

SIEMENS

For employment in zone 2 (IEC/EN 60079-10-1)

CE  II 3G Ex nA IIC T3 Gc

SIMOTICS FD

Induction motor

Type 1MQ1

Operating Instructions / Installation Instructions

Edition

04/2016

siemens.com

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

Legal information

Warning notice system

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



DANGER

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



WARNING

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



CAUTION

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

NOTICE

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:



WARNING

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

Trademarks

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

Disclaimer of Liability

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

Table of contents

1	Introduction.....	13
1.1	About these instructions.....	13
1.2	Compiling personal documents.....	13
2	Safety information.....	15
2.1	Information for the nominated person in control of the electrical installation.....	15
2.2	The five safety rules.....	16
2.3	Qualified personnel.....	16
2.4	Safe handling.....	16
2.5	For use in hazardous Zone 2 or Zone 22.....	18
2.6	Electrostatic sensitive devices.....	19
2.7	Processes that generate high levels of electrostatic charge.....	20
2.8	Electromagnetic compatibility.....	21
2.9	Interference immunity.....	21
2.10	Interference voltages when operating the converter.....	22
2.11	Electromagnetic fields when operating electrical power engineering installations.....	22
3	Description.....	23
4	Preparations for use.....	29
4.1	Safety-related aspects to consider when configuring the plant.....	29
4.2	Observing the operating mode.....	29
4.3	Ensuring cooling.....	29
4.4	Space required for ventilation.....	30
4.5	Interlock circuit for the external fan motor.....	30
4.6	Thermal motor protection.....	31
4.7	Thermal motor protection using PTC thermistors (option).....	31
4.8	Interlock circuit for the automatic regreasing system (option).....	31
4.9	Interlock circuit for anti-condensation heating.....	31
4.10	Support base for IM B5 construction type.....	32
4.11	Noise emissions.....	32
4.12	Rotational speed limit values.....	33
4.13	Complying with speed-torque curve.....	33
4.14	Phase synchronization during supply system switching.....	33

4.15	System-inherent frequencies.....	34
4.16	Torsional loading of the drive train due to faults in the electrical supply.....	34
4.17	Transport and storage.....	34
4.17.1	Checking the delivery.....	35
4.17.2	Requirements for safe lifting and transporting.....	35
4.17.3	Securing the rotor.....	36
4.17.4	Transporting the machine set.....	37
4.17.5	Storage.....	38
4.17.6	Protection against corrosion.....	41
4.18	Converter operation.....	41
4.18.1	Supply line configuration.....	41
4.18.2	Converter operation of explosion-proof machines.....	42
4.18.3	Reducing bearing currents.....	42
4.18.4	Insulated bearings when operating the converter.....	43
5	Assembly.....	47
5.1	Preparations for installation.....	47
5.1.1	Requirements for installation.....	47
5.1.2	Insulation resistance and polarization index.....	48
5.1.3	Testing the insulation resistance and polarization index.....	49
5.1.4	Prepare the mating faces (IM B3).....	51
5.1.5	Prepare the mating face for a flange connection.....	51
5.1.6	Prepare the mating face for wall mounting	52
5.2	Lift the machine to where it will be installed, and position it.....	52
5.2.1	Preconditions for correct alignment and secure attachment	52
5.2.2	Checking the load handling attachments.....	52
5.2.3	Removing the rotor shipping brace.....	52
5.2.4	Removing the rotor shipping brace from machines in vertical type.....	53
5.2.5	Removing anti-corrosion protection.....	53
5.2.6	Mounting the output elements.....	54
5.2.7	Requirements for safe lifting and transporting.....	56
5.2.8	Putting the machine down.....	58
5.2.9	Draining condensation.....	58
5.2.10	Roughly aligning the machine.....	60
5.3	Installing the machine.....	60
5.3.1	Safety instructions for installation.....	60
5.3.2	Selecting fixing screws.....	61
5.3.3	Preconditions for smooth, vibration-free operation.....	61
5.3.4	Aligning the machine to the driven machine and mounting (IM B3 / IM B35).....	62
5.3.5	Aligning the machine to the driven machine and attaching it to it (IM B5).....	63
5.3.6	Fastening the support base (IM B5).....	64
5.3.7	Aligning the machine to the driven machine and attaching it to it (IM V1, IM V10).....	64
5.3.8	Axial and radial forces.....	65
6	Electrical connection.....	67
6.1	Safety instructions relating to the electrical connection.....	67
6.2	Terminal box.....	67
6.2.1	Terminal box 1XB1621.....	68
6.2.2	Terminal box 1XB1631.....	69

6.2.3	Terminal box 1XB7730.....	70
6.2.4	Terminal box 1XB7731.....	70
6.2.5	Terminal box 1XB7740.....	71
6.2.6	Terminal box 1XB7750.....	72
6.2.7	Rotating the terminal box.....	72
6.2.8	Mounting/removing the terminal box.....	75
6.3	Preparation.....	76
6.3.1	Terminal designation.....	76
6.3.2	Selecting cables.....	76
6.3.3	Connecting the grounding conductor.....	76
6.3.4	Connect metal shield in the terminal box	77
6.3.5	Brought-out cables - Connection without terminal box.....	78
6.3.6	Connecting the machine for a specific direction of rotation.....	78
6.4	Connection.....	79
6.4.1	Bringing cables into the terminal box 1XB... with sealing insert with break-off ring.....	79
6.4.2	Bringing cables into the terminal box 1XB... with cable gland.....	81
6.4.3	Certified cable entries, thread adapters and sealing plugs.....	82
6.4.4	Laying cables.....	82
6.4.5	Connecting cables with cable lugs.....	82
6.4.6	Connecting cables without cable lugs.....	83
6.4.7	Use of aluminum conductors.....	85
6.4.8	Using single-stranded cables.....	86
6.4.9	Internal equipotential bonding.....	86
6.4.10	Stepless mating face for the seal in the terminal box cover	86
6.4.11	Minimum air clearances.....	87
6.4.12	Finishing connection work.....	87
6.5	Connecting the auxiliary circuits.....	88
6.5.1	Selecting cables.....	88
6.5.2	Bringing cables into the auxiliary terminal box and routing them.....	88
6.5.3	Intrinsically safe circuits for sensors or probes.....	89
6.5.4	Connect metal shield in the terminal box	89
6.5.5	Connecting an external fan motor.....	89
6.5.6	Connecting temperature monitoring for the stator winding.....	90
6.5.7	Terminating the connection work (auxiliary circuit).....	91
6.5.8	Converter operation.....	91
6.5.8.1	Maximum peak voltage at the motor terminals.....	92
6.5.8.2	Converter operation on a grounded network.....	92
7	Start-up.....	93
7.1	Checks to be carried out prior to commissioning	93
7.2	Measuring the insulation resistance before commissioning.....	94
7.3	Greasing the roller bearings prior to commissioning.....	95
7.4	Setting the automatic regreasing system.....	96
7.5	Commissioning an external fan.....	96
7.6	Setpoint values for monitoring the bearing temperature.....	97
7.7	Set values for monitoring the winding temperature.....	97
7.8	Test run.....	98

7.9	Switching off.....	99
7.10	Setting the motor parameters at the converter.....	100
7.10.1	Selecting the motor type and motor data in the STARTER program.....	100
7.10.2	Commissioning at the SINAMICS S/G converter using the AOP30.....	103
7.10.3	Commissioning at the SINAMICS G120P inverter using the IOP.....	106
8	Operation.....	107
8.1	Safety guidelines in operation.....	107
8.2	Operation in hazardous areas of Zone 2.....	108
8.3	Switching on the machine.....	109
8.4	Switching off the anti-condensation heating.....	110
8.5	Regreasing roller bearings.....	110
8.6	Stoppages.....	110
8.6.1	Avoidance of condensation or formation of condensation within the machine.....	111
8.6.2	Avoidance of damage to roller bearings during stoppages.....	111
8.6.3	Measurement of the insulation resistance after an extended stoppage.....	111
8.7	Decommissioning the machine.....	112
8.8	Switch off the external fan.....	112
8.9	Re-commissioning the machine.....	112
8.10	Switching on again after an emergency switching-off.....	113
8.11	faults.....	113
8.11.1	Inspections in the event of faults.....	113
8.11.2	Electrical faults.....	114
8.11.3	Mechanical faults.....	114
8.11.4	Faults at the external fan.....	116
8.11.5	Roller bearing faults.....	117
9	Maintenance.....	119
9.1	Inspection and maintenance.....	119
9.1.1	Safety instructions for inspection and maintenance.....	119
9.1.2	Risk of explosion when cleaning with compressed air.....	121
9.1.3	Measuring the insulation resistance during the course of maintenance work.....	121
9.1.4	Inspections in the event of faults.....	121
9.1.5	First service after installation or repair.....	122
9.1.6	General inspection.....	122
9.1.7	Servicing and maintaining the anti-condensation heating.....	123
9.1.8	Servicing the roller bearings.....	123
9.1.9	Roller bearings with automatic regreasing system.....	124
9.1.10	Regreasing intervals and types of grease for operating roller bearings.....	124
9.1.11	Sealing the rolling-contact bearings ("Increased degree of protection" option).....	128
9.1.12	Cleaning the cooling air ducts.....	128
9.1.13	Servicing the external fan.....	128
9.1.14	Touch up any damaged paintwork.....	129
9.1.15	Repainting.....	130
9.1.16	Maintaining terminal boxes.....	130
9.2	Corrective Maintenance.....	131

9.2.1	Prepare servicing work.....	132
9.2.2	Anti-condensation heating.....	133
9.2.3	External fan.....	133
9.2.3.1	External fan unit.....	133
9.2.3.2	Replacing the external fan.....	134
9.2.4	Roller-contact bearings.....	134
9.2.4.1	Removing roller bearing.....	134
9.2.4.2	Remove V ring.....	135
9.2.4.3	Removing the labyrinth sealing ring.....	136
9.2.4.4	Assembling the rolling-contact bearings.....	137
9.2.4.5	Install the V ring.....	138
9.2.4.6	Installing the V ring ("Increased degree of protection" option).....	138
9.2.4.7	Installing the labyrinth sealing ring.....	139
9.2.5	Seal the motor.....	140
10	Spare parts.....	143
10.1	Ordering data.....	143
10.2	Roller bearings.....	143
10.3	Anti-condensation heating.....	144
10.4	Housing, stators and rotors.....	145
10.5	External fan (radial mounting).....	146
10.6	External fan (axial mounting).....	147
10.7	Roller bearing cartridge at the drive and non-drive end.....	148
10.8	Roller bearing cartridge at the drive and non-drive end.....	149
10.9	Speed sensor (optional).....	150
10.10	Terminal box 1XB1621.....	151
10.11	Terminal box 1XB1631.....	153
10.12	Terminal box 1XB7730.....	154
10.13	Terminal box 1XB7731.....	155
10.14	Terminal box 1XB7740.....	156
10.15	Terminal box 1XB7750.....	157
10.16	Auxiliary terminal box 1XB9014.....	158
10.17	Auxiliary terminal box 1XB9015.....	159
10.18	1XB9016 auxiliary terminal box.....	160
10.19	Auxiliary terminal box 1XB302.....	161
11	Disposal.....	163
11.1	RoHS - restricting the use of certain hazardous substances.....	163
11.2	Dismantling the machine.....	163
11.3	Disposal of components.....	164

A	Service and Support.....	165
B	Technical data and drawings.....	167
B.1	Tightening torques for screw and bolt connections.....	167
C	Quality documents.....	169
D	Additional documents.....	171
D.1	Additional documents on CD.....	171
	Index.....	173

Tables

Table 3-1	Machine design	23
Table 3-2	Machine version with type of protection Ex nA.....	24
Table 3-3	Data on the rating plate.....	25
Table 3-4	Rolling-contact bearing variants.....	27
Table 4-1	Space required to ventilate the separately-driven fan.....	30
Table 4-2	Tightening torque for the shaft screw on the rotor shipping brace	37
Table 5-1	Stator winding insulation resistance at 40° C.....	49
Table 5-2	Permissible deviations for aligning the machine with flexible coupling.....	63
Table 6-1	Terminal designations using the 1U1-1 as an example.....	76
Table 6-2	Determining the cross-section of the grounding conductor.....	76
Table 6-3	Connection technology (with cable lug / connection without cable lug).....	79
Table 6-4	Cable entry plate versions.....	81
Table 6-5	Minimum air clearance dependent on rms value of the alternating voltage U_{rms}	87
Table 6-6	Maximum peak voltage at the motor terminals	92
Table 7-1	Set values for monitoring the bearing temperatures before commissioning.....	97
Table 7-2	Set values for monitoring the bearing temperatures.....	97
Table 7-3	Set value for commissioning.....	97
Table 7-4	Set values during normal operation.....	98
Table 8-1	Electrical faults	114
Table 8-2	Mechanical faults.....	114
Table 8-3	Cooling system faults	116
Table 8-4	Roller bearing faults	117
Table 9-1	Checks after assembly or repair	122
Table 9-2	Checks that have to be performed during the general inspection.....	122
Table 9-3	Criteria for selecting roller bearing greases.....	124
Table 9-4	Roller bearing greases for vertical and horizontal types of construction	126
Table 9-5	Alternative greases with NLGI class 2 for motors of horizontal construction.....	126
Table 10-1	Spare parts for housing, stators and rotors.....	145

Table 10-2	Spare parts for external fan	146
Table 10-3	Spare parts for external fan	147
Table 10-4	Spare parts for the bearing cartridge at the drive end and non-drive end.....	148
Table 10-5	Spare parts for the bearing cartridge at the drive end and non-drive end.....	149
Table 10-6	Spare parts for the speed sensor	150
Table 10-7	Terminal box 1XB1621 spare parts.....	151
Table 10-8	Additional spare parts.....	152
Table 10-9	Main terminal box 1XB7730 spare parts.....	154
Table 10-10	Additional spare parts.....	154
Table 10-11	Main terminal box 1XB7731 spare parts.....	155
Table 10-12	Additional spare parts.....	155
Table 10-13	Main terminal box 1XB7740 spare parts.....	156
Table 10-14	Additional spare parts.....	156
Table 10-15	Spare parts main terminal box 1XB7750.....	157
Table B-1	Tightening torques for screw/bolt connections with a tolerance of $\pm 10\%$	167

Images

Image 3-1	Schematic of the rating plate.....	25
Image 4-1	Axial location of the rotor.....	36
Image 4-2	Schematic representation of a single drive.....	44
Image 4-3	Schematic representation of a tandem drive.....	44
Image 5-1	Balancing type on the drive-end side.....	54
Image 5-2	Condensation water drain for vertical mounting.....	59
Image 5-3	Condensation water drain for horizontal mounting.....	59
Image 5-4	Schematic diagram: Aligning the machine to the driven machine.....	62
Image 6-1	Terminal box 1XB1621.....	68
Image 6-2	Terminal box 1XB1631.....	69
Image 6-3	Terminal box 1XB7730.....	70
Image 6-4	Terminal box 1XB7731.....	70
Image 6-5	Terminal box 1XB7740.....	71
Image 6-6	Terminal box 1XB7750.....	72
Image 6-7	Strain relief device and sealing insert.....	80
Image 6-8	Connection with cable lug and fixing screw (schematic diagram).....	82
Image 6-9	Connection using terminal clamps (schematic diagram).....	84
Image 7-1	Selecting a motor type.....	101
Image 7-2	Entering the motor data.....	102
Image 9-1	Remove the V ring.....	135
Image 9-2	Disassembling the labyrinth sealing ring (schematic diagram).....	136

Image 9-3	Install the V ring.....	138
Image 9-4	Roller-contact bearing with grease chamber (schematic diagram).....	139
Image 9-5	Position the set screws for the labyrinth sealing ring on the outer bearing cover.....	140
Image 10-1	Housing, stators and rotors.....	145
Image 10-2	External fan.....	146
Image 10-3	External fan.....	147
Image 10-4	Bearing cartridge at the drive end and non-drive end.....	148
Image 10-5	Bearing cartridge at the drive end and non-drive end.....	149
Image 10-6	Speed sensor.....	150
Image 10-7	Terminal box 1XB1621 with standard cable entry.....	151
Image 10-8	Two-part cable entry.....	151
Image 10-9	Terminal box 1XB1631.....	153
Image 10-10	Main terminal box 1XB7730.....	154
Image 10-11	Main terminal box 1XB7731.....	155
Image 10-12	Main terminal box 1XB7740.....	156
Image 10-13	Main terminal box 1XB7750 with standard cable entry.....	157
Image 10-14	Auxiliary terminal box 1XB9014	158
Image 10-15	Auxiliary terminal box 1XB9015	159
Image 10-16	1XB9016 auxiliary terminal box	160
Image 10-17	Auxiliary terminal box 1XB302.....	161

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 165) if you have any suggestions on how to improve this document.

Text format features

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

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

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

Note

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

1.2 Compiling personal documents

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

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

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

1.2 Compiling personal documents

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

The full functionality is only available for registered users.

Safety information

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

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

The persons responsible for the plant must ensure the following:

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

Note

Use the services and support provided by the appropriate Service Center (Page 165) for planning, installation, commissioning, and servicing work.

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

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

This machine has been designed and built in accordance with Directive 94/9/EC until April 19, 2016 and from April 20, 2016 in accordance with Directive 2014/34/EU ("Explosion Protection Directive"), and it is intended for use in industrial plants with a potentially explosive atmosphere.

Commissioning in the European Community in accordance with Directive 2006/42/EU ("Machinery Directive") is forbidden until the plant into which the machine will be installed has been shown to conform with this directive. Please observe the country-specific regulations when using the machine outside the European Community.



WARNING

Commissioning prior to establishing conformance

If the machine is commissioned prior to determining the plant conformance, the explosion protection of the plant is not ensured. An explosion can occur. This can result in death, serious injury or material damage.

Do not commission the machine until it has been confirmed that the plant conforms with the explosion protection directive.

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 16) when carrying out any work on the machine.
- Only remove the covers using the methods described by these operating instructions.
- Operate the machine properly.
- Regularly and correctly maintain the machine.



! 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-standing shaft ends and other rotating parts such as couplings, belt pulleys etc. against touch.



! WARNING

Hot surfaces

Electric machines have hot surfaces. Do not touch these surfaces. They could cause burns.

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



! CAUTION

Hazardous substances

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

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

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

 CAUTION
Flammable substances Chemical substances required for the setup, operation and maintenance of machines may be flammable. Burns and other damage to health and material may result. • Read the information in these operating instructions and the product information supplied by the manufacturer. • Observe the relevant safety regulations and wear the personal protective equipment specified.

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

2.5 For use in hazardous Zone 2 or Zone 22

Electrical systems in hazardous areas 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

You can find basic information relating to the assessment of ignition hazards arising from electrical devices and their operation in hazardous areas, for example, in directives 94/9/EC ("Explosion protection directive", up to April 19, 2016; from April 20, 2016 according to directive 2014/34/EU) and 1999/92/EC as well as in the series of standards IEC / EN 60079.

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.

2.6 Electrostatic sensitive devices

ESD protective measures



NOTICE

Electrostatic discharge

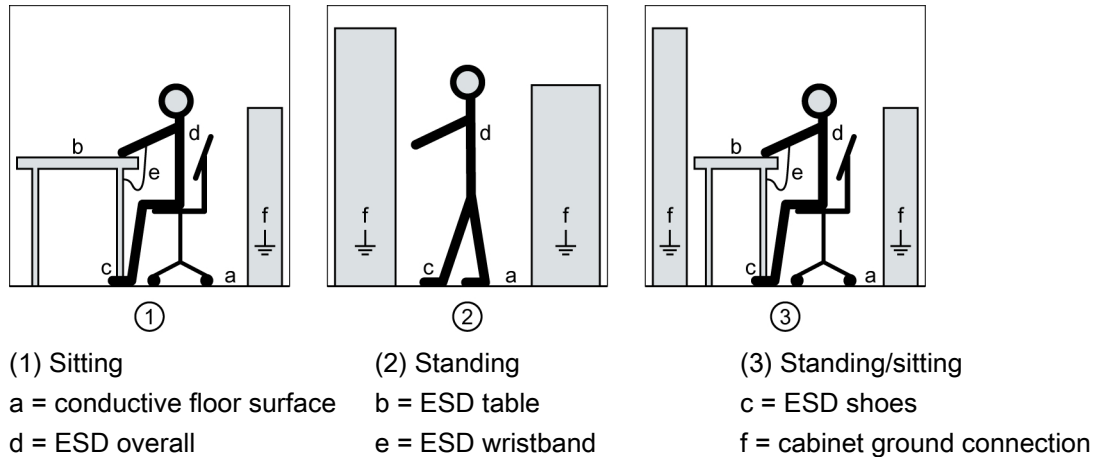
Electronic modules contain components that can be destroyed by electrostatic discharge. These modules can be easily destroyed by improper handling.

To protect 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.
- 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

2.7 Processes that generate high levels of electrostatic charge

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



WARNING

Risk of explosion due to electrostatic discharge

Electrostatic discharge poses a potential ignition source. In an explosive atmosphere, there is a risk of an explosion. This can result in death, serious injury or material damage.

Please comply with ESD protective measures.

2.7 Processes that generate high levels of electrostatic charge

Processes that generate high levels of electrostatic charge, which are far higher than those generated through manual friction, include the following:

- Operation of high-voltage electrodes and ionizers
- Presence of high-speed particles on surfaces, e.g. sprayed charges (electron and ion flows) in electrostatic coating processes
- Pneumatically conveyed dusts and bulk goods
- Flowing or hydraulically conveyed liquids and drops
- Belts, brushes and foils etc. moved by machines

**WARNING****Risk of explosion as a result of processes with high levels of electrostatic charging**

Processes with high levels of electrostatic charging can result in propagating brush discharge/brushing discharge and explosion

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

- Avoid all of these processes in areas where there is risk of gas and dust explosions at non-metallic exposed components, e.g. paint finishes. These discharge types are not addressed in current standards.
- The non-metallic exposed components, e.g. paint finishes are subject to an electrostatic suitability test in the factory. When supplied, the motor has its original paint finish. Use the tested, original paint when repainting or touching up. It is possible to use a paint that has not been tested by Siemens, which is however suitable from an electrostatic perspective. The operating company is responsible for carrying out an electrostatic test of the complete system.

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 2004/108/EC - from April 20, 2016 of the European directive 2014/30/EU on Electromagnetic Compatibility.

2.9 Interference immunity

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

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

2.10 Interference voltages when operating the converter

 WARNING
Interference voltages when operating the converter When a converter is in operation, the emitted interference varies in strength depending on the converter (manufacturer, type, interference suppression measures undertaken). On machines with integrated sensors (e.g. PTC thermistors), interference voltages caused by the converter may occur on the sensor lead. This can cause faults which can result in eventual or immediate death, serious injury or material damage. Observe the EMC instructions of the converter manufacturer in order to avoid exceeding the limit values according to IEC/EN 61000-6-3 for drive systems comprising machine and converter. You must put appropriate EMC measures in place.

