), the connections are made using jumpers in the terminal box. The jumpers for the open connection must not be removed when testing the winding; refer to the relevant circuit diagram.

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

6.3.2 Terminal designation

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

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

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

6.3.3 Selecting cables

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

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

6.3.4 Connecting the grounding conductor

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

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

Phase conductor cross-section S [mm ²]	Cross-section of grounding conductor [mm ²]
S > 35	S/2

6.3 Preparation

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

- With stranded cables with cable lugs
- With flat cables with cable end designed accordingly

As an alternative, you can connect the grounding conductor without cable lugs using a terminal plate at the marked connection point.

Connecting the grounding conductor

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

	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

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

6.3.5 Radio-frequency grounding for converter operation

In converter operation, the converter emits RF alternating currents. To establish an 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.

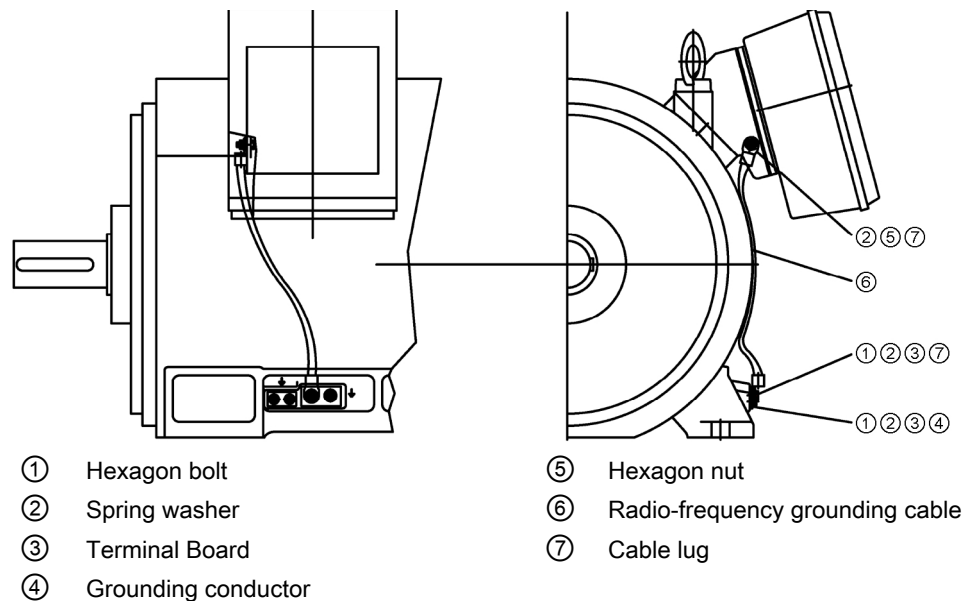


Figure 6-7 High-frequency grounding

You find further information in the "Operation with converter" section.

6.3.6 Connection without terminal box

If the machine was ordered without terminal box (where the cables are simply brought out of the motor), then the proper connection must be made in an external terminal box.

WARNING

Incorrect dimensioning

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

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

6.3.7 Connecting the machine for a specific direction of rotation

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

- If you connect the power cables in the phase sequence L1, L2, L3 to U, V, W, the resulting rotation will be clockwise.
- If you interchange two connections, e.g. L1, L2, L3 to W, V, U, the resulting rotation will be counter-clockwise.
- On machines which are only allowed to run in one direction, the rating plate shows an arrow which indicates the permitted direction of rotation, and it also specifies the terminal connections in the required phase sequence.

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

6.4 Introducing and routing the cables

Table 6-3 Connection technology (with cable lug / connection without cable lug)

Terminal box	Connection	
GT640	With cable lug (Page 75)	Without cable lug (Page 76)
1XB1621		
1XB1631		
1XB1634		
1XB9600		Connection without cable lug not possible

6.4.1 Inserting the cable into the GT640 terminal box

1. If necessary, disassemble the screw caps of the threaded holes at the underside of the terminal box.
2. Screw in suitable cable glands for the respective cable into the threaded holes.
3. Route the cable properly through the cable gland dependent on supply system or converter operation.

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

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

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

You can rotate the cable entry through 180°.

Table 6-4 Cable entry plate versions

Terminal box	Standard cable entry plate drilled with	Explosion-proof version
1XB1621	2 x M80 x 2 + 2 x M25 x 1.5	Undrilled
1XB1631	4 x M80 x 2 + 2 x M25 x 1.5	
1XB1634		
1XB9600	Onion ring only	-

Insert the cable into the terminal box

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

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

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

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

Table 6-5 Terminal boxes with onion sealing ring

Terminal box	Onion sealing ring
1XB9600	Standard design
1XB1621, 1XB1631, 1XB1634	Optional

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

Bringing cables into the terminal box and connecting them

The terminal box is opened, the cable cut to the correct length and stripped back. Make sure that no external forces are acting on the cable connection.

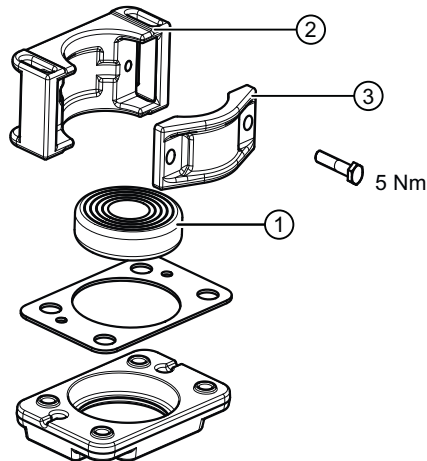


Figure 6-8 Strain relief device and sealing insert

1. Remove the top part of the strain relief ③ and release the fixing screws for the bottom part of the strain relief ②. The strain relief device can be located either in the terminal box or externally. If necessary, switch the direction sense of the strain relief device.
2. Cut the seal insert ① so that its opening is 1 to 3 mm smaller than the diameter of the cable.
3. Pull the sealing insert over the end of the cable.
4. Prepare the end of the cable depending on the cable and its use, e. g. with a cable lug.
5. Connect the ends of the cables to the terminals in accordance with the circuit diagram. The circuit diagram is located in the cover of the terminal box. Refer to the "Connecting cables..." section for more information.
6. You might need to use a sleeve made of suitable sealing tape to modify the diameter where it passes through the sealing insert. Push the sealing insert onto the prepared sleeve.
7. Insert the cable with the seal insert in position into the gland opening. Screw the strain relief device together once the cable is in a concentric position in the gland opening.
8. Secure the strain relief device.

9. Tighten the clamping screws of the strain relief device so that the cable is clamped as necessary, but do not damage the cable insulation. We recommend a torque of 5 Nm.
10. Retighten the clamping screws after 24 hours.

 WARNING
--

Clamping screws for the strain relief clip

Tightening the strain relief clip clamping screws too tightly can damage the insulation. This can cause a voltage flashover. This can result in death, serious injury, or material damage.
--

- | |
|---|
| <ul style="list-style-type: none">• Tighten the strain relief clip clamping screws to the specified torque. |
|---|

6.4.4 Laying cables

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

6.4.5 Connecting cables with cable lugs

1. Select the cable lugs according to the required cable cross-section and fixing screw or stud size. Information about the maximum cross-section for the respective standard terminal box design can be found in the catalog.
A sloped/angular arrangement of the supply cables is only permitted provided the required minimum air clearances are met.
2. Remove the insulation from the conductor ends so that the remaining insulation reaches almost up to the cable lug ①. Connect only one conductor per cable lug.

6.4 Introducing and routing the cables

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

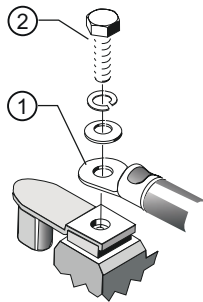


Figure 6-9 Connection with cable lug and fixing screw (schematic diagram)

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 terminal boxes 1XB7740 and 1XB7750, 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

6.4.6 Connection without cable lugs

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

NOTICE

Overheating of the conductor ends

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

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

Procedure

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

1. Open the terminal box and cut the cable to the correct length.
2. Prepare the end of the cable depending on the cable and its use. Make sure that no external forces are acting on the cable connection.
3. Insulate the conductor ends in such a way that the remaining insulation reaches almost up to the cable lug.
4. Make sure the terminal clamps ③, ④ are arranged correctly for the size of the conductor. Insert the cable into the terminal clamps. Tighten the clamping nuts ⑤ to a tightening torque of 8 Nm.
5. If you have loosened the terminal body clamping bolts ②, then retighten them to a torque of 40 Nm.

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

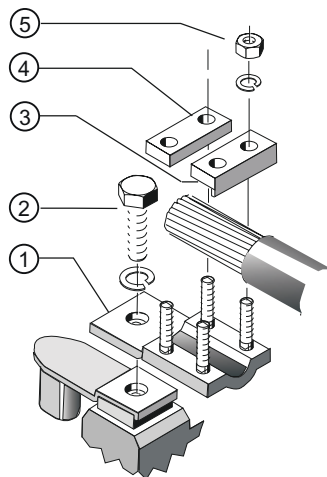


Figure 6-10 Connection using terminal clamps (schematic diagram)

6.4.7 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.

6.4.8 Using single-stranded cables

NOTICE

High temperatures from induced eddy currents

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

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

6.4.9 Internal equipotential bonding

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

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

A special external ground conductor is only installed if, for example, flat seals are mounted without additional support.

When performing any installation work, you must always take care to ensure that all equipotential bonding measures remain effective.

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

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

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

6.4.11 Minimum air clearances

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

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

Rms value of the alternating voltage V_{rms}	Minimum air clearance
$\leq 500 \text{ V}$	8 mm
$\leq 630 \text{ V}$	10 mm
$\leq 800 \text{ V}$	12 mm
$\leq 1000 \text{ V}$	14 mm
$\leq 1250 \text{ V}$	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.

