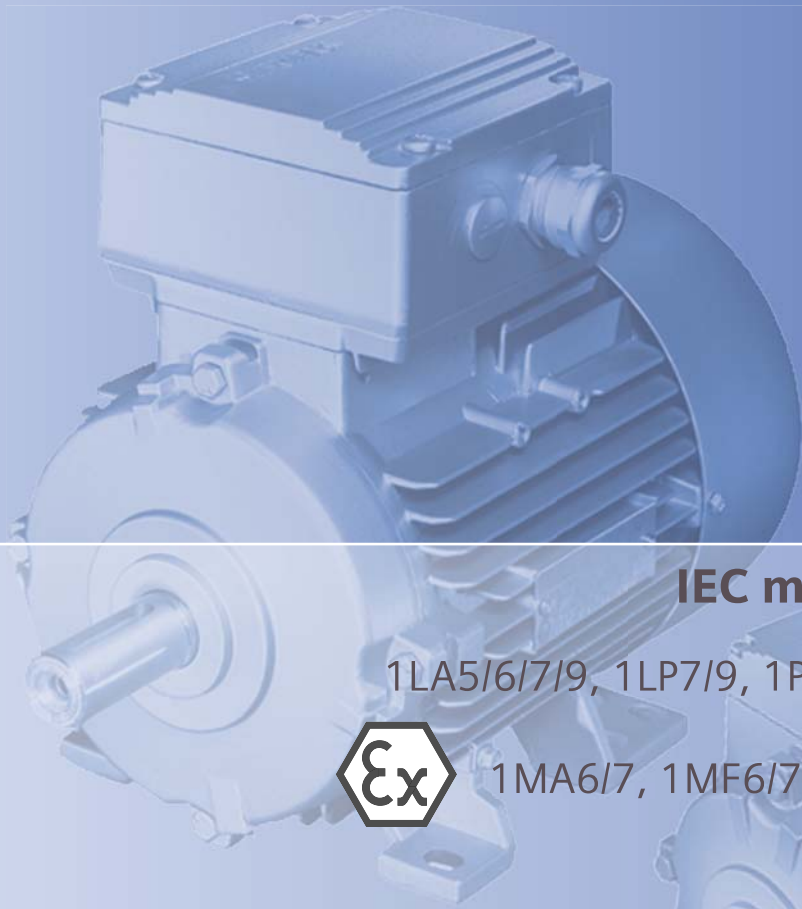




IEC motors

1LA5/6/7/9, 1LP7/9, 1PP6/7/9



1MA6/7, 1MF6/7, 1MJ6

en

low voltage motors

DOCUMENTATION

SIEMENS

Low Voltage Motors 1LA5/6/7/9, 1LP7/9, 1PP6/7/9, 1MA6/7, 1MF6/7, 1MJ6

Operating Instructions

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Safety Guidelines

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 device/system may only be set up and used in conjunction with this documentation. Commissioning and operation of a device/system may only be performed by **qualified personnel**. Within the context of the safety notes in this documentation qualified persons are defined as persons who are authorized to commission, ground and label devices, systems and circuits in accordance with established safety practices and standards.

Prescribed Usage

Note the following:

WARNING
--

This device may only be used for the applications described in the catalog or the technical description and only in connection with devices or components from other manufacturers which have been approved or recommended by Siemens. Correct, reliable operation of the product requires proper transport, storage, positioning and assembly as well as careful operation and maintenance.
--

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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Safety information

1.1 Safety and application instructions

The safe use of electrical machines



WARNING

Rotating or live parts

Rotating or live parts are dangerous.

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 accordance with regulations and operate machines correctly. Perform regular maintenance on the machine.

DANGER

Installation site safety/warning signs

If the machines are used outside industrial areas, the installation site must be safeguarded against unauthorized access by means of suitable protection facilities (e.g. fencing) and appropriate warning signs.

The persons responsible for the safety of the system are under an obligation to ensure that:

- the basic planning work for the system and all work relating to transportation, assembly, installation, commissioning, maintenance and repairs are carried out by qualified persons and checked by responsible, suitably skilled persons;
- these operating instructions and the machine documentation are made available at all times while work is in progress;
- the technical data and specifications relating to the installation, connection, ambient and operating conditions are taken into account at all times;
- the system-specific erection and safety regulations are observed and personal protective gear is used;
- work on these machines, or in the vicinity of these machines, by unqualified persons is prohibited.

These operating instructions therefore only contain the information which is necessary for the machines to be used by qualified persons in accordance with their intended purpose.

Note

We recommend engaging the support and services of your local Siemens service center for all planning, installation, commissioning and maintenance work.

[ID 2.01]

1.2 General safety instructions

WARNING
Electrical machines have hazardous parts which carry voltage and rotate and may also have hot surfaces.

NOTICE
Special models and types of construction
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.

Description

2.1 SIEMENS Service Center

Contact for further information

Details regarding the design of this electrical machine and the permissible operating conditions are described in these operating instructions. If you have any questions or suggestions, or if you require additional information, please contact the Siemens Service Center:

Table 2-1 Technical support

Europe - Germany:	Phone:	+49 (0)180 - 50 50 222
	Fax	+49 (0)180 - 50 50 223
America - USA:	Phone:	+1 423 262 2522
Asia - China:	Phone:	+86 1064 719 990
E-Mail:		support.automation@siemens.com
Internet English:		www.siemens.com/automation/support-request
Internet Deutsch:		www.siemens.de/automation/support-request

[ID 302.03]

2.2 Range of application

Overview

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

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

Proper use of the machines

These machines are intended for industrial installations. They comply with the harmonized standards of the series IEC / EN 60034-1 (VDE 0530-1). Their use in hazardous areas is forbidden unless the information on the rating plate expressly permits their operation. If other/more wide-ranging demands (e.g. protection against touching by children) are made in special cases – i.e. use in non-industrial installations – these conditions must have been complied with in the installation when the motors are installed.

Note

Machine directive

Low-voltage machines are components for installation in machines which comply with Machinery Directive 89/392/EEC. They must not be started up until the end product has been verified as complying with this directive (refer to EN 60204-1).

2.3 Delivery

Checking the delivery for completeness

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

Register a complaint about

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

The safety and start-up instructions are part of the scope of supply and must therefore be stored in an accessible place. This also applies to the operating instructions, which are available as an option.

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.

2.4 Rating plate

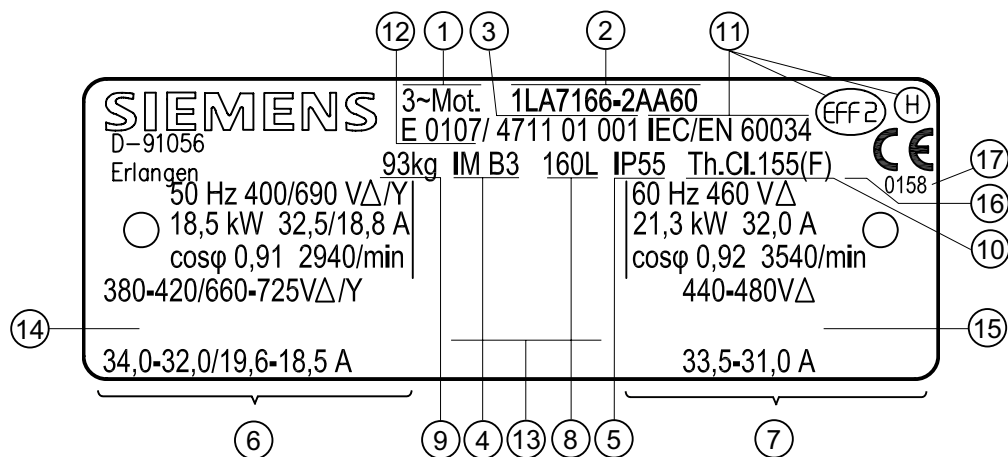
Technical Specifications

The machine rating plate shows the technical specifications applicable to the supplied machine.

The machine rating plate carries the following technical data:

Table 2-2 Machine rating plate - Technical data

Item	Technical Specifications	Item	Technical Specifications
1	Machine type: Three-phase low-voltage machine	10	Temperature class
2	Order No.	11	Standards and regulations
3	Factory number (Ident No., serial number)	12	Date of manufacture YYYYMM
4	Type of construction	13	Additional approvals (optional)
5	Degree of protection	14	Installation altitude (only if higher than 1000 m)
6	50 Hz data	15	Customer data (optional)
7	60 Hz data	16	Operating temperature range (only if different from the standard)
8	Frame size	17	Identification number of testing agency (optional)
9	Machine weight		



2.5 installation

2.5.1 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.

The position of the feet bolted onto the housing of the machine can be changed, e.g. in order to change the position of the terminal box, but this must only be done by authorized partners. The surfaces on which the feet rested must then be evened out and made parallel with the machine shaft, if necessary by placing shims underneath the machine. Any damaged paintwork must be correctly repaired.

2.5.2 Regulations

Overview

The machines comply with the following standards:

Table 2-3 Compliance with standards

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
IEC standard voltages	IEC 60038

2.5.3 Supplementary regulations for explosion-proof machines

Overview

Table 2-4 Compliance with standards

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

2.5.4 Cooling and ventilation

2.5.4.1 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 form of surface cooling can vary depending on the type of cooling provided:

2.5.4.2 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 cool air is fastened to the machine shaft.

The fan wheels are independent of the direction of rotation.

In the case of frequent switching or braking or if the speed is controlled continually below the nominal speed, the cooling effect must be checked.



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

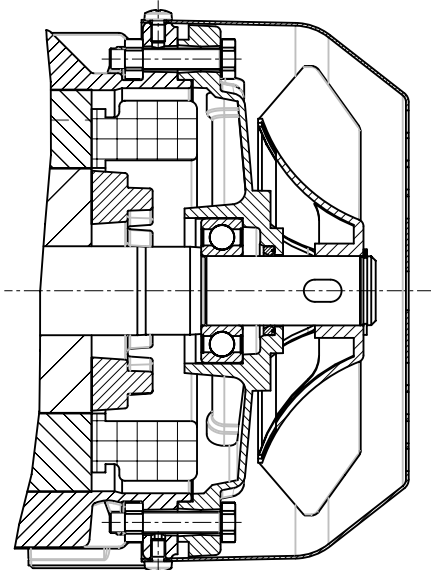


Figure 2-1 Self-ventilation

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

Cooling independent of the speed is achieved by means of a separately driven fan wheel (forced ventilation). Forced ventilation is independent of the operating state of the machine. It must be ensured that the machine is not operated without starting the external fan. The fan wheel for the external flow of cold air is powered by an independent module and is enclosed by the fan cowl.

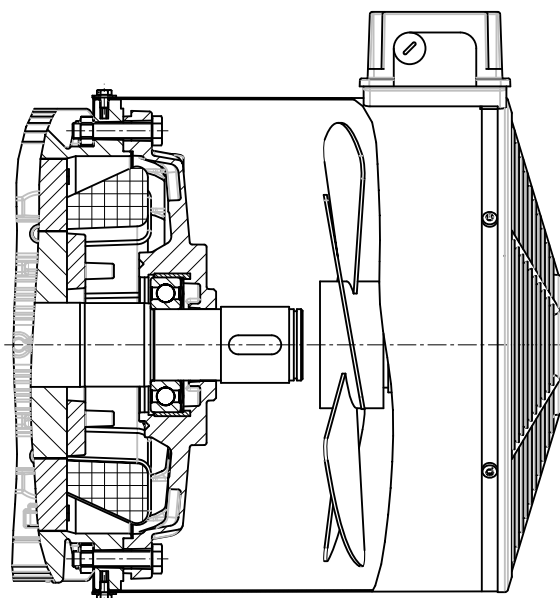


Figure 2-2 Forced ventilation

2.5.4.3 Machines without a fan (optional)

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

IC410 IC4A1A0

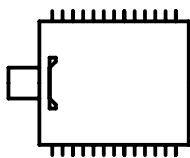


Figure 2-3 IC410

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

IC418 IC4A1A8

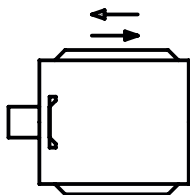


Figure 2-4 IC418

2.5.5 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 rolling-contact bearing performs the function of a location bearing which transfers axial and radial forces from the rotatable machine shaft to the non-moving part of the machine. The second rolling-contact bearing is a floating/guide bearing in order to allow thermal expansion inside the machine and transfer radial forces.