2.11 Electromagnetic fields when operating electrical power engineering installations

 WARNING
Interference to electronic devices caused by electrical power equipment Electrical power equipment generate electric fields during operation. Potentially lethal malfunctions can occur in medical implants, e.g. pacemakers, in the vicinity of electrical power equipment. Data may be lost on magnetic or electronic data carriers. • It is forbidden for people with pacemakers to enter the vicinity of the machine. • Protect the personnel working in the plant by taking appropriate measures, such as erecting identifying markings, safety barriers and warning signs and giving safety talks. • Observe the nationally applicable health and safety regulations. • Do not carry any magnetic or electronic data media.

Description

Applications

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

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

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

Type of protection Ex nA

This machine is designed in the "non-sparking" (Ex nA) type of protection according to IEC / EN 60079-15. It can therefore be operated in hazardous areas of **Zone 2** according to IEC / EN 60079-10-1.

 WARNING
Explosion hazard This machine is not designed for use in areas at risk of dust explosion or in areas where an explosion hazard exists due to hybrid mixtures. An explosion can occur if the machine is operated in these areas. This can result in death, serious injury or material damage. Never operate this machine in the presence of explosive dust or in areas where an explosion hazard exists due to hybrid mixtures.

Machine design

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

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

Table 3-1 Machine design

Feature	Standard
Rating and performance	IEC/EN 60034-1
Degree of protection	IEC/EN 60034-5
Cooling	IEC/EN 60034-6

Feature	Standard
Type of construction	IEC/EN 60034-7
Terminal markings and direction of rotation	IEC/EN 60034-8
Noise emission	IEC/EN 60034-9
Starting characteristics of rotating electrical machines *	IEC/EN 60034-12
Vibration severity grades	IEC/EN 60034-14
Efficiency classification of three-phase squirrel-cage induction motors **	IEC/EN 60034-30-1
Vibration limits	DIN ISO 10816-3

* For machines in line operation only

** Exception: Pole-changing motors

See also

Quality documents (Page 169)

The following standards additionally apply for explosion-proof motors:

Table 3-2 Machine version with type of protection Ex nA

Feature	Standard
Type of protection Ex nA ^①	IEC/EN 60079-0 IEC/EN 60079-15

^① Optional (depending on order)

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.

°										SIEMENS										°													
(1)				(2)				(3)				(4)																					
(5)				(6)				(7)				(8)				(9)				(10)				(25)									
(11)								(12)																									
(13)			(14)			(15)			(16)			(17)			(18)			(19)			(20)			(26)									
(21)																		(27)															
(22)						(23)														(28)													
(23)																																	
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°										(24)										CE°													

DEW0400

Image 3-1 Schematic of the rating plate

Table 3-3 Data on the rating plate

Item	Description	Item	Description
(1)	Type of motor	(15)	Rated power [kW or HP]
(2)	Order number	(16)	Rated efficiency factor
(3)	Identifier of the motor series	(17)	Rated speed [rpm]
(4)	Serial number	(18)	Rated frequency [Hz]
(5)	Weight	(19)	Efficiency class (IE code) or efficiency according to IEC/EN 60034-2-1 or empty
(6)	Degree of protection	(20)	Efficiency according to IEC/EN 60034-2-1 or current at service factor power
(7)	Type of construction	(21)	Motor design (converter or mains motor)
(8)	Permissible ambient temperature range	(22)	Line voltage/frequency
(9)	Thermal class of the insulation system	(23)	Optional additional data (e.g. service factor, design and code letter, amount of cooling water and intake temperature, etc.)
(10)	Thermal class of the utilization	(24)	Country of manufacture and location
(11)	Maximum speed [rpm]	(25)	Certification mark for UL/CSA + file number (optional)
(12)	Standards	(26)	Certificate number(s) for Ex motors for Zone 2 (optional)

Item	Description	Item	Description
(13)	Rated voltage [V] and connections	(27)	Direction of rotation
(14)	Rated current [A]	(28)	Data matrix code (order number and serial number)

Rotors

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

Drive

The motor speed is controlled using a converter. It has been optimized for operation with SINAMICS low-voltage converters.

Other converters must comply with certain requirements: You can find more information in the catalog or in the engineering documentation.

NOTICE

Destruction of the machine when operated directly from the line supply

The machine will be destroyed if it is directly connected to the line supply. Only operate the machine using a converter.

Cooling

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

Degree of protection

The machine is available with degree of protection IP55.

Rolling-contact bearings

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

Table 3-4 Rolling-contact bearing variants

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

Automatic regreasing system (option)

The roller bearings are optionally equipped with an automatic regreasing system. The roller bearings are supplied with new grease portions by the regreasing system in parameterized time intervals.

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

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

Layout

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

Terminal box

Depending on the machine design, the following terminal boxes are generally used for connecting the cables:

Terminal box	Comment	Application
GT640	Only for machines on the power supply	Not for explosion-proof versions
1XB1621		
1XB1631	2 × 1XB1631	
1XB7730		Not for IEC explosion-proof versions
1XB7731		Not for IEC explosion-proof versions
1XB7740	2 × 1XB7740	Not for IEC explosion-proof versions

Depending on the terminal box and version, it is possible to rotate the terminal box through $\pm 90^\circ$ in accordance with the connection direction. The implementation on the other motor side is possible only with the support of the Service Center. If you wish to retrofit using a different terminal box at a later date, please contact the Service Center (Page 165).

See also

Rotating the terminal box (Page 72)

Terminal box (Page 67)

Note

You can find more information in Chapter 2 of catalog D81.8.

Supplementary devices

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

Anti-condensation heating (option)

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

Preparations for use

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

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

4.1 Safety-related aspects to consider when configuring the plant

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

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

4.2 Observing the operating mode

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

4.3 Ensuring cooling

Ensure that the machine and/or any mounted external fan unit is sufficiently cooled by the cooling air flow at the installation site:

- The cooling air can flow in and out freely. The full air flow provided by the fan is only achieved if air can freely enter the impeller. Ensure that the required distance in accordance with the dimensioned drawing is maintained.
- Hot discharged air must not be drawn in again.
- On the vertical design with air intake from above, the air inlets must be protected against the ingress of foreign bodies and water.

See also

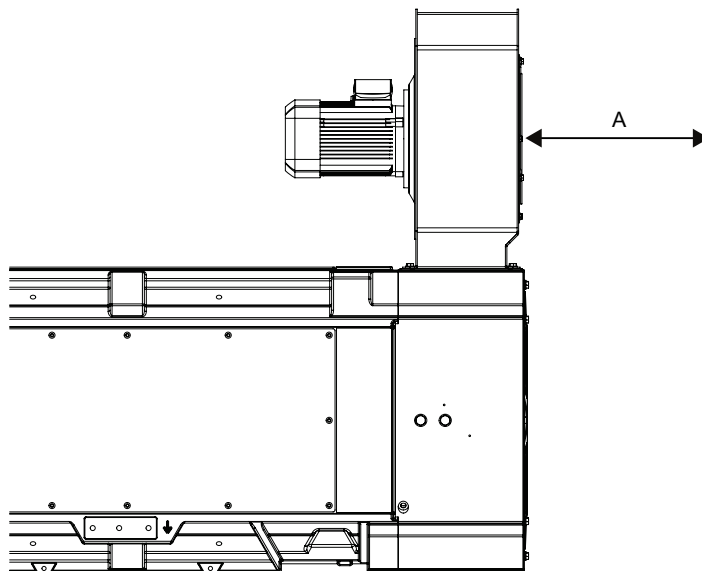
Connecting an external fan motor (Page 89)

4.4 Space required for ventilation

Maintain a clearance for the air intake where the machine is located (A). Provide sufficient space where the machine is located so that the fan cover can be removed and mounted as required. The necessary space requirements are listed in the following table:

Table 4-1 Space required to ventilate the separately-driven fan

Type	Space requirement / clearance A
1L.....-3A..... 1M.....-3A.....	200 mm
1L.....-3B..... 1M.....-3B.....	220 mm
1L.....-4A..... 1M.....-4A.....	260 mm
1L.....-4B..... 1M.....-4B.....	320 mm



4.5 Interlock circuit for the external fan motor

Interlock circuit for the external fan motor

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

See also

Connecting an external fan motor (Page 89)

Additional documents (Page 171)

4.6 Thermal motor protection

The machine is equipped with measuring equipment for direct monitoring of the motor temperature to protect the machine against overload during operation. Plan a corresponding circuit for monitoring.

4.7 Thermal motor protection using PTC thermistors (option)

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

4.8 Interlock circuit for the automatic regreasing system (option)

Relubrication is permitted only for a rotating shaft. Consequently, deploy an interlock circuit for machines with automatic regreasing system to prevent them from operating at machine standstill.

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

See also

Switching off the anti-condensation heating (Page 110)

 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.

4.10 Support base for IM B5 construction type

For construction type IM B5, the machine has to be supported with an additional support base at the NDE. The support base is not included in the scope of supply. Therefore, use an appropriately sized support base with corresponding rigidity. At the bottom of the machine, there is a plate with a threaded hole M36x40 where you can fasten the support base.

The weight of the machine is stated on the rating plate, data on geometry is shown in the dimension drawing.

 WARNING
Missing support at the NDE If the machine has no additional support at the NDE, the flange cannot hold the weight of the machine. The machine or machine parts may loosen. This can result in death, serious injury or material damage. Use an appropriately sized support base.

4.11 Noise emissions

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

4.12 Rotational speed limit values



WARNING

Excessively high speeds

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

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

4.13 Complying with speed-torque curve



WARNING

Exceeding the temperature class

If the speed-torque curve is not followed, the temperature class may be exceeded. An explosion can occur. This can result in death, serious injury or material damage.

- Comply with the speed-torque curve.
- Observe the data on the extra rating plate on the motor.

4.14 Phase synchronization during supply system switching

NOTICE

Supply system switching

Damage to the machine may be caused when switching to another supply system with different phasing.

- The phasing must be synchronized during switching. Use appropriate means to synchronize the phasing.

4.15 System-inherent frequencies

NOTICE

Machine damage caused by system resonances

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

4.16 Torsional loading of the drive train due to faults in the electrical supply

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

Note

The system planner is responsible for the entire drive train.



WARNING

Torsional loadings of the shaft assembly

If the configuration does not correctly recognize the mechanical torsional loadings of the shaft assembly, this can lead to serious damage to the machine. This can result in death, serious injury or material damage.

When planning the system, consider the configuration data.

Note

You can find more information in Chapter 2 of catalog D81.8.

4.17 Transport and storage

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

4.17.1 Checking the delivery

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

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

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

4.17.2 Requirements for safe lifting and transporting

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

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



WARNING

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

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

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



WARNING

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

If the center of gravity of a load is not located centrally between the attachment points, the motor can tip over or slip out of the lifting equipment and fall when it is being transported or lifted. This can result in death, serious injury or material damage.

- Comply with the handling instructions on the machine when transporting it.
- Be aware of the possibility of different loads on the sling ropes or lifting straps and the carrying capacity of the lifting equipment.
- Always take account of the center of gravity when transporting or lifting the motor. If the center of gravity is not located centrally between the attachment points, then position the hoisting hook above the center of gravity.

4.17.3 Securing the rotor

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

NOTICE

Damage during transport

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

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

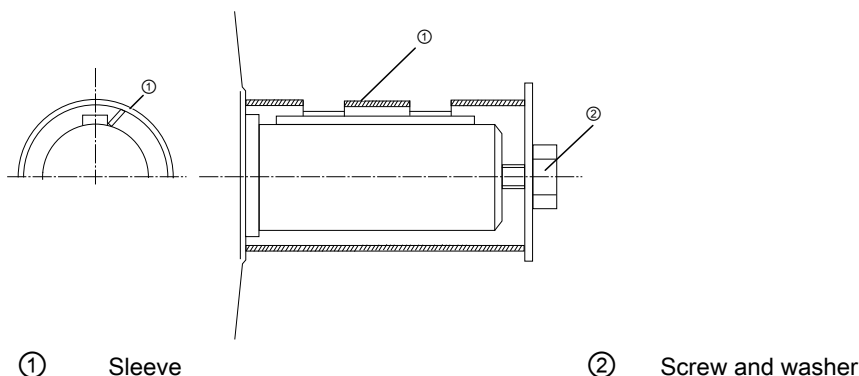


Image 4-1 Axial location of the rotor

Table 4-2 Tightening torque for the shaft screw on the rotor shipping brace

Thread in the shaft end	Tightening torque	Preload
M20	80 Nm	20 kN
M24	150 Nm	30 kN
M30	230 Nm	40 kN

Note

Store the rotor locking device

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

4.17.4 Transporting the machine set



WARNING

Falling down of the machine

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

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

Note

Place the machine in a secure and raised position

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



DANGER

Standing under suspended loads

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

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

4.17.5 Storage

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

NOTICE
Seizure damage to bearings
If the machine is stored incorrectly there is a risk that the bearings will suffer damage while out of use. Examples of resulting damage can include scoring and corrosion.
Read the following storage instructions.

Preconditions and preparations

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

General instructions for storage

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

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

Storing outdoors

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

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

Protection against humidity

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

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

NOTICE

Damage to the roller bearings

If storage conditions are inappropriate there is a risk of bearing seizure damage. This can result in material damage, such as damage to bearings caused by vibration.

On machines that have been supplied with a rotor shipping brace, secure the rotor as per the notes on transportation (Page 36). Protect the machine against strong radial vibrations, since the rotor shipping brace might not absorb these completely.

NOTICE

Bearing damage

If the customer has already mounted parts, for example coupling, belt pulley, etc., the bearing can be damaged during transport.

In this case, make sure that the customer uses a rotor locking device.



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.

The materials used are specially designed for the temperature range required by the customer. Do not store the motor in conditions that lie outside the specified temperature limits. The relevant temperature limits are specified on the rating plate.

Long-term storage

If you are storing a machine for more than six months, you must check its condition every six months. Store the machine in accordance with the specifications in Section "Storage (Page 38)", and if possible, packed.

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

Storage for longer than three months

Lubricate the machine after every two years of storage.

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

NOTICE

Damage to roller bearings

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

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

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

4.17.6 Protection against corrosion

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

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

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

4.18 Converter operation

The following chapter is relevant only if the machine has been ordered for converter operation.

Note

The order number shows whether the machine was ordered for converter operation. In this case, digits 1, 2, 3 or 4 is located at the 6th position of the order number.

WARNING

Operation with a converter that is not permissible for the application

If a certain converter type has been defined in the test verification document, on the extra rating plate, or in the certificate, the machine is only allowed to be operated with this converter. Death, serious injury, or material damage can result if it is operated with an unauthorized converter.

- Only operate the motor with the specified converter.

4.18.1 Supply line configuration

NOTICE

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

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

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

NOTICE

Ground fault during operation on an IT system

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

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

4.18.2 Converter operation of explosion-proof machines

The operation of the explosion-proof machine on the frequency converter is permitted, when the specifications for the speed control range and torque characteristic are observed, and if winding temperature monitoring is ensured via the integrated temperature sensors in conjunction with a tripping unit.

4.18.3 Reducing bearing currents

Taking the following actions will reduce the bearing currents:

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

Equipotential bonding conductors:

Use equipotential bonding conductors:

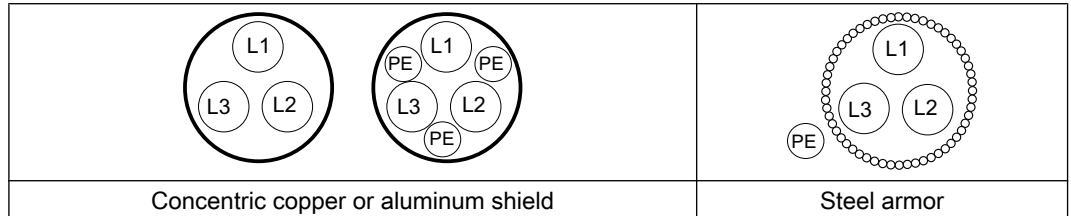
- Between motor and driven machine
- Between motor and converter
- Between the terminal box and the RF grounding point at the motor enclosure.

Selecting and connecting the cable:

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

- The shield is connected at both ends, at the motor and converter.
- To ensure good discharging of high-frequency currents, provide contacting over a large surface area:
 - as contact established through 360° at the converter
 - at the motor, for instance with EMC glands at the cable entries

- If the cable shield is connected as described, then it ensures the specified equipotential bonding between the motor enclosure and converter. A separate RF equipotential bonding conductor is then not necessary.



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

Overall system design

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

- In the overall system, set up a properly meshed grounding system with low impedance.
- Use the common-mode filter (damping cores) at the converter output. The Siemens sales representative is responsible for selection and dimensioning.
- Limit the rise in voltage by using output filters. Output filters dampen the harmonic content in the output voltage.

Note

Converter documentation

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

4.18.4 Insulated bearings when operating the converter

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

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

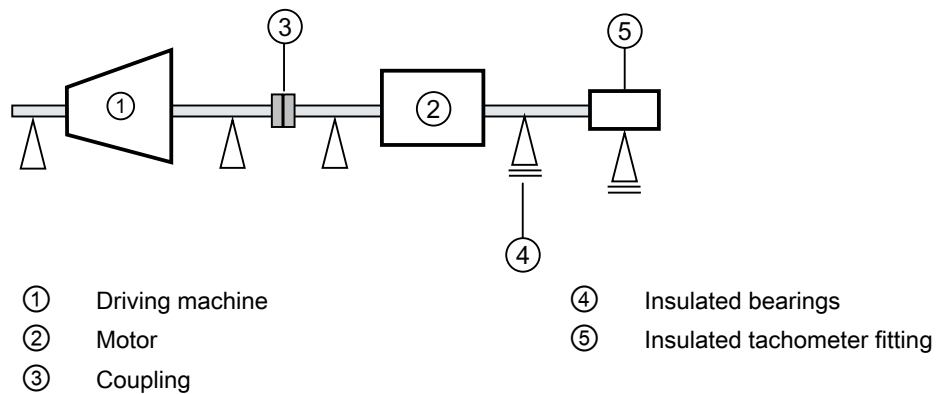


Image 4-2 Schematic representation of a single drive

NOTICE

Bearing damage

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

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

Tandem operation

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

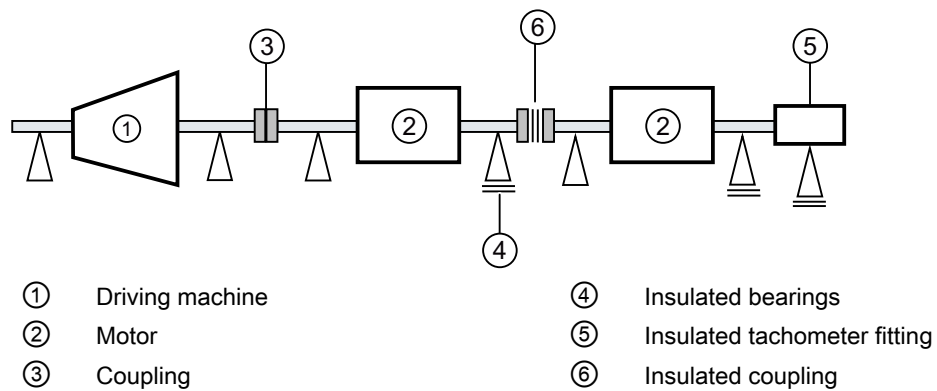


Image 4-3 Schematic representation of a tandem drive

NOTICE
Bearing damage Bearing currents can flow if the coupling between the motors of the tandem drive is not insulated. This can damage the DE bearings of both motors. • Use an insulated coupling to link the motors.

See also

Service and Support (Page 165)

If you connect two motors in series in "tandem operation", fit a coupling between the motors; this coupling should satisfy Directive 94/9/EC (up to April 19, 2016, from April 20, 2016 according to directive 2014/34/EU) or the regulations that apply in the country where the equipment is installed.

Assembly

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

Note

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.



WARNING

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.

Please contact the Service Center, if necessary.

See also

Service and Support (Page 165)

5.1 Preparations for installation

5.1.1 Requirements for installation

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

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

Note

Measure the insulation resistance of the winding before starting installation work

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

NOTICE
High temperatures
The motor components get very hot during operation. High temperatures can damage mounting parts such as the cable insulation.
• Temperature-sensitive parts such as normal cables or electronic components must not rest against or be attached to mounted machine parts. • Only use heat-resistant mounting parts. The connecting cables and cable entries must be suitable for the ambient temperature.

5.1.2 Insulation resistance and polarization index

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

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

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

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

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

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

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

"Testing the insulation resistance and polarization index" (Page 49)

5.1.3 Testing the insulation resistance and polarization index



WARNING

Hazardous voltage at the terminals

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

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

Measure the insulation resistance

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

Limit values for the stator winding insulation resistance

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

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

$V_N [V]$	$V_{Meas} [V]$	$R_C [M\Omega]$
$U \leq 1000$	500	≥ 5
$1000 \leq U \leq 2500$	500 (max. 1000)	100
$2500 < U \leq 5000$	1000 (max. 2500)	
$5000 < U \leq 12000$	2500 (max. 5000)	
$U > 12000$	5000 (max. 10000)	

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

U_{meas} = DC measuring voltage

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

Conversion to the reference temperature

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

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

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

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

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

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

Measuring the polarization index

1. To determine the polarization index, measure the insulation resistances after one minute and ten minutes.

2. Express the measured values as a ratio:

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

Many measuring devices display these values automatically following the measurement.

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

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

NOTICE**Damage to insulation**

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

- Contact the Service Center (Page 165).
- If the measured value is close to the critical value, you must subsequently check the insulation resistance at shorter intervals.

Limit values of the anti-condensation heating insulation resistance

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

5.1.4 Prepare the mating faces (IM B3)

- Ensure that the foundation faces are flat and free of contaminations.

Note**Shims**

To establish a defined mounting surface, you can order shims (option L31) from our Service Center. In this way you avoid vibration problems that would otherwise result in bearing damage.

- Check the dimensions of the mounting-foot holes.

See also

Removing anti-corrosion protection (Page 53)

Requirements for safe lifting and transporting (Page 35)

Service and Support (Page 165)

5.1.5 Prepare the mating face for a flange connection

- Clean the flange before installation, and make sure that the flange face is flat and free of contaminations.
- Check the geometry of the flange.

See also

Removing anti-corrosion protection (Page 53)

Requirements for safe lifting and transporting (Page 35)

5.1.6 Prepare the mating face for wall mounting

- Ensure that the wall surface is flat and free of contaminations.
- Check the dimensions of the mounting-foot holes.
- Support the machine from below, e.g. using a wall bracket or by bolting it.

