SIEMENS

Low-Voltage Motors 1LA5/6/7/9, 1LE1, 1LG4/6, 1LP7/9, 1MA6/7, 1MF6/7, 1MJ6/7, 1PC1/3, 1PP6/7/9

Operating Instructions

04/2011

5 610 00000 02 000

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

with a safety alert symbol, indicates that minor personal injury can result if proper precautions are not taken.

CAUTION

without a safety alert symbol, indicates that property damage can result if proper precautions are not taken.

NOTICE

indicates that an unintended result or situation can occur if the corresponding information is not taken into account.

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 for the specific task, 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 adhered to. The information in the relevant documentation must be observed.

Trademarks

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Disclaimer of Liability

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

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order number: 5 610 00000 02 000
℗ 04/2011

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Introduction 1

1.1 About these instructions

These instructions describe the machine and explain best practices in machine handling, from initial delivery to final disposal of the equipment.

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

If you find any mistakes or have suggestions for improvements, please contact our Service Center.

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 Information for the reader

Explanation of the icons

Information for 1LE1, 1PC1, and 1PC3 machines

Information about explosion-protected machines

Safety information 2

2.1 Information for those responsible for the plant or system

This electric machine has been designed and built in accordance with the specifications contained in Directive 2006/95/EC ("Low-Voltage Directive") and is intended for use in industrial plants. Please observe the country-specific regulations when using the electric machine outside the European Community.

Follow the local and industry-specific safety and setup regulations.

The persons responsible for the plant must ensure the following:

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

Note

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

In the individual chapters of this document, you will find safety instructions that must be obeyed absolutely, for your own safety, to protect other people and to avoid damage to property.

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

2.2 The five safety rules:

For your personal safety and to prevent material damage when working on the machine, always observe the safety 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 order stated before starting work at the machine.

Five safety rules

1. Disconnect the system.

   Disconnect the auxiliary circuits, for example anti-condensation heating
2. Prevent reconnection.
3. Make sure that the equipment is at zero voltage
4. Ground and short-circuit
5. Cover or isolate nearby components that are still live.

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 The safe use of electrical machines

⚠ WARNING

Live parts

Electrical machines contain live parts.

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

- Only remove covers in compliance with the applicable regulations.
- Operate the machines properly.
- Perform regular maintenance on the machine.

⚠ WARNING

Rotating parts

Electrical machines contain dangerous rotating parts.

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

- Only remove covers in compliance with the applicable regulations.
- Operate the machines properly.
- Perform regular maintenance on the machine.
- Secure free-standing shaft extensions.

⚠ WARNING

Hot surfaces

Electrical machines have hot surfaces.

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

- Allow the machine to cool down before starting any work on it.
- Only remove covers in compliance with the applicable regulations.
- Operate the machines properly.

2.5 Safety instructions: Explosion-proof machines

⚠ CAUTION
The increased level of danger in hazardous areas demands that you pay particular attention to the notes marked with ⟨Ex⟩.

2.6 Special designs and construction versions

NOTICE
If any problems or uncertainties arise, we urgently recommend that you contact the manufacturer specifying the type designation and serial number (No. ...., see rating plate) or have the equipment repaired by a Siemens Service Center.

2.7 Special conditions for explosion-proof machines

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

Flameproof enclosure "d"

Flameproof joints may only be repaired strictly in accordance with the manufacturer's design specifications. Repair in accordance with the values in Tables 1 and 2 of EN 60079-1 is not permitted.

Zone 21

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

Description

3

3.1 Area of application

Overview

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

Intended use of the machines

These machines are intended for industrial installations. They comply with the harmonized standards of the series IEC/EN 60034 (VDE 0530). Their use in hazardous areas is forbidden unless the marking on the rating plate expressly permits this operation. If other/more wide-ranging demands (e.g. protection so that they cannot be touched by children) are made in special cases – i.e. use in non-industrial installations – these conditions must have been complied with in the plant or system itself when the motors are installed.

Note

Machine directive

Low-voltage motors are components designed for installation in machines in accordance with the current Machinery Directive. They must not be commissioned until it has been verified that the end product complies with this directive (refer to EN 60204-1).

3.1.1 CE marking

Note

Use of machines without CE identification

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

3.2 Delivery

Checking the delivery for completeness

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

Register a complaint about

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

Keep the safety and commissioning notes, which are part of the scope of delivery, in an accessible place; this also applies to the optionally available operating instructions.

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

3.3 Rating plates

Rating plate

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

Data on the rating plate

Table 3- 1 Machine rating plate

Item	Description	Item	Description
General data		**Electrical data**	
1	Type of machine	31	50 Hz data
2	Machine type	32	60 Hz data
3	Serial number (incl. date of manufacture YY.MM)	33	Rated voltage [V]
4	Standards	34	Winding connections
5	Additional details (optional)	35	Frequency [Hz]
6	Customer data (optional)	36	Rated power [kW]
7	Country of origin	37	Rated current [A]
8	Production location	38	Power factor [cosφ]
9	Identification number of testing agency (optional)	39	Rated speed [rpm]
10	Regulations (optional)	40	Efficiency class
Mechanical data		41	Efficiency
11	Frame size	42	Torque [Nm] (optional)
12	Type of construction	43	Rated power [hp] (optional)
13	Degree of protection	44	Service factor (optional)
14	Machine weight [kg]	45	Starting current ratio (optional)
15	Temperature class	46	Operating mode (optional)
16	Coolant temperature range (optional)	47	NEMA data (optional)
17	Installation altitude (only if higher than 1000 m)	48	Anti-condensation heating (optional)
18	Vibration severity grade		
19	Bearing sizes		
20	Relubrication data (optional)		
21	Brake data (optional)		

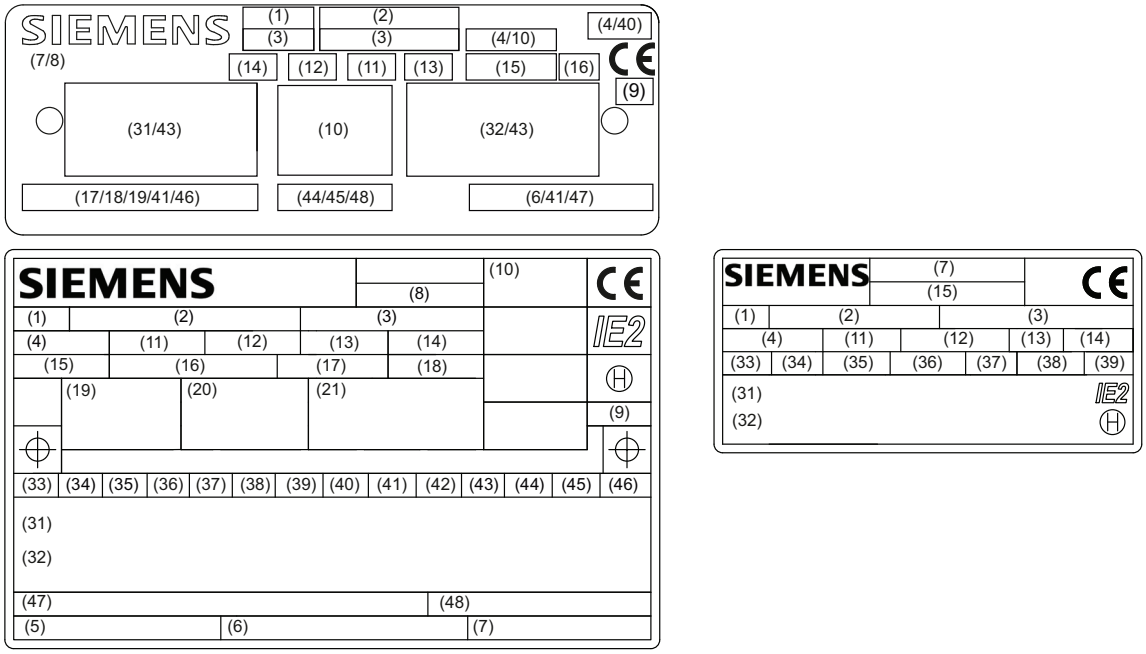


Figure 3-1 Rating plates

3.4 Installation

3.4.1 Machine design

Machines of this series are self-ventilated low-voltage three-phase asynchronous drives with a cylindrical shaft end and featherkey way. They can be supplied as single-speed machines with different efficiency classes or as pole changing machines for several speeds.

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

It is possible to change the feet bolted on the housing of the machine, e.g. to change the position of the terminal box; however, only have this performed by an authorized retrofit partner.
With the appropriate post working, ensure that the foot mounting surfaces are again on one plane and parallel to the machine shaft, and shim when required. Professionally touch up damaged painted surfaces.

3.4.2 Regulations

Machine design

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

Table 3- 2 Applicable general regulations

Feature	Standard
Dimensions and operating performance	IEC / EN 60034-1
Degree of protection	IEC / EN 60034-5
Cooling	IEC / EN 60034-6
Type of construction	IEC / EN 60034-7
Terminal designations and direction of rotation	IEC / EN 60034-8
Noise emission	IEC / EN 60034-9
Restart characteristics for 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
IEC standard voltages	IEC 60038

Supplementary regulations for ⟨Ex⟩ explosion-proof machines

Table 3- 3 Regulations applied for explosion-proof machines

Feature	Standard
Electrical equipment for hazardous gas atmospheres, Part 0: General requirements	IEC / EN 60079-0
Electrical equipment for hazardous gas atmospheres, Part 1: Flameproof enclosure "d"	IEC / EN 60079-1
Electrical equipment for hazardous gas atmospheres, Part 7: Increased safety "e"	IEC / EN 60079-7
Electrical equipment for hazardous gas atmospheres, Part 14: Electric installations for endangered atmospheres (except underground excavation)	IEC / EN 60079-14
Electrical equipment for hazardous gas atmospheres, Part 15: Type of protection "n"	IEC / EN 60079-15
Electrical equipment for hazardous gas atmospheres, Part 19: Repairs and overhauls	IEC / EN 60079-19
Electrical equipment for use in the presence of combustible dust - Part 0: General requirements	IEC / EN 61241-0
Electrical equipment for use in the presence of combustible dust - Part 1: Protection by enclosure "tD"	IEC / EN 61241-1
Electrical equipment for use in the presence of combustible dust - Part 17: Inspection and maintenance of electrical systems in hazardous areas (except underground excavation)	IEC / EN 61241-17 IEC / EN 60079-17
Directive on the approximation of the laws of the Member States concerning equipment and protective systems intended for use in hazardous areas.	RL94/9/EC

3.4.3 Cooling and ventilation

3.4.3.1 General

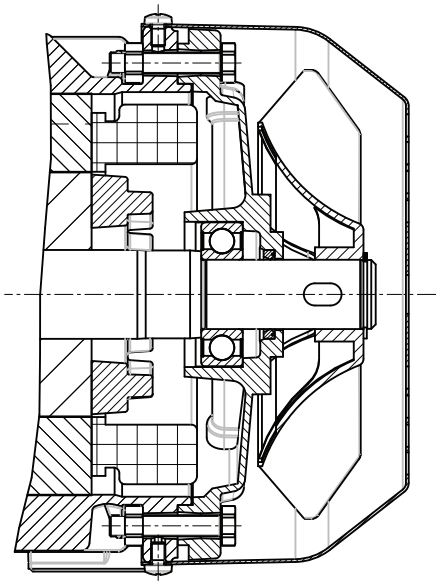
The machines of this series are three-phase asynchronous machines with a closed primary (internal) cooling circuit and an open secondary cooling circuit (surface cooling). The surface cooling varies depending on the version.

3.4.3.2 Machines with a fan

Self-ventilation (standard): Type of cooling IC 411 in accordance with IEC / EN 60034-6

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

Machines for use in Zone 21 and Zone 22 have a metal fan.



Forced ventilation (optional): Cooling method IC 416 in accordance with IEC/EN 60034-6

⚠ WARNING

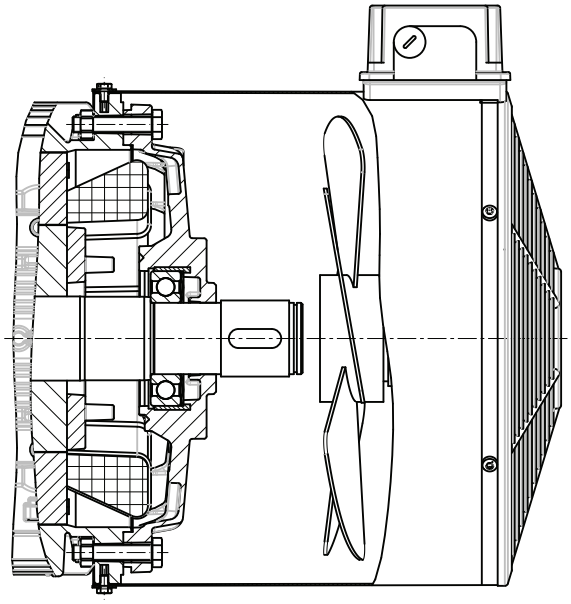
Hot surfaces

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

Never commission the machine without an external fan.

Cooling that does not depend on the speed is achieved by means of a separately driven fan wheel (forced ventilation). Forced ventilation does not depend on the operating state of the machine.

The fan wheel for the external flow of cooling air is powered by an independent module and is enclosed by the fan cover.



3.4.3.3 Machines without a fan (optional)

Surface cooling by free convection: Type of cooling IC 410 in accordance with IEC / EN 60034-6

IC410 IC4A1A0

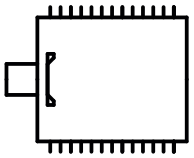


Figure 3-2 IC410

Surface cooling by relative movement of cooling air: Type of cooling IC 418 in accordance with IEC / EN 60034-6

IC418 IC4A1A8

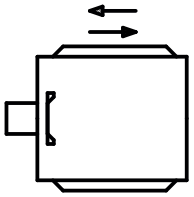


Figure 3-3 IC418

3.4.4 Bearings

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

Roller bearings with permanent lubrication are maintenance-free. For bearings that can be relubricated, observe the data on the rating plate or lubricant plate.

3.4.5 Balancing

The machines are balanced dynamically with a half featherkey (code "H") in accordance with ISO 8821.
The balancing quality corresponds to vibration severity grade "A" for the complete machine; vibration severity grade "B" is possible as an option.

3.4.6 Types of construction/method of installation

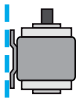
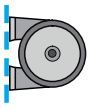
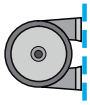
Further possible fields of application

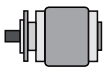
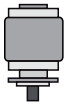
The type of construction of the machine is stated on the rating plate.

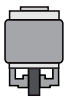
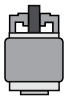
⚠ CAUTION

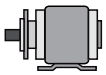
When lifting the machines for transport, only lift them in a position that corresponds to their basic construction type.

Table 3- 4 Type of construction

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

Basic type of construction code	Graphics-Based Representation	Other methods of installation	Graphics-Based Representation
IM B5 (IM 3001)		IM V1 (IM 3011)	
		IM V3 (IM 3031)	

Basic type of construction code	Graphics-Based Representation	Other methods of installation	Graphics-Based Representation
IM B14 (IM 3601)		IM V18 (IM 3611)	
		IM V19 (IM 3631)	

Basic type of construction code	Graphics-Based Representation
IM B35 (IM 2001)	
IM B34 (IM 2101)	

Types of construction/Installation conditions for explosion-proof machines

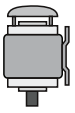
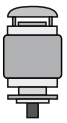
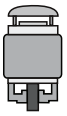
The type of construction of the machine is stated on the rating plate.

DANGER

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

- For types of construction with a shaft extension facing upwards, a suitable cover must be fitted to prevent small parts from falling into the fan cover (see also standard IEC/EN 60079-0).
- Prevent the cooling airflow from being reduced as a result of covers that might be in place.

Table 3- 5 Construction type with protective top cover

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

3.4.7 Degree of protection

The degree of protection the machines feature is stated on the rating plate. They can be installed in dusty or humid environments.

⚠ WARNING

Dangerous voltage

Condensation drain holes (optional)

Inserting objects into the condensation drain holes can damage the winding and can result in death, serious injury and damage to property!

Note the following to maintain the degree of protection:

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

NOTICE

Storage

If the machines are used or stored outdoors, we recommend keeping them under a shelter or an additional cover.

- Avoid exposing them to direct, intense solar radiation, rain, snow, ice, or dust for extended periods.
- If necessary, please consult us or seek advice regarding technical issues.

Environmental requirements

The machines are suitable for operation in tropical climates.

Guide value for the standard version 60 % relative humidity at a coolant temperature (CT) of 40 °C.

Ambient temperature: -20 °C to +40 °C

Installation altitude: ≤ 1000 m

Air with normal oxygen content, usually 21 % (V/V)

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

Machines intended for use in Zone 1 (type of protection Flameproof Enclosure "d" or Increased Safety "e") or in Zone 2 (type of protection "n") are designed with IP 55 degree of protection.

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

3.4.8 Optional built-on and built-in accessories

In addition to the current-dependent overload protective device located in the connecting leads, we recommend that you use temperature sensors embedded in the stator winding in order to monitor the temperature and protect the stator winding from overheating.

Machines whose winding is exposed to the danger of condensation due to the climate, e.g. machines at a standstill in a damp environment or machines which are exposed to large temperature fluctuations, can be equipped with an anti-condensation heater.
As an option, the machines can be fitted with additional built-on accessories on the ventilation side (e.g. brake, rotary pulse encoder).

Optional built-on and built-in accessories for explosion-proof machines

If the temperatures are within the specified limits at the mounting location, in the case of external sources of heat or cold, no additional measures are necessary. Using the type tests, for special applications with external sources of heat or cold, check the effect on the max. surface and operating temperatures, and if necessary, apply suitable measures.

Select mounted equipment such as brakes, forced ventilation or incremental encoders according to the requirements of the Directive 94/9/EC.

Preparing for use

4

4.1 Transport

⚠ WARNING

Use lifting eyes

The machine must only be transported and lifted using the lifting eyes, in a position that is appropriate for its type of construction. Otherwise, it could fall over or slip in the lifting tackle.

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

- Use all the lifting eyes on the machine.
- Any eyes that are screwed in must be tightly fastened.
- Eyebolts must be screwed in right up to their supporting surface.
- If necessary, use suitable, sufficiently-sized transport equipment such as lifting straps (EN1492-1) and lashing straps (EN12195-2).

⚠ WARNING

Suspended transport

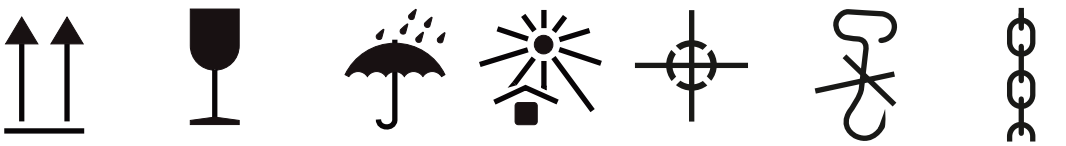
If several items of transport material are used for fastening, two straps must be able to carry the whole load.

- Use additional, suitable means of support for transport and during installation.
- Secure the support equipment to prevent it from slipping.

Remove any transport locks before start-up and either keep them in a safe place or unlock them. You can then use them again for transporting further items or you can apply them again.

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

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



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

4.2 Storage

Storing outdoors

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

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

CAUTION
Take all appropriate precautions under extreme climatic conditions, e.g. salt-laden and/or dusty, moist/humid atmospheres.

Storing indoors

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

Bare metal surfaces

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

Condensation drain hole

Open any condensation drain holes to drain the condensation (<6 months).

Storage time

Turn the shafts 1x every year to avoid bearing brinelling. Prolonged storage periods reduce the useful life of the bearing grease (aging).

Open bearings

- For open bearings e.g. 1Z, check the state of the bearing grease over 12 months.
- Replace the grease if it can be identified that the grease has lost oil content or has become dirty (ingress of condensation leads to consistency changes of the grease).

Closed bearings

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

4.3 Electromagnetic compatibility

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

NOTICE
Converter • If operated with a frequency converter, the emitted interference varies in strength, depending on the design of the converter (type, interference suppression measures, manufacturer). • Prevent the limit values stipulated by EN 61000-6-3 for the drive system (consisting of the machine and converter) from being exceeded. • You must observe the EMC information from the manufacturer of the converter. • The most effective method of shielding is to conductively connect a shielded machine supply cable to the metal terminal box of the machine (with a metal screw connection) over a large surface area. • On machines with integrated sensors (e.g. PTC thermistors), disturbance voltages caused by the converter may occur on the sensor cable.

When used in accordance with their intended purpose and operated on an electrical supply system with characteristics in accordance with EN 50160, the enclosed motors (IP 55 and higher) comply with the requirements of the current guidelines for electromagnetic compatibility.

Immunity to interference

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

Assembly 5

5.1 Installation

5.1.1 Safety instructions

⚠ WARNING

Hot surfaces

Electrical machines have hot surfaces.

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

- Allow the machine to cool down before starting any work on it.
- Only remove covers in compliance with the applicable regulations.
- Operate the machines properly.

It must be ensured that parts (cables etc.) do not come into contact with the machine enclosure.

CAUTION

Before start-up, please check that

- the customer has set the correct direction of rotation of the machine - e.g. by decoupling from the driven machine - by taking appropriate measures!
- there are no temperature-sensitive parts (cables etc.), which are in contact with the machine enclosure.
- condensation drain holes are always located at the lowest point of the motor!

NOTICE

Please note the technical data on the rating plates on the machine enclosure.

5.1.2 Safety instructions: Explosion-proof machines

⚠ CAUTION

The increased level of danger in hazardous areas demands that you pay particular attention to the notes marked with  .

5.1.3 Machine installation

General

NOTICE
After installing, tighten the eyebolts or remove them!

Note

Do not use mounted components (e.g. rotary pulse encoder) to help lift the motor!

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

- Only use explosion-protected machines in appropriate areas in accordance with directive 1999/92/EG .
  If the certificate is supplemented by an X, observe the special conditions listed in the EC type examination certificate.
- When installing electrical systems in hazardous zones, carefully observe EN 60079-14 and the corresponding country regulations.
- The machine temperature class specified on the rating plate must be equal to or greater than the temperature class of any combustible gases that may develop.