The nominal (calculated) useful life of the bearings (ISO 281) is 20,000 hours if the permissible radial/axial forces are fully utilized. However, the achievable useful life of the bearings can be considerably longer in the case of smaller forces (e.g. coupling mode).

The rolling-contact bearings are lubricated for life (standard feature) and therefore do not require maintenance.

If the option for re-lubrication is taken up, the information on the rating plate must be complied with.

2.5.6 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.

2.5.7 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

During transport, machines may only be hoisted in a position corresponding to their basic type of construction.

Table 2-5 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)			

2.5.8 Types of construction/Installation conditions for explosion-proof machines



Other possible fields of application for explosion-proof machines

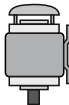
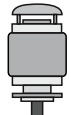
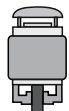
The type of construction of the machine is stated on the rating plate.



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. A protective top cover is automatically installed at the factory for explosion-proof motors with IM V5, IM V1 or IM V18 types of construction. For types of construction with shaft extension pointing upwards, a suitable cover must be implemented to prevent small parts from falling into the fan cover (see the standard IEC/EN 60079-0). The cover must not block the cooling air flow.

Table 2-6 Construction type with protective top cover

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

2.5.9 Degree of protection

The machines have degree of protection IP 55 (see rating plate). They can be installed in dusty or humid environments.

NOTICE
Condensation holes
In order to comply with the degree of protection, any existing condensation holes are to be sealed!

If the machines are used or are stored outdoors, we recommend that they be kept under some sort of additional cover so that they are not subjected to direct intensive solar radiation, rain, snow, ice or dust over a long period of time.
In such cases, technical consultation may be appropriate.

The machines are suitable for use in the tropics.

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

Ambient temperature: -20° C to +40° C

Installation altitude: ≤ 1000 m

If the specified ambient conditions are different to these values, they must be indicated on the rating plate. These values will then be applicable.

2.5.10 Degree of protection for explosion-proof machines



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 maltings, as well as in certain areas of the chemical industry.

2.5.11 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 fitted 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).

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



No additional measures are required in the case of external sources of heat or cold, provided that the temperatures are within limits at the relevant location. Special application cases involving external sources of heat and cold should be investigated in respect of how maximum surface and operating temperatures are affected. This should be carried out by means of type tests, and appropriate measures implemented as necessary.

Built-on accessories such as brakes, forced ventilation or pulse encoders must be selected for conformity to the specifications of Directive 94/9/EC.

Assignment planning

3.1 Transport

Use lifting eyes

CAUTION

During transport, all the lifting eyes on the machine are to be used and any eyes which are screwed in must be firmly tightened. They are designed to bear the weight of the machine alone and therefore no additional loads should be added. If necessary, use suitable rated transport materials such as lifting straps (EN 1492-1) and lashing straps (EN12195-2).

Suspended transport

WARNING

Use suitable means of conveyance for transport and during installation. If several items of transport material are used for fastening, two straps must be able to carry the whole load. Secure lifting materials to make sure they cannot slip!

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. Unless agreed otherwise in the contract, the packaging is in accordance with the packing guidelines of ISPM (International Standards for Phytosanitary Measures).

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



3.2 Storage

Storing outdoors

If possible, choose a dry storage location which is safe from flooding and free from vibrations. Repair any damage to the packaging before putting the equipment in storage in so far as this is necessary to ensure proper storage conditions. Position machines, devices and crates on pallets, wooden beams or foundations that guarantee protection against ground dampness. Prevent the equipment from sinking into the ground and also make sure that the circulation of air underneath the equipment is not impeded.

Covers or tarpaulins used to protect the equipment against the weather must not make contact with the surfaces of the stored equipment. Ensure adequate air circulation by positioning wooden spacer blocks between the equipment and such covers.

CAUTION
Under extreme climatic conditions, e.g., saline and/or dusty atmospheres, suitable precautions are to be taken.

Storing indoors

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

Bare metal surfaces

For transport, the bare parts are to be coated with anti-corrosion paint which will last for a limited amount of time (<6 months). For longer storage times, the customer must take suitable anti-corrosion measures to protect bare metal surfaces (shaft end, flanging surface, surfaces where feet are bolted on).

3.3 Bearing lifetime

Storage time

Prolonged storage periods reduce the useful life of the bearing grease. If stored for more than 12 months, the condition of the grease must be checked. If the grease is found to have lost some of its oil content or is contaminated (ingress of condensation leads to changes in the consistency of the grease), the grease must be replaced.

Rolling-contact bearings

The shafts must be turned once a year to prevent marks due to the shafts resting in the same position for a long time. The rolling-contact bearings should be renewed if the time from delivery to start-up of the machine is longer than 4 years. The probability of the bearing system's surviving decreases, the longer the storage time is.

3.4 Electromagnetic compatibility

When used in accordance with their intended purpose and operated in an electrical supply system with characteristics to EN 50160, the enclosed motors (IP 55 and higher) comply with the requirements of the EC Directive concerning electromagnetic compatibility 89/336/EEC.

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 bring about an excessive reaction on the supply system and so cause excessive emitted interference.

NOTICE

If operated with a frequency converter, the emitted interference varies in strength, depending on the design of the converter (type, interference suppression measures, manufacturer). In order to prevent exceeding of the limit values stipulated by EN 50081 for the drive system, consisting of machine and converter, the EMC instructions specified by the converter manufacturer must be strictly observed. If the manufacturer recommends that the cable leading to the machine be shielded, the shield is most effective if it is conductively connected over a large surface area to the metal terminal box of the machine (with metal screw-type connections).

In the case of machines with built-in sensors (e.g. PTC thermistors), interference voltages resulting from the converter can occur and affect the sensor cable.

Immunity to interference

The machines fulfil the requirements of interference immunity in conformity with EN 50082. If machines with integrated sensors (e.g. PTC thermistors) are used, the operator himself must ensure sufficient interference immunity by selecting a suitable sensor signal lead (possible with shielding, connected in the same way as supply cable leading to machine) and a suitable evaluation unit.

If the machines are operated with a converter at higher speeds than the rated speed, the mechanical speed limits (safe operating speed IEC / EN 60034-1) are to be complied with.

3.5 Disposal

Machines must be disposed of carefully taking into account national and local regulations in the normal recycling process or by returning the machines to the manufacturer.

The following must be taken into account when disposing of a machine:

- Oil and grease in accordance with the directive on used oil.
- No mixing with solvents, cleaner solvents or paint residues
- For purposes of recycling, the components must be separated into:
 - electronic scrap (encoder electronics)
 - scrap iron
 - aluminum
 - non-ferrous heavy metal (machine windings, worm gears)
 - plastic

Mounting, installation

4.1 Installation

4.1.1 Safety instructions

CAUTION
--

The housing parts of electrical machines can become very hot!

CAUTION

It must be ensured that parts which are sensitive to temperature changes (cables etc.) do not rest against the housing of the machine.
--

NOTICE

Comply with the technical data on the plates fitted to the housing of the machine!
--

4.1.2 Machine installation

- When motors are being mounted vertically, all the existing lifting eyes and hoisting straps, if any, (DIN EN 1492-1) and/or belts (DIN EN 12195-2) should be used to stabilize the position of the motor.
- When the machine is installed vertically with the shaft end facing downwards, a protective cover for the fan cowl is recommended to prevent foreign bodies from falling into the machine.
- If the motor is installed with the shaft end facing upwards, the end user must prevent the ingress of fluid along the shaft.
- Do not impede ventilation! It must be ensured that discharged air - including that of adjacent items of equipment - is not immediately sucked in again.
- If the motors are used or stored outdoors, we recommend that they be kept under some sort of additional cover so that they are not subjected to direct intensive solar radiation, rain, snow, ice or dust over a long period of time.
- It must be ensured that the maximum permissible axial and radial forces are not exceeded.

Note

Built-on parts (e.g. tachometer) are not to be used for lifting.

NOTICE

Screwed-in lifting eyes are to be tightened or removed after installation.
--

4.1.3 Installation of explosion-proof machines

CAUTION
--

The increased level of danger in areas where there is a risk of explosion or firedamp demands that you pay particular attention to the notes marked with  .
--

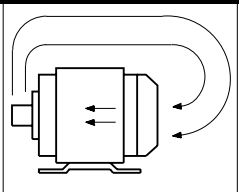
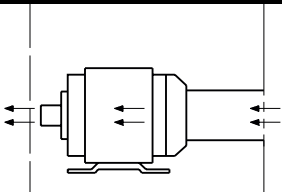
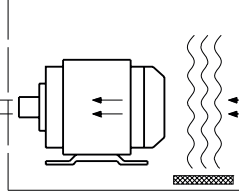
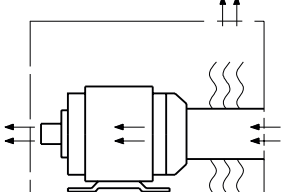
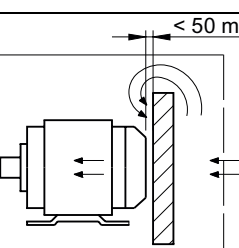
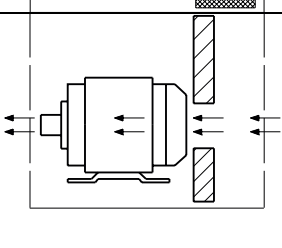
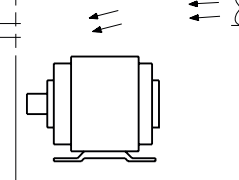
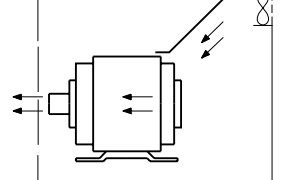
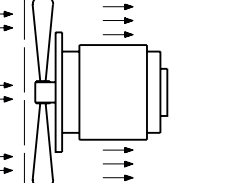
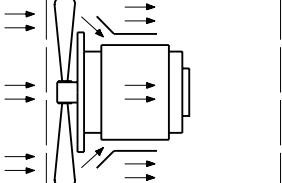


- Explosion-proof machines may only be used in suitable areas and as prescribed by the responsible supervisory body. They are responsible for determining the hazard level of each area (division into zones).
An X on the certificate denotes that special conditions of the EC-type examination certification must be observed.
- In Germany, DIN EN 60079-14 and the German Health and Safety at Work Regulations must be observed when installing electrical systems in hazardous areas. Elsewhere, the equivalent local regulations must be observed.
- 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.

4.1.4 Cooling

Do not impede ventilation! It must be ensured that discharged air - including that of adjacent items of equipment - is not immediately sucked in again.

Table 4-1 Air guidance

Incorrect			Correct		
					
					
					
					
					

In the case of vertical types of machine where air enters from above, the ingress of foreign bodies and water into the air inlets is to be prevented, e.g. by using a protective cover.
If the shaft end is facing upwards, the user must prevent liquid from entering along the shaft.

4.1.5 Balancing

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.

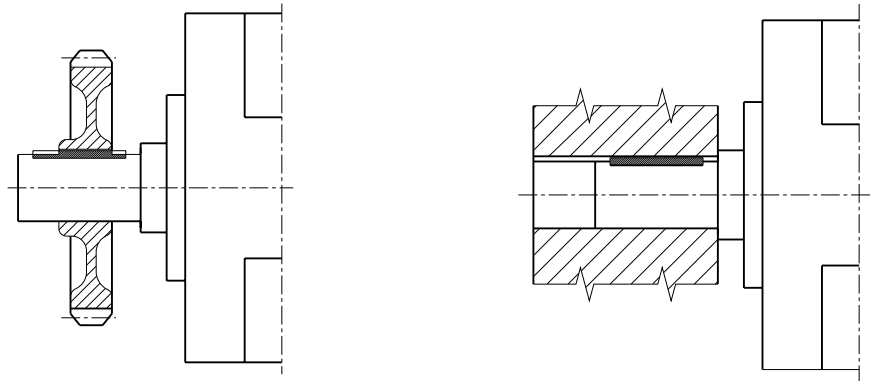
The declaration regarding the type of featherkey for balancing is marked on the face of the shaft end and on the rating plate.

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.