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

5.2.1 Preconditions for correct alignment and secure attachment

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

- Preparing the foundation
- Selecting and mounting the coupling
- Measuring the concentricity and axial eccentricity tolerances
- Positioning the machine

If you are not familiar with the prescribed measures and procedures, then you can make use of the services offered by the local Service Center (Page 165).

5.2.2 Checking the load handling attachments

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

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



WARNING

The machine can be dropped

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

5.2.3 Removing the rotor shipping brace

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

5.2.4 Removing the rotor shipping brace from machines in vertical type

NOTICE
Damage to the bearing Dismantling the rotor shipping brace when the machine is in a horizontal position could damage the bearings. Only remove the rotor shipping brace when the machine is in a vertical position.

NOTICE
Damage to the bearing Failure to fit the rotor shipping brace can result in damage to the bearings while the machine is being turned onto its side. Fix the rotor in place before you turn the machine into a horizontal position.

Note**Store the rotor locking device**

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

5.2.5 Removing anti-corrosion protection

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

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

Bright surfaces on machine parts

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

NOTICE

Paintwork damage

Painted surfaces can be damaged if they come into contact with detergents or solvents.

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

NOTICE

Damage to the machine surface

Metal objects, such as scrapers, spatulas or pieces of metal, are not suitable to remove the anti-corrosion protection.

These could damage the surfaces of the machine parts.

- Lightly oil the depreserved surfaces.

5.2.6 Mounting the output elements

Balance quality

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

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

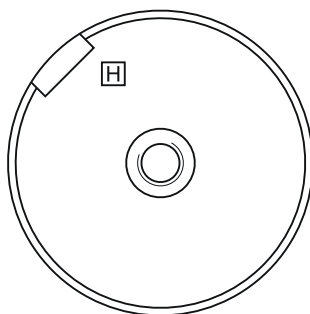


Image 5-1 Balancing type on the drive-end side

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

The feather key can fall out

The feather keys are only locked against falling out during shipping. If a machine with two shaft extensions does not have an output element on one shaft extension, the feather key can fall out during operation.

Death or serious injury can result.

- Do not operate the machine unless the transmission elements have been pulled on.
- On shaft extensions without output element, make sure that the feather key cannot fall out and shorten it by approximately half for balance type "H".

5.2.7 Requirements for safe lifting and transporting

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

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

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

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

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

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

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

If the center of gravity of a load is not located centrally between the attachment points, the motor can tip over or slip out of the lifting equipment and fall when it is being transported or lifted. This can result in death, serious injury or material damage.

- Comply with the handling instructions on the machine when transporting it.
- Be aware of the possibility of different loads on the sling ropes or lifting straps and the carrying capacity of the lifting equipment.
- Always take account of the center of gravity when transporting or lifting the motor. If the center of gravity is not located centrally between the attachment points, then position the hoisting hook above the center of gravity.

Note**Place the machine in a secure and raised position**

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

**DANGER****Standing under suspended loads**

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

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

5.2.8 Putting the machine down

Requirements

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

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

Setting down the machine

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

See also

Draining condensation (Page 58)

5.2.9 Draining condensation

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

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

NOTICE
Damage due to condensate If the stator winding is damp, its insulation resistance will be reduced. This can result in voltage flashovers, which can destroy the winding. Condensate can also cause rust to form within the machine. Ensure that condensate can drain away.

Depending on the type of installation, the water drainage holes are located at the bottom:

Allow the condensation water to discharge for vertical placement

In the DE bearing shield, water drain holes are located in the area of the mounting feet or opposite the regreasing system. They are sealed with screw plugs.

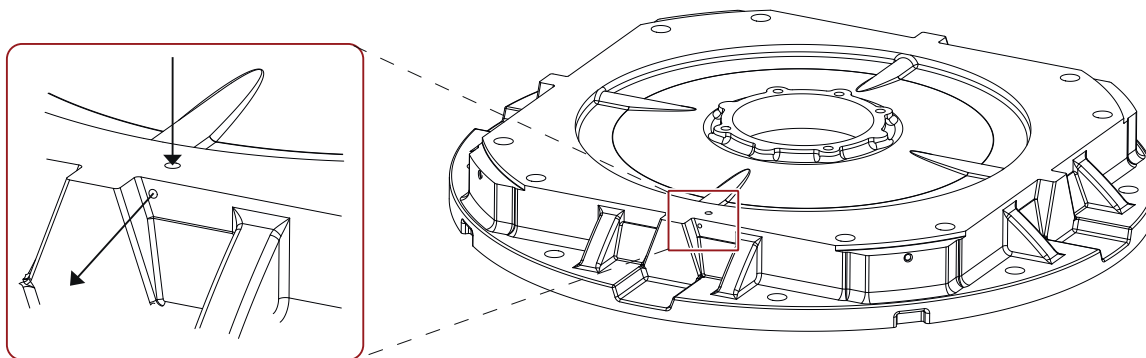


Image 5-2 Condensation water drain for vertical mounting

Allow the condensation water to discharge for horizontal placement

The water drain holes are located in the lower side of the stator enclosure, and sealed with screw plugs.

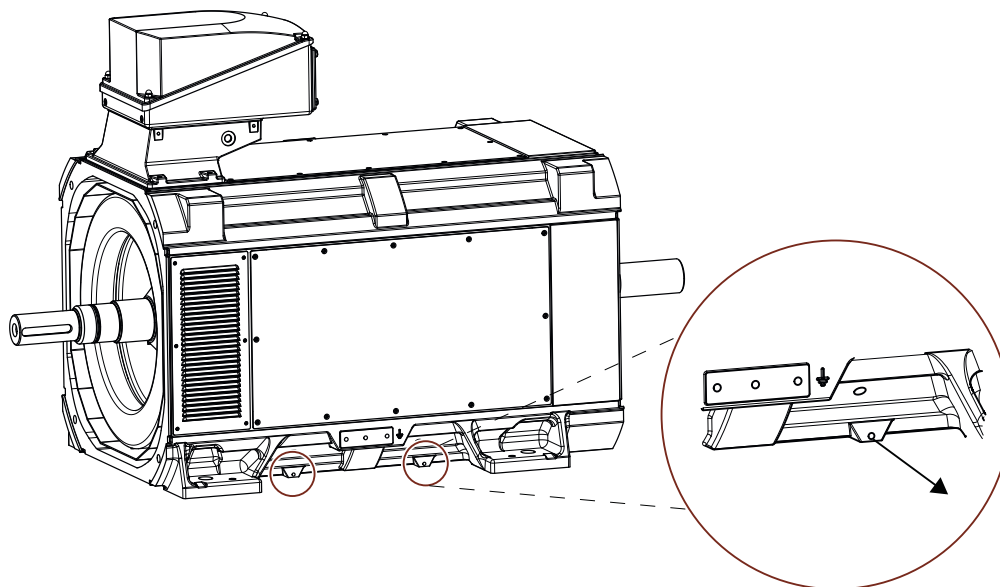


Image 5-3 Condensation water drain for horizontal mounting

To drain the condensation water, proceed as follows:

1. Remove the screw plugs to allow the condensation water to drain.
2. Then reinsert the screw plugs.

NOTICE

The degree of protection is reduced

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

5.2.10 Roughly aligning the machine

Requirement

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

Roughly aligning the machine

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

5.3 Installing the machine

5.3.1 Safety instructions for installation



WARNING

Inappropriate fastening material

If screws of an incorrect property class have been selected or if they have been fastened to an incorrect tightening torque, they may break or become loose. This will cause the machine to move, which could damage the bearings. The rotor could smash into the machine enclosure and machine parts could be flung out of place. This can result in death, serious injury or material damage.

- Comply with the required property classes for screwed connections.
- Tighten the screwed connections to the specified tightening torques.



WARNING

Incorrect alignment

If the machine has not been properly aligned, this will mean the fastening parts are subjected to stress/distortion. Screws may become loose or break, the machine will move, machine parts could be flung out of place. This can result in death, serious injury or material damage.

- Carefully align the machine to the driven machine.

NOTICE**Improper handling**

Mounting parts such as temperature sensors or speed sensors are attached to the machine and could be ripped off or destroyed as a result of improper handling. This could lead to machine malfunctions, extending even to total loss of the machine.

- Where necessary, use suitable steps when performing installation work on the machine.
- Do not stand on cables or attachments during installation. Do not use attachments as steps.

5.3.2 Selecting fixing screws

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

See also

Technical data and drawings (Page 167)

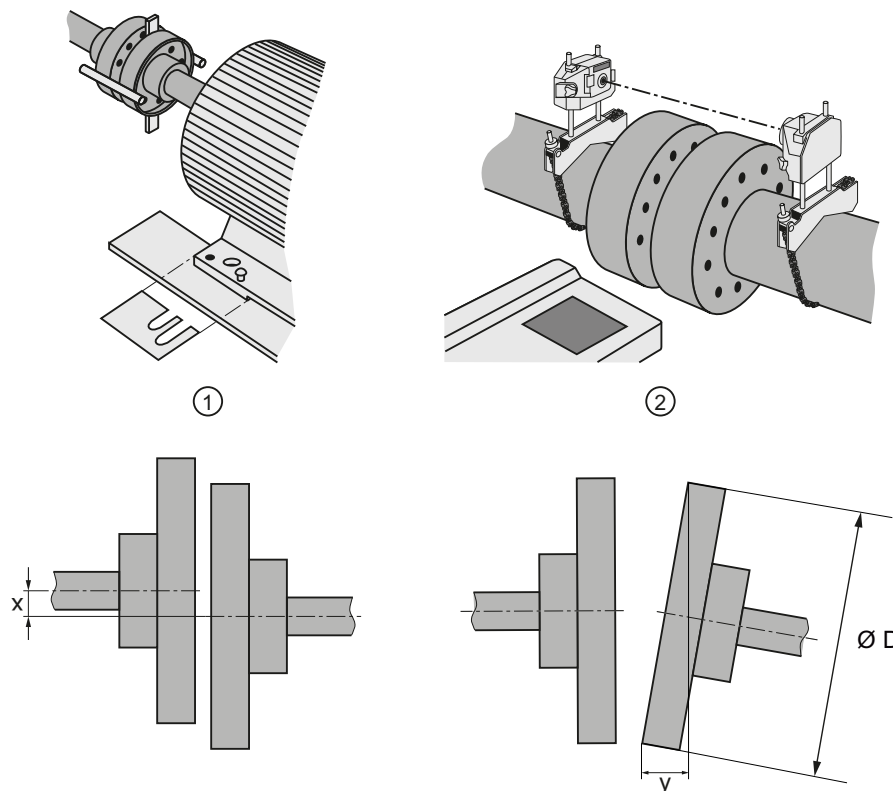
5.3.3 Preconditions for smooth, vibration-free operation

Preconditions for smooth, vibration-free operation:

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

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

1. Refer to any instructions for aligning the driven machine and those of the coupling manufacturer.
2. Align the machines with coupling output to the driven machine in such a manner that the center lines of the shafts at the operating temperature do not have any parallel or angular offset. This ensures that no additional forces affect their bearings during operation. If the thermal change of the motor and the driven machine is different, couple in the cold state with an appropriate alignment offset. The alignment offset to be set in the cold state must be determined and specified by the system specialist.
3. For the vertical positioning ($x \rightarrow 0$), place thin shims over a large surface area under the machine feet. The number of shims should be kept as low as possible, i.e. stack as few as possible. This also prevents the machine being subjected to any stress/distortion. Use the existing tapped holes for the forcing-off bolts to raise the machine. The balance state of the shaft (full-key or half-key balancing) and alignment errors primarily influence the service life of the bearing, especially for high motor speeds or when using rigid couplings.
4. When positioning the machine, ensure that a uniform axial gap ($y \rightarrow 0$) is maintained around the coupling.
5. Fix the machine to the foundation. The choice of fixing elements depends on the foundation and is the plant operator's responsibility.



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

Image 5-4 Schematic diagram: Aligning the machine to the driven machine

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

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

Note**Machine expansion**

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

See also

Tightening torques for screw and bolt connections (Page 167)

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

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

Note

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

Procedure

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

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

See also

Tightening torques for screw and bolt connections (Page 167)

5.3.6 Fastening the support base (IM B5)

At the bottom of the machine, there is a plate with a threaded hole M36x40 where you can fasten the support base.

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



WARNING

Mechanical tensions

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

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

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

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

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

Note

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

Procedure

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

1. Grease the centering flange with assembly paste to make the process easier.
2. Screw in two studs into tapped holes on opposite sides of the driven machine flange. The studs act as positioning aids.
3. Lower the machine slowly toward the driven machine and into the centering, so that the flanges do not quite touch. Lowering too quickly risks damaging the centering.
4. If necessary, rotate the machine into the right position so that the clearance holes in the flange are central to the tapped holes.

5. Lower the machine completely onto the mating flange so that it is fully in contact; then remove the studs.
6. Fix the machine using the flange fixing bolts.

See also

Tightening torques for screw and bolt connections (Page 167)

Alignment accuracy

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

5.3.8 Axial and radial forces

You can obtain the permissible values for axial and radial forces by contacting the Siemens Service Center (Page 165) or referring to the machine catalog.

NOTICE**Damage to bearings or the shaft**

Large output masses and their centers of gravity outside the shaft extensions can lead to resonance in operation. This can result in damage to the bearings and shaft.

Ensure that the permissible loads for the forces on the shaft extension are adhered to in accordance with the catalog data or configuration data.

Note

You can find more information in Chapter 2 of catalog D81.8.

Electrical connection

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

Note

Service Center

If you require support when electrically connecting up the machine, please contact the Service Center (Page 165).

6.1 Safety instructions relating to the electrical connection



WARNING

Connected parts can loosen

If you use fixing elements made from the wrong material or apply the wrong tightening torque, this could impair current transfer or cause connecting parts to become loose. 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.

See also

Tightening torques for screw and bolt connections (Page 167)

6.2 Terminal box

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

6.2 Terminal box

Terminal box 1XB1621 (Page 68)

Terminal box 1XB1631 (Page 69)

Terminal box 1XB7730 (Page 70)

Terminal box 1XB7731 (Page 70)

Terminal box 1XB7740 (Page 71)

Terminal box 1XB7750 (Page 72)

6.2.1 Terminal box 1XB1621

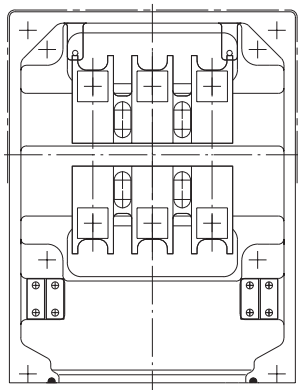


Image 6-1 Terminal box 1XB1621

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

You can find additional information here:

- Bringing cables into the terminal box 1XB... with cable gland (Page 81)
- Connecting cables without cable lugs (Page 83)
- Connecting cables with cable lugs (Page 82)

See also

Bringing cables into the terminal box 1XB... with sealing insert with break-off ring (Page 79)

6.2.2 Terminal box 1XB1631

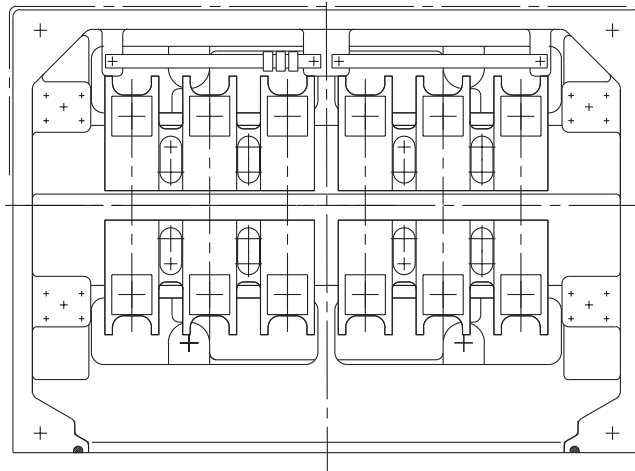


Image 6-2 Terminal box 1XB1631

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

You can find additional information here:

- Bringing cables into the terminal box 1XB... with cable gland (Page 81)
- Connecting cables without cable lugs (Page 83)
- Connecting cables with cable lugs (Page 82)

See also

Bringing cables into the terminal box 1XB... with sealing insert with break-off ring (Page 79)

6.2.3 Terminal box 1XB7730

Only a three-core power cable can be connected in terminal box 1XB7730.

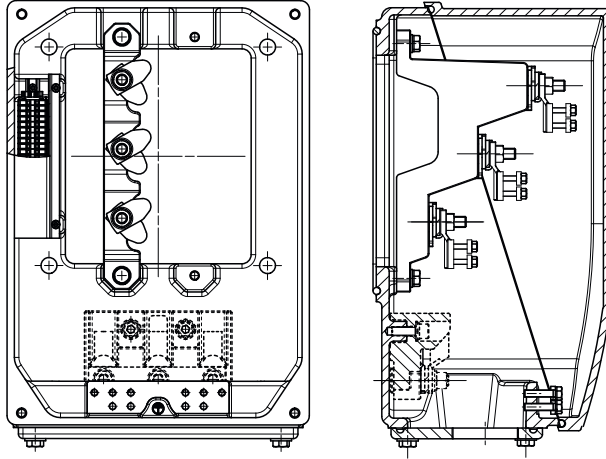


Image 6-3 Terminal box 1XB7730

The connecting cables are introduced into the 1XB7730 terminal box through the cable glands with threaded holes 1 x M72 x 2 and 3 x M25 x 1.5. The cable glands are not included in the standard scope of supply.

You can find additional information here:

- Bringing cables into the terminal box 1XB... with cable gland (Page 81)
- Connecting cables with cable lugs (Page 82)
- Connecting cables without cable lugs (Page 83)

6.2.4 Terminal box 1XB7731

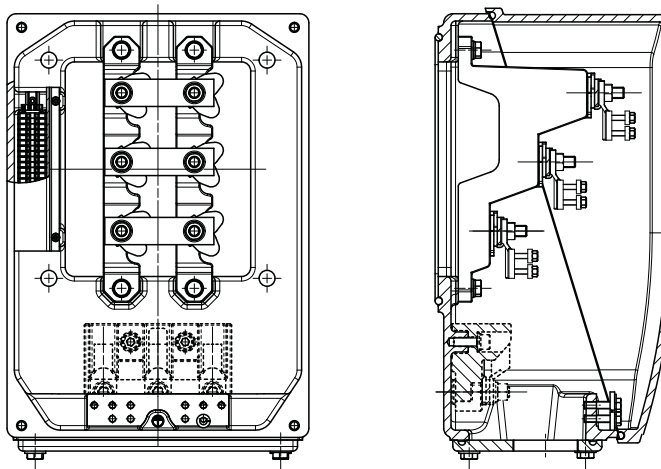


Image 6-4 Terminal box 1XB7731

The connecting cables are introduced into the 1XB7731 terminal box through the cable glands with threaded holes 2 x M72 x 2 and 3 x M25 x 1.5. The cable glands are not included in the standard scope of supply.

You can find additional information here:

- Bringing cables into the terminal box 1XB... with cable gland (Page 81)
- Connecting cables with cable lugs (Page 82)
- Connecting cables without cable lugs (Page 83)

6.2.5 Terminal box 1XB7740

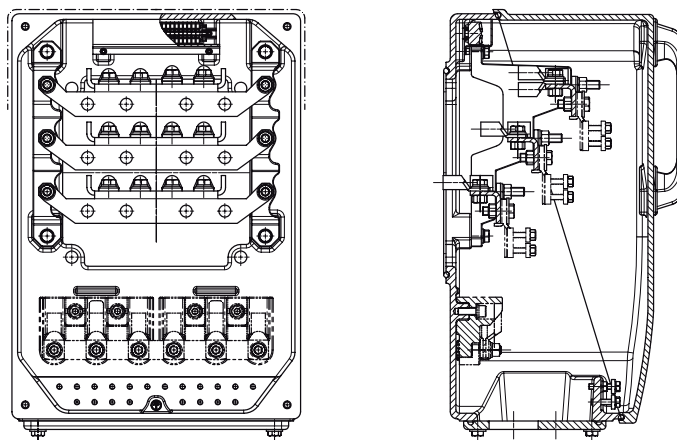


Image 6-5 Terminal box 1XB7740

The connecting cables are introduced into the 1XB7740 terminal box through the cable glands with threaded holes 4 x M80 x 2 and 3 x M25 x 1.5. The cable glands are not included in the standard scope of supply.

You can find additional information here:

- Bringing cables into the terminal box 1XB... with cable gland (Page 81)
- Connecting cables with cable lugs (Page 82)
- Connecting cables without cable lugs (Page 83)

6.2.6 Terminal box 1XB7750

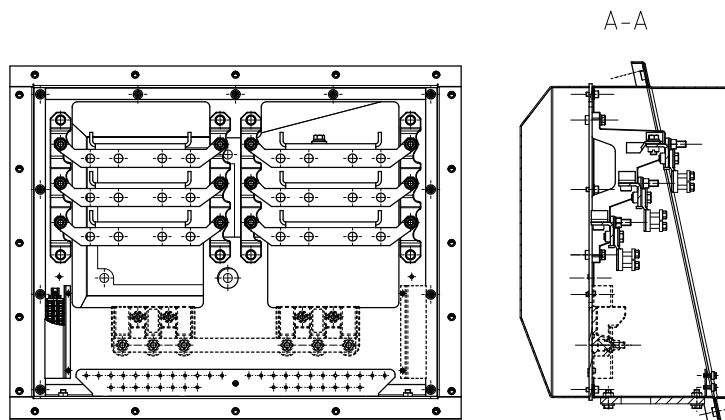


Image 6-6 Terminal box 1XB7750

The connecting cables are introduced into the 1XB7750 terminal box through the cable glands with threaded holes 8 x M72 x 2 and 3 x M25 x 1.5. The cable glands are not included in the standard scope of supply.

You can find additional information here:

- Bringing cables into the terminal box 1XB... with cable gland (Page 81)
- Connecting cables with cable lugs (Page 82)
- Connecting cables without cable lugs (Page 83)

6.2.7 Rotating the terminal box

Depending on the terminal box and version, you can rotate the terminal box through $\pm 90^\circ$ in accordance with the connection direction. The implementation on the other motor side is possible only with the support of the Service Center (Page 165). If you want to rotate a terminal box not listed below, then also contact the Service Center.

Rotating the terminal box depends on the mount and the cross-section of the internal stator cables as well as the terminal box type:

- 1XB7730
 - With installed internal stator cables, you can rotate the terminal box through $\pm 90^\circ$.
- 1XB7731
 - For six or fewer cables, you can rotate the terminal box with installed stator cables through $\pm 90^\circ$.
 - For more than six cables, you must remove the internal stator cables before rotation.

