

SIEMENS

For use in Zone 1 (IEC/EN 60079-10-1)

CE⁰¹⁵⁸ Ex II 2G Ex db eb IIC T. Gb

Optional: For use in Zone 21 (IEC/EN 60079-10-2)

CE⁰¹⁵⁸ Ex II 2D Ex tb IIIC T... °C Db

Optional: For use in Zone 22 (IEC / EN 60079-10-2)

CE⁰¹⁵⁸ Ex II 3D Ex tc IIIB T... °C Dc

Operating Instructions

Low-voltage motors

SIMOTICS XP

1MB155 / 1MB555

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Low-voltage motors

SIMOTICS XP 1MB155 / 1MB555

Operating Instructions

<u>Introduction</u>	1
<u>Safety information</u>	2
<u>Description</u>	3
<u>Preparations for use</u>	4
<u>Assembly</u>	5
<u>Electrical connection</u>	6
<u>Start-up</u>	7
<u>Operation</u>	8
<u>Maintenance</u>	9
<u>Spare Parts</u>	10
<u>Disposal</u>	11
<u>Service and Support</u>	A
<u>Technical data</u>	B
<u>Quality documents</u>	C

For use in Zone 1 (IEC / EN 60079-10-1)

Optional:


For use in Zone 21 (IEC/EN 60079-10-2)


For use in Zone 22 (IEC / EN 60079-10-2)


Legal information

Warning notice system

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

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

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

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

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


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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

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

Trademarks

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Disclaimer of Liability

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

Table of contents

1	Introduction.....	9
1.1	About these instructions	9
1.2	Compiling personal documents	9
2	Safety information.....	11
2.1	Information for those responsible for the plant or system.....	11
2.2	The five safety rules.....	12
2.3	Qualified personnel	12
2.4	Safe handling	12
2.5	Electromagnetic fields when operating electrical power engineering installations.....	14
2.6	Use in hazardous areas.....	15
2.7	Electrostatic sensitive devices	15
2.8	Electromagnetic compatibility	17
2.9	Interference immunity	17
2.10	Influence on the line power supply through a strongly irregular torque.....	17
2.11	Interference voltages when operating the converter	17
2.12	Special designs and construction versions.....	18
2.13	Special conditions for explosion-proof machines	18
3	Description.....	19
3.1	Area of application	19
3.2	Rating plates	21
3.3	Design	22
3.3.1	Cooling and ventilation	24
3.3.1.1	Machines with a fan	24
3.3.2	Bearings.....	24
3.3.3	Balancing	25
3.3.4	Types of construction/method of installation	25
3.3.5	Degree of protection	27
3.3.6	Environmental conditions.....	27
3.3.7	Optional built-on and built-in accessories.....	27
3.3.8	Identification.....	28
3.3.8.1	Zone 1 with Ex db IIC Gb type of protection (flameproof enclosure "d" for the machine)	28
3.3.8.2	Zone 1 with type of protection Ex de IIC Gb (flameproof enclosure "d" for the machine and increased safety "e" for the terminal box).....	29
3.3.8.3	Zone 21 with type of protection Ex tb IIIC Db (equipment dust explosion protection provided by the enclosure "t").....	29

3.3.8.4	Zone 22 with type of protection Ex tc IIIB Dc (equipment dust explosion protection provided by the enclosure "t")	30
3.3.9	Terminal box	30
3.3.10	Paint finish.....	30
4	Preparations for use	31
4.1	Safety-related aspects to consider when configuring the plant	31
4.2	Observing the operating mode.....	31
4.3	Machines without final paint coating	31
4.4	Delivery	32
4.5	Transport and storage.....	32
4.5.1	Storage.....	34
4.5.2	Securing the rotor	36
4.5.3	Commissioning after storage	38
4.5.3.1	Insulation resistance and polarization index	38
4.5.3.2	Lubricating the rolling bearings	38
4.5.3.3	Regreasing rolling bearings after storage periods of up to two years	38
4.5.3.4	Releasing the rotor shipping brace before commissioning	38
4.6	Ensure adequate cooling	39
4.7	Thermal protection	41
4.8	Interlock circuit for anti-condensation heating	41
4.9	Noise emission.....	42
4.10	Voltage and frequency fluctuations during line operation.....	42
4.11	Rotational speed limit values	43
4.12	System-inherent frequencies	43
4.13	Electromagnetic compatibility	43
4.14	Converter operation	45
4.14.1	Parameterizing the converter.....	45
4.14.2	Converter input voltage.....	45
4.14.3	Reducing bearing currents when operated with a converter	46
4.14.4	Insulated bearings when operated with a converter	47
4.14.5	Tandem operation.....	48
4.14.6	Mechanical limit speeds for converter operation	48
5	Assembly	49
5.1	Preparations for installation	49
5.1.1	Requirements for installation	49
5.1.2	Insulation resistance	50
5.1.2.1	Insulation resistance and polarization index	50
5.1.2.2	Testing the insulation resistance and polarization index	51
5.2	Installing the machine	54
5.2.1	Preparing the assembly area	54
5.2.2	Balancing	55
5.2.2.1	Mounting and withdrawing output transmission elements	56
5.3	Alignment and fastening	56

5.3.1	Repainting/touching up the paint finish of explosion-protected machines.....	57
5.3.2	Measures for alignment and mounting	57
5.3.3	Flatness of the supporting surfaces for conventional motors	58
5.4	Installing the machine	58
5.4.1	Preconditions for smooth, vibration-free operation.....	58
5.4.2	Aligning the machine to the driven machine and mounting	59
5.4.2.1	Selecting bolts.....	59
5.4.2.2	Horizontal types of construction with mounting feet	59
5.4.2.3	Horizontal types of construction with flange	59
5.4.2.4	Vertical types of construction with flange	60
5.4.3	Removing the rotor shipping brace.....	60
5.4.4	Recommended alignment accuracy	61
5.4.5	Mounting the output elements	62
5.4.6	Axial and radial forces	63
6	Electrical connection.....	65
6.1	Preparation	65
6.1.1	Selecting cables.....	65
6.2	Connecting the machine	66
6.2.1	Terminal box	66
6.2.1.1	Terminal designation.....	67
6.2.1.2	Circuit diagram inside the terminal box cover.....	67
6.2.1.3	Direction of rotation.....	67
6.2.1.4	Documenting holes in the terminal box.....	68
6.2.1.5	Cable entry.....	68
6.2.1.6	Thread sizes in terminal box Ex e and Ex d	69
6.2.2	Minimum air clearances.....	69
6.2.3	Internal equipotential bonding.....	70
6.3	Tightening torques	70
6.3.1	Terminal board and grounding.....	70
6.3.2	Stud-type bushings	70
6.3.3	Additional connecting terminals for monitoring equipment and anti-condensation heating	70
6.3.4	Cable entries, sealing plugs and thread adapters	71
6.4	Connecting the grounding conductor.....	71
6.4.1	Grounding connection type.....	72
6.5	Connecting the temperature sensor/anti-condensation heater	74
6.5.1	Connecting optional integrated devices and equipment.....	74
6.5.2	Auxiliary circuit connection	74
6.6	Conductor connection	75
6.6.1	Cable ends with wire end sleeves	77
6.6.2	Connecting aluminum conductors	77
6.7	Connecting converters.....	78
6.7.1	Connecting explosion-proof machines to the converter	78
6.8	Final checks	79

7	Start-up	81
7.1	Measures before commissioning	81
7.1.1	Insulation resistance and polarization index	83
7.1.2	Testing the insulation resistance and polarization index	84
7.1.3	Testing the cooling of the machine	86
7.1.4	Commissioning an external fan	87
7.1.5	Setpoint values for monitoring the bearing temperature	88
7.1.6	Further documents	88
7.2	Switching on	89
7.2.1	Test run	90
8	Operation	93
8.1	Safety instructions for operation	93
8.1.1	Safe handling	93
8.1.2	Safety instructions during operation	95
8.1.3	Safety note for ventilation	97
8.1.4	Bridging insulated bearings	98
8.1.5	Switching on with the anti-condensation heating active	98
8.2	Switching on the machine	99
8.3	Switching off the external fan	99
8.4	Switching on again after an emergency switching-off	99
8.5	Stoppages	99
8.5.1	Avoidance of damage to rolling bearings during stoppages	101
8.5.2	Decommissioning the machine	101
8.5.3	Re-commissioning the machine	102
8.6	faults	102
8.6.1	Inspections in the event of faults	102
8.6.2	Electrical faults	102
8.6.3	Mechanical faults	104
8.6.4	Rolling bearing faults	105
8.6.5	Faults at the external fan	105
9	Maintenance	107
9.1	Inspection and maintenance	107
9.1.1	Safety instructions for inspection and maintenance	107
9.1.2	Static charging when cleaning	110
9.1.3	Inspections in the event of faults	110
9.1.4	First inspection	110
9.1.5	General inspection	111
9.1.6	Assessing the rolling bearings	111
9.1.7	Bolt grade	112
9.1.8	Mechanical explosion protection for rolling bearings	112
9.1.9	Maintenance	113
9.1.9.1	Explosion protection for machines with type of protection "Ex d"	113
9.1.9.2	Explosion hazard due to increased surface temperature	113
9.1.9.3	Insulation resistance and polarization index	113
9.1.9.4	Regreasing intervals and types of grease for operating rolling-contact bearings	114
9.1.9.5	Cleaning	115
9.1.9.6	Maintenance and repair for machines of protection type "Ex d/Ex db"	116

9.1.9.7	Maintaining the external fan (forced ventilation).....	117
9.1.9.8	Maintaining terminal box "Ex d"	118
9.1.9.9	Repainting.....	118
9.2	Corrective Maintenance	119
9.2.1	Extended motor marking.....	119
9.2.2	Anti-condensation heating	120
9.2.3	Installing rolling bearings	121
9.2.4	Shaft sealing, mounting dimension "L"	123
9.2.5	Insulated roller bearings	123
9.2.6	O-ring seal	123
10	Spare Parts.....	125
10.1	Parts order	125
10.2	Ordering data	125
10.3	Ordering spare parts via the Internet.....	126
10.4	Roller bearings.....	126
10.5	Anti-condensation heating	126
10.6	Parts groups definition	126
10.7	Ordering example	128
10.8	Machine parts	128
10.9	Standardized parts.....	130
10.10	Exploded drawings.....	131
10.10.1	Frame sizes 71 ... 132	131
10.10.2	Frame sizes 160 ... 225	132
10.10.3	Frame sizes 250 ... 355	133
10.10.4	Ex e terminal box frame sizes 71 ... 225.....	134
10.10.5	Ex e terminal box frame sizes 250 ... 355	135
10.10.6	Auxiliary terminal box Ex e optional, frame size 160 ... 355.....	136
11	Disposal.....	137
11.1	RoHS - restricting the use of certain hazardous substances	137
11.2	Preparing for disassembly	137
11.3	Dismantling the machine	138
11.4	Disposal of components	138
A	Service and Support	141
B	Technical data	143
B.1	Tightening torques for screw and bolt connections	143
C	Quality documents.....	145
C.1	Quality documents SIMOTICS in SIOS	145
	Index.....	147

Introduction

1.1 About these instructions

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

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

Please contact the service center (Page 141) 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. Carefully comply with all of the safety-relevant information in these instructions and attached to the product itself.

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

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

Note

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

1.2 Compiling personal documents

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

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

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

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

The full functionality is only available for registered users.

Safety information

2.1 Information for those responsible for the plant or system

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

The persons responsible for the plant must ensure the following:

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

Note

Use the services and support provided by the local service center for planning, installation, commissioning and service work.

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

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

Explosion Protection Directive

This machine has been designed, built and tested in accordance with Directive 2014/34/EU ("Explosion Protection Directive") and is intended for use in industrial plants with a potentially explosive atmosphere. Commissioning the machine in hazardous zones is absolutely prohibited until conformance with these guidelines has been proven based on the appropriate certificate. If the machine is commissioned prior to determining the conformance, then explosion protection is not ensured. An explosion can occur. This can result in death, serious injury or material damage.

Please observe the country-specific regulations when using the machine outside the European Community.

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 12) when carrying out any work on the machine.
- Only remove covers in the manner described in the operating instructions.
- Operate the machine properly.
- Regularly and professionally maintain the machine according to the instructions provided in the "Maintenance" (Page 113) chapter of the operating instructions.

! WARNING

Rotating parts

Electric machines contain dangerous rotating parts.

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

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

! WARNING

Hot surfaces

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

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

! CAUTION

Hazardous substances

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

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

 CAUTION

Flammable substances

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

Burns and other damage to health and material may result.

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

During operation, the machine's noise emission levels can exceed those permitted at the workplace, which can cause hearing damage.

- Take steps to reduce noise, such as introducing covers and protective insulation or adopting hearing protection measures, so that the machine can be operated safely within your system.

 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).

2.5 Electromagnetic fields when operating electrical power engineering installations

Interference to electronic devices caused by electrical power equipment

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

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

2.6 Use in hazardous areas

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

Note

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

Ignition hazards

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

Note

The basic requirements relating to the assessment of ignition hazards arising from electrical equipment and their operation in hazardous zones are specified in the 2014/34/EU and 1999/92/EC directives as well as in the IEC/EN 60079 series of standards.

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

The certificate must be available before commissioning.

2.7 Electrostatic sensitive devices

Material damage due to electrostatic discharge

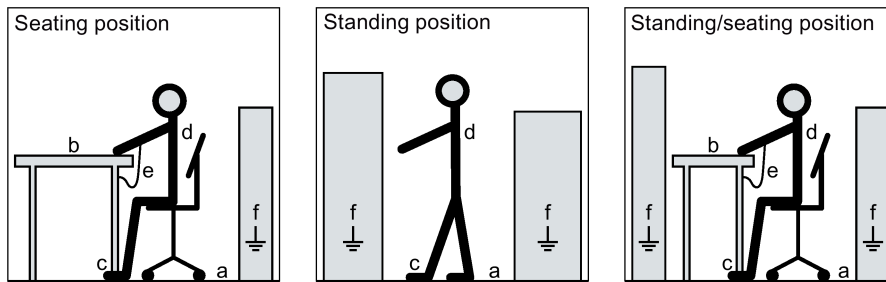
Electronic modules contain components that can be destroyed by electrostatic discharge. These components can be damaged or destroyed if they are not handled correctly. To protect equipment against damage, follow the instructions given below.

- Only touch electronic modules if you absolutely have to work on them.
- The body of the person concerned must have been electrostatically discharged and grounded immediately before any electronic modules are touched.

2.7 Electrostatic sensitive devices

- Electronic modules should not be brought into contact with electrically insulating materials, such as:
 - Plastic film
 - Plastic parts
 - Insulating table supports
 - Clothing made of synthetic fibers
- Always place electrostatic sensitive devices on conductive bases.
- Always pack, store and transport electronic modules or components in conductive packaging, such as:
 - Metallized plastic or metal containers
 - Conductive foam material
 - Domestic aluminum foil

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



a = conductive floor surface

b = ESD table

c = ESD shoes

d = ESD overall

e = ESD wristband

f = cabinet ground connection

Risk of explosion due to electrostatic discharge

Electrostatic discharge poses a potential ignition source. Dangerous electrostatic charges can occur, for example as a result of mechanical friction, flowing air that contains particles - or persons that are not appropriately grounded, e.g. when carrying out maintenance or cleaning work.

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

- Avoid carrying out work specified above on non-metallic parts, e.g. foam rubber for noise dampeners/attenuators.
- Please comply with ESD protective measures.

2.8 Electromagnetic compatibility

This machine is designed in accordance with IEC/EN 60034, and when used as prescribed it satisfies the requirements of European Directive 2014/30/EU on Electromagnetic Compatibility.

2.9 Interference immunity

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

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

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

2.11 Interference voltages when operating the converter

WARNING

Interference voltages when operating the converter

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

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

2.12 Special designs and construction versions

Note

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

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

2.13 Special conditions for explosion-proof machines

Special conditions for the safe application of explosion-proof machines marked with X (excerpt from the EC type-examination certificate, point 17).