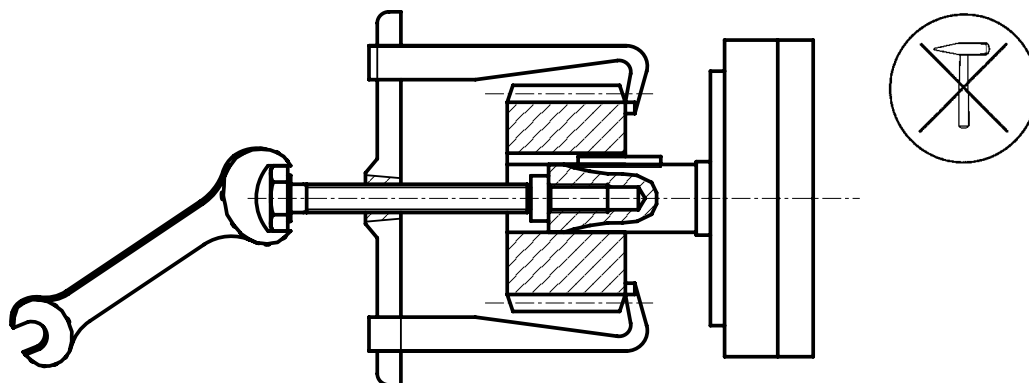


Note

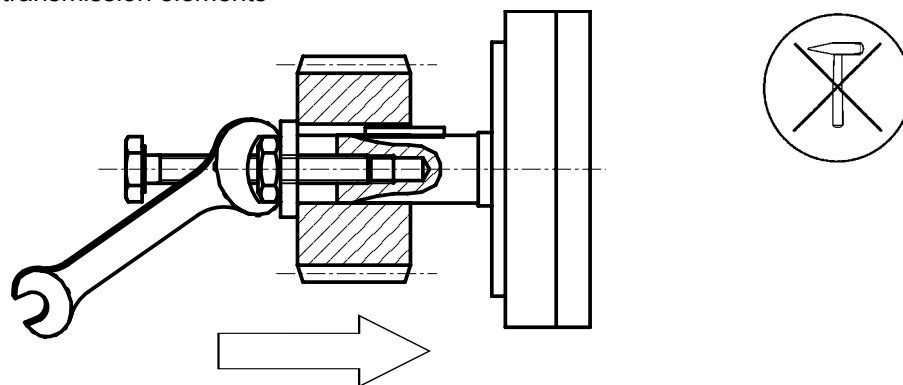
The permissible vibration levels in line with the evaluation zones according to ISO 10816 determine whether mounting and balancing have been carried out correctly. If the coupled machine does not comply with the vibration level according to EN 10816, complete dynamic balancing or an alteration to the foundations may be necessary.

CAUTION

It is permissible to push on or pull off transmission elements only with suitable equipment. The featherkeys are to be secured during transport to prevent them falling out. The generally required measures for touch protection of the transmission elements are to be observed.



Pulling off transmission elements



Pushing on transmission elements

NOTICE

If a machine without a transmission element is started up, the featherkey must be secured to prevent it from being thrown out.

When pushing on transmission elements (coupling, gear wheel, belt pulley etc.), use the thread at the shaft end and - if possible - heat the transmission elements as required. Use suitable tools for pulling transmission elements off. When the elements are being pushed on or pulled off, it is not permissible to hit the elements (with a hammer or similar) or to apply greater radial or axial forces to the machine bearings via the shaft end than those permitted according to the catalog.

4.1.6 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.
--

4.2 Alignment and fastening

4.2.1 General measures

Make sure that the machine is level and ensure secure fastening of feet and flanges, precise alignment in the case of direct coupling, and also cleanliness of the fastening surfaces. Avoid installation-related resonances with the rotating frequency and double line frequency. Turn rotor by hand and pay attention to any unusual noises. Check the direction of rotation with the motor uncoupled.

NOTICE

Any paint damage that occurs when the machine is being aligned and fastened is to be immediately repaired in a technically appropriate manner.
--

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**
Place shims under the machine feet to position it vertically and to prevent stress/distortion. The number of shims should be kept as low as possible, i.e. stack as few as possible.
- **Horizontal positioning**
To position the machine horizontally, push it sideways on the foundations and ensure that the axial position is maintained (angularity error).
- When positioning the motor, ensure that there is a uniform axial gap 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 transmission element (coupling, belt pulleys, fans, etc.), are prerequisites for smooth running with low vibration.
- Complete balancing of the machine with the transmission element may be necessary. For details and evaluation criteria, see ISO 10816.

- **Foot/Flange mounting**

The thread sizes prescribed in EN 50347 should be used for mounting the feet and flanges of the machine on the foundations or at the machine flange. The machine is to be fastened in place with 4 foot-mounting bolts and, where necessary, all the flange fastening screws. In the case of IM B14 flanges, the correct screw length must be chosen.

Note

The feet bolted onto the housing of the machine can be re-positioned, e.g. in order to change the position of the terminal box, but this must only be done by authorized partners.

The surfaces on which the feet were resting must then be made level by machining them or placing thin metal plates under the machine and must also be made parallel to the machine shaft in order to prevent distortion of/stress on the machine.

- **Flatness of the supporting surfaces for conventional motors**

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

4.2.1.1 Foot dimensions

Frame size (FS)	Type of feet
1LA/1MA FS 90S	Cast-on feet with double hole
1LA/1MA FS 90L	Cast-on feet with double hole
1MA6/1MJ6 FS 180M/L	Screwed-on feet with double hole

NOTICE

As far as type of construction IM B3 is concerned, the standard foot dimensions prescribed by EN 50347 should be used.
--

4.3 Connecting

4.3.1 Connection of the machine

4.3.1.1 Electrical connection

 WARNING

Any work on the stationary machine must be performed by qualified personnel, with the machine isolated from the supply and secured so that it cannot be switched back on again. This also applies to auxiliary circuits (e.g. anti-condensation heater). Check for isolation from supply!

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 magnify the increase in temperature and influence electromagnetic compatibility.

Before starting work, make sure that a protective conductor is securely connected.

The stipulations in IEC / EN 60034-1 (VDE 0530-1) regarding operation at the limits of the A zones ($\pm 5\%$ voltage difference or $\pm 2\%$ 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, are to be complied with. It must be ensured that the limits are not exceeded under any circumstances!

The machine must be connected in such a way that a permanently safe, electrical connection is guaranteed (no protruding wire ends); use the assigned cable-end fittings (e.g. cable lugs, wire end ferrules).

Connect the supply voltage and arrange the jumpers according to the circuit diagram 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 or IEC/EN 60204-1).

The necessary connection data regarding

- the direction of rotation,
- the number and arrangement of the terminal boxes,
- the circuit and connection of the machine winding,

are defined in the "Technical specifications".

4.3.1.2 Electrical connection for explosion-proof machines



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

- Area A in IEC/EN 60034-1 (VDE 0530-1) ($\pm 5\%$ voltage or $\pm 2\%$ frequency deviation, curve, supply symmetry) must be maintained 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 may the limits be exceeded.
- Any machine with type of protection Increased Safety "e" must be protected against overheating in accordance with EN 60079-14 using an inverse-time delay circuit-breaker with phase loss protection and asymmetry detection to EN 60947, or using an equivalent device in all phases.
- In the case of machines with type of protection Increased Safety "e", the overcurrent device with an inverse-time delay tripping mechanism should be selected so that the time to disengagement (taken from the characteristic of the switch for the I_A/I_N ratio of the machine to be protected) is no greater than the machine heating time t_E . The I_A/I_N ratio and the heating time t_E should be taken from the rating plate. The protective device should also be set to the rated current. A tripping device that conforms to RL94/9/EC should be used.
- As regards machines with type of protection Increased Safety "e", in the event of a locked rotor the protective device must disconnect within the t_E time specified for the relevant temperature class. In accordance with the specifications of the EC-type examination certificate, electrical machines used for heavy starting (ramp-up time $> 1.7 \times t_E$ time) should be protected by startup monitoring.
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.

4.3.1.3 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 4-2 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

4.3.1.4 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 swapped, then the resulting direction of rotation is counter-clockwise (e.g. L1, L2, L3 to V, U, W).

In the case of machines intended for only one direction of rotation, the prescribed direction of rotation is marked by a direction arrow on the machine.

4.3.1.5 Connection with/without cable lugs

In the case of terminals with terminal clips, the conductors are to be spread out in such a way that the terminating heights on both sides of the web are about the same. This method of connection requires that a single conductor must be bent into a U shape or is to be connected with a cable lug. The same applies to the inner and outer terminals of the ground conductor

When using cable lugs to make the connection, the choice of cable lug size must match the required conductor cross-section and the bolt size. A skewed arrangement is only permissible if the required air gaps and creepage distances are adhered to.

Strip the insulation from conductor ends in such a way that the remaining insulation almost reaches the cable lug.

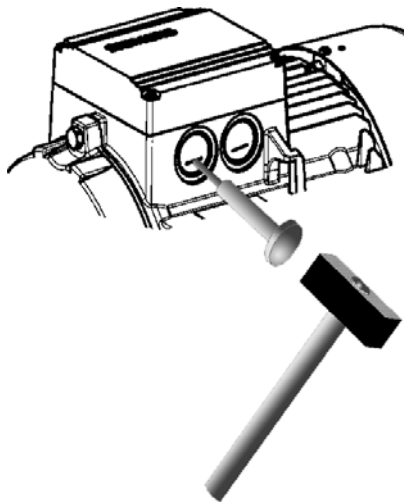
Note

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

4.3.1.6 Cable entry

Knockout openings

NOTICE
Knockout openings in the terminal box must be knocked out appropriately. Care must be taken to ensure that the terminal box and the terminal board and cable connections, etc., that it contains are not damaged.



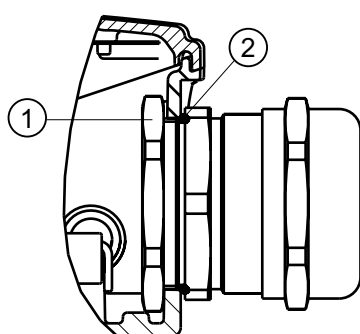
Assembly and laying of cables

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

Note

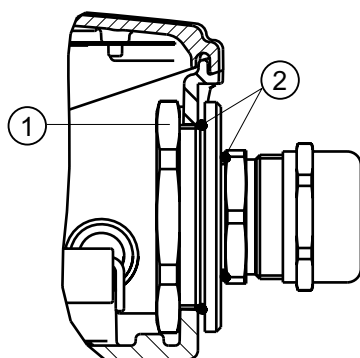
The screw-type connections must have been matched to the connecting cables used (armoring, braid, shield).

Screw-type connections with (sheet metal) nuts (DIN EN 50262)



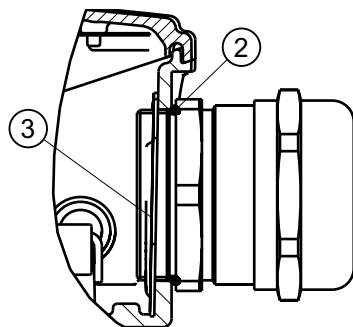
- ① Nut
- ② O ring

Screw-type connections with adapters and (sheet metal) nuts (DIN EN 50262)



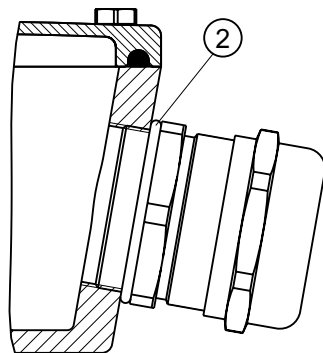
- ① Nut
- ② O ring

Mounting position of sheet metal nuts in screw-type connections



- ② O ring
- ③ Mounting position of metal-sheet nuts

Screw-type connections with connecting thread in terminal box (DIN EN 50262)



- ② O ring

Thread size in terminal box

Table 4-3 Thread sizes in terminal box

Shaft height	Motor type	Type of protection/Zone	Standard thread		Additional thread with mounting parts	
			Size	Number	Size	Number
63 - 90	1LA7 1LA9 1MA7 1MJ6	Without Increased Safety "e" Non-sparking "n" Zone 21 Zone 22	M 16 x 1.5 M 25 x 1.5	1 1		
71 - 90	1MJ6	Flameproof Enclosure "d" Zone 21	M 20 x 1.5	1	M 25 x 1.5	1
100 - 132	1LA7 1LA9 1MA7	Without Increased Safety "e" Non-sparking "n" Zone 21 Zone 22	M 32 x 1.5	4		
100 - 132	1MJ6	Flameproof Enclosure "d" Zone 21	M 32 x 1.5	1	M 16 x 1.5	1
160	1LA7 1LA9 1MA7	Without Increased Safety "e" Zone 21 Zone 22	M 32 x 1.5	4		
160	1MJ6	Increased Safety "e" Zone 21	M 40 x 1.5	2	M 20 x 1.5	2
160	1MJ6	Flameproof Enclosure "d" Zone 21	M 40 x 1.5	1	M 16 x 1.5	1
180	1MA6 1MJ6	Increased Safety "e" Zone 21	M 40 x 1.5	2	M 16 x 1.5	2
180	1MJ6	Flameproof Enclosure "d" Zone 21	M 40 x 1.5	1	M 20 x 1.5	1
200 - 225	1LA5	Without Increased Safety "e" Zone 21 Zone 22	M 50 x 1.5	2	M 16 x 1.5	2
200	1MA6 1MJ6	Increased Safety "e" Zone 21	M 50 x 1.5	2	M 16 x 1.5	2
200	1MJ6	Flameproof Enclosure "d" Zone 21	M 50 x 1.5	1	M 20 x 1.5	1

Cable entries for explosion-proof machines



Cable entries must be permitted for use in hazardous areas. Openings that are not being used must be sealed with approved plugs. Pay attention to the manufacturer documentation in respect of cable entries.

