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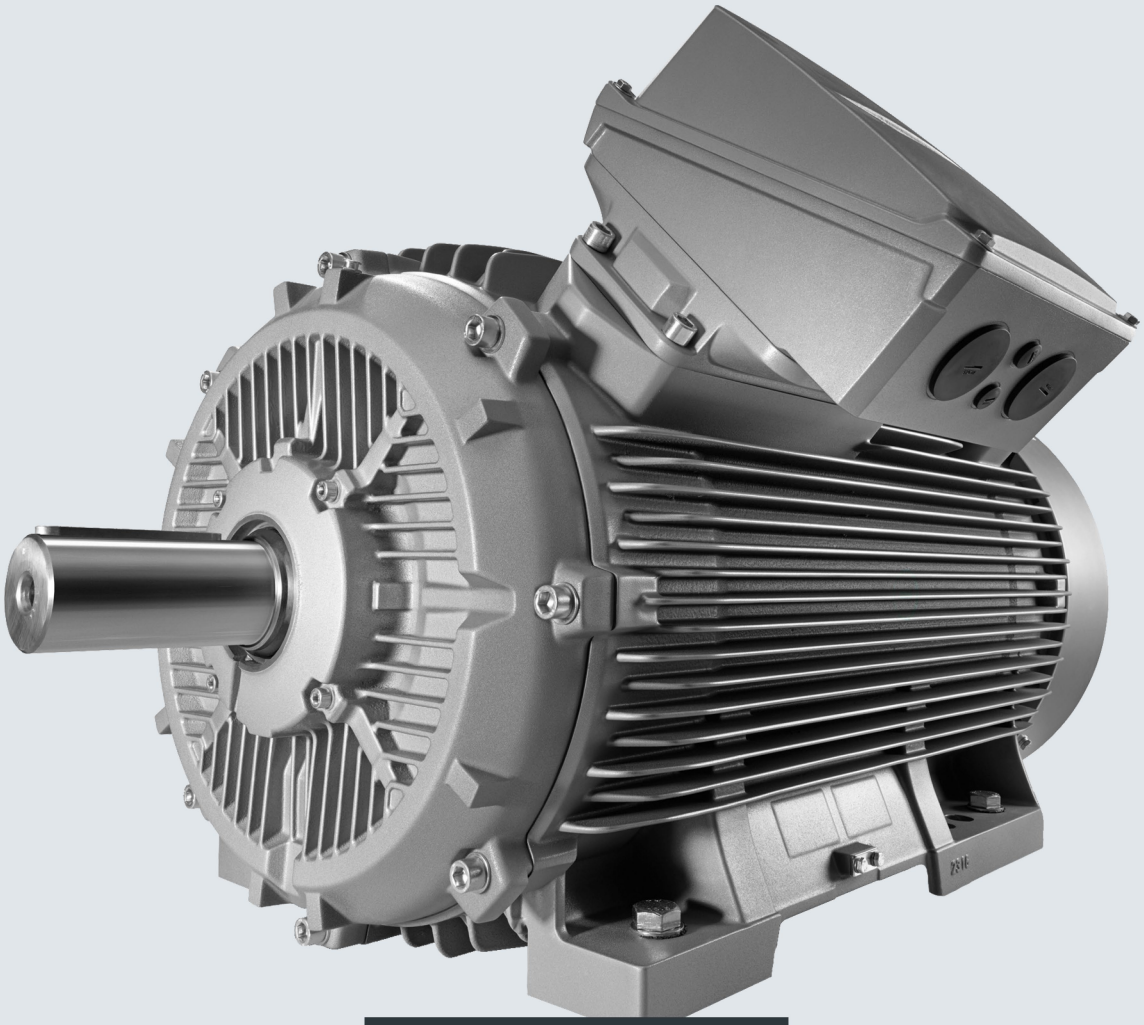

Operating instructions

Low-voltage motors

SIMOTICS SD

1LE5

Edition 03/2017

www.siemens.com

SIEMENS

Low-voltage motors

SIMOTICS SD 1LE5

Operating Instructions

03/2017

A5E41126458A

Legal information

Warning notice system

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

DANGER

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

WARNING

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

CAUTION

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

NOTICE

indicates that property damage can result if proper precautions are not taken.

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

WARNING

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

Trademarks

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

Disclaimer of Liability

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

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Division Process Industries and Drives
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Document order number: A5E41126458A
℗ 03/2017 Subject to change

Table of contents

Introduction 1

1.1 About these instructions

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

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

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

Text format features

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

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

1. Handling instructions are always formatted as a numbered list. Always perform the steps in the order given.

- Lists are formatted as bulleted lists.
  - Lists on the second level are hyphenated.

Note

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

1.2 Compiling personal documents

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

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

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

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

The full functionality is only available for registered users.

Safety information 2

2.1 Information for those responsible for the plant or system

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

The persons responsible for the plant must ensure the following:

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

Note

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

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

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

2.2 The five safety rules

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

Five safety rules

1. Disconnect the system.

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

4. Ground and short-circuit.
5. Provide protection against adjacent live parts.

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

2.3 Qualified personnel

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

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

2.4 Safe handling

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

Also observe the following to prevent accidents:

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

WARNING

Live parts

Electric machines contain live parts.

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

- Always observe the “five safety rules" (Page 113) 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" (Page 177).

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

Interference to electronic devices caused by electrical power equipment

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

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

2.5 Interference voltages when operating the converter

WARNING

Interference voltages when operating the converter

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

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

2.6 Special designs and construction versions

Note

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

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

Description 3

3.1 Area of application

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

Intended use of the machines

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

Note

Machine directive

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

WARNING

Risk of explosion

This machine is not designed for use in hazardous areas. An explosion can occur if the machine is operated in these areas. This can result in death, serious injury or material damage.

- **Never** operate this machine in hazardous areas.

3.1.1 CE marking

Note

Use of machines without CE identification

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

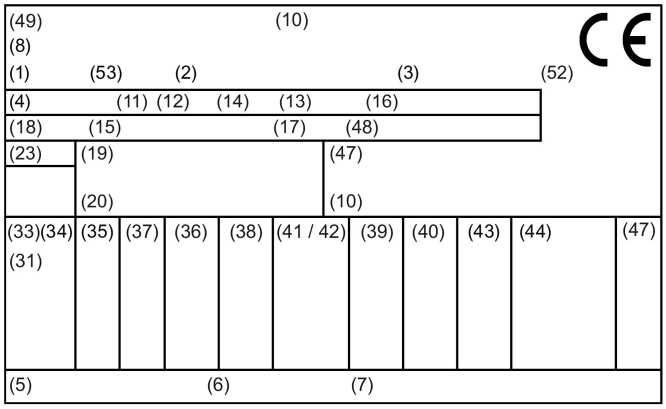
3.2 Rating plate

Rating plate

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

Data on the rating plate

Item	Description	Item	Description
General data		**Electrical data**	
1	Type of machine	31	Electrical data
2	Machine type	33	Rated voltage [V]
3	Serial number (incl. date of manufacture YY.MM)	34	Winding connections
4	Standards	35	Frequency [Hz]
5	Additional details (optional)	36	Rated power [kW]
6	Customer data (optional)	37	Rated current [A]
7	Country of origin	38	Power factor [cosφ]
8	Production location	39	Rated speed [rpm]
10	Regulations (optional)	40	Efficiency class
23	Cooling methods	41	Efficiency
49	Company logo	42	Torque [Nm] (optional)
52	Marine regulation	43	Rated power [hp] (optional)
53	Machine family type	44	Service factor (optional)
Mechanical data		47	NEMA data (optional)
11	Frame size	48	Anti-condensation heating (optional)
12	Type of construction		
13	Degree of protection		
14	Machine weight [kg]		
15	Temperature class		
16	Ambient temperature range (optional)		
17	Installation altitude (only if higher than 1000 m)		
18	Vibration severity grade		
19	Bearing sizes		
20	Relubrication data/specifications (optional)		



3.3 Installation

3.3.1 Machine design

Machines of this series are low-voltage three-phase induction drives with a cylindrical shaft extension and keyway. They can be supplied as single-speed machines with different efficiency classes or as pole changing machines for several speeds.

In the case of machines with feet (IM B3 type of construction), the feet are cast or bolted on.

It is possible to change over the bolted on mounting feet on the machine enclosure, for example to change the terminal box position; only authorized retrofit partners may carry out this work.
Measures for alignment and mounting (Page 147)

3.3.2 Regulations

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

Table 3- 1 Applicable general regulations

Feature	Standard
Dimensioning and operating behavior	EN / IEC 60034-1
Procedure for determining the losses and the efficiency of rotating electrical machines and inspections	EN / IEC 60034-2-1 EN / IEC 60034-2-2 EN / IEC 60034-2-3
Degree of protection	EN / IEC 60034-5
Cooling	EN / IEC 60034-6
Type of construction	EN / IEC 60034-7
Terminal designations and direction of rotation	EN / IEC 60034-8
Noise emission	EN / IEC 60034-9

Feature	Standard
Starting characteristics of rotating electrical machines	EN / IEC 60034-12
Vibration severity grades	EN / IEC 60034-14
Efficiency classification of three-phase squirrel-cage induction motors	EN / IEC 60034-30-1
IEC standard voltages	IEC 60038

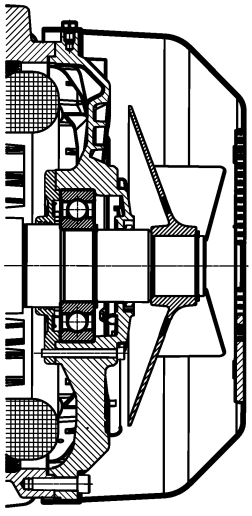
3.3.3 Cooling and ventilation

The machines of this series are three-phase induction machines with a closed primary (internal) cooling circuit and an open secondary cooling circuit (surface cooling). The surface cooling varies depending on the version.