Dust explosion protection "tb"

- Do not operate the motors with excessively thick deposits of dust.
- When the motors are mounted with the free shaft end pointing upwards, prevent foreign bodies from dropping into the ventilation openings using an appropriate mechanical design.
- For motors with a fixed connecting cable: The free end of the cable must be connected according to valid regulations for electrical installations.

Flameproof enclosure "db"

Flameproof joints may only be repaired strictly in accordance with the manufacturer's design specifications. Repair in accordance with the values in Table 3 of EN/IEC 60079-1: 2014 is not permitted.

For closing the flameproof compartment, bolts with a tensile strength of at least 700 N/mm² are permissible.

Description

3.1 Area of application

The three-phase machines of this series are used as industrial drives. They are designed for a wide range of drive applications both for line operation as well as in conjunction with frequency converters.

They are characterized by their high power density, extreme robustness, long service life and outstanding reliability.

Intended use of the machines

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

Note

Machine directive

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



Use of machines without CE marking

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

Use in hazardous areas

Explosion-proof electrical machines correspond to standards of the IEC/EN 60034 and IEC/EN 60079 series. Only operate the machine in hazardous areas, strictly complying with the specifications of the responsible supervisory authority. The relevant supervisory authority is responsible for determining the hazard level of each area and classifying the zones. The type of protection as well as special regulations are stamped on the rating plate or in the test certificate. If the certificate number is supplemented by an X, to safely operate the machine observe the special notes in the operating instructions or if available in the EC or EU type-examination certificate or in the IECEx Certificate of Conformity. Operation with a converter must be certified. It is essential that you observe the separate manufacturer's information and instructions.



Explosion hazard from hybrid mixtures

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

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

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

Type of protection Ex db

The machine including the terminal box has type of protection "flameproof enclosure" Ex db in accordance with IEC / EN 60079-0 and IEC / EN 60079-1 and is designed for operation in Zone 1 or Zone 2 in accordance with IEC / EN 60079-10-1.

Type of protection Ex db eb

The machine without the terminal box has type of protection "flameproof enclosure" Ex db in accordance with IEC / EN 60079-0 and IEC / EN 60079-1. The terminal box has type of protection "increased safety" Ex eb in accordance with IEC / EN 60079-0 and IEC / EN 60079-7. The machine and the terminal box are intended for use in Zone 1 or Zone 2 in accordance with IEC / EN 60079-10-1.

Type of protection Ex tb, Ex tc

Optionally, this motor has "Protection through enclosure" (Ex t) type of protection according to IEC / EN 60079-0 and IEC / EN 60079-31 . Then, it may be operated in hazardous areas of **Zones 21 and 22** in the Ex tb type of protection and **Zone 22** in the Ex tc type of protection according to IEC / EN 60079-10-2.

3.2 Rating plates

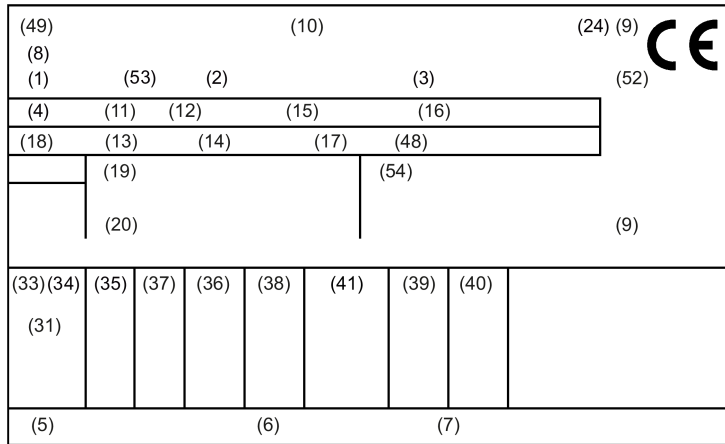
Rating plate

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.

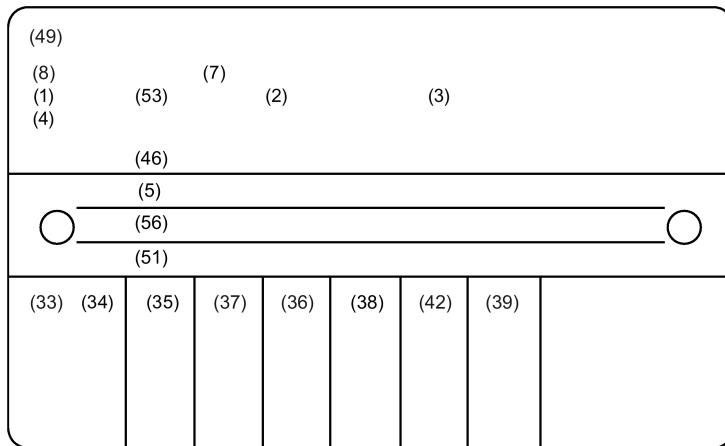
Data on the rating plate

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
9	Identification number of testing agency (optional)	40	Efficiency class
10	Regulations (optional)	41	Efficiency
49	Company logo	42	Torque Nm (optional)
52	Marine regulation	46	Operating mode (optional)
53	Machine family type	48	Anti-condensation heating (optional)
54	Data for explosion-proof machines	51	Electrical converter data
56	Converter type		
Mechanical data			
11	Frame size		
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)		
24	Feather key arrangement		

Line operation (DOL) rating plate



Converter operation (VSD) rating plate



3.3 Design

Table 3- 1 Applicable general regulations

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

Feature	Standard	EAC
Cooling	EN / IEC 60034-6	GOST R IEC 60034-6
Type of construction	EN / IEC 60034-7	GOST R IEC 60034-7
Terminal designations and direction of rotation	EN / IEC 60034-8	GOST R IEC 60034-8
Noise emission	EN / IEC 60034-9	GOST R IEC 60034-9
Starting characteristics of rotating electrical machines	EN / IEC 60034-12	GOST R IEC 60034-12
Vibration severity grades	EN / IEC 60034-14	GOST R IEC 60034-14
Efficiency classification of three-phase squirrel-cage induction motors	EN / IEC 60034-30-1	GOST R IEC 60034-30-1
IEC standard voltages	IEC 60038	GOST R IEC 60038

Table 3- 2 Regulations applied for explosion-protected machines

Feature	Standard	EAC
Electrical equipment for hazardous gas atmospheres, Part 0: General requirements	EN / IEC 60079-0	GOST 30852 0 - 2002
Electrical equipment for hazardous gas atmospheres – Part 1: Device protection provided by flameproof enclosure "d"	EN / IEC 60079-1	GOST 30852 1 - 2002
Electrical equipment for hazardous gas atmospheres, Part 7: Increased safety "e"	EN / IEC 60079-7	GOST 30852 8 - 2002
Electrical equipment for hazardous gas atmospheres, Part 14: Electric installations for endangered atmospheres (except underground excavation)	EN / IEC 60079-14	GOST 30852 13 - 2002
Electrical equipment for hazardous gas atmospheres, Part 15: Type of protection "n"	EN / IEC 60079-15	GOST 30852 14 - 2002
Electrical equipment for use in the presence of combustible dust - Part 17: Inspection and maintenance of electrical systems in hazardous areas (except underground excavation)	EN / IEC 60079-17	GOST 30852 16 - 2002
Electrical equipment for hazardous gas atmospheres, Part 19: Repairs and overhauls	EN / IEC 60079-19	GOST 30852 18 - 2002
Potentially explosive atmosphere - Part 31: Device dust explosion protection by enclosure "t"	EN / IEC 60079-31	GOST R IEC 60079-31
Directive on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in hazardous areas.	Directive 2014/34/EU	TR CU

3.3.1 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.

3.3.1.1 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.

3.3.2 Bearings

In order to support the machine shaft and maintain its position in the non-moving part of the machine, only 2 rolling bearings are used. One rolling bearing performs the function of a location bearing that transfers axial and radial forces from the rotating machine shaft to the non-moving part of the machine. The second rolling bearing is implemented as floating and support bearing in order to allow thermal expansion inside the machine and transfer radial forces.

The nominal (calculated) useful life of the bearings according to ISO 281 is at least 20,000 hours with utilization of the permissible radial/axial forces. However, the achievable useful life of the bearings can be significantly longer in the case of lower forces (e.g. operation with self-aligning couplings).

Rolling bearings with permanent lubrication are maintenance-free.

The machine is equipped with grease-lubricated rolling bearings.

- The bearings of the standard size machines (up to size 250) are permanently lubricated.
- The bearings of machines size 280 and above have a relubrication facility and automatic grease quantity control.

3.3.3 Balancing

As standard, the motor is balanced dynamically with a half feather key (code "H").
Vibration level "A" is standard and, if ordered as an option, vibration level B is specified on the rating plate.


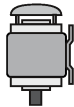

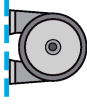
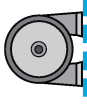
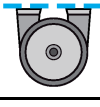
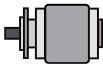
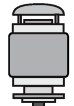

See also




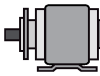

Balancing (Page 55)

3.3.4 Types of construction/method of installation

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

Table 3- 3 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)	


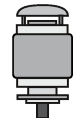
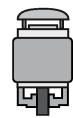
Basic type of construction code	Diagram	Other methods of installation	Diagram
IM B14 (IM 3601)		IM V18 (IM 3611)	
		IM V19 (IM 3631)	
Basic type of construction code	Diagram		
IM B35 (IM 2001)			
IM B34 (IM 2101)			

Types of construction/Installation conditions for explosion-proof machines

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

In the case of explosion-proof machines where the shaft extensions point downwards (types of construction IM V5, IM V1 or IM V18) a protective top cover is mandatory. Explosion-proof machines with IM V5, IM V1 and IM V18 types of construction are fitted with a canopy at the factory.

Table 3- 4 Construction type with protective top cover

Conditions of installation	Graphics-Based Representation
IM V5 (IM 1011)	
IM V1 (IM 3011)	
IM V18 (IM 3611)	

3.3.5 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.

Machines intended for use in Zone 1 (type of protection flameproof enclosure "db" or increased safety "eb") or in Zone 2 (type of protection "ec") are designed with IP 55 degree of protection.

Machines intended for use in Zone 21 (dust explosion protection "tb") have IP 65 degree of protection. Machines intended for use in Zone 22 (dust explosion protection "tc") have IP 55 degree of protection and can be used in dusty environments such as in grinders, silos, animal feed plants, and malhouses, as well as in certain areas of the chemical industry.

3.3.6 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 % (VV)

The standard machines are not suitable for use in corrosive atmospheres, atmospheres with a high salt content, or outdoor applications.

Limit values for the special versions

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

3.3.7 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


Note

Further documents

Observe all of the other documents provided with this machine.


Supplementary devices

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

 DANGER
<p>Risk of explosion during operation due to too high surface temperature</p> <p>This can result in death, serious injury, or material damage.</p> <ul style="list-style-type: none"> • Prevent the maximum surface temperature from being exceeded by maintaining the specified operating conditions. • Monitor the coil temperature. Use the temperature sensor that is built into the stator winding for this as specified on the rating plate or extra rating plate.


3.3.8 Identification

3.3.8.1 Zone 1 with Ex db IIC Gb type of protection (flameproof enclosure "d" for the machine)

CE	0158		II	2	G	Ex	db	IIC	T4	Gb
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪


- ① CE - or EAC marking
- ② Identification number or name of nominated testing agency
- ③ Code for prevention of explosions
- ④ Device group: II not for mines susceptible to firedamp, but other hazardous zones
- ⑤ Device category: 2 for occasional danger and for use in Zone 1
- ⑥ Atmosphere: G for gas
- ⑦ Explosion protection: International
- ⑧ Type of protection: "db" flameproof enclosure of machine for a high level of protection
- ⑨ Explosion group: IIC for acetylene
- ⑩ Temperature class: T4 for maximum surface temperature of 135° C
- ⑪ Device protection level: Gb for a high level of protection in hazardous zones with explosive gas mixtures

3.3.8.2 Zone 1 with type of protection Ex de IIC Gb (flameproof enclosure "d" for the machine and increased safety "e" for the terminal box)

CE	0158		II	2	G	Ex	db	eb	IIC	T4	Gb
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫


- ① CE - or EAC marking
- ② Identification number or name of nominated testing agency
- ③ Code for prevention of explosions
- ④ Device group: II not for mines susceptible to firedamp, but other hazardous zones
- ⑤ Device category: 2 for occasional danger and for use in Zone 1
- ⑥ Atmosphere: G for gas
- ⑦ Explosion protection: International
- ⑧ Type of protection: "db" flameproof enclosure of machine for a high level of protection
- ⑨ Type of protection: "eb" increased safety of terminal box for high protection level
- ⑩ Explosion group: IIC for acetylene
- ⑪ Temperature class: T4 for maximum surface temperature of 135° C
- ⑫ Device protection level: Gb for a high level of protection in hazardous zones with explosive gas mixtures

3.3.8.3 Zone 21 with type of protection Ex tb IIIC Db (equipment dust explosion protection provided by the enclosure "t")

CE	0158		II	2	D	Ex	tb	IIIC	T125°C	Db
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪

- ① CE - or EAC marking
- ② Identification number or name of nominated testing agency
- ③ Code for prevention of explosions
- ④ Equipment group: II not for mines susceptible to firedamp, but other hazardous zones
- ⑤ Device category: 2 for occasional danger
- ⑥ Atmosphere: D for dust
- ⑦ Explosion protection: International
- ⑧ Protection type: "tb" for protection by enclosure
- ⑨ Explosion group: IIIC for conductive dust
- ⑩ Maximum surface temperature: T 125° C
- ⑪ Device protection level: Db for a high level of protection in flammable dusty atmospheres

3.3.8.4 Zone 22 with type of protection Ex tc IIIB Dc (equipment dust explosion protection provided by the enclosure "t")

CE		II	3	D	Ex	tc	IIIB	T125°C	Dc
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

- ① CE - or EAC marking
- ② Code for prevention of explosions
- ③ Device group: II not for mines susceptible to firedamp, but other hazardous zones
- ④ Device category: 3 for infrequent, short-term danger
- ⑤ Atmosphere: D for dust
- ⑥ Explosion protection: International
- ⑦ Type of protection: "tc" for protection by enclosure
- ⑧ Explosion group: IIIB for non-conductive dust
- ⑨ Maximum surface temperature: T 125° C
- ⑩ Device protection level: Dc for an extended protection level in flammable dust atmospheres

3.3.9 Terminal box

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

3.3.10 Paint finish

Paint finish

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

Suitability test of the paint system for hazardous areas

Proof is available for the electrostatic suitability with explosion-proof machines for the paint systems ordered by default. Such evidence is not available for paint systems that are non-standard or specifically requested by customers. Take into consideration that the provided evidence is not valid for repainting.

Preparations for use

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

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

4.1 Safety-related aspects to consider when configuring the plant

A number of residual risks are associated with the machine. These are described in the chapter titled "Safety information" (Page 11) and in related sections.

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

4.2 Observing the operating mode

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

4.3 Machines without final paint coating

For machines, which are only delivered with primer, you must paint them to comply with the applicable guidelines for the specific application. The primer alone does not provide adequate corrosion protection.

The paint applied must conform to the requirements to avoid electrostatic charging, see EN 60079-0.

Please contact the Service Center for recommendations relating to the paint finish.

4.4 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.

4.5 Transport and storage

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

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

WARNING

Risk of dropping and swinging when transported suspended

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

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

 **WARNING**

Toppling over or slipping of the motor

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

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

- Never remain under or in the immediate vicinity of the machine when it is lifted. If the lifting gear or load handling attachments were to fail, the machine could fall. This can result in death, serious injury or material damage.
- In order to gain easy and safe access to the underside of the machine, place it in a secure and raised position.

Note

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

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

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

4.5.1 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.

The materials used are specially designed for the temperature range required by the customer. The relevant temperature limits are specified on the rating plate.