6.4.12 Finishing connection work

1. Before closing the terminal box, please check that:
 - The electrical connections in the terminal box have been made in accordance with the specifications above and tightened with the correct tightening torque.
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 149)

6.5 Connecting the auxiliary circuits

6.5.1 Selecting cables

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

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

6.5.2 Bringing cables into the auxiliary terminal box and routing them

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

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

Adapting the cable glands

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

1. Open the auxiliary terminal box and undo the cable entry plate screws. Depending on the terminal box version, the cable entry plate is below a steel screening plate.
2. For the undrilled version, drill the required number of holes or threads in the required size of the cable gland into the cable entry plate.
3. Mark the cables if necessary for subsequent assignment.
4. Pull the cables through the cable glands and the cable entry plate, and connect the cables.
5. Fit the cable entry plate.
6. Make sure that the seal on the screwed sockets for the cable glands satisfies the degree of protection.

See also

Tightening torques for screw and bolt connections (Page 149)

Spare parts (Page 125)

6.5.3 Connecting temperature monitoring for the stator winding

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".

6.5.4 Connecting an external fan motor

Connect the separate fan motor in accordance with the associated terminal connection diagram located in the external fan terminal box and in accordance with any data provided on rating plates.

1. When working on the external fan motor, refer to the operating instructions.
2. Check:
 - The line voltage and line frequency match the details on the rating plate;
 - the cross-sections of the designated connecting cables are matched to the rated current of the motor (with due consideration for the relevant installation directives).
3. Connect the protective conductor to the protective conductor terminal.
4. Establish the other electrical connections as per the circuit diagram.
5. If the separate fan is supplied with a connector already attached, check whether the pin allocation of the connector matches the pin allocation of the socket.
6. Complete the work at the external fan terminal box. For this, proceed as described in the "Completing connection work in the auxiliary terminal box" (Page 83) section.

Check direction of rotation

The direction of rotation of the external fan must match the arrow indicating the direction of rotation. The fan impeller is visible through the air inlet opening in the fan cover on the external fan motor.

- If the direction of rotation is wrong, then interchange two line cables in the external fan motor terminal box.

See also

Interlock circuit for the external fan motor (Page 27)

NOTICE
Inadequate cooling
The external fan guarantees that the motor is cooled irrespective of the motor speed or direction of rotation. If the direction of rotation of the external fan is incorrect, the machine will not be sufficiently cooled.
Switch two line conductors in the terminal box of the external fan motor. The direction of rotation information is located on the hood of the external fan.

6.5.5 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 149)" for the tightening torque of the fixing bolts for the cover.

Start-up

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

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

See also

Safety information (Page 15)

7.1 Checks to be carried out prior to commissioning

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

Note

Checks to be carried out prior to commissioning

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

- The machine is undamaged.
- The machine has been correctly installed and aligned, the transmission elements are correctly balanced and adjusted.
- All fixing screws, connection elements, and electrical connections have been tightened to the specified tightening torques.
- The operating conditions match the data provided in accordance with the technical documentation, such as degree of protection, ambient temperature, etc..
- Moving parts such as the coupling move freely.
- All touch protection measures for moving and live parts have been taken.
- For test operation or when commissioning **without output element**, carefully secure the feather key using a suitable security element. When doing this, take into account the balancing type of the motor.

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.

Cooling

- Check that the machine cooling is available for commissioning.

Electrical connection

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

See also

Set values for monitoring the winding temperature (Page 90)

Setpoint values for monitoring the bearing temperature (Page 90)

7.2 Converter operation

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

Note

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

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.

7.2.1 Operation on a converter with a low pulse frequency**NOTICE****Increased motor temperature**

If the pulse frequency is less than the rated pulse frequency, then increased motor losses occur. This results in a higher motor temperature.

- Reduce the power to prevent exceeding the temperature class and to avoid consequential premature thermal aging of the insulation.
- Contact the Service Center if necessary.

 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 15) are followed before working on the motor.

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

7.3 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 47)

7.4 Greasing the roller bearings prior to commissioning

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

General specifications

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

Regreasing the roller bearings prior to commissioning

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

Regreasing roller bearings before commissioning

You must regrease the roller bearings under the following conditions:

- If the machine has been in storage for more than four years.
- If the machine has not been stored in accordance with the specifications in the "Storage" section.

Procedure

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

See also

Types and quantities of grease for high-speed machines (Page 111)

Regreasing intervals and types of grease for operating roller bearings (Page 107)

Stoppages (Page 95)

Transport and storage (Page 31)

7.5 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.

7.6 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
Disconnecting during commissioning	120 °C

Normal operation

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

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

Set value	Temperature
Warning in normal operation	$T_{op} + 5 \text{ K} \leq 115 \text{ °C}$
Disconnection in normal operation	$T_{op} + 10 \text{ K} \leq 120 \text{ °C}$

See also

Thermal motor protection (Page 27)

7.7 Set values for monitoring the winding temperature

Prior to commissioning

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

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

Set value	Temperature
Shutdown	145 °C

Normal operation

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

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

Set value	Insulation class 155(F)	Insulation class 180(H)
Warning	$T_{\text{op}} + 10 \text{ K} \leq 145 \text{ °C}$	$T_{\text{op}} + 10 \text{ K} \leq 170 \text{ °C}$
Shutdown	$T_{\text{op}} + 15 \text{ K} \leq 155 \text{ °C}$	$T_{\text{op}} + 15 \text{ K} \leq 180 \text{ °C}$

7.8 Test run

After installation or inspection, carry out a test run:

1. Start up the machine without a load. To do this, close the circuit breaker and do not switch off prematurely. Check whether it is running smoothly.
Switching the machine off again while it is starting up and still running at slow speed should be kept to a bare minimum, for example for checking the direction of rotation or for checking in general.
Allow the machine to run down before switching it on again.
2. If the machine is running smoothly and evenly, switch on the cooling equipment. Continue to observe the machine for a while in no-load operation.
3. If it runs perfectly, connect a load.

NOTICE

Thermal overload of motors connected directly to the line supply

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

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

- Monitor the ramp-up time and number of consecutive starts.
- Comply with the limit values and/or ramp-up conditions specified in the catalog or the order documentation.

4. During the test run, check and document the following:
 - Check whether it is running smoothly.
 - Document the voltage, current and power values. As far as possible, document the corresponding values of the driven machine.
 - If this is possible using the available measuring equipment, check the bearing and stator winding temperatures until they have reached steady-state values.
 - Check the machine for noise or vibrations on the bearings or bearing shields as it runs.
5. In case of uneven running or abnormal noise, switch off the machine. As the machine runs down, identify the cause.
 - If the mechanical operation improves immediately after the machine is switched off, then the cause is magnetic or electrical.
 - If the mechanical running does not improve immediately after switching the machine off, then the cause is mechanical.
 - Imbalance of the electrical machine or the driven machine
 - The machine set has not been adequately aligned
 - The machine is being operated at the system resonance point. System = motor, base frame, foundation, ...

NOTICE
Serious damage to the machine
If the vibration values in operation are not maintained in accordance with DIN ISO 10816-3, then the machine can be mechanically destroyed.
<ul style="list-style-type: none">• During operation, observe the vibration values in accordance with DIN ISO 10816-3.

7.9

De-energizing

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

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


- Comply with the general safety instructions
- 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.

See also


Safety information (Page 15)

8.1 Safety guidelines in operation





 WARNING
<p>Live parts</p> <p>Terminal boxes accommodate live parts and components. If you open the terminal box cover, this can result in death, serious injury or material damage.</p> <ul style="list-style-type: none"> • When the machine is in operation, the terminal boxes must remain closed at all times. Terminal boxes may be opened only when the machine is stopped and de-energized.



 WARNING
<p>Rotating and live parts</p> <p>Rotating or live parts are dangerous. If you remove the required covers, this can result in death, serious injury or material damage.</p> <ul style="list-style-type: none"> • Any covers that prevent live electrical or rotating parts from being touched, ensure compliance with a particular degree of protection or are required for ensuring proper air flows, and hence effective cooling, must not be opened during operation.



 WARNING
<p>Fire hazard resulting from hot surfaces</p> <p>Certain parts of the machine become hot during operation. Severe burns can result from contact with these parts.</p> <ul style="list-style-type: none"> • Check the temperature of parts before touching them. If required, apply suitable protective measures. • Allow the machine to cool before starting work on the machine.

 WARNING
Faults in operation Deviations from normal operation such as increased power consumption, temperatures or vibrations, unusual noises or odors, tripping of monitoring devices, etc., indicate that the machine is not functioning properly. This can cause faults which can result in eventual or immediate death, serious injury or material damage. <ul style="list-style-type: none">• Immediately inform the maintenance personnel.• If you are in doubt, immediately switch off the motor, being sure to observe the system-specific safety conditions.

NOTICE
Risk of corrosion due to condensate Humid air can condense inside the machine during operation as a result of intermittent duty or load fluctuations. Condensate can collect inside the motor. Damage such as rust can result. <ul style="list-style-type: none">• Make sure that any condensation can drain away freely.

8.2 Switching off the anti-condensation heating

NOTICE
Excessive machine temperature If the anti-condensation heating is operated while the machine is running, this can increase the temperatures inside the machine. This can result in material damage. <ul style="list-style-type: none">• Make sure that the anti-condensation heating is switched off before the machine is switched on.• Only operate anti-condensation heating when the machine is switched off.

See also

Interlock circuit for anti-condensation heating (option) (Page 28)

De-energizing (Page 92)

8.3 Switching on the machine

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

NOTICE

Thermal overload of motors connected directly to the line supply

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

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

- Monitor the ramp-up time and number of consecutive starts.
- Comply with the limit values and/or ramp-up conditions specified in the catalog or the order documentation.