See also

Special conditions for explosion-proof machines (Page 11)

5.1.4 Cooling

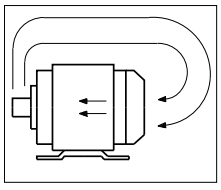
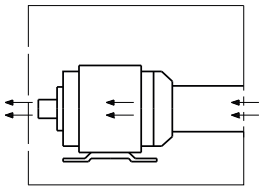
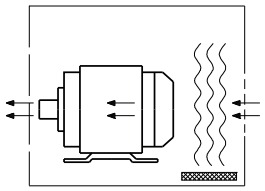
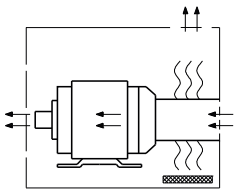
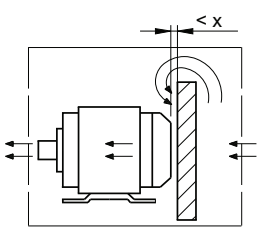
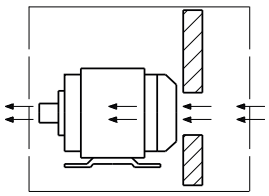
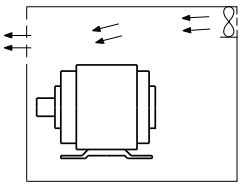
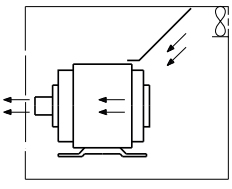
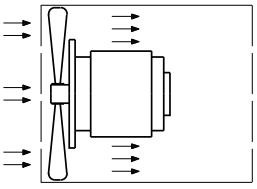
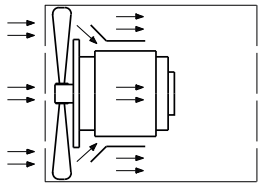
5.1.4.1 Ventilation

⚠ CAUTION

Ventilation

- Do not obstruct ventilation.
- Prevent the air expelled by neighboring equipment from being immediately sucked in again.
- On the vertical type of machine construction with air intake from above, protect the air inlets from the ingress of foreign bodies and water.
- If the shaft extension is facing upwards, liquid must be prevented from entering by moving along the shaft.

Table 5- 1 Air guidance

Incorrect	Correct
	
	
	
	
	

The minimum dimension "x" for the distance between neighboring modules

Table 5- 2 Minimum dimension "X" for the distance between neighboring modules

Frame size (BG)	X mm
63 ... 71	15
80 ... 100	20
112	25
132	30
160	40
180 ... 225	45
180 ... 200 (1LG)	90
225 ... 250 (1LG, 1MA6, 1MJ7)	100
280 ... 315	110

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

Special types of construction

⚠ CAUTION

Follow these instructions:

- The IM B3 bearing shield with built-in distance ring mounted at the DE is only used as transport lock. A warning label is attached to this bearing shield!
- The spacer ring is not a roller bearing!
- Remove the bearing shield and the spacer ring!
- Remove the transport lock before commissioning!

These machines do not have their own bearing system for the machine shaft at the drive end (DE). The machine shaft is accepted by the (hollow) shaft or coupling of the plant or driven machine.
Using the centering flange, the machine is aligned with respect to enclosures, flanges or driven machines.
Note that the temperature of the machine and machine shaft increases during operation. The thermal expansion of the machine shaft must be compensated by the customer in the form of suitable measures.
Use the spring washers provided to locate the NDE bearing without any play.

5.1.6 Balancing

⚠ CAUTION

Safety precautions

- The general touch protection measures for drive output elements must be observed.
- Output elements may only be attached or withdrawn using the correct equipment.
- The feather keys are only secured against falling out during shipping. If you commission a machine without an output element, the feather keys must be secured to prevent them from being thrown out.

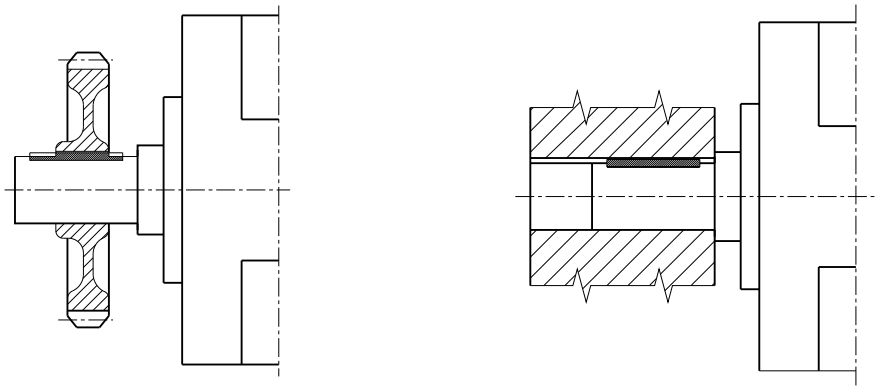
The rotors are balanced dynamically. The balancing quality corresponds to vibration severity grade "A" for the complete machine as standard. The optional vibration severity grade "B" is indicated on the rating plate.

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

Designation:

- As a standard measure, balancing is carried out dynamically with a half featherkey (code "H") in accordance with ISO 8821.
- "F" means balancing with a whole featherkey (optional version).
- "N" means balancing without a featherkey (optional version).

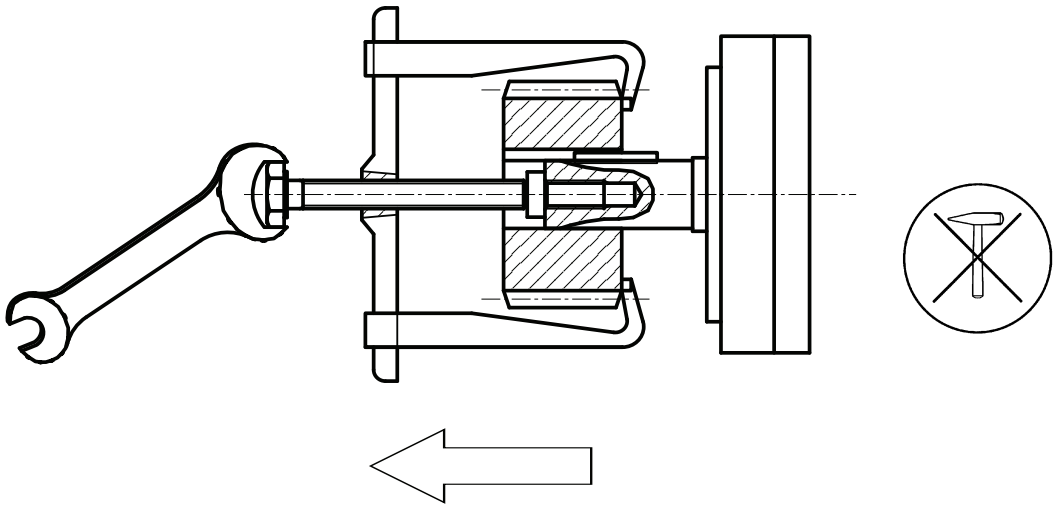
The featherkey declaration on the shaft and transmission element must indicate the correct type of balancing in each case and must be correctly mounted.
The balancing quality corresponds to vibration severity grade "A" for the complete machine; vibration severity grade "B" is possible as an option, i.e.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



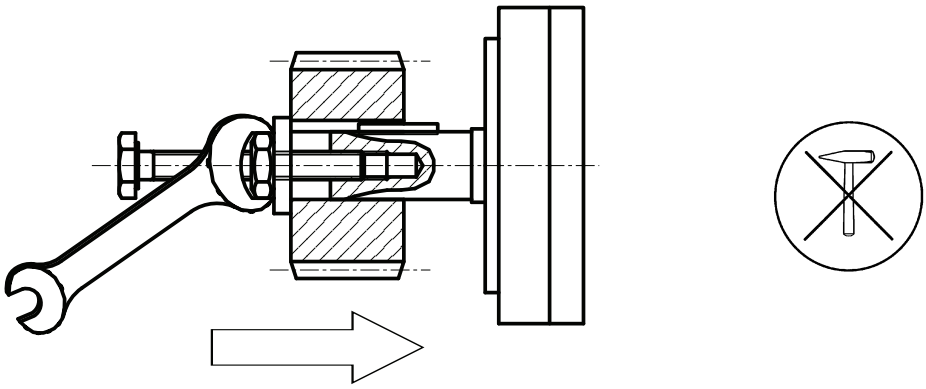
Note

Measures conforming to ISO 10816 must be taken in order to compensate any offset between electrical machines and driven machines.
The foundation must be designed according to DIN 4024.

5.1.6.1 Mounting and withdrawing output elements



Withdrawing output elements



Mounting output elements

Note

- When mounting output elements (coupling, gear wheel, belt pulley etc.) use the thread at the shaft end and - if possible - heat up the output elements as required.
- Use a suitable device when withdrawing output elements.
- Do not apply any blows when mounting and withdrawing the output element (e.g. with hammer or similar).
- Transfer no more than the radial or axial forces specified in the catalog to the machine bearings via the shaft extension.

5.1.7 Noise emission

NOTICE
When the noise that is emitted at workplaces of the personnel responsible for operating the equipment is assessed, it must be borne in mind that the A-weighted sound pressure level, measured in accordance with ISO 1680, namely 70 dB(A), is not exceeded if the three-phase machines are operated with the rated output.

5.2 Alignment and fastening

General

When aligning and fastening the machine, please bear the following in mind:

- The machine must be level.
- Feet and flanges must be fastened securely.
- Alignment must be precise in the case of direct coupling.
- Fastening surfaces must be clean
- Look out for any damage to paint; this must be rectified immediately and correctly.
- Look out for traces of anti-corrosion protection agents; these must be removed using mineral turpentine.
- Look out for installation-related resonances with the rotating frequency and double line frequency; these must be prevented.
- Listen for unusual noises when turning the rotor manually.
- Check the direction of rotation with the machine decoupled.
- Avoid using rigid coupling measures.

Measures

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

- Vertical positioning.
  When vertically positioning the machine, place thin metal shins under the mounting feet in order to avoid tensioning and deforming the machine. The number of shims should be kept as low as possible i.e. only stack a few shims.
- Horizontal positioning
  To position the machine horizontally, push it sideways on the foundation and ensure that the axial position is maintained (angularity error).
- When positioning the motor, ensure that a uniform axial gap is maintained around the coupling.
- Smooth running
  Stable, vibration-free design of the foundations in accordance with DIN 4024 and precise alignment of the coupling, as well as a well-balanced output element (coupling, belt pulleys, fans, etc.), are prerequisites for smooth running with low vibration levels.
- Complete balancing of the machine with the output element may be necessary.
  For details and evaluation criteria, refer to ISO 10816.
- Foot/flange mounting
  Use thread sizes specified in EN 50347 for mounting the machine to foundations or to machine flanges. Attach the machine at four foot or flange holes in a rectangular configuration with respect to one another. The customer is responsible for selecting the strength of the fixing elements.
  For the fixing elements up to and including frame size 160, property class 5.6 or higher is recommended, from frame size 180, property class 8.8 or higher.
  For IM B14 flanges, select the correct screw length.

Note

Only use authorized retrofit partners to change over the mounting feet bolted to the machine frame, e.g. in order to change the position of the terminal box.
In order to prevent the machine from being deformed, ensure that the mounting feet surfaces are located in one plane and parallel to the machine shaft by post working or by using shims.

5.2.1 Flatness of supporting surfaces

Flatness of the supporting surfaces for conventional motors

Frame size (FS)	Flatness mm
≤ 132	0.10
160	0.15
≥ 180	0.20

5.2.2 Machine frame mounting feet (special design)

Frame size (FS)	Type of feet
1LA / 1MA FS 90S/L	Cast-on feet with double hole
1LE16/5 frame size 132S/M, 160M/L	Cast-on feet with double hole
1MA6/1MJ6 FS 180M/L	Screwed-on feet with double hole
1LG/LE frame size 180 ... 280 S/L	Cast or bolted-on feet with double hole
1LG/LE frame size 315 S/M/L	Screwed-on feet with double hole
1LG/LE frame size 315 S	Screwed-on feet with double hole
1LG/LE frame size 315 M/L	Screwed-on feet with double hole
1MA6 frame size 180 / 225 1MA6 frame size 280 ... 315	Cast or bolted-on feet with double hole
1MJ7 frame size 180 / 225 1MJ7 frame size 280 ... 315	Screwed-on feet with double hole

NOTICE
Maintain the standardized foot dimensions with type of construction IM B3 according to EN 50347!

Electrical connection 6

6.1 Connection of the machine

6.1.1 General

⚠ WARNING

Note the following safety information before connecting-up the machine:

- Only qualified and trained personnel should carry out work on the machine while it is stationary.
- Disconnect the machine from the power supply and take measures to prevent it being reconnected. This also applies to auxiliary circuits, e.g. anti-condensation heating.
- Check that the machine really is in a no-voltage condition.
- Establish a safe protective conductor connection before starting any work.
- If the incoming power supply system displays any deviations from the rated values in terms of voltage, frequency, curve form or symmetry, such deviations will increase the temperature and influence electromagnetic compatibility.

⚠ WARNING

Line supply with non-grounded neutral point

Operating the machine on a line supply system with a non-grounded neutral point is only permitted over short time intervals that occur rarely, e.g. the time leading to a fault being eliminated (ground fault of a cable, EN 60034-1).

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

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

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

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

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

The following features make this type of electrical connection different from that for standard machines:

- Maintain the area A in IEC/EN 60034-1 (VDE 0530-1) (±5 % voltage or ±2 % frequency deviation, waveform, line supply symmetry) so that the temperature rise remains within the permissible limits.
- Larger deviations from the rated data may result in electrical machines heating up to impermissible levels. This information must be specified on the rating plate. Under no circumstances exceed the limits!
- Protect every machine with type of protection increased safety "e" in accordance with EN 60079-14 against an inadmissible temperature rise using a current-dependent, delayed circuit breaker with phase failure protection and asymmetry detection corresponding to EN 60947 or using an equivalent device in all phases.
- For machines with type of protection increased safety "e", select the overcurrent device with current-dependent delayed trip so that the tripping time, which should be taken from the characteristic of the switch for the ratio I_A / I_N of the machine to be protected, is no longer than the safe-locked rotor time t_E. Take the ratio I_A / I_N as well as the safe-locked rotor time t_E from the rating plate. Set the protective device to the rated current. Use a certified tripping unit in accordance with RL 94/9/EC.
- For machines with increased safety "e" type of protection, in the event of a locked rotor the protective device must disconnect within the t_E time specified for the relevant temperature class. Protect electrical machines for heavy duty starting (acceleration time > 1.7 x t_E time) according to the specifications of the EC-type examination certificate using a starting monitoring function.
  Direct monitoring of the winding temperature is permissible as a means of thermal machine protection, provided that this is certified and specified on the rating plate.
- With pole-changing machines, separate, interlocked protective devices are required for each speed step. Devices with an EC-type examination certificate are recommended.

6.1.2 Terminal designations

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

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

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

6.1.3 Direction of rotation

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

Connection of the power cables in the phase sequence L1, L2, L3 to U, V, W results in clockwise rotation (looking at the DE shaft end on the drive side). If two of the connections are interchanged then the resulting direction of rotation is counter-clockwise (e.g. L1, L2, L3 at V, U, W).
In the case of machines intended for only one direction of rotation, the defined direction of rotation e.g. for machines with an axial fan, is marked by a direction arrow on the machine.

6.1.4 Connection with/without cable lugs

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

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

Note

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

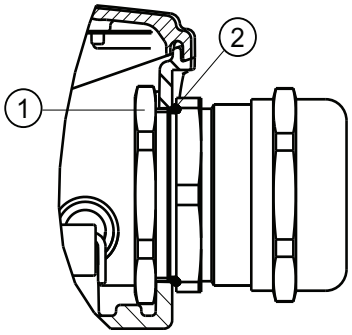
6.1.5 Connecting protruding cables

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

The connection cables are color coded or labeled and are provided with end sleeves by the customer. The customer directly connects individual cables in the control cabinet for their system in accordance with the labeling.

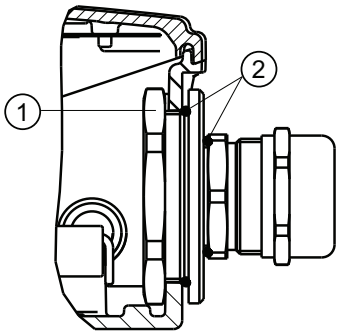
6.1.6 Cable glands

Cable glands with (sheet metal) nuts (EN 50262)



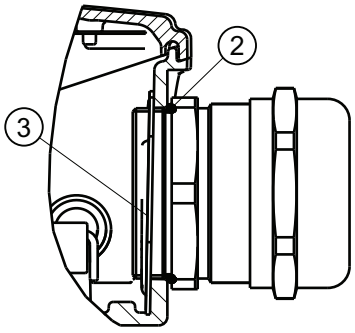
① Nut
② O ring

Cable glands with reductions and (sheet metal) nuts (EN 50262)



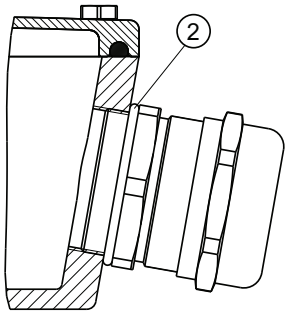
① Nut
② O ring

6.1.6.1 Mounting position of sheet metal nuts in screw-type connections



② O ring
③ Mounting position of metal-sheet nuts

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



② O ring

6.1.7 Terminal box

6.1.7.1 General

⚠ DANGER

Dangerous voltage

Electric machines contain hazardous voltages.

If the machine is not de-energized and brought into a no-voltage condition, death or serious injury will occur.

When work is carried out on the machine with the terminal box open, it must not be electrically connected!

CAUTION

Damage to property

Note the following information to avoid damage to the terminal box.

- Make sure that the components inside the terminal box e.g. terminal board and cable connections) are not damaged!
- It must be ensured that there are no foreign bodies, dirt or moisture in the terminal box. Cable entries into the terminal box according to DIN 42925.
- Close any additional open cable entries with O-rings or suitable flat gaskets, the terminal box itself must be sealed so that it is dust and water tight using the original seal.
- Please observe the tightening torques for cable glands and other screws.
- When performing a test run, secure the feather keys without output elements.

NOTICE

The terminal box must be sealed so that dust and water cannot enter.

Frame sizes 80 to 90

⚠ WARNING

Dangerous voltage

Loosening the safety torx screw can result in death, serious injury or material damage!

Do not loosen the safety torx screw with respect to the center terminal, as this ensures a conductive connection between the grounding conductor and frame!

CAUTION

Serious damage to the machine

Failure to observe these measures will result in serious damage to the machine!

- Do not rotate the terminal box unless the connection cables have not yet been laid.
- If you release the safety torx screw to both sides of the outer connecting terminals, this can destroy the machine!
- Remove the three large snap hooks on the terminal board before rotating the the terminal box. Keep the snap hooks pressed while rotating the terminal box and use a screwdriver to re-engage when finished.

6.1.7.2 Versions

Standard design

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

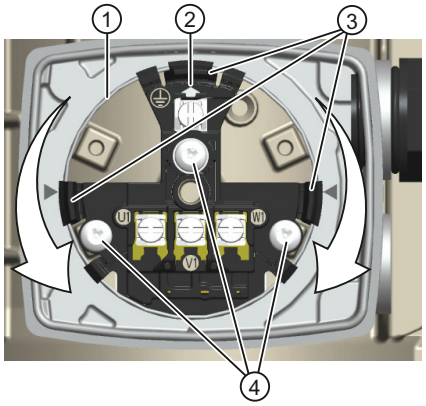
The terminal box can be turned 4x90 degrees on the terminal base of the machine's housing in the case of a terminal board with 6 terminal studs (standard design).

Frame sizes 80 to 90

For machines with frame sizes 80 to 90, it is possible to rotate the terminal box continuously through 360 degrees.

Installation instructions

1. Press the three large snap hooks ③ over the flange ① of the terminal box towards the inside.
2. Hold the snap hooks ③ pressed inwards, detach the terminal box, raise it slightly and rotate it to the required POSITION. Observe the arrow for the position of the terminal box ②.
3. Press the terminal box lightly towards the machine housing. Use a screwdriver to allow the large snap hooks ③ to engage over the flange ① of the terminal box.



① Flange
② Terminal box positioner
③ Snap hooks
④ Safety Torx screws

Terminal box 1LE 80...90 optional terminal board

Frame sizes 80 to 90

CAUTION
Arcing at the optional terminal board can destroy the machine Failure to observe this information can result in destruction of the machine as a result of arcing. To change the operating mode, always press the jumper fully into the base of the slot and use the red locking lever to ensure that it is engaged.

Connection methods for two-pole and four-pole machines

Frame sizes 80 to 90

Machines of sizes 80 to 90 can be delivered with standard terminal board or with optional terminal board.

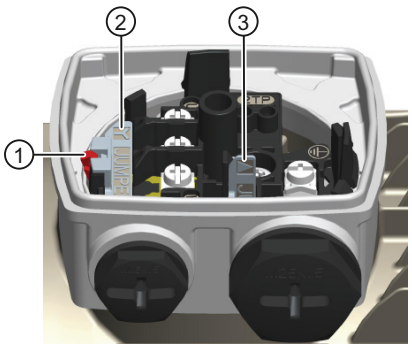
All electrical connections and locking elements on the terminal board are operable using flat-head/cross-tip screwdrivers.

Optional terminal board (star or delta circuit)

You can use the jumpers to set the operating mode for machines that have an optional terminal board.

Installation instructions

1. Open the red locking lever ① and remove the jumper ② from the slot.
2. Release the snap hook on the compartment and remove the jumper ③.
3. Press the jumper ③ fully into the base of the slot and engage the locking lever at its end position.
4. Press the jumper ② into the compartment and allow the snap hooks to re-engage at the compartment.



Explosion-protected machines (with the exception of machines for Zone 22) are equipped with terminal boxes with type of protection increased safety "e".

For 1MJ machines, terminal boxes with type of protection flameproof enclosure "d" with explosion group IIC are available as an option.

Please note in this regard design, connection options and spare parts.

Note the explosion protection information designated with ⟨Ex⟩ in the operating instructions!

Have authorized Siemens workshops perform any repairs.

6.1.7.3 Protruding connection cables

⚠ WARNING

Short-circuit hazard

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

⚠ CAUTION

It must be ensured that there are no foreign bodies, dirt, or moisture in the terminal base of the machine enclosure.

- Use O-rings or suitable flat gaskets to seal entries in cover plates (DIN 42925) and other open entries.
- Seal the terminal base of the machine enclosure using the original seal of the cover plate to prevent dust and water from entering.
- Please observe the tightening torques for cable glands and other screws.
- When performing a test run, secure the feather keys without output elements.

6.1.7.4 Connecting the temperature sensor/anti-condensation heater

The temperature sensor / anti-condensation heater is connected in the terminal box.