- 1XB7740
 - For 12 or fewer cables and lower cross-sections, you can rotate the terminal box with installed stator cables through $\pm 90^\circ$.
 - For more than 12 cables - or for cables with a cross-section greater than 50 mm² - you must remove the internal stator cables before rotating the terminal box.
- 1XB7750
 - Remove the internal stator cables before rotating the terminal box.

Rotating a terminal box with mounted stator cables

1. Ensure that the motor is disconnected from the power supply.
2. Release two diagonally opposed screws for the cover, and secure the cover using two M10 threaded bars screwed in diagonally opposing one another. Release the two other screws and lift the cover off the terminal box. The terminal box cover is very heavy. Especially when in a lateral position, ensure that the terminal box does not fall down.
3. If the motor is already connected:
 - Remove the cables of the power supply.
 - Release the screw connection of the cable entry. Remove the cables through the opening.
4. Remove the grounding straps on two sides of the terminal box lower section.
5. Remove the screwed joints of the lower section with the console or optionally the cable duct.
6. Screw in two eye-bolts diagonally in the M10 thread at the corners. Slightly raise the terminal box housing using a crane.
7. Rotate the terminal box through $\pm 90^\circ$ in the desired direction. Carefully place the terminal box down. Take care not to damage the seal.
8. Screw the terminal box with the console / cable duct (4 x M16, tightening torque 170 Nm).
9. Fasten the grounding straps to the terminal box lower section and the console or cable duct:
 - After rotation, remove the plugs of the two nearest M8 threads on the console or cable duct.
 - Grind the surface at the drilled holes so that the grounding straps have metallic contact.
 - Then fasten the two straps to the terminal box lower section and the console or cable duct (4x M8, tightening torque 11 Nm).
 - Protect the bare areas at the contact with corrosion protection.
10. Reconnect the power supply cables. More information:
 - Connecting the grounding conductor (Page 76)
 - Introducing and routing the cables ...
 - Connecting cables ...
11. Screw in the two diagonally arranged threaded bars and slide the cover onto these bars. Take care not to damage the seal.

6.2 Terminal box

12. Fix the two free screw connections and tighten by hand.
13. Remove the threaded bars and screw in the two other screws.
14. Tighten all screws (4 x M10, tightening torque 40 Nm).

Rotating a terminal box with removed stator cables

1. Ensure that the motor is disconnected from the power supply.
2. Release two diagonally opposed screws for the cover, and secure the cover using two M10 threaded bars screwed in diagonally opposing one another. Release the two other screws and lift the cover off the terminal box. The terminal box cover is very heavy. Especially when in a lateral position, ensure that the terminal box does not fall down.
3. If the motor is already connected:
 - Remove the cables of the power supply.
 - Release the screw connection of the cable entry. Remove the cables through the opening.
4. Release the screwed connections of the internal stator cables, optionally also those at the neutral point.
5. Remove the grounding straps on two sides of the terminal box lower section.
6. Remove the screwed joints of the lower section with the console or optionally the cable duct.
7. Screw in two eye-bolts diagonally in the M10 thread at the corners. Slightly raise the terminal box housing using a crane.
8. Rotate the terminal box through $\pm 90^\circ$ in the desired direction. Carefully place the terminal box down. Take care not to damage the seal.
9. Screw the terminal box with the console / cable duct (4 x M16, tightening torque 170 Nm).
10. Fasten the grounding straps to the terminal box lower section and the console or cable duct:
 - After rotation, remove the plugs of the two nearest M8 threads on the console or cable duct.
 - Grind the surface at the drilled holes so that the grounding straps have metallic contact.
 - Then fasten the two straps to the terminal box lower section and the console or cable duct (4x M8, tightening torque 11 Nm).
 - Protect the bare areas at the contact with corrosion protection.
11. Connect the cables in accordance with the circuit diagram on the inside of the cover (M12, tightening torque 20 Nm). Ensure that the minimum air clearances are observed. More information:
Minimum air clearances (Page 87)
12. Reconnect the power supply cables. More information:
 - Connecting the grounding conductor (Page 76)
 - Introducing and routing the cables ...
 - Connecting cables ...

13. Screw in the two diagonally arranged threaded bars and slide the cover onto these bars.
Take care not to damage the seal.
14. Fix the two free screw connections and tighten by hand.
15. Remove the threaded bars and screw in the two other screws.
16. Tighten all screws (4 x M10, tightening torque 40 Nm).

See also

Connecting cables with cable lugs (Page 82)

Connecting cables without cable lugs (Page 83)

Bringing cables into the terminal box 1XB... with cable gland (Page 81)

6.2.8 Mounting/removing the terminal box

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

Removing the terminal box

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

Mounting the terminal box

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

6.3 Preparation

6.3.1 Terminal designation

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

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

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

6.3.2 Selecting cables

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

- Rated current
- Rated voltage
- Possibly a service factor
- System-dependent conditions, such as ambient temperature, routing type, cable cross-section as defined by required length of cable, etc.
- Requirements according to IEC/EN 60204-1
- Requirements according to IEC/EN 60079-14
- Configuration notes

6.3.3 Connecting the grounding conductor

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

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

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

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

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

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

Connecting the grounding conductor

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

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

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

See also

Converter operation (Page 91)

6.3.4 Connect metal shield in the terminal box

If you are using metal-armored cables that are inserted into the terminal or auxiliary terminal boxes with non-intrinsically safe circuits, then ground the metal shield in the terminal box. Additional grounding points are permissible.

- In terminal boxes **with** internal grounding part, connect the metal shield to the internal grounding point.
- In terminal boxes **without** internal grounding part, connect the metal shield to one of the green-yellow grounding terminals.

6.3.5 Brought-out cables - Connection without terminal box

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

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



WARNING

Faults as a result of incorrect technical design

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

Observe the data on the rating plate.

If the motor has been ordered with **brought-out leads**, in this case you must comply with the relevant conditions for **Zone 2**. It is assumed that the buyer, the installer and users of the installation are familiar with these conditions and will carefully observe them.

6.3.6 Connecting the machine for a specific direction of rotation

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

- If you connect the power cables in the phase sequence L1, L2, L3 to U, V, W, the resulting rotation will be clockwise.
- If you interchange two connections, e.g. L1, L2, L3 to W, V, U, the resulting rotation will be counter-clockwise.

Note

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

NOTICE

Incorrect direction of rotation

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

Observe the direction of rotation data on the nameplate.

6.4 Connection

The following generally applies to electrical connections:

- Ensure that there is a safe and reliable PE ground connection before starting any work.
- The connecting cables can be sealed and secured at every cable entry point into the terminal box.
- Lay the connecting cables and in particular the PE conductor in the terminal box in an open arrangement so that chafing of the cable insulation is prevented.
- Connect the machine in such a way that a permanent, safe electrical connection is maintained. Avoid protruding wire ends.
- Lay and secure external auxiliary cables separately from the main cable. Elements with cable ties may be present for this purpose.

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

Terminal box	Connection	
GT640	With cable lug (Page 82)	Without cable lug (Page 83)
1XB1621		
1XB1631		
1XB7730		
1XB7731		
1XB7740		
1XB7750		

6.4.1 Bringing cables into the terminal box 1XB... with sealing insert with break-off ring

The 1XB1621, 1XB1631 terminal boxes can be equipped optionally with a sealing insert with break-off ring. The connecting cable is sealed at the cable entry location using a cut-out sealing insert and is fastened using a strain relief device.

Bringing cables into the terminal box and connecting them

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

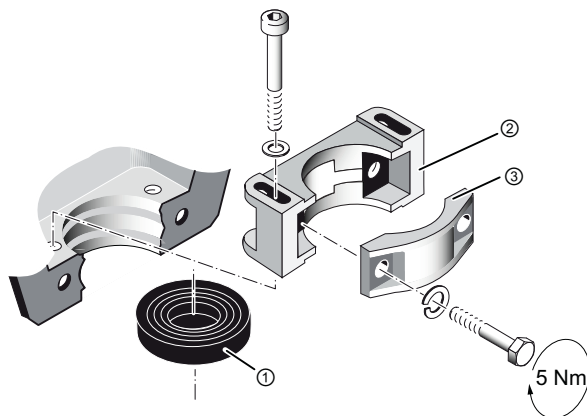


Image 6-7 Strain relief device and sealing insert

Proceed as follows when connecting the cables:

1. Remove the top part of the strain relief ③ and release the fixing screws for the bottom part of the strain relief ②. The strain relief device can be located either in the terminal box or externally. If necessary, switch the direction sense of the strain relief device.
2. Cut the seal insert ① so that its opening is 1 to 3 mm smaller than the diameter of the cable.
3. Pull the sealing insert over the end of the cable.
4. Prepare the end of the cable depending on the cable and its use, e.g. with a cable lug.
5. Connect the ends of the cables to the terminals in accordance with the circuit diagram. The circuit diagram is located in the cover of the terminal box. Refer to the "Connecting cables..." section for more information.
6. You might need to use a sleeve made of suitable sealing tape to modify the diameter where it passes through the sealing insert. Push the sealing insert onto the prepared sleeve.
7. Insert the cable with the seal insert in position into the gland opening. Screw the strain relief device together once the cable is in a concentric position in the gland opening.
8. Secure the strain relief device.
9. Tighten the clamping screws of the strain relief device so that the cable is clamped as necessary, but do not damage the cable insulation. We recommend a torque of 5 Nm.
10. Retighten the clamping screws after 24 hours.



WARNING

Damage to insulation

If you tighten the strain relief clip clamping screws too tightly this can damage the insulation. Damaged insulation can result in arcing. This can result in death, serious injury or material damage.

Tighten the strain relief clip clamping screws to the specified torque.

6.4.2 Bringing cables into the terminal box 1XB... with cable gland

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

You can rotate the cable entry through 180°.

Table 6-4 Cable entry plate versions

Terminal box	Standard Cable entry plate with boreholes	Explosion protected version / option L01
1XB1621	2 x M80 x 2 + 2 x M25 x 1.5	Undrilled (Page 81)
1XB1631	4 x M80 x 2 + 2 x M25 x 1.5	
1XB7730	1 x M72 x 2 + 3 x M25 x 1.5	
1XB7731	2 x M72 x 2 + 3 x M25 x 1.5	
1XB7740	4 x M80 x 2 + 3 x M25 x 1.5	
1XB7750	8 x M72 x 2 + 3 x M25 x 1.5	

Insert the cable into the terminal box

Proceed as follows when introducing cables into the terminal box:

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

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

Drill holes in the cable entry plate

If you drill holes in the cable entry plate 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.

6.4.3 Certified cable entries, thread adapters and sealing plugs

Use only sealing plugs, cable entries & conductor entries and thread adapters that are certified and marked for use in the respective hazardous zone.

6.4.4 Laying cables

- Lay the cables in accordance with IEC/EN 60364-5-52.
- For fixed cables, use EMC- and Ex-certified cable glands with strain relief. Screw the cable glands into the threaded holes in the entry plate, which can be unscrewed. The cable glands are not included in the scope of supply.
Comply with the installation and operation conditions specified in the certificate for these cable glands and check that they have been fully complied with.
- For loose cables, use twist-protection cable glands with strain relief.
- Use shielded cables whose shields are conductively connected to a large area of the terminal box of the motor via EMC cable glands.
- Arrange the exposed connecting cables in the terminal box so that the PE conductor has excess length and the insulation of the cable strands cannot be damaged.
- In the case of aluminum connecting bars, insert a steel washer between the cable lug and the connecting bar. This prevents contact corrosion.
- 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.
Replace the cable glands that are not being used by appropriately certified screw plugs.

6.4.5 Connecting cables with cable lugs

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

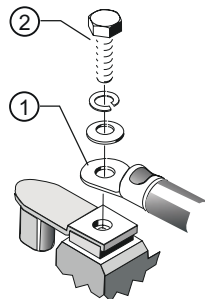


Image 6-8 Connection with cable lug and fixing screw (schematic diagram)

4. Insulate the cable lug sleeves where necessary to ensure minimum air clearances and the creepage distance are maintained.
5. Place the cable lug on the terminal support. If you are using a disconnecting link, check its positioning.
For terminal boxes 1XB7740 and 1XB7750, place the cable lug on the busbar.
6. Tighten the fixing element ② with the corresponding tightening torque:

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

Note

You can find more information in Chapter 2 of catalog D81.8.

**WARNING****Explosion hazard if cable lugs without side guards are used**

For cable cross-sections under 70 mm², cable lugs without side guard may twist. The minimum air clearances may be overrun and cause an explosion.

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

- For cable cross-sections under 70 mm², use only cable lugs with side guard.
- Make sure that the minimum air clearances (Page 87) are observed.

6.4.6**Connecting cables without cable lugs**

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

NOTICE**Overheating of the conductor ends**

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

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

Procedure

Ensure that the minimum air clearances and the creepage distance are maintained for the connection.

1. Open the terminal box and cut the cable to the correct length.
The clips of the 1XB7730/1XB7731 terminal boxes can accept cables with maximum 185 mm² cross-section.
2. Prepare the end of the cable depending on the cable and its use. Make sure that no external forces are acting on the cable connection.
3. Insulate the conductor ends in such a way that the remaining insulation reaches almost up to the cable lug.
4. Make sure the terminal clamps ③, ④ are arranged correctly for the size of the conductor. Insert the cable into the terminal clamps. Tighten the clamping nuts ⑤ to the tightening torque as specified in the following table.

Terminal box	Tightening torque
GT640 / 1XB1621 / 1XB1631 / 1XB1634	8 Nm
1XB7730 / 1XB7731	4 Nm
1XB7740 / 1XB7750	8 Nm

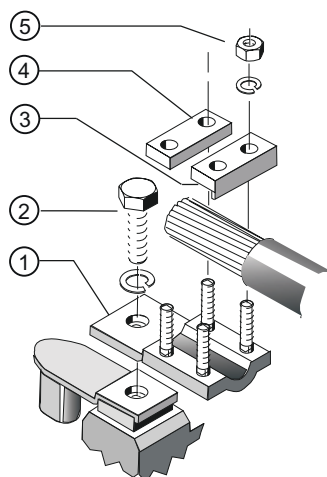


Image 6-9 Connection using terminal clamps (schematic diagram)

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

Terminal box	Tightening torque
1XB1621 / 1XB1631 / 1XB1634	40 Nm
GT640 / 1XB7730 / 1XB7731 / 1XB7740 / 1XB7750	20 Nm

For terminal boxes GT640, 1XB7730 and 1XB7731, the terminal element ① is fastened using a terminal nut M12 on the threaded stud of the terminal support with a torque of 20 Nm.

Lug terminal connections may be installed if ordered accordingly, which are suitable for connecting flexible and stranded conductors without the use of wire end ferrules. If you wish

to use wire end ferrules, then before connecting the cable, attach these so as to form an appropriate, current-carrying crimped joint at the end of the conductor.

**WARNING****Danger of explosion if the conductor ends become too hot**

If the end of the conductor is not correctly enclosed by the wire end ferrule, but is trapped by it, this can lead to overheating. 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 wire end ferrule. Attach the wire end ferrule correctly.
- Insert only one conductor end into each terminal.

6.4.7

Use of aluminum conductors

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

- Use only cable lugs that are suitable for connecting aluminum conductors.
- Immediately before inserting the aluminum conductor, remove the oxide layer from the contact areas on the conductor and/or the mating piece, by brushing or filing.
- Then grease the contact areas immediately using neutral vaseline in order to avoid re-oxidation.

NOTICE**Aluminum flow due to contact pressure**

Aluminum flows following installation due to the contact pressure. The connection with the clamping nuts can loosen as a result. The contact resistance would increase and the current-carrying impeded; as a consequence the terminal box and the surrounding components could burn. This could result in material damage to the machine or even in total failure, which could in turn lead to indirect material damage to the system.

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

6.4.8 Using single-stranded cables

 WARNING

High temperatures from induced eddy currents

With high currents and where several single-stranded cables are used instead of multiple-stranded cables, high temperatures can result in the cable entry area due to induced eddy currents. A short-circuit and an explosion may occur. This can result in death, serious injury, or material damage.

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

6.4.9 Internal equipotential bonding

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

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

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

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

6.4.10 Stepless mating face for the seal in the terminal box cover

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

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

6.4.11 Minimum air clearances

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

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

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

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

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

6.4.12 Finishing connection work

- Before closing the terminal box, please check that:
 - The electrical connections in the terminal box have been made in accordance with the specifications above and tightened with the correct tightening torque.
 - The machine is connected in such a way that it rotates in the direction specified.
 - The inside of the terminal box is clean and free of any cable debris, dirt and foreign bodies.
 - All of the seals and sealing surfaces of the terminal box are intact and in a good condition.
 - Any unused cable entries are sealed with **glued-in ferrous or certified sealing elements**. The sealing elements can only be removed with a tool.
 - The connecting cables are laid in an open arrangement, so that the cable insulation cannot be damaged during operation.
- Close the terminal box with the cover fixing screws, see chapter Tightening torques for screw and bolt connections (Page 167).

See also

Mounting/removing the terminal box (Page 75)

6.5 Connecting the auxiliary circuits

6.5.1 Selecting cables

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

- Rated current
- Rated voltage
- System-dependent conditions, such as ambient temperature, routing type, cable cross-section as defined by required length of cable, etc.
- Requirements according to IEC/EN 60204-1
- Requirements according to IEC/EN 60079-14

Use only sealing plugs, cable entries & conductor entries and thread adapters that are certified and marked for use in the respective hazardous zone.

6.5.2 Bringing cables into the auxiliary terminal box and routing them

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

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

Adapting the cable glands

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

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

6.5.3 Intrinsically safe circuits for sensors or probes

Observe Standard IEC / EN 60079-14 when selecting and routing connecting cables.

NOTICE

Intrinsically safe circuits for sensors or probes

If blue connection terminals are installed for sensors, you must connect them to certified intrinsically safe circuits. This can otherwise result in damage.

Ensure that you also observe the additional requirements laid down in IEC / EN 60079-14 for intrinsically safe equipment and the associated connecting cables.

NOTICE

Connecting the temperature sensors

Temperature sensors may be connected only to intrinsically safe circuits with certified evaluation devices. The maximum permissible input currents and powers according to the EC or EU prototype test certificate must not be exceeded. This can otherwise result in damage.

If shielded, intrinsically safe temperature sensors are fitted or mounted, they must be connected using the blue connecting terminals. The cable shield is grounded just once; multiple grounding is not permitted.

6.5.4 Connect metal shield in the terminal box

If you are using metal-armored cables that are inserted into the terminal or auxiliary terminal boxes with non-intrinsically safe circuits, then ground the metal shield in the terminal box. Additional grounding points are permissible.

- In terminal boxes **with** internal grounding part, connect the metal shield to the internal grounding point.
- In terminal boxes **without** internal grounding part, connect the metal shield to one of the green-yellow grounding terminals.

6.5.5 Connecting an external fan motor

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

1. When working on the external fan motor, refer to the operating instructions.
2. Check:
 - The line voltage and line frequency match the details on the rating plate;
 - the cross-sections of the designated connecting cables are matched to the rated current of the motor (with due consideration for the relevant installation directives).
3. Connect the protective conductor to the protective conductor terminal.

6.5 Connecting the auxiliary circuits

4. Establish the other electrical connections as per the circuit diagram.
5. If the separate fan is supplied with a connector already attached, check whether the pin allocation of the connector matches the pin allocation of the socket.
6. Complete the work at the external fan terminal box. For this, proceed as described in the "Completing connection work in the auxiliary terminal box" (Page 91) section.

Check direction of rotation

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

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

6.5.6 Connecting temperature monitoring for the stator winding

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

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



WARNING

Hazard due to electric shock

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

- When connecting the temperature sensor to external temperature monitoring devices, when required, apply additional measures to fully comply with the requirements set out in IEC 60664-1 or IEC 61800-5-1 "Hazard due to electric shock".

6.5.7 Terminating the connection work (auxiliary circuit)

1. Before closing the auxiliary terminal box, please check that:
 - The cables are connected in accordance with the terminal diagram.
 - The cables are freely arranged so that they cannot come into contact with the machine, and the cable insulation cannot be damaged.
 - The inside of the terminal box is clean and free of any cable debris, dirt and foreign bodies.
 - The cable glands are firmly tightened, are suitable with respect to the degree of protection, type of cable routing, permissible cable diameter, etc., and have been mounted in full compliance with specifications and regulations
 - The threads in the connection plate are sealed using cable and conductor entries, thread adapters or sealing plugs that achieve the respective degree of protection.
 - Unused cable entries are sealed. The sealing elements are firmly screwed in, and can only be released using a tool.
 - All of the seals/gaskets and sealing surfaces of the terminal box are in good condition
 - The screws of all of the screw clamps are fully tightened, even if they are not being used.
2. Close the auxiliary terminal box using the cover supplied for this purpose. See section "Tightening torques for screw and bolt connections (Page 167)" for the tightening torque of the fixing bolts for the cover.

6.5.8 Converter operation

The following chapter is relevant only if the machine has been ordered for converter operation.

Note

The order number shows whether the machine was ordered for converter operation. In this case, digits 1, 2, 3 or 4 is located at the 6th position of the order number.



WARNING

Dangerous voltage via the converter

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

Ensure that the five safety rules (Page 16) are followed before working on the motor.

6.5.8.1 Maximum peak voltage at the motor terminals

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

Table 6-6 Maximum peak voltage at the motor terminals

Rated motor voltage [V]	Maximum peak voltage at the motor terminals $\hat{U}_{\max}$		
	Conductor - conductor	Conductor - ground	DC link
≤ 500 V	1500 V Rise time 0.5 μ s	1100 V Rise time 0.5 μ s	750 V
> 500 to 690 V	2250 V Rise time 0.4 μ s	1500 V Rise time 0.4 μ s	1125 V

NOTICE

Insulation damage caused by cable reflections

Cable reflections can double the voltage load at the motor or at the terminals. This can damage the insulation system and result in complete destruction of the machine.

6.5.8.2 Converter operation on a grounded network

NOTICE

Damage resulting from protective conductor currents

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

- Use an appropriately sized PE conductor.
- Connect the PE conductor to the grounding terminal on the motor enclosure.

Start-up

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

7.1 Checks to be carried out prior to commissioning

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

Note

Checks to be carried out prior to commissioning

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

- The machine is undamaged.
- The machine has been correctly installed and aligned, the transmission elements are correctly balanced and adjusted.
- All fixing screws, connection elements, and electrical connections have been tightened to the specified tightening torques.
- The operating conditions match the data provided in accordance with the technical documentation, such as degree of protection, ambient temperature, etc..
- Moving parts such as the coupling move freely.
- All touch protection measures for moving and live parts have been taken.
- If the second shaft extension is not in use, its feather key is secured to prevent it from being thrown out, and cut back to roughly half its length if the rotor has balancing type "H" (standard type). The unused shaft extension is covered and protected against accidental contact.
- The bearing insulation should be executed as shown on the plates.