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

8.4 Regreasing roller bearings

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

8.5 Switch off the external fan

Do not immediately switch off the separately-driven (external) fan after switching off the machine. First wait for the machine to cool down. This will prevent the accumulation of residual heat.

8.6 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

8.7 Stoppages

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

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

NOTICE
Damage due to improper storage
Damage may occur to the motor if it is not stored properly.
If the machine is to be taken out of operation for more than 12 months, suitable anti-corrosion, preservation, packaging, and drying measures must be taken.

See also

Transport and storage (Page 31)

Start-up (Page 85)

8.7.1 Avoidance of condensation or formation of condensation within the machine

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

8.7.2 Avoidance of damage to roller bearings during stoppages

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

- During stoppages, regularly start the machine up for a brief period once a month. As a minimum, rotate 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 the machine up.
Make sure that the resting position of the roller bearings after the rotor has been turned over is different from what it previously had been. Use the fitted key or the coupling halves as reference markers.
- During re-commissioning, refer to the information in the "Commissioning" section.


See also

Start-up (Page 85)

Greasing the roller bearings prior to commissioning (Page 88)

8.7.3 Shaft grounding brushes (option)

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

 WARNING
Live parts
If the shaft grounding does not function correctly, the shaft can be at a high voltage level that does not decay quickly enough when the machine comes to a standstill. This can lead to death or serious injury as a result of electric shock, or bearing damage caused by current flowing through the bearing.
<ul style="list-style-type: none">• Regularly inspect the shaft grounding brushes and replace them if necessary.• Keep the brushes' running surface clean: Regularly inspect the brushes' running surface and remove any rust before starting the machine up.

8.7.4 Measurement of the insulation resistance after an extended stoppage

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

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

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

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

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

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

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

"Testing the insulation resistance and polarization index" (Page 47)

8.8 Decommissioning the machine

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

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

8.9 Re-commissioning the machine

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

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

See also

Start-up (Page 85)

8.10 faults

8.10.1 Inspections in the event of faults

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

Immediately perform an inspection after such faults.

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

8.10.2 Electrical faults

Note

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

Table 8-1 Electrical faults

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

8.10.3 Mechanical faults

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

Table 8-2 Mechanical faults

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

[Ⓢ] Note any changes taking place during warm up

8.10.4 Faults at the external fan

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

Table 8-3 Cooling system faults

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

See also

Connecting an external fan motor (Page 82)

8.10.5 Roller bearing faults

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

Table 8-4 Roller bearing faults

↓ Bearing overheats			
↓ Bearing "whistles"			
↓ Bearing "knocks"			
		Possible causes of faults	Remedial measures
X		High coupling pressure	Align the machine more accurately.
X		Belt tension too high	Reduce the drive belt tension.
X		Bearing contaminated	Clean 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	Properly install the bearing.
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

Maintenance

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

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

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

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

See also

Safety information (Page 15)


Note


Service Center


Please contact the Service Center (Page 147), if you require support with servicing, maintenance or repair.

9.1 Inspection and maintenance

9.1.1 Safety instructions for inspection and maintenance

 WARNING
<p>Rotating and live parts</p> <p>Electric machines contain live and rotating parts. Fatal or serious injuries and substantial material damage can occur if maintenance work is performed on the machine when it is not stopped or not de-energized.</p> <ul style="list-style-type: none"> • Perform maintenance work on the machine only when it is stopped. The only operation permissible while the machine is rotating is regreasing the roller bearings. • When performing maintenance work, comply with the five safety rules (Page 15).

 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. <ul style="list-style-type: none">• When carrying out maintenance work, make sure that no foreign bodies are left in or on the machine.• Securely attach all loose parts again once you have completed the maintenance procedures.• Carefully remove any dirt.

Note

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

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

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

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

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

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

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

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

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

"Testing the insulation resistance and polarization index" (Page 47)

9.1.3 Inspections in the event of faults

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

Immediately perform an inspection after such faults.

9.1.4 First inspection after installation or repair

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

Table 9-1 Checks after assembly or repair

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

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

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

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

9.1.5 General inspection

Check that the installation conditions are observed. After approximately 16,000 operating hours – or the latest after two years – we recommend that the following checks are performed:

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

Checking	When the motor is running	At standstill
The electrical parameters are maintained	X	
The permissible bearing temperatures are not exceeded	X	
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 (Page 90)		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.

See also

Setpoint values for monitoring the bearing temperature (Page 90)

9.1.6 Servicing the roller bearings

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

9.1.7 Servicing and maintaining the anti-condensation heating

The anti-condensation heating is maintenance-free. If it is defective, contact the Service Center (Page 147).

9.1.8 Regreasing intervals and types of grease for operating roller bearings

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

Initial lubrication

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

Grease selection criteria

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

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

The lubricating grease must satisfy the criteria listed in the table below and must match the operating conditions. 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	<ul style="list-style-type: none"> "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	<ul style="list-style-type: none"> Approx. 100 mm²/s at 40 °C Approx. 10 mm²/s at 100 °C 	mm ² /s

9.1 Inspection and maintenance

Criteria	Standard	Property, characteristic value	Unit
Additives	-	<ul style="list-style-type: none"> • Anti-Oxidation (AO), Anti-Wear (AW) • No solid lubricants • Alternatively: Extreme-pressure (EP) only after prior consultation with grease and bearing manufacturers 	-
FE9 test: A/1500/6000	DIN 51821-1/-2	F10 ≥50 h at +130 °C F50 ≥100 h at +130 °C	H
Behavior in the presence of water	DIN 51807	0 or 1 at a test temperature of +90° C	-
Corrosive effect on copper	DIN 51811	0 or 1 at a test temperature of +120° C	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

Manufacturer	Grease type
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 ($n_{\min} = 250 \text{ rpm}$, $n_{\max} = 3600 \text{ rpm}$) to ensure an even distribution of grease.



WARNING

Rotating components

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

- When regreasing, pay attention to all rotating components.

2. Clean the grease 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.

9.1.9 Types and quantities of grease for high-speed machines

For high-speed machines, only the types of grease specified on the lubricant plate are permitted. The following grease types have been tested and are suitable.

- Lubcon Sintono GPE 702

First lubrication after changing the bearings

1. For every first lubrication, fill the bearing with the amount of grease specified.

Bearing version	Grease quantities for initial lubrication
6218	30 g
6220	40 g

Grease quantities per bearing for initial lubrication

2. Distribute the lubricant by running the machine systematically at different speeds. This prevents the bearings from become hot too quickly.
 - Level 1: 10 min at $0.8 \cdot n_{\max}$
 - Level 2: 10 min at n_{\max}

9.1.10 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.

9.1.11 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.

9.1.12 Servicing the external fan



 WARNING
Rotating or live parts
Live electrical parts are dangerous. Contact with them can cause death, serious injury or material damage.
Before carrying out any maintenance work on the external fan, disconnect it from the mains, particularly before opening the terminal box. Make sure that the device cannot be switched back on.

Servicing the external fan

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

- Remove the dirt and dust deposits regularly; the intervals depend on how dirty the surrounding area is.
- Make sure that the impeller is cleaned evenly, as irregular deposits can lead to an imbalance.
- The full air discharge rate is only achieved if the inward flow to the impeller is unrestricted.
- Therefore, a clearance of at least 1 x inlet diameter must be provided in the axial direction.
- An unbroken uniform gap must be maintained between the impeller and the inlet nozzle.

Servicing the external fan motor

- Perform an occasional visual inspection of the external fan motor and check it electrically and mechanically every time the roller bearings are replaced.
- Replace the permanently lubricated rolling bearing on the external fan motor after 40,000 operating hours or five years at the latest.

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


9.1.14 Maintaining terminal boxes

Requirement

The machine is de-energized.

Checking the terminal box

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

 WARNING
Short-circuit hazard
Damaged components can cause short circuits, possibly resulting in death, serious injuries and property damage.
Replace damaged components.

9.2 Corrective Maintenance

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

Note

If the motor has to be transported, please observe the information and instructions in the "Transport" (Page 32) section.

9.2.1 Prepare servicing work

- The drawings and parts lists do not contain any detailed information about the type and dimensions of fixing elements and components. For this reason, you should establish this information when dismantling them and make a note of it for the purpose of reassembly.
- Document the type, dimensions and arrangement of the parts so that you will be able to reassemble the machine to its original state.
- Use suitable tools to disassemble the machine.

- Take measures to prevent parts from dropping down before you dismantle them, e.g. by replacing fastening elements with extra-long screws, threaded bolts or similar. This ensures that the part is supported after it is pulled off.
- The centerings in the shaft extensions have reset threads. Use lifting gear which is suitable for the rotor weight and direction of loading.

 **WARNING**

Rotor can fall down

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

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

 **WARNING**

Machine damage caused by improper repair work

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

- Properly assemble or disassemble the machine.
- Use only suitable tools and equipment.
- Immediately replace damaged components.
- Contact the Service Center (Page 147), if necessary.

 **WARNING**

Rotor can fall out

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

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

9.2.2 Seal the motor

Extreme caution and attention to cleanliness are vital to installation.

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

9.2.3 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.

9.2.4 External fan cowl

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.

9.2.5 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.

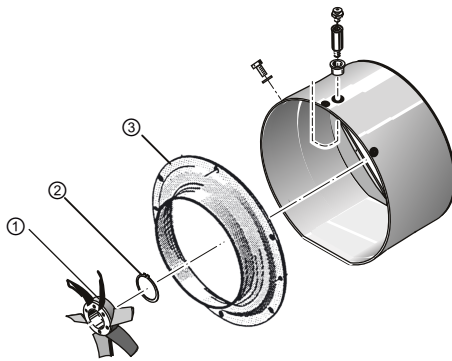


Figure 9-1 Ventilation (schematic diagram with axial fan)

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.

9.2.6 Internal fan

The internal fan is located on the rotor inside the machine. If the internal fan is defective or must be replaced, please contact the Service Center (Page 147).