4.3.1.7 Terminal box

Standard design

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

CAUTION

It must be ensured that the terminal box, terminal board and cable connections etc. inside the terminal box are not damaged.

NOTICE

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

CAUTION

It must be ensured that there are no foreign bodies, dirt or moisture in the terminal box. Entries in the terminal box (see DIN 42925) and other open entries are to be sealed with an O ring or a suitable flat gasket so that dust and water cannot enter, whereas the terminal box itself is to be sealed against dust and water with the original seal. Comply with the specified tightening torques for cable glands and other screw-type connections. Secure featherkey for trial operation without transmission elements.

Terminal boxes for explosion-proof machines



Explosion-proof machines (with the exception of machines for Zone 22) are fitted with terminal boxes with type of protection Increased Safety "e".

In the case of 1MJ machines, terminal boxes with type of protection Flameproof Enclosure "d" - explosion group IIC are available as an option. For information on installation, connection options and spare parts, see Chapter 8. Please pay attention to the notes on hazardous areas in the operating instructions. Repairs must only be carried out in or by authorized Siemens workshops.

Connecting the temperature sensor/anti-condensation heater

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

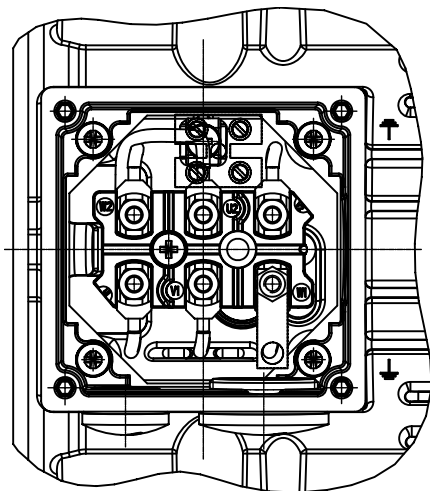


Figure 4-1 Connection to terminal strip

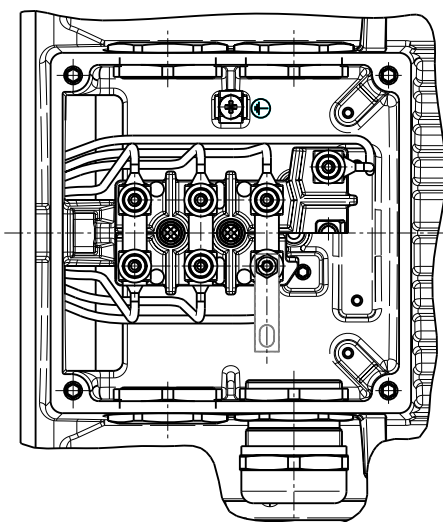


Figure 4-2 Connection to terminal board

Final checks

Before closing the terminal box, check that

- The electrical connections in the terminal box have been made in accordance with the specifications above and tightened to the required tightening torque.
- the air clearances between non-insulated parts are maintained:
≥ 5.5 mm to 690 V, ≥ 8 mm to 1000 V.
- No wire ends are protruding
- The connecting cables are laid without touching the machine, and the cable insulation cannot be damaged.
- The machine is connected up corresponding to the specified direction of rotation.
- The inside of the terminal box is clean and free of any cable pieces.
- All seals and sealing surfaces are clean and not damaged.
- Unused openings in the terminal boxes are properly closed off.
- The pressure relief device must be undamaged (depending on the type of terminal box: either cast-in slots or an overpressure diaphragm). Any damage may only be repaired after prior discussion with the person responsible for the safety of the installation and only by using original parts.

Final checks for explosion-proof machines

Before closing the terminal box, check that



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

4.3.2 Tightening torques

4.3.2.1 General notes

CAUTION

It must be ensured that there are no foreign bodies, dirt or moisture in the terminal box. Cable glands in the terminal box (see DIN 42925) and other open entries with dummy plugs are to be sealed with an O ring or a suitable flat gasket so that dust and water cannot enter, whereas the terminal box itself is to be sealed against dust and water with the original seal. Comply with the specified tightening torques for cable glands and other screw-type connections.
Secure featherkey for trial operation without transmission elements.

4.3.2.2 Electrical connections - Terminal board connections

Table 4-4 Tightening torques for screws at the terminal box, end shields, screw-type ground conductor connections

	Thread Ø		M 4	M 5	M 6	M 8	M 10	M 12	M 16
	Nm (lbf-in)	min	0,8	1,8	2,7	5,5	9	14	27
		max	1,2	2,5	4	8	13	20	40

4.3.2.3 Cable glands

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 4-5 Tightening torques for cable glands

	Metal ± 10% Nm	Plastic ± 10% Nm	O ring String Ø mm
M 12 x 1.5	8	4	2
M 16 x 1.5	10		
M 20 x 1.5	12		
M 25 x 1.5			
M 32 x 1.5	18	6	
M 40 x 1.5			
M 50 x 1.5	20		
M 63 x 1.5			

NOTICE

If different kinds of cable sheath material are used, smaller tightening torques are to be used.

Damage to cable sheaths is to be prevented by using smaller tightening torques.

4.3.2.4 Cable glands on explosion-proof machines



Cable glands must be permitted for use in hazardous areas. Openings that are not being used must be sealed with approved plugs. Pay attention to the manufacturer documentation in respect of cable glands.

4.3.2.5 Terminal boxes, end shields, ground conductors

Note

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

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

	Thread Ø		M 4	M 5	M 6	M 8	M 10	M 12	M 16	M 20
	Nm (lbf-in)	min	2	3,5	6	16	28	46	110	225
		max	3	5	9	24	42	70	165	340

4.3.2.6 Connecting conductors

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

Table 4-7 Max. conductor connection for standard machines and Zone 22

Frame size	Max. connectable conductor cross-section mm ²	
	with wire end ferrule	with cable lug
56 - 90	1.5	2.5
100 - 112	4.0	4.0
132	6.0	6.0
160 - 180	16.0	16.0
200	25.0	25.0
225	35.0	35.0

Table 4-8 Max. conductor connection for explosion-proof machines (with the exception of Zone 22) and VIK standard version

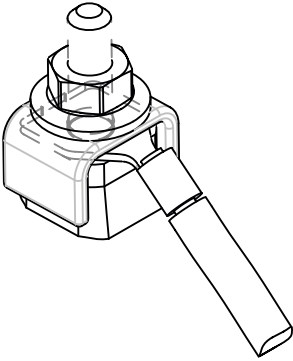
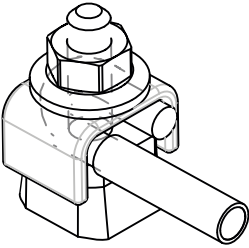
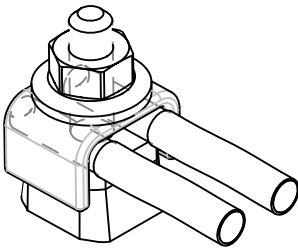
Frame size	Max. connectable conductor cross-section mm ²	
	with wire end ferrule	with cable lug
56 - 112	4.0	4.0
132	6.0	6.0
160	16.0	16.0
180	10.0	10.0
200 - 225	50.0	50.0

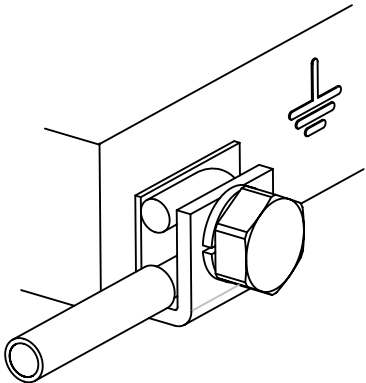
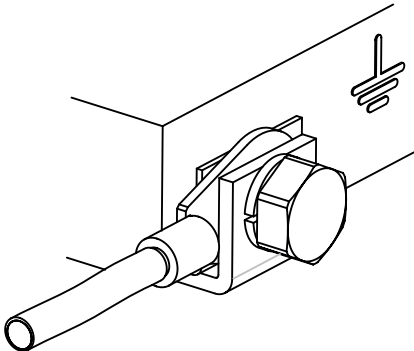
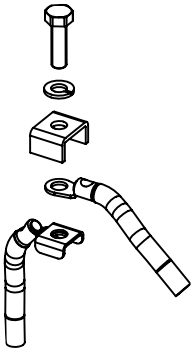
4.3 Connecting

Table 4-9 Max. conductor connection for standard 1MJ machines

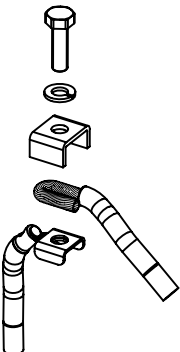
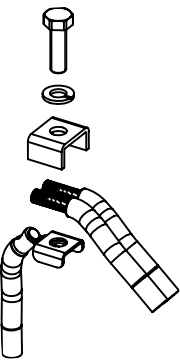
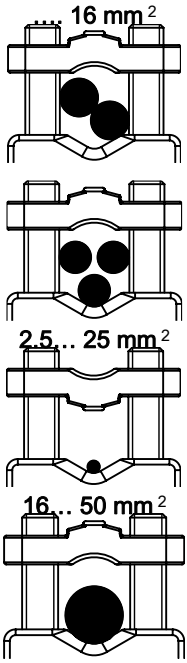
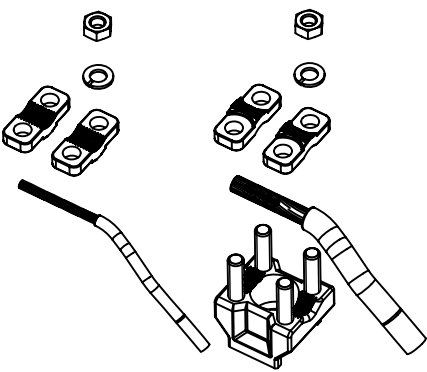
Frame size	Max. connectable conductor cross-section mm ²	
	with wire end ferrule	with cable lug
71 - 80	4.0	4.0
90 - 160 M	6.0	6.0
160 L	16.0	16.0
180	25.0	25.0
200	50.0	50.0

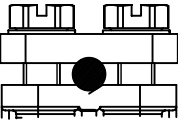
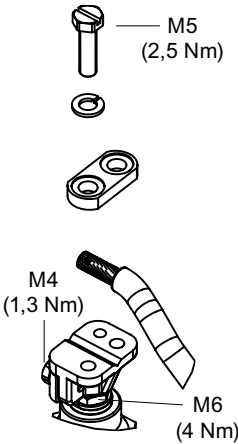
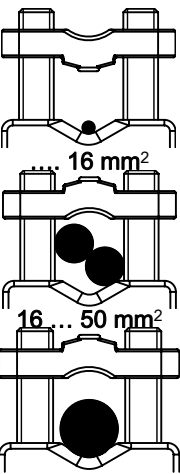
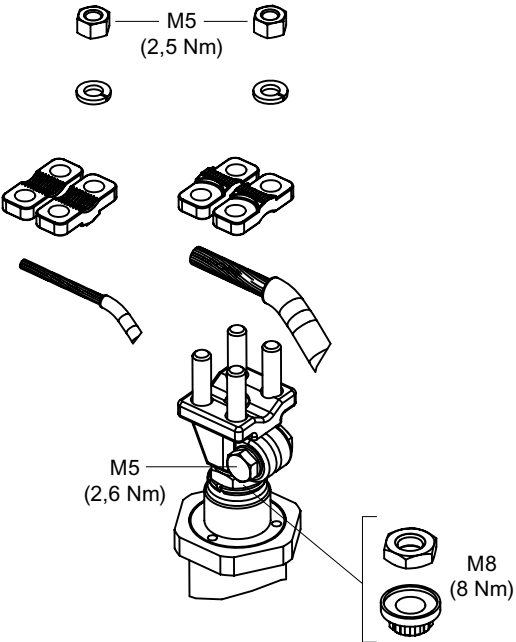
Table 4-10 Type of connection

.... 25 mm ²		If a connection is made with a DIN cable lug, the latter must be angled downwards. DIN 46234
.... 10 mm ²		Connection of an individual conductor with terminal clip.
.... 25 mm ²		Connection of two conductors of approximately the same thickness with terminal clip.