3.3.3.1 Machines with a fan

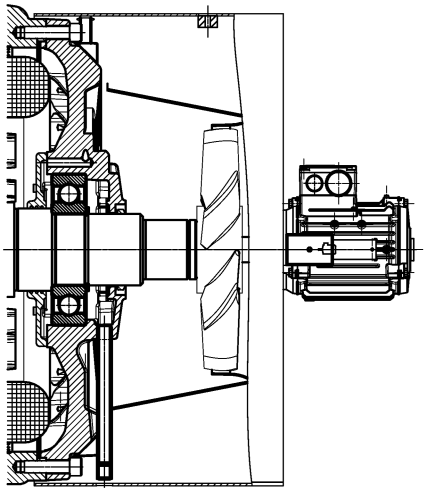
Self-ventilation (standard): Cooling method IC 411 according to EN / IEC 60034-6

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



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

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



3.3.3.2 Machines without a fan (optional)

Surface cooling by free convection: Cooling method IC 410 according to EN / IEC 60034-6

IC410 IC4A1A0

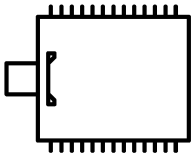


Figure 3-1 IC410

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

IC418 IC4A1A8

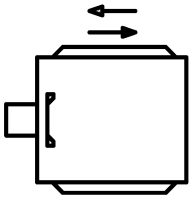


Figure 3-2 IC418

3.3.4 Bearings

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

Roller bearings with permanent lubrication are maintenance-free.

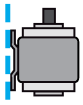
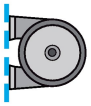
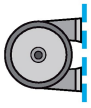
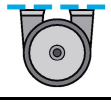
3.3.5 Balancing

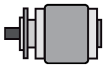
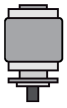
As standard, the motor is balanced dynamically with a half featherkey (code "H") in accordance with ISO 8821.
The balance quality corresponds to vibration level "A". Vibration level "B" is optional or possible on request.

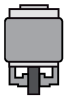
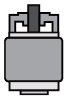
3.3.6 Types of construction/method of installation

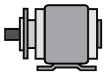
The type of construction of the machine is stated on the rating plate.

Table 3- 2 Type of construction

Basic type of construction code	Diagram	Other methods of installation	Diagram
IM B3 (IM 1001)		IM V5 (IM 1011)	
		IM V6 (IM 1031)	
		IM B6 (IM 1051)	
		IM B7 (IM 1061)	
		IM B8 (IM 1071)	

Basic type of construction code	Diagram	Other methods of installation	Diagram
IM B5 (IM 3001)		IM V1 (IM 3011)	
		IM V3 (IM 3031)	

Basic type of construction code	Diagram	Other methods of installation	Diagram
IM B14 (IM 3601)		IM V18 (IM 3611)	
		IM V19 (IM 3631)	

Basic type of construction code	Diagram
IM B35 (IM 2001)	
IM B34 (IM 2101)	

3.3.7 Degree of protection

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

3.3.8 Environmental conditions

Limit values for the standard version

Relative humidity for ambient temperature T_{amb} 40 °C	Max. 55 %
Ambient temperature	-20 °C to +40 °C
Installation altitude	≤ 1000 m
Air with normal oxygen content, usually	21 % (V/V)

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

The machine is suitable for tropical climates.

3.3.9 Optional built-on and built-in accessories

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

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

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

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

Preparing for use

4

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

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

4.1 Safety-related aspects to consider when configuring the plant

A number of residual risks are associated with the machine. These are described in the chapter titled "Safety information" (Page 113) 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 Delivery

Checking the delivery for completeness

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

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

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

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

4.4 Transport and storage

When carrying out any work on the machine, observe the general safety instructions (Page 113) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

WARNING

Risk of dropping and swinging when transported suspended

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

- Use additional, suitable lifting equipment for transport and during installation.
- Two cables alone must be able to carry the complete load.
- Prevent the lifting equipment from sliding by appropriately securing it.

WARNING

Toppling over or slipping of the motor

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

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

Note

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

4.4.1 Types of construction on the rating plate

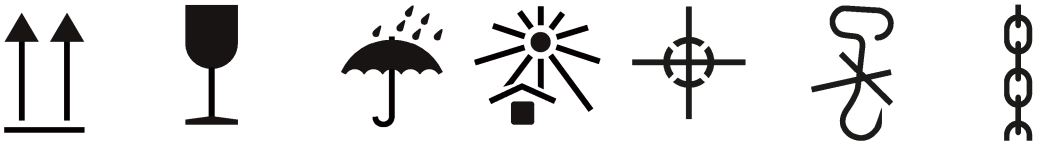
The type of construction of the machine is stated on the rating plate.

4.4.2 Transport

If any transport locks are in place, remove them before commissioning. Store the transport locks or disable them. Use the transport locks when transporting the motors again or reactivate the transport locks.

The machines are packed in different ways depending on how they are transported and their size. If not otherwise contractually agreed, the packaging corresponds to the packing guidelines according to ISPM (International Standards for Phytosanitary Measures).

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



Up | Fragile goods | Protect against moisture | Protect against heat | Center of gravity | Hand hooks forbidden | Attach here

4.4.3 Storage

Storing outdoors

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

Choose a dry storage location which is safe from flooding and free from vibration. Repair any damage to the packaging before putting the equipment into storage if this is necessary to ensure proper storage conditions. In order to ensure protection against ground moisture, locate machines, equipment and crates on pallets, wooden beams or foundations. Prevent equipment from sinking into the ground. Do not impede air circulation under the stored items.

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

Storing indoors

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

Bare metal surfaces

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

Condensation drain hole

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

4.5 Bearing lifetime

Storage temperature

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

Maximum permissible air humidity: 60%

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

Storage time

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

Open bearings

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

Closed bearings

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

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

4.6 Electromagnetic compatibility

Note

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

Note

Converter

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

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

Immunity to interference

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

4.7 Converter operation

4.7.1 Parameterizing the converter

- If the design of the motor requires connection to a particular converter type, the rating plate will contain corresponding additional information.
- Correctly parameterize the converter. Parameterizing data can be taken from the machine rating plate (not the supplementary rating plate with the operating data when connected to a converter).
  You can find parameter data here:
  - In the operating instructions for the converter.
  - In the SIZER engineering tool
  - In the SINAMICS Configuration Manuals.
- Do not exceed the specified maximum speed limit n_{max}. You can either find this on the rating plate n_{max}, on the supplementary plate for converter operation as the highest speed, or in the type-specific catalog.
- Operate the machine only for a short period at the maximum speed. Operating the machine for an extended period at the maximum speed may cause vibrations with an increased frequency and consequently higher noise levels.
- Check that the machine is cooled sufficiently for commissioning purposes.

4.7.2 Reducing bearing currents during operation with converter (low voltage)

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:

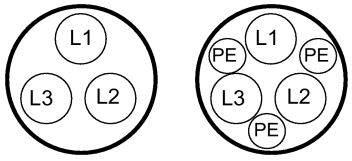
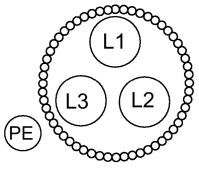
Use equipotential bonding conductors:

- 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.

	
Concentric copper or aluminum shield	Steel armor

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

Overall system design

To specifically reduce 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

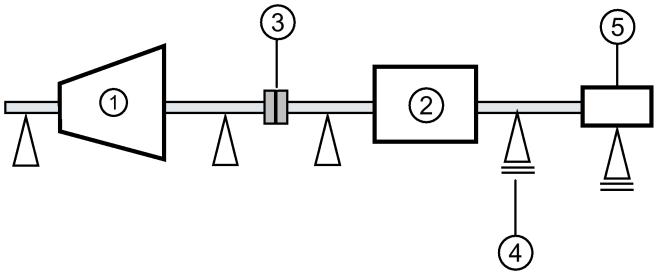
Converter documentation

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

4.7.3 Insulated bearings when operated with a 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.



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

Figure 4-1 Schematic representation of a single drive

NOTICE

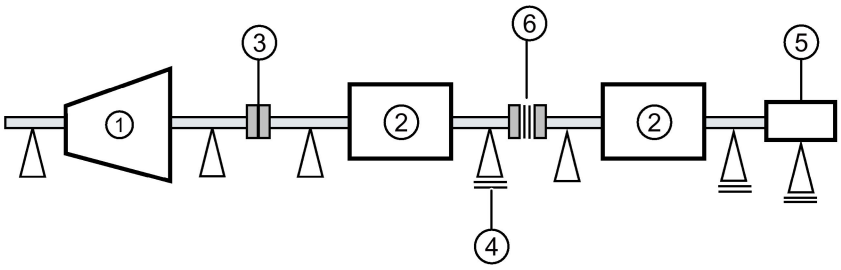
Bearing damage

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.



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

Figure 4-2 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.

Assembly 5

When carrying out any work on the machine, observe the general safety instructions (Page 113) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

Note

Loss of conformity with European directives

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

5.1 Preparing 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

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

Note

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

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

5.1.2 Insulation resistance

5.1.2.1 Insulation resistance and polarization index

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

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

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

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

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

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

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

"Testing the insulation resistance and polarization index" (Page 138)

5.1.2.2 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 [MΩ]
U ≤ 1000	500	≥ 5
1000 ≤ U ≤ 2500	500 (max. 1000)	100
2500 < U ≤ 5000	1000 (max. 2500)	
5000 < U ≤ 12000	2500 (max. 5000)	
U > 12000	5000 (max. 10000)	

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

U_{meas} = DC measuring voltage

R_C = minimum insulation resistance at 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:

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

   Many measuring devices display these values automatically following the measurement.

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

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

NOTICE

Damage to insulation

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

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

Limit values of the anti-condensation heating insulation resistance

The insulation resistance of the anti-condensation heating with respect to the machine housing should not be lower than 1 MΩ when measured at 500 V DC.

5.2 Installation

5.2.1 Installing the machine

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

Note

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

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

5.2.2 Ensure adequate cooling

WARNING

Overheating and failure of the motor

Death, severe injury or material damage can occur if you do not carefully observe the following points.

- Do not obstruct ventilation.
- Prevent the air expelled by neighboring equipment from being immediately sucked in again.
- For machines with a vertical type construction with air entry from above, prevent the ingress of foreign bodies and water in the air entry openings (standard IEC / EN 60079-0).
- If the shaft extension is facing upwards, liquid must be prevented from entering by moving along the shaft.