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.

Cooling

- Check that the machine cooling is available for commissioning.

7.2 Measuring the insulation resistance before commissioning

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

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

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

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

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

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

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

"Testing the insulation resistance and polarization index" (Page 49)

7.3 Greasing the roller bearings prior to commissioning

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

General specifications

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

Regreasing the roller bearings prior to commissioning

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

Regreasing roller bearings before commissioning

You must regrease the roller bearings under the following conditions:

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

Procedure

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

See also

Regreasing intervals and types of grease for operating roller bearings (Page 124)

Stoppages (Page 110)

Transport and storage (Page 34)

7.4 Setting the automatic regreasing system

The relubrication is performed depending on the external voltage present at the regreasing system.

- Prior to commissioning, set the time interval and the relubrication quantity at the automatic regreasing system.
- Observe the operating instructions for the regreasing system for its operation and the replacement of the grease cartridges.

See also

Interlock circuit for the automatic regreasing system (option) (Page 31)

7.5 Commissioning an external fan

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

See also

Additional documents (Page 171)

7.6 Setpoint values for monitoring the bearing temperature

Prior to commissioning

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

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

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

Normal operation

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

Table 7-2 Set values for monitoring the bearing temperatures

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

7.7 Set values for monitoring the winding temperature

Prior to commissioning

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

Table 7-3 Set value for commissioning

Set value	Temperature
Alarm	145° C
Shutting down	155° C

Normal operation

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

Table 7-4 Set values during normal operation

Set value	Temperature for insulation class 180(H), utilization 155(F)
Alarm	$T_{op} + 10 \text{ K} \leq 145^{\circ} \text{ C}$
Shutting down	$T_{op} + 15 \text{ K} \leq 155^{\circ} \text{ C}$

7.8 Test run

After installation or inspection, carry out a test run:

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

NOTICE

Thermal overload of motors connected directly to the line supply

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

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

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

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

NOTICE**Serious damage to the machine**

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

- During operation, observe the vibration values in accordance with DIN ISO 10816-3.

Note

You can find more information in Chapter 2 of catalog D81.8.

7.9 Switching off

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

7.10 Setting the motor parameters at the converter

The selection of the motor type is used to pre-assign specific motor parameters and to optimize the operating characteristics and behavior. If you use the SINAMICS G120/G150 or SINAMICS S120/S150 converter, you can set the motor parameters via STARTER or the "Advanced Operating Panel" AOP30.

If you use the SINAMICS G120P inverter, you can set the motor parameters via the "Intelligent Operator Panel" (IOP).

NOTICE
Undesirable operating states
If the incorrect motor type has been selected, then this can result in undesirable operating states, for instance increased noise.

Note**Preset space-vector modulation for SINAMICS S converters**

Unlike SINAMICS G converters, space-vector modulation is preset for SINAMICS S converters. Provided permitted by the application, the space-vector modulation can be changed manually to an optimized pulse pattern for SIMOTICS FD motors.

The SINAMICS parameter is p1802 = 19 in the STARTER and in the AOP30.

7.10.1 Selecting the motor type and motor data in the STARTER program

Prerequisites

- The motor is connected to the converter and is ready for operation.
- The converter must have at least software version 4.6.
- You have installed the STARTER software with at least version 4.3.1 with SSP, and you are connected to the converter. You require SSP V4.6 for the SINAMICS G120P inverter.
- The STARTER program has been started. You are in the "Configuration" dialog screen form.

Selecting motor parameters

1. Enter a name for the motor in the "Motor name" input field.
Subsequent motor assignment is simplified by selecting a unique name.
2. Select the "Enter motor data" option.

3. In the "Motor type" field, select the entry "[14] SIMOTICS FD induction motor series".

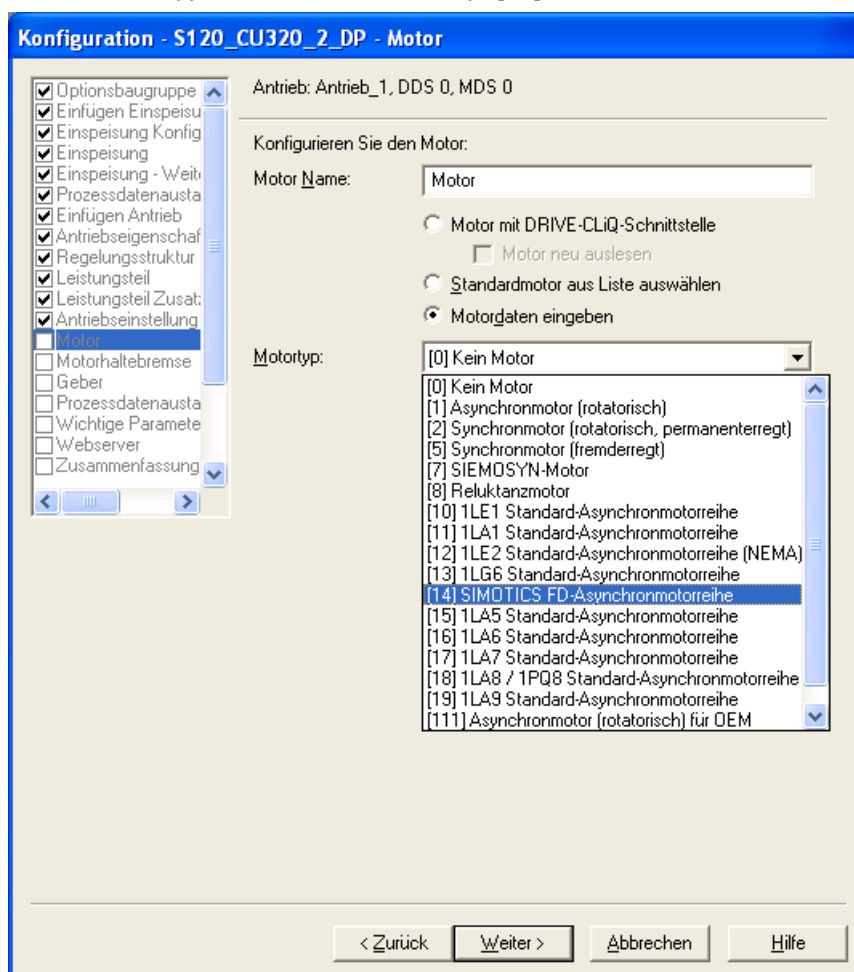


Image 7-1 Selecting a motor type

4. Click "Continue" to confirm your entries.

7.10 Setting the motor parameters at the converter

5. Enter the appropriate motor data in the "Motor data" table in the "Value" column.
 - You can find the values for parameters p304...p311 on the motor rating plate.
 - The value for parameter p335 (motor cooling method) is encrypted from the motor order number:

Motor order number	Cooling method	Parameter p335
1LL1	IC01	0
1LP1	IC06	1
1LM1/1MM1	IC411	4
1LQ1/1MQ1	IC416	5
1LH1/1MH1	IC71W	6
1LN1/1MN1	IC86W	6

Konfiguration - S120_CU320_2_DP - Motordaten

Antrieb: Antrieb_1, DDS 0, MDS 0

Motordaten, Asynchronmotor (rotierend):

Parameter	Parametertext	Wert	Einheit
p304[0]	Motor-Bemessungsspannung	0	Veff
p305[0]	Motor-Bemessungsstrom	0.00	Aeff
p307[0]	Motor-Bemessungsleistung	0.00	kW
p308[0]	Motor-Bemessungsleistungsfaktor	0.000	
p310[0]	Motor-Bemessungsfrequenz	0.00	Hz
p311[0]	Motor-Bemessungsdrehzahl	0.0	1/min
p335[0]	Motor-Kühlart	[0] Selbstl	

Die Motordaten müssen vollständig eingegeben werden!

☐ optionale Motordaten eingeben

☐ optionale Ersatzschaltbilddaten eingeben

Hinweis:
Eine Abwahl der optionalen bzw. der Ersatzschaltbilddaten setzt diese unwiderruflich zurück.

Bei Abwahl der Ersatzschaltbilddaten ist eine Motoridentifikation erforderlich. Bei Eingabe der Ersatzschaltbilddaten ist eine Motoridentifikation optional.

< Zurück Weiter > Abbrechen Hilfe

Image 7-2 Entering the motor data

6. Click "Continue" to confirm your entries.

7.10.2 Commissioning at the SINAMICS S/G converter using the AOP30

In the AOP30, navigate as follows:

- Navigate within the selection fields using <F2> and <F3>.
- In the entry fields, you can either directly enter the required value or select it from a list.
- Activate the selection with <F5>.

Selecting the motor type and motor data at the AOP30

1. In the dialog screen form, select the motor standard and motor type.
As motor type, select the entry "SIMOTICS FD induction motor series".

{2:VECTOR} motor standard/motor type

Continue

p0100 motor standard IEC/NEMA 0:IEC[50Hz/kW]

p0300mMotor type selection 1:induction_motor

Interr. COMM Continue

Help ▲ ▼ OK

F1 F2 F3 F4 F5

↓

2. Enter the motor parameters.
 - You can find the values for parameters p304...p311 on the motor rating plate.
 - The value for parameter p335 (motor cooling method) is encrypted from the motor order number:

Motor order number	Cooling method	Parameter p335
1LL1	IC01	0
1LP1	IC06	1
1LM1/1MM1	IC411	4
1LQ1/1MQ1	IC416	5
1LH1/1MH1	IC71W	6
1LN1/1MN1	IC86W	6

7.10 Setting the motor parameters at the converter

{2:VECTOR} motor parameters m:0

Back

p0210 U_connection 400 V

p0304mMot U_rated 400.00 Vrms

p0305mMot I_rated 405.00 Arms

Help ▲ ▼ OK

F1 F2 F3 F4 F5

↑ ↓

{2:VECTOR} motor parameters m:0

p0306mMot number 1

p0307mMot P_rated 235.00 kW

p0308mMot cosphi_rated 0.870

Interr. COMM Continue

Help ▲ ▼ OK

F1 F2 F3 F4 F5

↑ ↓

{2:VECTOR} motor parameters m:0

p0310mMot f_rated 50.00 Hz

p0311mMot n_rated 1485.00 rpm

p0335mMot cooling method 0:natural cooling

Interr. COMM Continue

Help ▲ ▼ OK

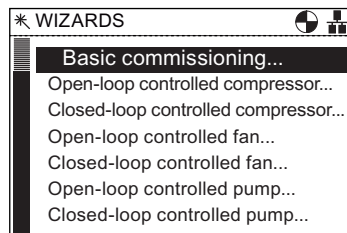
F1 F2 F3 F4 F5

- Exit the motor data input by selecting the "Continue" field and activating the selection with <F5>.

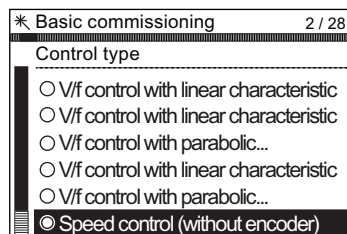
7.10.3 Commissioning at the SINAMICS G120P inverter using the IOP

The SINAMICS G120P provides the IOP (Intelligent Operator Panel) located in the enclosure door for operating, monitoring, and commissioning tasks. It can be used to set the motor parameters.

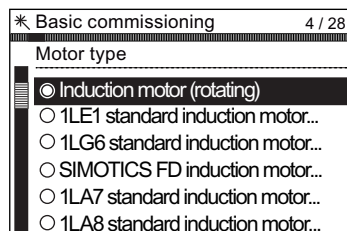
1. Select the "basic commissioning" wizard. Only so can you enter unusual frequencies, such as 50.39 Hz or 100 Hz.



2. Select "speed control" as control type.



3. Select "SIMOTICS FD" as motor type. This sets specific motor parameters for optimizing the operating behavior.



4. Enter the performance plate data.

- Motor voltage
- Motor current
- Rated power
- Rated power factor $\cos \varphi$
- Motor speed

The optimized pulse patterns are activated automatically once the "SIMOTICS FD" motor type is selected (p300=14).

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

8.1 Safety guidelines in operation



WARNING

Live parts

Terminal boxes accommodate live parts and components. If you open the terminal box cover, this can result in death, serious injury or material damage.

- When the machine is in operation, the terminal boxes must remain closed at all times. Terminal boxes may be opened only when the machine is stopped and de-energized.



WARNING

Rotating and live parts

Rotating or live parts are dangerous. If you remove the required covers, this can result in death, serious injury or material damage.

- Any covers that prevent live electrical or rotating parts from being touched, ensure compliance with a particular degree of protection or are required for ensuring proper air flows, and hence effective cooling, must not be opened during operation.



WARNING

Fire hazard resulting from hot surfaces

Certain parts of the machine become hot during operation. Severe burns can result from contact with these parts.

- Check the temperature of parts before touching them. If required, apply suitable protective measures.
- Allow the machine to cool before starting work on the machine.

 WARNING
Faults in operation Deviations from normal operation such as increased power consumption, temperatures or vibrations, unusual noises or odors, tripping of monitoring devices, etc., indicate that the machine is not functioning properly. This can cause faults which can result in eventual or immediate death, serious injury or material damage. • Immediately inform the maintenance personnel. • If you are in doubt, immediately switch off the motor, being sure to observe the system-specific safety conditions.

NOTICE
Risk of corrosion due to condensate Humid air can condense inside the machine during operation as a result of intermittent duty or load fluctuations. Condensate can collect inside the motor. Damage such as rust can result. • Make sure that any condensation can drain away freely.

 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.

8.2 Operation in hazardous areas of Zone 2

Safe handling

In addition to the danger notices in the previous section, the following also applies:

Electrical systems in hazardous zones must be mounted, installed, and operated in accordance with the applicable rules and regulations. It is assumed that companies operating these plants and systems take the appropriate measures to ensure that these regulations and directives are observed during mounting, installation and operation, and that the appropriate tests are carried out. We recommend that these tests be carried out and documented in coordination with the responsible authorities.

System-specific ignition hazards

The criteria for the respective zonal classification are not harmonized and the assessment of the operational risks, the local operating conditions and the various monitoring methods are not standard. As a consequence, the remedial measures recommended by the supervisory authorities may also differ depending on the authority's area of responsibility. The machine manufacturer cannot provide general recommendations in this regard.

Note

Binding clarification of the local risks and of any required measures can only be provided by the company operating the plant or system in agreement with the supervisory authority responsible. The risk assessments from IEC / EN 60079-15 can be used to assess system-specific ignition hazards.

8.3 Switching on the machine

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

NOTICE

Thermal overload of motors connected directly to the line supply

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

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

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

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

8.4 Switching off the anti-condensation heating

NOTICE
Excessive machine temperature If the anti-condensation heating is operated while the machine is running, this can increase the temperatures inside the machine. This can result in material damage. • Make sure that the anti-condensation heating is switched off before the machine is switched on. • Only operate anti-condensation heating when the machine is switched off.

8.5 Regreasing roller bearings

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

8.6 Stoppages

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

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

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

See also

Transport and storage (Page 34)

Start-up (Page 93)

8.6.1 Avoidance of condensation or formation of condensation within the machine

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

 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.

8.6.2 Avoidance of damage to roller bearings during stoppages

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

- During stoppages, regularly start the machine up for a brief period once a month, or at least turn the rotor over several times.
If you have uncoupled the machine from the driven machine and secured the rotor with a rotor shipping brace, then remove this before turning the rotor over or starting the machine up.
Make sure that the resting position of the roller bearings after the rotor has been turned over is different from what it previously had been. Use the fitted key or the coupling halves as reference markers.
- During re-commissioning, refer to the information in the "Commissioning" section.

See also

Start-up (Page 93)

8.6.3 Measurement of the insulation resistance after an extended stoppage

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

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

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

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

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

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

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

"Testing the insulation resistance and polarization index" (Page 49)

8.7 Decommissioning the machine

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

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

8.8 Switch off the external fan

If the controller does not switch off the external fan automatically, switch it off when the machine is stopped.

See also

Additional documents (Page 171)

8.9 Re-commissioning the machine

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

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

See also

Start-up (Page 93)

8.10 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

8.11 faults

8.11.1 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.

8.11.2 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.

8.11.3 Mechanical faults

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

Table 8-2 Mechanical faults

↓ Grinding noise					
	↓ Overheating				
		↓ Radial vibrations			
			↓ Axial vibrations		
				Possible causes of faults	Remedial measures
X				Rotating parts are grinding	Establish the cause and realign the parts.
		X		Rotor not balanced	Decouple the rotor and then rebalance it.
		X		Rotor out of true, shaft bent	Contact the Service Center.

↓ Grinding noise					
↓ Overheating					
↓ Radial vibrations					
↓ Axial vibrations					
				Possible causes of faults	Remedial measures
		X	X	Poor alignment	Align the machine set and check the coupling. ¹⁾
		X		Coupled machine not balanced	Rebalance the coupled machine.
			X	Shocks from coupled machine	Examine the coupled machine.
		X	X	Resonance of the overall system comprising motor and foundation	Reinforce the foundation after prior consultation with the Service Center.
		X	X	Changes in foundation	Determine the cause of the changes and, if necessary, rectify. Realign the machine.
	X			Reduced air supply, direction of rotation of fan possibly incorrect	Check the air ducts; clean the machine.
		X	X	Uneven gearbox operation	Resolve any gearbox faults.

¹⁾ Take into account possible changes which may occur during overheating.

8.11.4 Faults at the external fan

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

Table 8-3 Cooling system faults

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

See also

Additional documents (Page 171)

8.11.5 Roller bearing faults

Note

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

Table 8-4 Roller bearing faults

↓ Bearing overheats			
↓ Bearing "whistles"			
↓ Bearing "knocks"			
		Possible causes of faults	Remedial measures
X		High coupling pressure	Align the machine more accurately.
X		Belt tension too high	Reduce the drive belt tension.
X		Bearing contaminated	Clean the bearing or replace it. Check the seals.
X		High ambient temperature	Use a suitable high-temperature grease.
X	X	Insufficient lubrication	Grease the bearings as instructed.
X	X	Bearing canted	Properly install the bearing.
X	X	Insufficient bearing play	Only after consultation with the manufacturer: Fit a bearing with greater play.
	X	Excessive bearing play	Only after consultation with the manufacturer: Fit a bearing with lower play.
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	Scoring (brinelling)	Replace the bearing. Avoid any vibration at standstill

Maintenance

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

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

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

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

Note

Service Center

Please contact the Service Center (Page 165), if you require support with servicing, maintenance or repair.

9.1 Inspection and maintenance

9.1.1 Safety instructions for inspection and maintenance



WARNING

Rotating and live parts

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

- Perform maintenance work on the machine only when it is stopped. The only operation permissible while the machine is rotating is regreasing the roller bearings.
- When performing maintenance work, comply with the five safety rules (Page 16).



WARNING

Machine damage

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

Perform regular maintenance on the machine.



CAUTION

Dust disturbances when working with compressed air

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

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

NOTICE

Damage to insulation

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

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

NOTICE

Machine damage caused by foreign bodies

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

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

Note

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

9.1.2 Risk of explosion when cleaning with compressed air

 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 plastic parts in an explosive atmosphere. When cleaning the machine, make sure that the air in the vicinity of the motor is free of gas and dust.

9.1.3 Measuring the insulation resistance during the course of maintenance work

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

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

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

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

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

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

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

"Testing the insulation resistance and polarization index" (Page 49)

9.1.4 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.

9.1.5 First service after installation or repair

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

Table 9-1 Checks after assembly or repair

Check	When the motor is running	At stand-still
The stated electrical characteristics are being observed.	X	
The permissible bearing temperatures are not exceeded (Page 97).	X	
The smooth running characteristics and machine running noise have not deteriorated.	X	
The motor foundation has no cracks and indentations. (*)	X	X

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

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

NOTICE

Machine damage

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

9.1.6 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 9-2 Checks that have to be performed during the general inspection

Checking	When the motor is running	At stand-still
The electrical parameters are maintained	X	
The permissible bearing temperatures are not exceeded (Page 97)	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

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

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

NOTICE

Machine damage

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

See also

Set values for monitoring the winding temperature (Page 97)

9.1.7 Servicing and maintaining the anti-condensation heating

The anti-condensation heating is maintenance-free. If it is defective, contact the Service Center (Page 165).

9.1.8 Servicing the roller bearings

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

WARNING

Overheating of the rolling bearings

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

9.1.9 Roller bearings with automatic regreasing system

The roller bearings are supplied with new grease by the regreasing system.

- Replace the grease cartridge timely.
- Observe the operating instructions for the regreasing system when replacing the grease cartridges.

See also

Interlock circuit for the automatic regreasing system (option) (Page 31)

NOTICE

Unsuitable greases

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

9.1.10 Regreasing intervals and types of grease for operating roller bearings

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

Initial lubrication

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

Grease selection criteria

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

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

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

Table 9-3 Criteria for selecting roller bearing greases

Criteria	Standard	Property, characteristic value	Unit
Type of base oil	-	Mineral oil	-
Thickener	-	Lithium	-

Criteria	Standard	Property, characteristic value	Unit
Consistency in accordance with NLGI class	DIN 51818	"3" for vertical and horizontal types of construction "2" alternatively for horizontal type of construction with reduced lubrication interval	-
Operating temperature range	-	At least -20° C ... +130° C	°C
Dropping point	DIN ISO 2176	At least +180° C	°C
Basic oil viscosity	DIN 51562-1	- Approx. 100 mm²/s at 40° C - Approx. 10 mm²/s at 100° C	mm ² /s
Additives	-	- Anti-Oxidation (AO), Anti-Wear (AW) - No solid lubricants - Alternative: Extreme-pressure (EP) only after consultation with grease and bearing manufacturers	-
FE9 test: A/1500/6000	DIN 51821-1/-2	F10 ≥ 50 h at +130° C F50 ≥ 100 h at +130° C	H
Behavior in the presence of water	DIN 51807	0 or 1 at a test temperature of +90° C	-
Corrosive effect on copper	DIN 51811	0 or 1 at a test temperature of +120° C	Corr. °
Resistance to corrosion (EMCOR)	DIN 51802 / ISO 11007	0 - 0	Corr. °
Solid matter content, particle sizes > 25 µm	DIN 51813	< 10 mg/kg	mg/kg
Suitability of bearings Speed characteristic nxdm	-	Suitable for the built-in motor bearings, seals and these speeds	- mm/min

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

Note

Deviating operating conditions and characteristics

Only those greases named on the lubricant plate may be used.