 WARNING
Risk of explosion due to damaged sealing materials
Storing the machine at temperatures that do not fall within the specified limits can damage the material of the seals and cause them to fail. As a result, a potentially explosive gaseous atmosphere can enter the machine and be ignited during commissioning. Explosions can occur. This can result in death, serious injury or material damage.
<ul style="list-style-type: none">• Do not store the machine in conditions that lie outside the specified temperature limits.

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. <ul style="list-style-type: none">• Protect the motor against intensive solar radiation, rain, snow, ice and dust. Use a superstructure or additional cover, for example.• If required, contact the service center, or technically coordinate outdoors use.

4.5.2 Securing the rotor

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

NOTICE

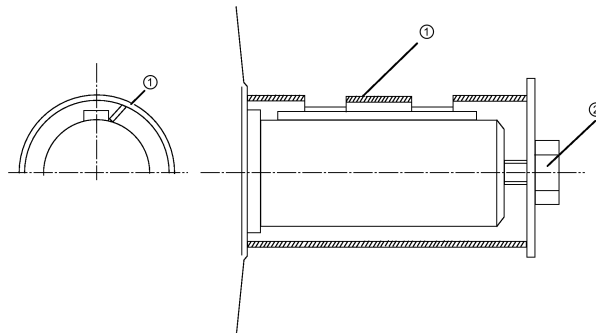
Motor damage due to vibrations

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

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

Alternative rotor bracing

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



① Sleeve

② Shaft screw and washer

Figure 4-1 Axial fastening of the rotor

Thread in the shaft extension	Tightening torque
M16	40 Nm
M20	80 Nm
M24	150 Nm
M30	230 Nm

Tightening torques for other rotor shipping brace types

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

Thread in the shaft extension	Preload
M16	13 kN
M20	20 kN
M24	30 kN
M30	40 kN

Axial preload force for other rotor shipping brace types

Store the rotor locking device

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

4.5.3 Commissioning after storage

4.5.3.1 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 51)

4.5.3.2 Lubricating the rolling bearings

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

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

4.5.3.3 Regreasing rolling bearings after storage periods of up to two years

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

4.5.3.4 Releasing the rotor shipping brace before commissioning

If one is being used, release the rotor shipping brace before commissioning.

4.6 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

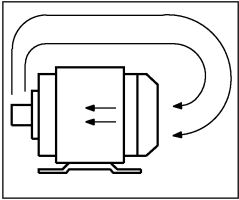
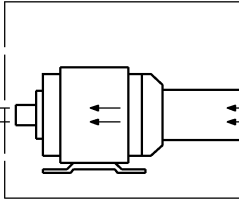
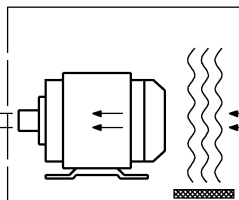
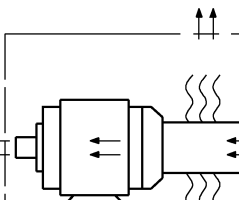
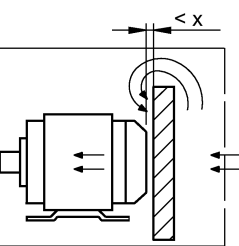
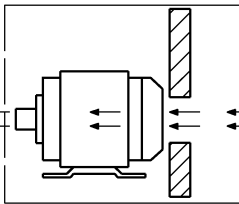
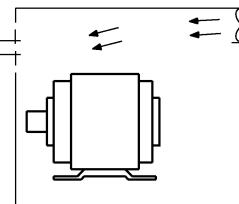
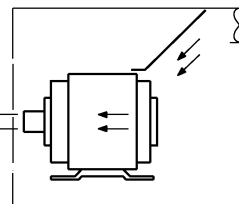
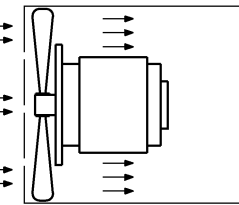
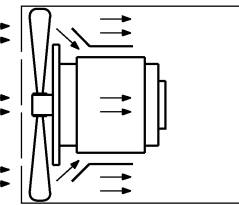
Material damage and injury can occur if the fan is destroyed and therefore the motor overheats.

- 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.

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

4.6 Ensure adequate cooling

Table 4- 1 Air guidance

Incorrect	Correct
	
	
	
	
	

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

Table 4- 2 Minimum dimension "X" for the distance between adjacent modules and the air intake of the machine

Frame size	X mm
63 ... 71	15
80 ... 100	20
112	25
132	30
160	40
180 ... 200	90
225 ... 250	100
280 ... 315	110
355	140

4.7 Thermal protection

The machine is optionally equipped with PTC thermistors, Pt100, Pt1000 or bimetallic sensors. Thermal machine protection by directly monitoring the winding temperature is permissible if this is certified and test data specified on the rating plate. PTC thermistors for direct temperature monitoring (sole protection) ensure explosion protection in conjunction with function tested tripping devices in accordance with local regulations.

- Direct temperature monitoring for line (DOL) operation: You can operate the machine without a circuit breaker. Evaluate the temperature sensors.
- Direct temperature monitoring for inverter operation: Evaluate the temperature sensors.
- If you have to perform a continuity test of the temperature sensors, do not apply a voltage >2.5 V. If no test data is specified on the rating plate, this means that the winding protection is only intended as an additional protection.
- For pole-changing machines, use a direct temperature monitoring sensor as stated on the rating plate, e.g. PTC thermistor, for each speed level in addition to the separate, mutually interlocked machine protection relays.

4.8 Interlock circuit for anti-condensation heating


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

- Install an interlock circuit that switches off the anti-condensation heating once the main machine is switched on.
- Only switch on the anti-condensation heating after the machine has been switched off.

See also

Switching on with the anti-condensation heating active (Page 98)

4.9 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).

4.10 Voltage and frequency fluctuations during line operation

Maintain the ranges stated on the rating plate and in the documentation (e.g. range B acc. to IEC/EN 60034-1) for voltage fluctuation ($\pm 10\%$) and frequency fluctuation ($\pm 2\%$) at all times.

NOTICE
Overheating of the winding
Tolerances must not be exceeded. Impermissibly high winding temperatures and therefore long-term damage to the machine can result.
Keep within the permissible tolerance for voltage and frequency.

Every machine must be protected against an inadmissible temperature rise. Observe the following notes:

- Protect every machine according to IEC/EN 60079–14 using a current-dependent, delayed circuit breaker with phase failure protection according to IEC/EN 60947 or a similar device in all phases.
- Set the protective device to the rated current (value is stamped on the rating plate).
- Protect the windings in a delta connection in such a way that the tripping unit or relay is connected in series with the winding phases. When selecting and setting the tripping unit, define the rated value of the phase current. The phase current is 0.58 times the rated machine current. Any thermal machine protection via direct temperature monitoring to be used in addition to the machine circuit breaker is specified on the rating plate if required.

4.11 Rotational speed limit values

Danger as a result of resonance within certain speed ranges

At over-critical speeds, machines encounter resonance within certain speed ranges. Such vibrations can reach impermissibly high levels. This can result in death, serious injury or material damage.

- The controller must ensure that those speed ranges are blocked when the converter is in operation. Please note the data on the blocked speed ranges specified in the Electrical Data.
- The blocked speed ranges must be run through rapidly.

Machine damage due to excessively high speeds

Excessive rotational speed can lead to serious damage to the machine. This can result in death, serious injury or material damage.

- Avoid operation above the permissible speed by using the appropriate control function.
- Observe the speeds stamped on the rating plate and in the Electrical Data.

4.12 System-inherent frequencies

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

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

4.13 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).

4.14 Converter operation

4.14.1 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 plates.
You can find parameter data here:
 - In the operating instructions for the converter.
 - In the SIZER engineering tool
 - In the SINAMICS Configuration Manuals.
 - For explosion-protected machines, also in the declaration of compliance with the order 2.1.
- Do not exceed the specified maximum speed limit n_{max} . You can either find this on the rating plate n_{max} or on the supplementary plate for converter operation as the highest speed.
- Check that the machine is cooled sufficiently for commissioning purposes.

4.14.2 Converter input voltage

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

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

NOTICE

Material damage caused by an excessively high supply voltage

The insulation system will be damaged if the supply voltage is too high for the insulation system. This can completely destroy the machine.

- Comply with the peak voltages as laid down in the guidelines above.

4.14.3 Reducing bearing currents when operated with a converter

Taking the following actions will reduce the bearing currents:

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

Equipotential bonding conductors:

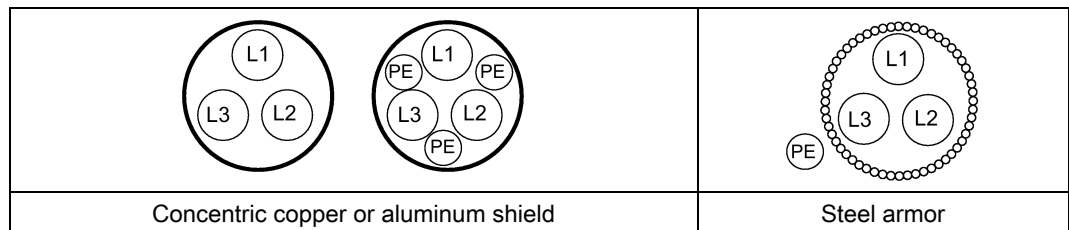
Use equipotential bonding conductors:

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

Selecting and connecting the cable:

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

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



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

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

4.14.4 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.

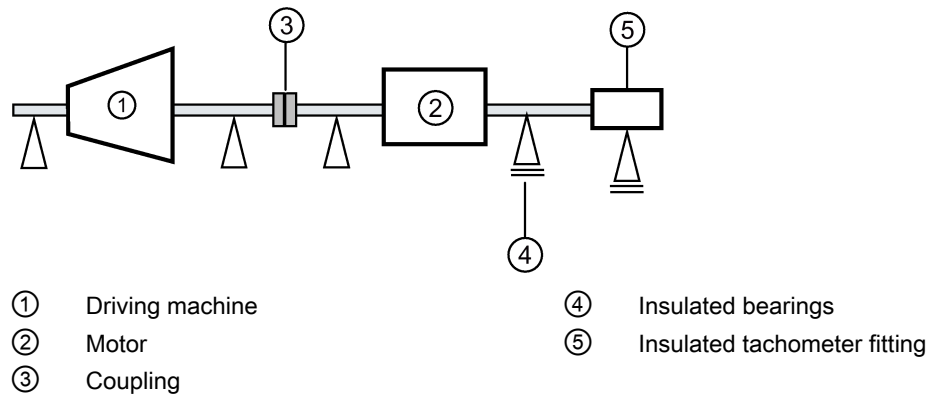


Figure 4-2 Schematic representation of a single drive

NOTICE

Bearing damage

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

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

Tandem operation

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

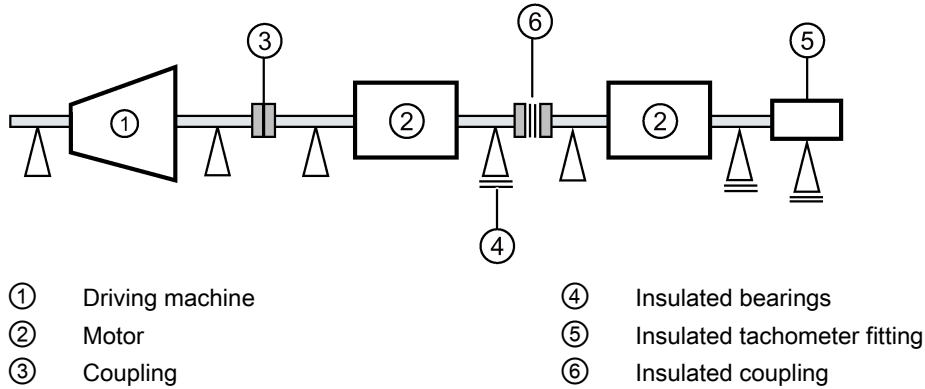


Figure 4-3 Schematic representation of a tandem drive

NOTICE

Bearing damage

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

- Use an insulated coupling to link the motors.

4.14.5 Tandem operation

If you connect two motors in series in "tandem operation", locate a coupling between the motors; this coupling should satisfy the Directive 2014/34/EU or the regulations that apply in the country where the equipment is installed.

4.14.6 Mechanical limit speeds for converter operation

Observe the information on the rating plate regarding the mechanical limit speeds for inverter operation.

Assembly

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

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

Loss of conformity with European directives

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

Explosion hazard when making modifications to the machine

Substantial modifications to the machine are not permitted – or may only be performed by the manufacturer. Otherwise an explosion can occur in an explosive atmosphere. This can result in death, serious injury or material damage.

- If necessary, please contact the service center.

5.1 Preparations for installation

5.1.1 Requirements for installation

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

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

Note

Measure the insulation resistance of the winding before starting installation work

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.

Damage to mounted parts and components as a result of high temperatures

The motor components get very hot during operation. High temperatures can damage parts mounted by customers, such as cables manufactured out of materials that are not heat resistant.

- Temperature-sensitive parts must not come in contact with or be attached to components mounted on the machine.
- Only use heat-resistant mounting parts. The connecting cables and cable entries must be suitable for the particular application.

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 51)

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. Short-circuit the ends of the temperature sensor cables before applying the test voltage. If the test voltage is connected to only one temperature sensor terminal, the temperature sensor will be destroyed.
3. Make sure that no power cables are connected.
4. Measure the winding temperature and the insulation resistance of the winding in relation to the machine enclosure. The winding temperature should not exceed 40° C during the measurement. Convert the measured insulation resistances in accordance with the formula to the reference temperature of 40° C. This thereby ensures that the minimum values specified can be compared.
5. Read out the insulation resistance one minute after applying the measuring voltage.

Limit values for the stator winding insulation resistance

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

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

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

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

U_{meas} = DC measuring voltage

R_C = minimum insulation resistance at a reference temperature of 40 °C

Conversion to the reference temperature

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

(1) $R_C = K_T \cdot R_T$	R_C	Insulation resistance converted to 40° C reference temperature
	K_T	Temperature coefficient according to equation (2)
	R_T	Measured insulation resistance for measuring/winding temperature T in °C
(2) $K_T = (0.5)^{(40-T)/10}$	40	Reference temperature in °C
	10	Halving/doubling of the insulation resistance with 10 K
	T	Measuring/winding temperature in °C

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

- The insulation resistance halves every time the temperature rises by 10 K.
- The resistance doubles every time the temperature falls by 10 K.

For a winding temperature of approx. 25° C, the minimum insulation resistances are 20 MΩ ($U \leq 1000$ V) or 300 MΩ ($U > 1000$ V). The values apply for the complete winding to ground. Twice the minimum values apply to the measurement of individual assemblies.

- Dry, new windings have an insulation resistance of between 100 and 2000 MΩ, or possibly even higher values. An insulation resistance value close to the minimum value could be due to moisture and/or dirt accumulation. The size of the winding, the rated voltage and other characteristics affect the insulation resistance and may need to be taken into account when determining measures.
- Over its operating lifetime, the motor winding insulation resistance can drop due to ambient and operational influences. Calculate the critical insulation resistance value depending on the rated voltage by multiplying the rated voltage (kV) by the specific

critical resistance value. Convert the value for the current winding temperature at the time of measurement, see above table.

Measuring the polarization index

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

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

Many measuring devices display these values automatically following the measurement.

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

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

NOTICE

Damage to insulation

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

- Contact the service center (Page 141).
- If the measured value is close to the critical value, you must subsequently check the insulation resistance at shorter intervals.

See also

Insulation resistance and polarization index (Page 50)

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 Installing the machine

5.2.1 Preparing the assembly area

1. Prepare a suitable assembly area (e.g. assembly stands). Make sure that the assembly area has sufficient clearance from the floor for the DE shaft end. The necessary data is provided in the machine dimension drawing.
2. Using the shipping papers, check whether all of the motor components are available for assembly.
 - 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.
 - Only use explosion-protected machines in appropriate areas in accordance with directive 1999/92/EC.
If the certification is supplemented by an X, please note the special conditions in the EC type examination certificate. Special conditions for explosion-proof machines (Page 18)
 - When installing electrical systems in hazardous zones, observe EN/IEC 60079-14 and the corresponding country regulations.
 - The machine temperature class specified on the rating plate must be equal to or greater than the temperature class of any combustible gases that may develop.
 - Select optional mounted equipment according to the requirements of Directive 2014/34/EU.