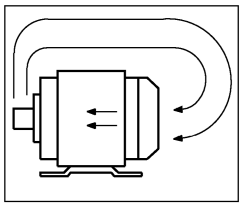
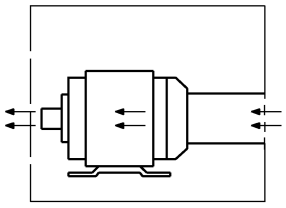
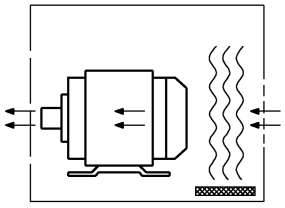
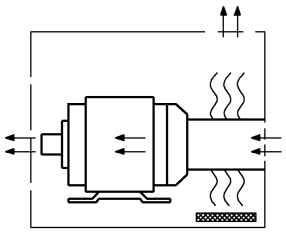
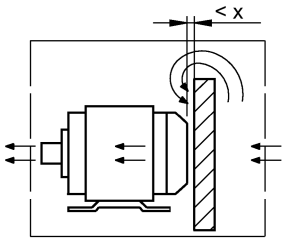
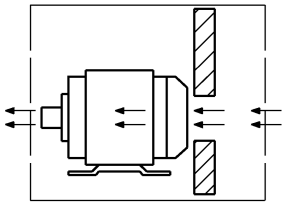
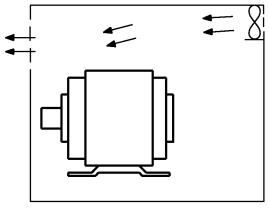
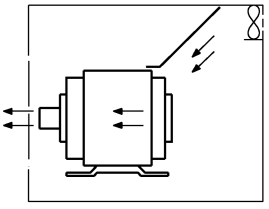
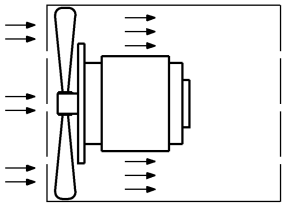
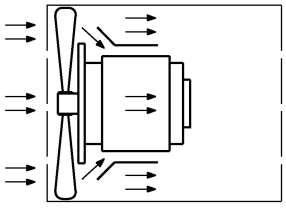
WARNING

Damage caused by small parts falling in

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

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

Table 5- 2 Air guidance

Incorrect	Correct
	
	
	
	
	

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

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

Frame size	X [mm]
315	110
355	140

5.2.3 Machines with type of construction IM B15, IM B9, IM V8 and IM V9

Types of construction without bearings on the drive side

These machines do not have their own bearing system for the machine shaft at the drive end (DE). The machine shaft is accepted by the (hollow) shaft or coupling of the system or driven machine.

- Using the centering edge, the machine is aligned with respect to enclosures, flanges or driven machines.
- Note that the temperature of the motor and motor shaft increases during operation. The thermal expansion of the machine shaft must be compensated by the customer by applying suitable measures.
  Use the spring washers provided to locate the NDE bearing without any play.

NOTICE
Damage to the motor Material damage can occur if the following notes are not carefully observed: • The IM B3 bearing shield with integrated distance ring mounted at the drive end (DE) is only used transport lock. A warning label is attached to this bearing shield. • The spacer ring is not a roller bearing. • Remove the bearing shield and the spacer ring. • Remove the transport lock before commissioning.

5.2.4 Foot mounting

Note

Only authorized retrofit partners must be employed to relocate the bolted on mounting feet at the machine enclosure.

After attaching the mounting feet, you must note the following in order to avoid stressing and deforming the machine.

- Ensure that the foot mounting surfaces are aligned in one plane and are parallel to the machine shaft.
- Post-machine the foot mounting surfaces or use thin shims, for example.
- Professionally touch up damaged painted surfaces.
- Observe the information provided in Chapter Aligning and mounting (Page 147)

5.2.5 Balancing

The rotor is dynamically balanced. The balancing quality corresponds to vibration severity grade "A" for the complete machine as standard. The optional vibration severity grade "B" is indicated on the rating plate.

The declaration regarding the type of featherkey for balancing is generally marked on the rating plate and optionally on the face of the shaft end.

Designation:

- As a standard measure, balancing is carried out dynamically with a half featherkey (code "H") in accordance with ISO 21940-32.
- "F" means balancing with a whole featherkey (optional version).
- "N" means balancing without a featherkey (optional version).

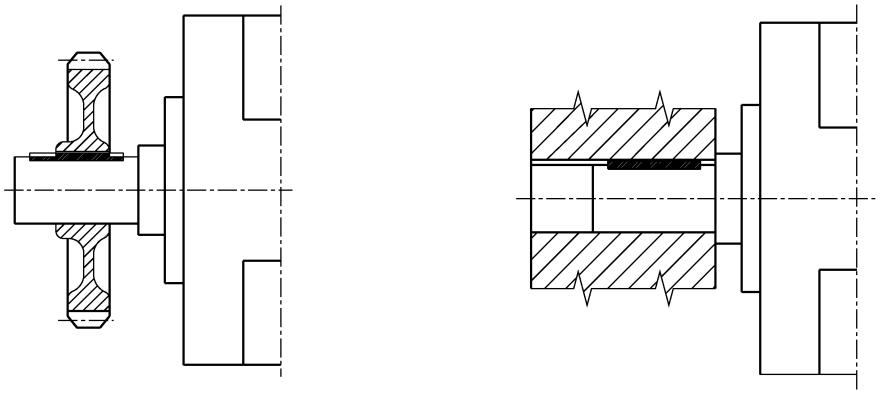
CAUTION

Incorrect installation or removal

To avoid injury and material damage, carefully observe general touch protection measures for output transmission elements:

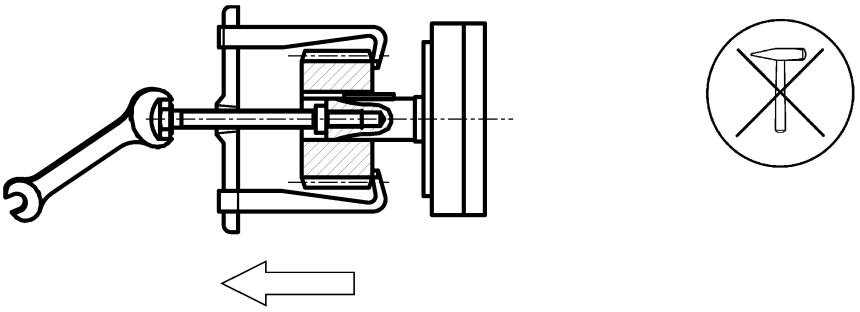
- The general touch protection measures for drive output elements must be observed.
- Drive output elements may only be pushed on or pulled off with the correct equipment.
- The feather keys are only locked against falling out during shipping. If you commission a machine without a drive output element,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

The featherkey data on the shaft and transmission element must indicate the correct type of balancing in each case and must be correctly mounted.
The balancing quality corresponds to vibration severity grade "A" for the complete machine; vibration severity grade "B" is possible as an option, i.e. in order to ensure the desired balancing quality, it must be ensured that the featherkey data on the hub and machine shaft complement each other in the case of a shorter or longer output transmission element.

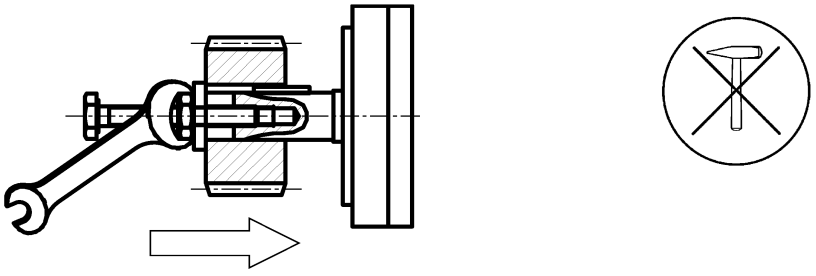


Align the offset at the coupling between electrical machines and the driven machines so that the maximum permissible vibration values according to ISO 10816 are not exceeded.

5.2.5.1 Mounting and withdrawing output transmission elements



Withdrawing output transmission elements



Mounting output transmission elements

- When mounting output transmission elements (coupling, gear wheel, belt pulley etc.) use the thread at the shaft end.
  If possible, heat up the output transmission elements as required.
- Use a suitable device when withdrawing output elements.
- When mounting or withdrawing, do not apply any blows, for example with a hammer or similar tool, to the parts to be mounted or withdrawn.
- Only transfer radial or axial forces specified in the catalog to the motor bearings via the shaft extension.

5.2.6 Noise emission

CAUTION

Hearing damage when operating three-phase motors

If the permissible sound pressure level is exceeded, hearing damage can occur when operating three-phase motors at their rated power.

Observe the maximum permissible sound pressure level according to the ISO 1680 standard. The maximum permissible sound pressure level is 70 dB (A).

5.3 Alignment and fastening

Observe the following when aligning and mounting:

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

5.3.1 Measures for alignment and mounting

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

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

- **Smooth running**

  Preconditions for smooth, vibration-free operation according to DIN 4024 include:

  – Stable foundation design free of any shock or vibration.

  – A precisely aligned coupling.

  – A well-balanced drive output element (coupling, belt pulleys, fans, ...)

  Maintain the maximum permissible vibration in operation according to ISO 10816.
  Avoid inadmissible vibration caused by imbalance, for example (drive output element), external vibration or any resonance over the complete speed range.
  It may be necessary to completely balance the machine with the drive output element or the system resonance frequency must be shifted.

- **Foot mounting/flange mounting**

  – Use the specified thread size laid down in EN 50347 when flanging the machine to a foundation or a machine flange.

  – Mount the machine at four foot or flanged holes that are at right angles to one another. The customer is responsible for selecting the strength (property class) of the mounting elements.
  Property class 8.8 or higher is recommended for the mounting elements.

  – Select the correct screw length for IM B14 flanges.