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

Note

Use of other greases

If greases other than those named on the lubricant plate are used, it cannot be guaranteed that they are compatible with the complete system.

If you use greases that satisfy only the minimum requirements of DIN 51825 or ISO 6743-9, then reduce the lubrication intervals by half or adapt them as appropriate. If in doubt, consult the manufacturer.

Recommended greases for roller bearings

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

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

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

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

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

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

NOTICE**Damage due to mixing grease types**

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

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

Regreasing

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

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

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

NOTICE

Damage to roller bearings

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

Pay attention to the instructions on the lubricant plate.

Grease replacement intervals

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

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

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

Regreasing

Pay attention to the instructions on the lubricant plate.

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



WARNING

Rotating components

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

When regreasing, pay attention to all rotating components.

2. Clean the grease nipples before regreasing and then gradually press in an appropriate type and amount of grease, as described on the lubricant plate and by the specifications in these operating instructions.
The roller bearing temperature rises sharply at first, then drops to the normal value again after the excess grease has been displaced out of the bearing.
3. The used grease collects outside each bearing in a spent grease chamber.

Lubricating roller bearings prior to commissioning

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

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

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

Relubricating the grease tank

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

Regreasing intervals

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

9.1.12 Cleaning the cooling air ducts

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

9.1.13 Servicing the external fan



WARNING

Rotating or live parts

Live electrical parts are dangerous. Contact with them can cause death, serious injury or material damage.

Before carrying out any maintenance work on the external fan, disconnect it from the mains, particularly before opening the terminal box. Make sure that the device cannot be switched back on.

Servicing the external fan

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

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

Servicing the external fan motor

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

See also

Additional documents (Page 171)

9.1.14 Touch up any damaged paintwork

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

Note

Paint system

Contact the Service Center (Page 165) before you repair any paint damage. They will provide you with more information about the correct paint system and methods of repairing paint damage.

9.1.15 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

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 repaintings.

9.1.16 Maintaining terminal boxes

Requirement

The machine is de-energized.

Checking the terminal box

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

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

9.2 Corrective Maintenance

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

WARNING
Explosion hazard when carrying out repair work
Repairs are only permissible within the scope of the work described in these operating instructions. Otherwise an explosion can occur in an explosive atmosphere. This can result in death, serious injury or material damage.
For repairs to go beyond this scope, please contact the Service Center.

See also

Service and Support (Page 165)

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

Note

If the motor has to be transported, please observe the information and instructions in the "Transport" (Page 35) section.

9.2.1 Prepare servicing work

- The drawings and parts lists do not contain any detailed information about the type and dimensions of fixing elements and components. For this reason, you should establish this information when dismantling them and make a note of it for the purpose of reassembly.
- Document the type, dimensions and arrangement of the parts so that you will be able to reassemble the machine to its original state.
- Use suitable tools to disassemble the machine.
- Take measures to prevent parts from dropping down before you dismantle them, e.g. by replacing fastening elements with extra-long screws, threaded bolts or similar. This ensures that the part is supported after it is pulled off.
- The centerings in the shaft extensions have reset threads. Use lifting gear which is suitable for the rotor weight and direction of loading.

**WARNING****Rotor can fall down**

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

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

**WARNING****Machine damage caused by improper repair work**

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

- Properly assemble or disassemble the machine.
- Use only suitable tools and equipment.
- Immediately replace damaged components.
- Contact the Service Center (Page 165), if necessary.

**WARNING****Rotor can fall out**

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

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

9.2.2 Anti-condensation heating

 WARNING
Explosion hazard when repairing the anti-condensation heating If repairs to the anti-condensation heating are not carried out correctly, e.g. if unauthorized or untested spare parts are used, explosions can occur when the machine is operated in an explosive atmosphere. This can result in death, serious injury or material damage. The anti-condensation heating must be repaired and the necessary routine testing that follows repair must always be undertaken by experts from the Service Center (Page 165), as this work requires extensive specialist knowledge. Only authorized and tested spare parts may be used.

9.2.3 External fan

9.2.3.1 External fan unit

The external fan unit is mounted on the NDE radially (at the top or side) or axially. In case of replacement, remove the complete external fan unit.

Deinstalling



 WARNING
Rotating or live parts Live electrical parts at the external fan motor are dangerous. Contact with them can cause death, serious injury or material damage. 1. Before you start working on the fan, disconnect the fan motor from the supply system. 2. Make sure that the device cannot be switched back on. 3. Wait until the external fan has stopped before you continue.

1. Secure the external fan unit against falling before you start working.
2. Loosen the fixing screws that secure the external fan unit to the bearing shield.
3. Observe existing retaining components and retain them for the reassembly.

Assembly

To mount the external fan unit, perform the above instructions in reverse order.

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

9.2.3.2 Replacing the external fan

If the external fan is defective, contact the Service Center (Page 165).



WARNING

Danger of explosion as a result of a fan impeller coming into contact with its surroundings

The fan impeller of a metallic external fan coming into contact with another component can cause arcing and explosion. This can result in death, serious injury or material damage.

- Remove any dirt.
- Regularly and after any performed work check the distance between the fan impeller and adjacent components, such as air inlet nozzle. Correct the alignment of the components, if necessary. The gap between the air inlet nozzle and the fan impeller should be at least 2 mm around the complete circumference.
- Please contact the Service Center if you require any support when aligning the components.

See also

Service and Support (Page 165)

9.2.4 Roller-contact bearings

9.2.4.1 Removing roller bearing

Preparation

- Remove any grease feeders, shock pulse measurement equipment and possibly mounted instrumentation at the DE and NDE.
- Remove the coupling on the drive end or make the shaft extension freely accessible.
- At the NDE, proceed as follows depending on the machine type:
 - First, remove the fan cowl or external fan cowl (Page 133).
 - Remove the external fan.

Note

For a schematic diagram of the respective component layout, see Section "Spare parts (Page 143)".

Procedure

1. Remove the components of the bearing mounting.
 - Dismount the outer bearing cover.
Remove the V ring (Page 135).
Remove the labyrinth sealing ring (only for the option "Increased degree of protection") (Page 136).
 - Ensure that the inner bearing cover is no longer attached to the bearing housing or end shield.
 - Support the rotor for the removal of bearing housing or end shield.
 - If necessary, remove the bearing housing from the end shield.
 - Remove the end shield. Dependent the on shaft height, roller bearing type and design, it is either a bearing head design or a bearing housing design.
 - Remove the locking ring from the shaft.
2. Pull off the roller bearing together with the grease slinger.

9.2.4.2 Remove V ring

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

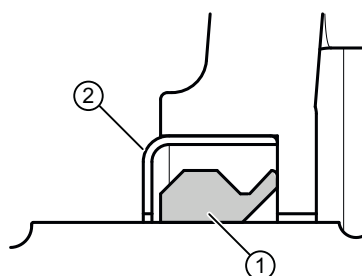


Image 9-1 Remove the V ring

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

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

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

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

See also

Install the V ring (Page 138)

9.2.4.3 Removing the labyrinth sealing ring

Note

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

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

The labyrinth sealing ring ③ is fixed with three grub screws that are separably secured with adhesive such as Loctite 243.

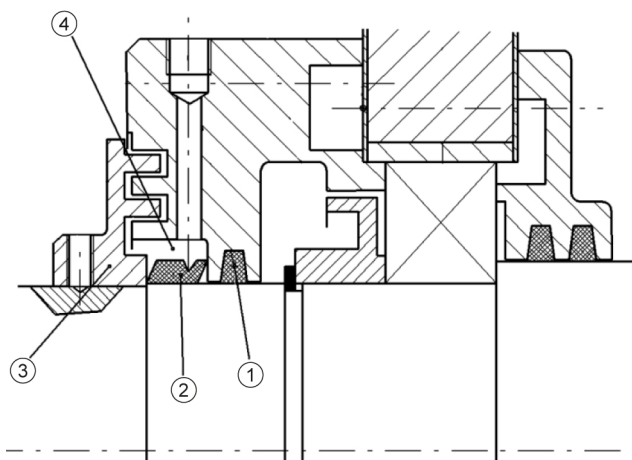


Image 9-2 Disassembling the labyrinth sealing ring (schematic diagram)

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

See also

Installing the labyrinth sealing ring (Page 139)

9.2.4.4 Assembling the rolling-contact bearings

- Extreme caution and attention to cleanliness are vital to installation. Observe the correct assembly sequence of the components.
- Attach all components with the specified tightening torques (Page 167).

Note

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

Procedure

1. Remove the required components and replace damaged components.
2. Remove any dirt from the components. Remove any grease and the remains of sealant or liquid threadlocker.
3. Prepare the bearing journals:
 - Lightly oil the inner ring seat.
 - Grease the outer ring seat with solid lubricant such as the anti-fretting paste Altemp Q NP 50.
4. Warm up the roller bearing.
5. Push the inner ring of the warmed up roller bearing onto the shaft. Avoid any blows that might damage the bearing.
6. Make sure that the roller bearing is resting against the shaft shoulder or the second bearing. Otherwise, axial vibrations may occur.
7. Fill the bearing to the top with the specified lubricating grease.
8. Warm up the grease slinger and push it onto the shaft.
9. Locate the locking ring in the shaft groove or attach the bearing using the shaft nut or a set screw, depending on the particular version.
10. Support the rotor for the installation of bearing housing or end shield.
11. Grease the bearing locations (bearing shield/bearing cartridge) with solid lubricant such as the anti-fretting paste Altemp Q NP 50.
12. Use a suitable sealant when assembling.
13. Install the bearing shield or bearing housing together with the bearing shield.
14. Install the outer bearing cover if one is being used.
15. Install the sealing elements:
 - If present: V ring (Page 138)
 - Labyrinth sealing ring (special design) (Page 139)

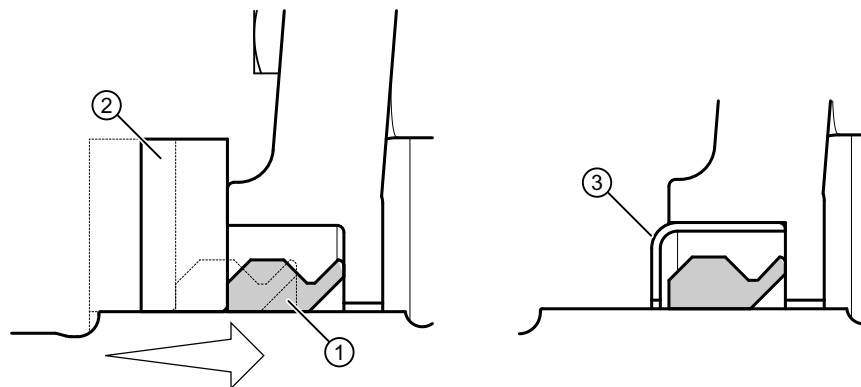
9.2.4.5 Install the V ring

Requirement

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

Install the V ring

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



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

Image 9-3 Install the V ring

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

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

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

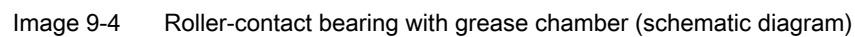
1. Push the protective ring onto the shaft.
2. Verify that the ring is sufficiently pretensioned. Replace the protective ring, if necessary.
3. Position the protective ring so that one of the longitudinal grooves meets the corresponding water separation groove at the bottom in the bearing cover flange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

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

The grease chamber of the labyrinth sealing ring together with the V ring ensures compliance with degree of protection IP65.

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

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



Install the V ring (Page 138)

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

1. Apply a soluble adhesive to the three set screws such as Loctite 243) and screw them partially into the labyrinth sealing ring.
2. Apply an corrosion protection paint to the shaft in the area of the labyrinth sealing ring.

3. Warm up the labyrinth sealing ring. Push the labyrinth sealing ring to approx. 3 mm before the bearing cover before the paint or adhesive cures on the set screws.

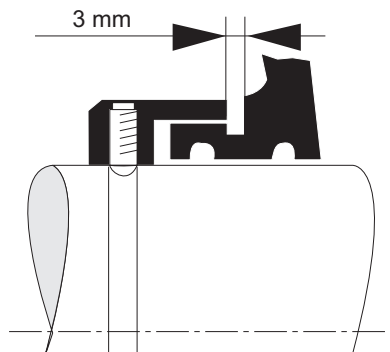


Image 9-5 Position the set screws for the labyrinth sealing ring on the outer bearing cover

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

9.2.5 Seal the motor

Extreme caution and attention to cleanliness are vital to installation.

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

Replace the seals if necessary with original parts or with tested sealing elements. The seals must be fully bonded to the motor and the air intake housing. It is impermissible to have gaps and holes where seals make contact.

- Surfaces whose mating faces are sealed using liquid sealant can be resealed by applying the original liquid sealant (Hylomar M).
- Surfaces whose mating faces are sealed using sealings that adhere to one side only can be resealed with the original sealing using the original adhesives (Loctite).

If you are installing covers that are sealed with liquid gasket, proceed as follows to maintain the IP degree of protection of the machine before closing it again:

1. Use only approved liquid sealants.
2. Clean the sealing surfaces according to the technical data sheet of the liquid sealant. The sealing surfaces must be clean and dry before reassembly.
3. Apply the liquid gasket as a continuous bead with a diameter of approx. 3 mm.

4. Assemble the components after the solvent has had a chance to vaporize, while still assembling within the specified assembly time.
5. Retighten the fixing screws of the cover after a few minutes after the liquid gasket has set.

Note

Service Center

If you have any questions, contact the Service Center.

See also

Service and Support (Page 165)

Spare parts

10.1 Ordering data

When ordering spare parts, in addition to the precise designation of the spare part, specify the motor type and the serial number of the motor. Ensure that the spare part designation matches the designation in the spare part lists and add the associated part number.

Example

- Bearing shield, drive end (Part 5.00)
- Machine type 1MQ1
- Serial number D21234567010001

The machine type and the serial number are indicated on the rating plate and in the technical data, and are also embossed on the drive end of the shaft.

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

Risk of explosion

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

- Use only original spare parts for explosion-proof machines; this also applies to components such as seals, terminals, cables and cable entries. Should you have any questions, please contact the Service Center (Page 165).
- Commercially available equivalent standard parts such as screws may be used.

10.2 Roller bearings

If roller-contact bearings with an insulated design are installed, use roller bearings of the same type as spare parts. This will prevent any bearing damage being caused by bearing currents.

10.3 Anti-condensation heating



WARNING

Risk of explosion

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 165), because this work requires extensive specialist knowledge. Only authorized and tested spare parts may be used.

10.4 Housing, stators and rotors

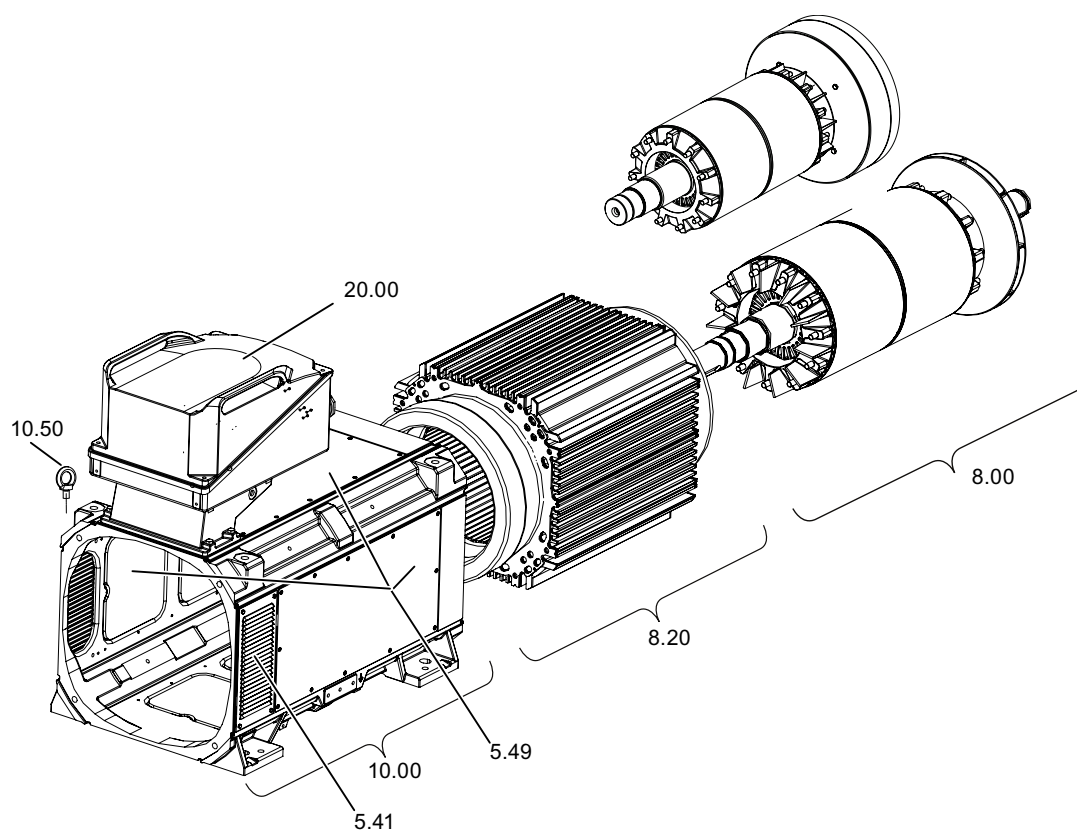


Image 10-1 Housing, stators and rotors

Table 10-1 Spare parts for housing, stators and rotors

Part	Description
5.41	Gill plate and cover for air discharge opening
5.49	Enclosure cover
8.00	Rotor, complete
8.20	Stator core with winding
10.00	Stator frame
10.50	Lifting lugs
20.00	Terminal box without cable entry

See also

Terminal box 1XB1621 (Page 151)

Terminal box 1XB7730 (Page 154)

Terminal box 1XB7731 (Page 155)

Terminal box 1XB7740 (Page 156)

Terminal box 1XB7750 (Page 157)

10.5 External fan (radial mounting)

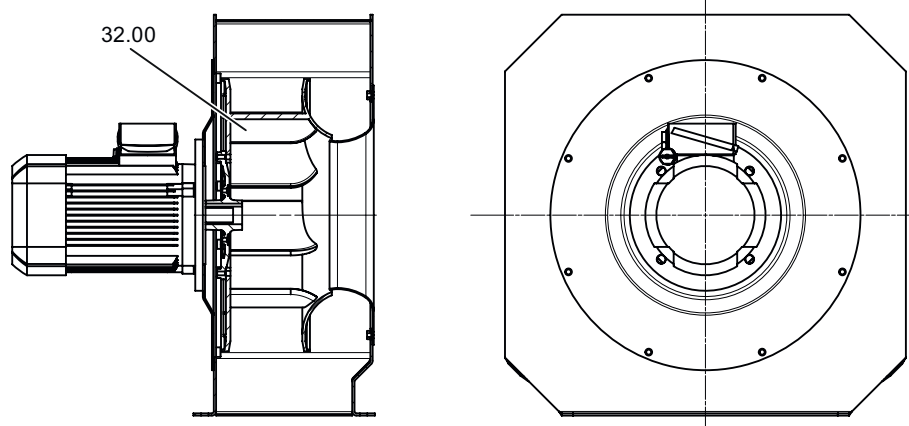


Image 10-2 External fan

Table 10-2 Spare parts for external fan

Part	Description
32.00	Fan unit

You can order the fan unit only as complete kit.

10.6 External fan (axial mounting)

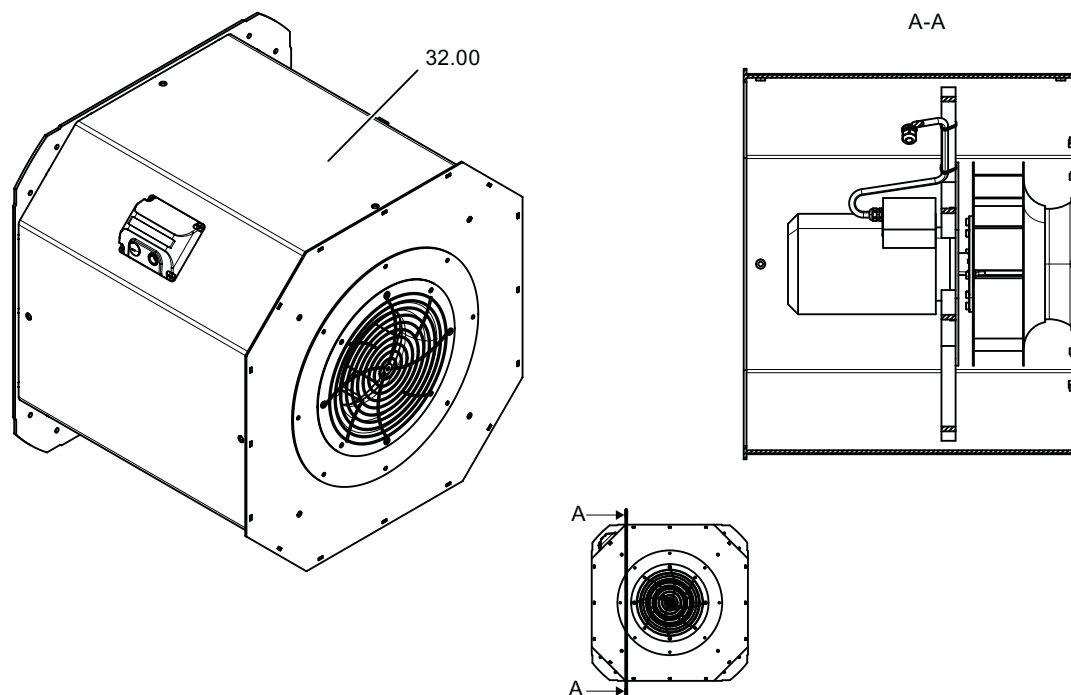


Image 10-3 External fan

Table 10-3 Spare parts for external fan

Part	Description
32.00	Fan unit

You can order the fan unit only as complete kit.