9.2.7 External fan

If the external fan is defective, contact the Service Center (Page 147).

9.2.8 Ensuring cooling by means of external fans

- Ensure that an unbroken uniform gap of at least 2 mm is maintained between the fan impeller and the inlet nozzle.
- Pay attention to the central alignment of the nozzle to the fan impeller.

9.2.9 Roller-contact bearings

9.2.9.1 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
External fan cowl (Page 115)
 - Remove the external fan.
External fan made of metal (Page 116)
External fan made of plastic

Note

For a schematic diagram of the respective component layout, see the chapter "Spare parts (Page 125)".

Procedure

1. Remove the bearing mounting components.
 - Remove the outer bearing cover if one is being used.
Remove V ring (Page 118).
Removing the labyrinth sealing ring (Page 119).
 - Ensure that the inner bearing cover is no longer attached to the bearing housing or end shield.
 - Support the rotor for the removal of bearing housing or end shield.
 - If necessary, remove the bearing housing from the end shield.
 - Remove the end shield. Depending on the shaft height, roller bearing type and design, it is either a bearing head version or a bearing housing version.
 - Remove the locking ring from the shaft.
2. Pull off the roller bearing together with the grease slinger.

9.2.9.2 Remove V ring

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

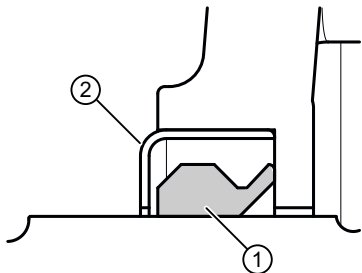


Figure 9-2 Remove the V ring

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 degree of protection IP56 (non-heavy-sea)

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

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

See also

Install the V ring (Page 121)

9.2.9.3 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 separately secured with adhesive such as Loctite 243.

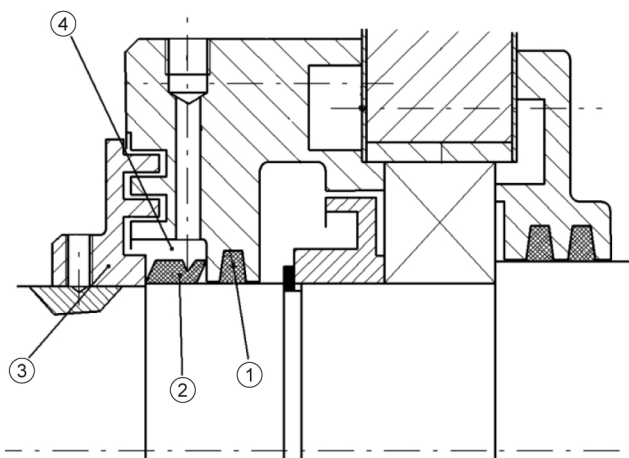


Figure 9-3 Disassembling the labyrinth sealing ring (schematic diagram)

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 122)

9.2.9.4 Assembling the rolling-contact bearings

- Extreme caution and attention to cleanliness are vital to installation. Observe the correct assembly sequence of the components.
- Attach all components with the specified tightening torques (Page 149).

Note

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

Procedure

1. Remove the required components and replace damaged components.
2. Remove any dirt from the components. Remove any grease and the remains of sealant or liquid threadlocker.
3. Prepare the bearing journals:
 - Lightly oil the inner ring seat.
 - Grease the outer ring seat with solid lubricant such as the anti-fretting paste Altemp Q NP 50.
4. Warm up the roller bearing.
5. Push the inner ring of the warmed up roller bearing onto the shaft. Avoid any blows that might damage the bearing.
6. Make sure that the roller bearing is resting against the shaft shoulder or the second bearing. Otherwise, axial vibrations may occur.
7. Fill the bearing to the top with the specified lubricating grease.
8. Warm up the grease slinger and push it onto the shaft.
9. Locate the locking ring in the shaft groove or attach the bearing using the shaft nut or a set screw, depending on the particular version.
10. Support the rotor for the installation of bearing housing or end shield.
11. Grease the bearing locations (bearing shield/bearing cartridge) with solid lubricant such as the anti-fretting paste Altemp Q NP 50.
12. Use a suitable sealant when assembling.
13. Install the bearing shield or bearing housing together with the bearing shield.
14. Install the outer bearing cover if one is being used.
15. Install the sealing elements:
 - If present: V ring (Page 121)
 - Labyrinth sealing ring (special design) (Page 122)

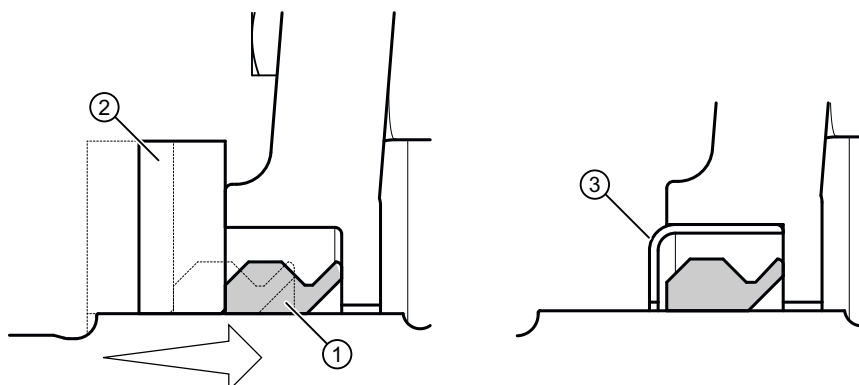
9.2.9.5 Install the V ring

Requirement

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

Install the V ring

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



- ① V ring
- ② Mounting aid washer
- ③ Protective ring

Figure 9-4 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 degree of protection IP56 (non-heavy-sea)

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

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

9.2.9.6 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.

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.

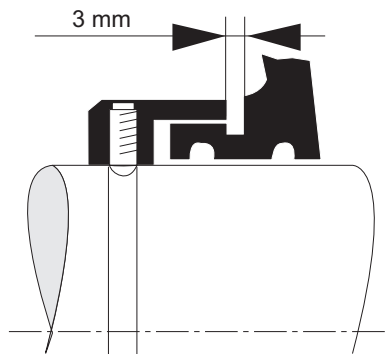


Figure 9-6 Position the set screws for the labyrinth sealing ring on the outer bearing cover

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

10.1 Ordering data

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

Example

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

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

Note

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

10.2 Using commercially available spare parts

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

10.3 Ordering spare parts via the Internet



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/>).

See also

Guide for Spares on Web (<http://support.automation.siemens.com/WW/news/en/25248626>)

Rolling bearings

When ordering rolling 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.

Always replace the rolling bearings with the identical bearings.

If insulated rolling bearings are fitted, use insulated rolling bearings of the same type as spare parts. This will prevent any bearing damage being caused by bearing currents.

10.4 Anti-condensation heating

The anti-condensation heater is mounted directly on the winding. The anti-condensation heater cannot be removed without causing damage to the winding. A new anti-condensation heater may only be installed by Siemens Service Center (Page 147) specialists.

10.5 Stator and rotor

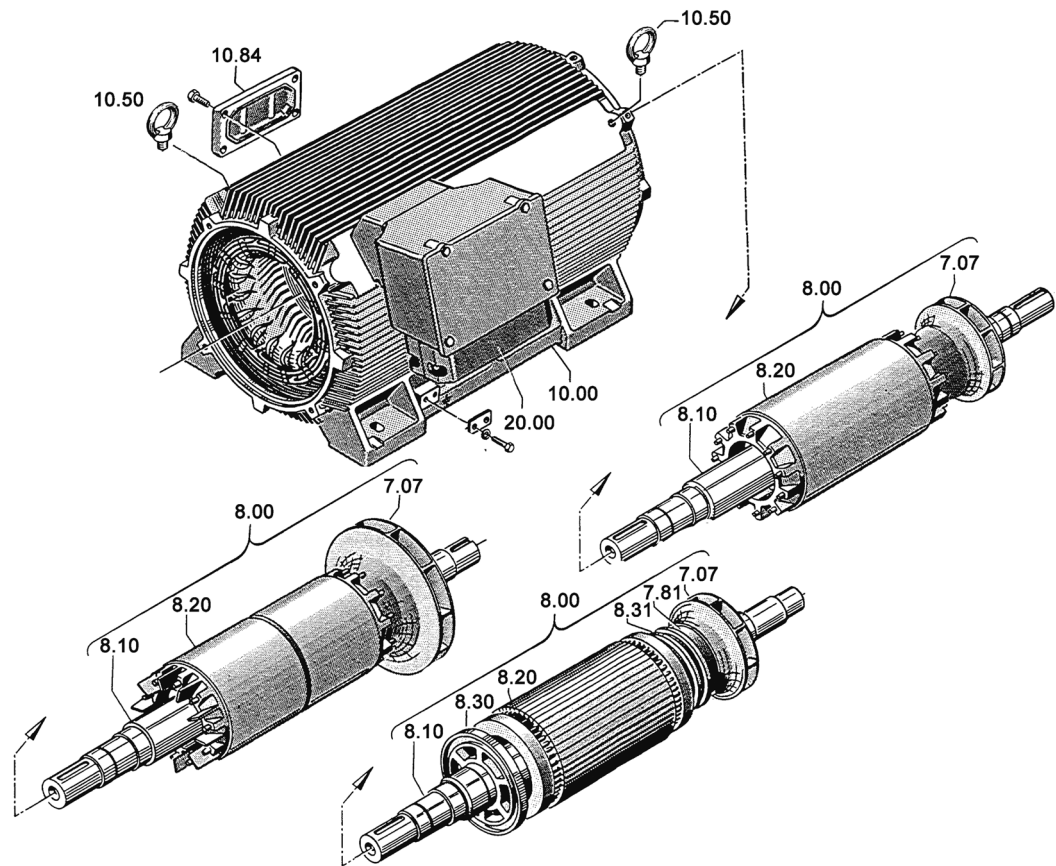


Figure 10-1 Stator and rotor

Table 10-1 Spare parts for stators and rotors

Part	Description	Part	Description
7.07	Internal fan	8.31	Non-drive end balancing ring
7.81	Air guide insert	10.00	Stator frame with laminated core and winding
8.00	Rotor, complete	10.50	Lifting lug
8.10	Shaft	10.84	Cover with seal
8.20	Rotor core with winding	20.00	Terminal box
8.30	Drive-end balancing ring		