  – Ensure that the screw heads are in full contact with the flange surface. Use additional flat washers (ISO 7093), especially for elongated foot mounting holes.

5.3.2 Flatness of the supporting surfaces for conventional motors

Frame size	Flatness [mm]
315	0.20
355	0.20

5.3.3 Machine frame mounting feet (special design)

Note

For terminal boxes mounted at the NDE (option H08), dimension C can deviate from EN 50347.

Electrical connection

6

When carrying out any work on the machine, observe the general safety instructions (Page 113) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

6.1 Connecting the machine

DANGER

Hazardous voltages

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

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

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

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

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

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

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

6.1.1 Terminal designations

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

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

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

6.1.2 Direction of rotation

The standard motors are suitable for clockwise and counter-clockwise rotation.

For defined directions of rotation (direction of rotation arrow), appropriately connect the line power cables.

- If you connect the line cables with phase sequence L1, L2, L3 at U, V, W or according to NEMA at T_1 T_2 T_3 , then the machine rotates in the clockwise direction.
- If you interchange two connections, e.g. L1, L2, L3 at V, U, W or according to NEMA at T_2 T_1 T_3 , then the machine rotates counter-clockwise.

	According to IEC	According to NEMA
Clockwise rotation	U V W	T_1 T_2 T_3
Counter-clockwise rotation	V U W	T_2 T_1 T_3

Direction of rotation of the motor when looking at DE

6.1.3 Connection with/without cable lugs

In the case of terminals with terminal clamps, distribute the conductors in such a way that the clamping heights on both sides of the fillet are about the same. This method of connection requires that you must bend a single conductor in a U shape or use a cable lug. The same applies to the inner and outer terminals of the ground conductor.

When connecting up using cable lugs, select their size corresponding to the required cable cross-section and the stud size. An inclined arrangement is only permitted provided the required air clearances and creepage distances are carefully maintained.
Remove insulation from the ends of the conductors so that the remaining insulation almost reaches the cable lug.

Note

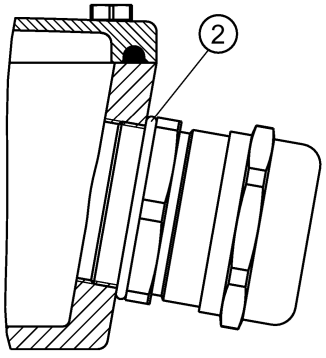
The direct contact between the cable lug surfaces and the contact nuts or contact screws ensure that the connection can conduct current.

6.1.4 Connecting protruding cables

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

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

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



② O ring

6.1.5 Terminal box

DANGER

Hazardous voltage

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

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

NOTICE

Damage to the terminal box

If you incorrectly carry out work on or in the terminal box, this can result in material damage. You must observe the following to avoid damaging the terminal box:

- Ensure that the components inside the terminal box are not damaged.
- It must be ensured that there are no foreign bodies, dirt or moisture in the terminal box.
- Close the terminal box using the original seal so that it is dust tight and water tight.
- Use O-rings or suitable flat gaskets to seal entries in the terminal box (DIN 42925) and other open entries.
- Please observe the tightening torques for cable glands and other screws.

Standard design

It is possible to turn the top side of a machine terminal box 4 x 90 degrees (if screwed on).

6.1.5.1 Protruding connection cables

WARNING

Risk of short-circuit and voltage hazard

A short circuit can occur if connecting cables are clamped and crushed between parts of the enclosure and the cover plate.
This can result in death, severe injury and material damage.

- During disassembly and particularly when installing the cover plate, make sure that the connecting cables are not clamped between enclosure parts and the cover plate.

CAUTION

Damage to connecting cables that are freely led out

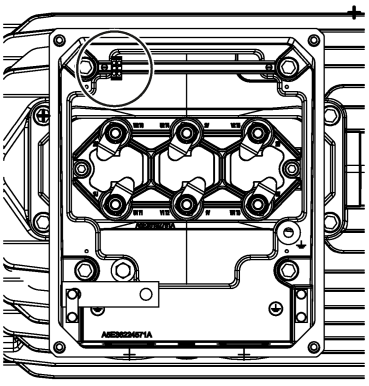
You must observe the following note to avoid damaging connecting cables that are freely led out:

- It must be ensured that there are no foreign bodies, dirt, or moisture in the terminal base of the machine enclosure.
- Use O-rings or suitable flat gaskets to seal entries in cover plates (DIN 42925) and other open entries.
- Seal the terminal base of the machine enclosure using the original seal of the cover plate to prevent dust and water from entering.
- Please observe the tightening torques for cable glands and other screws.

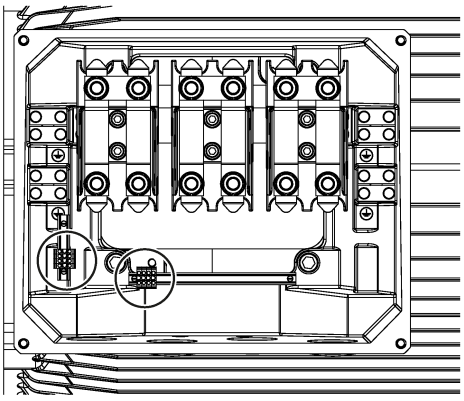
6.1.5.2 Connecting the temperature sensor/anti-condensation heater

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

Connecting temperature sensor/anti-condensation heating in the terminal box.



FS 315



FS 355

6.2 Tightening torques

6.2.1 Electrical connections - Termincal board connections

Table 6- 2 Tightening torques for electrical connections on the terminal board

	Thread ∅		M 3,5	M 4	M 5	M 6	M 8	M 10	M 12	M 16
	Nm	min	0,8	0,8	1,8	2,7	5,5	9	14	27
		Max.	1,2	1,2	2,5	4	8	13	20	40

6.2.2 Cable glands

Note

Avoid damaging the cable jacket.

Adapt the tightening torques to the cable jacket materials.

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

Table 6- 3 Tightening torques for cable glands

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

6.2.3 Terminal boxes, end shields, ground conductors

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

Table 6- 4 Tightening torques for screws on the terminal box, end shields, screw-type grounding conductor connections

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

Tightening torque for the condensation drain plug

Tighten the condensation drain plug M6x0.75 with a torque between 1.5 and 2.0 Nm.

6.3 Connecting the grounding conductor

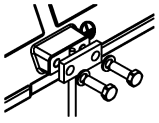
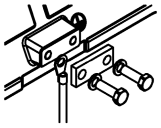
The machine's grounding conductor cross-section must comply with EN / IEC 60034-1.

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

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

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

6.3.1 Grounding connection type

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

6.3.2 Minimum surface area of grounding conductor

Table 6- 5 Minimum cross-sectional area of grounding conductor

Minimum cross-sectional area of phase conductor for installation S [mm²]	Minimum surface area of associated grounding connection [mm²]
S ≤ 16	S
16 < S ≤ 35	16
S > 35	0.5 S

Internal ground terminal

When making connections, ensure the following:

- Ensure that the connecting surface is bare and is protected against corrosion using a suitable substance, e.g. acid-free Vaseline.
- Arrange the flat washer and spring washer under the bolt head.
- Locate the cable lug under the clamping bracket.
- Use the terminals designated for the grounding conductor in the terminal box.
- Observe the tightening torque (Page 155) for the clamping screw.

For machines, frame sizes 80 ... 90 with central terminal box locking, a cable lug, size M4 according to DIN 46237 can be used to connect the inner grounding.

External ground terminal

When making connections, ensure the following:

- Ensure that the connecting surface is bare and is protected against corrosion using a suitable substance, e.g. acid-free Vaseline.
- Position the cable lug between the contact bracket and the grounding bracket; do not remove the contact bracket pressed into the enclosure!
- Arrange the flat washer and spring washer under the bolt head.
- Use the terminals designated for the grounding conductor in the terminal box.
- Observe the tightening torque (Page 155) for the clamping screw.

6.3.3 Size of grounding conductor screw

Table 6- 6 Screw size of the grounding cable, external grounding

Frame size	Thread size for the grounding conductor
315	2x M8
355	2x M12

6.4 Conductor connection

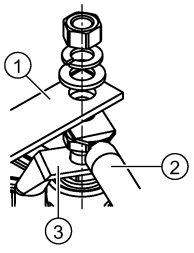
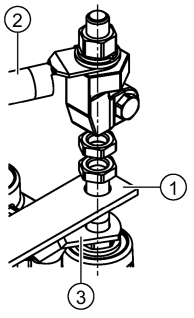
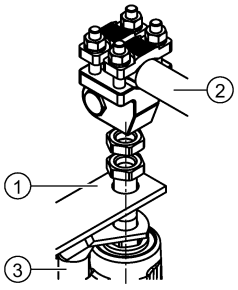
Cross-sections that can be connected depending on the size of the terminal (possibly reduced due to size of cable entries)

6.4.1 Connecting conductors

Table 6- 7 Max. conductor connection

Frame size	Max. connectable conductor cross-section [mm²]
315	240.0
355	300.0

6.4.2 Type of conductor connection

Terminal board		FS 315				SH 355 SH315+R50 *)			
		M12				M16			
		TB3Q01		TB3Q61		TB3R01		TB3R61	
		Max. conductor cross-section [mm²]	Recommended conductor cross-section [mm²]	Max. conductor cross-section [mm²]	Recommended conductor cross-section [mm²]	Max. conductor cross-section [mm²]	Recommended conductor cross-section [mm²]	Max. conductor cross-section [mm²]	Recommended conductor cross-section [mm²]
Connection with cable lug DIN 46234		185	120	240	185	300	240	300	240
Connection with cable lug DIN 46234 with terminal stud for cable connection						300 *)	240 *)	300 *)	240 *)
Connection with clamp terminal for connections without cable lug									

① Connecting busbar
② Line connecting cable
③ Motor connecting cable

6.5 Connecting converters

NOTICE

Excessively high supply voltage

Material damage can occur if the supply voltage is too high for the insulation system.

SIMOTICS machines can be operated with SINAMICS G converters and SINAMICS S converters (uncontrolled and controlled infeed) when maintaining the permissible peak voltages.

Carefully observe the values in the following tables.