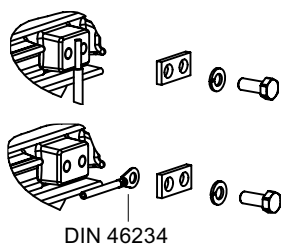
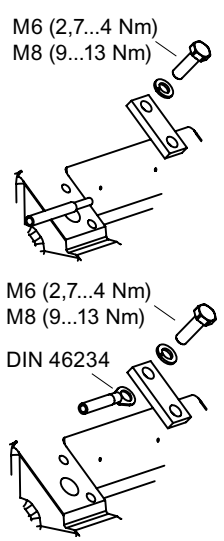
.... 10 mm²		Connection of an individual conductor under external grounding angle.
.... 25 mm²		In the case of connection with a DIN cable lug under the external grounding angle. DIN 46234
.... 10 mm² AH 180 35 mm² AH 200		If a connection is made with a DIN cable lug, the latter must be angled downwards. 1MA618. - 20.

4.3 Connecting

.... 25 mm²		Connection of an individual conductor with terminal clip 1MA618. - 20.
.... 25 mm²		Connection of two conductors of the same thickness with terminal clip 1MA618. - 20.
		Connecting terminal for large cross sections 1MA618. - 20.

2.5.... 25 mm² 	 M5 (2,5 Nm) M4 (1,3 Nm) M6 (4 Nm)	Connecting terminal 1MJ6180 M/L
2.5.... 25 mm² 16 mm² 16 ... 50 mm² 	 M5 (2,5 Nm) M5 (2,6 Nm) M8 (8 Nm)	Connecting terminal 1MJ6200 M/L

4.3 Connecting

.... 25 mm² SH 71 - 132 35 mm² AH 160	 DIN 46234	External grounding 1MJ6071... 160 L
.... 35 mm² AH 180 50 mm² AH 200	 M6 (2,7...4 Nm) M8 (9...13 Nm) M6 (2,7...4 Nm) M8 (9...13 Nm) DIN 46234	External grounding 1MJ6180 M ... 200 L

4.3.3 Connecting the ground conductor

General

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

- Internal grounding with connection in terminal box at the place intended for this purpose and marked accordingly.
- External grounding with connection at the stator housing at one of the four places intended for this purpose and marked accordingly.

The cross-section of the ground conductor of the machine must comply with the regulations for electrical installations, e.g. DIN EN IEC 60204-1.

Table 4-11 Minimum surface area of grounding conductor

Minimum surface area of insulation phase conductor S mm ²	Minimum surface area of corresponding ground connection mm ²
S ≤ 16	S
16 < S ≤ 35	16
S > 35	0.5 S

Interior ground terminal

Please note the following when connecting-up:

- The contact surface must be clean and bright, and protected with a suitable anti-corrosion agent, e. g. acid-free Vaseline.
- The cable lug must be inserted between the terminal clips.
- The spring washer must be under the head of the screw.

Exterior ground terminal

Please note the following when connecting-up:

- The contact surface must be clean and bright, and protected with a suitable anti-corrosion agent, e. g. acid-free Vaseline.
- The cable lug must be inserted between the contact angle and the grounding angle; it is not permissible to remove the contact angle pressed into the housing.
- 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.

Table 4-12 Size of grounding conductor screw (except for 1MJ machines)

Shaft height	Thread size for the grounding conductor
63 - 90	M4
100 - 112	M5
132 - 180	M6
200 - 225	M8

Table 4-13 Size of grounding conductor screw for 1MJ machines

Shaft height	Thread size for the grounding conductor
71 - 180	M6
200	M8

4.3.4 Connection of optional built-on accessories

Separately driven fan, encoder, brake

See list of additional operating instructions attached

4.3.5 Connecting optional built-on accessories for explosion-proof machines



Built-on accessories such as brakes, forced ventilation or pulse encoders must be selected for conformity to the specifications of Directive 94/9/EC.

4.3.6 Connection to the converter

CAUTION

The standard insulating system is suitable for converter voltages up to 500 V. For higher voltages, a machine with a special insulating system must be used.

Note

EMC

Comply with the instructions given in the section regarding electromagnetic compatibility.

See list of additional operating instructions attached

4.3.7 Connecting explosion-proof machines to the converter



Where machines with type of protection Increased Safety "e" are concerned, connection to a converter must be expressly certified. The separate manufacturer notes must be observed. For type of protection Increased Safety "e", the machine, converter and protective devices must be labeled as working in conjunction with one another, and the permitted operating data must be specified in the devices' collective EC-type examination certificate.

Machines connected to a converter for Zone 21 and Zone 22 are generally fitted with 3 PTC thermistors in accordance with DIN 44082 with a rated intervention temperature that depends on the maximum possible surface temperature. PTC thermistor evaluators should be selected for conformity to this standard. The maximum temperature at the cable entries is 120°C. Appropriate cables for this temperature must be used. The maximum frequency, which is dependent on the number of poles, is stamped on the rating plate and must not be exceeded. In cases where the system linking the converter, cable and electrical machine draws its power from a public grid with an operating voltage of up to 690 V, the maximum value of the transients at the end of the cable must not be more than twice the converter's DC link voltage (approx. 2 kV).

Commissioning

5.1 Checking the insulation resistance

Safety information

WARNING

Only expert personnel should be entrusted with work on power installations.

All covers which are designed to prevent active or rotating parts from being touched, or which are necessary to ensure correct air guidance and thus effective cooling, must be installed prior to start-up.

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 manual for the insulation resistance meter you are going to use. Any cables of the main circuit which are already connected should be disconnected from the terminals in order to carry out the insulation measurements.

WARNING

During the measurement, and immediately afterwards, some of the terminals are at hazardous voltage levels and must not be touched. Carry out a check with the power cables connected that no voltage can be applied.

Measure the minimum insulation resistance of the winding to the machine housing, if possible at a winding temperature between 20 and 30°C. Different insulation resistance values apply at other temperatures. When making the measurement, you must wait until the final resistance value is reached (approx. 1 minute).

The critical insulation resistance is reached at the operating temperature of the winding.

Limit values

The following table indicates the measuring circuit voltage together with the minimum insulation resistance and the critical insulation resistance.

Table 5-1 Insulation resistance

	Rated voltage $U_{\text{rated}} < 2 \text{ kV}$
Measuring circuit voltage	500 V
Minimum insulation resistance with new, cleaned or repaired windings	10 MΩ
Critical specific insulation resistance after a long operating time	0.5 MΩ/kV

(values apply at a winding temperature of 25 °C)

Note the following points:

- If the measurements are performed at winding temperatures other than 25°C, the measured value will need to be converted to the reference temperature of 25°C in order to be able to compare the values with the table above. The insulation resistance is reduced by a factor of a half for every 10 K increase in temperature, and it is increased by a factor of two for every 10 K decrease in temperature.
- New, dry windings have an insulation resistance of between 100 and 2000 MΩ, or even higher values, if required. If the insulation resistance is close to or below the minimum value, the cause could be humidity and/or dirt accumulation. The windings must then be dried.
- 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 for a 25°C winding temperature can be calculated, depending on the rated voltage, by multiplying the rated voltage (kV) by the specific critical resistance value (0.5 MΩ/kV);
e.g. critical resistance for a rated voltage (U_N) 690 V:
 $690 \text{ V} \times 0.5 \text{ MΩ/kV} = 0.345 \text{ MΩ}$

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, the insulation resistance should be subsequently checked at appropriately frequent intervals.

5.2 Measures before start-up

Overview

After assembling the motor in line with technical requirements and before starting up the system, check that:

- The machine has been assembled and aligned properly.
- The machine has been connected up in accordance with the specified direction of rotation.
- The operating conditions are in accordance with the data specified on the rating plate.
- The bearings have been regreased (depending on model). Rolling-contact bearing machines which have been in storage for more than 24 months must be regreased.
- Any supplementary motor monitoring devices and equipment have been correctly connected and are functioning correctly.
- If bearing thermometers are fitted, the bearing temperatures are checked during the initial run of the motor and the values for warning and switch-off are set on the monitoring device.
- Appropriately configured control functions and speed monitoring equipment ensure that the motor cannot reach speeds higher than the permissible speeds stated on the rating plate.
- The transmission 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 values and the minimum air gap values have been complied with.
- The grounding and equipotential bonding connections have been correctly made.
- all retaining bolts, connecting elements and electrical connections have been tightened to the specified torque.
- Screwed-in lifting eyes are to be removed after installation or secured to prevent them from becoming loose.
- The rotor can be spun without coming into contact with the stator.
- all shock protection measures for moving and live parts have been taken.
- If the end of the shaft is not used, its featherkey has been secured so that it cannot fall out and the open shaft end is covered.
- all separately driven fans fitted are ready for operation and have been connected such that they rotate in the direction specified.
- the flow of cooling air is not impeded.
- all brakes are operating correctly.
- The specified mechanical limit speed $n_{\max}$ is not exceeded.

If the design of the machine requires that the converter is assigned in a particular way, the rating plate will contain corresponding additional information.

Note

It may be necessary to make additional checks and tests in accordance with the situation specific to the particular place of installation.

5.3 Switching on

Measures for start-up

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

- Start the motor without a load; to do this, close the circuit-breaker and preferably do not switch it off prematurely. Switching the motor back off again while it is starting up and still running at slow speed should be kept to a bare minimum, for example for checking the direction of rotation or for checking the operation of the motor. 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 the mechanical operation improves immediately after switching the motor off, then the cause is magnetic or electrical. If the mechanical operation does not improve immediately after switching the motor off, then the cause is mechanical: e.g. an imbalance in the electrical machines or in the driven machine, inadequate alignment of the machine set, operation of the machine with the system resonating (system = machine + base frame + foundations etc.).
- If the motor runs perfectly in terms of its mechanical operation, switch on any cooling devices which exist and continue to monitor the machine for a while as it idles.
- 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 must be in accordance with DIN ISO 10816, as 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 equipment.

5.4 Switching on explosion-proof machines

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 power switch and preferably do not switch it off prematurely. Switching the motor back off again while it is starting up and still running at slow speed should be kept to a bare minimum, for example for checking the direction of rotation or for checking the operation of the motor. Allow the machine to run to a standstill before switching it back on again.

6

Operation

6.1 Safety information

Energizing the machine with anti-condensation heating (optional)

CAUTION

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

Machine operation

WARNING

All covers which are designed to prevent active or rotating parts from being touched, or which are necessary to ensure correct air guidance and thus effective cooling, must not be opened during operation.

All deviations from normal operation (higher power consumption, temperature or vibration level, unusual noises or odors, tripped monitoring devices, etc.) are indications that the motor is no longer functioning correctly. In this case, the maintenance engineer must be immediately notified in order to prevent disturbances that could either directly or indirectly lead to severe personal injury or substantial material damage. If in doubt, power down the machine immediately in accordance with the system-specific safety requirements!

CAUTION

The surfaces of the machines can reach high temperatures, which can lead to burns if touched. That is why appropriate measures against accidental contact must be taken.

Cleaning

To ensure proper functioning of the machine's cooling system, the air ducts must be free of pollution (grilles, ducts, ribs, pipes).