10.7 Roller bearing cartridge at the drive and non-drive end

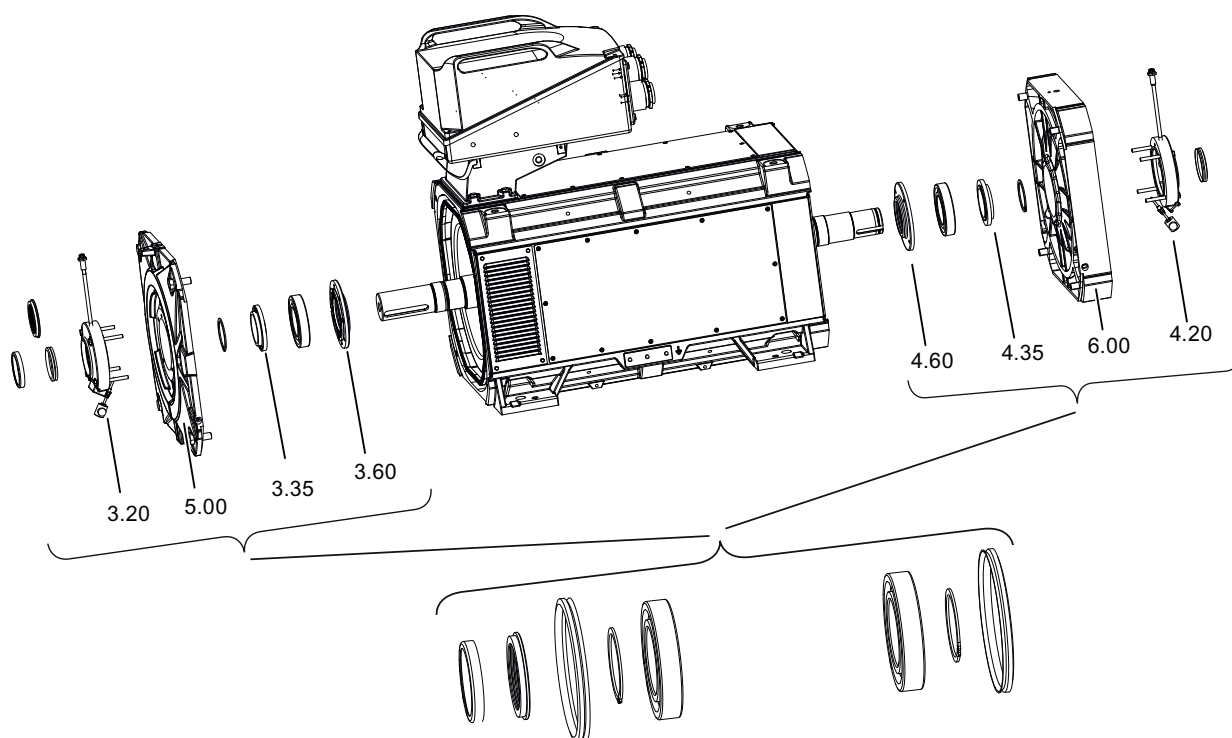


Image 10-4 Bearing cartridge at the drive end and non-drive end

Table 10-4 Spare parts for the bearing cartridge at the drive end and non-drive end

Part	Description	Part	Description
3.20	Outer bearing cover	4.20	Outer bearing cover
3.35	Grease slinger	4.35	Grease slinger
3.60	Inner bearing cover	4.60	Inner bearing cover
5.00	End shield	6.00	End shield
Bearing kit at the drive end and non-drive end consists of the following components			
Deep-groove ball bearing (locating bearing)		Deep-groove ball bearings	
Shaft sealing ring, labyrinth ring (optional)		Shaft sealing ring	
Locking ring, guard ring		Locking ring	

10.8 Roller bearing cartridge at the drive and non-drive end

As of shaft height 400, fast running motors have bearing cartridges with a reduced diameter in the bearing housing design.

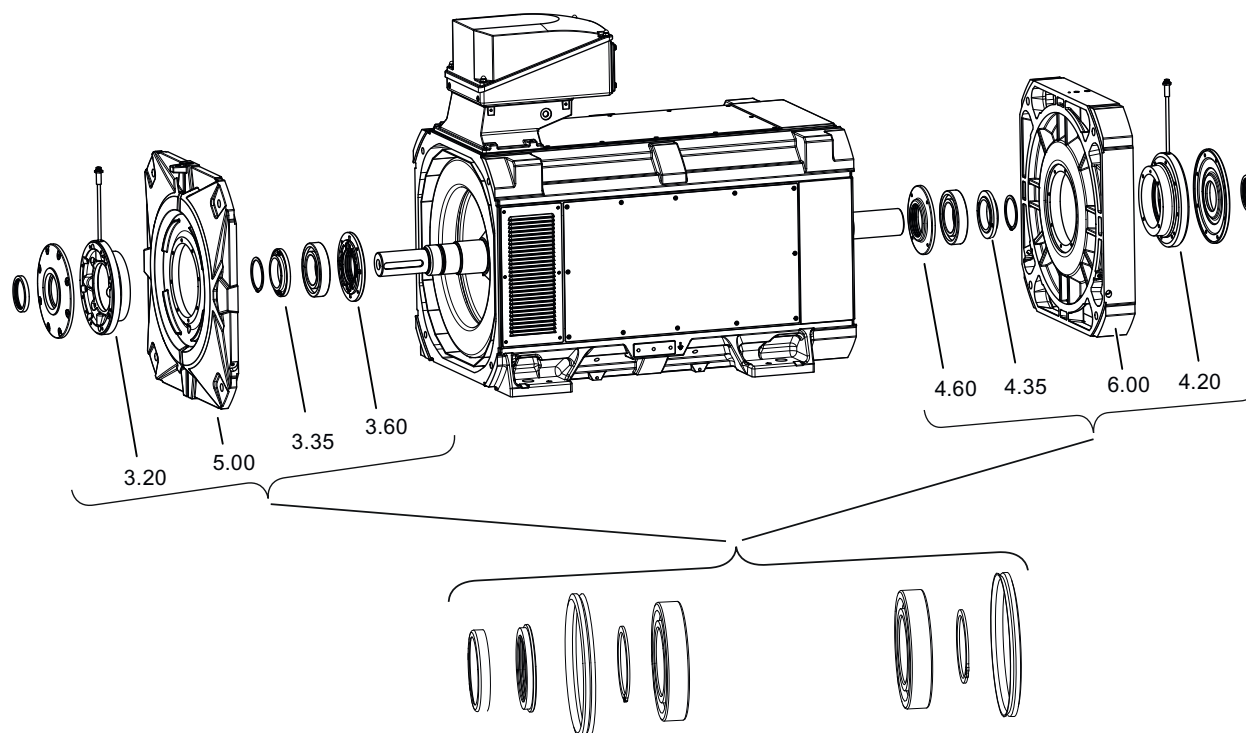


Image 10-5 Bearing cartridge at the drive end and non-drive end

Table 10-5 Spare parts for the bearing cartridge at the drive end and non-drive end

Part	Description	Part	Description
3.20	Outer bearing cover	4.20	Outer bearing cover
3.35	Grease slinger	4.35	Grease slinger
3.60	Inner bearing cover	4.60	Inner bearing cover
5.00	End shield	6.00	End shield
Bearing kit at the drive end and non-drive end consists of the following components			
Deep-groove ball bearing (locating bearing)		Deep-groove ball bearings	
Shaft sealing ring, labyrinth ring (optional)		Shaft sealing ring	
Locking ring, guard ring		Locking ring	

10.9 Speed sensor (optional)

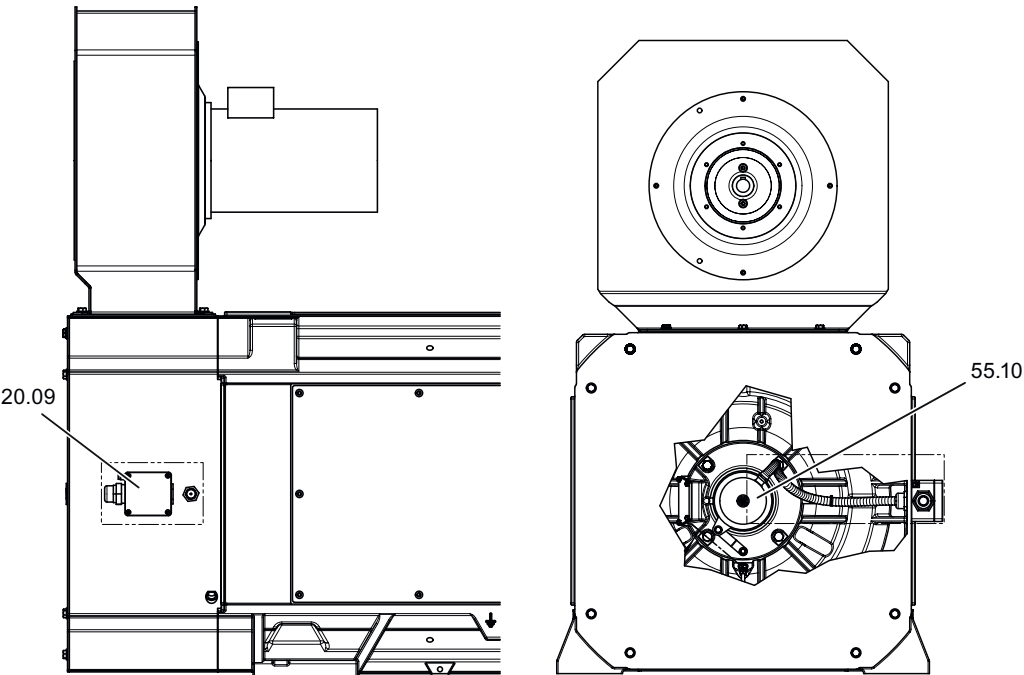


Image 10-6 Speed sensor

Table 10-6 Spare parts for the speed sensor

Part	Description
20.09	Auxiliary terminal box 1XB3020
55.10	Speed sensor kit (sensor, torque bracket, fastening material)

The speed sensor kit can be ordered only as complete kit.

10.10 Terminal box 1XB1621

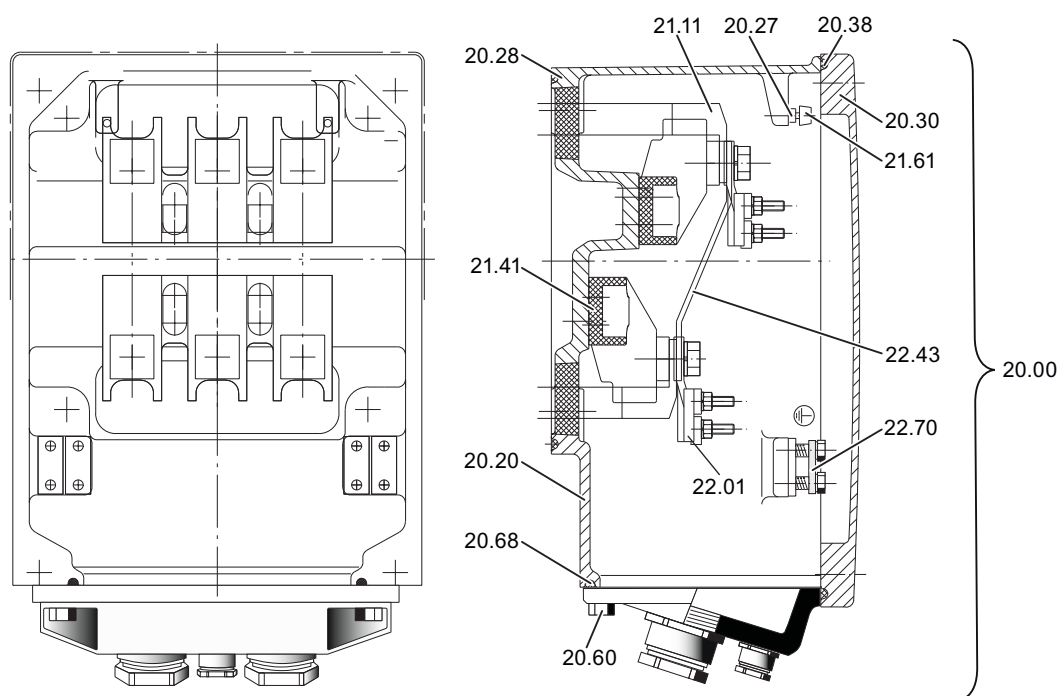


Image 10-7 Terminal box 1XB1621 with standard cable entry

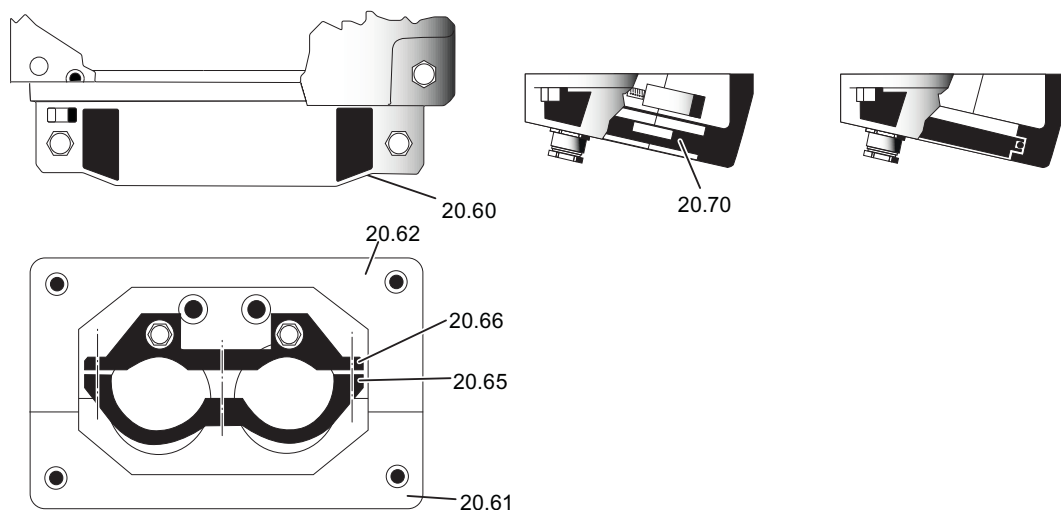


Image 10-8 Two-part cable entry

Table 10-7 Terminal box 1XB1621 spare parts

Part	Description	Part	Description
20.00 Terminal box without cable entry comprising the following components:			
20.20	Terminal box housing	21.41	Terminal supports
20.27	Mounting rail	21.61	Terminal strip for auxiliary circuit

Spare parts

10.10 Terminal box 1XB1621

Part	Description	Part	Description
20.28	Seal	22.01	Saddle terminal, complete
20.30	Cover	22.43	Terminal link, stepped with two holes
20.38	Seal	22.70	Fixing lug for PE conductor
21.11	Connecting plate with internal cable		

Table 10-8 Additional spare parts

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

10.11 Terminal box 1XB1631

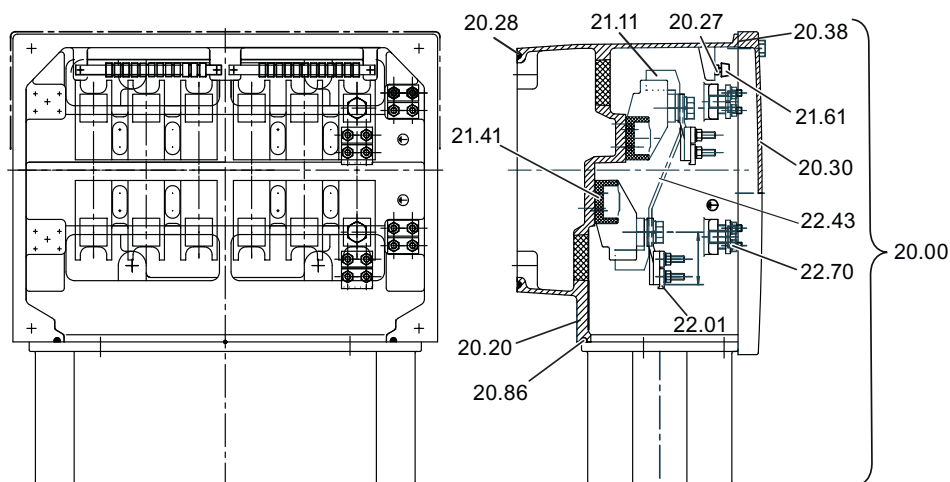


Image 10-9 Terminal box 1XB1631

Part	Description	Part	Description
20.00 Terminal box without cable entry comprising the following components			
20.20	Terminal box housing	21.11	Connecting plate with internal cable
20.27	Mounting rail (depending on version)	21.41	Terminal bushings
20.28	Seal	21.61	Terminal strip for the auxiliary circuit (depending on version)
20.30	Cover	22.43	Terminal link, stepped with two holes
20.38	Cover seal	22.70	Fixing lug for PE conductor
20.86	Entry for auxiliary cable		

You can order the terminal box just as one component.

10.12 Terminal box 1XB7730

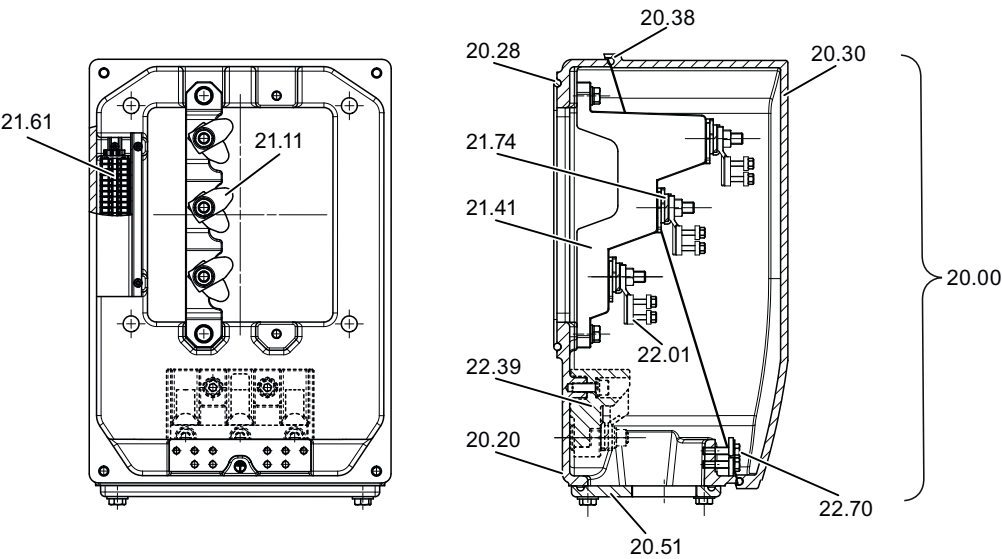


Image 10-10 Main terminal box 1XB7730

Table 10-9 Main terminal box 1XB7730 spare parts

Part	Description	Part	Description
20.00 Terminal box without cable entry comprising the following components			
20.20	Terminal box housing	21.61	Terminal strip for auxiliary circuit
20.28	Seal	21.74	Anti-rotation cartridge
20.30	Cover	22.01	Saddle terminal, complete
20.38	Seal	22.39	Neutral point connection
21.11	Connecting plate with internal cable	22.70	Fixing lug for PE conductor
21.41	Terminal bushings		

Table 10-10 Additional spare parts

Part	Description	Part	Description
20.51	Entry plate with seal		

10.13 Terminal box 1XB7731

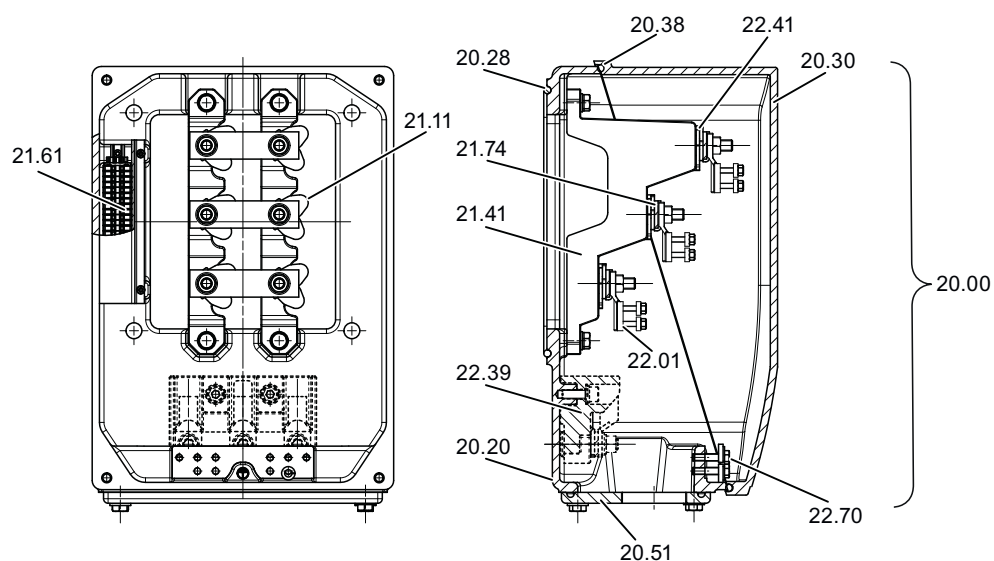


Image 10-11 Main terminal box 1XB7731

Table 10-11 Main terminal box 1XB7731 spare parts

Part	Description	Part	Description
20.00 Terminal box without cable entry comprising the following components			
20.20	Terminal box housing	21.61	Terminal strip for auxiliary circuit
20.28	Seal	21.74	Anti-rotation cartridge
20.30	Cover	22.01	Saddle terminal, complete
20.38	Seal	22.39	Neutral point connection
21.11	Connecting plate with internal cable	22.41	Terminal link, straight with two holes
21.41	Terminal bushings	22.70	Fixing lug for PE conductor