Rise times t_r > 0.1 µs.

The insulation system of SIMOTICS machines corresponds to the specifications laid down in IEC 60034-18-41 according to voltage stress category C (IVIC C = high stress).

Table 6- 8 Maximum voltage peaks at the motor terminals for line (DOL) motors, converter operation possible

Rated motor voltage [V]	Maximum peak voltage at the motor terminals $\hat{U}_{max}$ dependent on the rise time t_r			
	$\hat{U}_{phase\text{-}to\text{-}phase}$ [V_{pk}]	$\hat{U}_{phase\text{-}to\text{-}ground}$ [V_{pk}]	Rise time t_r [µs]	DC link U_{DC} [V]
≤ 500 V	1500	1100	0.5	750
	900	900	0.1	

Table 6- 9 Maximum voltage peaks at the motor terminals for motors specifically designed for converter operation (e.g. VSD 10)

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

6.6 Final measures

Before closing the terminal box/terminal base of the machine enclosure, check the following:

- Establish the electrical connections in the terminal box in accordance with the details in the sections above and tighten with the correct torque.
- Maintain air clearances between non-insulated parts:
  ≥ 5.5 mm up to 690 V, ≥ 8 mm up to 1000 V.
- Avoid protruding wire ends!
- In order not to damage the cable insulation, freely arrange the connecting cables.
- Connect the machine corresponding to the specified direction of rotation.
- Keep the inside of the terminal box clean and free from trimmed-off ends of wire.
- Ensure that all seals and sealing surfaces are undamaged and clean.
- Correctly and professionally close unused openings in the terminal boxes.

7 Commissioning

When carrying out any work on the machine, observe the general safety instructions (Page 113) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

7.1 Setpoint values for monitoring the bearing temperature

Prior to commissioning

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

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

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

Normal operation

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

Table 7- 2 Set values for monitoring the bearing temperatures

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

7.2 Measures before commissioning

NOTICE

Damage to the machine

In order to avoid material damage, check the following points before commissioning the motor:

- Using appropriate measures, check whether the correct direction of rotation of the motor has been set by the customer, e.g. by decoupling from the driven load.
- Ensure that temperature-sensitive parts (cables, etc.) are not in contact with the machine enclosure.
- Ensure that the condensation drain holes are always located at the lowest part of the motor.

NOTICE

Damage caused by insufficient cooling

Effective cooling is no longer possible if air guidance of the machine is not provided as intended. This can damage the machine.

- Before commissioning, attach the covers to guarantee the intended air guidance.

Measures

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

- Ensure that the machine has been correctly installed and aligned.
- Connect the machine corresponding to the specified direction of rotation.
- Ensure that the operating conditions match the data specified on the rating plate.
- Lubricate the bearings, depending on the version. Ensure that machines with roller bearings, which have been stored for longer than 24 months, are relubricated.
  Also observe the notes in Chapter Preparation for use.
- Ensure that any optional supplementary machine monitoring equipment has been connected correctly and is functioning as it should.
- For versions with bearing thermometers, check the bearing temperatures when the machine starts to run for the first time. Set the values for alarm and shutdown at the monitoring device. Also observe the notes in Chapter Setting values for monitoring the bearing temperature.
- Corresponding to the control and speed monitoring functions implemented, ensure that the machine cannot exceed the permissible speeds specified on the rating plate.
- Ensure the correct setting conditions of the drive output elements depending on the type (e.g. alignment and balancing of couplings, belt forces in the case of a belt drive, tooth forces and tooth flank backlash/play in the case of gear wheel output, radial and axial clearance in the case of coupled shafts).
- Comply with the minimum insulation resistances and minimum air clearances.

- Ensure correct grounding and potential bonding connection of the protective conductor.
- Tighten all mounting bolts, connection elements and electrical connections to the specified torques.
- Remove any lifting eyes that were screwed after installation – or secure them to prevent them becoming loose.
- Rotate the rotor to ensure that it does not touch the stator.
- Implement all touch protection measures for both moving and live parts.
- Ensure that free shaft extensions cannot be touched, e.g. by attaching covers.
- Secure any featherkeys so that they cannot be flung out.
- Ensure that the optional external fan is ready for operation and connected so that it rotates in the specified direction.
- Ensure that the cooling airflow is not obstructed or diminished in any way.
- If an optional brake is being used, ensure that it is functioning perfectly.
- Comply with the specified mechanical limit speed n_{max}, and ensure that it is not exceeded.

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

Note

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

See also

Observing the operating mode (Page 127)

7.3 Switching on

Measures for start-up

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

- Start the machine without a load. To do this, close the circuit breaker and do not switch the machine off prematurely. Switching the machine off again while it is starting up and still running at slow speed should be kept to a bare minimum, for example for checking the direction of rotation or for checking in general. Allow the machine to run to a standstill before switching it back on again.
- Check mechanical operation for noise or vibration at the bearings or end shields.
- If the machine is not running smoothly or is emitting abnormal noises, switch it off, and determine the cause of the fault as it runs down.

- If mechanical operation improves immediately after the machine is switched off, then the cause is magnetic or electrical, e.g. voltage imbalance, magnetic imbalance. If mechanical operation does not improve immediately after switching the machine off, then the cause is mechanical, e.g. an imbalance in the electrical machines or in the driven machine, inadequate alignment of the machine set, operation of the machine with the system resonating (system = machine + base frame + foundations etc.).
- If the machine runs perfectly in terms of its mechanical operation, switch on any cooling devices present and continue to monitor the machine for a while as it idles.
- If it runs perfectly, connect a load. Check that it runs smoothly.
  Read off and document the values for voltage, current, and power.
  Where possible, read off corresponding values for the driven machine and document them as well.
- Monitor the bearing temperature, winding temperature, etc. until the system reaches a steady state.
  Document these, provided this is possible with existing measuring instruments.

Operation 8

When carrying out any work on the machine, observe the general safety instructions (Page 113) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

8.1 Safety instructions

8.1.1 Safe handling

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

Also observe the following to prevent accidents:

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

WARNING

Live parts

Electric machines contain live parts.

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

- Always observe the “five safety rules" (Page 113) 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" (Page 177).

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.

Switching on the machine

DANGER

Hazardous voltages

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

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

NOTICE

Damage to the machine or premature bearing failure

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

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

WARNING

Faults in operation

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

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

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

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

NOTICE

Risk of corrosion due to condensation

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

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

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

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

CAUTION

Machine overheating

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

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

See also

Converter operation (Page 132)

8.1.2 Operating UL-certified machines with a converter

Note

Operating a machine with a converter

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

8.1.3 Safety instruction regarding cooling and ventilation

8.1.3.1 Safety instructions when operating machines with fan

CAUTION

Risk of injury when touching the fan

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

- Do not touch the rotating fan.
- Do not put your fingers into the larger air discharge openings.
- Manual intervention must be prevented on the customer's side by using suitable measures, e.g. appropriate housings or a protective grating.

8.1.3.2 Safety instruction regarding forced ventilation/external fan (optional)

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

WARNING

Risk of burning

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

- Never commission the machine without an external fan.

8.1.3.3 Machines with textile fan covers

In order to guarantee an essentially unobstructed flow of cooling air containing fluff, remains of materials or similar dirt, machines with a fan cover for textile applications have a larger air discharge cross-section between the edge of the cover and the cooling ribs of the machine frame.

These machines have a warning sticker on the fan cover.

8.1.4 Stoppages

Longer non-operational periods

Note

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

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

Switching on the anti-condensation heater

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

Taking the machine out of service

Details regarding the necessary measures, Chapter Preparing for use (Page 127).

Lubricating before recommissioning

NOTICE
Dry running bearings Bearings can be damaged if they do not have sufficient grease. • Re-grease the bearings if they have been out of service for more than one year. The shaft must rotate so that the grease can be distributed in the bearings. Observe the data on the lubricant plate. Chapter Storage (Page 181).

8.2 Faults

Note

Before removing any faults, please read the information in Chapter Safety information (Page 113).

Note

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

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

Table 8- 1 Electrical influences

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

(1) As well as eliminating the cause of the fault (as described under "Remedial measures"), you must also rectify any damage the machine may have suffered.

Table 8- 2 Mechanical effects

				Mechanical fault characteristics	
↓				Grinding noise	
	↓			Overheating	
		↓		Radial vibrations	
			↓	Axial vibrations	
				Possible causes of faults	**Remedial measures**[1)]
X				Rotating parts are grinding	Determine cause and adjust parts concerned
	X			Reduced air supply, fan possibly rotating in the wrong direction	Check airways, clean machine
		X		Rotor not balanced.	Check feather key declaration (H, F, N)
		X		Rotor out of true, shaft bent	Please consult the manufacturer.
		X	X	Poor alignment	Align machine set, check coupling. [2)]
		X		Coupled machine not balanced	Re-balance coupled machine
			X	Surges from coupled machine	Inspect coupled machine
		X	X	Imbalance originating from gearing	Adjust/repair gearing
		X	X	Resonance in the overall system (comprising machine and foundation)	Reinforce foundation following consultation
		X	X	Changes in foundation	Determine cause of changes; eliminate if necessary; realign machine

1) In addition to the cause of the fault (according to remedial measures), also eliminate the damage caused to the machine, if necessary.
2) Note any changes that take place while the temperature is rising.

8.3 Deactivating

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

Maintenance 9

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

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

When carrying out any work on the machine, observe the general safety instructions (Page 113) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

Note

Service Center

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

9.1 Safety instructions for inspection and maintenance

WARNING

Rotating and live parts

Electric machines contain live and rotating parts. Fatal or serious injuries and substantial material damage can occur if maintenance work is performed on the machine when it is not stopped or not de-energized.

- Perform maintenance work on the machine only when it is stopped. The only operation permissible while the machine is rotating is regreasing the roller bearings.
- When performing maintenance work, comply with the five safety rules (Page 113).

WARNING

Machine damage

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

Perform regular maintenance on the machine.