10.6 Stator and rotor (high-speed version)

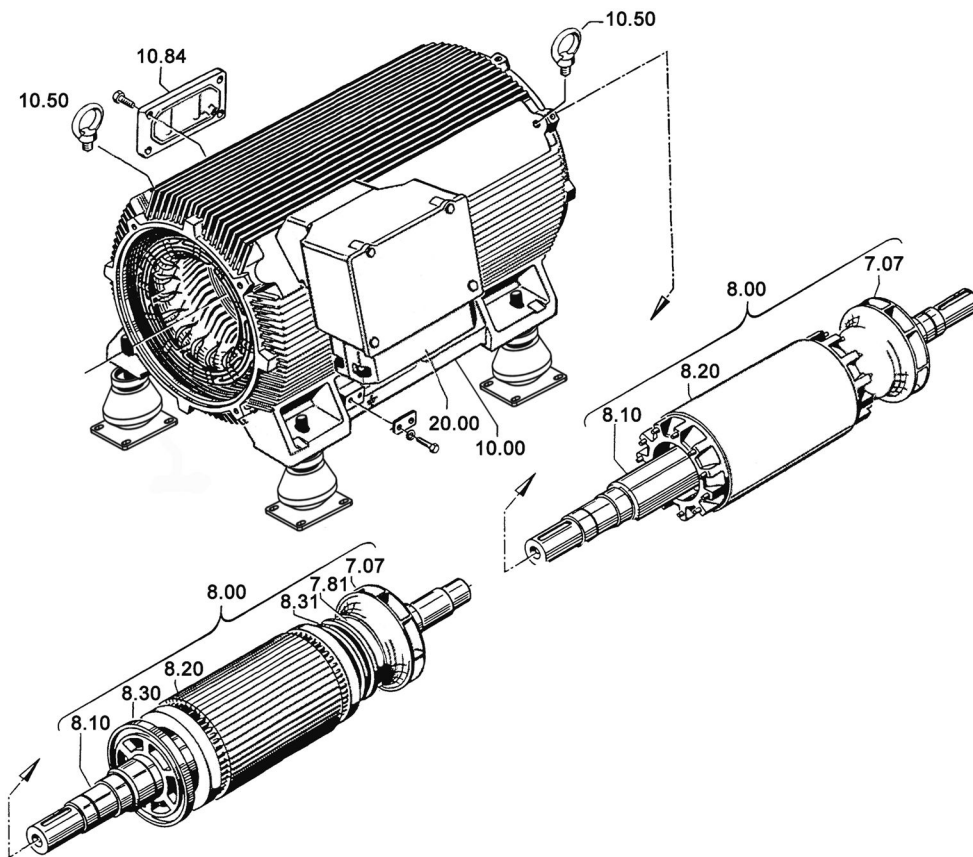


Figure 10-2 Stator and rotor

Table 10-2 Spare parts for stators and rotors

Part	Description	Part	Description
7.07	Internal fan	8.31	Non-drive end balancing ring
7.81	Air guide insert	10.00	Stator frame with laminated core and winding
8.00	Rotor, complete	10.50	Lifting lugs
8.10	Shaft	10.84	Cover with seal
8.20	Rotor core with winding	20.00	Terminal box
8.30	Drive-end balancing ring		

10.7 External fan

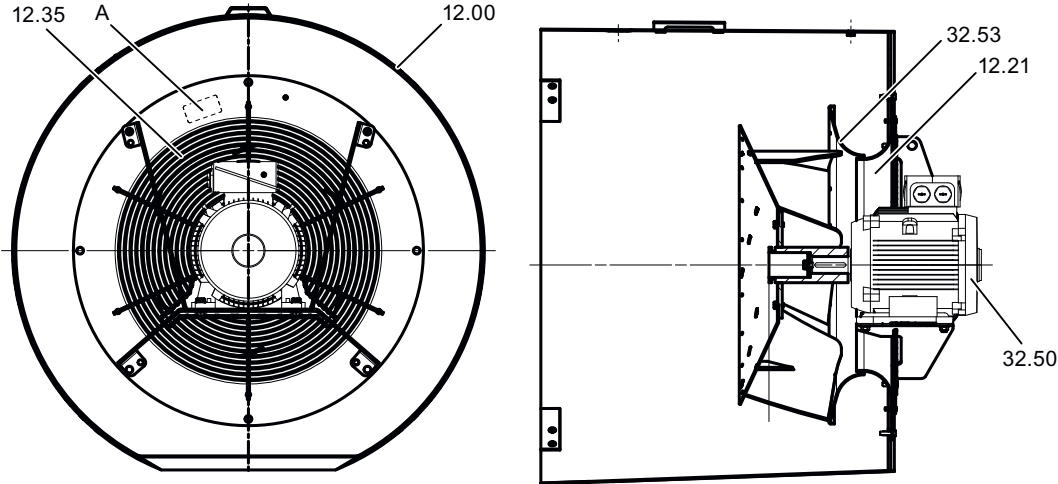


Figure 10-3 Fan cowl with external fan

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

10.8 Drive end rolling-contact bearings with bearing housing

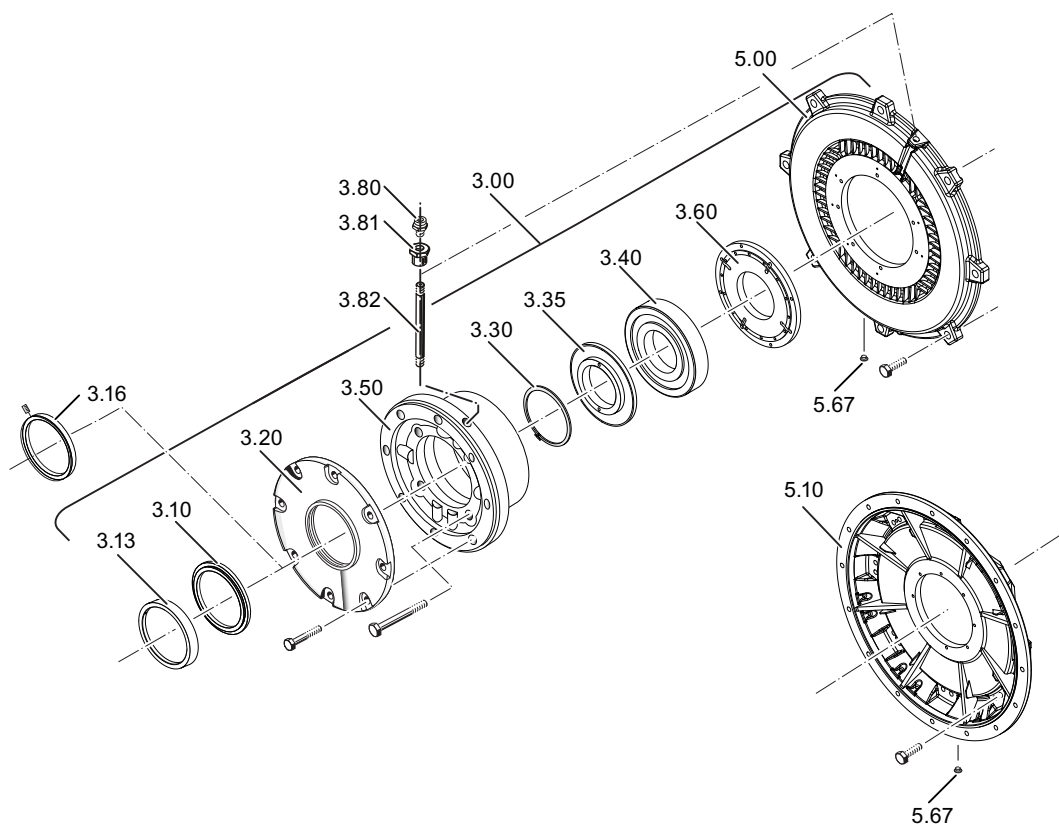


Figure 10-4 Drive end roller bearings with bearing housing

Table 10-4 Spare parts for drive end roller bearings with bearing housing

Part	Description	Part	Description
3.00	Roller bearing cartridge (locating bearing)	3.50	Bearing housing
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	End shield, design B3
3.35	Grease slinger	5.10	Flanged end shield
3.40	Deep-groove ball bearing (locating bearing)	5.67	Sealing plug