CAUTION
With varying machine temperatures, humid air can condense inside the machine. Depending on the environmental and operating conditions, therefore, remove the condensation water plug to drain the water. Afterwards, reinsert the plug. [ID 619.2]

6.2 Safety information for explosion-proof machines



Machines with type of protection Flameproof Enclosure "d" and Increased Safety "e", and machines for Zone 2, may only be used in hazardous areas as prescribed by the responsible supervisory body. 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 not 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. The machines may only be used for the operating mode specified on the rating plate.

- **Measures for maintaining the temperature class:**

With S1 line supply operation, a function-tested, inverse-time delayed protective device that monitors all three external 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. At 1.05x the rated current, machines must not be switched off within 2 hours.

Pole-changing machines require a separate switch for each pole number. Any anti-condensation heaters used must only supply heat when the machines are not in operation.

With S2 to S9 line supply operation, machines with type of protection Flameproof Enclosure "d" must be equipped with at least 3 temperature sensors (one per phase) and a suitable electronic switchoff device with a temperature sensor in the protective sleeve.

6.3 Stoppages

Overview

If the machine remains out of service for an extended period of time (> 1 month), it should be started up about once a month or at least the rotor should be turned. Refer to the instructions in the "Switching on" section before restarting the machine. If a rotor locking device has been fitted to the machine, you must remove it before you spin the rotor.

CAUTION

If the motor is not to be used for a period in excess of 12 months, suitable anti-corrosion, mothballing, packaging and drying measures must be taken.
--

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 required measures, see "Transport" and "Storage" sections.

Lubricating before recommissioning

CAUTION

If the motor has not been used for more than 1 year, it must be regreased before being restarted. The shaft must rotate so that the new grease can be distributed throughout the bearings. When relubricating, comply with the information on the lubrication plate. Only in the case of relubrication; otherwise, similarly to section entitled "Application planning - Useful life of bearings"
--

Overview

Before rectifying the fault, refer to section entitled "Safety instructions".

In the event that electrical faults occur during operation of the machine with a converter, please also refer to the operating instructions of the frequency converter.

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

Table 6-1 Fault table, electrical causes

								Electrical fault characteristics							
↓								Machine will not start up							
	↓								Machine starts up slowly						
		↓								Rumbling noise during start-up					
			↓								Rumbling noise during operation				
				↓							High temperature rise during idling				
						↓							High temperature rise under load		
								↓							High temperature rise 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 cable	Check switches and supply cables						
	X	X	X			X	X	Interruption of a phase in the supply after switching on	Check switches and supply cables						
X	X							Mains voltage too low, frequency too high	Check mains conditions						
					X			Mains voltage too high, frequency too low	Check mains 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) Apart from eliminating the cause of the fault (as described under "Remedial measures"), you must also rectify any damage the machine may have suffered.

Table 6-2 Fault table, mechanical causes

Mechanical fault characteristics				
↓				Grinding noise
	↓			High temperature rise
		↓		Radial vibrations
			↓	Axial vibrations
				Possible causes of faults
				Remedial measures¹⁾
X				Rotating parts rubbing/grinding
	X			Determine cause and adjust parts
				Reduced air supply, fan possibly running in the incorrect direction of rotation
		X		Check airways, clean motor
		X		Rotor not balanced
		X		Check featherkey declaration (H, F, N)
		X		Rotor out of true, shaft bent
		X		Consult the manufacturer
		X	X	Poor alignment
		X		Align motor unit, check coupling ²⁾
		X		Coupled machine not balanced
		X		Rebalance coupled motor
		X		Shocks from coupled machine
		X		Check coupled motor
		X	X	Imbalance originating from gearing
		X		Adjust/repair gearing
		X	X	Resonance of the overall system comprising machine and foundations
		X		After consultation, reinforce foundations
		X	X	Changes in foundation
		X		Determine cause of changes, eliminate if necessary; realign motor

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

2) Take into account possible changes due to a rise in temperature.

6.5 Deactivating

Note

Machine must be completely isolated from the supply.

Measures for shutting down the machine

Any devices provided for protection against condensation are to be started up after the machine has been shut down, e.g. anti-condensation heater.

6.6 Class

6.6.1 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		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 acetylenes
- ⑪ Temperature class: T4 For maximum surface temperature of 135°C

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

CE	158		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

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

CE	Ex-91.Y.3721		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

6.6.4 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

6.6.5 Zone 22

		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

Maintenance

7.1 Preparation and notes

Safety instructions

	WARNING
Before starting any work on the machines, make sure that the system has been isolated from the supply in accordance with the regulations. In addition to the main circuits, also make sure that that supplementary and auxiliary circuits are isolated from the supply, especially the anti-condensation heater. 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 cleaning the machine with compressed air, ensure that suitable exhaustion measures are used and you use personal protective gear (goggles, face mask/filter or similar)! If chemical cleaning agents are used, observe the instructions and any warnings indicated on the associated safety data sheets. Chemical agents must be compatible with the machine's components/parts, especially when they contain plastics.	

Note

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

Machines for the North American market (optional)

If any changes are made to the listed machines or if repairs are carried out on them, the corresponding construction standards are to be complied with. These machines are indicated on the rating plate with the following markings.

Table 7-1 Markings for the North American market

	Underwriters Laboratories
	Canadian Standard Association
	Canadian Standard Association Energy Efficiency Verification

7.2 Preparation and notes for explosion-proof machines



Repairs must be carried out in or by authorized Siemens workshops.

Changes, repairs and overhauls on machines for **hazardous areas** must only be carried out by qualified personnel. It is imperative that you pay attention to the regulations laid down by IEC 60079-19.

It is imperative that you pay attention to the regulations laid down by EN 61241-17 regarding changes, repairs and overhauls on machines for use with **combustible dust**.

7.3 Maintenance

7.3.1 Maintenance intervals

General

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

Careful and regular maintenance, inspections and overhauls are essential for detecting and eliminating faults in good time before they can cause any 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.), carry out the inspections immediately.

Measures, intervals

Measures after operating period intervals have elapsed:

Table 7-2 Operating period intervals

Measures	Operating period intervals	Intervals
Initial inspection	After 500 operating hours	After 6 months 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	

7.3.2 Re-greasing

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. Information on regreasing intervals, the amount and types of grease, are indicated on the rating plate in this case.

Note

Do not mix different types of grease!

Prolonged storage periods reduce the useful life of the bearing grease. If stored for more than 12 months, the condition of the grease must be checked. If the grease is found to have lost oil content or has become contaminated, regreasing must be carried out before start-up. For permanently greased bearings, see section entitled "Repair".

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 plate).

Note

The information on the rating plate must be complied with. Regreasing should be carried out when the machine is running.

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

7.3.3 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. Remove the used grease when you replace a bearing.

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



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

7.3.4 Drain condensate

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

NOTICE
In order to comply with the degree of protection, any existing condensate drain holes must be closed!

7.4 Inspection

7.4.1 General inspection specifications

Safety-relevant information

NOTICE
The required regreasing intervals for rolling-contact bearings are not the same as the inspection intervals and must be adhered to.

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.

7.4.2 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 6 months.

Procedure

While the motor is running, check that:

- The equipment conforms to the stated electrical characteristics.
- The permissible bearing temperatures are not exceeded.
- The smooth running characteristics and machine noise during operation have not deteriorated.

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
Any inadmissible deviations from these requirements which are detected during this inspection must be eliminated immediately.

7.4.3 Main inspection

Inspection interval

1x yearly

Procedure

While the motor is running, check that:

- The equipment conforms to the stated electrical characteristics.
- The permissible bearing temperatures are not exceeded.
- The smooth running characteristics and machine noise during operation have not deteriorated.

With the machine at a standstill, check that:

- The machine foundations have no indentations or cracks.
- The three-phase machine is within the permissible tolerance ranges.
- All of the mounting bolts for the mechanical and electrical connections have been securely tightened.
- The winding isolation resistances are sufficiently high.
- Cables and insulating parts and components are in a good condition and are not discolored.

NOTICE
Any inadmissible deviations from these requirements which are detected during this inspection must be eliminated immediately.

7.5 Corrective maintenance

7.5.1 Instructions for repair

Qualified personnel

Only properly qualified persons should be entrusted with the commissioning and operation of machines and equipment. Qualified persons, as far as the safety instructions given in this manual are concerned, are those who have the necessary authorization to commission, ground and identify 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 the machine has to be transported, comply with the instructions in the section entitled "Application planning".

7.5.2 Bearings

Description

The bearings used are indicated on 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 reduction of the bearings' useful life. Replacement of the bearings is recommended after only 12 months of storage. If the bearings are stored for more than 4 years, they must be replaced.

Replacement of bearings

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

Table 7-3 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

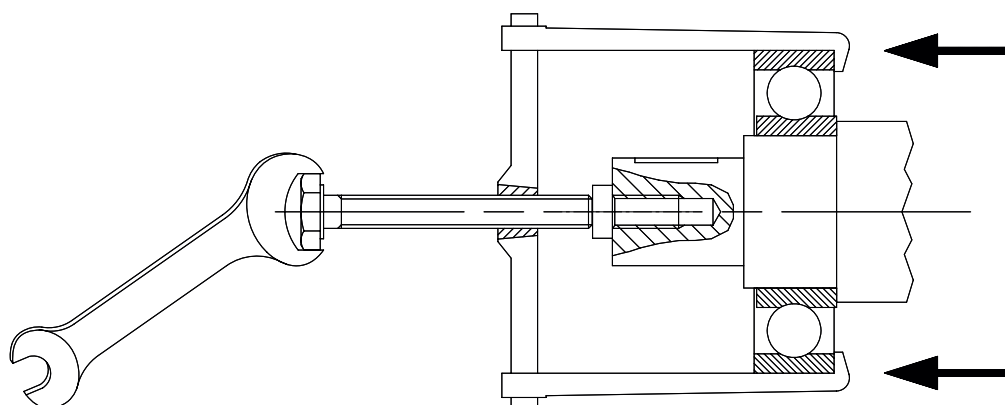
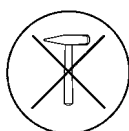
Note

Special operating conditions

The operating hours decrease in the case of, e.g., vertical machine installation, large vibrational and impact stress, frequent reversing, higher coolant temperature, higher speeds etc.

NOTICE

It is not permissible to reuse bearings that have been removed.



Replacement of bearings

7.5.3 Bearings in explosion-proof machines

Replacing bearings in explosion-proof machines



When replacing bearings, seals must also be replaced. With machines for use in Zone 21, you should use AS type rotary shaft seals without ring springs, which conform to DIN 3760 and are made from a suitable material. For machines with a shaft height of up to and including 132, rotary shaft seals made from acrylonitrile butadiene rubber (NBR) are used; from shaft height 160, rotary shaft seals made from fluorine rubber (FKR) are used. When installing the seals, the space in the middle of the seal and in the end shield hub should be completely filled with a suitable type of grease. When replacing seals on machines for use in Zone 22, you should use A type rotary shaft seals without ring springs or CD rings.

7.5.4 Dismantling

Dismantling instructions

NOTICE
Before dismantling is started, the respective assignment of fastening elements as well as the location of internal connections are to be marked for re-assembly.

Fan

If a fan has a snapping mechanism, make sure that this is not damaged. If any damage is caused, request new parts.

Bearing bushes

Protect bearings against the ingress of dirt and moisture.

Links

- Replace any corroded screws/bolts
- Avoid damage to the insulation of parts which carry voltage
- Record the position of any rating plates or auxiliary plates which have to be removed.
- Avoid damage to the centering flanges

7.5.5 Assembly

Notes on assembly

If possible, assemble the machine on a surface plate. This ensures that the feet surfaces are all on the same level.

NOTICE

Avoid damage to the windings protruding out of the stator housing when fitting the end shield.

Sealing measures

- Apply Fluid-D to the centering flange
- Check terminal box seals and, if necessary, replace.
- Repair any paintwork damage (also on screws/bolts)
- Take necessary measures to ensure compliance with required 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)



With explosion-proof machines, apply a small amount of acid-free, non-resinous grease to the centering flanges. Sealing agents may not be used.

Installation of the bearing bushes

Observe the specified screw tightening torques (Page 73).

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)

Fan

If a fan has a snapping mechanism, make sure that this is not damaged. If any damage is caused, request new parts.

Miscellaneous

- Number and position of rating plates and auxiliary plates as in original condition
- If necessary, fix electrical cables/wires in place
- Check tightening torques of all screws, also those of screws which have not been unscrewed



The number on the EC-type examination certificate for machines with type of protection Flameproof Enclosure "d" is represented by an X, since the flameproof joints deviate from IEC standard 60079-1, Table 2. Repairs must only be carried out following consultation with the manufacturer and only original parts must be used.