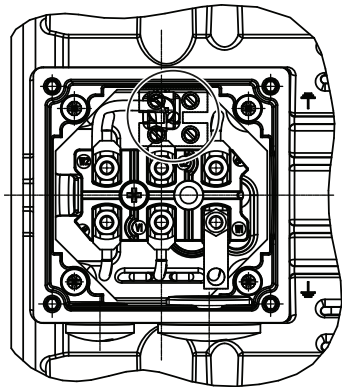


Figure 6-1 Connection to terminal strip

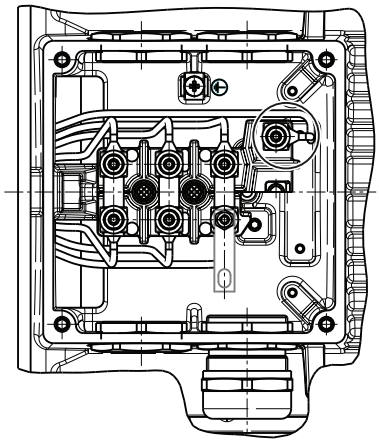
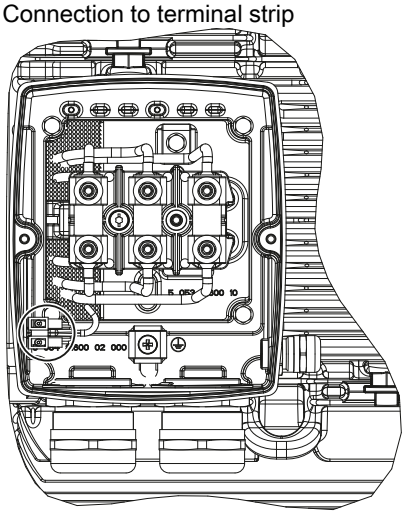


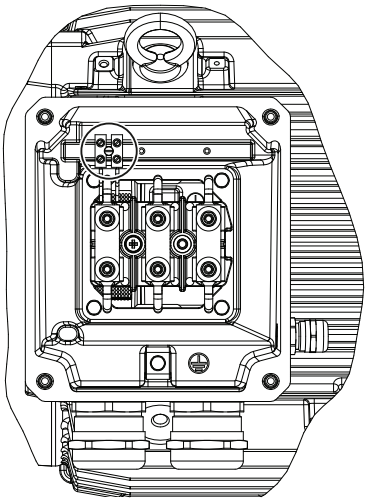
Figure 6-2 Connection to terminal board

The temperature sensor / anti-condensation heater is connected in the terminal box.

Table 6- 2 Connection to terminal strip



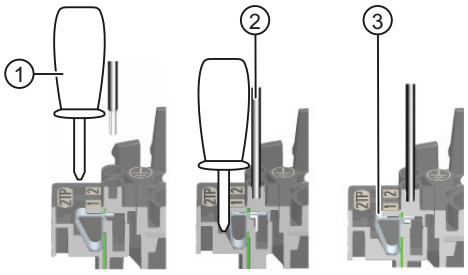
Aluminum



Cast iron

Connection at the temperature sensor using a spring-loaded connection system

Frame sizes 80 to 90

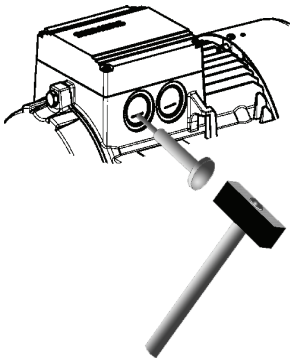


① Flat-head screwdriver
② Sensor cable
③ Tension spring

6.1.7.5 Cable entry

Knockout openings

NOTICE
Knockout openings • Knockout openings in the terminal box must be knocked out using appropriate methods. • Take care not to damage the terminal box or its interior components (the terminal board, cable connections, and so on).



Assembly and laying of cables

Screw the screw-type connection into the housing or fasten with a nut.

Note

The screw-type connections must have been matched to the connecting cables used (armoring, braid, shield).

Frame sizes 80 to 90

CAUTION
Damage to terminal board Observe the following measures to prevent damage to the terminal board: • Remove the screw-type connections (EN 50262) only when the terminal box is closed. • Tighten the screw-type connections to rated torque value only when the terminal box is closed. • Tighten the screw-type connections only finger tight when the terminal box is open. • Make sure that the three large snap hooks are engaged when tightening the screw-type connections!

Cable entries for explosion-proof machines

The cable glands must have an EC-type examination certificate and be certified for the respective hazardous zone.

- Any openings that are not being used must be sealed using the corresponding certified plugs.
- Please observe the manufacturer's specifications when fitting cable entries.
- Before installing the cable, remove the dust protection element or plug from the cable gland.

6.1.7.6 Thread sizes in terminal box

Table 6- 3 Thread sizes in the cast iron terminal box

Frame size (BG)	Type	Type of protection/Zone	Standard thread		Additional threads with mounting parts	
			Size	Number	Size	Number
71 ... 90	1MJ6	Increased safety "e" Zone 21	M 25x1.5 M 16x1.5	2 1		
71 ... 90	1MJ6	Flameproof enclosure "d" Zone 21	M 25x1.5	1	M 20x1.5	1
100 ... 132	1LA6 1MA6	Increased safety "e" Non sparking "n" Zone 22	M 32x1.5	2	M 16x1.5	1
100 ... 132	1MJ6	Increased safety "e" Zone 21	M 32x1.5 M 16x1.5	2 1		
100 ... 132	1MJ6	Flameproof enclosure "d" Zone 21	M 32x1.5	1	M 20x1.5	1
160	1LA6 1MA6	Increased safety "e"	M 40x1.5	2	M 16x1.5	1
160M/L	1MJ6	Increased safety "e" Zone 21	M 40x1.5	2	M 16x1.5	2
160	1MJ6	Flameproof enclosure "d" Zone 21	M 40x1.5	1	M 20x1.5	1
180	1MA6 1MJ6	Increased safety "e" Zone 21	M 40x1.5	2	M 16x1.5	2
180	1MJ6	Flameproof enclosure "d" Zone 21	M 40x1.5	1	M 20x1.5	1
180	1LG4 1LG6	Non sparking "n" Zone 21 Zone 22	M 40x1.5	2	M 20x1.5	2
200	1MA6 1MJ6	Increased safety "e" Zone 21	M 50x1.5	2	M 16x1.5	2
200	1MJ6	Flameproof enclosure "d" Zone 21	M 50x1.5	1	M 20x1.5	1
200	1LG4 1LG6	Non sparking "n" Zone 21 Zone 22	M 50x1.5	2	M 20x1.5	2
225	1LG4 1LG6 1MA6 1MJ7	Increased safety "e" Non sparking "n" Zone 21 Zone 22	M 50x1.5	2	M 20x1.5	2
250 ... 315	1LG4 1LG6 1MA6 1MJ7	Increased safety "e" Non sparking "n" Zone 21 Zone 22	M63 x 1.5	2	M 20x1.5	2

Table 6- 4 Thread sizes in the aluminum terminal box

Frame size (BG)	Type	Type of protection/Zone	Standard thread		Additional threads with mounting parts	
			Size	Number	Size	Number
63 ... 90	1LA7 1LA9 1MA7	Increased safety "e"	M 16 x 1.5 M 25 x 1.5	1 1		
		Non sparking "n"				
		Zone 21				
		Zone 22				
71 ... 90	1MJ6	Increased safety "e"	M 25x1.5	2	M 16x1.5	1
		Zone 21				
100 ... 132	1LA7 1LA9 1MA7	Increased safety "e"	M 32x1.5	4		
		Non sparking "n"				
		Zone 21				
		Zone 22				
100 ... 132	1MJ6	Increased safety "e"	M 32x1.5	2	M 16x1.5	1
		Zone 21				
160	1LA7 1LA9 1MA7	Increased safety "e"	M 40x1.5	4		
		Zone 21				
		Zone 22				
160M	1MJ6	Increased safety "e"	M 40x1.5	2	M 16x1.5	1
		Zone 21				
180	1LA5	Zone 21	M 40x1.5	2	M 16x1.5	1
		Zone 22				
180	1LG4 1LG6	Non sparking "n"	M 40x1.5	2	M 20x1.5	2
		Zone 21				
		Zone 22				
180	1MA6 1MJ6	Increased safety "e"	M 40x1.5	2	M 16x1.5	2
		Zone 21				
200 ... 225	1LA5	Zone 21	M 50x1.5	2	M 16x1.5	1
		Zone 22				
200	1MA6 1MJ6	Increased safety "e"	M 50x1.5	2	M 16x1.5	2
		Zone 21				
200	1LG4 1LG6	Non sparking "n"	M 50x1.5	2	M 20x1.5	2
		Zone 21				
		Zone 22				
225	1LG4 1LG6 1MA6	Increased safety "e"	M 50x1.5	2	M 20x1.5	2
		Non sparking "n"				
		Zone 21				
		Zone 22				

6.2 Tightening torques

6.2.1 Electrical connections - Termincal board connections

Table 6- 5 Tightening torques for electrical connections on the terminal board

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

6.2.2 Cable glands

NOTICE
Take care not to damage the cable jacket. Tightening torques must be adapted to suit the type of cable jacket material in use.

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

Table 6- 6 Tightening torques for cable glands

	Metal ± 10% Nm	Plastic ± 10% Nm	Clamping range in mm		O ring Cord ∅ mm
			Standard -30 °C ... 100 °C Ex -30 °C ... 90 °C	Ex -60 °C ... 105 °C	
M 12 x 1,5	8	1,5	3,0 ... 7,0	-	2
M 16 x 1,5	10	2	4,5 ... 10,0	6,0 ... 10,0	
M 20 x 1,5	12	4	7,0 ... 13,0	6,0 ... 12,0	
M 25 x 1,5			9,0 ... 17,0	10,0 ... 16,0	
M 32 x 1,5	18	6	11,0 ... 21,0	13,0 ... 20,0	
M 40 x 1,5			19,0 ... 28,0	20,0 ... 26,0	
M 50 x 1,5	20		26,0 ... 35,0	25,0 ... 31,0	
M 63 x 1,5			34,0 ... 45,0	-	

The cable glands must have an EC-type examination certificate and be certified for the respective hazardous zone.

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

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

Note

The specified tightening torques are applicable unless other values are indicated.

Table 6- 7 Tightening torques for screws on the terminal box, end shields, screw-type grounding conductor connections

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

Table 6- 8 Tightening torques for self-tapping screws on the terminal box, end shields, screw-type grounding conductor connections, sheet metal fan covers

	Thread ∅		M 4	M 5	M 6
	Nm	min	4	7,5	12,5
		Max.	5	9,5	15,5

6.3 Conductor connection

6.3.1 General information on conductor connection

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

Frame sizes 80 to 90

⚠ WARNING

Short-circuit hazard

Electric machines contain hazardous voltages.

If the appropriate precautions are not taken, death or serious physical injury can occur.

- Do not lay connection cables over the central dome of the terminal board.
- Observe the opening direction and the mounting position of the cover washers on the terminal board.

Table 6- 9 Max. conductor connection for standard machines and Zone 22

Frame size (BG)	Max. connectable conductor cross-section mm^2
56 ... 90	1,5 2.5 with cable lug
100 ... 112	4,0
132	6,0
160 ... 180	16,0
200	25,0
225	35.0 with cable lug
250 ... 280	120,0
315	240,0

Table 6- 10 Max. conductor connection for explosion-proof machines (with the exception of Zone 22 and 1MJ) and VIK standard version

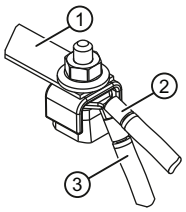
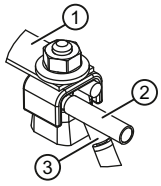
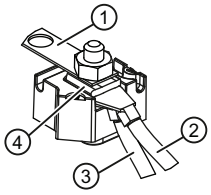
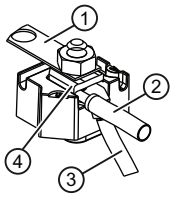
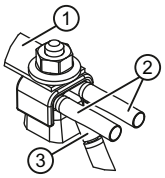
Frame size (BG)	Max. connectable conductor cross-section mm^2
56 ... 112	4,0
132	6,0
160	16,0
180	10,0
180 (1LG4, 1LG6)	16,0
200 ... 225	50,0
250 ... 280	120,0
315	240,0

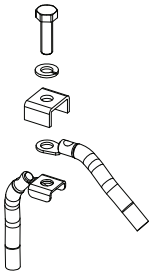
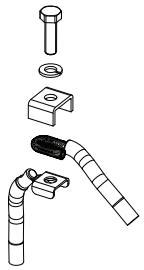
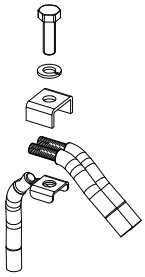
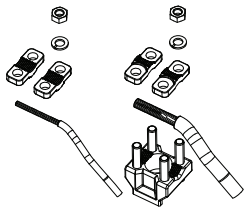
Table 6- 11 Max. conductor connection for standard 1MJ machines

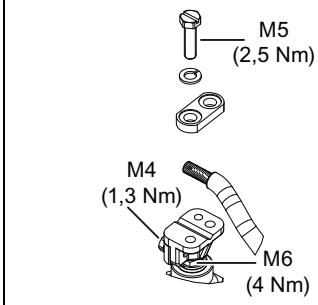
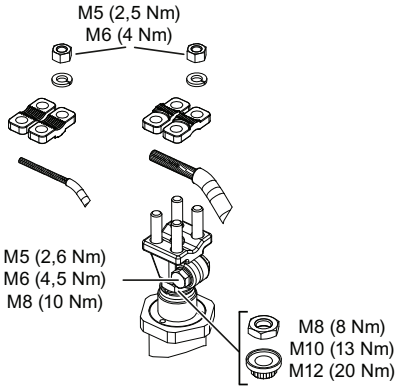
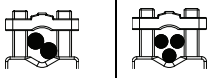
Frame size (BG)	Max. connectable conductor cross-section mm^2
71 ... 80	4,0
90 ... 160 M	6,0
160 L	16,0
180	25,0
200 ... 225	50,0
250 ... 280	120,0
315	240,0

6.3.2 Type of conductor connection

Table 6- 12 Type of connection

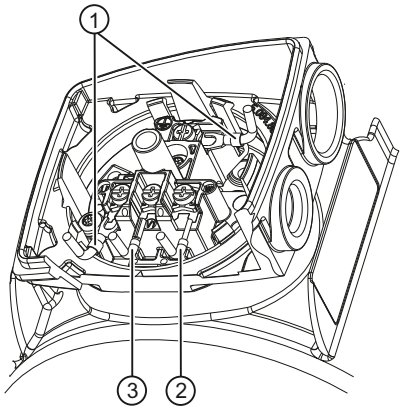
<table>
<tr><td colspan="4">If a connection is made with a DIN cable lug, then this must be angled downwards. DIN 46 234</td></tr>
<tr><td colspan="3"> 
</td><td>... 25 mm 2</td></tr>
<tr><td colspan="4">Connection of an individual conductor with terminal clamp.</td></tr>
<tr><td> 
</td><td> 
</td><td> 
</td><td>... 10 mm 2</td></tr>
<tr><td colspan="4">Connection of two conductors of approximately the same thickness with terminal clamp.</td></tr>
<tr><td colspan="3"> 
</td><td>... 25 mm 2</td></tr>
<tr><td colspan="4">① Link rail
② Power supply cord
③ Motor connection cable
④ Cover washer</td></tr>
</table>

<table>
<tr><td colspan="4">If a connection is made with a DIN cable lug, the latter must be angled downwards.</td></tr>
<tr><td rowspan="2">  </td><td colspan="2">… 10 mm 2</td><td>1MA618.</td></tr>
<tr><td colspan="2">… 35 mm 2</td><td>1MA620.</td></tr>
<tr><td colspan="4">Connection of an individual conductor with terminal clamp</td></tr>
<tr><td>  </td><td colspan="2">… 25 mm 2</td><td>1MA618. ... 20.</td></tr>
<tr><td colspan="4">Connection of two conductors of the same thickness with terminal clamp</td></tr>
<tr><td>  </td><td colspan="2">… 25 mm 2</td><td>1MA618. ... 20.</td></tr>
<tr><td colspan="4">Connecting terminal for cross-sections ≥ 16 mm2</td></tr>
<tr><td rowspan="12">  </td><td rowspan="4">  </td><td>2,5 … 25 mm 2</td><td>1MA618. ... 22.</td></tr>
<tr><td>10 … 95 mm 2</td><td>1MA625. ... 28.</td></tr>
<tr><td>25 … 135 mm 2</td><td>1MA631.</td></tr>
<tr><td>50 … 300 mm 2</td><td>1MA631. + L00</td></tr>
<tr><td rowspan="4">  </td><td rowspan="4">  </td><td>… 16 mm 2</td><td>1MA618. ... 22.</td></tr>
<tr><td>… 35 mm 2</td><td>1MA625. ... 28.</td></tr>
<tr><td>… 70 mm 2</td><td>1MA631.</td></tr>
<tr><td>… 120 mm 2</td><td>1MA631. + L00</td></tr>
<tr><td rowspan="4">  </td><td>16 … 50 mm 2</td><td>1MA618. ... 22.</td></tr>
<tr><td>50 … 120 mm 2</td><td>1MA625. ... 28.</td></tr>
<tr><td>95 … 240 mm 2</td><td>1MA631.</td></tr>
<tr><td>120 … 400 mm 2</td><td>1MA631. + L00</td></tr>
</table>

<table>
<tr><td colspan="4">Connecting terminal</td></tr>
<tr><td> 
</td><td>  </td><td>2,5 ... 25 mm 2</td><td>1MJ618.</td></tr>
<tr><td colspan="4">Connecting terminal 1MJ62.. / 1MJ722. ... 31.</td></tr>
<tr><td rowspan="9"> 
</td><td rowspan="3">  </td><td>2,5 ... 25 mm 2</td><td>1MJ62. / 1MJ722.</td></tr>
<tr><td>10 ... 95 mm 2</td><td>1MJ725. ... 28.</td></tr>
<tr><td>25 ... 135 mm 2</td><td>1MJ731.</td></tr>
<tr><td rowspan="3">  </td><td>16 mm 2</td><td>1MJ62. / 1MJ722.</td></tr>
<tr><td>35 mm 2</td><td>1MJ725. ... 28.</td></tr>
<tr><td>70 mm 2</td><td>1MJ731.</td></tr>
<tr><td rowspan="3">  </td><td>16 ... 50 mm 2</td><td>1MJ62. / 1MJ722.</td></tr>
<tr><td>50 ... 120 mm 2</td><td>1MJ725. ... 28.</td></tr>
<tr><td>95 ... 240 mm 2</td><td>1MJ731.</td></tr>
</table>

Recommended connection variants

Frame sizes 80 to 90



① Cable lugs DIN 46237 with insulating sleeve (round and open)

② Rigid cable (insulation removed at ends ≤ 8 mm)

③ End sleeves DIN 46228 ≤ 8 mm

If air gaps ≥ 5.5 mm (up to 690 V) are observed between non-insulated components, you can also use alternative connection elements without insulating sleeve, for example cable lugs acc. to DIN 46234 .

6.4 Connecting the ground conductor

6.4.1 General information on connecting the grounding conductor

Note

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

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

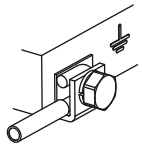
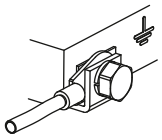
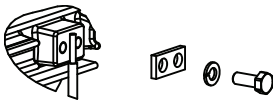
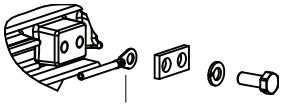
Frame sizes 80 to 90

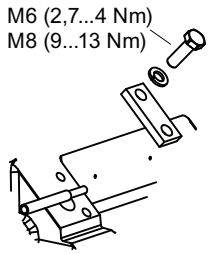
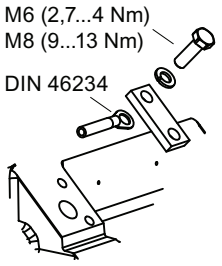
Basically, there are two ways of connecting a grounding conductor to the machine.

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

6.4.2 Grounding connection type

Table 6- 13 Type of connection

Connection of an individual conductor under the external grounding bracket.		
	**... 10 mm** ^{2}	
Where a connection is made using a DIN cable lug under the external grounding bracket. DIN 46 234		
	**... 25 mm** ^{2}	
External grounding		
	**... 25 mm** ^{2}	1MJ6071 ... 132
 DIN 46234	**... 35 mm** ^{2}	1MJ6160 L

	**... 35 mm** 2	1MJ618.
	**... 50 mm** 2	1MJ620.

6.4.3 Minimum surface area of grounding conductor

Table 6- 14 Minimum cross-sectional area of grounding conductor

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

Internal ground terminal

Please note when connecting, that

- the connecting surface is bare and is protected against corrosion using a suitable substance, e.g. acid-free Vaseline
- The cable lug must be inserted between the terminal clamps.
- The spring washer must be under the head of the screw.

External ground terminal

Please note when connecting, that

- the connecting surface is bare and is protected against corrosion using a suitable substance, e.g. acid-free Vaseline
- The cable lug must be inserted between the contact bracket and the grounding bracket; it is not permissible to remove the contact bracket pressed into the enclosure.
- The spring washer must be under the head of the screw.
- The tightening torque of the terminal screw must be as specified in the table.

6.4.4 Size of grounding conductor screw

Table 6- 15 Size of grounding conductor screw (except for 1MJ machines)

Frame size (BG)	Thread size for the grounding conductor
63 ... 90	M3.5 / M4
100 ... 112	M5
132 ... 180	M6
200 ... 225	M8
200 1LG4/6, 1LE1	2x M6
200 ... 315 1LG, 1LE, 1MA	2x M8

Table 6- 16 Size of grounding conductor screw for 1MJ machines

Frame size (BG)	Thread size for the grounding conductor
71 ... 180	2x M6
200 ... 315	2x M8

6.5 Final measures

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

- Establish the electrical connections in the terminal box in accordance with the details in the sections above and tighten with the correct torque.
- The clearances between non-insulated parts have been maintained: ≥ 5.5 mm to 690 V, ≥ 8 mm to 1000 V.
- Avoid protruding wire ends!
- In order not to damage the cable insulation, freely arrange the connecting cables.
- Connect the machine corresponding to the specified direction of rotation.
- Keep the inside of the terminal box clean and free from trimmed-off ends of wire.
- Ensure that all seals and sealing surfaces are undamaged and clean.
- Correctly and professionally close unused openings in the terminal boxes.
- The pressure relief device is undamaged (depending on the type of terminal box, this involves either cast-in slots or an overpressure diaphragm). Only repair damage after prior consultation with the person responsible for the safety of the equipment and use only original parts.

Before closing the terminal box, check that

- the air clearances for explosion-protected machines (with the exception of machines for Zone 22) between non-insulated parts are maintained: ≥ 10 mm to 690 V.
- the minimum creepage distance for explosion-protected machines (with the exception of machines for Zone 22) between non-insulated parts is maintained: ≥ 12 mm to 690 V.

6.6 Connection of optional add-on units

6.6.1 External fan, incremental encoder, brake

See the list of additional operating instructions: Further documents (Page 104)

Select mounted components such as external fans, incremental encoders or brakes according to the requirements of the directive 94/9/EG .