Table 10-12 Additional spare parts

Part	Description	Part	Description
20.51	Entry plate with seal		

10.14 Terminal box 1XB7740

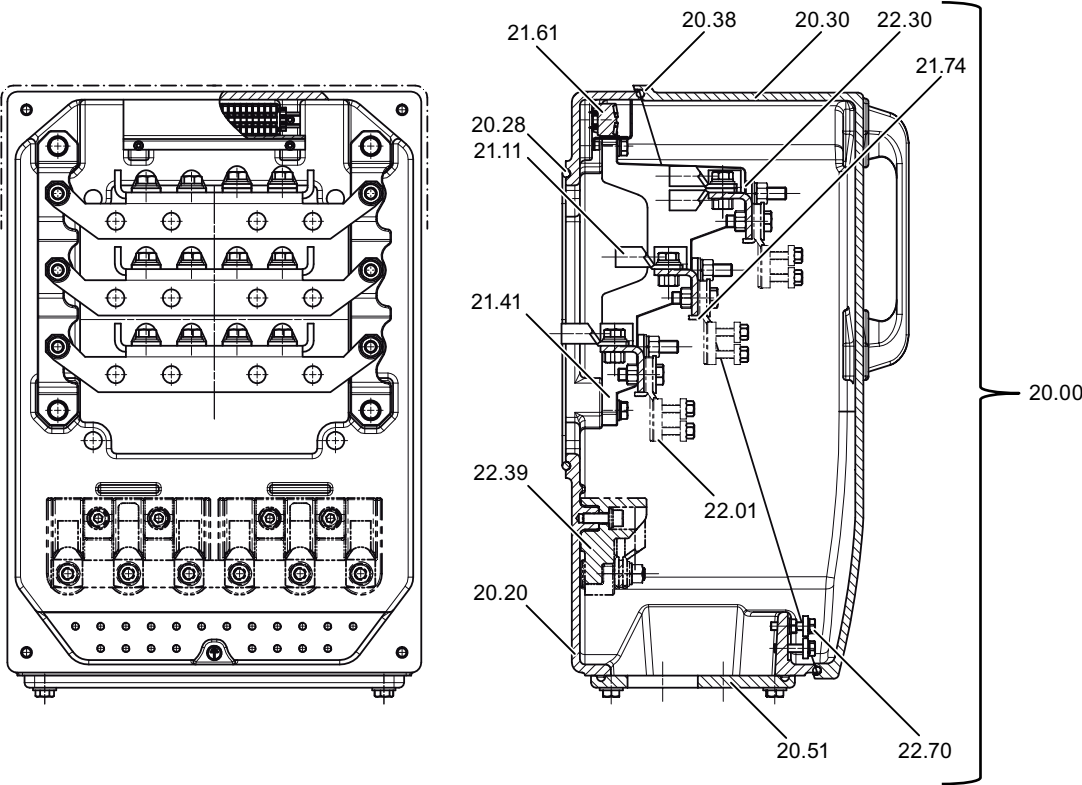


Image 10-12 Main terminal box 1XB7740

Table 10-13 Main terminal box 1XB7740 spare parts

Part	Description	Part	Description
20.00 Terminal box without cable entry comprising the following components			
20.20	Terminal box housing	21.61	Terminal strip for auxiliary circuit
20.28	Seal	21.74	Anti-rotation cartridge
20.30	Cover	22.01	Saddle terminal, complete
20.38	Seal	22.30	Connecting bar for main current
21.11	Connecting plate with internal cable	22.39	Neutral point connection
21.41	Terminal bushings	22.70	Fixing lug for PE conductor

Table 10-14 Additional spare parts

Part	Description	Part	Description
20.51	Cable entry plate with seal		

10.15 Terminal box 1XB7750

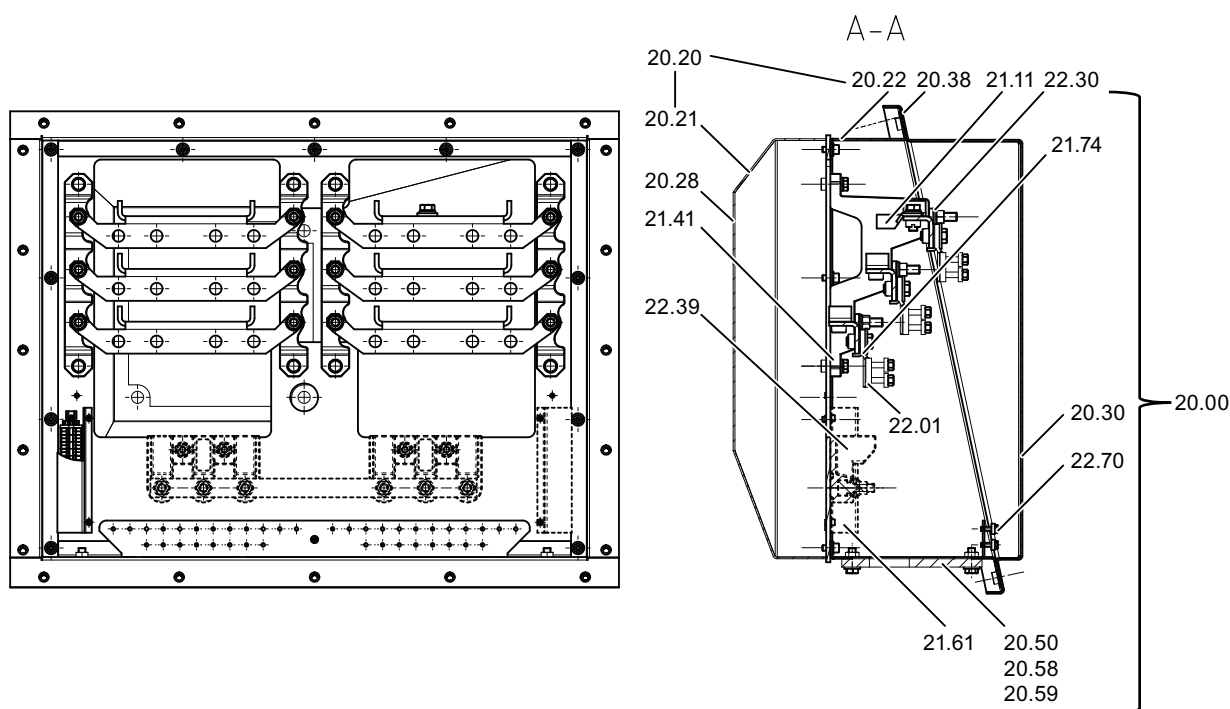


Image 10-13 Main terminal box 1XB7750 with standard cable entry

Table 10-15 Spare parts main terminal box 1XB7750

Part	Description			Part	Description
20.00 Terminal box without cable entry comprising the following components					
20.20	Terminal box housing consisting of	20.2 1	Lower part of enclosure	21.41	Terminal bushings
		20.2 2	Upper part of enclosure		
20.28	Seal			21.61	Terminal strip for auxiliary circuit
20.30	Cover			21.74	Anti-rotation cartridge
20.38	Seal			22.01	Saddle terminal, complete
20.50	Cable entry plate			22.30	Connecting bar for main current
20.58	Seal			22.39	Neutral point connection
20.59	Spacer			22.70	Fixing lug for PE conductor
21.11	Connecting plate with internal cable				

10.16 Auxiliary terminal box 1XB9014

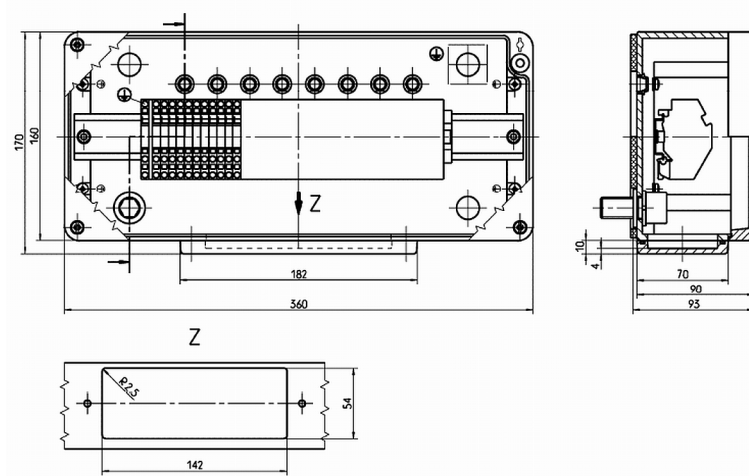


Image 10-14 Auxiliary terminal box 1XB9014

Note

The auxiliary terminal box can only be ordered as one complete part, single parts are not available. Contact the Siemens Service Center (Page 165).

10.17 Auxiliary terminal box 1XB9015

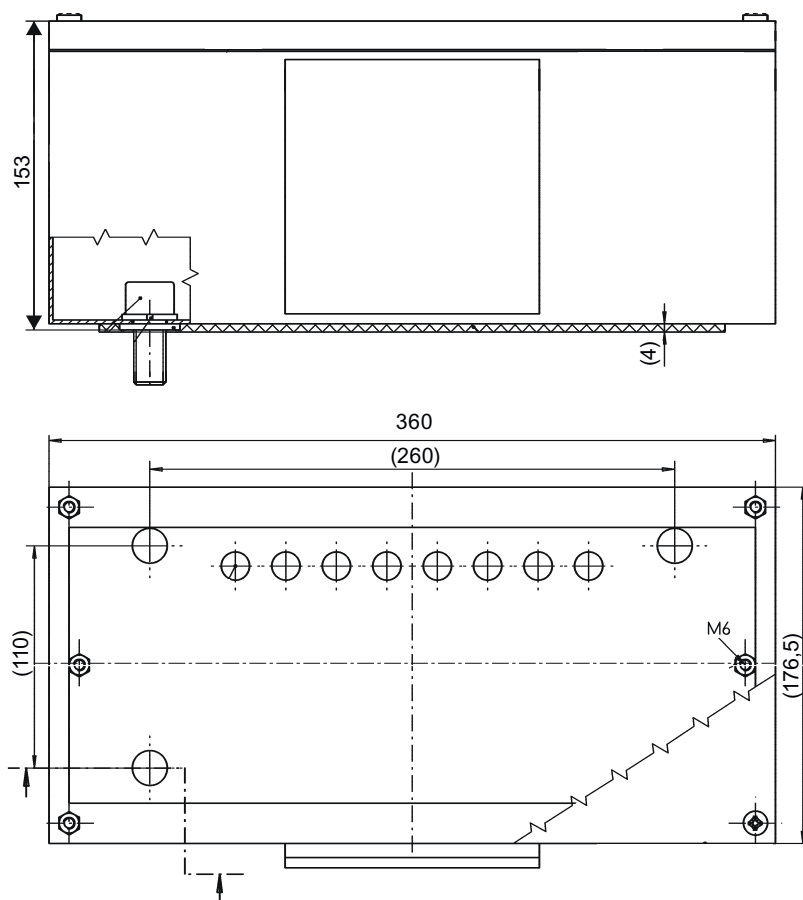


Image 10-15 Auxiliary terminal box 1XB9015

Note

The auxiliary terminal box can only be ordered as one complete part, single parts are not available. Contact the Siemens Service Center (Page 165).

10.18 1XB9016 auxiliary terminal box

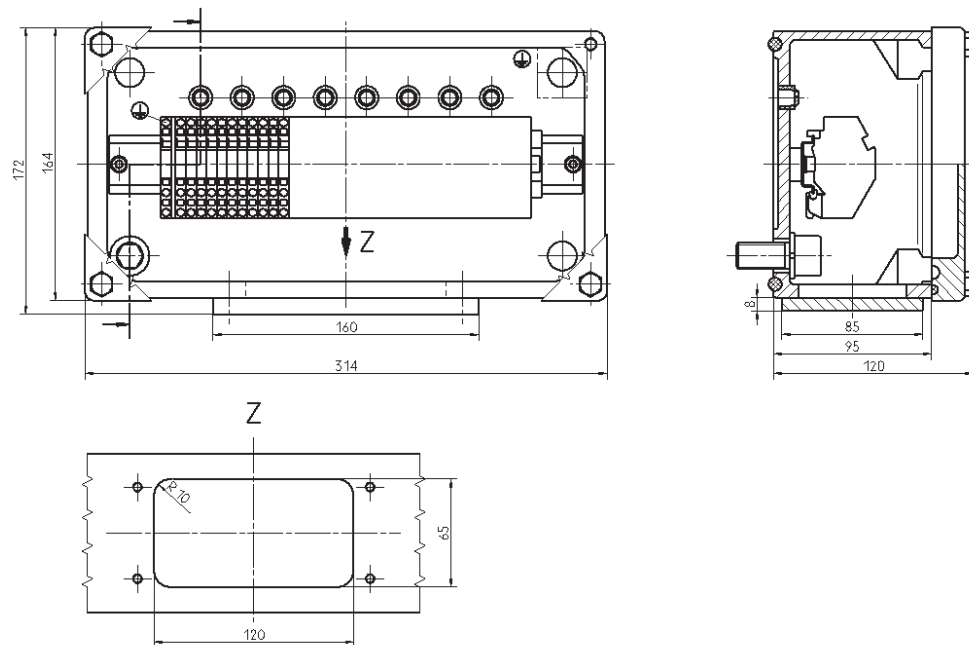


Image 10-16 1XB9016 auxiliary terminal box

Note

The auxiliary terminal box can only be ordered as one complete part, single parts are not available. Contact the Siemens Service Center (Page 165).

10.19 Auxiliary terminal box 1XB302.

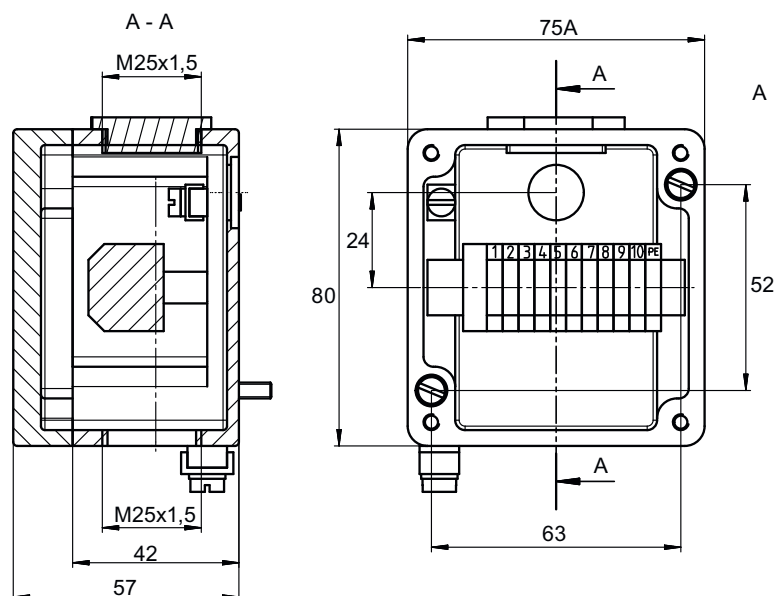


Image 10-17 Auxiliary terminal box 1XB302.

Note

The auxiliary terminal box can only be ordered as one complete part, single parts are not available. Contact the Siemens Service Center (Page 165).

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.

Note

Country-specific legislation

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

11.2 Dismantling the machine

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



WARNING

Machine parts can fall

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

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

11.3 Disposal of components

Components

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

Sort the components for recycling according to whether they are:

- Iron and steel
- Aluminum
- Non-ferrous metal, e.g. windings
The winding insulation is incinerated during copper recycling.
- Insulating materials
- Cables and wires
- Electronic waste

Process materials and chemicals

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

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

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

Packaging material

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

Service and Support

Technical queries or additional information



If you have any technical queries or you require additional information, please contact Technical Support (<https://support.industry.siemens.com/cs/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 and drawings

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 screw/bolt connections with a tolerance of $\pm 10\%$

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

Applications

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

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

Note

Non-standard tightening torques

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

See also

Securing the rotor (Page 36)

Quality documents



You can find the quality documents here:

<https://support.industry.siemens.com/cs/ww/de/ps/13318/cert> (<https://support.industry.siemens.com/cs/ww/en/ps/13318/cert>)

Additional documents

D.1 Additional documents on CD

The documentation for components from other manufacturers that are installed in the machine can be found on the CD.

Index

A

- Aligning, 60, 63, 64
 - Accuracy, 65
 - Prerequisites, 52
- Aluminum conductors, 85
- Anti-condensation heating, 31, 99, 110, 111, 123, 133
 - Insulation resistance, 51
 - Mounting, 144
 - Repairs, 144
- Applications, 23
- Assembly
 - External fan unit, 133
 - Labyrinth sealing ring, 139
 - Outer bearing seal, 139
 - Roller bearings, 137
 - Sealing, 140
 - V ring, 138
- Auxiliary terminal box
 - close, 91
- Axial force, 65
- Axial gap, 62

B

- Balance quality, 54
- Bearing cover, 135
- Bearing currents
 - Reduction, 42
- Bearing insulation, 43, 93
- Bearing seizure damage, 38
- Bearing temperature
 - Monitoring, 97
 - Set values, 97
- Bolt locking device, 167
- Brought-out cables, 78

C

- Cable entries, 82
 - certified, 82, 88
- Cable entry and routing, 80
- Cable entry plate, 81
- Cable gland, 82
- Cable lugs without side guard, 83
- Center of gravity, 36, 57

- Centering flange, 63, 64
- Checks to be carried out prior to commissioning, 93
- Common-mode filters, 43
- Condensate, 58, 108
- Connecting cables
 - Selection, 76, 88
- Connecting the auxiliary circuit, 89
- Converter, 26
- Converter documentation, 43
- Cooling, 26
- Cooling system
 - faults, 116
- Correct usage, 24
- Corrosion protection, 41, 139
 - Removing, 53
- Coupling, 45
- Cross-section of grounding conductor, 76
- Cross-section of the line conductor, 76

D

- Damage during transport, 36
- Damage during transportation, 35
- Damping cores, 43
- De-energizing
 - Anti-condensation heating, 99, 111
- Degree of protection, 26
 - Derating, 60
 - Increased, 27
- Deinstalling
 - External fan unit, 133
- Delivery, 35
- Direction of rotation, 78
 - External fan, 90
- Disassembly
 - Machine, 132
 - Roller bearings, 135
- Disposal
 - Chemicals, 164
 - Components, 164
- Distance over surface, 84
- Drive, 26

E

- Electrical faults, 114
- Electromagnetic compatibility, 21
- Electromagnetic fields, 22

Emergency off, 113
Emitted interference, 22
End shield, 135
Equipotential bonding, 86
Equipotential bonding conductor, 42
ESD guidelines, 19
Explosion hazard, 23, 134
 Bridging the insulated bearing, 108
 electrostatic discharge, 20
External fan, 30
 Commissioning, 96
 Connection, 89
 Direction of rotation, 90
 Maintenance, 128
 Test run, 96
 turning off, 112

F

faults, 108
Faults
 Cooling system, 116
 Electric, 114
 Inspection, 113, 121
 Mechanical, 114
 Roller bearings, 117
Feather key, 56
Five safety rules, 16
Flammable substances, 18
Foundation surfaces, 51

G

General inspection, 122
Geometry of the flange, 51
Grease chamber, 138
Grease tank, 128
Grounding conductor
 Connection, 77
Grounding system
 Meshed, 43

H

Hazardous substances, 17
Hearing damage, 18, 32
Hot surfaces, 17

I

Ignition hazard, 18, 109
Increased degree of protection, 27
Induced eddy currents, 86
Insert cable, 81
Inspection
 Faults, 113, 121
Installation
 Initial inspection, 122
Installing the protective ring, 138
Insulated bearings, 27, 43, 108
Insulated coupling, 44
Insulation resistance, 48, 94, 111, 121
 Anti-condensation heating, 51
 measure, 49
Interference immunity, 21
Interference voltages, 22
Interlocking circuit
 Anti-condensation heating, 31
 External fan, 30
Intrinsically safe circuits, 89
IP56 (non-heavy-sea), 138

L

Labyrinth ring, 136
Lifting, 35, 57
Line operation, 26
Local service, 165
Long-term storage, 40
Low-Voltage Directive, 15

M

Machine
 Aligning to the driven machine, 62
 Mounting, 61
 setting down, 58
Machine design
 IEC, 23
Machine expansion, 63
Maintenance
 Maintenance intervals, 119
Maximum peak voltage at the motor terminals, 92
Metal shield, 77, 89
Metal-armored cables, 77, 89
Minimum air clearances, 87
More information, 165
Mounting parts, 48

Mounting the terminal box, 75
 Mounting-foot hole dimensions, 51, 52

N

Noise emissions, 18, 32

O

Operating mode, 29
 Operation with converter
 Explosion-protected machine, 41
 Output element, 55
 Overspeed, 29

P

Paint system, 129
 Paintwork damage, 129
 Polarization index, 48, 50, 94, 111, 121
 Positioning, 62
 Precision alignment, 62
 Preparations for assembly, 47
 Property class, 61
 Protective conductor, 92
 Protective ring, 135

Q

Qualified personnel, 16

R

Radial force, 65
 Rating plate, 24, 25
 Re-commissioning, 112
 Regreasing, 110, 127
 Regreasing interval, 128
 Regreasing system, 27
 Commissioning, 96
 Interlocking circuit, 31
 Maintenance, 124
 Removing the terminal box, 75
 Repainting, 130
 Repair
 Initial inspection, 122
 Residual risks, 29
 Restriction of certain Hazardous Substances, 163
 RF grounding point, 42

Risk of explosion, 40, 133, 144
 Cleaning with compressed air, 121
 Spare parts, 143
 RoHS, 163
 Roller bearings
 Assembly, 137
 faults, 117
 Regreasing, 95
 Roller-contact bearings, 27
 Rolling-contact bearings
 Inspection, 123
 Rotating parts, 17
 Rotor, 26
 attach, 132
 Rotor shipping brace, 36, 39, 53
 Remove, 52
 Rotor winding, 26

S

Safety instructions
 Flammable substances, 18
 Hazardous substances, 17
 Hot surfaces, 17
 Live parts, 17
 Maintenance work, 119
 Rotating parts, 17
 Seal insert, 80
 Sealing, 86
 Sealing grease, 27
 Sealing insert with break-off ring, 79
 Sealing plugs
 certified, 82, 88
 Selection of bolts, 61
 Setting the motor parameters, 100
 Shaft assembly, 34
 Shipping, 36
 Space requirement, 30
 Spare parts, 143, 165
 1XB9016 auxiliary terminal box, 160
 Auxiliary terminal box 1XB302., 161
 Auxiliary terminal box 1XB9014, 158
 Auxiliary terminal box 1XB9015, 159
 Bearing housing design, 149
 Bearing shield cartridge, 148
 enclosure, 145
 External fan, 146, 147
 Main terminal box 1XB7730, 154
 Main terminal box 1XB7731, 155
 Main terminal box 1XB7740, 156
 Main terminal box 1XB7750, 157
 Rotor, 145

- Speed sensor, 150
- Stator, 145
 - Terminal box 1XB1621, 151
- Spare parts ordering, 143
- Speed, 33
- Speed-torque curve, 33
- Standard flange, 63, 64
- Stator winding
 - Temperature monitoring, 90
- Stoppages, 110
 - Roller bearings, 111
- Storage, 39
- Storage location, 39
- Strain relief, 80
- Supplementary devices, 28
- Support base, 32
- Switching on, 98, 109
- System resonances, 34
- System-inherent frequencies, 34

T

- Tandem operation, 44
- Technical Support, 165
- Temperature class, 32, 111
- Temperature limits, 40
- Temperature monitoring
 - Stator winding, 90
- Terminal box, 28, 67, 77, 89
 - Closing, 87
 - Maintaining, 131
 - rotating, 72
- Terminal designation, 76
- Terminal diagram, 88
- Test run, 98
- Thermal motor protection, 31
- Tightening torques, 67
 - Bolted connection, 167
 - Cable lug, 77
 - Ground terminals, 77
 - Rotor shipping brace, 37
- Torsional loadings, 34
- Transporting, 35, 57
- Turning the machine on to its side, 53
- Type of balancing, 54
- Type of protection, 23, 143

V

- V ring, 135, 138
- Ventilation, 26

- Vibration values, 34, 99
- Voltage via the converter, 91

W

- Wall faces, 52
- Wall mounting, 52
- Winding temperature
 - Monitoring, 97
 - Set values, 97
- Wire end ferrules, 83, 85

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