5.2.2 Balancing

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

- "H" means balancing with a half feather key (standard)
- "F" means balancing with a whole feather key

CAUTION

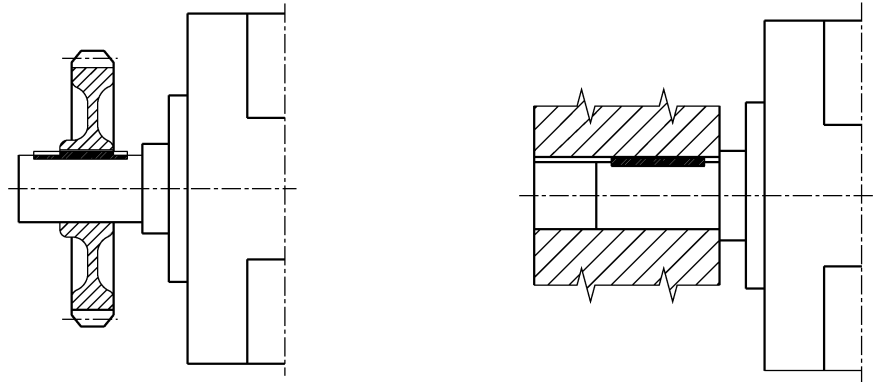
Risk of injury due to Incorrect installation or removal

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

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

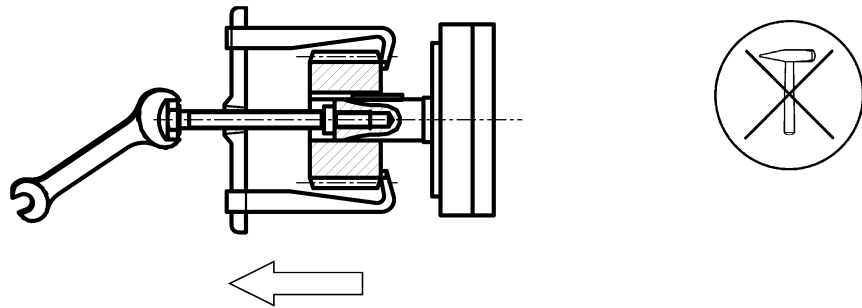
The featherkey data on the shaft and transmission element must indicate the correct type of balancing in each case and must be correctly mounted.

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.

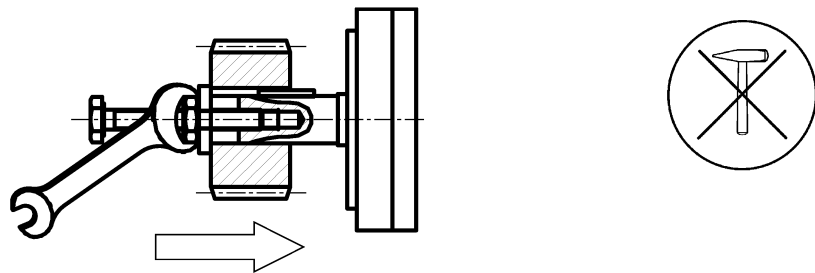


Align the offset at the coupling between electrical machines and the driven machines so that the maximum permissible vibration values according to ISO 10816 are not exceeded.

5.2.2.1 Mounting and withdrawing output transmission elements



Withdrawing output transmission elements



Mounting output transmission elements

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

5.3 Alignment and fastening

Observe the following when aligning and mounting:

- Ensure a flat and uniform contact surface for foot and flange mounting.
- When mounting on the wall, support the machine from below, e.g. using a bracket, or bolt it.
- Precisely align the machine when couplings are used.
- Ensure that the mounting surfaces are clean and free of any dirt.
- Remove any anti-corrosion protection using white spirit.
- Avoid installation-related resonances with the rotating frequency and twice the line frequency.

- Note any unusual noise when the rotor is manually turned.
- Check the direction of rotation with the motor uncoupled.
- Avoid rigid couplings.
- Repair any damage to the paint, this must be done immediately and correctly.

5.3.1 Repainting/touching up the paint finish of explosion-protected machines

Note**Repainting/touching up the paint finish of explosion-protected machines**

For explosion-protected machines, observe the information in Chapter Repainting/touching up.

5.3.2 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:

- 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 all the foot or flanged holes provided. The choice of fixing elements depends on the foundation and is the plant operator's responsibility. Comply with the required property classes for screwed connections and materials for fixing 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.

5.3.3 Flatness of the supporting surfaces for conventional motors

Frame size	Flatness [mm]
≤ 132	0.10
160	0.15
≥ 180	0.20

5.4 Installing the machine

5.4.1 Preconditions for smooth, vibration-free operation

Preconditions for smooth, vibration-free operation:

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

5.4.2 Aligning the machine to the driven machine and mounting

5.4.2.1 Selecting bolts

- Unless specified otherwise, use fixing screws with at least strength class 8.8 to ISO 898-1 to ensure that the machine is securely mounted and to transmit the torque-generated forces.
- When selecting the bolts and the design of the foundation, take into account the maximum forces occurring in the case of a fault such as short circuit or system transfers in phase opposition, etc.

Request the foundation force values from the Service Center if required.

See also

Tightening torques for screw and bolt connections (Page 143)

5.4.2.2 Horizontal types of construction with mounting feet

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

Note

Machine expansion

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

5.4.2.3 Horizontal types of construction with flange

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

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

Procedure

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

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

5.4.2.4 Vertical types of construction with flange

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

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

Procedure

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

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

5.4.3 Removing the rotor shipping brace

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

Store the rotor locking device

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

Details about the alignment accuracy can be found in the Section "Information about the machine dimension drawing".

5.4.4 Recommended alignment accuracy

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

Table 5- 2 Recommended alignment accuracy

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

To avoid stressing the motor feet, the overall flatness of the installation surfaces must satisfy the values in the following table:

Table 5- 3 Overall flatness of the installation surfaces

Frame size	Overall flatness of the installation surfaces
≤ 080	0.1 mm
090 - 355	0.2 mm
≥ 400	0.3 mm

If shims are necessary for height adjustment and to avoid stresses, make them out of adequately sized pieces of flat rolled strip. Complete balancing of the rotor together with the transmission element may be found necessary.

5.4.5 Mounting the output elements

Balance quality

The rotor is dynamically balanced. For shaft ends with feather keys, the balancing type is specified using the following coding on the rating plate:

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

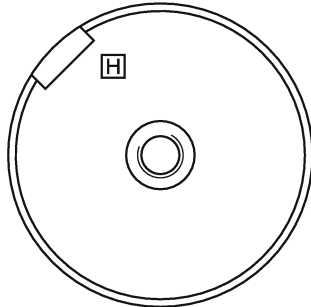


Figure 5-1 Balancing type on the drive-end side

Pushing on the power output elements

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

Shaft extensions with feather key


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

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

The following applies to all four-pole machines with a frequency ≥ 60 Hz:


- The feather key must be shortened if the coupling hub is shorter than the feather key.
- The center of gravity of the coupling half should be within the length of the shaft end.
- The coupling used must be prepared for system balancing.

The number of poles of the machine is specified on the rating plate, at the 10th position of the motor type. There, four-pole machines are marked with a "B".

 WARNING
<p>The feather key can fall out</p> <p>The feather keys are only locked against falling out during shipping. If a machine with two shaft extensions does not have an output element on one shaft extension, the feather key can fall out during operation.</p> <p>Death or serious injury can result.</p> <ul style="list-style-type: none"> • Do not operate the machine unless the transmission elements have been pulled on. • On shaft extensions without output element, make sure that the feather key cannot fall out and shorten it by approximately half for balance type "H".

5.4.6 Axial and radial forces

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

 WARNING
<p>Damage to bearings or the shaft</p> <p>Large output masses and their centers of gravity outside the shaft extensions can lead to resonance in operation. This can result in damage to the bearings and shaft. In an explosive atmosphere, there is a risk of explosion. Death, serious injury, or material damage can result.</p> <ul style="list-style-type: none"> • Ensure that the permissible loads for the forces on the shaft extension are adhered to in accordance with the catalog data or configuration data.

Electrical connection

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

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

Note

Service Center

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

Risk of explosion by fixing elements becoming loose

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

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

6.1 Preparation


6.1.1 Selecting cables

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

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


6.2 Connecting the machine



 DANGER
Hazardous voltages Death, injury or material damage can occur. Note the following safety information before connecting-up the machine: <ul style="list-style-type: none">• 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).

6.2.1 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: <ul style="list-style-type: none">• Ensure that the components inside the terminal box are not damaged.• It must be ensured that there are no foreign bodies, dirt or moisture in the terminal box.• Close the terminal box using the original seal so that it is dust tight and water tight.• Use O-rings or suitable flat gaskets to seal entries in the terminal box (DIN 42925) and other open entries.• Please observe the tightening torques for cable entries and other screws.

See also

Tightening torques for screw and bolt connections (Page 143)

6.2.1.1 Terminal designation

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

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

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

6.2.1.2 Circuit diagram inside the terminal box cover

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

6.2.1.3 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 line cables with a phase sequence of L1, L2, L3 at U, V, W, the resulting rotation is clockwise.
- If you interchange two connections, e.g. you connect L1, L2, L3 to V, U, W, the resulting rotation will be counter-clockwise.

	According to IEC
Clockwise rotation	U V W
Counter-clockwise rotation	V U W

Direction of rotation of the motor when looking at DE

6.2.1.4 Documenting holes in the terminal box

Note

Have additional holes in the terminal box with type of protection Ex d made only by the manufacturer or by a specialist workshop for electrical machinery authorized by the manufacturer.

Making holes in the terminal box

If you drill holes in the terminal box for explosion-protected motors, then document the data about these holes in the motor documentation:

- Number and size of the holes
- Type of thread, e.g. metric or NPT

Data regarding the installation of pipes and accessories is provided in IEC / EN 60079-14.

Requirements placed on drilled holes in Zone 21/22

For applications in Zone 21 (Ex tb) or Zone 22 (Ex tc), according to EN 60079-31, the following requirements are placed on drilled holes:

Through holes:

- The nominal diameter of the through holes for the entry may not be 0.7 mm larger than the nominal diameter of the thread of the cable entry or connection element.
- The inside of the terminal box must have sufficient space to attach a locking nut at the cable entry or at the connection element.

Openings with thread must have the following attributes:

- Conical thread: Without additional sealant or seals, not less than three and one half thread turns.
- Cylindrical threads: At least five thread turns, tolerance of 6 H, even better according to ISO 965-1. For less than five thread turns, an additional seal or sealant is required.

6.2.1.5 Cable entry

Certified cable entries, thread adapters and sealing plugs

Only use sealing plugs, cable entries and conductor entries or thread adapters that are suitable, certified and marked for use in the respective explosion protection type and degree of protection (DIN EN 60079-14).

Terminal box

The number and size of the cable entry tapped holes is provided in the machine dimension drawing.

Inserting cables into the terminal box

1. Only use cable entries that are suitable for the cables.
2. Only use cable entries and cables suitable for the prevailing ambient temperature.
3. Ensure that the power cables are strain relieved when inserting them in the terminal box.
4. Carefully connect the cables and ensure a reliable protective conductor connection.
5. Tighten the glands and the elements for the strain relief with the torque specified by the manufacturer.
6. Check the cable entries and cables to ensure that they are correctly sealed and firmly seated.
7. Correctly close and seal threads or holes that are not being used ensuring that the IP degree of protection is maintained. The IP degree of protection is specified on the rating plate.

6.2.1.6 Thread sizes in terminal box Ex e and Ex d

Frame size	Threaded entry	
	Size	Quantity
71 ... 90	M 16 x 1.5 M 25 x 1.5	1
100 ... 132	M 32x1.5	2
160 ... 180	M 40x1.5	2
200 ... 225	M 50x1.5	2
250 ... 315	M63x1.5	2
355	M 80x2	2

Thread size for additional entries, e.g. PTC thermistor or heater M16x1.5 or M20x1.5.
Other thread sizes are possible as an option.

6.2.2 Minimum air clearances

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

Table 6- 2 Minimum air clearance dependent on rms value of the alternating voltage U_{rms}

Rms value of the alternating voltage U_{rms}	Minimum air clearance	
	Ex d	Ex e
≤ 500 V	6 mm	8 mm
≤ 630 V		10 mm
≤ 1000 V	8 mm	14 mm

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

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

6.2.3 Internal equipotential bonding

The internal equipotential bonding between the grounding terminal in the terminal box, the terminal box components and the machine enclosure is ensured via metallic contact, a copper braided strip or a stranded wire.

6.3 Tightening torques

In the technical data you will find the Tightening torques for screw and bolt connections (Page 143).

6.3.1 Terminal board and grounding

Table 6- 3 Tightening torques for electrical connections on the terminal board and grounding

Thread Ø		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

6.3.2 Stud-type bushings

Table 6- 4 Tightening torques for stud-type bushings

Thread Ø		M 4	M 5	M 6	M 8	M 10	M 12	M 16	M 20
Nm	Min.	1	1.6	2.5	5	8	13	25	42
	Max.	1.2	2	3	6	10	15.5	30	52

6.3.3 Additional connecting terminals for monitoring equipment and anti-condensation heating

Table 6- 5 Tightening torques for monitoring equipment and anti-condensation heating

Main terminal box EN 60999-1: 2000 table 4 III	0.4 Nm	
Auxiliary terminal box	min 0.6 Nm	max 0.8 Nm

6.3.4 Cable entries, sealing plugs and thread adapters

All cable entries and sealing plugs must be approved for use in the respective hazardous area.

- Any openings that are not being used must be sealed using the appropriate certified sealing plugs.
- Please observe the manufacturer's specifications when fitting cable entries.

Note the following when mounting:

- Avoid damaging the cable jacket.
- Adapt the tightening torques to the cable jacket materials.

Ex e

Observe the attached documentation for tightening torques of the cable entries and sealing plugs for direct mounting to the machine as well as further glands (e.g. adapters).

Ex d

Table 6- 6 Tightening torques of the sealing plugs

Thread size	Tightening torque	
	Nm	
	Min.	Max.
M 16x1.5	5	6
M 20x1.5	8	10
M 25x1.5	11	13
M 32x1.5	16	19
M 40x1.5	18	22
M 50x1.5	30	35
M 63x1.5	30	35
M 80x2.0	58	63

6.4 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.

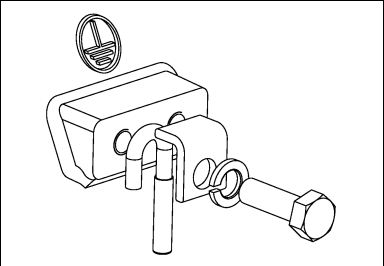
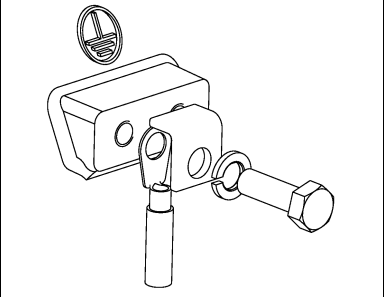
- Internal grounding with a connection in terminal box at the location intended for this purpose and marked accordingly.
- External grounding with connection at the stator housing at the locations intended for this purpose and marked accordingly.