CAUTION

Dust disturbances when working with compressed air

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

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

NOTICE

Damage to insulation

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

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

NOTICE

Machine damage caused by foreign bodies

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

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

Note

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

9.2 Preparation and notes

9.2.1 North American market (optional)

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

Underwriters Laboratories

Canadian Standard Association

Canadian Standard Association Energy Efficiency Verification

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

9.3 Inspection

Note

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

Note

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

9.3.1 First inspection after installation or repair

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

Table 9- 1 Checks after assembly or repair

Check	When the motor is running	At stand-still
The stated electrical characteristics are being observed.	X	
The permissible bearing temperatures are not exceeded (Page 161).	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.

9.3.2 Main inspection

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

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

Checking	When the motor is running	At stand-still
The electrical parameters are maintained	X	
The permissible bearing temperatures are not exceeded (Page 161)	X	
The smooth running characteristics and machine running noise have not deteriorated	X	
The motor foundation has no cracks and indentations (*)	X	X
The machine is aligned within the permissible tolerance ranges		X
All the fixing bolts/screws for the mechanical and electrical connections have been securely tightened		X
All the potential connections, grounding connections and shield supports are correctly seated and properly bonded		X

Checking	When the motor is running	At stand-still
The winding insulation resistances are sufficiently high		X
Any bearing insulation is fitted as shown on the plates and labels		X
The CABLES and insulating parts and components are in good condition and there is no evidence of discoloring		X

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

NOTICE

Machine damage

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

9.4 Maintenance

9.4.1 Maintenance intervals

CAUTION

Skin irritations and eye inflammations

Many greases can cause skin irritations and eye inflammations.

- Follow all safety instructions of the manufacturer.

The machines are equipped with permanently lubricated roller bearings. A regreasing device is optional.

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

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

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

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

Measures, intervals and deadlines

Measures after operating period intervals or deadlines have elapsed:

Table 9- 3 Operating period intervals

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

9.4.2 Re-greasing

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

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

Note

It is not permissible to mix different types of grease.

Prolonged storage periods reduce the useful lifetime of the bearing grease. Check the condition of the grease if the equipment has been in storage for more than 12 months. If the grease is found to have lost oil content or to be contaminated, the machine must be immediately relubricated before commissioning. For information on permanently-greased bearings, please refer to the section titled Storage (Page 181).

Procedure

To relubricate the roller bearings, proceed as follows:

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

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

9.4.3 Cleaning

Cleaning the grease ducts and spent grease chambers

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

Note

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

Cleaning the cooling air ducts

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

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

NOTICE

Damage to the machine

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

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

Note

Please note the safety instructions for cleaning (Page 179).

9.4.4 Cleaning machines with cover for the textile industry

In the case of machines with fan covers for the textile industry, regularly remove fluff balls, fabric remnants, and similar types of contamination (particularly at the air passage opening between the fan cover and cooling fins of the machine enclosure) to ensure that the cooling air can flow without obstruction.

9.4.5 Drain condensate

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

WARNING

Hazardous voltage

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

Note the following to maintain the degree of protection:

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

NOTICE

Reduction of the degree of protection

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

9.5 Corrective maintenance

When carrying out any work on the machine, observe the general safety instructions (Page 113) and the specifications contained in EN 50110-1 regarding safe operation of electrical equipment.

WARNING

Explosion hazard when carrying out repair work

Repairs are only permissible within the scope of the work described in these operating instructions. Otherwise an explosion can occur in an explosive atmosphere. This can result in death, serious injury or material damage.

For repairs to go beyond this scope, please contact the Service Center.

9.5.1 Storage

Refer to the rating plate or the catalog for the designations of the bearings being used.

Bearing lifetime

Prolonged storage periods reduce the useful lifetime of the bearing grease. For permanently lubricated bearings, this reduces the bearing service life.
We recommend that the bearings or grease are replaced after a storage time of 12 months; if the time exceeds 4 years, replace the bearings or the grease.

Replacing bearings

Recommended interval after which bearings are to be replaced under normal operating conditions:

Table 9- 4 Bearing replacement intervals

Ambient temperature	Principle of operation	Bearing replacement intervals
40 °C	Horizontal coupling operation	40 000 h
40 °C	With axial and radial forces	20 000 h

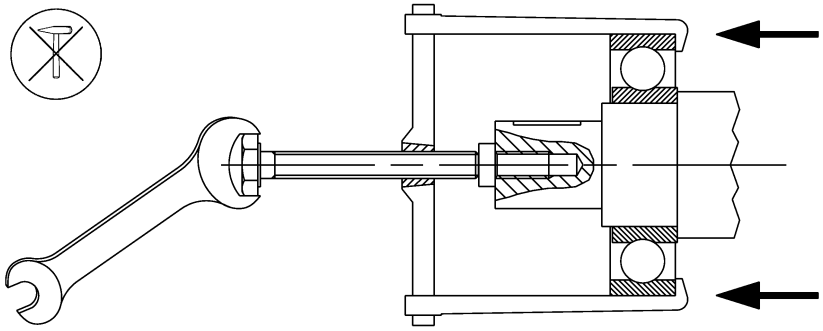
- Do not reuse bearings that have been removed.
- Remove the dirty spent grease from the bearing shield.
- Replace the existing grease with new grease.
- Replace the shaft seals when the bearings are replaced.
- Slightly grease the contact surfaces of the sealing lips.

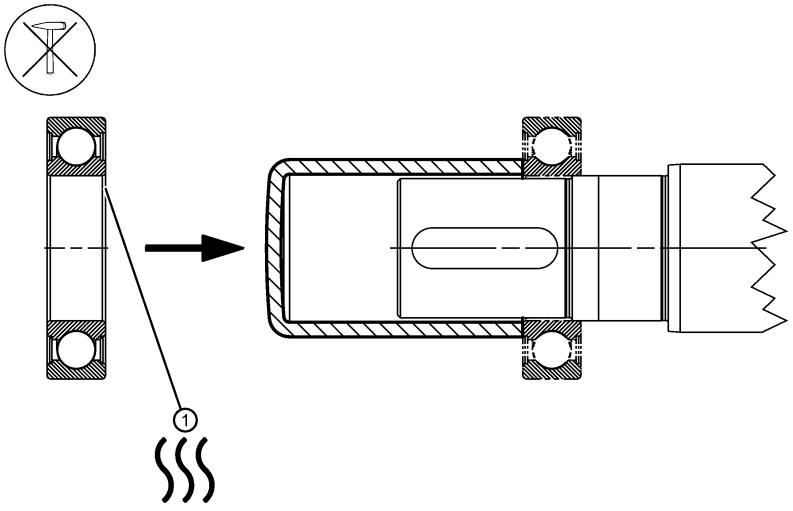
Note

Special operating conditions

The operating hours are reduced, e.g.

- When machines are vertically mounted.
- High vibration and surge loads
- Frequent reversing operation
- Higher ambient temperatures.
- High speeds etc.





① Heat up 80 ... 100 °C

9.5.2 Dismantling

Note

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

9.5.2.1 Bearing bushes

Protect the bearings against the ingress of dirt and moisture.

9.5.2.2 Links

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

9.5.3 Assembly

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

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

Sealing measures

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

9.5.3.1 Fitting the bearing cartridges

When fitting the bearing cartridges, observe the specified screw tightening torques (Page 186).

9.5.3.2 Fitting bearings

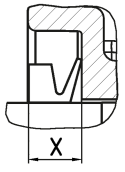
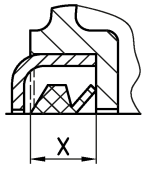
Sealing the bearings

Note the following details:

- Shaft sealing rings are used to seal machines at the rotor shaft.
  - For V rings, comply with the assembly dimension.
- Use the specified bearings.
- Ensure that the bearing sealing disks are in the correct position.
- Insert the elements for bearing preloading at the correct end.
- Fixed bearings can have a locking ring or bearing cover.
- Seal the bearing cap screws with the appropriate gaskets or with grease.
- Do not interchange the position of the bearing covers (DE and NDE or inner and outer).

9.5.3.3 Mounting dimension "x"

Mounting dimension "x" of V rings

<table>
<tr><th>Frame size</th><th colspan="2">X
[mm]</th></tr>
<tr><td>315</td><td rowspan="2">13.5 ±1.2</td><td>Standard design
 
</td></tr>
<tr><td>355</td><td>Special design
 
</td></tr>
</table>

9.5.3.4 Mounting fans

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

9.5.3.5 Canopy; mounting a rotary pulse encoder under the canopy

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

9.5.3.6 Reassembly: Miscellaneous information

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

9.5.4 Screw lock washers

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

Locking and sealing elements must always be replaced!

9.5.5 Electrical connections - Termincal board connections

Table 9- 5 Tightening torques for electrical connections on the terminal board

	Thread ∅		M 3,5	M 4	M 5	M 6	M 8	M 10	M 12	M 16
	Nm	min	0,8	0,8	1,8	2,7	5,5	9	14	27
		Max.	1,2	1,2	2,5	4	8	13	20	40

9.5.6 Cable glands

Note

Avoid damaging the cable jacket.

Adapt the tightening torques to the cable jacket materials.

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

Table 9- 6 Tightening torques for cable glands

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

9.5.7 Terminal boxes, end shields, grounding conductors, sheet metal fan covers

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

Table 9- 7 Tightening torques for screws on the terminal box, end shields, screw-type grounding conductor connections

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

9.5.8 Mounting a brake (optional)

Table 9- 8 Assigning standard brakes for 1LE5 machines

Frame size (FS)	Brake type	Size assignment of the brakes
315	SFB 205-SH	250
355	SFB 400-SH	400

Spare parts 10

10.1 Parts order

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

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

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

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

10.2 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.automation.siemens.com/sow).

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

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

10.3 Parts groups definition

A distinction is made between the following groups of parts:

Spare parts

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

Repair parts

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

Standardized parts

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

Other parts

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

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

- For up to 3 years after the delivery of the original machine, in the event of total machine failure, Siemens will supply a comparable replacement machine with regard to the mounting dimensions and functions; it is possible that this will involve a new series.
- If a replacement machine is supplied within the 3 year period, this does not mean that the warranty restarts.
- Replacement machines delivered after the active production of the machine series are also identified as spare motors on the rating plate.
- Spare parts are offered only for these spare motors on request; repair and replacement are not possible.
- After a period of 3 years (after the delivery of the original machine), it is only possible to repair these machines (depending on the availability of the spare parts required).
- For up to 5 years after the delivery of the original motor, spare parts will be available and for a further 5 years, Siemens will provide information about spare parts and will supply documents when required.