10.9 Drive end rolling-contact bearings without bearing housing

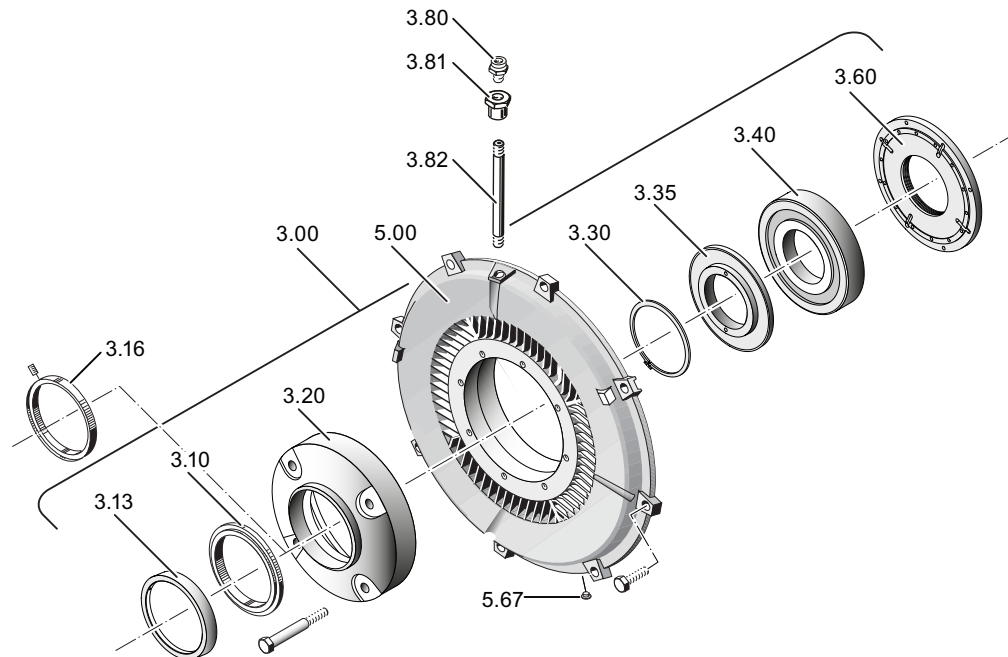


Figure 10-5 Drive end roller bearings without bearing housing

Table 10-5 Spare parts for drive end roller bearings without bearing housing

Part	Description	Part	Description
3.00	Roller bearing cartridge (locating bearing)	3.50	Bearing housing
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	End shield
3.35	Grease slinger	5.67	Sealing plugs
3.40	Deep-groove ball bearing (locating bearing)		

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

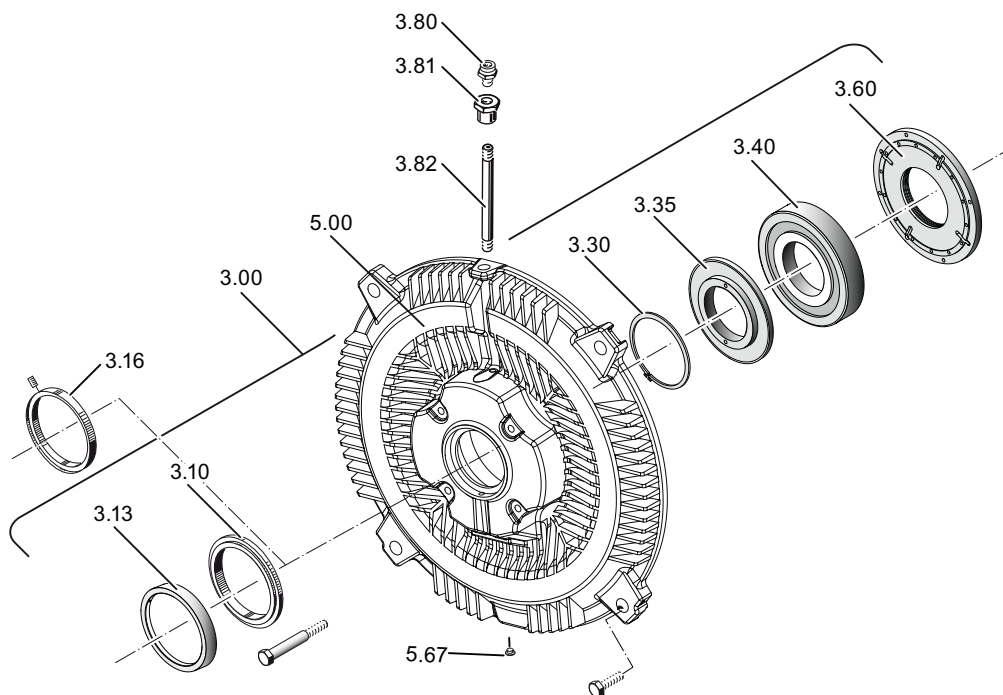


Figure 10-6 Roller bearings, DE - end shield with integrated bearing cover

Table 10-6 Spare parts for roller bearings, DE

Part	Description	Part	Description
3.00	Roller bearing cartridge (locating bearing)	3.50	Bearing housing
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

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

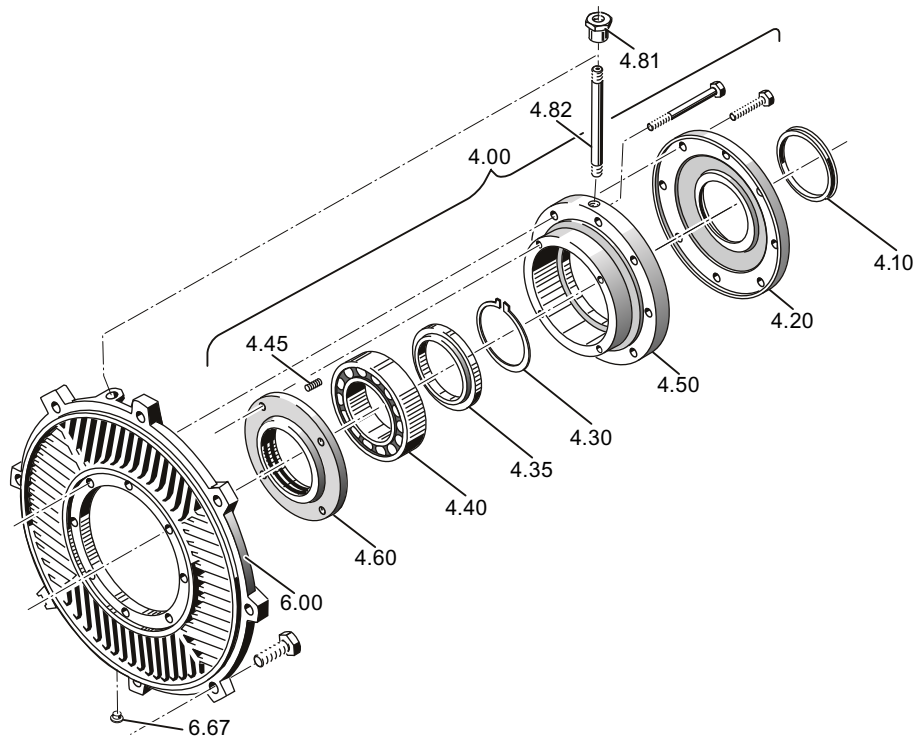


Figure 10-7 Non-drive end roller bearings with bearing housing

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

Part	Description	Part	Description
4.00	Roller bearing cartridge (floating bearing)	4.50	Bearing housing
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		

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

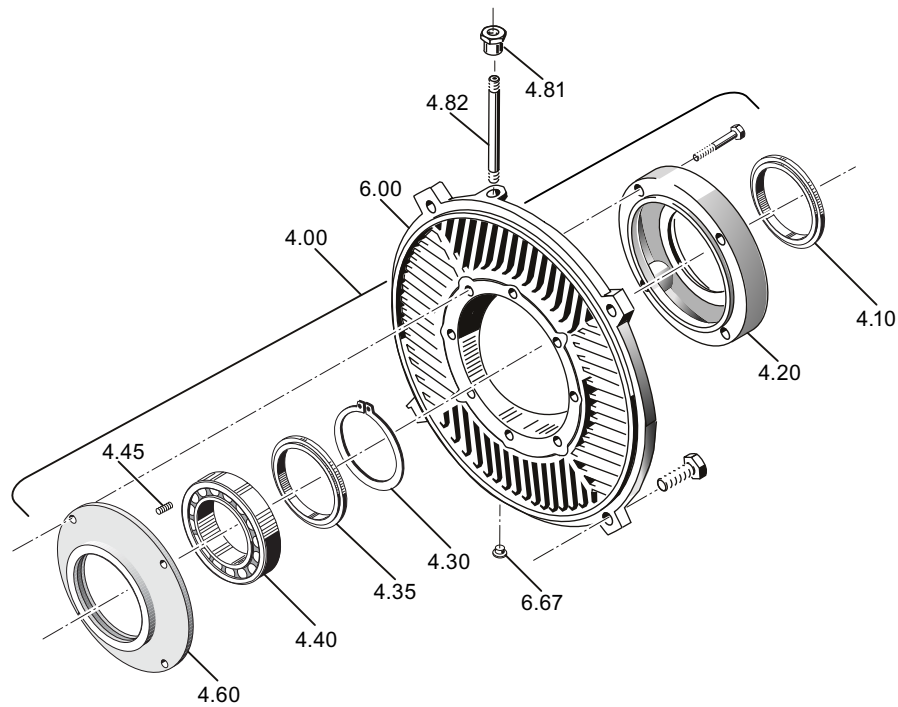


Figure 10-8 Non-drive end roller bearings without bearing housing

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

Part	Description	Part	Description
4.00	Roller bearing cartridge (floating bearing)	4.45	Compression spring
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