6.6.1.1 Mounting a brake

Table 6- 17 Assigning standard brakes for 1LE1 machines

Frame size (BG)	Brake type	Size assignment of the company INTORQ for PINTSCH BUBENZER	Tightening torque of manual lifting lever Nm
100	2LM8 040–5NA10	12	4,8
112	2LM8 060–6NA10	14	12
132	2LM8 100–7NA10	16	12
160	2LM8 260–8NA10	20	23
180	2LM8 315–0NA10	20	23
200	2LM8 400–0NA10	25	23
225	2LM8 400–0NA10	25	23
250	KFB 63	63	40
280	KFB 100	100	40
315	KFB 160	160	40

6.6.1.2 Mounted external fan

Tightening torque applied to the fastening screws used for attaching external fans to the housing, see Terminal boxes, end shields, grounding conductors, sheet metal fan covers (Page 51)

6.7 Connection to the converter

⚠ CAUTION

The standard insulating system is suitable for converter voltages up to 460 V. For higher voltages, a special insulating system must be used or special measures must be taken, e.g. an output filter.

CAUTION

Machines must always be connected to frequency converters using shielded machine supply cables. The most effective method of shielding is to conductively connect the cable to the metal terminal box of the machine (with a metal screw connections) over a large surface area.

Note

EMC

Please observe the section containing instructions on ensuring electromagnetic compatibility.

See the list of additional operating instructions: Further documents (Page 104)

⚠ WARNING

Operating explosion-protected machines on a converter

Always with PTC thermistor monitoring. For this purpose, tripping units according to directive 94/9/EC are necessary.

Machines with increased safety "e" type of protection

Converter operation for these machines must be expressly certified. It is essential that you observe the separate manufacturer's information and instructions. Converter and protective devices must be marked as belonging together and the permitted operating data must be defined in the common EC-type examination certificate.

Machines operated from a converter for Zone 21 and Zone 22

These machines are generally equipped with 3 PTC thermistors in accordance withDIN 44082 with a rated response temperature that depends on the max. possible surface temperature. Select the PTC thermistors in accordance with this standard. The maximum temperature at the cable entries is 120 °C. Use suitable cables for this temperature. Do not exceed the maximum frequency dependent on the number of poles, which is stamped on the rating plate.

System, converter-cable-electrical machine

For line supplies with operating voltages up to 690 V, the maximum value of the voltage peaks at the end of the cable must not exceed twice the value of DC link voltage of the converter (approx. 2 KV). Also observe the information provided in EN 60034-17 and EN 60034-25.

Machines with type of protection flameproof enclosure "d" or "de"

Temperature sensors for tripping

These machines are equipped with three temperature sensors in the winding and one temperature sensor in the gland plate in order that the temperature class is maintained. Connect the temperature sensors in series according to circuit diagram.

Temperature sensors for alarm and trip

These machines have three temperature sensors in the winding and one temperature sensor in the gland plate. Connect the temperature sensors in series according to circuit diagram.

Mechanical limit speeds for converter operation

Table 6- 18 Explosion-protected motors in Zone 1 with type of protection "de" (motor series 1MJ)

Motor-frame size	Motor type	2-pole [1]		4-pole		6-pole		8-pole	
		n_{max} rpm	f_{max} Hz	n_{max} rpm	f_{max} Hz	n_{max} rpm	f_{max} Hz	n_{max} rpm	f_{max} Hz
1MJ6									
71 M	**1MJ6 07.**	6000	100	3000	100	2000	100	1500	100
80 M	**1MJ6 08 .**	6000	100	3000	100	2000	100	1500	100
90 L	**1MJ6 09 .**	6000	100	3000	100	2000	100	1500	100
100 L	**1MJ6 10 .**	5400	90	3000	100	2000	100	1500	100
112 M	**1MJ6 11 .**	5400	90	3000	100	2000	100	1500	100
132 S/M	**1MJ6 13 .**	4800	80	3000	100	2000	100	1500	100
160 M/L	**1MJ6 16 .**	4500	75	3000	100	2000	100	1500	100
180 M/L	**1MJ6 18 .**	5100	85	3000	100	2000	100	1500	100
200 L	**1MJ6 20 .**	5100	85	3000	100	2000	100	1500	100
1MJ7									
225 S/M	**1MJ7 22 .**	4500	75	3000	100	2000	100	1500	100
250 M	**1MJ7 25 .**	3900	65	3700	100	2000	100	1500	100
280 S	**1MJ7 28 .**	3600	60	3000	100	2000	100	1500	100
315 S/M	**1MJ7 31 .**	3600 [2]	60 [2]	2600	87	2000	100	1500	100

Table 6- 19 Explosion-proof motors in Zones 2, 21 and 22 with type of protection "n" or protection against dust explosions (motor series 1LA, 1LG)

Motor-frame size	Motor type		2-pole [1] n_{max} rpm	f_{max} Hz	4-pole n_{max} rpm	f_{max} Hz	6-pole n_{max} rpm	f_{max} Hz	8-pole n_{max} rpm	f_{max} Hz
1LA5, 1LA6, 1LA7, 1LA9										
56 M	**1LA7/1LA9**	05.	6000	100	3000	100	2000	100	1500	100
63 M	**1LA7/1LA9**	06.	6000	100	3000	100	2000	100	1500	100
71 M	**1LA7/1LA9**	07.	6000	100	3000	100	2000	100	1500	100
80 M	**1LA7/1LA9**	08.	6000	100	3000	100	2000	100	1500	100
90 L	**1LA7/1LA9**	09.	6000	100	3000	100	2000	100	1500	100
100 L	**1LA6/1LA7/1LA9**	10.	5400	90	3000	100	2000	100	1500	100
112 M	**1LA6/1LA7/1LA9**	11.	5400	90	3000	100	2000	100	1500	100
132 S/M	**1LA6/1LA7/1LA9**	13.	4800	80	3000	100	2000	100	1500	100
160 M/L	**1LA6/1LA7/1LA9**	16.	4500	75	3000	100	2000	100	1500	100
180 M/L	**1LA5/1LA9**	18.	5100 [3) 4)]	85 [3) 4)]	3000	100	2000	100	1500	100
200 L	**1LA5/1LA9**	20.	5100 [3) 4)]	85 [3) 4)]	3000	100	2000	100	1500	100
225 S/M	**1LA5**	22.	5100 [4)]	85 [4)]	3000	100	2000	100	1500	100
1LG4, 1LG6										
180 M/L	**1LG4/1LG6**	18.	4500	75	3000	100	2000	100	1500	100
200 L	**1LG4/1LG6**	20.	4500	75	3000	100	2000	100	1500	100
225 S/M	**1LG4/1LG6**	22.	4500	75	3000	100	2000	100	1500	100
250 M	**1LG4/1LG6**	25.	3900	65	3000	100	2000	100	1500	100
280 S/M	**1LG4/1LG6**	28.	3600	60	3000	100	2000	100	1500	100
315 S/M/L	**1LG4/1LG6**	31.	3600 [1)]	60 [1)]	2600	87	2000	87	1500	100

1) For continuous operation in the range $f_{max}(n_{max})$, an inquiry is required.

2) For vertical mounting n_{max}= 3000 rpm, f_{max}= 50 Hz.

3) For 1LA9 motors, frame sizes 180 M/L and 200 L, n_{max}= 4500 $min^{-1}$and f_{max}= 75 Hz.

4) For explosion-protected motors with option D19

Frame size	N_{max} rpm	f_{max} Hz
180 M/L	3300	55
200 L	3100	51
225 S/M	3000	50

Commissioning 7

7.1 Insulation resistance

7.1.1 Checking the insulation resistance

⚠ WARNING

Working on electrical power installations

Only appropriately trained personnel may carry out this work.

Before starting commissioning, install all covers that are designed to prevent active or rotating parts from being touched, or which are necessary to ensure correct air guidance and thus effective cooling.

⚠ WARNING

Hazardous voltage at the terminals

Dangerous voltages are sometimes present on the terminals during and immediately after measurement of the winding insulation resistance. 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 connected. Once you have measured the insulation resistance, discharge the winding by connecting to the ground potential.

Checking the insulation resistance

CAUTION

The insulation resistance needs to be checked prior to start-up and again after any extended periods of storage or periods during which the equipment is not in operation. Before you begin measuring the insulation resistance, please read the operating manual for the insulation resistance meter you are going to use. Disconnect any main-circuit cables that are connected to the terminals before measuring the insulation resistance.

NOTICE

If the critical insulation resistance is less than or equal to this value, the windings must be dried or, if the fan is removed, cleaned thoroughly and dried.

Please note that the insulation resistance of dried, clean windings is lower than that of warm windings. The insulation resistance can only be properly assessed after conversion to the reference temperature of 25 °C.

NOTICE

If the measured value is close to the critical value, you must check the insulation resistance at suitably frequent intervals.

Measuring 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. Disconnect any main circuit cables from the terminals before measuring the insulation resistance.
3. Where possible, measure the insulation resistance of the winding with respect to the motor enclosure when the winding temperature is between 20 ... 30 °C. Different insulation resistance values apply for other temperatures.
4. When measuring, wait until the final resistance value is reached. This is reached after approximately one minute. Then read off the insulation resistance.

Limit values of the stator winding insulation resistance

The following table indicates the measuring circuit voltage and the limit values for the minimum insulation resistance and the critical insulation resistance of the stator winding.

Table 7- 1 Insulation resistance of the stator unwinding at 25 °C

	Rated voltage U_{rated}< 2 kV
Measuring circuit voltage	500 V
Minimum insulation resistance for new, cleaned or repaired windings	10 MΩ
Critical specific insulation resistance after a long operating time	0,5 MΩ / kV

Note the following:

- If the measurements are performed at winding temperatures ≠ 25 °C, convert the measured value to the reference temperature of 25 °C in order to be able to compare the values with the table above.
  - The insulation resistance halves every time the temperature rises by 10 K.
  - The resistance doubles every time the temperature falls by 10 K.
- Dry, new windings have a typical insulation resistance of more than 100 ... 2000 MΩ depending on the winding size, design and rated voltage. An insulation resistance value close to the minimum value could be due to moisture and/or dirt accumulation.
- During operation, the insulation resistance of the windings can fall to the critical insulation resistance due to ambient and operational influences. The critical insulation resistance value for a winding temperature of 25 °C can be calculated by multiplying the rated voltage (kV) by the specific critical resistance value (0,5 MΩ / kV).

  Example:
  Critical resistance for rated voltage U_N = 690 V:
  690 V x 0,5 MΩ / kV = 0,345 MΩ

NOTICE
Critical insulation resistance reached or fallen below If the critical insulation resistance is reached or fallen below, this can result in damage to the insulation or voltage flashovers. • Contact your Siemens Service Center. • If the measured value is close to the critical value, you must check the insulation resistance at suitably frequent intervals.

See also

SIEMENS Service Center (Page 103)

7.2 Measures before start-up

Measures before commissioning

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

- The machine has been assembled and aligned correctly.
- The machine has been connected so that it rotates in the direction specified.
- The operating conditions match the data specified on the rating plate.
- The bearings have been lubricated as appropriate for the version used. Rolling-contact bearing machines which have been in storage for more than 24 months have been relubricated.
- Any supplementary machine monitoring equipment has been connected correctly and is functioning as it should.
- For versions with bearing thermometers, the bearing temperatures must be checked during the machine's first period of operation. The warning and shutdown values are set on the monitoring device.
- Appropriately configured control and speed monitoring functions ensure that the machine cannot exceed the permissible speeds specified on the rating plate.
- The output elements have the correct settings for their type (e.g. alignment and balancing of couplings, belt forces in the case of a belt drive, tooth forces and tooth face clearance in the case of toothed-wheel power output, radial and axial clearance in the case of coupled shafts).
- The minimum insulation resistance and minimum clearance values have been adhered to.
- The grounding and equipotential bonding connections have been established correctly.
- All fixing screws, connection elements, and electrical connections have been tightened to the specified torques.
- Lifting eyes that were screwed in have been removed following installation or secured to prevent them becoming loose.
- The rotor can turn without coming into contact with the stator.
- All touch protection measures for both moving and live parts have been implemented.
- In cases where the shaft extension is not being used and is, therefore, exposed, it has been covered and the feather key has been secured to prevent it from being thrown out.
- If being used, the external fan is ready for operation and connected so that it rotates in the direction specified.
- The flow of cooling air is not obstructed.
- If a brake is being used, it is functioning correctly.
- The specified mechanical limit speed n_{max} is adhered to.

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

Note

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

7.3 Switching on

Measures for start-up

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

- Start the machine without a load; to do this, close the motor starter protector and do not switch the machine off prematurely. You should limit how often you switch the machine off while it is starting up and still running at a slow speed, for checking the direction of rotation or the required dimensions, for example. Allow the machine to run to a standstill before switching it back on again.
- Check the mechanical operation for noises or vibrations at the bearings and bearing end shields.
- If the motor does not run smoothly and/or there are any abnormal noises, switch it off and determine the cause as it slows down.
- If mechanical operation improves immediately after the machine is switched off, then the cause is magnetic or electrical. If mechanical operation does not improve immediately after switching the machine off, then the cause is mechanical, such as an imbalance in the electrical machines or in the driven machine, inadequate alignment of the machine set, operation of the machine with the system resonating (system = machine + base frame + foundation, etc.).
- If there are no problems with the machine's mechanical operation, switch on any cooling devices that are being used and continue to monitor the machine for a while during no-load operation.
- If it runs perfectly, connect a load. Check that it runs smoothly, and read off and document the values for voltage, current and power. As far as possible, read off and document the corresponding values for the driven machine as well.

⚠ WARNING
The vibration values encountered during operation comply with ISO 10816 (otherwise the machine could be damaged or destroyed).

- Monitor and document the temperatures of the bearings, windings, etc. until the system reaches a steady state, in as much as this is possible with the available measuring instruments.

Measures to take when commissioning explosion-proof machines

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

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

Operation 8

8.1 Safety instructions

8.1.1 Safety instructions during operation

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

⚠ CAUTION

Before switching on, always make sure that the (optional) anti-condensation heating is switched off.

Machine operation

⚠ WARNING

Line supply with non-grounded neutral point

Operating the machine on a line supply system with a non-grounded neutral point is only permitted over short time intervals that occur rarely, e.g. the time leading to a fault being eliminated (ground fault of a cable, EN 60034-1).

⚠ WARNING

Do not remove covers when the motor is running

Rotating or live parts are dangerous. Death, serious injury, or material damage can result if the required covers are removed.

- De-energize the machine and bring it into a no voltage condition before removing any covers.
- Ensure that any covers, which are designed to prevent active or rotating parts from being touched, which are necessary to ensure correct air guidance and thus effective cooling, or which guarantee the degree of protection of the machine, remain closed during operation.

⚠ CAUTION

The surfaces of the machines can reach high temperatures, which can lead to burns if touched.

CAUTION

Minimum load for cylindrical roller bearings

Be sure to comply with the minimum radial load of 30% of the cylindrical roller bearings in accordance with catalog data.

⚠ WARNING

Faults during operation

Deviations from conditions during normal operation, such as an increase in 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, severe injury or material damage.

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

CAUTION

Risk of corrosion due to condensation

When changing machines and/or ambient temperatures, air humidity can condense within the machines.

- If available, remove the screw plugs to drain the water depending on the ambient and operating conditions.
- Reinsert them afterwards.

If the machine is equipped with drainage plugs, the water can drain away automatically.

⚠ WARNING

Machines with textile fan covers

The machine fan is not completely protected against contact.
The customer must put suitable measures in place, e.g. housings or protective grating, to prevent manual intervention.

8.1.2 Safety instructions for cleaning

Cleaning

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

⚠ DANGER

Explosion hazard

⟨Ex⟩ This electrical equipment is not suitable for operation in a hybrid explosive environment. This may result in death, serious injury and material damage.

Usage in atmospheres where there is a risk of explosion caused by both gas and dust is prohibited.

⚠ DANGER

Explosion hazard

⟨Ex⟩ It is forbidden to clean the machine in an explosive atmosphere!
This can result in death, serious injury or material damage.

Surfaces can become statically charged and discharge to ignite potentially explosive atmospheres.

8.1.3 Safety information for explosion-protected machines in operation

Only install machines with type of protection flameproof enclosure "d", increased safety "e", and machines for Zone 2 in hazardous areas, according to the regulations laid down by the responsible supervisory authority. They are responsible for determining the hazard level of each area (division into zones). Layers of dust on machines for Zone 21 and Zone 22 must – under no circumstances – be higher than 5 mm.

- If there are no other specifications in the EC-type examination certificate or on the rating plate regarding operating mode and tolerance, electrical machines are designed for continuous duty and normal startup procedures that are performed infrequently and do not result in excessive temperature rise. Only use these machines for the operating mode specified on the rating plate.
- Measures for maintaining the temperature class:
  For S1 line supply operation, a function-tested, current-dependent protective device that monitors all three phase conductors provides sufficient protection for the machine. This protective device is set to the rated current and must switch off machines with 1.2x the rated current within 2 hours or less. Do not switch off the machines within 2 hours for 1.05 times the rated current. Pole-changing machines require a separate switch for each number of poles. If an anti-condensation heating system is available, it may only be switched on when the machines are not in operation.
  For S2 to S9 line supply operation, equip machines with type of protection flameproof enclosure "d" with at least 3 temperature sensors (one per phase) and a suitable electronic tripping device with a temperature sensor in the gland plate.

8.1.4 Machines with textile fan covers

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

These machines have a warning sticker on the fan cover.

8.2 Stoppages

Overview

If the machine remains out of service for an extended period of time (> 1 month), it should be commissioned regularly (around once a month) or, at the very least, the rotor should be turned. Please refer to the instructions in the section titled "Switching on" before recommissioning the machine. If a rotor locking device has been fitted to the machine, you must remove it before the rotor starts to turn.

CAUTION
If the machine is to be out of service for a period in excess of 12 months, you must take suitable anti-corrosion, mothballing, packaging, and drying measures.

Switching on the anti-condensation heater

If an anti-condensation heater is provided, switch it on during the machine stoppages.

Taking the machine out of service

For details of measures that need to be implemented, please refer to Section Preparing for use (Page 25).

Lubricating before recommissioning

CAUTION
The machine must be relubricated during commissioning if it has been out of service for more than 1 year, in order to ensure that the grease is distributed throughout the bearings. The shaft must rotate for the grease to be distributed. Please observe the information on the lubricant plate if carrying out relubrication using relubrication equipment. See also the section titled "Application planning - Bearing lifetime".

8.3 Fault tables

Overview

NOTICE
Before rectifying any faults, please read the information in the section titled Safety information (Page 9).

Note

In the event that electrical faults occur while the machine is being operated with a converter, please also refer to the operating instructions for the frequency converter.

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

Table 8- 1 Fault table, electrical causes

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

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

Table 8- 2 Fault table, mechanical causes

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

(1) As well as eliminating the cause of the fault (as described under "Remedial measures"), you must also rectify any damage the machine may have suffered.
2) Note any changes that take place while the temperature is rising.

8.4 Deactivating

Note

Switch off the machine and disconnect it from the power supply!

Measures for shutting down the machine

Commission any devices provided for protection against condensation after switching off the machine, e.g. anti-condensation heating.

8.5 Class

8.5.1 Zone 1 with type of protection Ex de II (Flameproof Enclosure "d" for the machine and Increased Safety "e" for the terminal box)

CE	158	Ex	II	2	G	Ex	d	e	IIC	T4
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪

① CE marking
② Identification number of designated testing agency
③ Code for prevention of explosions
④ Device group: II For hazardous areas, except mines
⑤ Device category: 2 For occasional danger, and for use in Zone 1
⑥ Atmosphere: G For gas
⑦ Explosion protection: International
⑧ Type of protection: "d" Flameproof Enclosure of machine
⑨ Type of protection: "e" Increased Safety of terminal box
⑩ Explosion group: IIC For acetylene
⑪ Temperature class: T4 For maximum surface temperature of 135°C

8.5.2 Zone 1 with Ex e II type of protection (Increased Safety "e")

CE	158	Ex	II	2	G	Ex	e	II	T3
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

① CE marking
② Identification number of designated testing agency
③ Code for prevention of explosions
④ Device group: II For hazardous areas, except mines
⑤ Device category: 2 for occasional danger
⑥ Atmosphere: G For gas
⑦ Explosion protection: International
⑧ Type of protection: "e" Increased Safety
⑨ Device group: II For hazardous areas, except mines
⑩ Temperature class: T3 For maximum surface temperature of 200°C

8.5.3 Zone 2 with type of protection Ex nA II (non-sparking)

CE	PTB 05 ATEX 3006		II	3	G	Ex	nA	II	T3
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩

① CE marking
② Declaration of conformity no. for designated testing agency
③ Code for prevention of explosions
④ Device group: II For hazardous areas, except mines
⑤ Device category: 3 For infrequent, short-term danger
⑥ Atmosphere: G For gas
⑦ Explosion protection: International
⑧ Type of protection: "nA" For non-sparking
⑨ Device group: II For hazardous areas, except mines
⑩ Temperature class: T3 For maximum surface temperature of 200°C

8.5.4 Zone 21

CE	158		II	2	D	Ex	tD	A	21	IP65	T125°C
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪	⑫

① CE marking
② Identification number of designated testing agency
③ Code for prevention of explosions
④ Device group: II For hazardous areas, except mines
⑤ Device category: 2 For occasional danger
⑥ Atmosphere: D For dust
⑦ Explosion protection: International
⑧ Type of protection: "tD" For protection by enclosure
⑨ Version: A For process A to EN 61241-1
⑩ Zone in which the equipment can be used: 21 For Zone 21
⑪ Degree of protection of enclosure: IP 65
⑫ Maximum surface temperature: T 125° C or T 135° C

8.5.5 Zone 22

CE		II	3	D	Ex	tD	A	22	IP55	T125°C
①	②	③	④	⑤	⑥	⑦	⑧	⑨	⑩	⑪

① CE marking
② Code for prevention of explosions
③ Device group: II For hazardous areas, except mines
④ Device category: 3 For infrequent, short-term danger
⑤ Atmosphere: D For dust
⑥ Explosion protection: International
⑦ Type of protection: "tD" For protection by enclosure
⑧ Version: A For process A to EN 61241-1
⑨ Zone in which the equipment can be used: 22 For Zone 22
⑩ Degree of protection of enclosure: IP 55
⑪ Maximum surface temperature: T 125° C or T 135° C

Maintenance 9

9.1 Preparation and notes

⚠ WARNING

Safety instructions

- Before starting work on the machines, make sure that the plant or system has been disconnected in a manner that is compliant with the appropriate specifications and regulations.
- In addition to the main currents, make sure that supplementary and auxiliary circuits, particularly in heating devices, are also disconnected.
- Certain parts of the machine may reach temperatures above 50 °C. Physical contact with the machine could result in burn injuries! Check the temperature of parts before touching them.
- When carrying out cleaning using compressed air, make sure that appropriate methods of extracting fumes are in place and that personal protective gear such as gloves, goggles, face masks, or similar are worn.
- If you are using chemical cleaning agents, observe the instructions and any warnings provided in the relevant safety data sheet. Chemical agents must be compatible with the machine's components, especially if these contain plastics.