10.4 Ordering example

Table 10- 1 Ordering example

End shield, drive end	1.40 End shield
Machine type *	1LE5504-3AB73-4AB0
Ident: No. *	UD 1504/156750601

* corresponding to the rating plate

Take the type and serial number from the rating plate and the machine documentation.

When replacing rolling-contact bearings, in addition to the bearing identification code, the replacement code for the bearing version is required. Both of these codes are specified on the rating plate and in the machine documentation. They are also shown on the installed bearings.

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

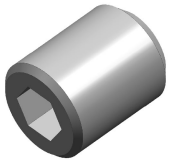
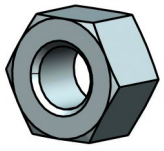
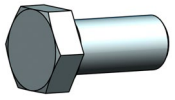
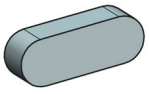
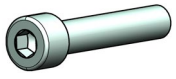
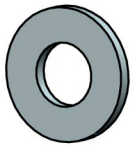
10.5 Machine parts

Part	Description	Part	Description
1.00	**DE bearings**	5.54	O ring
1.30	Bolt	5.55	Nut
1.40	End shield	5.58	Mounting rail
1.43	Shaft sealing ring	5.59	Connecting bar
1.46	Cover ring	5.60	Terminal board screw
1.49	Bolt	5.63	Mounting rail
1.58	Spring washer	5.68	Sealing plugs
1.60	Roller bearing	5.76	Clamping plate / contact bracket
1.62	Sealing plug	5.78	Spring washer
1.64	Bearing cover NDE, inner	5.79	Screw
1.65	Grease nipple	5.84	Terminal box cover
3.00	**Rotor, complete**	5.89	Bolt
3.38	Featherkey	5.96	Sealing plug
4.00	**Stator, complete**	5.99	Adapter plate
4.04	Eyebolt	**6.00**	**Bearings, NDE**
4.38	Spring washer	6.02	Locking ring
4.39	Grounding screw (self-tapping screw)	6.10	Roller bearings
4.41	Grounding lug	6.20	Bearing shield
5.00	**Terminal box, complete**	6.23	Shaft sealing ring
5.06	Mounting rail	6.24	Bearing cover NDE, inner
5.10	Complete terminal board	6.25	Lubrication sleeve
5.11	Terminal block	6.29	Screw
5.13	Link rail	6.65	Grease nipple
5.18	Spring washer	6.74	Sleeve
5.36	Spring washer	6.75	Bolt
5.37	Spring washer	**7.00**	**Complete ventilation**
5.44	Upper section of the terminal box	7.04	Fan
5.45	Housing	7.40	Fan cover
5.46	Screw	7.49	Bolt
5.49	Screw		

Tools for mounting and withdrawing roller bearings; fans and output transmission elements cannot be supplied.

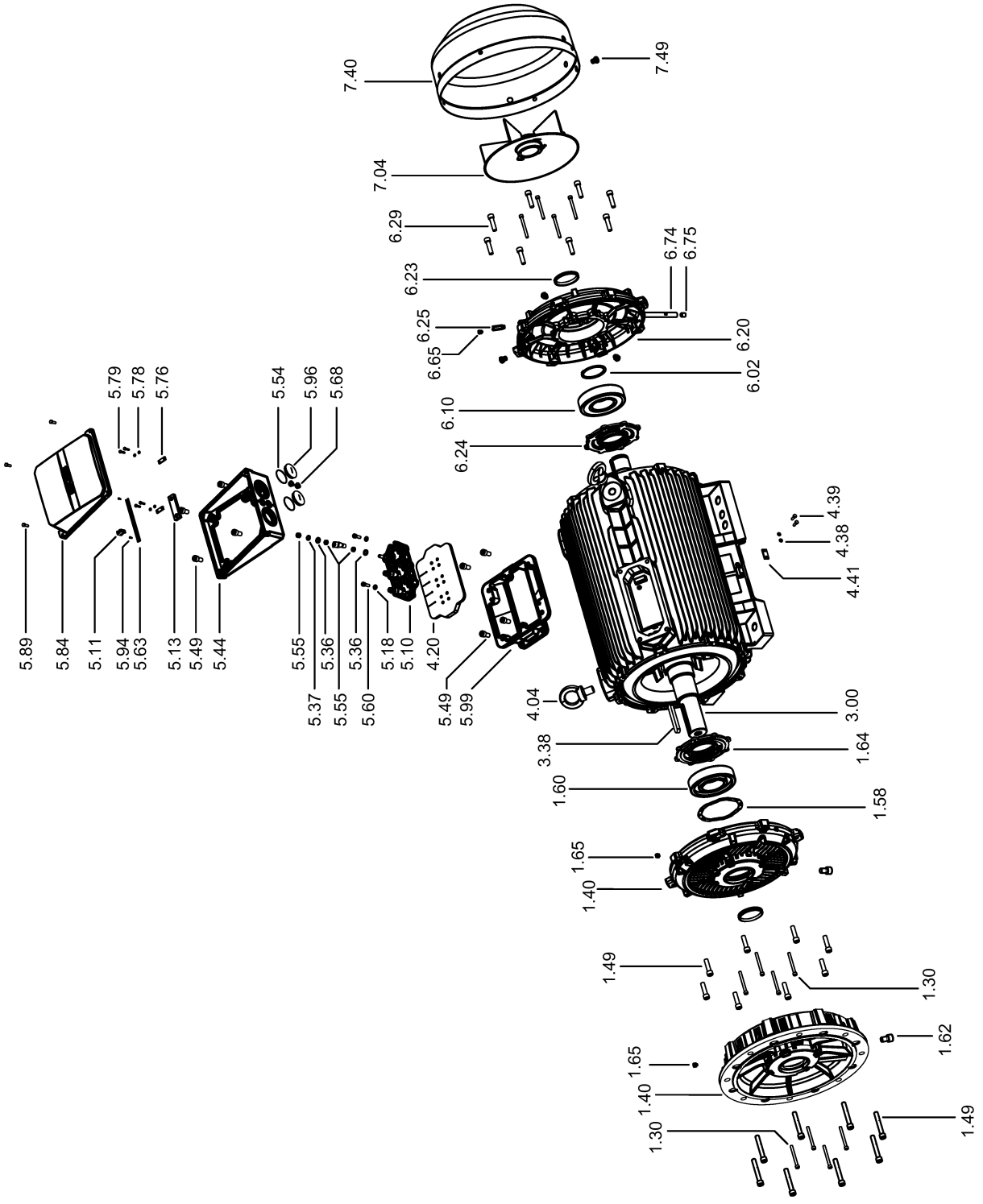
10.6 Standardized parts

Table 10- 2 Purchase standard parts according to dimensions, material and surface properties through normal commercial channels.

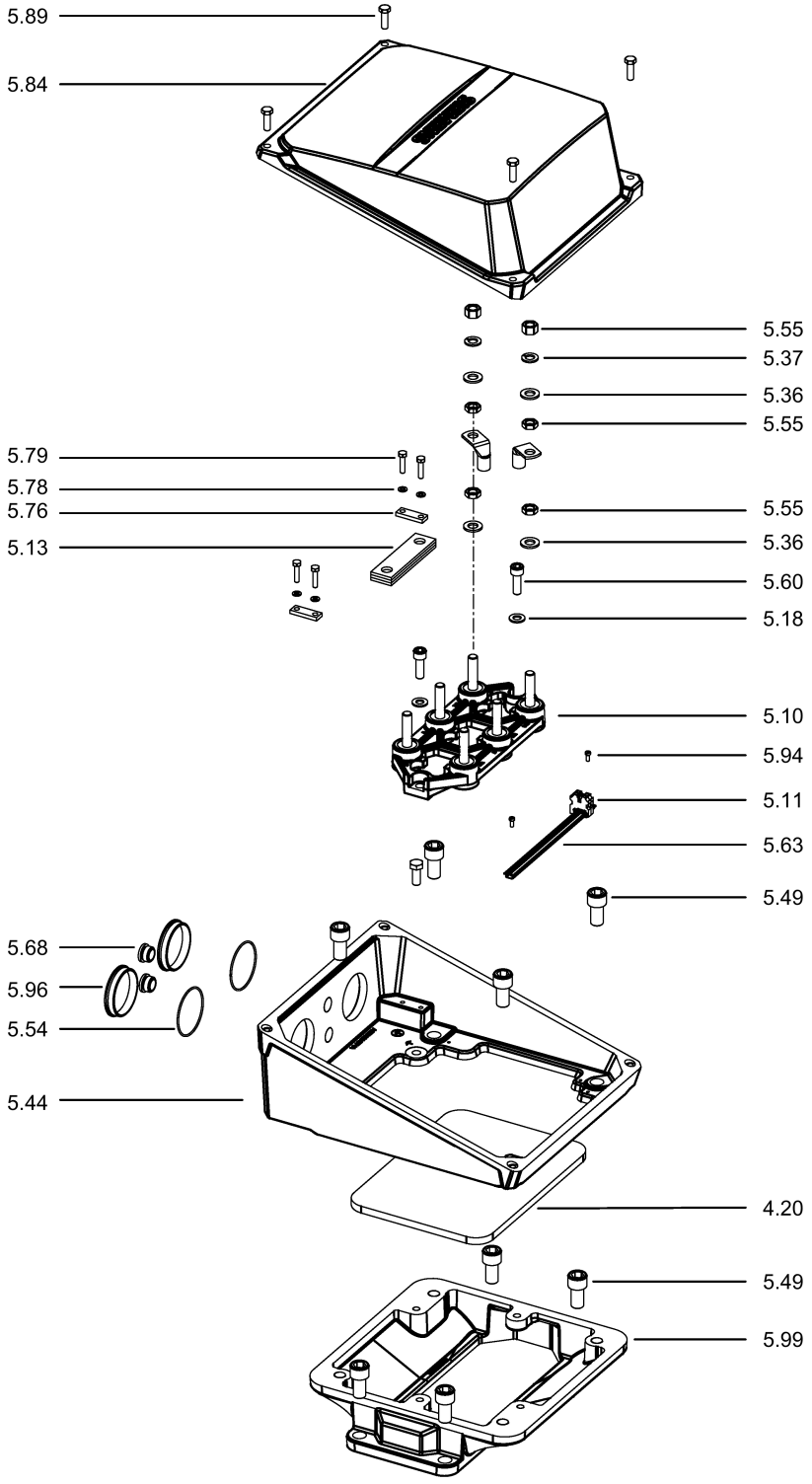
No	Standard	Picture	No	Standard	Picture
6.02	DIN 471		6.75	EN ISO 4026	
4.04	DIN 580		5.55	EN ISO 4032	
1.60 6.10	DIN 625		4.39 5.79 5.89	EN ISO 4017	
3.38	DIN 6885		1.30 1.49 5.46 5.49 5.60 6.29 7.49	EN ISO 4762	
			5.18 5.36	EN ISO 7089	