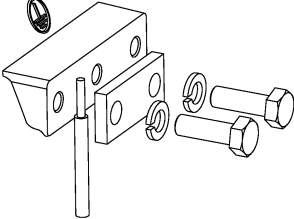
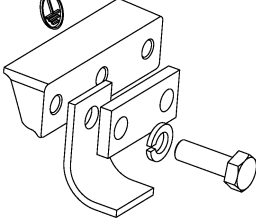
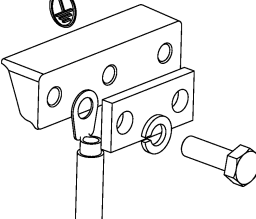
6.4 Connecting the grounding conductor

Table 6- 7 Minimum cross-sectional area of grounding conductor

Minimum cross-section of the phase conductor for installation S [mm ²]	Minimum cross-section of the associated ground- ing connection [mm ²]
$S \leq 25$	S
$25 < S \leq 50$	25
$S > 50$	0.5 S

6.4.1 Grounding connection type

Frame size	Enclosure grounding method	
71 ... 112	Cable connection with free cable	
	Cable connection with cable lug (DIN 46234; JB/T2436.1)	

Frame size	Enclosure grounding method	
132 ... 355	Cable connection with free cable	
	Cable connection with grounding strap	
	Cable connection with cable lug (DIN 46234; JB/T2436.1)	

The additional threaded hole on the grounding socket is optionally available for additional equipotential bonding of high-frequency voltages and currents in converter operation.

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 for the locking screw.

External ground terminal

When making connections, ensure the following:

- Ensure that the connecting surface is bare and is protected against corrosion using a suitable substance, e.g. acid-free Vaseline.
- Position the cable lug between the contact bracket and the grounding bracket; do not remove the contact bracket pressed into the enclosure!
- Arrange the flat washer and spring washer under the bolt head.

6.5 Connecting the temperature sensor/anti-condensation heater

- Use the marked connection location for the grounding conductor on the stator housing.
- Observe the tightening torque for the locking screw.

Table 6- 8 Screw size of the grounding cable, external grounding

Frame size	Thread size for the grounding conductor
71 ... 112	1 x M 5
132 ... 160	2 x M 6
180 ... 280	2 x M 8
315 ... 355	2 x M 12

The additional threaded hole on the grounding socket is optionally available for additional equipotential bonding of high-frequency voltages and currents in converter operation.

See also

Tightening torques for screw and bolt connections (Page 143)

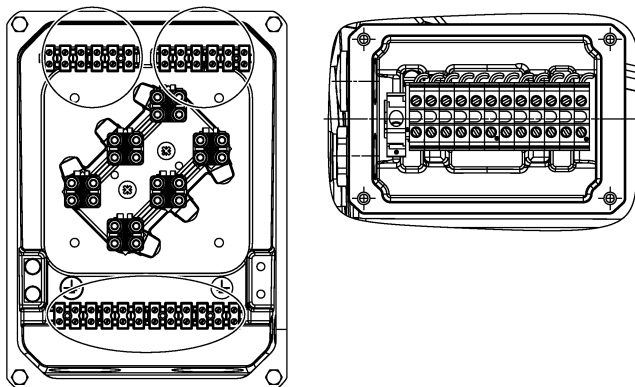
6.5 Connecting the temperature sensor/anti-condensation heater

6.5.1 Connecting optional integrated devices and equipment

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

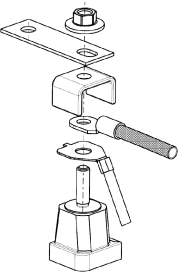
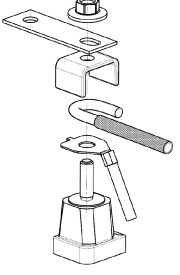
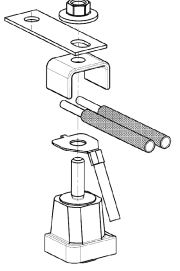
6.5.2 Auxiliary circuit connection

Auxiliary circuits are connected in the terminal box.

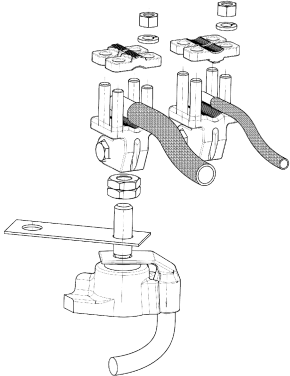


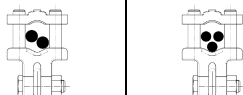
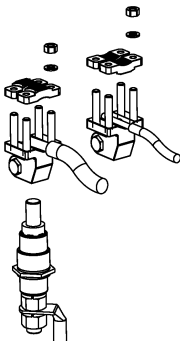


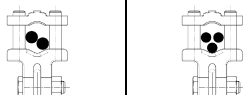


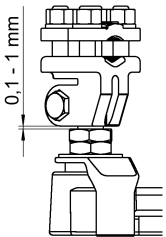
6.6 Conductor connection

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

Type of connection	Terminal studs	Cable cross-section mm ²
Connection with cable lug DIN 46234 	M 4	1 ... 4 1 ... 6 (FS 132)
	M5	1 ... 16
	M6	4 ... 35
Connection of a single conductor 	M 4	1 ... 4 1 ... 6 (FS 132)
	M5	1 ... 16
	M6	4 ... 35
Connection of two conductors of the same thickness with terminal clamp 	M 4	Not permitted
	M5	Not permitted
	M6	4 ... 35

6.6 Conductor connection

Type of connection	Terminal studs	Cable position with terminal	Cable cross-section mm ²
	M 8		2.5 ... 25
			16 ... 50
			10 ... 16
	M 10		10 ... 95
	M 12		25 ... 185
	M 16		50 ... 300
	M 10		50 ... 120
	M 12		95 ... 240
	M 16		120 ... 300
	M 10		16 ... 35
	M 12		16 ... 70
	M 16		16 ... 120

Assembly of clamping device	
	<p style="text-align: center;">M8</p> <p style="text-align: center;">Mount the clamping devices on the terminal board at a distance of 0.1 ... 1 mm to the lock nuts.</p>

6.6.1 Cable ends with wire end sleeves

1. Preferably use end sleeves instead of soldering cable ends.
2. Before connecting, attach the end sleeves so as to form a technically correct, current-carrying crimped joint at the end of the conductor.

 **WARNING**

Risk of explosion due to excessive temperature rise

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

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

6.6.2 Connecting aluminum conductors

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

- Use only cable lugs that are suitable for connecting aluminum conductors.
- Immediately before inserting the aluminum conductor, remove the oxide layer from the contact areas on the conductor and/or the mating piece. Do this using a brush or file.
- Then grease the contact areas immediately using neutral Vaseline. This prevents a new oxide layer from forming.

NOTICE

Aluminum flow due to contact pressure

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

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

6.7 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 $t_r > 0.1 \mu\text{s}$.

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 6-9 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			
	$\hat{U}_{\text{phase-to-phase}}$ V _{pk}	$\hat{U}_{\text{phase-to-ground}}$ V _{pk}	Rise time t_r μs	DC link U_{bc} V
$\leq 500 \text{ V}$	1500	1100	0.5	750
	900	900	0.1	

6.7.1 Connecting explosion-proof machines to the converter

WARNING

Machine overheating

Operating explosion-protected machines at the converter without using the appropriate protective equipment can result in death or severe injury.

Always use PTC thermistor monitoring when operating explosion-protected machines at the converter. Tripping units according to Directive 2014/34/EU ("Explosion Protection Directive") are always necessary when using PTC thermistor monitoring.

Machines with types of protection flameproof enclosure "db", dust explosion protection "tb" or dust explosion protection "tc"

These machines are generally equipped with 3 PTC thermistors in accordance with DIN 44082 with a rated response temperature that depends on the maximum possible surface temperature. Select the PTC thermistors in accordance with this standard. If the temperature of the cable bushings is not stated on the rating plate, it is max. 70 °C. Use suitable cables

for this temperature. Do not exceed the maximum frequency dependent on the number of poles, which is stamped on the rating plate.

System, converter - cable - electrical machine

Please observe the information in accordance with EN / IEC 60034-17 and EN / IEC 60034-25 regarding winding stress. For line supplies with operating voltages up to 690 V, the maximum value of the voltage peaks at the end of the cable must not exceed twice the value of the converter's DC-link voltage.

6.8 Final checks

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 the air clearances between non-insulated parts as described in Chapter Minimum air clearances. (Page 69):
- 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. Please observe the specifications in the sections above and tighten with the correct torque.

See also

Tightening torques for screw and bolt connections (Page 143)

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

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

Note**Service Center**

Please contact the Service Center (Page 141) if you require commissioning support.

7.1 Measures before commissioning

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

Note**Checks to be carried out prior to commissioning**

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

- The machine is undamaged.
- The machine has been correctly installed and aligned, the transmission elements are correctly balanced and adjusted.
- All fixing screws, connection elements, and electrical connections have been tightened to the specified tightening torques.
- The operating conditions match the data provided in accordance with the technical documentation, such as degree of protection, ambient temperature, etc..
- Moving parts such as the coupling move freely.
- All touch protection measures for moving and live parts have been taken.

See also

Tightening torques for screw and bolt connections (Page 143)

Second shaft extension

If the second shaft extension is not used:

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

 WARNING
--

Risk of losing the IP degree of protection as a result of damaged shaft sealing rings
--

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

- | |
|---|
| <ul style="list-style-type: none">• Replace damaged components immediately. |
|---|

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

Electrical connection

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

Converter operation

- If the design of the motor requires connection to a particular converter type, the rating plate will contain corresponding additional information.
- The converter is correctly parameterized. The parameterization data is specified on the rating plate of the machine. Information about the parameters is available in the operating instructions for the converter.

- Any supplementary motor monitoring devices and equipment have been correctly connected and are functioning correctly.
- In continuous operation, the motor cannot exceed the specified upper speed limit n_{\max} or undershoot the lower speed limit n_{\min} .

The permissible acceleration time to the limit speed n_{\min} depends on the parameter assignment.

7.1.1 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 84)

7.1.2 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. Short-circuit the ends of the temperature sensor cables before applying the test voltage. If the test voltage is connected to only one temperature sensor terminal, the temperature sensor will be destroyed.
3. Make sure that no power cables are connected.
4. Measure the winding temperature and the insulation resistance of the winding in relation to the machine enclosure. The winding temperature should not exceed 40° C during the measurement. Convert the measured insulation resistances in accordance with the formula to the reference temperature of 40° C. This thereby ensures that the minimum values specified can be compared.
5. Read out the insulation resistance one minute after applying the measuring voltage.

Limit values for the stator winding insulation resistance

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

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

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

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

U_{meas} = DC measuring voltage

R_C = minimum insulation resistance at a reference temperature of 40 °C

Conversion to the reference temperature

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

(1)	R_C	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
$R_C = K_T \cdot R_T$		
(2)	40	Reference temperature in °C
	10	Halving/doubling of the insulation resistance with 10 K
	T	Measuring/winding temperature in °C
$K_T = (0.5)^{(40-T)/10}$		

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 ($U \leq 1000$ V) or 300 MΩ ($U > 1000$ V). The values apply for the complete winding to ground. Twice the minimum values apply to the measurement of individual assemblies.

- Dry, new windings have an insulation resistance of between 100 and 2000 MΩ, or possibly even higher values. An insulation resistance value close to the minimum value could be due to moisture and/or dirt accumulation. The size of the winding, the rated voltage and other characteristics affect the insulation resistance and may need to be taken into account when determining measures.
- Over its operating lifetime, the motor winding insulation resistance can drop due to ambient and operational influences. Calculate the critical insulation resistance value depending on the rated voltage by multiplying the rated voltage (kV) by the specific

critical resistance value. Convert the value for the current winding temperature at the time of measurement, see above table.

Measuring the polarization index

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

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

Many measuring devices display these values automatically following the measurement.

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

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

NOTICE

Damage to insulation

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

- Contact the service center (Page 141).
- If the measured value is close to the critical value, you must subsequently check the insulation resistance at shorter intervals.

See also

Insulation resistance and polarization index (Page 83)

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.

7.1.3 Testing the cooling of the machine

Cooling

- Check that the machine cooling is available for commissioning.

See also

Preparations for use (Page 31)

7.1.4 Commissioning an external fan

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

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

Checks before the first test run

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

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

Performing the test run

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

Note

Use these operating instructions for motors with external fans.

7.1.5 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- 2 Set values for monitoring the bearing temperatures before commissioning

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

Normal operation

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

Table 7- 3 Set values for monitoring the bearing temperatures

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

7.1.6 Further documents

Note

Further documents

Observe all of the other documents provided with this machine.

7.2 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.
- Start the machine without a load; to do this, close the motor starter protector and do not switch the machine off prematurely.
- You should limit how often you switch the machine off while it is starting up and still running at a slow speed, for checking the direction of rotation or the required dimensions, for example.
- Allow machines to reach a standstill before switching them back on.

7.2.1 Test run

After installation or inspection, carry out a test run:

1. Start up the machine without a load. To do this, close the circuit breaker and do not switch off prematurely. Check whether it is running smoothly.

Switching the machine off again while it is starting up and still running at slow speed should be kept to a bare minimum, for example for checking the direction of rotation or for checking in general.

Allow the machine to run down before switching it on again.

NOTICE
Avoiding mechanical damage to the cylindrical roller bearing
Under all circumstances maintain the minimum load on cylindrical roller bearings of 50% corresponding to what is specified in the catalog.

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

NOTICE
Thermal overload of motors connected directly to the line supply
In addition to the load torque, the ramp-up (accelerating) time is essentially influenced by the moment of inertia to be accelerated. While ramping up when connected to the line supply, the inrush (starting) current is a multiple of the rated current. This can result in thermal overload. This can damage the motor.
As a consequence, when ramping up, observe the following:
<ul style="list-style-type: none">• Monitor the ramp-up time and number of consecutive starts.• Comply with the limit values and/or ramp-up conditions specified in the catalog or the order documentation.

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

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

Operation

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

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

8.1 Safety instructions for operation

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 12) when carrying out any work on the machine.
- Only remove covers in the manner described in the operating instructions.
- Operate the machine properly.
- Regularly and professionally maintain the machine according to the instructions provided in the "Maintenance" (Page 113) chapter of the operating instructions.

 **WARNING**

Rotating parts

Electric machines contain dangerous rotating parts.

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

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

 **WARNING**

Hot surfaces

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


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

 **CAUTION**

Hazardous substances

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

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

 **CAUTION**

Flammable substances

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

Burns and other damage to health and material may result.

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

8.1.2 Safety instructions during operation

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.
<ul style="list-style-type: none">• If the motor has anti-condensation heating, switch it on after the motor has been switched off.

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:
<ul style="list-style-type: none">• If available, switch off the anti-condensation heating each time before switching on.

 DANGER
Explosion hazard from hybrid mixtures
Hybrid mixtures are mixtures of flammable dusts with explosive gas/air atmospheres which can together create a dangerous explosive atmosphere if they occur at the same time. Changes can arise in the safety characteristics here, such as a change in the zonal classification, increase in the explosion pressure, reduction in the minimum ignition energy and a reduction in the maximum temperatures to be observed.
An explosion can result. This can result in death, serious injury or material damage.
<ul style="list-style-type: none">• For this reason, the relative characteristics must be considered both for gas (zones 0, 1 and 2) and for dust (zones 20, 21 and 22) where hybrid mixtures arise. It is necessary for a competent assessor to determine in the individual case whether the parameters determining ignition are unfavorably affected in a particular hybrid mixture.• Motors with dual plates for G (“Gas”) and D (“Dust”) may only be used where these two occur after prior examination of the properties of the hybrid mixtures by the user.

 WARNING
Explosion hazard due to overheating of the machine caused by a layer of dust
Layers of dust thicker than 5mm can insulate the machine, resulting in overheating. The maximum surface temperature of the machine cannot be adhered to. The dust can ignite, resulting in an explosion. This can result in death, serious injury or material damage.
<ul style="list-style-type: none">• Dust the machine regularly.• Do not allow dust layers thicker than 5 mm to build up on the machine surface.• Do not switch the machine on until the dust has been removed.

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

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

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

To ensure problem-free machine cooling, the air ducts (ventilation grilles, channels, cooling fins, tubes) must be free of pollution.

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

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

- Do not use compressed air to clean motors when installed in hazardous zones!

8.1.3 Safety note for ventilation

⚠ CAUTION**Risk of injury when touching the fan**

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

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


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

⚠ WARNING**Risk of burning**

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

- Never commission the machine without an external fan.