Note

Operation characteristics can vary widely. For this reason, only general maintenance intervals can be specified here.

Preparation and notes for explosion-protected machines

- Only have the machines repaired in authorized Siemens workshops!
- For machines intended for use in hazardous areas, only have modifications, repairs and overhaul work carried out by appropriately qualified personnel.
  It is essential that you observe the regulations laid down in IEC 60079-19!
- When making changes or performing repair or overhauling work on machines intended for use with combustible dust, please observe the regulations laid down by EN 61241-17.

9.1.1 North American market

Machines for the North American market (optional)

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

Table 9- 1 Markings for the North American market

	Underwriters Laboratories
	Canadian Standard Association
	Canadian Standard Association Energy Efficiency Verification

9.1.2 Touch up any damaged paintwork

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

CAUTION

Paint system

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

9.1.3 Repainting

⚠ WARNING

Repainting explosion-proof motors

The paint coat can become electrostatically charged where there is a thick coat. A discharge may occur, e.g. by diversion of the charge to ground when a person approaches. There is a risk of explosion if potentially explosive mixtures are also present at this moment. This can result in personal injury or damage.

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

- Limit the total paint coating 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:
  - IIA, IIB, IIC, III: Surface resistance ≤ 1 GΩ for motors of groups II and III (gas and dust)
- Breakdown voltage ≤ 4 kV for explosion group III (dust only)

9.2 Inspection

9.2.1 General inspection specifications

Instructions relevant to safety

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

Note

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

9.2.2 Optional built-on accessories

See the list of additional operating instructions: Appendix (Page 103)

9.2.3 Initial inspection

Inspection interval

The first inspection after installation or repair of the three-phase machine is, under normal circumstances, conducted after approx. 500 operating hours, but at the latest after 1/2 year.

Procedure

While the motor is running, check that:

- The electrical parameters are maintained.
- The permissible bearing temperatures are not exceeded.
- The smooth running characteristics and noise of the three-phase machine have not deteriorated during operation.

With the machine at a standstill, check that:

- The motor foundations have no indentations or cracks.

NOTICE
Further tests are also necessary in line with the additional instructions assigned or in line with the particular system-specific conditions.

NOTICE
Immediately correct any impermissible deviations that are determined in the inspection.

9.2.4 Main inspection

Inspection interval

1x yearly

Procedure

While the motor is running, check that:

- The electrical parameters are maintained.
- The permissible bearing temperatures are not exceeded.
- The smooth running characteristics and noise of the three-phase machine have not deteriorated during operation.

With the machine at a standstill, check that:

- The machine foundation has no indentations or cracks.
- The three-phase machine is aligned within the permissible tolerance ranges.
- All of the fixing bolts/screws for the mechanical and electrical connections are tight.
- The winding insulation resistances are sufficiently high.
- Cables and insulating parts and components are in a good condition and are not discolored.

NOTICE
Immediately correct any impermissible deviations that are determined in the inspection.

9.3 Maintenance

9.3.1 Maintenance intervals

General

The machines have grease-lubricated, rolling-contact bearings. A regreasing device is optional.

Carry out careful and regular maintenance, inspections, and revisions to detect faults at an early stage and eliminate them before they can cause further damage.

Operating situations 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.).

NOTICE
In the event of faults or extraordinary conditions that lead to the three-phase machine being overloaded either electrically or mechanically (e.g. overload, short circuit, etc.), immediately carry out an inspection.

Measures, intervals

Measures after operating period intervals have elapsed:

Table 9- 2 Operating period intervals

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

9.3.2 Regreasing (optional)

General

As a standard feature, the machines have rolling-contact bearings which are permanently lubricated with grease (UNIREX N3, made by ESSO). A regreasing device is possible as an option. In this case, you can find information about relubrication intervals, quantities and types of grease, and, if required, additional data on the rating plate or lubricant plate.

Note

Do not mix different types of grease!

Prolonged storage periods reduce the useful life of the bearing grease. Check the condition of the grease if the equipment has been in storage for more than 12 months. If the grease is found to have lost oil content or to be contaminated, the machine must be immediately relubricated before commissioning. For information on permanently-greased bearings, please refer to the section titled Storage (Page 84).

Note

Regreasing

1. Clean the grease nipples at the drive end and non-drive end.
2. Press in the type and quantity of grease specified (see rating/lubricant plate data).

- Please observe the information on the rating and lubricant plates.
- Regreasing should be carried out when the machine is running (max. 3600 rpm)!

The bearing temperature rises sharply at first, then drops to the normal value again when the excess grease is displaced out of the bearing.

9.3.3 Cleaning

Cleaning the greasing channels and used grease chambers

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

NOTICE
You have to separate the active parts of the bearings to replace the grease that is in the greasing channel.

Cleaning the cooling air passages

Regularly clean the cooling air passages through which the ambient air flows, e.g. using dry compressed air.

NOTICE
Never direct compressed air in the direction of the shaft outlet or machine openings.

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

NOTICE
The frequency of the cleaning intervals depends on the local degree of contamination.

⚠ WARNING
Particularly when carrying out cleaning using compressed air, make sure you use suitable extraction equipment and wear personal protective gear (safety goggles, respiratory filter, etc.).

See also

Safety instructions for cleaning (Page 68)

9.3.4 Drain condensate

If there are condensate drain holes present, these must be opened at regular intervals, depending on climatic conditions.

NOTICE
To maintain the degree of protection, any condensation drain holes need to be closed.

9.4 Corrective maintenance

9.4.1 Instructions for repair

Qualified personnel

Only appropriately qualified persons should be deployed to commission and operate equipment. Qualified persons, as far as the safety instructions specified in this manual are concerned, are those who have the necessary authorization to commission, ground and identify/tag equipment, systems and circuits in accordance with the relevant safety standards.

Instructions relevant to safety

⚠ WARNING
Before you begin working on the three-phase machine, in particular before you open the covers of active parts, make sure that the three-phase machine or system is properly isolated from the supply.

NOTICE
If it is necessary to transport the machine, carefully observe the information provided in Chapter Preparing for use !

See also

Preparing for use (Page 25)

9.4.2 Storage

Take the bearing used up to frame size 90 only for special versions, and generally for frame size 100 and higher from the rating plate.

Bearing lifetime

Prolonged storage periods reduce the useful life of the bearing grease. In the case of permanently lubricated bearings, this leads to a shorter bearing lifetime.
Bearing or grease replacement is recommended after a storage time of 12 months, for longer than 4 years, replace the bearings or grease.

Replacing bearings

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

Table 9- 3 Bearing replacement intervals

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

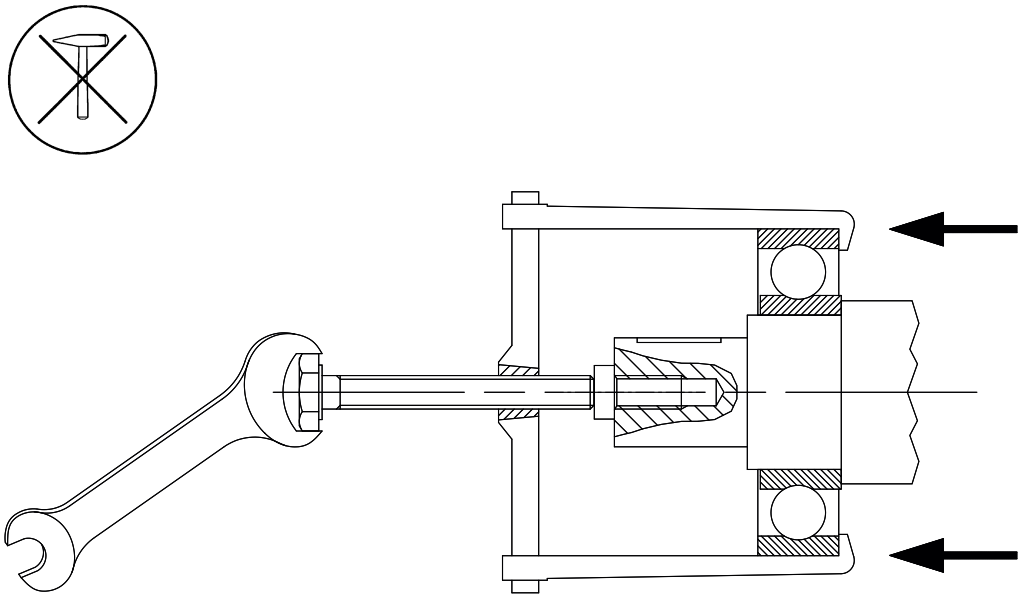
Note

Special operating conditions

Examples of factors that can reduce operating hours are vertical machine installation, high vibrational and impact loads, frequent reversing, higher coolant temperature, higher speeds, etc.

NOTICE
Do not reuse bearings that have been removed.

9.4.2.1 Changing bearings



Replacing bearings

9.4.2.2 Replacing bearings in explosion-proof machines

- When changing the bearings, renew the sealing rings and only use original Siemens spare parts.
- When installing the sealing rings, the space in the middle of the sealing ring and in the end shield hub should be completely filled with a suitable type of grease.

9.4.3 Dismantling

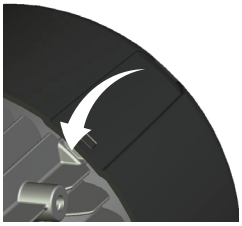
NOTICE
Before commencing disassembly, you should mark how each of the fastening elements has been assigned, as well as how internal connections are arranged, for re-assembly purposes.

Fan

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

Fan cover

- Carefully lever the snap openings on the cover out of the snap-in lugs one after the other; do not apply the lever directly under the web (risk of breakage).
- Do not damage the snap mechanisms. If any damage is caused, request new parts.



Canopy; incremental encoder under the canopy

Loosen the fixing screws on the external surface of the protective cover.

Under no circumstances should the spacing bolts be disassembled or forcibly separated from each other or the cover. Forcibly removing or separating the spacing bolts or fan cover can result in damage to them.

9.4.3.1 Bearing bushes

Note

Protect the bearings against the ingress of dirt and moisture!

9.4.3.2 Links

Links

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

9.4.4 Assembly

Notes on assembly

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

9.4.4.1 Assemly

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

9.4.4.2 Assemly

- Apply Fluid-D to the centering edge.
- Check the terminal box seals and if required, replace.
- Repair any damage to the paint (also on screws/bolts).
- Take the necessary measures to ensure compliance with the applicable degree of protection.
- Do not forget the foam cover in the cable entry (seal all holes completely and prevent cables from touching any sharp edges).

For flameproof machines, apply just a small amount of acid-free, non-resinous grease to the centering edges. Do not use any sealing agents.

See also

Terminal boxes, end shields, grounding conductors, sheet metal fan covers (Page 90)

9.4.4.3 Installing bearing bushes

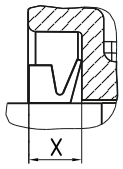
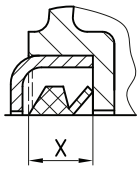
Carefully observe the specified screw tightening torques.

9.4.4.4 Reassembling bearings

Sealing the bearings

- V rings on shaft
- Use the prescribed bearings and check that sealing washers are in the correct position
- Do not forget the elements for keeping the bearings in position (correct side).
- Fixed bearings (retaining ring or bearing cover)

Table 9- 4 Mounting dimension "x" of V rings

Frame size (BG)	X mm	
100 ... 112	6 ±0,8	
132 ... 225	7 ±1	
180 ... 225 (1LG, 1MA622.)	11 ±1	
225 (1LG, 1LE; 2-pole)		
250 ... 315 (1LG, 1LE; 4 ... 8-pole)	13,5 ±1,2	
225 (1LG, 1LE; 2-pole)	11 ±1	
250 ... 315 (1LG, 1LE; 2-pole)	13,5 ±1,2	
250 ... 315 (1MJ7; 2 ... 8-pole)	13,5 ±1,2	

9.4.4.5 Reassembling fans

Fans

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

9.4.4.6 Refitting the fan cover

Fan cover

- When fitting the cover, do not overstretch it (risk of breakage).
- First engage two snap openings positioned next to one other, then carefully press the cover into position with the two openings situated opposite these using the snap-in lugs, and snap it into place.
- Latch all snap openings cleanly into the snap-in lugs.

9.4.4.7 Refitting the canopy; incremental encoder under canopy

Canopy; incremental encoder under the canopy

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

9.4.4.8 Reassembly: Miscellaneous information

Miscellaneous

- Number and position of rating plates and additional labels as in original condition
- If necessary, fix cables in place.
- Check the tightening torques of all screws, as well as those of screws which have not been unscrewed.

The number on the EC-type examination certificate for machines with flameproof enclosure "d" type of protection is represented by an X, since the flameproof joints deviate from IEC standard 60079-1, Table 2. Only perform repairs following consultation with the manufacturer and be sure to use original parts.

9.4.5 Screw-type connections

Screw lock washers

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

Always replace locking elements.

9.4.6 Electrical connections - Termincal board connections

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

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

9.4.7 Cable glands

NOTICE
Take care not to damage the cable jacket. Tightening torques must be adapted to suit the type of cable jacket material in use.

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

Table 9- 6 Tightening torques for cable glands

	Metal ± 10% Nm	Plastic ± 10% Nm	Clamping range in mm		O ring Cord ∅ mm
			Standard -30 °C ... 100 °C Ex -30 °C ... 90 °C	Ex -60 °C ... 105 °C	
M 12 x 1,5	8	1,5	3,0 ... 7,0	-	2
M 16 x 1,5	10	2	4,5 ... 10,0	6,0 ... 10,0	
M 20 x 1,5	12	4	7,0 ... 13,0	6,0 ... 12,0	
M 25 x 1,5			9,0 ... 17,0	10,0 ... 16,0	
M 32 x 1,5	18	6	11,0 ... 21,0	13,0 ... 20,0	
M 40 x 1,5			19,0 ... 28,0	20,0 ... 26,0	
M 50 x 1,5	20		26,0 ... 35,0	25,0 ... 31,0	
M 63 x 1,5			34,0 ... 45,0	-	

The cable glands must have an EC-type examination certificate and be certified for the respective hazardous zone.

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

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

Note

The specified tightening torques are applicable unless other values are indicated.

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

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

Table 9- 8 Tightening torques for self-tapping screws on the terminal box, end shields, screw-type grounding conductor connections, sheet metal fan covers

Thread ∅		M 4	M 5	M 6
Nm	min	4	7,5	12,5
	Max.	5	9,5	15,5

9.4.9 Optional add-on units

See the list of additional operating instructions: Appendix (Page 103)

Table 9- 9 Assigning standard brakes for 1LE1 machines

Frame size (BG)	Brake type	Size assignment of the company INTORQ for PINTSCH BUBENZER	Tightening torque of manual lifting lever Nm
100	2LM8 040–5NA10	12	4,8
112	2LM8 060–6NA10	14	12
132	2LM8 100–7NA10	16	12
160	2LM8 260–8NA10	20	23
180	2LM8 315–0NA10	20	23
200	2LM8 400–0NA10	25	23
225	2LM8 400–0NA10	25	23
250	KFB 63	63	40
280	KFB 100	100	40
315	KFB 160	160	40

Tightening torque applied to the fastening screws used for attaching external fans to the housing, see Terminal boxes, end shields, grounding conductors, sheet metal fan covers (Page 51)

Spare parts

10

10.1 Spare parts ordering

General

In addition to the exact part designation, please specify the machine type and the serial number in all orders for spare parts. The part designation should be identical to the designation stated in the list of spare parts and specified together with the appropriate part number.

Table 10- 1 Ordering example

End shield, drive end	1.40 End shield
Machine type *	1LA7163-4AA60
ID no. *	E0705/1234567 01 001

* corresponding to the rating plate

Table 10- 2 Ordering example

End shield, drive end	1.40 End shield
Machine type *	1LE1002-1DB43-4AA0
ID no. *	E0605/0496382 02 001

* corresponding to the rating plate

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

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

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

10.2 Spare parts

Part	Description	Part	Description
1.00	**DE bearings**		**Terminal box, complete**
1.31	Spring lock washer to SN 60727	5.30	Rubber stopper (1MA618.-20.)
1.40	End shield	5.31	Terminal clamp (1MA618.-20.)
1.43	Shaft sealing ring	5.32	Angle (1MA618.-20.)
1.44	Bearing cover	5.33	Washer (1MA618.-20.)
1.46	Cover ring	5.43	Cable gland
1.47	O ring	5.44	Terminal box top side
1.56	Spacer washer	5.48	Spring lock washer to SN 60727
1.58	Spring washer	5.52	Cable gland
1.60	Roller bearing	5.53	Sealing plug
1.61	Spring band for end shield hub (FS 90 only)	5.54	O ring
1.64	DE bearing cover, inner	5.70	Terminal clamp
		5.72	Contact bracket
3.00	**Rotor, complete**	5.76	Terminal Board
3.88	Featherkey for fan	5.78	Spring lock washer to SN 60727
		5.79	Bolt
4.00	**Stator, complete**	5.82	O ring
4.07	Housing foot	5.83	Seal
4.08	Housing foot, left	5.84	Terminal box cover
4.09	Housing foot, right	5.86	Protection mark
4.10	Spring lock washer to SN 60727	5.88	Spring lock washer to SN 60727
4.12	Nut	5.89	Bolt
4.14	Nut	5.90	The top side of the terminal box can be rotated 4 x 90 degrees, complete (for subsequent mounting)
4.18	Rating plate	5.92	Terminal box cover
4.19	Self-tapping screw	5.93	Seal
4.20	Cover	5.95	Terminal box top side
4.30	Contact bracket	5.96	Sealing plug
4.31	Grounding bracket	5.97	Nut
4.37	Terminal board	5.98	Metal-sheet nut
4.38	Spring lock washer to SN 60727	5.98	Seal
4.39	Grounding screw (self-tapping screw)	5.99	Adapter plate

Part	Description	Part	Description
5.00	**Terminal box, complete**	**6.00**	**NDE bearings**
5.02	spacer	6.10	Roller bearing
5.03	Seal	6.11	Spring band for end shield hub
5.04	Seal	6.20	End shield
5.08	Spacer sleeve	6.23	Shaft sealing ring
5.10	Complete terminal board	6.24	Bearing cover NDE, outer
5.11	Terminal strip (for 1MJ machines: Bushing)	6.26	Cover
5.12	Ex d terminal box (1MJ6) (star point connection)	6.64	Nut
5.13	Link rail	6.30	Bearing cover NDE, inner
5.14	Terminal box underside		
5.15	Plug (1MJ6)	**7.00**	**Complete ventilation (not applicable for 1LP6, 1LP7, 1LP9, 1PP6, 1PP7, 1PP9, 1MF6, 1MF7)**
5.16	Spring lock washer to SN 60727	7.04	Fan
5.18		7.40	Fan cover
5.20	Cable entry, complete	7.41	bracket
5.22	Connecting terminal	7.47	Sleeve
5.23	Cable entry, complete	7.48	Spring lock washer to SN 60727

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

Part	Description	Part	Description
1.00	**DE bearings**	**5.00**	**Terminal box, complete**
1.40	End shield	5.10	Complete terminal board
1.43	Shaft sealing ring	5.11	Terminal strip
1.49	Self-tapping screw (frame size 100/112)	5.19	Self-tapping screw
1.50	Flanged nut	5.44	Terminal box housing, including seal
1.58	Spring washer	5.49	Self-tapping screw
1.60	Roller bearing	5.70	Terminal clamp
1.61	Spring band for end shield hub (not for FS160)	5.79	Self-tapping screw
		5.84	Terminal box cover, including seal
4.00	**Stator, complete**	5.89	Self-tapping screw
4.07	Housing foot	5.96	Sealing plug
4.08	Housing foot, left	5.97	Nut
4.09	Housing foot, right	5.98	Metal-sheet nut
4.12	Flanged nut		
4.18	Rating plate	**6.00**	**NDE bearings**
4.19	Self-tapping screw	6.10	Roller bearing
4.20	Cover	6.11	Spring band for end shield hub (not for FS160)
4.30	Contact bracket	6.20	End shield
4.31	Grounding bracket	6.23	Shaft sealing ring
4.39	Grounding screw (self-tapping screw)	6.29	Self-tapping screw (frame size 100/112)
		7.00	**Complete ventilation**
		7.04	Fan
		7.40	Fan cover

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

Frame sizes 80 ... 90

Part	Description	Part	Description
5.00	**Terminal box**	**7.00**	**Complete ventilation**
5.25	Combination screws M3.5	7.40	Fan cover
5.26	Set: Jumper plug Y, jumper plug Δ		
5.84	Terminal box cover including seal, screw		
5.96	Sealing plug		

10.2.1 Spare parts frame size 100 ... 315 cast iron

Table 10- 3 Cast iron version frame size 100 ... 315

Part	Description	Part	Description
1.00	**DE bearings**	5.21	Screw (drilled)
1.40	End shield	5.44	Terminal box housing
1.43	Shaft sealing ring	5.49	Self-tapping screw
1.44	DE bearing cover	5.70	Terminal clamp
1.46	Cover ring	5.79	Self-tapping screw
1.49	Self-tapping screw	5.83	Seal
1.58	Spring washer	5.84	Terminal box cover
1.60	Roller bearing	5.89	Self-tapping screw
1.61	T plugs	5.96	Sealing plug
4.00	**Stator, complete**	**6.00**	**NDE bearings**
4.08	Housing foot, left	6.10	Roller bearing
4.09	Housing foot, right	6.11	Spring band for end shield hub (not for FS160)
4.18	Rating plate	6.20	End shield
4.19	Self-tapping screw	6.23	Shaft sealing ring
4.20	Cover	6.24	Bearing cover NDE
4.31	Grounding bracket	6.25	Lubrication sleeve
4.37	Terminal board	6.29	Self-tapping screw
4.35	Spacer ring	6.65	Grease nipple
4.39	Grounding screw (self-tapping screw)		
5.00	**Terminal box, complete**	**7.00**	**Complete ventilation**
5.03	Seal	7.04	Fan
5.10	Complete terminal board	7.40	Fan cover
5.19	Self-tapping screw		

10.2.2 Spare parts 1LG

Part	Description	Part	Description
1.00	**DE bearings**	**6.00**	**NDE bearings**
1.40	End shield	6.10	Roller bearing
1.43	Shaft sealing ring	6.20	End shield
1.58	Spacer washer	6.23	Shaft sealing ring
1.60	Roller bearing	6.24	Bearing cover NDE, outer
1.61	Sealing plug	6.25	Grease tube
1.65	DE bearing cover, inner	6.26	Outer bearing cover
1.67	Outer bearing cover	6.65	Grease nipple
1.68	Grease slinger (optional)	6.67	Rubber bush
1.69	Compression spring	6.72	Grease slinger
3.00	**Rotor, complete**	**7.00**	**Complete ventilation**
		7.04	Fan
4.00	**Stator, complete**	7.40	Fan cover
4.07	Housing foot	7.41	Bracket
4.18	Rating plate	7.49	Bolt
4.35	Disk		
4.41	Grounding lug		
5.00	**Terminal box, complete**		
5.03	Seal		
5.10	Complete terminal board		
5.12	Clamp for PE conductor		
5.19	High saddle terminal		
5.22	Clamp		
5.23	Lower saddle terminal		
5.44	Terminal box top side		
5.45	Housing		
5.47	Entry plate		
5.51	Nut		
5.52	Link		
5.70	Terminal clamp		
5.83	Seal		
5.84	Terminal box cover		
5.95	Terminal		
5.96	Mounting rail		
5.97	Strut, complete		
5.99	Contact plate		

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

10.3 Standardized parts

Table 10- 4 Standardized parts are to be obtained from free trade outlets in accordance with their necessary dimensions, materials and surface finish.