10.7 Exploded drawings

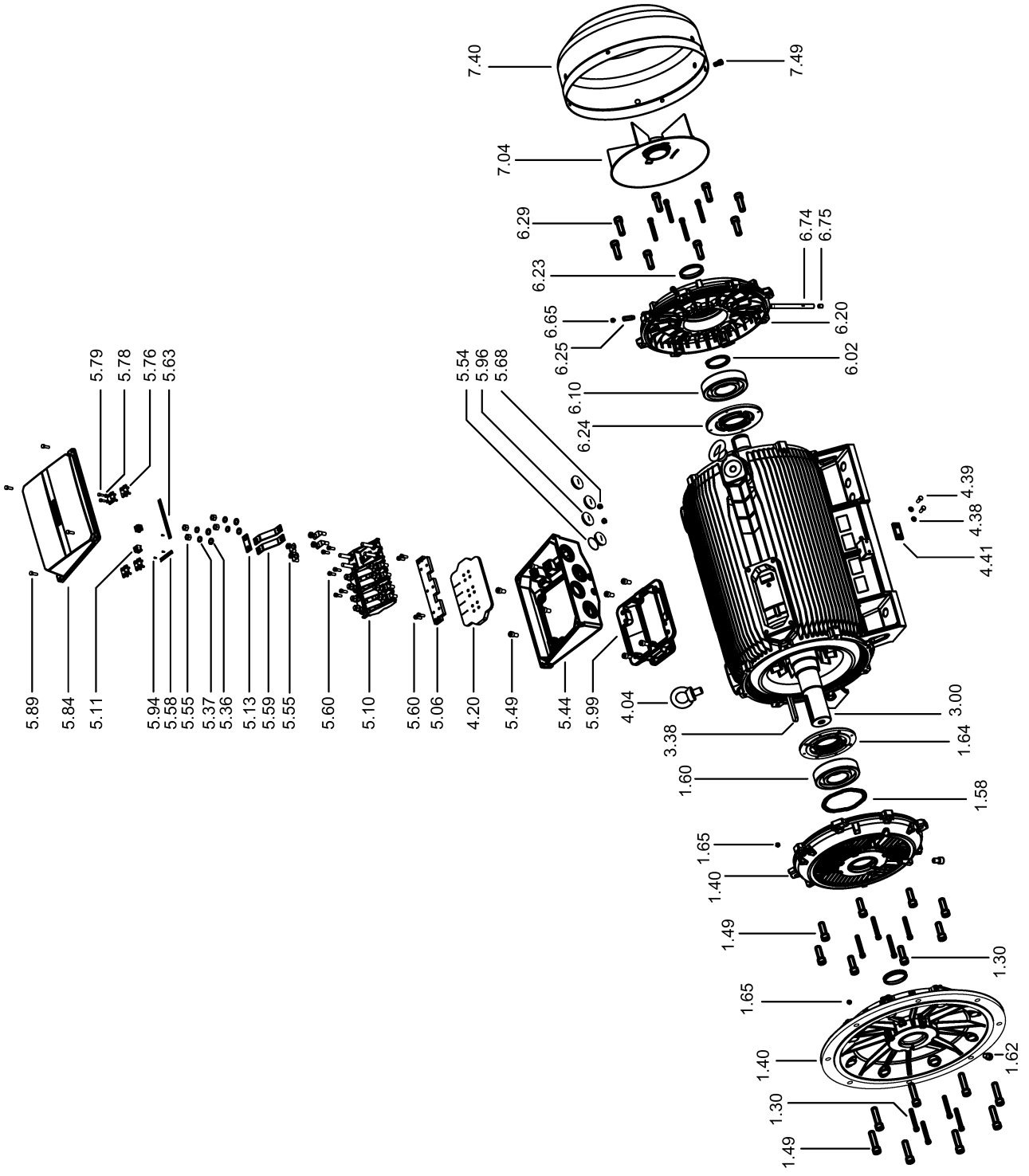
10.7.1 1LE5 FS 315



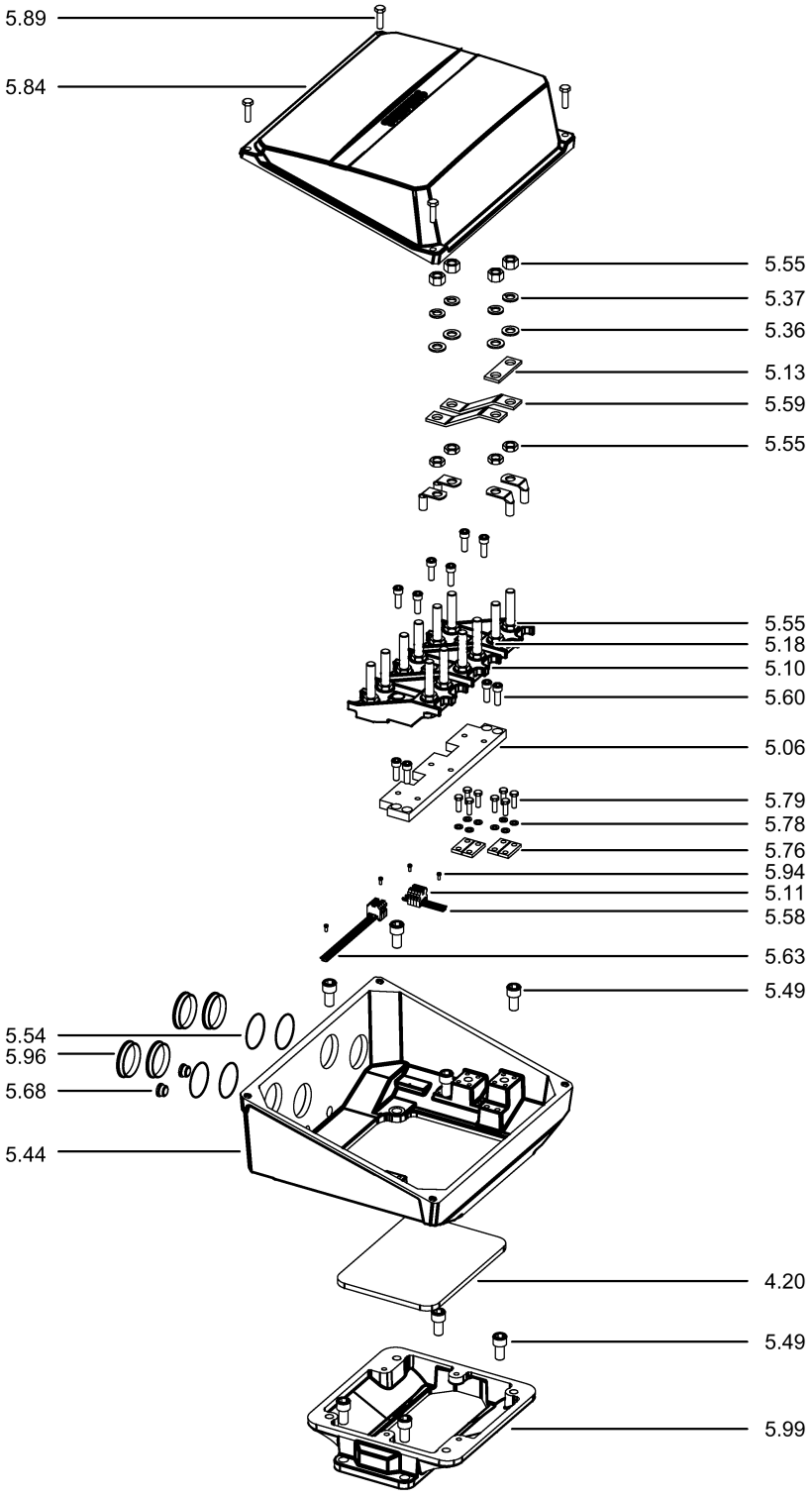
10.7.2 Terminal box FS 315



10.7.3 1LE5 FS 355



10.7.4 Terminal box FS 355



11 Disposal

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

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

11.1 RoHS - restricting the use of certain hazardous substances

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

11.2 Country-specific legislation

Note

Country-specific legislation

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

11.3 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 113).
3. Disconnect all electrical connections and remove all cables.
4. Remove all liquids such as oil and cooling liquids. Collect the liquids separately and dispose of them in a professional manner.
5. Detach the machine fixings.
6. Transport the machine to a suitable location for disassembly.

See also

Corrective maintenance (Page 180)

11.4 Dismantling the machine

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

WARNING

Machine parts can fall

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

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

11.5 Disposal of components

Components

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

Sort the components for recycling according to whether they are:

- Iron and steel
- Aluminum
- Non-ferrous metal, e.g. windings

  The winding insulation is incinerated during copper recycling.
- Insulating materials
- Cables and wires
- Electronic waste

Process materials and chemicals

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

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

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

Packaging material

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

Service & support

A

Technical questions or additional information

If you have any technical questions or 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/your contact

See also

Technical Support (https://support.industry.siemens.com/cs/ww/en/sc/2090)

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.

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