7.5.6 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.

7.5.7 Electrical connections - Terminal board connections

Table 7-4 Tightening torques for screws at the terminal box, end shields, screw-type ground conductor connections

	Thread Ø		M 4	M 5	M 6	M 8	M 10	M 12	M 16
	Nm (lbf-in)	min	0,8	1,8	2,7	5,5	9	14	27
		max	1,2	2,5	4	8	13	20	40

7.5.8 Cable glands

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 7-5 Tightening torques for cable glands

	Metal ± 10% Nm	Plastic ± 10% Nm	O ring String Ø mm
M 12 x 1.5	8	4	2
M 16 x 1.5	10		
M 20 x 1.5	12		
M 25 x 1.5			
M 32 x 1.5	18	6	
M 40 x 1.5			
M 50 x 1.5	20		
M 63 x 1.5			

NOTICE

If different kinds of cable sheath material are used, smaller tightening torques are to be used.
Damage to cable sheaths is to be prevented by using smaller tightening torques.

7.5.9 Cable glands on explosion-proof machines



Cable glands must be permitted for use in hazardous areas. Openings that are not being used must be sealed with approved plugs. Pay attention to the manufacturer documentation in respect of cable glands.

7.5.10 Terminal boxes, end shields, ground conductors

Note

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

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

	Thread Ø		M 4	M 5	M 6	M 8	M 10	M 12	M 16	M 20
	Nm (lbf-in)	min	2	3,5	6	16	28	46	110	225
		max	3	5	9	24	42	70	165	340

Spare parts/accessories

8.1 Spare parts ordering

General

In addition to the exact part designation, please specify the machine type and the factory 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 8-1 Ordering example

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

* Analogously to rating plate

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

8.2 Spare parts

Part	Description	Part	Description
1.00	D end bearings	5.31	Terminal clip (1MA618.-20.)
1.40	End shield	5.32	Angle (1MA618.-20.)
1.43	Rotary shaft seal	5.33	Washer (1MA618.-20.)
1.44	Bearing cover	5.43	Cable gland
1.46	Cover ring	5.44	Terminal box top side
1.47	O ring	5.52	Cable gland
1.56	Plain washer	5.53	Screw plug
1.58	Spring lock washer	5.54	O ring
1.60	Rolling-contact bearings	5.70	Terminal clip
1.61	Spring band for end shield hub (FS 90 only)	5.72	Contact angle
1.64	AS bearing cover, internal	5.76	Terminal Board
		5.79	Bolt
3.00	Rotor, complete	5.82	O ring
3.88	Featherkey for fan	5.83	Seal
		5.84	Terminal box cover
4.00	Complete stator	5.86	Protection mark
4.07	Housing foot	5.89	Bolt
4.08	Housing foot, left	5.90	Top side of terminal box Can be rotated 4 x 90 degrees, complete (For subsequent mounting)
4.09	Housing foot, right	5.92	Terminal box cover
4.12	Nut	5.93	Seal
4.14	Nut	5.95	Terminal box top side
4.18	Rating plate	5.96	Sealing plug
4.19	Thread-tapping screw	5.97	Nut
4.20	Cover	5.98	Metal-sheet nut
4.30	Contact angle	5.98	Seal
4.31	Grounding angle	5.99	Adapter plate
4.37	Terminal Board		
4.39	Grounding screw (thread-tapping screw)		
5.00	Complete terminal box	6.00	NDE bearings
5.02	spacer	6.10	Rolling-contact bearings
5.03	Seal	6.11	Spring band for end shield hub
5.04	Seal	6.20	End shield
5.08	Spacer sleeve	6.23	Rotary shaft seal
5.10	Complete terminal board	6.24	Bearing cover BS, external
5.11	Terminal strip (For 1MJ machines: Bushing)	6.26	Cover

Part	Description	Part	Description
5.12	Ex d terminal box (1MJ6) (Star point connection)	6.64	Nut
5.13	Link rail	6.30	Bearing cover BS, internal
5.14	Terminal box underside		
5.15	Plug (1MJ6)	7.00	Complete ventilation (does not apply to 1LP6, 1LP7, 1LP9, 1PP6, 1PP7, 1PP9, 1MF6, 1MF7)
5.20	Cable duct, complete	7.04	Fan
5.22	Connecting terminal	7.40	Fan cowl
5.23	Cable duct, complete	7.41	bracket
5.30	Rubber stopper (1MA618.-20.)	7.47	Sleeve
Devices for pushing on and pulling off rolling-contact bearings; fans and transmission elements cannot be supplied.			

8.3 Standardized parts

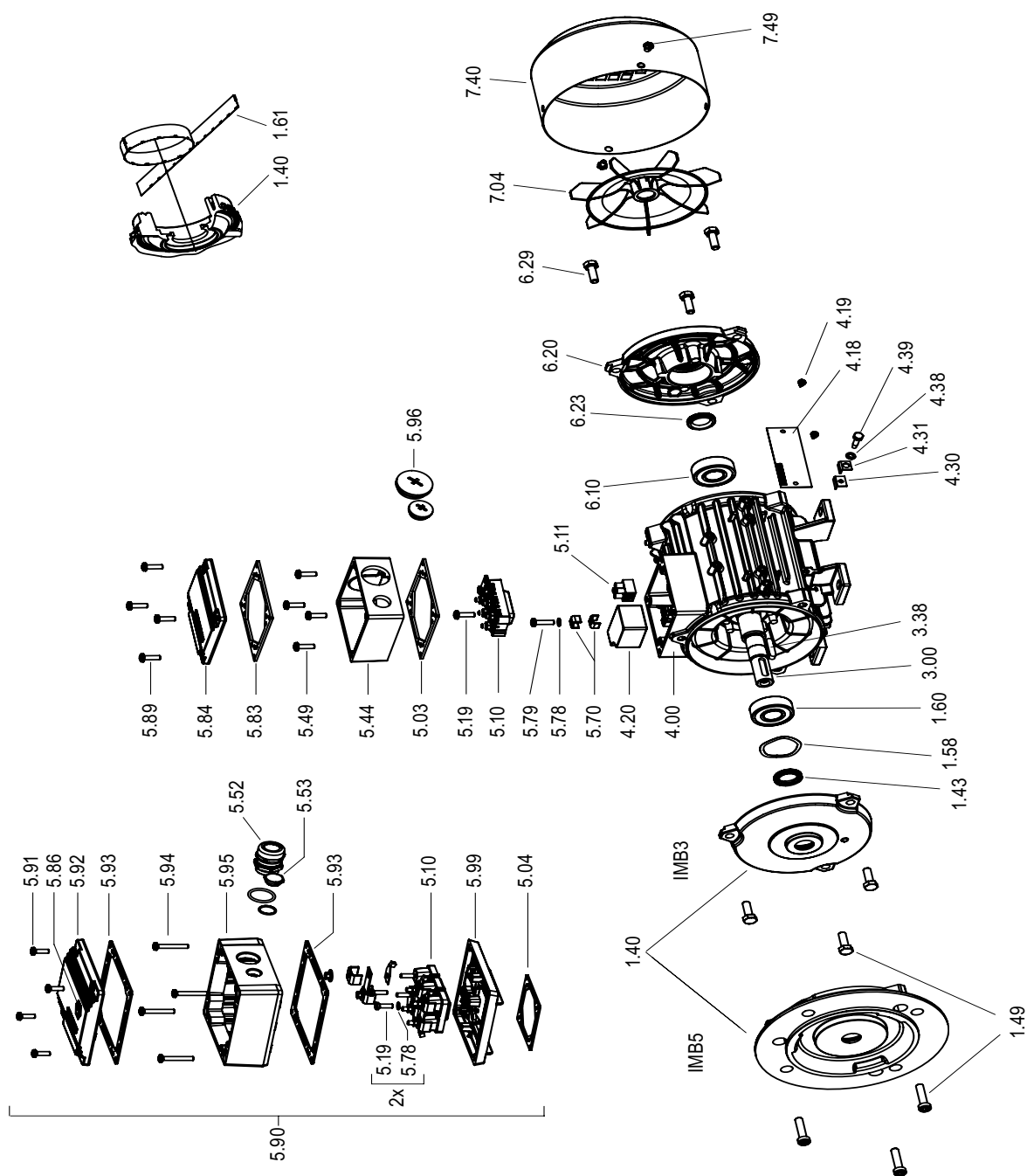
Standardized parts

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

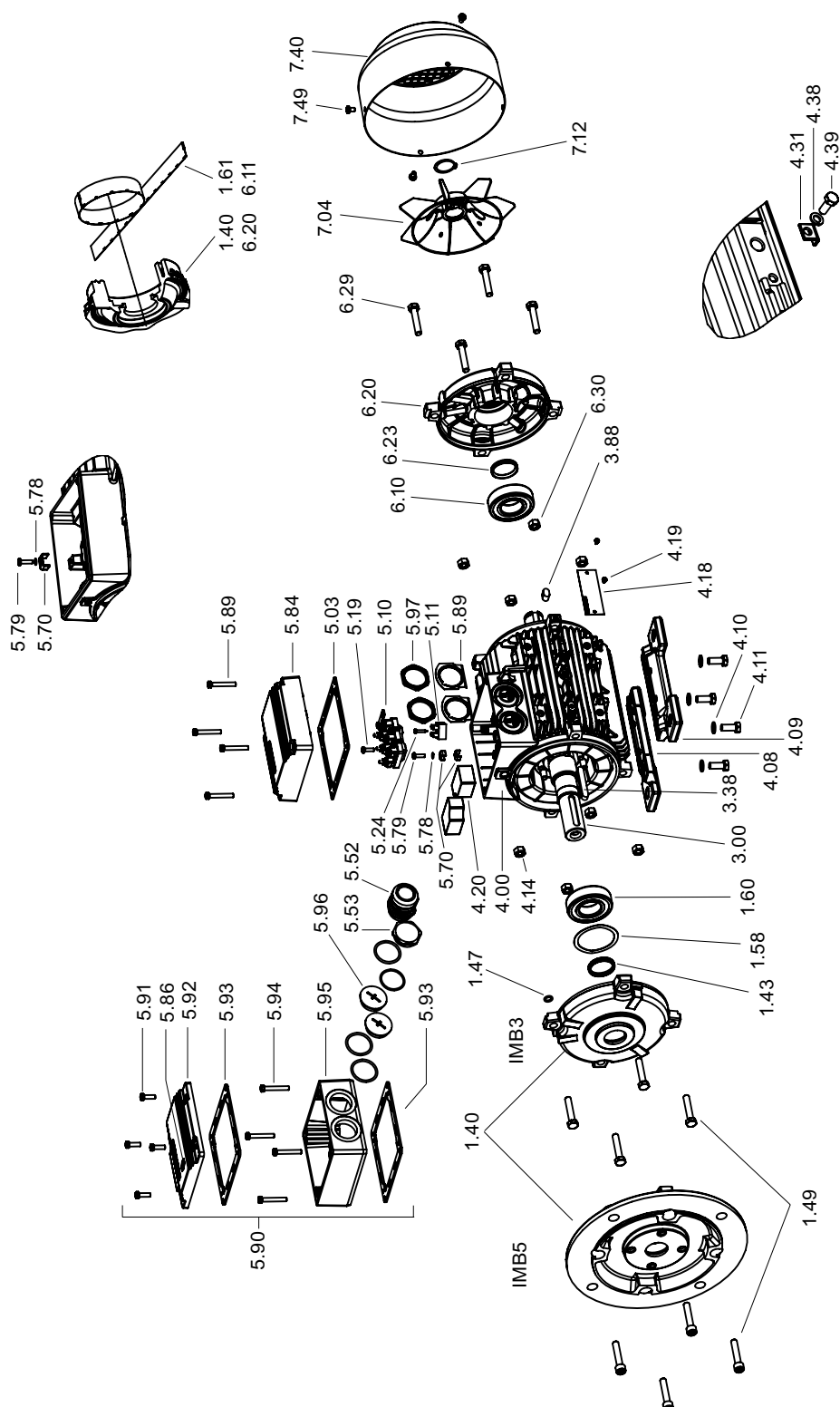
No	Standard	Picture	No	Standard	Picture
1.31 4.10 4.38 5.08 5.16 5.18 5.48 5.78 5.88 7.48	DIN 128		1.30 1.32 1.45 1.49 4.11 5.09 5.17 5.19 5.24 5.42 5.49 5.79 5.87 5.89 5.91 5.94 6.29 6.45 7.49	DIN 939	
3.02 6.02 7.12	DIN 471			DIN 6912	
	DIN 472			DIN 7964	
4.04	DIN 580			DIN EN ISO 4014	
	DIN 582			DIN EN ISO 4017	
1.60 6.10	DIN 625			DIN EN ISO 4762	
3.38	DIN 6885			DIN EN ISO 7045	
1.33 6.30	DIN EN 24032			DIN EN ISO 7049	
			4.05 7.48	DIN EN ISO 7089 DIN EN ISO 7090	