8.1.4 Bridging insulated bearings


 DANGER
Explosion hazard if the bridging is removed from the insulated bearing
Removing the factory-fitted bridging of the insulated bearing leads to potential differences between the rotor and the grounded motor. This can cause the generation of sparks, which especially in an explosive atmosphere can ignite surrounding dust or combustible gases. Explosions can occur. There is also a risk of an electric shock. Death, serious injury, or material damage will result.
Do not open the bridging of the bearing insulation during operation.

8.1.5 Switching on with the anti-condensation heating active

Excessively high machine temperature when heating is switched on

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

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

 WARNING
Explosion hazard
If the anti-condensation heating is switched on during operation, the temperature class or the maximum surface temperature of the machine can be exceeded.
In an explosive atmosphere, there is a risk of an explosion. This can result in death, serious injury or material damage.
Only switch the anti-condensation heating on after the motor has been switched off.

8.2 Switching on the machine

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

NOTICE

Thermal overload of motors connected directly to the line supply

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

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

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

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

8.3 Switching off the external fan

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

8.4 Switching on again after an emergency switching-off

- Check the machine before recommissioning the driven machine after an Emergency Off.
- Eliminate all the causes that have led to the emergency off

8.5 Stoppages

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

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

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. <ul style="list-style-type: none">• 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 Preparations for use (Page 31).

Lubricating before recommissioning

NOTICE
Dry running bearings Bearings can be damaged if they do not have sufficient grease. <ul style="list-style-type: none">• 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 Installing rolling bearings (Page 121).

 **WARNING**

Explosion hazard

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

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

- Only switch on the anti-condensation heating after the motor has been switched off. Carefully comply with the data on the anti-condensation heating plate.

8.5.1 Avoidance of damage to rolling bearings during stoppages

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

- During stoppages, regularly start up the machine for a brief period once a month. As a minimum, turn the rotor several times.

If you have uncoupled the machine from the driven machine and secured the rotor with a rotor shipping brace, then remove this before turning the rotor over or starting up the machine.

Make sure that the resting position of the rotor after the rotor has been turned over is different from its previous position. Use the fitted key or the coupling halves as reference markers.

- During recommissioning, refer to the information in Chapter "Commissioning".

See also

Start-up (Page 81)

8.5.2 Decommissioning the machine

- Record the decommissioning steps. This log will be useful upon recommissioning.
- If the machine is going to be out of service for longer than six months, then take the necessary measures for preservation and storage. Otherwise, the machine could be damaged as a result of not being operated.

8.5.3 Re-commissioning the machine

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

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

See also

Decommissioning the machine (Page 101)

Start-up (Page 81)

8.6 faults

8.6.1 Inspections in the event of faults

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

Immediately perform an inspection after such faults.

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

8.6.2 Electrical faults

Note

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

Table 8- 1 Electrical faults

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

8.6.3 Mechanical faults

Table 8- 2 Mechanical faults

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

⁽¹⁾ Take any changes into account when warming up the machine.

8.6.4 Rolling bearing faults

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

Table 8-3 Rolling bearing faults

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

8.6.5 Faults at the external fan

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

Table 8-4 Cooling system faults

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

Maintenance

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

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

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

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


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


Note


Please contact the service center (Page 141), if you require support with service, maintenance or repair.

9.1 Inspection and maintenance

9.1.1 Safety instructions for inspection and maintenance

 WARNING
<p>Rotating and live parts</p> <p>Electric machines contain live and rotating parts. Fatal or serious injuries and substantial material damage can occur if maintenance work is performed on the machine when it is not stopped or not de-energized.</p> <ul style="list-style-type: none"> • Perform maintenance work on the machine only when it is stopped. The only operation permissible while the machine is rotating is regreasing the rolling bearings. • When performing maintenance work, comply with the five safety rules (Page 12).

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

 CAUTION
Dust disturbances when working with compressed air When cleaning with compressed air, dust, metal chips, or cleaning agents can be whirled up. Injuries can result. When cleaning using compressed air, make sure you use suitable extraction equipment and wear protective equipment (safety goggles, protective suit, etc.).

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

NOTICE
Machine damage caused by foreign bodies Foreign bodies such as dirt, tools or loose components, such as screws etc., can be left by accident inside the machine after maintenance is performed. These can cause short circuits, reduce the performance of the cooling system or increase noise in operation. They can also damage the machine. <ul style="list-style-type: none">• When carrying out maintenance work, make sure that no foreign bodies are left in or on the machine.• Securely attach all loose parts again once you have completed the maintenance procedures.• Carefully remove any dirt.

Note

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

 **WARNING****Risk of explosion due to an increased surface temperature**

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

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

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

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

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

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

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

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

9.1.2 Static charging when cleaning

Risk of explosion due to static charging

If you clean the motor, plastic components may become statically charged and ignite a potentially explosive atmosphere. An explosion can occur. This can result in death, serious injury or material damage.

- When cleaning ensure that there is **absolutely no** explosive atmosphere present.
- Clean the plastic parts and components so that **absolutely no** static charging occurs
- Do **not** use compressed air for cleaning.

9.1.3 Inspections in the event of faults

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

Immediately perform an inspection after such faults.

9.1.4 First inspection

- Check after approx. 500 operating hours, but after not more than one year:

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

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

- Further checks may be required if so specified in operating instructions of components or in accordance with the plant-specific conditions.
- If you find any deviations during the inspection, you must rectify them immediately. They may otherwise damage the motor.

9.1.5 General inspection

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

Table 9- 1 Checks that have to be performed during the general inspection

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

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

NOTICE
<p>Machine damage</p> <p>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.</p>

9.1.6 Assessing the rolling bearings

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

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

9.1.7 Bolt grade

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

Frame size	Bolt grade for ambient temperature T_U	
	$\geq -40\text{ °C}$	
	Standard	Stainless steel bolts
71 ... 355	8.8	A4-70 A4-80

9.1.8 Mechanical explosion protection for rolling bearings

All machines marked in accordance with Directive 2014/34/EU ("Explosion Protection Directive") must be regularly inspected for mechanical damage which could constitute a risk of ignition in accordance with IEC/EN 60079-17 .

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


9.1.9 Maintenance

9.1.9.1 Explosion protection for machines with type of protection "Ex d"

For explosion-protected machines with type of protection "Ex d" or "Ex db" in accordance with IEC / EN 60079-0 and IEC / EN 60079-1, observe the following:

- Machined bearing and fitting surfaces on the following components must not be reworked or painted:
 - Stator frame
 - End shields, bearing cover
 - Motor shaft
 - Gland plate
 - Terminal box lower part, terminal box cover
 - Gland plates for additional terminal boxes, where present
- Keep these surfaces clean and protect them against corrosion by applying a thin coating of grease. It is not permissible that any seals are fitted between the surfaces that guarantee that flame is not transmitted.

9.1.9.2 Explosion hazard due to increased surface temperature

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

9.1.9.3 Insulation resistance and polarization index

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

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

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 84)

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

Regreasing intervals

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

Note

Observe the regreasing intervals for the rolling bearings

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

Regreasing

The spent grease chamber is designed to accommodate the spent grease for a computed, rated service life of 20000 operating hours.

- Clean the grease nipples before regreasing and then gradually press in an appropriate type and amount of grease, as described on the lubricant plate. The shaft must rotate so that the new grease can be distributed in the rolling bearing. The rolling bearing temperature rises sharply at first, then drops to the normal value again after the excess grease has been displaced out of the bearing.
 - If the machine is fitted with **grease collection chambers** :

Unbolt the grease collection chambers at the intervals shown on the notice plate with the motor stopped, and remove the used bearing grease. If this is not done, the grease will clog and the bearings will overheat.

 **WARNING**

Rotor can fall out

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

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

Grease types

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

Note

Grease quantity control

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

9.1.9.5 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.
<ul style="list-style-type: none">• Avoid pointing compressed air directly onto shaft sealing rings or labyrinth seals of the machine.

Note

Please note the safety instructions for cleaning (Page 95).

9.1.9.6 Maintenance and repair for machines of protection type "Ex d/Ex db"

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

- Maintain the special conditions for repairs. The gap dimensions for the electric machine **do not** comply with the standardized values in IEC / EN 60079-1. For repair work, obtain the gap dimensions of the electrical machine from the manufacturer.
- Perform maintenance, repair and modification work on explosion-protected machines in strict compliance with the corresponding national health and safety legislation, the safety instructions and descriptions in the general maintenance instructions.


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

- Repairs to the stator or rotor windings and to the terminals
- Repairs to the ventilation system
- Repairs to the bearings
- Dismantling machines with flameproof enclosures
- Connection work performed in the terminal box

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


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

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

 WARNING
<p>Risk of explosion due to alteration of the ignition gap geometry</p> <p>Changing ignition gap geometries (gap dimensions) as part of repair work according to the minimum specifications of IEC / EN 60079–1 is not permissible.</p> <p>This can result in death, serious injury or material damage.</p> <ul style="list-style-type: none"> • Obtain the gap dimensions of the electrical machine from the manufacturer for the repair or restoration of ignition gap geometries.

9.1.9.7 Maintaining the external fan (forced ventilation)



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

Servicing the external fan

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

- Remove the dirt and dust deposits regularly; the intervals depend on how dirty the surrounding area is.
- Make sure that the impeller is evenly cleaned, as irregular deposits can lead to an imbalance.
The full flowrate is only achieved if the inward flow of air to the impeller is unrestricted.

Servicing the external fan motor

Please observe all specifications and intervals in the operating instructions for the external fan motor. If a **SIMOTICS XP** 1MB1.5/1MB5.5 low-voltage motor is used as an external fan motor, these operating instructions also apply for the external fan motor.

9.1 Inspection and maintenance

To avoid unnecessary downtimes, always carry out all inspection and maintenance work on the main and external fan motor simultaneously.

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


9.1.9.8 Maintaining terminal box "Ex d"

Requirement


The machine is de-energized.

Check the terminal box

- Terminal boxes must be regularly checked for tightness, undamaged insulation, and tight terminal connections.
- If dust or humidity have infiltrated the terminal box, this should be cleaned and dried (particularly the insulators).
Check all the seals and sealing surfaces and address the cause of the leakiness.
- Check the insulators, connectors and cable connections in the terminal box.
- Line entries inside the terminal box are part of the regular inspection in accordance with IEC/EN 60079-17.
- Replace the damaged components if necessary.

 WARNING
Short-circuit hazard Short-circuits can occur as a result of damaged components that can lead to death, serious injury or material damage. Replace damaged components.

9.1.9.9 Repainting

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

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

- Limit the total paint film thickness according to the explosion protection group:
 - IIA, IIB: Total paint coating thickness ≤ 2 mm
 - IIC: Overall coating thickness ≤ 0.2 mm for motors of group II (gas)
- Limit the surface resistance of the paint used:
 - Surface resistance ≤ 1 G Ω for motors of groups II and III (gas and dust)
- Charge transfer limit
 - 60 nC for Group I or Group IIA devices
 - 25 nC for Group IIB devices
 - 10 nC for Group IIC devices
 - 200 nC for Group III devices (values not valid for strongly charge generating processes)
- Breakdown voltage ≤ 4 kV for explosion group III (gas and dust)

Suitability test of the paint system for hazardous areas

Suitability certificates for the electrostatic suitability on explosion-protected machines are available for paint systems ordered as standard. These certificates are not available for non-standard or customized paint systems. Take into consideration that the provided evidence is not valid for repaintings.

9.2 Corrective Maintenance

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

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

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

9.2.1 Extended motor marking

The machine marking based on IEC / EN 60079–0 was supplemented by the "X" symbol.

- Maintain the special conditions for repairs. The gap dimensions for the electric machine **do not** comply with the standardized values in IEC / EN 60079–1. For repair work, obtain the gap dimensions of the electrical machine from the manufacturer.
- Perform maintenance, repair and modification work on explosion-protected machines in strict compliance with the corresponding national health and safety legislation, the safety instructions and descriptions in the general maintenance instructions.


Have work influencing explosion protection performed by the manufacturer or by a specialist workshop for electrical machinery authorized by the manufacturer. This includes the following operations, for example:

- Repairs to the stator or rotor windings and to the terminals
- Repairs to the ventilation system
- Repairs to the bearings
- Dismantling machines with flameproof enclosures
- Connection work performed in the terminal box


Identify the work performed by an additional repair plate bearing the following information:

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

Test in accordance with the relevant EU directives after repair.

 WARNING
Risk of explosion due to alteration of the ignition gap geometry Changing ignition gap geometries (gap dimensions) as part of repair work according to the minimum specifications of IEC / EN 60079–1 is not permissible. This can result in death, serious injury or material damage. <ul style="list-style-type: none">• Obtain the gap dimensions of the electrical machine from the manufacturer for the repair or restoration of ignition gap geometries.

9.2.2 Anti-condensation heating

 WARNING
Incorrectly repairing the anti-condensation heating If the anti-condensation heating is not correctly repaired, e.g. if unauthorized or untested spare parts are used, this can result in explosions during operation in a potentially explosive atmosphere. This can result in death, serious injury or material damage. <ul style="list-style-type: none">• Only appropriately trained specialists in the service center (Page 141) are authorized to repair anti-condensation heating systems. The anti-condensation heating must then be subject to a routine test, which requires extensive specialist knowledge.• Only use authorized and tested spare parts.

⚠ WARNING**Explosion hazard due to increased surface temperature**

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

- Do not open the motor in an explosive and dusty atmosphere when it is still at normal operating temperature.
- Allow the machine to cool down before opening it.

⚠ WARNING**Explosion hazard due to improper maintenance**

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

- Repairing and mounting the anti-condensation heating and the subsequent routine testing must always be undertaken by experts from the service center (Page 141), because this work requires extensive specialist knowledge.
- Only authorized and tested spare parts may be used.

9.2.3 Installing rolling bearings

- Extreme caution and attention to cleanliness are vital when installing rolling bearings. Observe the correct assembly sequence of the components.
- Attach all components with the specified tightening torques (Page 143).

Note

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

Procedure

1. Replace the damaged components.
2. Remove any dirt from the components. Remove any grease and the remains of sealant or liquid threadlocker.

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

 **WARNING**

Rotor can fall out

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

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

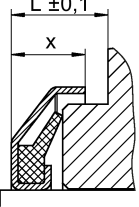
 **WARNING**

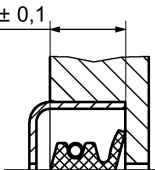
Explosion hazard due to overheating of the rolling bearings

If the rolling bearings are not regularly regreased, local overheating may be possible, and, as a consequence, an explosion in an explosive atmosphere. This can result in death, serious injury, or material damage.

- Regrease the rolling bearings regularly according to the lubrication plate.
- Implement bearing temperature monitoring if not yet in existence.

9.2.4 Shaft sealing, mounting dimension "L"

Shaft \varnothing mm	x mm	L mm	Gamma ring
15 ... 25	6	8	
30 ... 45	6.5	8.5	
50 ... 100	7.5	9.5	

Shaft \varnothing mm	L mm	V ring with protective cap
40 ... 65	11	
70 ... 100	13.5	

Make sure the sealing surface is free of dirt and damage.
Lightly grease the sealing lips.

9.2.5 Insulated roller bearings

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

9.2.6 O-ring seal

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

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

- Adapters, tapers
- Entries, glands
- Bearing seals
- End shield seals
- Terminal box sealing
- etc.

Spare Parts

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.

See also

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

10.2 Ordering data

Note

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

WARNING

Explosion hazard due to unsuitable spare parts

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

- Use only original spare parts for explosion-proof machines, including components, such as seals, terminals, cables, and cable entries. If you have any questions, please contact the service center (Page 141).
- Commercially available equivalent standard parts such as screws and bolts may be used.

10.3 Ordering spare parts via the Internet

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

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



10.4 Roller bearings

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

10.5 Anti-condensation heating

⚠ WARNING

Explosion hazard due to improper maintenance

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

- Repairing and mounting the anti-condensation heating and the subsequent routine testing must always be undertaken by experts from the service center (Page 141), because this work requires extensive specialist knowledge.
- Only authorized and tested spare parts may be used.

10.6 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.