No	Standard	Picture	No	Standard	Picture
3.02 6.02 7.12	DIN 471		1.30 1.32 1.45 1.49 4.11 5.09 5.17 5.19 5.24 5.42 5.49 5.79 5.87 5.89 5.91 5.94 6.29 6.45 7.49	DIN 939	
	DIN 472			DIN 6912	
				DIN 7964	
4.04	DIN 580			EN ISO 4014	
	DIN 582			EN ISO 4017	
1.60 6.10	DIN 625			EN ISO 4762	
3.38	DIN 6885			EN ISO 7045	
1.33 6.30	EN ISO 4032			EN ISO 7049	
			4.05 7.48	EN ISO 7089 EN ISO 7090	

Note

1MJ spare parts

Use screws of property class ≥ 8.8 and in the case of nuts, ≥ 8.

Table 10- 5 Standardized parts are to be obtained from free trade outlets in accordance with their necessary dimensions, materials and surface finish.

No	Standard	Picture	No	Standard	Picture
6.02	DIN 472 (frame size 160)		1.49 (frame size 132/160)	EN ISO 4014	
				EN ISO 4017	
4.04	DIN 580		4.11 6.29 (frame size 132/160)	EN ISO 4762	
3.38	DIN 6885		4.05	EN ISO 7089 EN ISO 7090	

Disposal 11

11.1 Introduction

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.

11.2 Preparing for disassembly

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

1. Contact a certified waste disposal organization in your vicinity. Clarify what is expected in terms of the quality of dismantling the machine and provision of the components.
2. Follow the five safety rules (Page 9).
3. Disconnect all electrical connections.
4. Remove all liquids such as oil, cooling liquids, …
5. Remove all cables.
6. Deatch the machine fixings.
7. Transport the machine to a suitable location for disassembly.

Refer also to the information in the section headed "Maintenance" (Page 83).

11.3 Dismantling the machine

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

⚠ WARNING
Machine parts can fall The machine is made up of heavy parts. These parts are liable to fall during dismantling. This can result in death, serious injury, or material damage. Secure the machine parts being dismantled to prevent them falling.

11.4 Disposal of components

Components

The machines consist for the most part 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 for printers with
- 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

Dispose of the separated components according to local regulations or via a specialist disposal company. The same goes 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 thermically. Dirty foil must be disposed of via waste incineration.

Appendix A

A.1 SIEMENS Service Center

Details regarding the design of this electrical machine and the permissible operating conditions are described in these instructions.

Field service visits and spare parts

If you wish to request a field service call or order spare parts, please contact your local Siemens sales office. This office will contact the responsible service center on your behalf. You can find your local contact partner here.

Technical queries or additional information

If you have any technical queries or you require additional information, please contact the Siemens Service Center.

Please have the following machine data ready:

- Machine type
- Serial number

You can find this data on the rating plate of the machine.

Service numbers

Table A- 1 Siemens Service Center contact details

Time zone	Telephone	Fax	Internet
Europe / Africa	+49 911 895 7222	+49 911 895 7223	http://www.siemens.com/automation/support-request (http://www.siemens.de/automation/support-request)
Americas	+1 423 262 2522	+1 423 262 2200	mailto:techsupport.sea@siemens.com
Asia / Pacific	+86 1064 757 575	+86 1064 747 474	mailto:support.asia.automation@siemens.com

A.2 Language versions on the Internet

Language versions can be found on the Internet

Internet page: http://www.siemens.com/motors ()

If you require additional language versions, please contact the Siemens Service Center.

A.3 Further documents

These operating instructions can also be obtained at the following Internet site:

http://www.siemens.com/motors

General Documentation

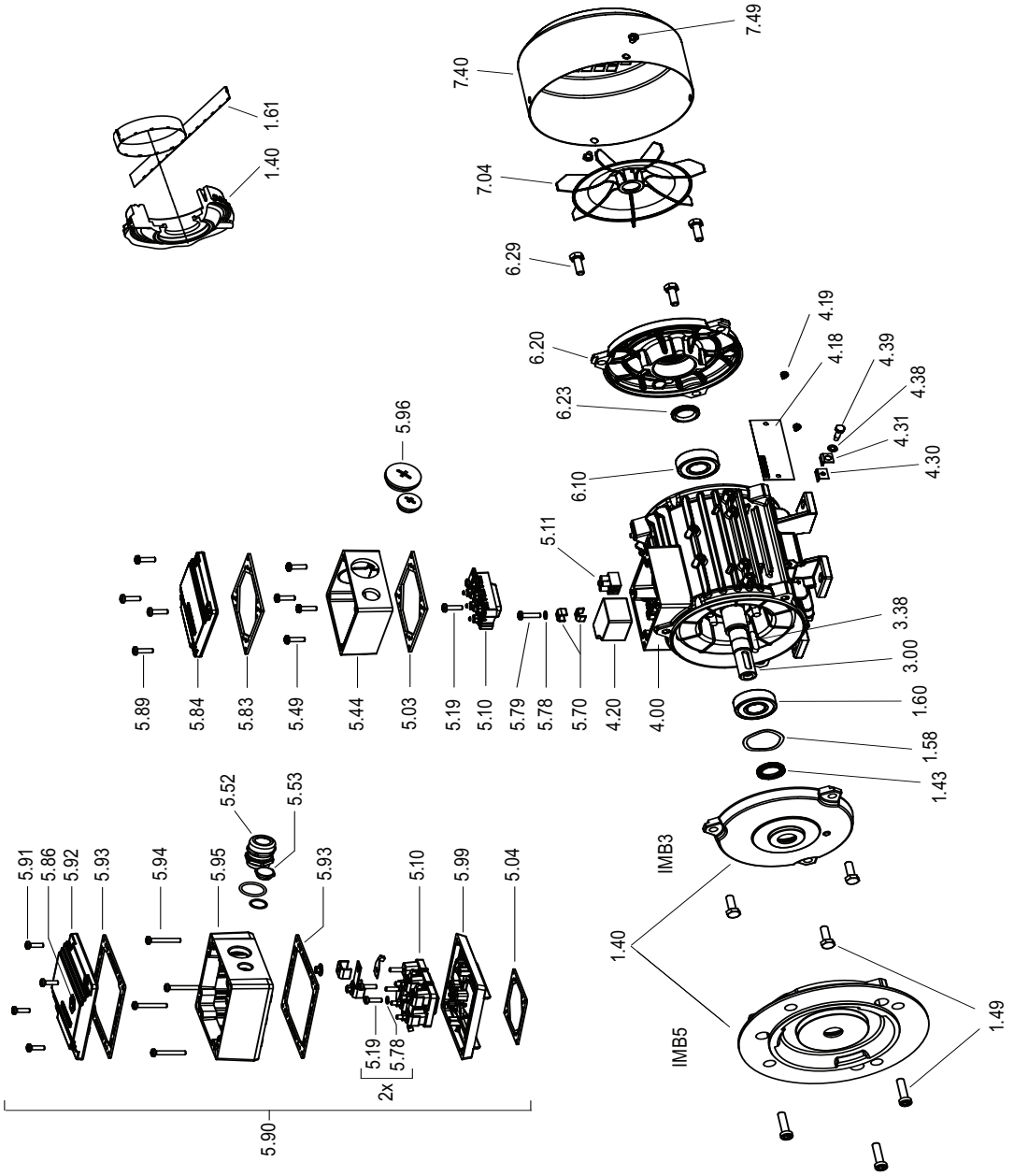
1.517.30777.30.000	1XP8001 encoder
5.610.70000.02.015	External fan
5.610.70000.10.020	Spring-loaded brake
5 610 00002 09 000	Incremental encoder 1XP8012-1x
5 610 00002 09 001	Incremental encoder 1XP8012-2x

Technical data and drawings

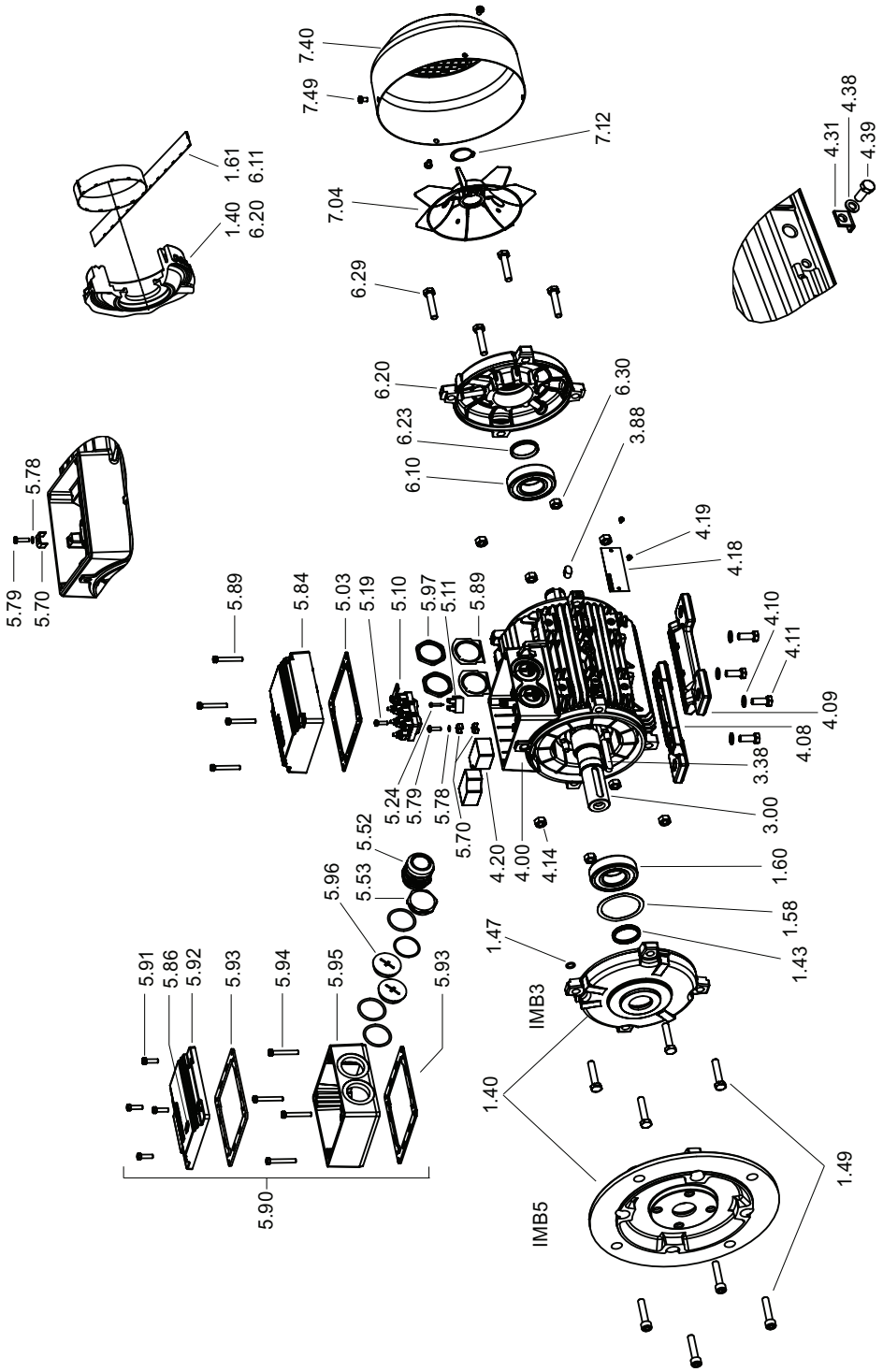
B

B.1 Exploded drawings

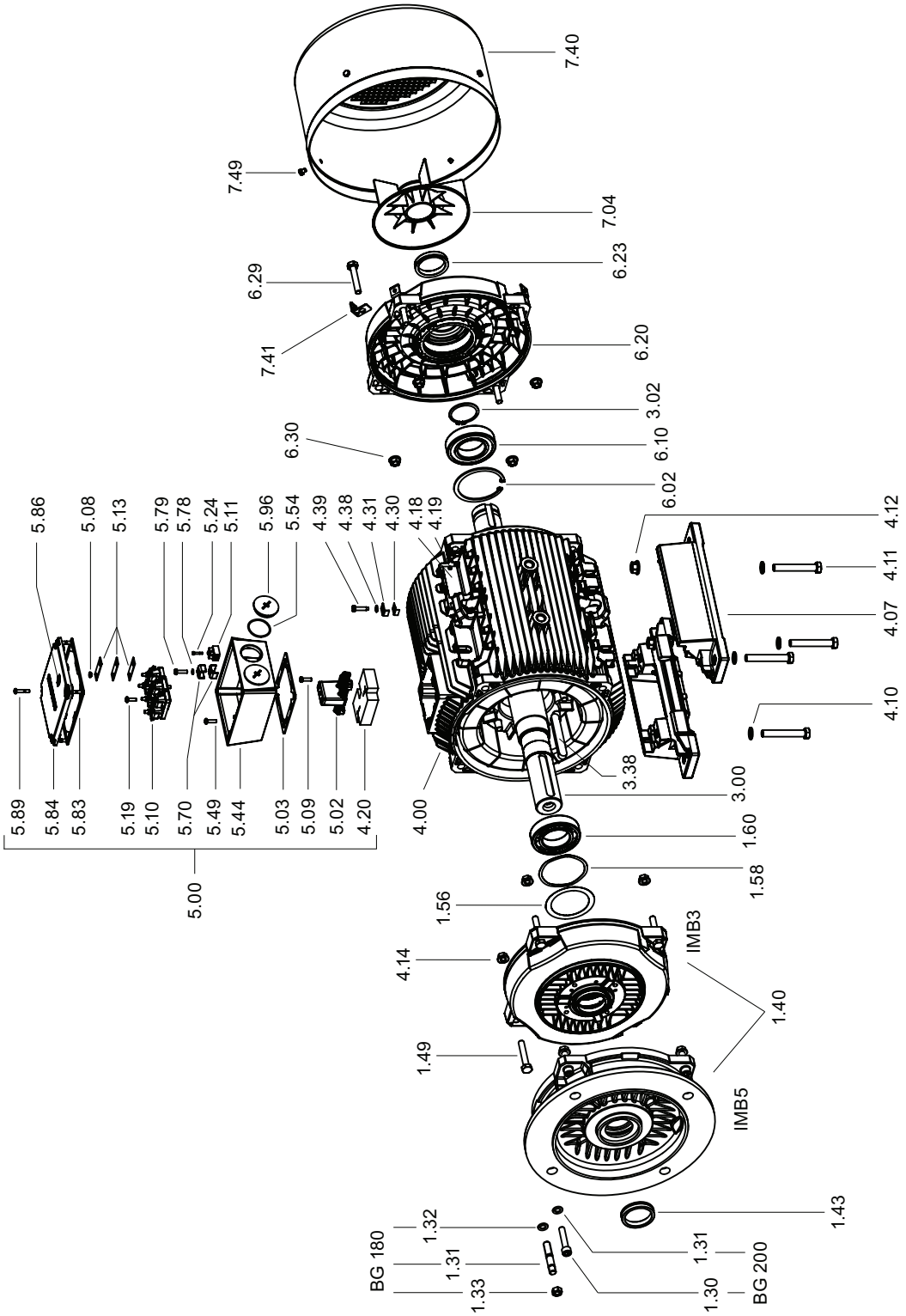
B.1.1 1LA,1LP,1MA,1MF,1PP6/7/9 FS 56 ... 90L



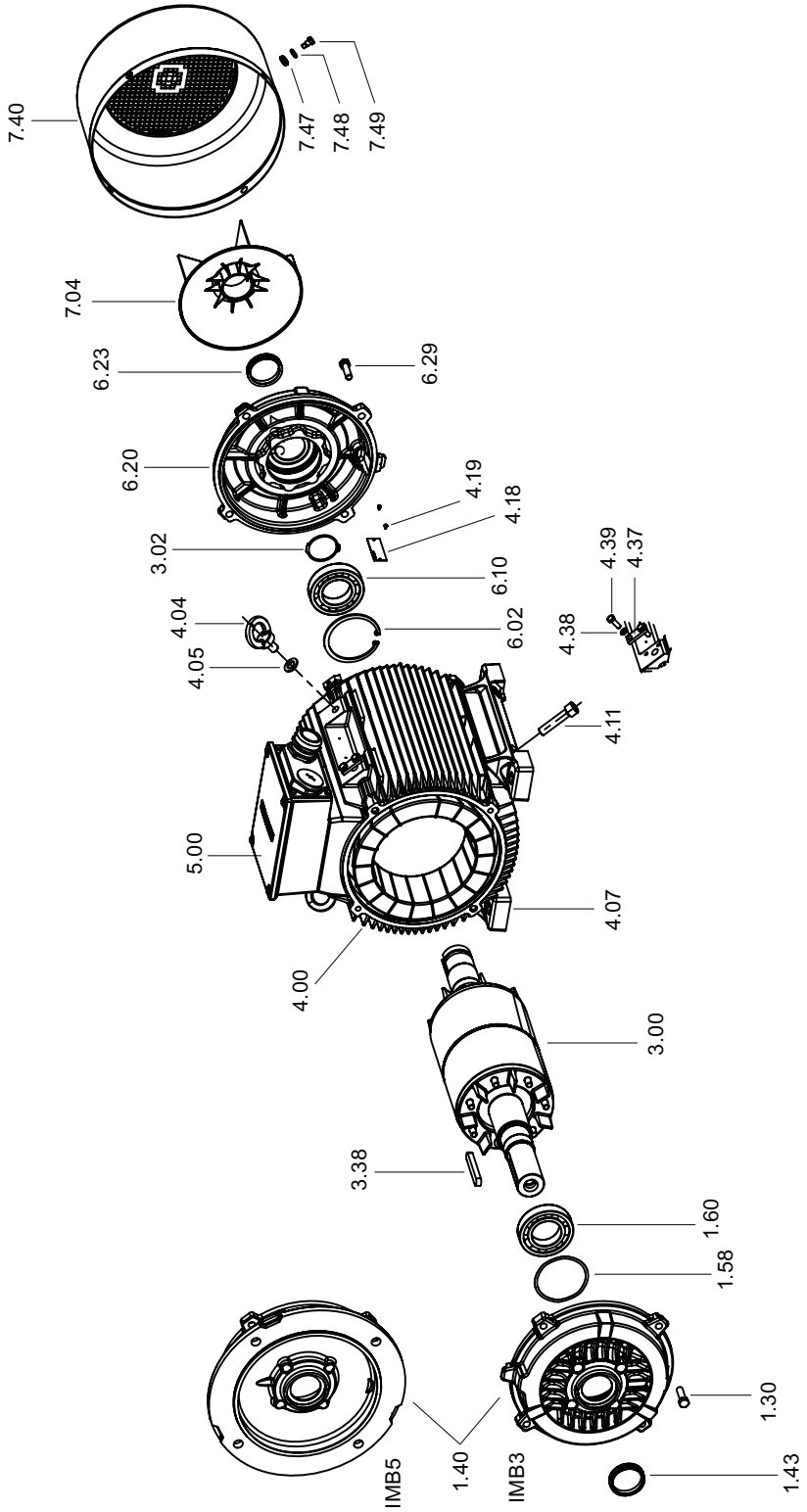
B.1.2 1LA,1LP,1MA,1MF,1PP6/7/9 FS 100 ... 160