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

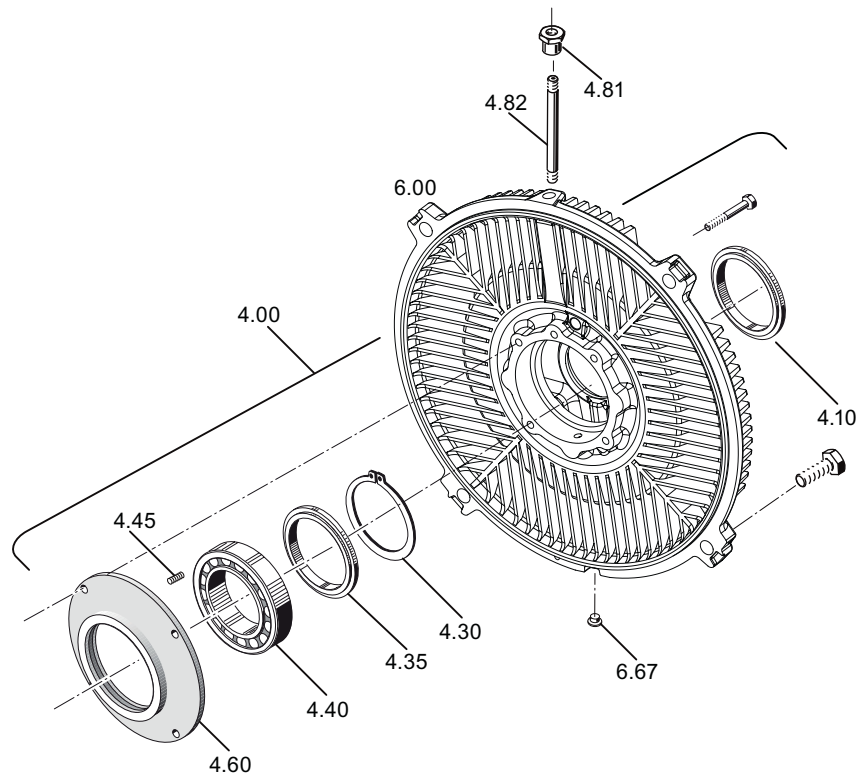


Figure 10-9 Roller bearings, NDE - end shield with integrated bearing cover

Table 10-9 Spare parts for roller bearings, NDE

Part	Description	Part	Description
4.00	Roller bearing cartridge (floating bearing)	4.60	Inner bearing cover
4.10	V ring	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		

10.14 Terminal box GT640

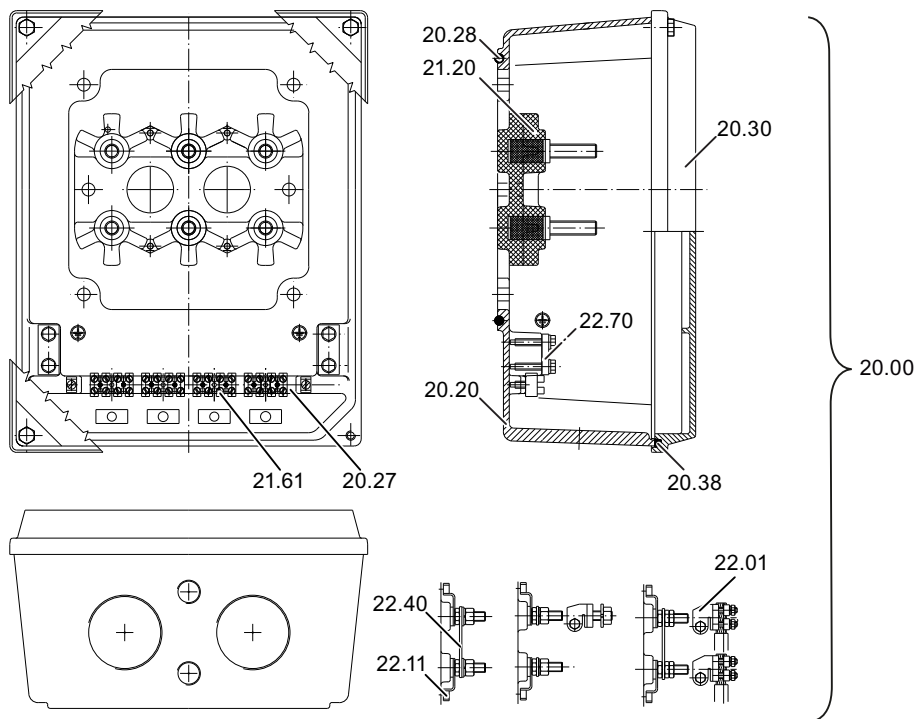


Figure 10-10 Terminal box GT640

Table 10-10 Terminal box GT640

Part	Description	Part	Description
20.00 Terminal box without cable entry comprising the following components:			
20.20	Housing	21.61	Terminals for auxiliary circuits, max. connection 2.5 mm ²
20.27	Mounting rail	22.01	Saddle terminal, complete
20.28	Seal	22.11	Connecting plate with internal cable
20.30	Cover	22.40	Terminal link (two holes)
20.38	Seal	22.70	Fixing lug for PE conductor
21.20	Bushing insulator		

The terminal box can only be ordered as one component.

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

10.15 Terminal box 1XB1621

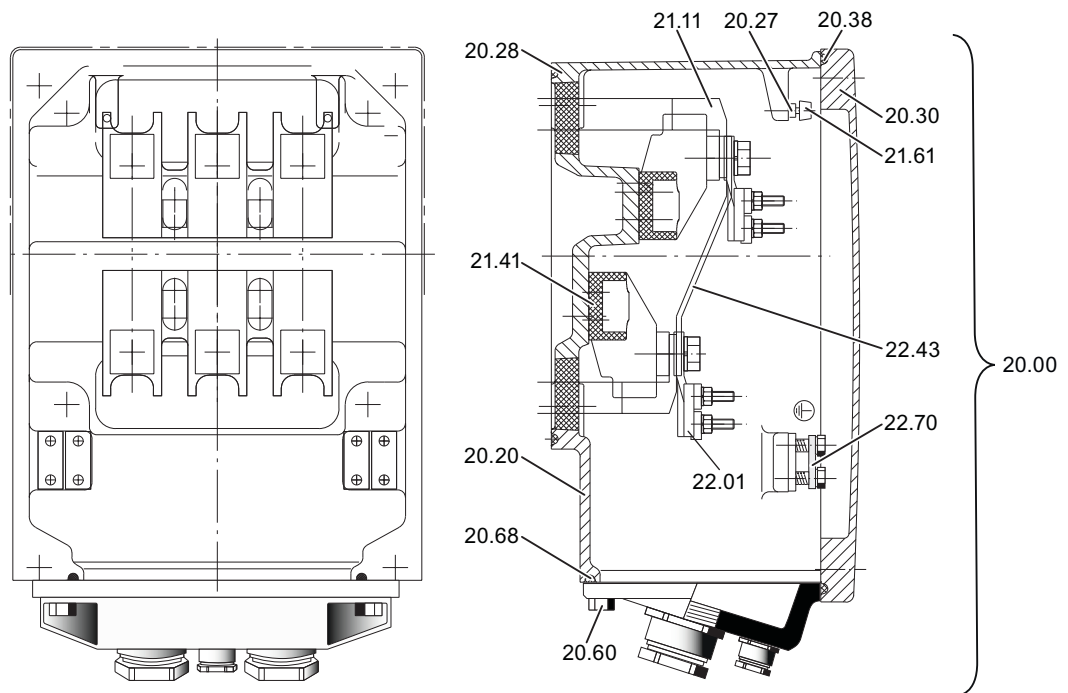


Figure 10-11 Terminal box 1XB1621 with standard cable entry

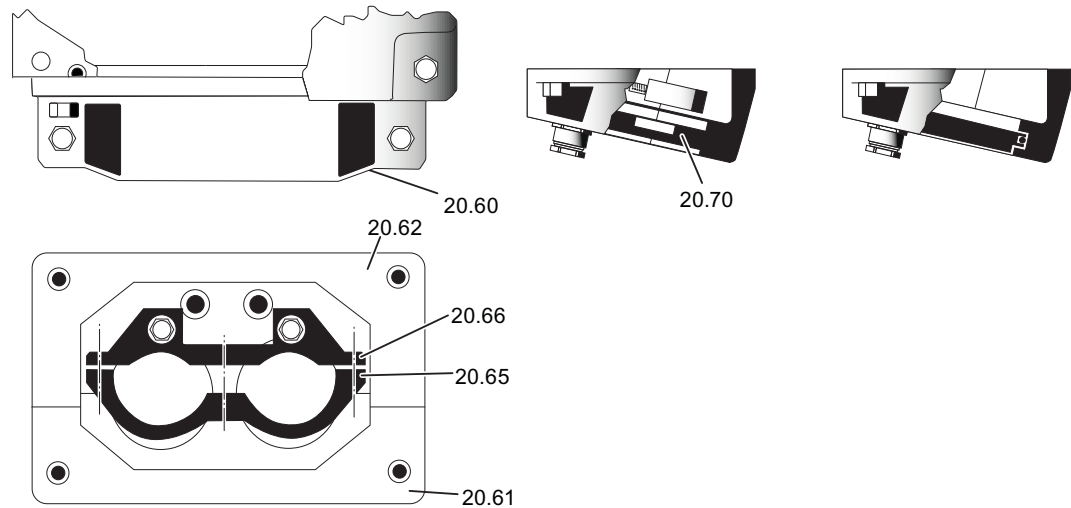


Figure 10-12 Two-part cable entry

Table 10-11 Terminal box 1XB1621 spare parts

Part	Description	Part	Description
20.00 Terminal box without cable entry comprising the following components:			
20.20	Terminal box housing	21.41	Terminal supports
20.27	Mounting rail	21.61	Terminal strip for auxiliary circuit
20.28	Seal	22.01	Saddle terminal, complete

Spare parts

10.16 1XB1631 terminal box

Part	Description	Part	Description
20.30	Cover	22.43	Terminal link, stepped with two holes
20.38	Seal	22.70	Fixing lug for PE conductor
21.11	Connecting plate with internal cable		

Table 10-12 Additional spare parts

Part	Description	Part	Description
20.60	Cable gland	20.66	Strain relief - lower part
20.61	Cable gland - upper part	20.68	Seal
20.62	Cable gland - lower part	20.70	Sealing insert for cable entry
20.65	Strain relief - upper part		

10.16 1XB1631 terminal box

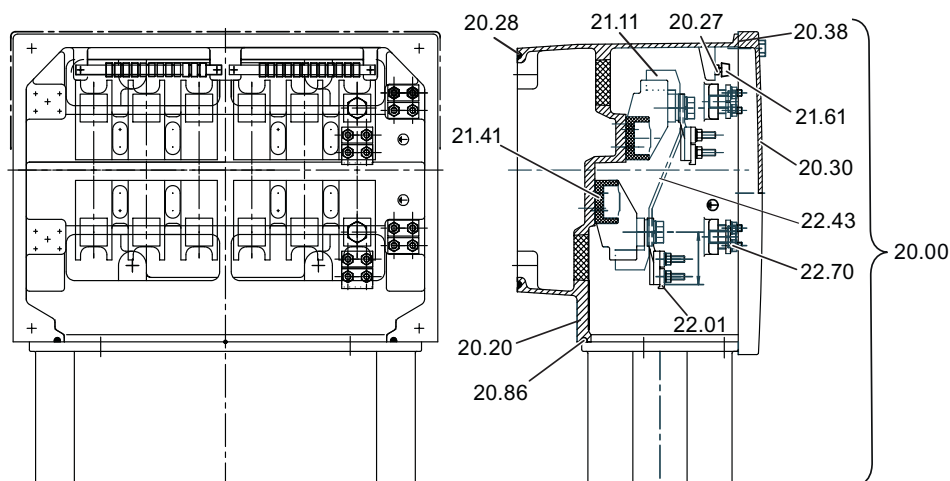


Figure 10-13 Terminal box 1XB1631

Part	Description	Part	Description
20.00 Terminal box without cable entry comprising the following components			
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.