10.7 Ordering example

Table 10- 1 Ordering example

End shield, drive end	1.40 End shield
Machine type *	1MB1553-1EB43-4AB4
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 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.

10.8 Machine parts

Part	Description	Part	Description
1.00	DE bearings	5.52	Cable entry
1.30	Bolt	5.53	Sealing plug
1.31	Spring washer	5.55	Nut
1.34	Spring washer	5.63	Mounting rail
1.40	End shield	5.65	Bolt
1.43	Shaft sealing ring	5.70	Terminal clamp
1.44	Bearing cover	5.76	Clamping plate/contact bracket
1.49	Bolt	5.78	Spring washer
1.59	Locking ring	5.79	Screw
1.60	Rolling bearing	5.83	Seal
1.64	DE bearing cover, inner	5.84	Terminal box cover
1.65	Grease nipple	5.89	Bolt
1.68	Grease slinger	5.94	Bolt
3.00	Rotor, complete	6.00	Bearings, NDE
3.02	Locking ring	6.02	Locking ring
3.38	Feather key	6.03	NDE bearing cover, inner
4.00	Stator, complete	6.10	Rolling bearing
4.04	Eyebolt	6.20	End shield
4.05	Washer	6.23	Shaft sealing ring
4.07	Housing foot	6.29	Bolt
4.10	Spring washer	6.32	Spring washer

Part	Description	Part	Description
4.11	Bolt	6.45	Bolt
4.13	Grooved drive stud	6.46	Spring washer
4.15	Dowel pin	6.59	Rubber sub-plate
4.18	Rating plate	6.60	Cover plate
4.31	Grounding bracket	6.61	Spring washer
4.37	Ground terminal plate	6.62	Spring washer
4.38	Spring washer	6.63	Bolt
4.39	Grounding stud	6.65	Grease nipple
5.00	Terminal box, complete	6.72	Grease slinger
5.03	Seal	7.00	Complete ventilation
5.06	Mounting rail	7.04	Fan
5.10	Complete terminal board	7.12	Locking ring
5.11	Terminal block	7.40	Fan cover
5.12	Slotted screw	7.42	Sealing plug
5.13	Link rail	7.48	Spring washer
5.14	Gland plate	7.49	Bolt
5.16	Spring washer	8.00	Auxiliary terminal box
5.17	Bolt	8.01	Bolt
5.20	Cable gland	8.02	Auxiliary terminal box cover
5.22	Stud-type bushings	8.03	Seal
5.25	Spring washer	8.04	Cheek
5.26	Nut	8.05	Terminal block
5.27	Clamp	8.06	Bolt
5.29	Lower saddle terminal	8.07	End angle
5.35	Special nut	8.08	Bolt
5.36	Spring washer	8.09	Standard mounting rail
5.37	Spring washer	8.10	Bolt
5.43	Entry plate	8.11	Spring washer
5.44	Upper section of the terminal box	8.12	Auxiliary terminal box housing
5.47	Screw	8.13	Sealing plug
5.49	Screw	8.14	O ring
		8.15	Seal

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

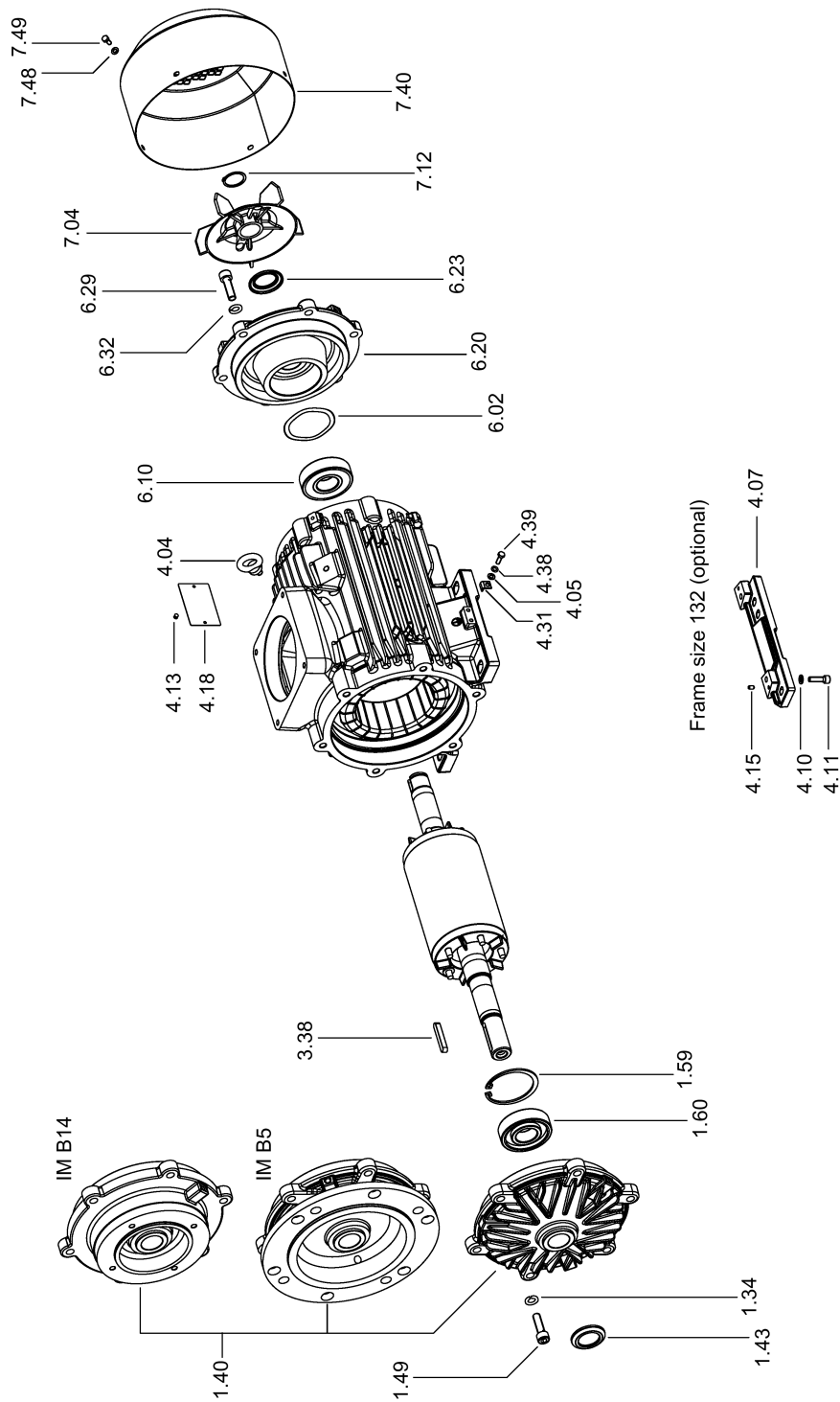
10.9 Standardized parts

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

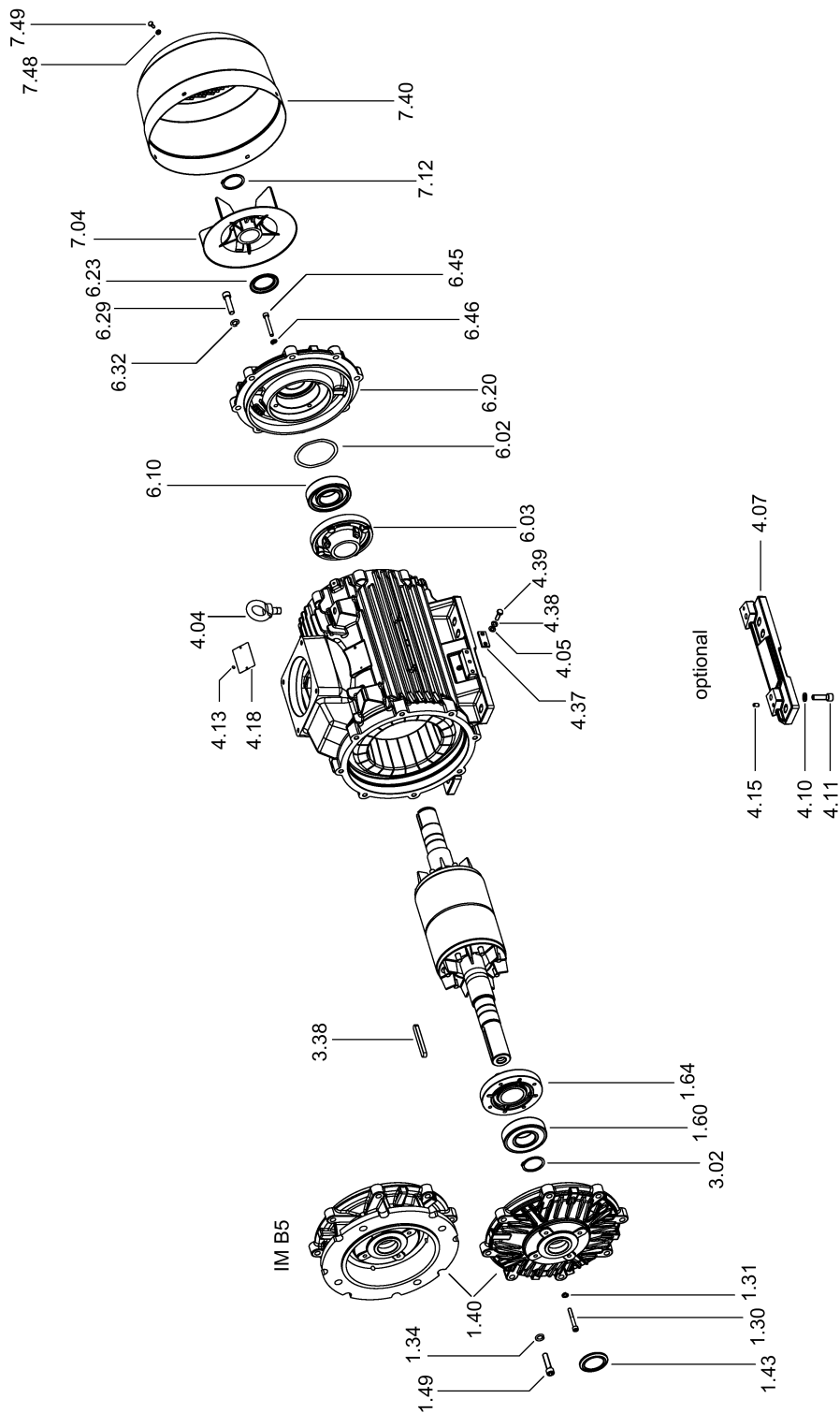
No	Standard	Picture	No	Standard	Picture
3.02 6.02 7.12	DIN 471		4.39 5.65 5.79 5.89 8.01 8.10	EN ISO 4017	
1.59	DIN 472		5.26 5.55	EN ISO 4032	 
4.04	DIN 580		1.30 1.49 4.11 5.17 5.47 5.49 6.29 6.45 7.49	EN ISO 4762	
1.60 6.10	DIN 625				
3.38	DIN 6885		5.94	EN ISO 7045	
5.12 8.06 8.08	EN ISO 1207		4.05 5.36 7.48	EN ISO 7089	
			4.13	EN ISO 8746	
			4.15	DIN EN ISO 8752	