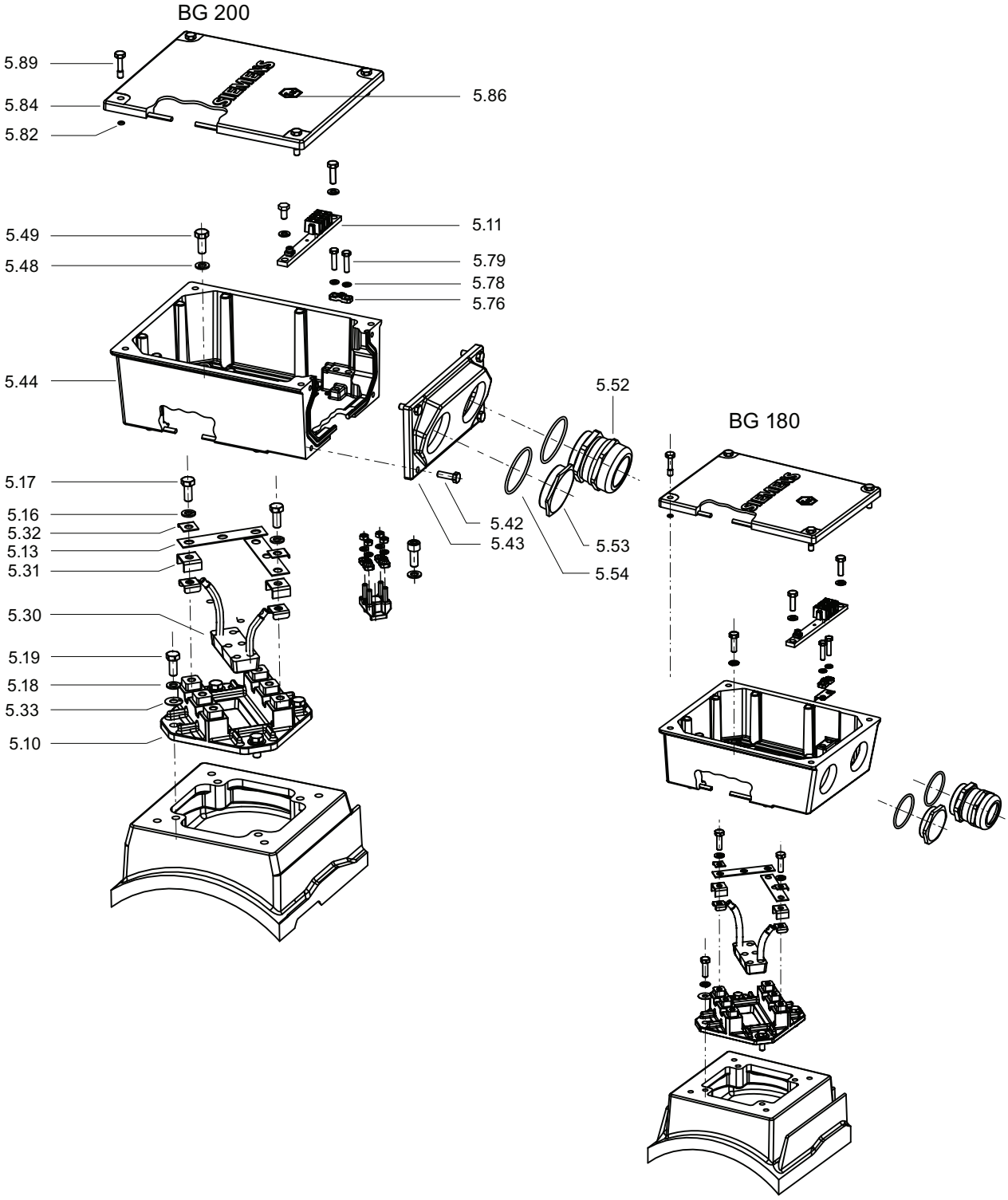
B.1.3 1LA5180 ... 225



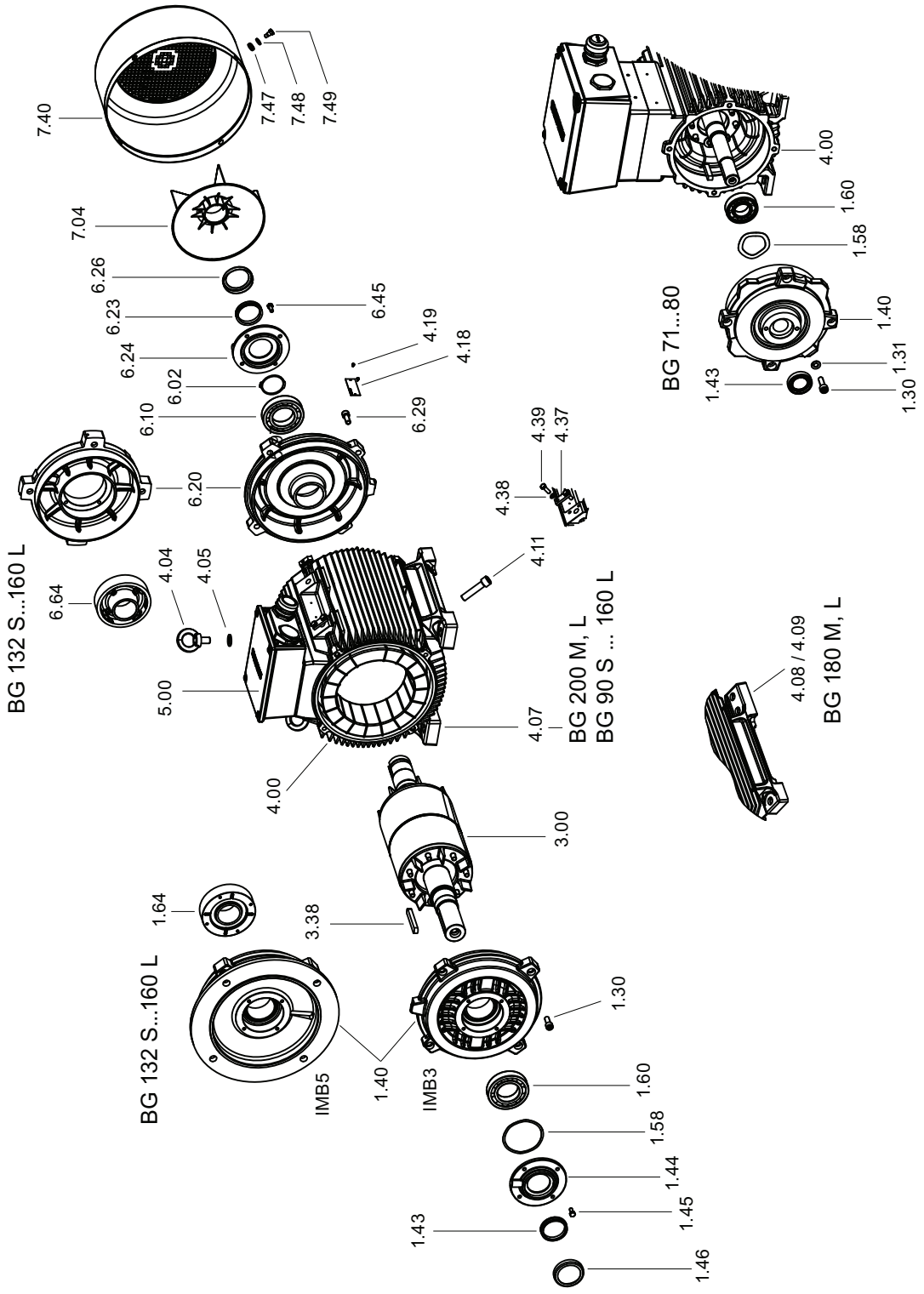
B.1.4 1MA6180 ... 200



B.1.5 Terminal boxes 1MA6180 ... 200

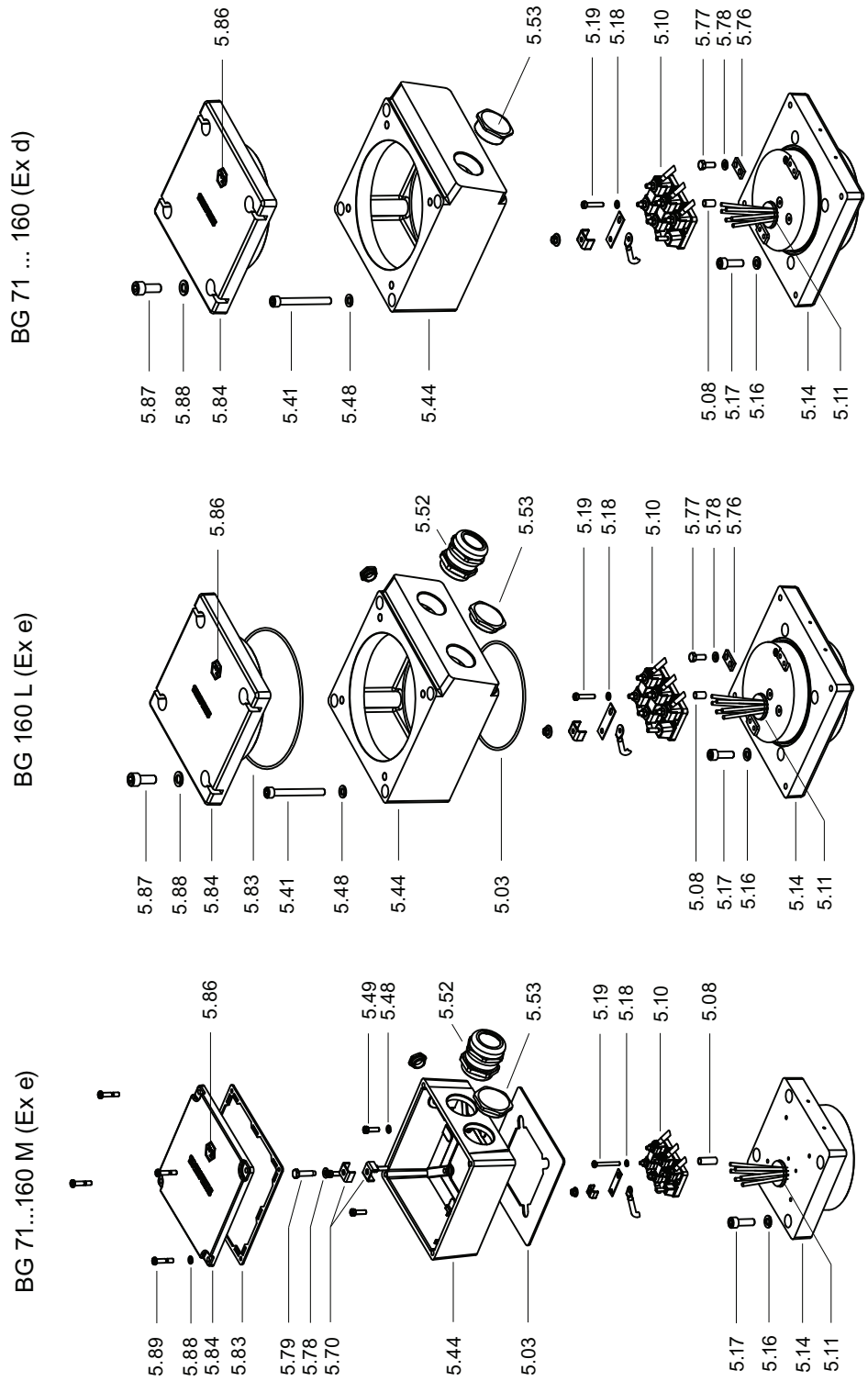


B.1.6 1MJ6070 ... 200

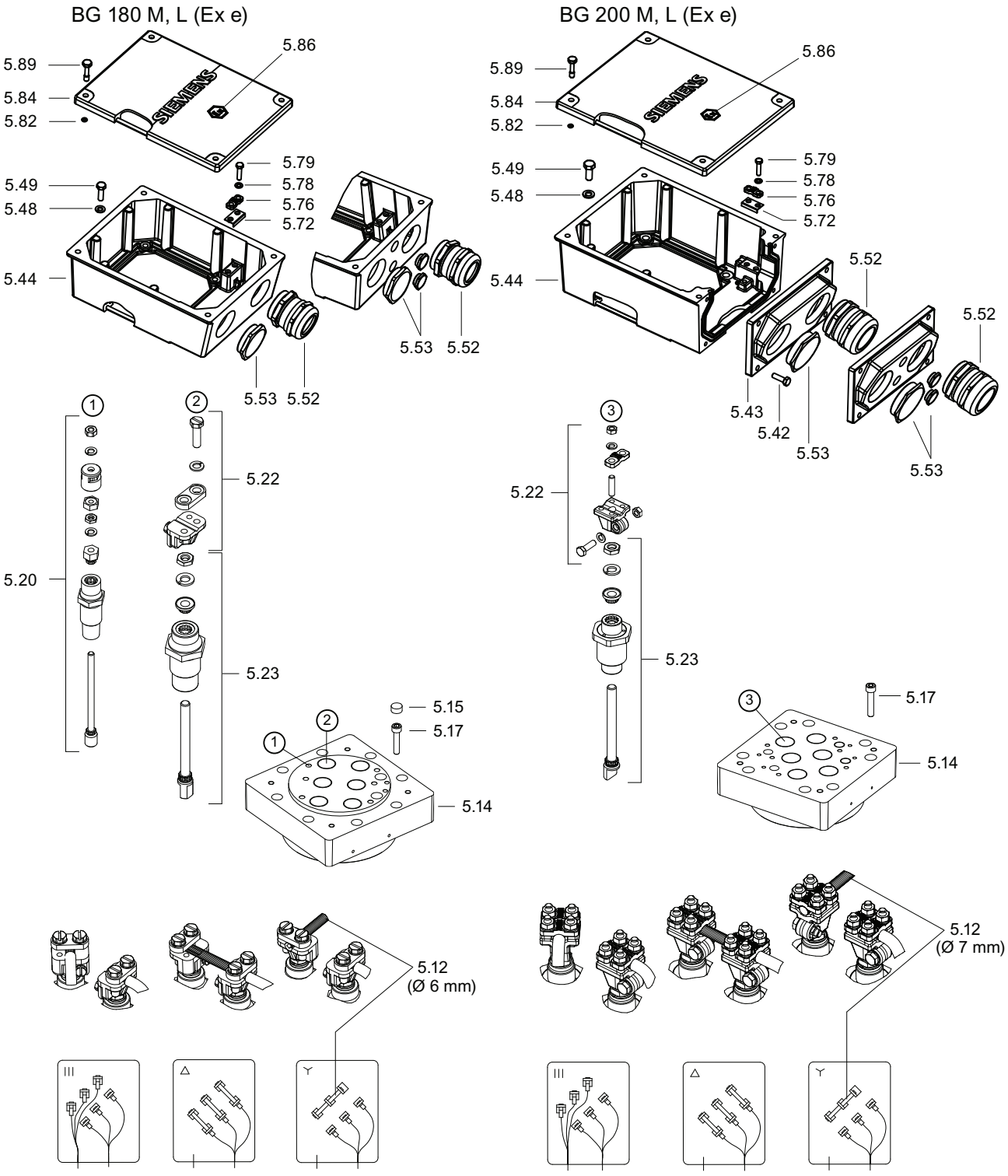


B.1.7 Terminal boxes 1MJ6070 ... 160

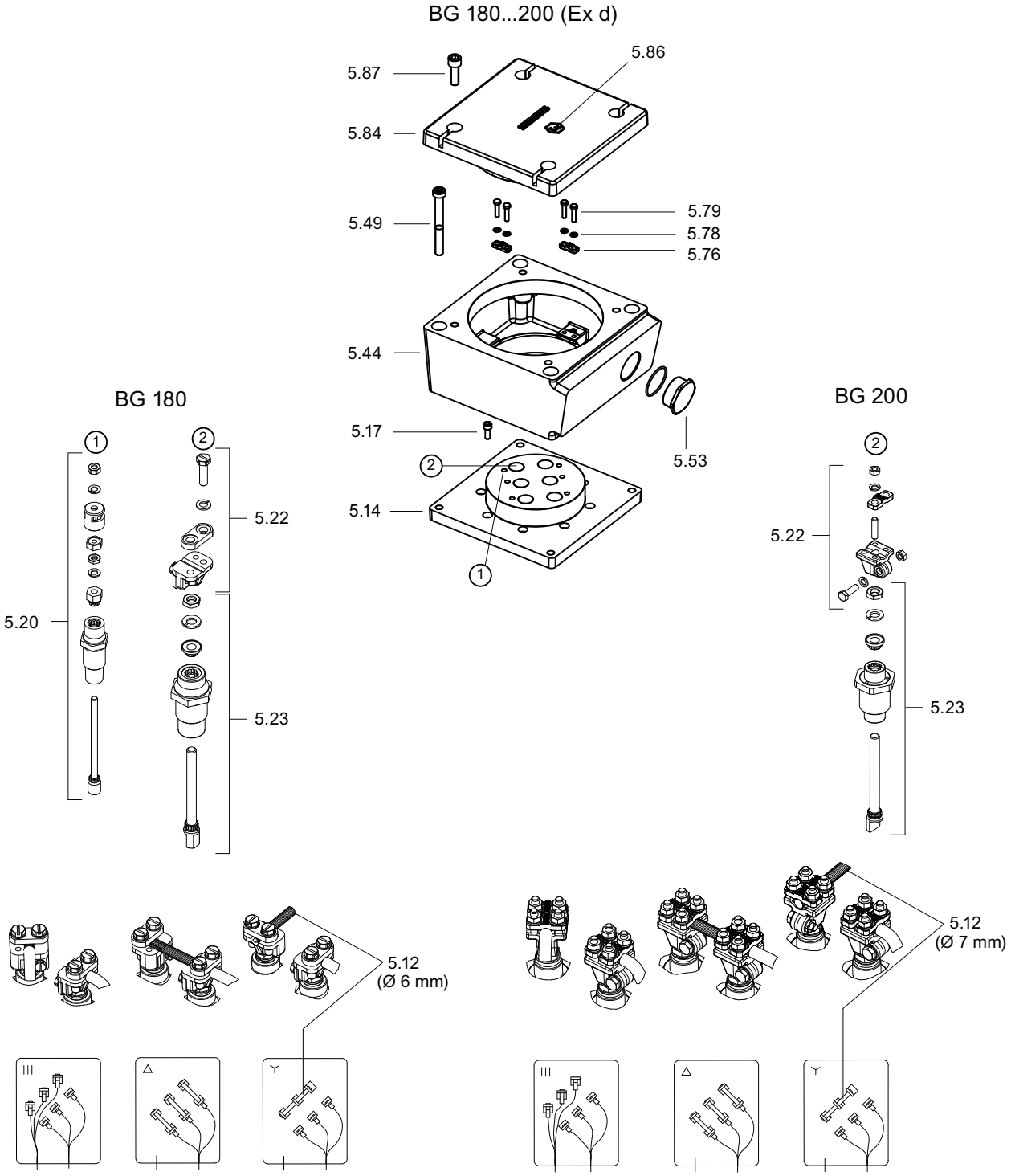
CHANGE FS 71...160 Ex d



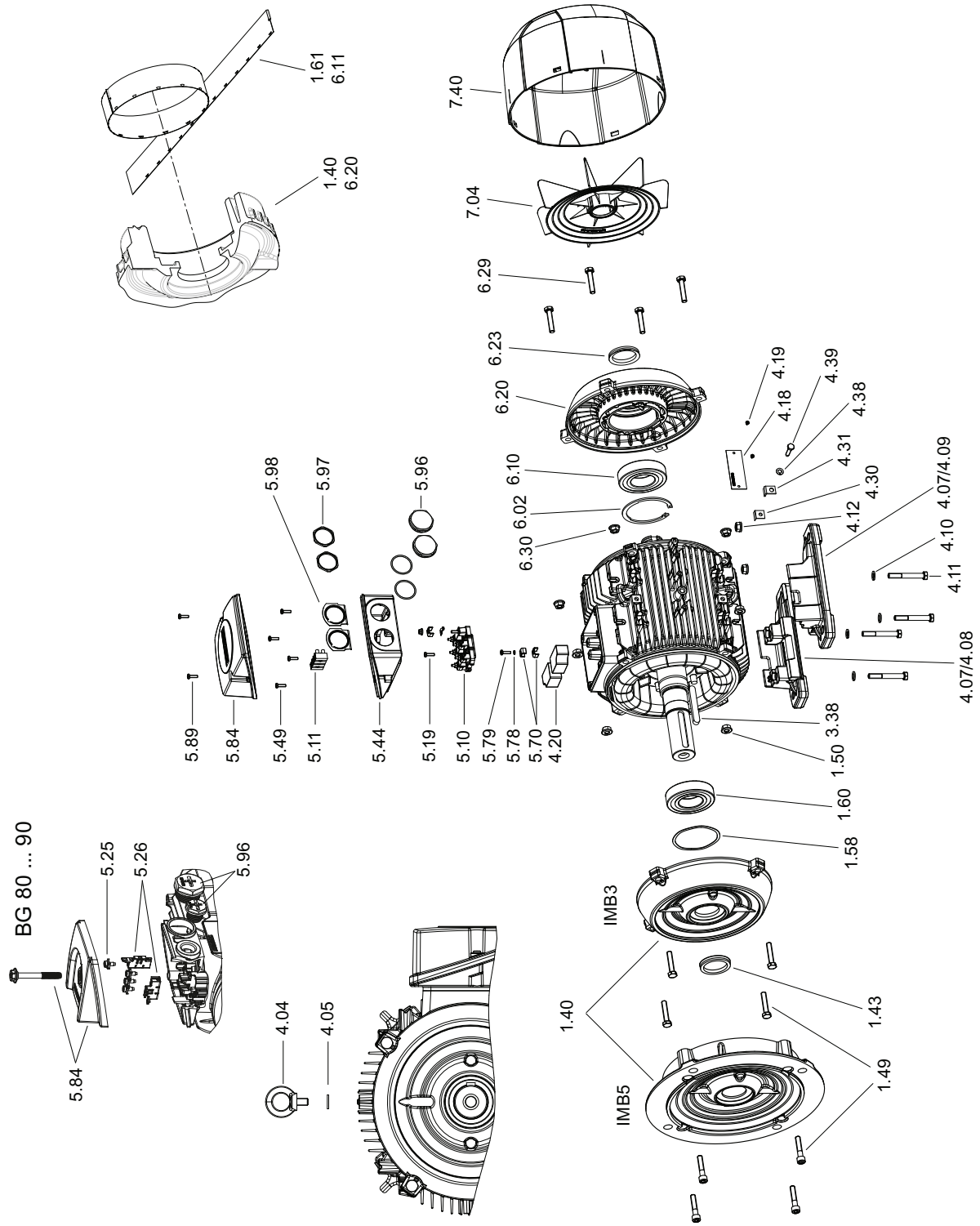
B.1.8 Terminal boxes 1MJ6180 ... 200 (Ex e)



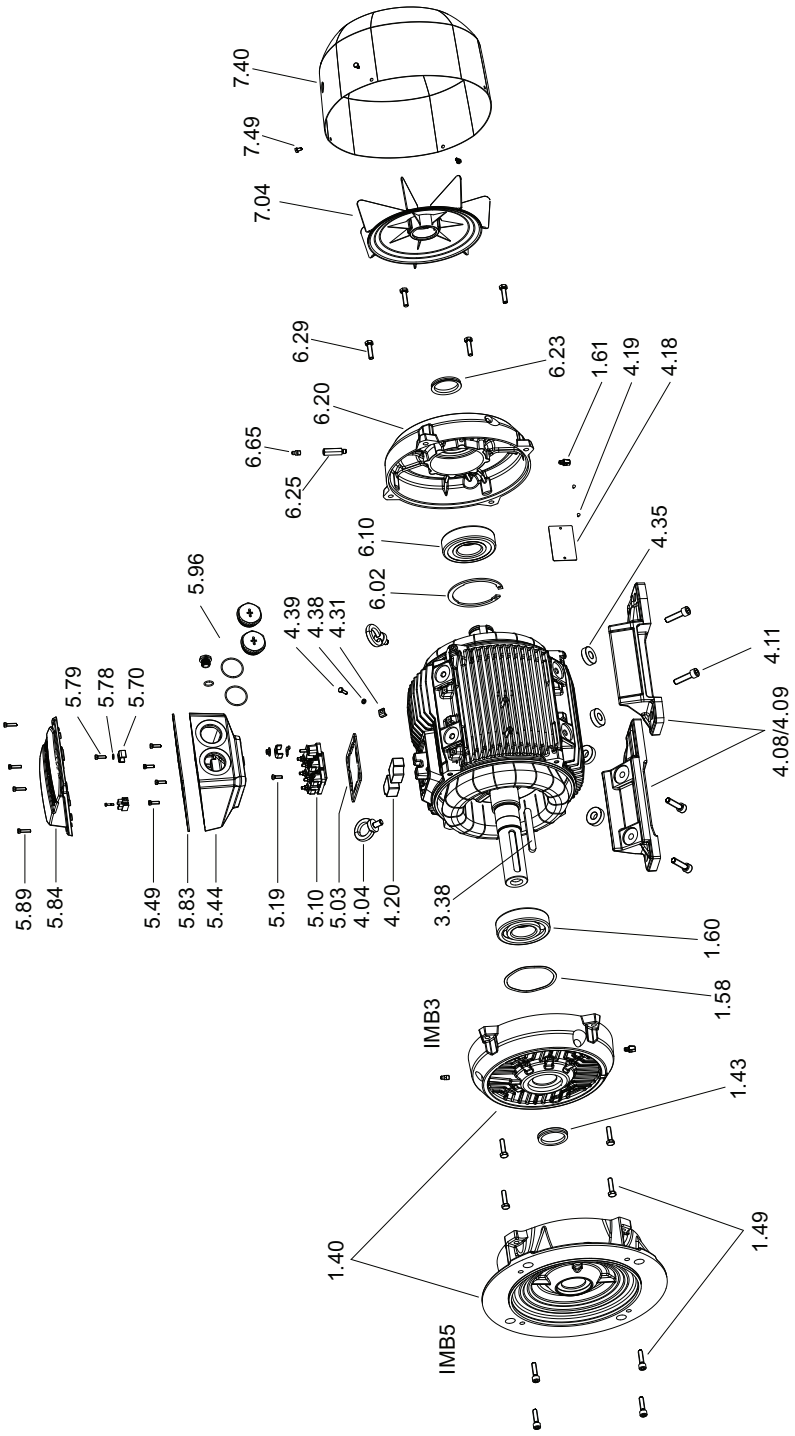
B.1.9 Terminal boxes 1MJ6180 ... 200 (Ex d)