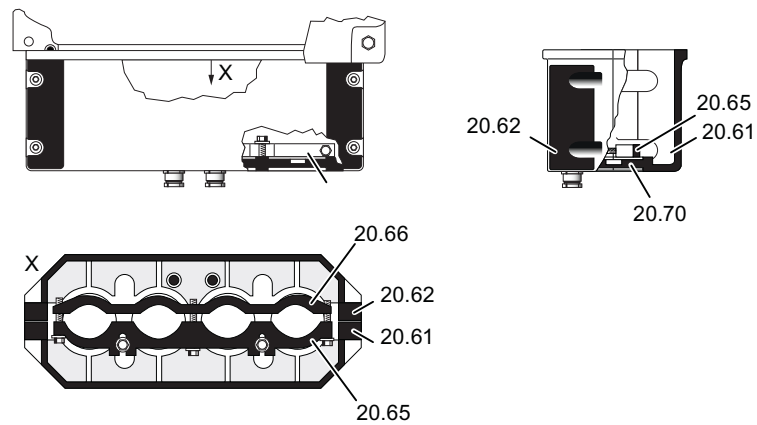


Table 10-13 Additional spare parts for terminal box 1XB1631 with split cable entry

Part	Description	Part	Description
20.61	Cable gland - upper part	20.66	Strain relief - lower part
20.62	Cable gland - lower part	20.70	Sealing insert for cable entry
20.65	Strain relief - upper part		

10.17 Terminal box 1XB1634

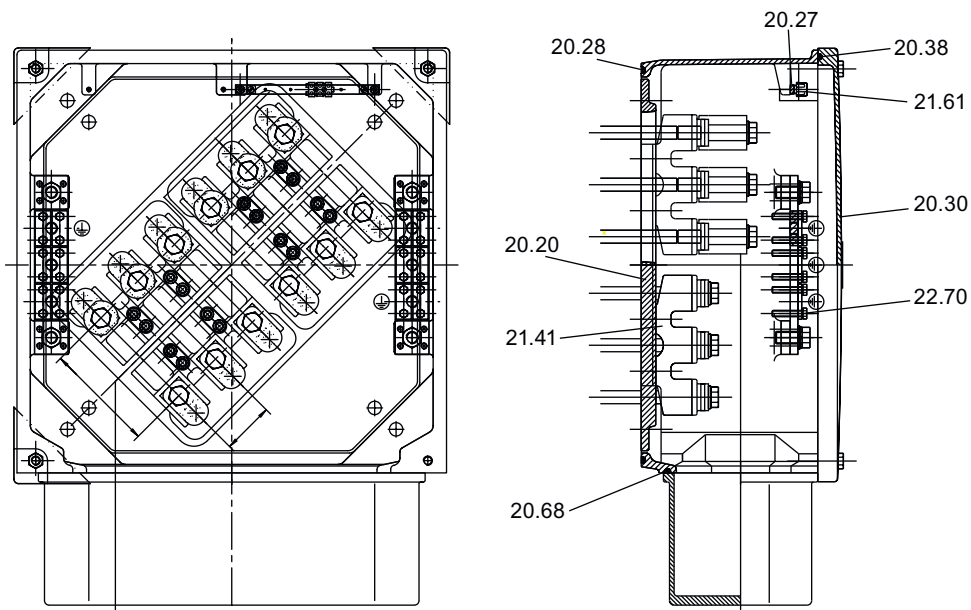


Figure 10-14 Terminal box 1XB1634 with standard cable entry

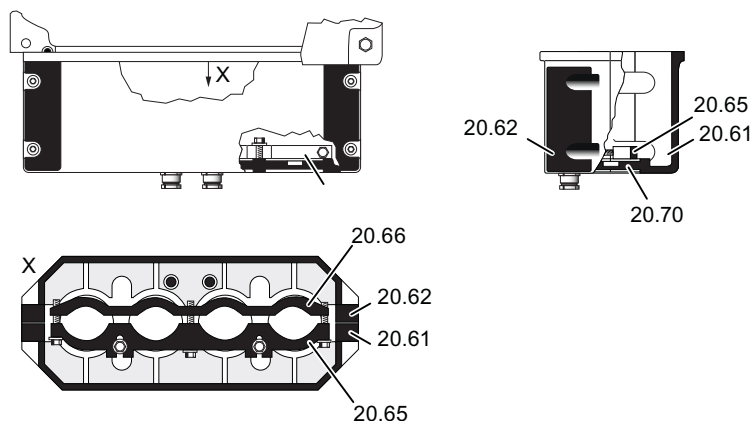


Figure 10-15 Two-pane cable entry

Table 10-14 Spare parts for terminal box 1XB1634

Part	Description	Part	Description
20.20	Terminal box enclosure	20.65	Strain relief (upper part)
20.27	Mounting rail	20.66	Strain relief (lower part)
20.28	Seal	20.68	Seal
20.30	Cover	20.70	Sealing insert for cable entry
20.38	Seal	21.41	Terminal supports
20.60	Cable gland	21.61	Terminal strip for auxiliary circuit
20.61	Cable gland (upper part)	22.70	Fixing lug for PE conductor
20.62	Cable gland (lower part)		

10.18 Terminal box 1XB9600

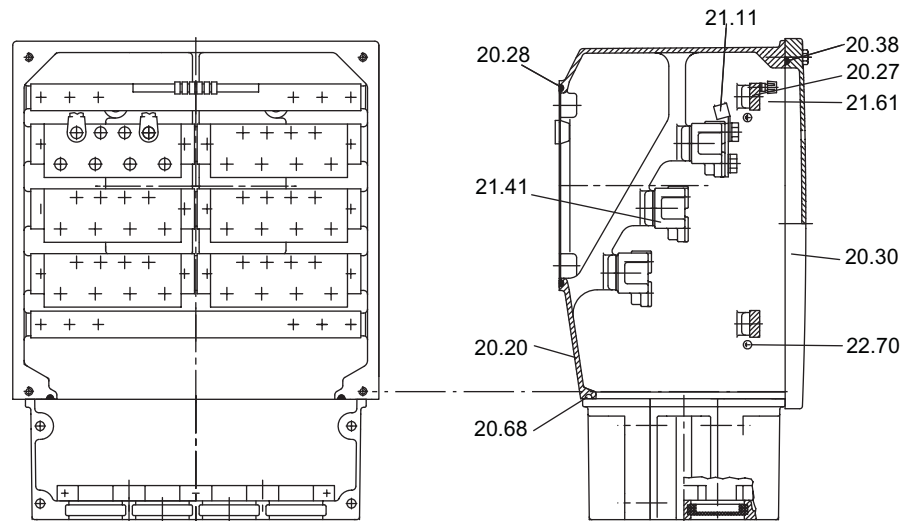


Figure 10-16 Terminal box 1XB9600

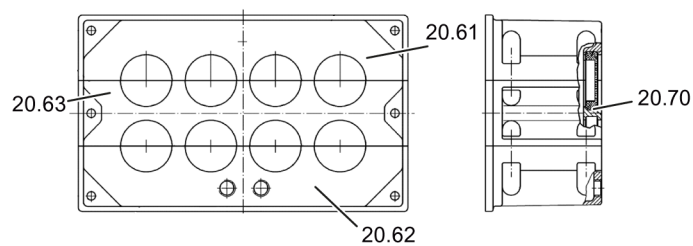


Figure 10-17 Three-part cable entry

Table 10-15 Spare parts for terminal box 1XB9600

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

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.

Country-specific legislation



The machine uses materials that can be recovered or recycled. Correctly separating materials helps to simply recycle important materials.

- 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.
- Please contact your local authorities for more information about disposal.

11.1 Information according to Article 33 of the REACH regulation

This product contains one or several subproducts in which the following substance – belonging to the "list of candidates" – exists in a concentration exceeding 0.1 percent by weight.

- CAS No. 7439-92-1, lead

Based on the currently available information, we assume that this substance does not represent any risk when correctly used, including its disposal.

11.2 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.

11.3 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 15).
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.

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 and Support

Technical questions or additional information



If you have any technical questions or you require additional information, please contact the Technical Support.

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

See also

Technical Support (<https://support.industry.siemens.com/cs/sc?nld=2090&lc=en-WW>)

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.1 Tightening torques for screw and bolt connections

Bolt locking devices

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

Tightening torques

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

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

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

Applications

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

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

Note

Non-standard tightening torques

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

See also

Securing the rotor (Page 33)

Quality documents



You can find the quality documents here:

<https://support.industry.siemens.com/cs/ww/en/ps/13320/cert> (<https://support.industry.siemens.com/cs/ww/en/ps/13320/cert>)

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Further Information

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