10.10 Exploded drawings

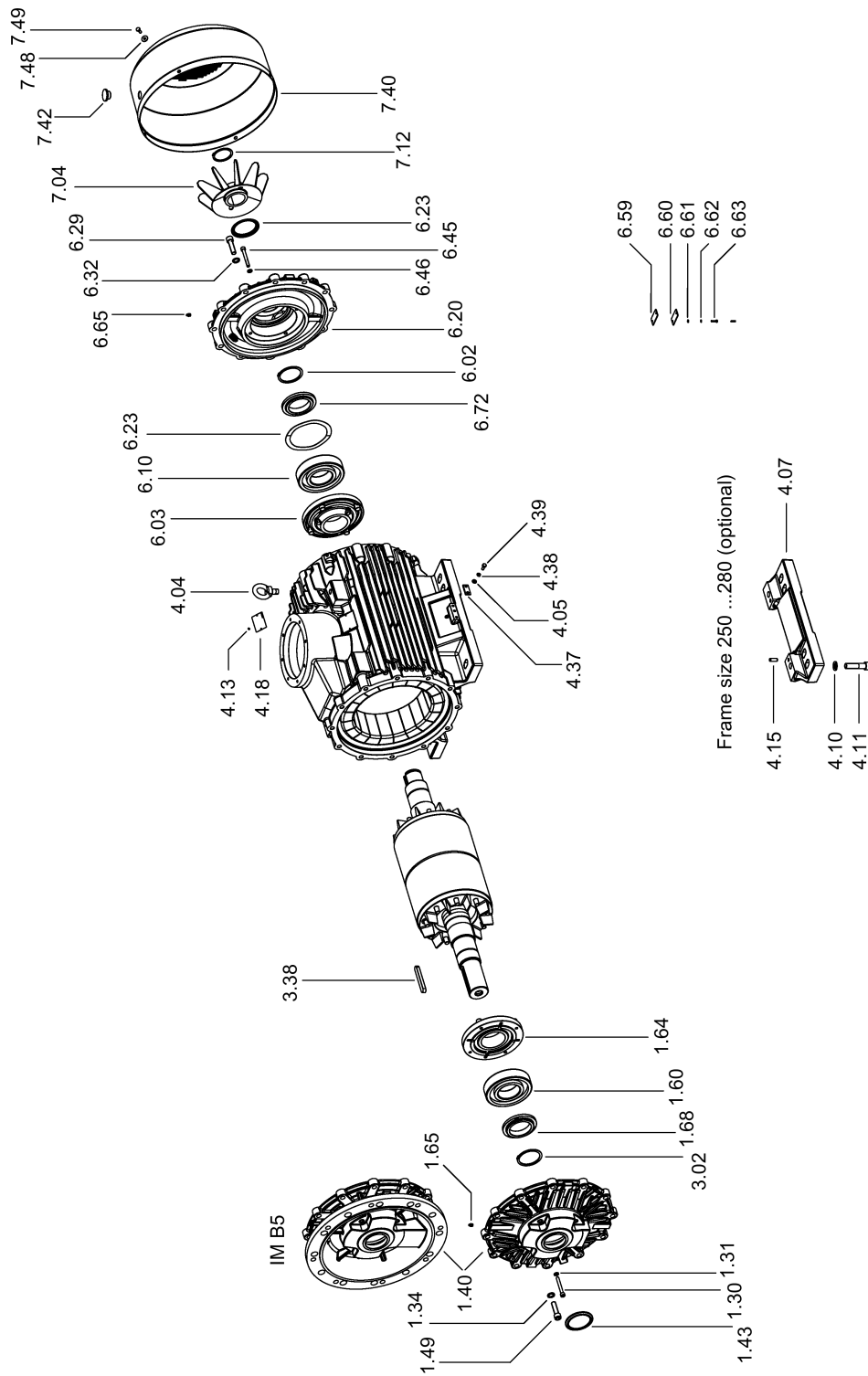
10.10.1 Frame sizes 71 ... 132



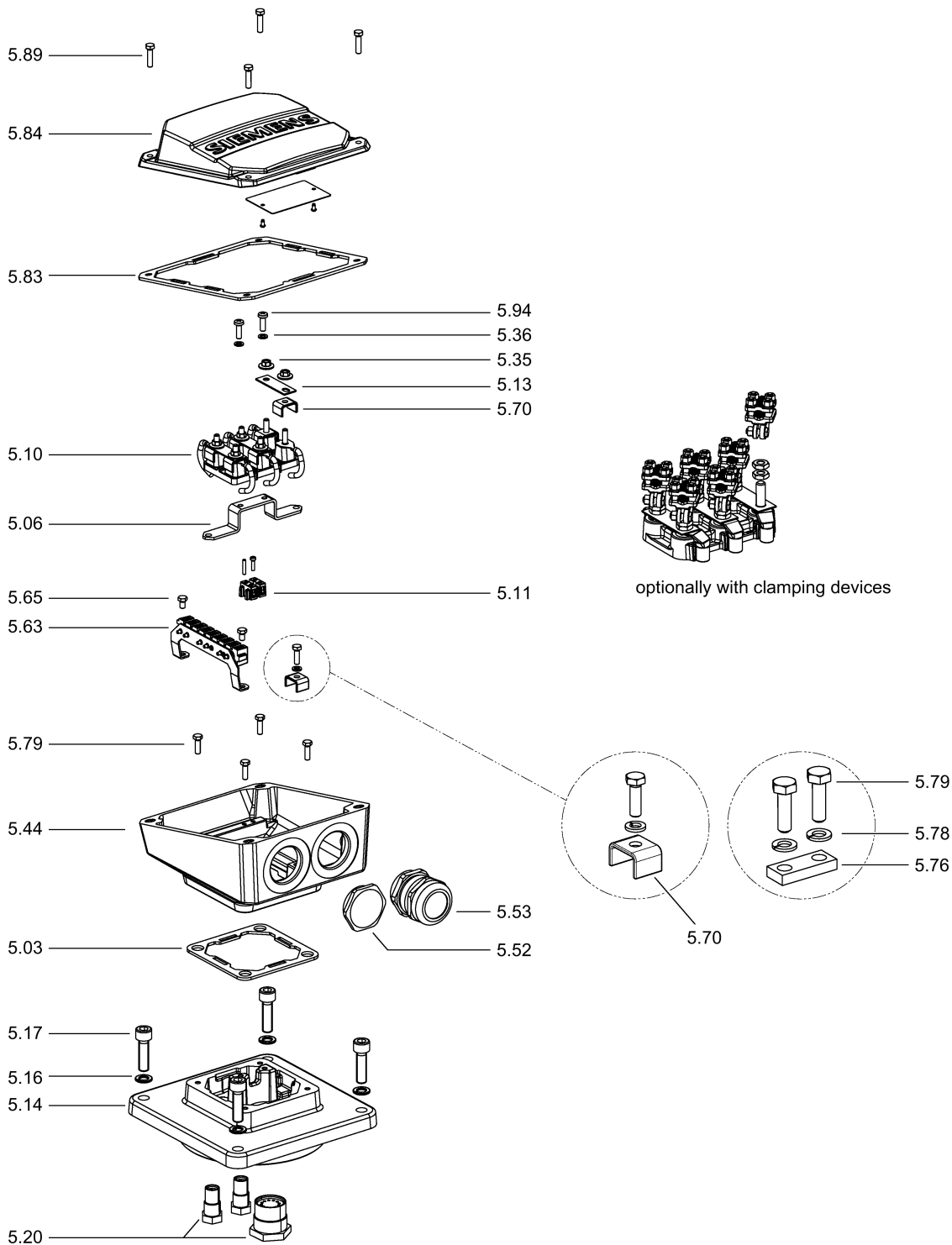
10.10.2 Frame sizes 160 ... 225



10.10.3 Frame sizes 250 ... 355

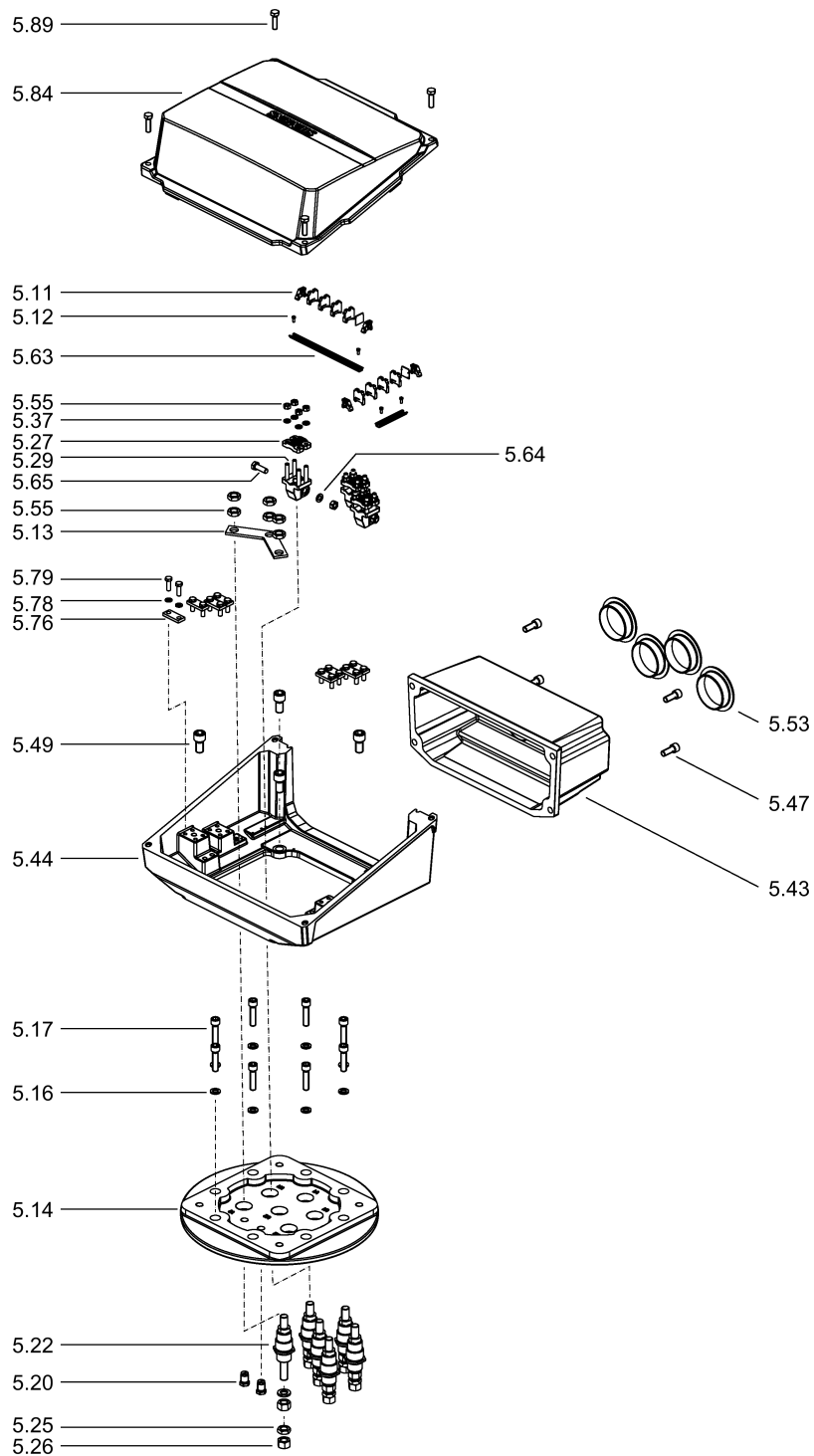


10.10.4 Ex e terminal box frame sizes 71 ... 225

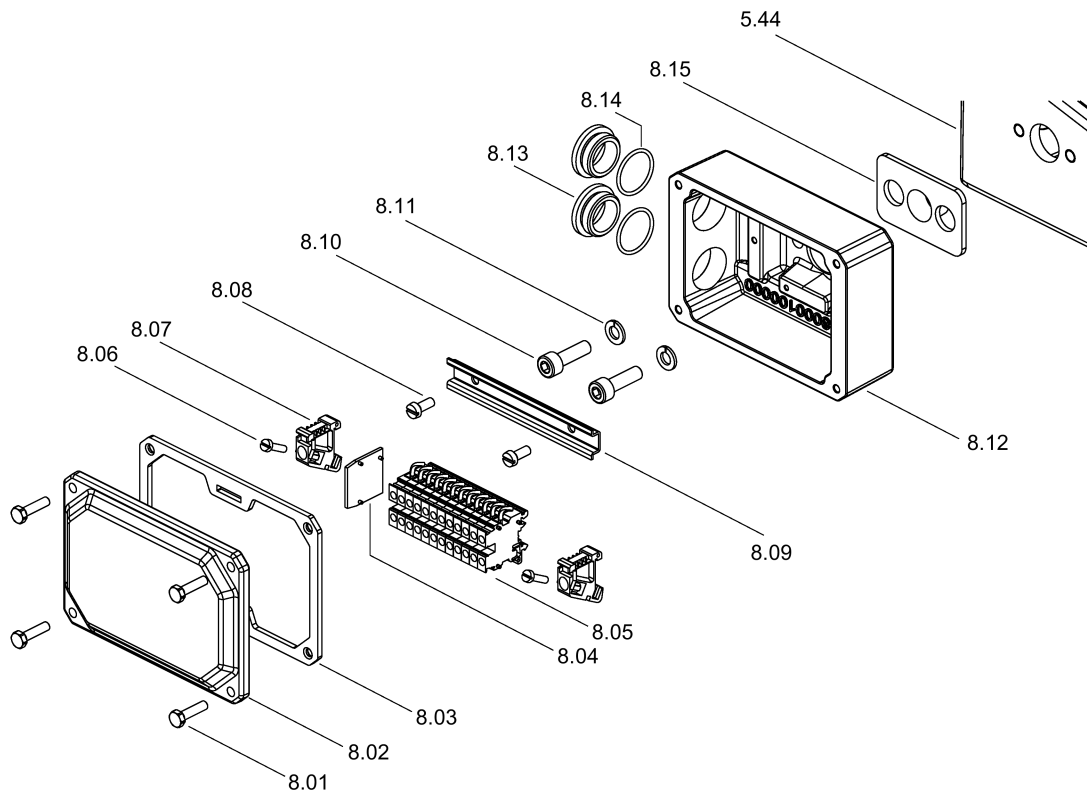


optionally with clamping devices

10.10.5 Ex e terminal box frame sizes 250 ... 355



10.10.6 Auxiliary terminal box Ex e optional, frame size 160 ... 355



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.

Country-specific legislation

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

11.2 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.
3. Disconnect all electrical connections and remove all cables.
4. Remove all liquids such as oil and cooling liquids. Collect the liquids separately and dispose of them in a professional manner.
5. Detach the machine fixings.
6. Transport the machine to a suitable location for disassembly.

11.3 Dismantling the machine

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

 **WARNING**

Machine parts can fall

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

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

11.4 Disposal of components

Components

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

Sort the components for recycling according to whether they are:

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

The winding insulation is incinerated during copper recycling.

- Insulating materials
- Cables and wires
- Electronic waste

Process materials and chemicals

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

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

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

Packaging material

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

Service and Support

Technical questions or additional information



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

Please have the following data ready:

- Type
- Serial number

You can find this data on the rating plate.

Contact person



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

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

Siemens Support for on the move



You can obtain optimum support anywhere you go using the "Siemens Industry Online Support" app. The app is available for Apple iOS, Android and Windows Phone.

Technical data

B.1 Tightening torques for screw and bolt connections

Bolt locking devices

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

Tightening torques

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

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

Thread \varnothing	M5	M6	M8	M10	M12	M16	M20
Nm	5	8	20	40	70	170	340

The tightening torques stated above apply to bolts with property class 8.8, A4-70 or A4-80 according to ISO 898-1, however only to bolts screwed into components made from materials with higher property class, e.g. cast iron, steel or cast steel.

Non-standard tightening torques

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

Quality documents

C.1 Quality documents SIMOTICS in SIOS



You can find the quality documents here:

<https://support.industry.siemens.com/cs/ww/de/ps/13310/cert>
(<https://support.industry.siemens.com/cs/ww/en/ps/13310/cert>)

Index

A

- Aligning, 59, 60
- Alignment accuracy, 61
- Aluminum conductors, 77
- Anti-condensation heating, 41, 98, 120
 - Insulation resistance, 53, 86
 - Repairs, 121, 126
- Assembly
 - Rolling bearings, 121
- Axial force, 63
- Axial gap, 59

B

- Balance quality, 62
- Balancing type, 55
- Bearing currents
 - Reduction, 46
- Bearing insulation, 47
- Bearing shipping brace, 38
- Bearing temperature
 - Monitoring, 88
 - Set values, 88
- Blocked speed ranges, 43
- Bolt locking device, 143

C

- Cable entries
 - certified, 68
- Centering flange, 59, 60
- Checks to be carried out prior to commissioning, 81
- Circuit diagram, 67
- Common-mode filters, 47
- Connecting cables
 - Selection of, 65
- Cooling system
 - faults, 105
- Correct usage, 21
- Coupling, 48

D

- Damping cores, 47

- Disassembly

 - Disposal, 137

- Disposal

 - Chemicals, 138

 - Components, 138

E

- Electrical faults, 103
- Electromagnetic compatibility, 17
- Electromagnetic fields, 14
- Emergency off, 99
- Emitted interference, 14
- Equipotential bonding conductor, 46
- ESD guidelines, 15
- Explosion hazard, 20, 34, 96, 113, 121, 121, 126
 - Bridging the insulated bearing, 98
 - Electrostatic discharge, 16
 - Spare parts, 125
- External fan, 39
 - Commissioning, 87
 - Maintenance, 117
 - Test run, 87

F

- faults
 - Mechanical, 104
- Faults
 - Cooling system, 105
 - Electric, 103
 - Inspection, 102, 110
 - Rolling bearings, 105
- Feather key, 63
- Five safety rules, 12
- Flammable substances, 14, 94
- Foundation forces, 59

G

- General inspection, 111
- Grease types, 115
- Grounding system
 - Meshed, 47

H

Hazardous substances, 13, 94
Hearing damage, 14
Hot surfaces, 13, 94
Hybrid mixtures, 20, 96

I

Ignition hazard, 15
Inspection
 Faults, 102, 110
Installation
 Initial inspection, 110
Insulated bearings, 47, 98
Insulated coupling, 48
Insulation resistance, 38, 50, 83, 113
 Anti-condensation heating, 53, 86
 measure, 51, 84
Interference immunity, 17
Interference voltages, 17
Interlocking circuit
 Anti-condensation heating, 41
 External fan, 39

L

Limit speed, 45
Low-Voltage Directive, 11
Lubricant plate, 114

M

Machine
 Aligning to the driven machine, 59
 Securing, 59
Machine expansion, 59
Machine marking, 116, 119
Maintenance
 Maintenance intervals, 107
Mechanical faults, 104
Minimum air clearances, 69
More information, 141

N

Noise emissions, 14

O

On-site service, 141
Operating mode, 31
O-ring seals, 123
Output element, 62
Overall flatness, 61
Over-critical machine, 43
Overspeed, 31

P

Paint finish, 30
Polarization index, 38, 50, 53, 83, 86, 113
Positioning, 59
Precision alignment, 59
Preload
 Rotor bracing, 37
Preparations for assembly, 49
Property class, 59

Q

Qualified personnel, 12

R

Radial force, 63
Rating plate, 21
Re-commissioning, 102
Regreasing, 114
Regreasing interval, 114
Regreasing system, 38
Repainting, 118
Repair
 Initial inspection, 110
Residual risks, 31
Restriction of certain Hazardous Substances, 137
RF grounding point, 46
Risk of explosion, 120
 Bearing temperature, 97, 109
 Cleaning, 110
 Layer of dust, 96, 109
RoHS, 137
Rolling bearings
 Assembly, 121
 faults, 105
 Inspection, 111
Rotating parts, 13, 94
Rotor shipping brace, 36
 Remove, 60

S

- Safety instructions
 - Flammable substances, 14, 94
 - Hazardous substances, 13, 94
 - Hot surfaces, 13, 94
 - Live parts, 13, 93
 - Maintenance work, 107
 - Rotating parts, 13, 94
- Sealing plugs
 - certified, 68
- Selection of bolts, 59
- Spare parts, 125, 141
- Spares on Web, 126
- Standard flange, 59, 60
- Stoppages, 99
 - Rolling bearings, 101
- Supplementary devices, 28
- Switching on, 90, 90, 99
- System resonances, 43

T

- Tandem operation, 48
- Technical Support, 141
- Temperature class, 98, 101
- Temperature limits, 34
- Terminal marking, 67
- Test run, 90
- Thermal motor protection, 41
- Tightening torques, 65
 - Bolted connection, 143
- Type of balancing, 62
- Type of protection, 125

V

- Vibration limits, 43
- Vibration values, 43, 91

More information

www.siemens.com/drives/...

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