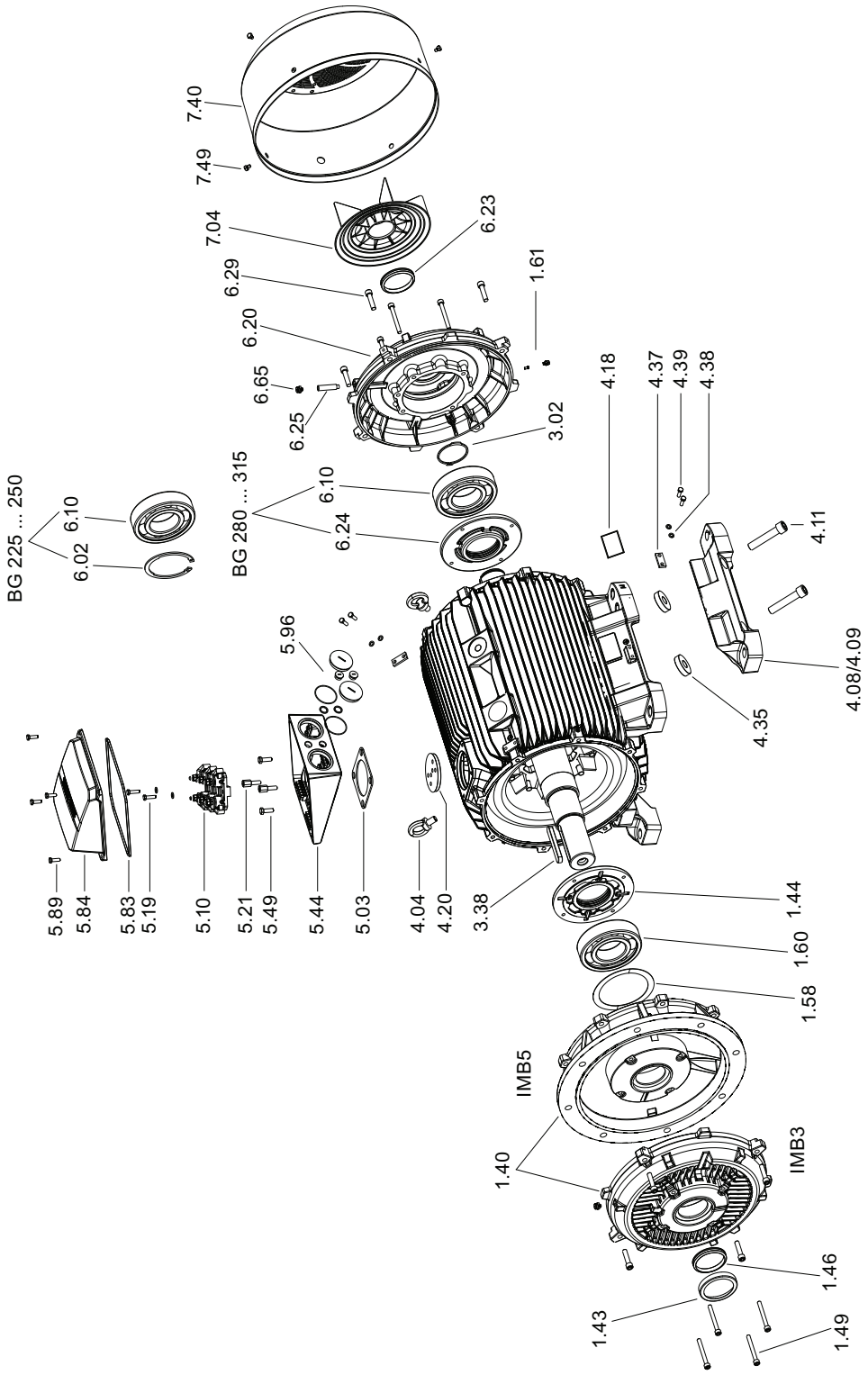
B.1.10 1LE1 FS 80 ... 160 aluminum



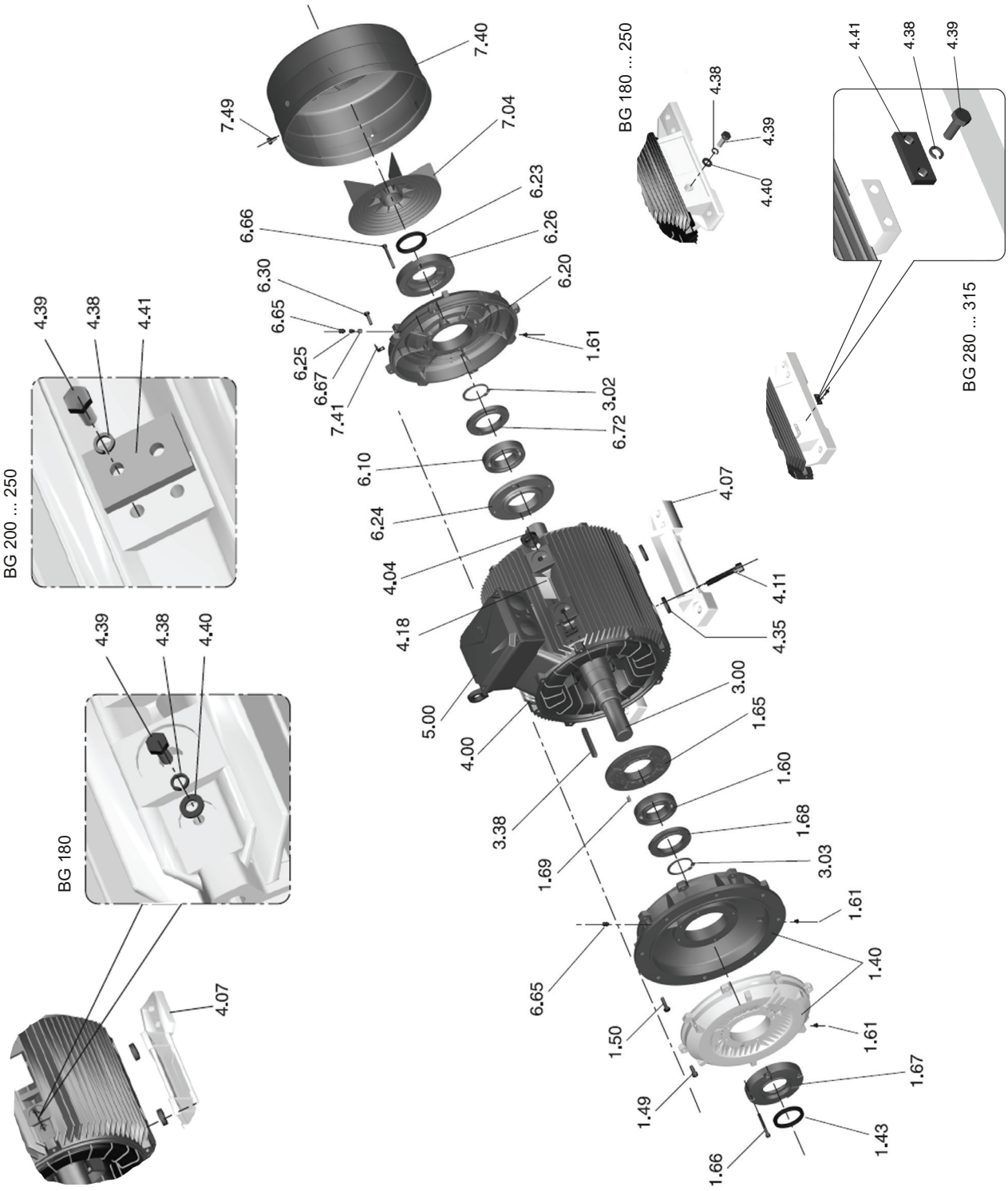
B.1.11 1LE1 FS 100 ... 200 cast iron



B.1.12 1LE1 FS 225 ... 315 cast iron

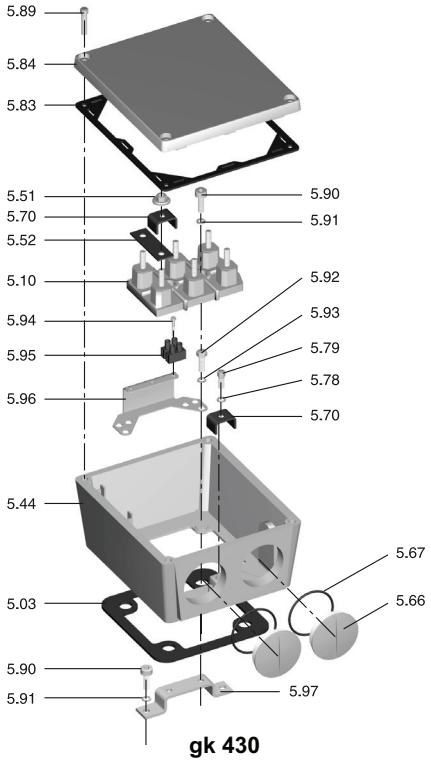


B.1.13 1LG4/6 FS 180 ... 315

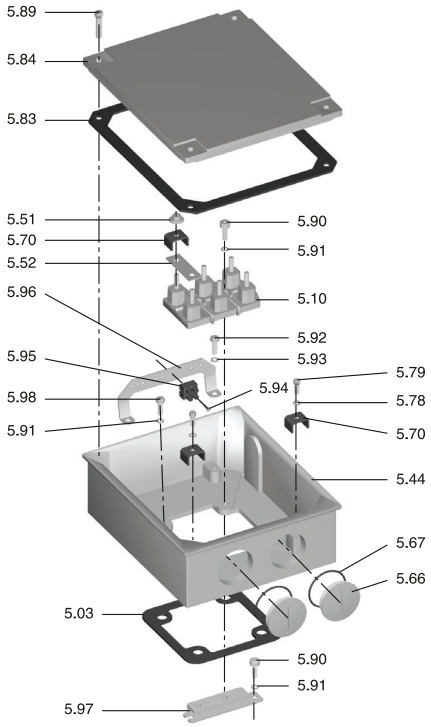


B.1.14 1LG4/6 gk330, gt320, gk430, gt420

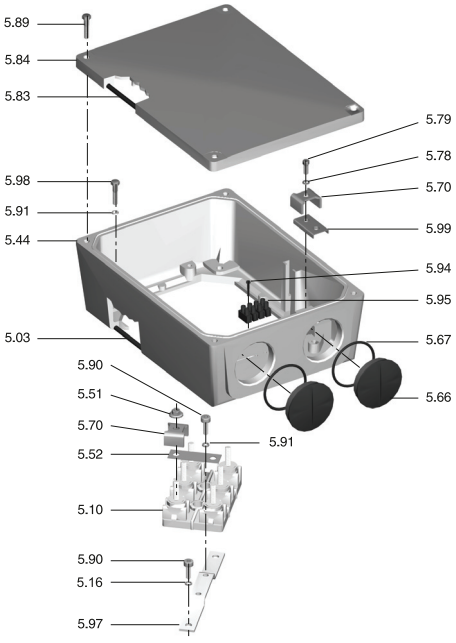
gk 330



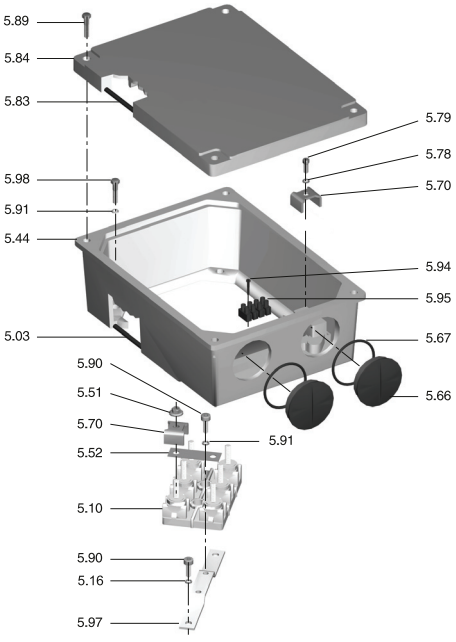
gt 320



gk 430

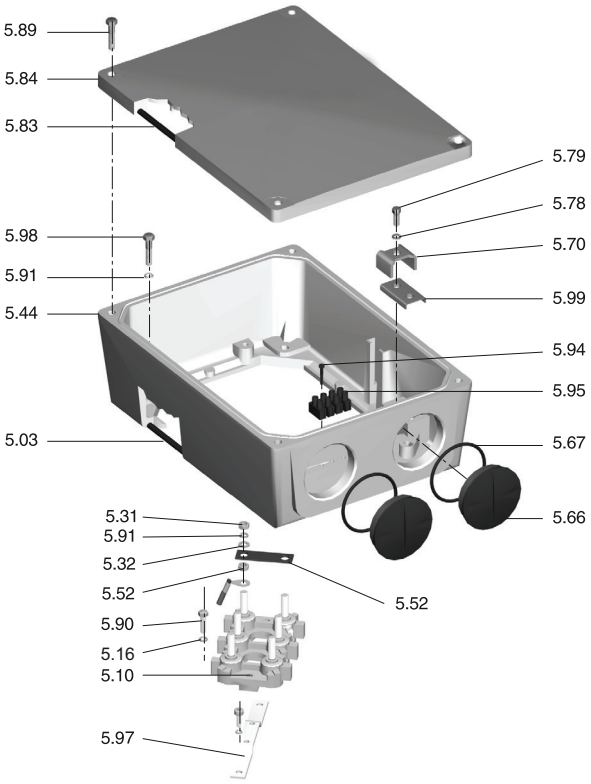


gt 420

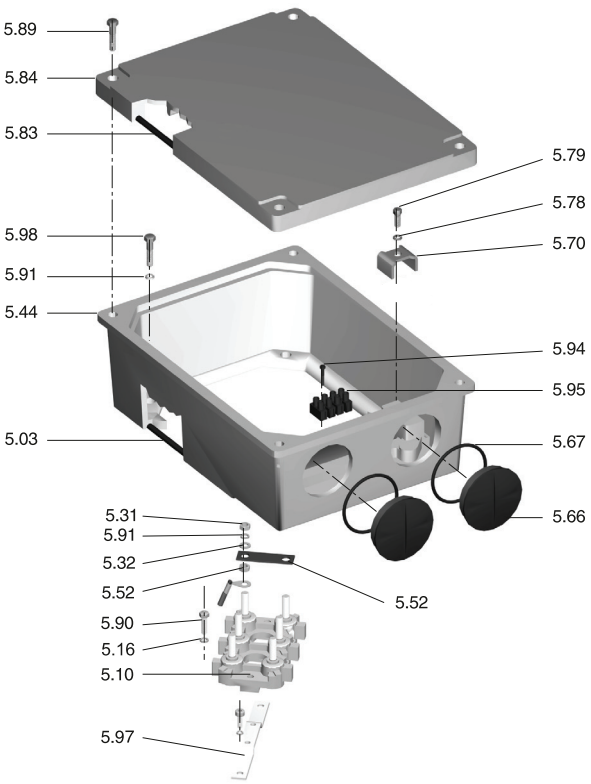


B.1.15 1LG4/6 gk431, gt421, gt520, gt540

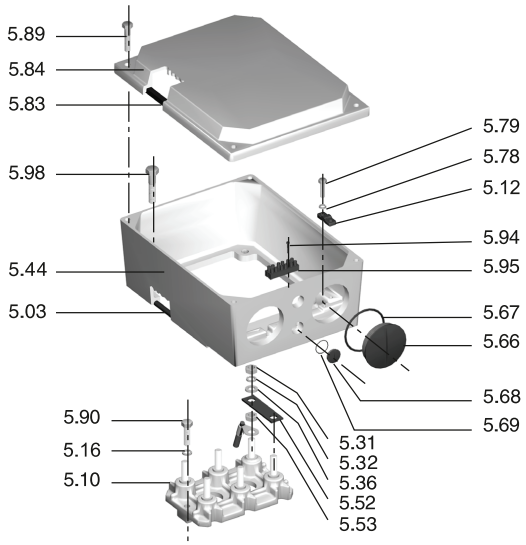
gt 431



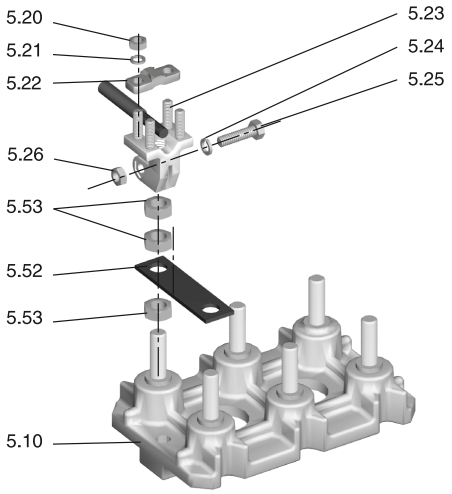
gt 421



gt 520

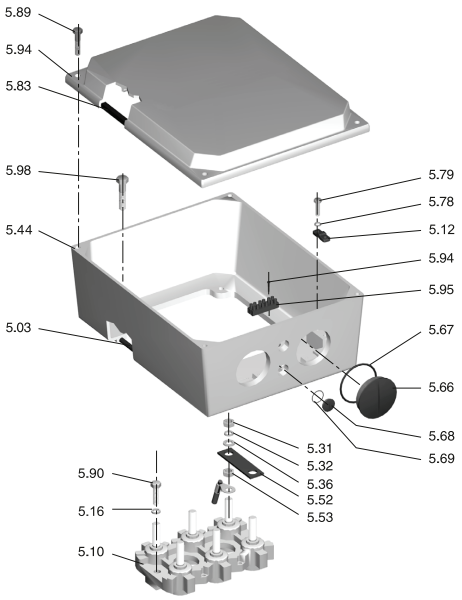


gt 540

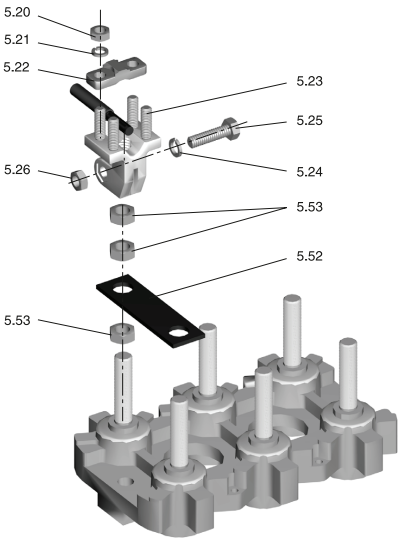


B.1.16 1LG4/6 gt620, gt640, gt791

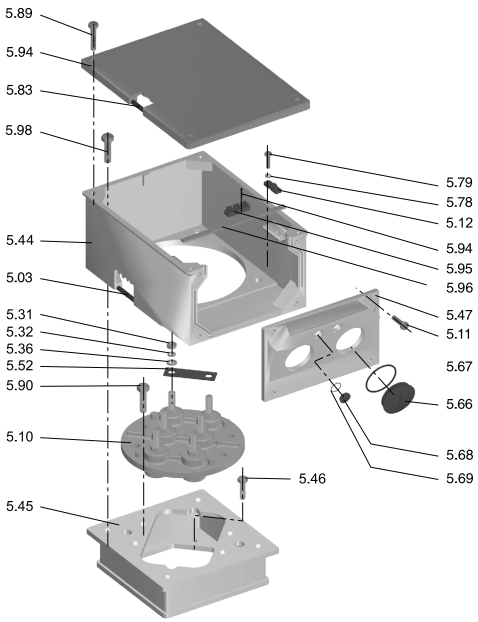
gt 620



gt 640



gt 791



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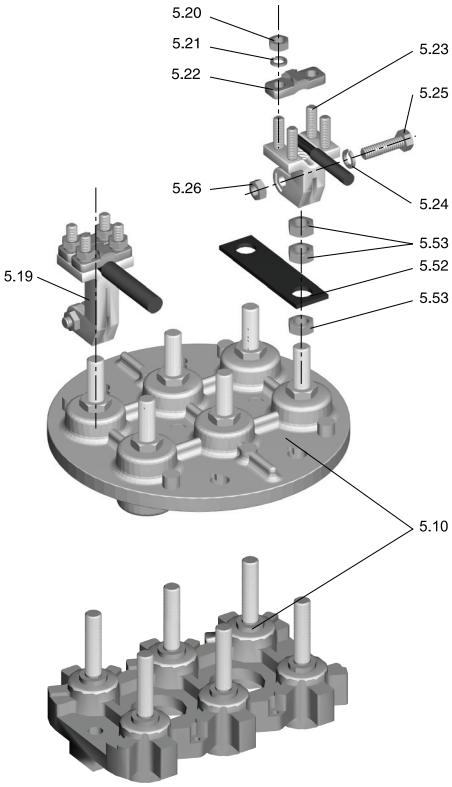

12 Notes

Glossary

AS

Drive end (DE)

BA

Operating instructions

BG

Frame size

CE

CE marking

Code F

Balanced with whole featherkey (full)

Code H

Balanced with half featherkey (half)

CSA

Canadian Standard Association

CSA E

Canadian Standard Association Energie Efficiency Verification

CT

Coolant temperature

DE

Drive end (D end of shaft)

EC type-examination certificate

Evidence of a machine certified by an inspection body

EMC

Electromagnetic compatibility

Ex

Codes for explosion-protected equipment

IC

International Cooling (standard)

IM

International mounting standard design

Internet

www.siemens.com/motors

IP

Degree of protection

ISPM

International Standards for Phytosanitary Measures

N code

Balanced without featherkey (non)

NDE

Non-drive end

NE/NDE

Non-drive end

SH

Shaft height

UL

Underwriters Laboratories

VIK

Verband der industriellen Energie- und Kraftwirtschaft e.V. (German Association of Industrial Energy Users and Self-Generators)

Zone 1

Atmosphere: Gas; Danger level: Occasional danger; Type of protection: Increased Safety "e" + Flameproof Enclosure "d"

Zone 2

Atmosphere: Gas; Danger level: Infrequent and short-term danger; Type of protection: Non-sparking "n"

Zone 21

Atmosphere: Dust; Danger level: Occasional danger; Type of protection: Protection by enclosure "tD"

Zone 22

Atmosphere: Dust; Danger level: Infrequent and short-term danger; Type of protection: Protection by enclosure "tD"