8.4 Exploded drawings

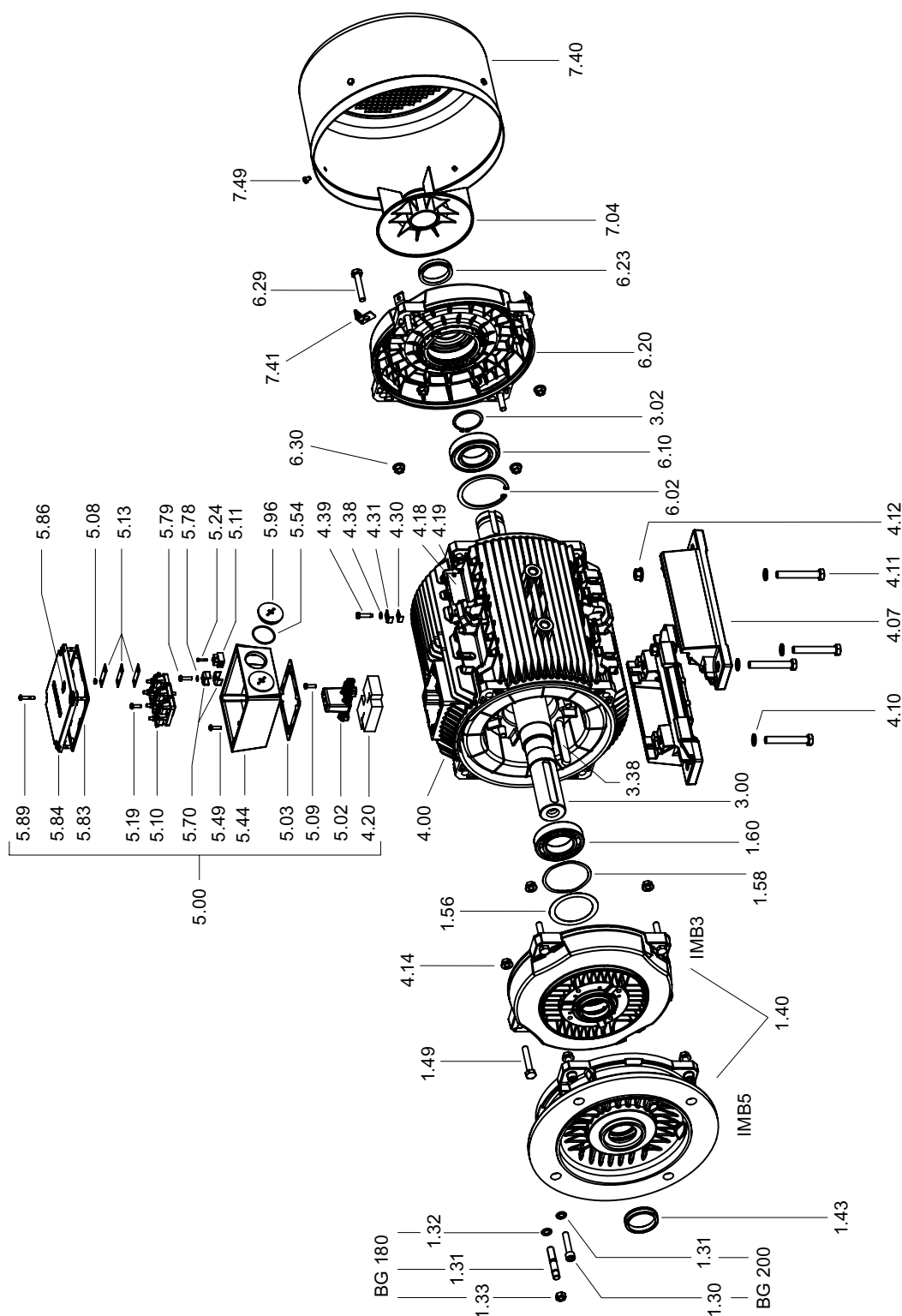
8.4.1 1LA,1LP,1MA,1MF,1PP6/7/9 FS 56...90L



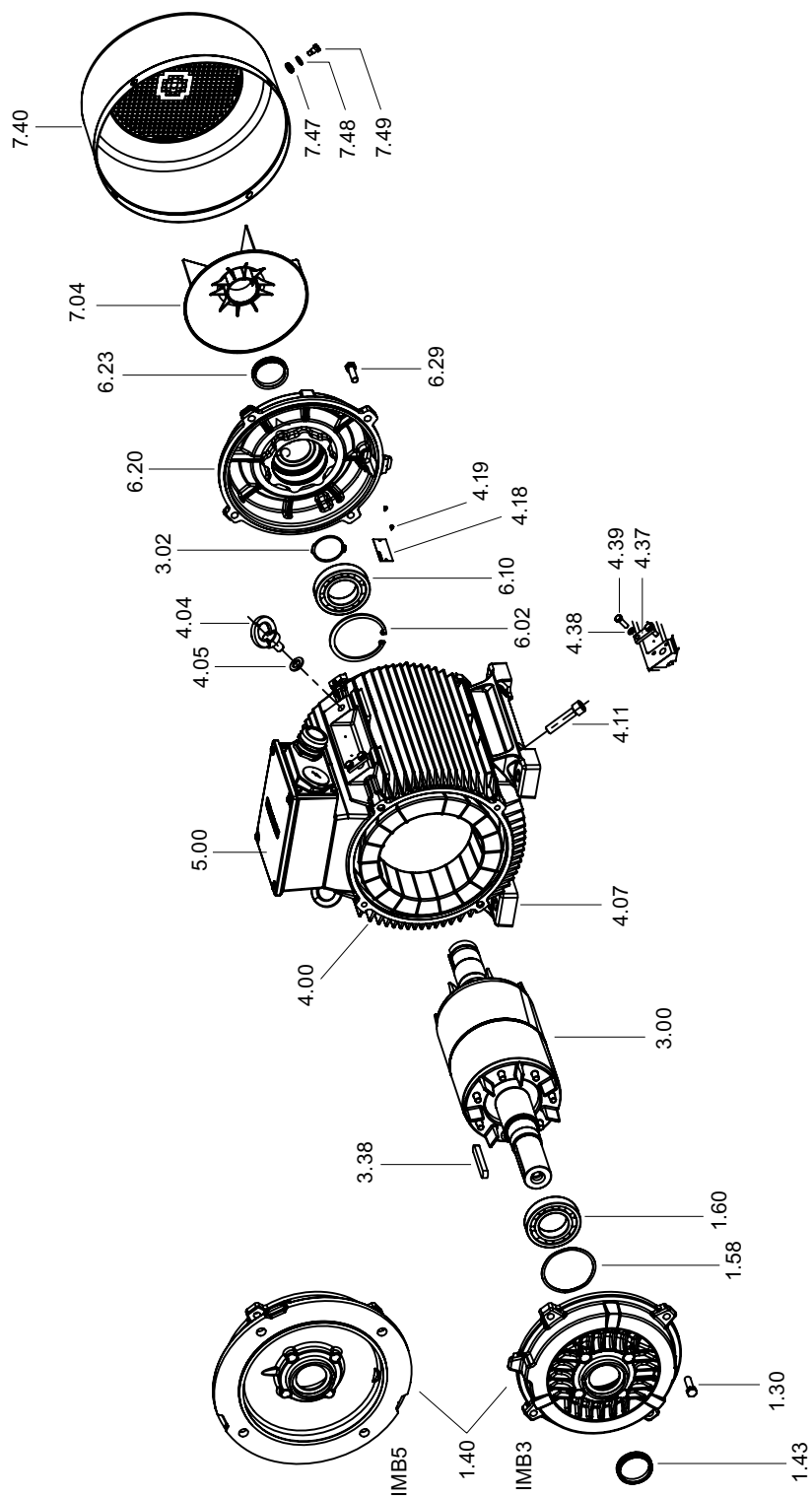
8.4.2 1LA,1LP,1MA,1MF,1PP6/7/9 FS 100...160



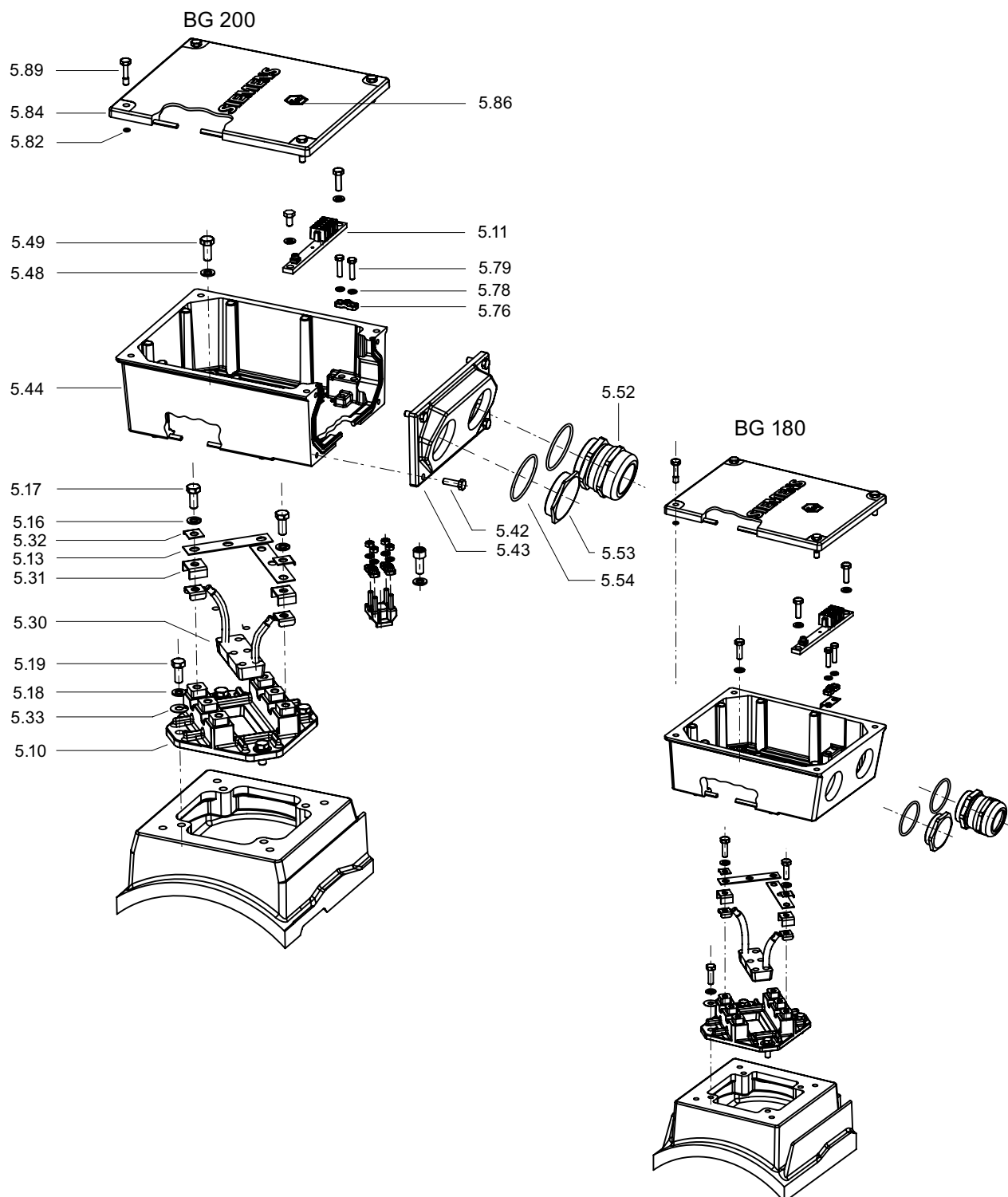
8.4.3 1LA5180...225



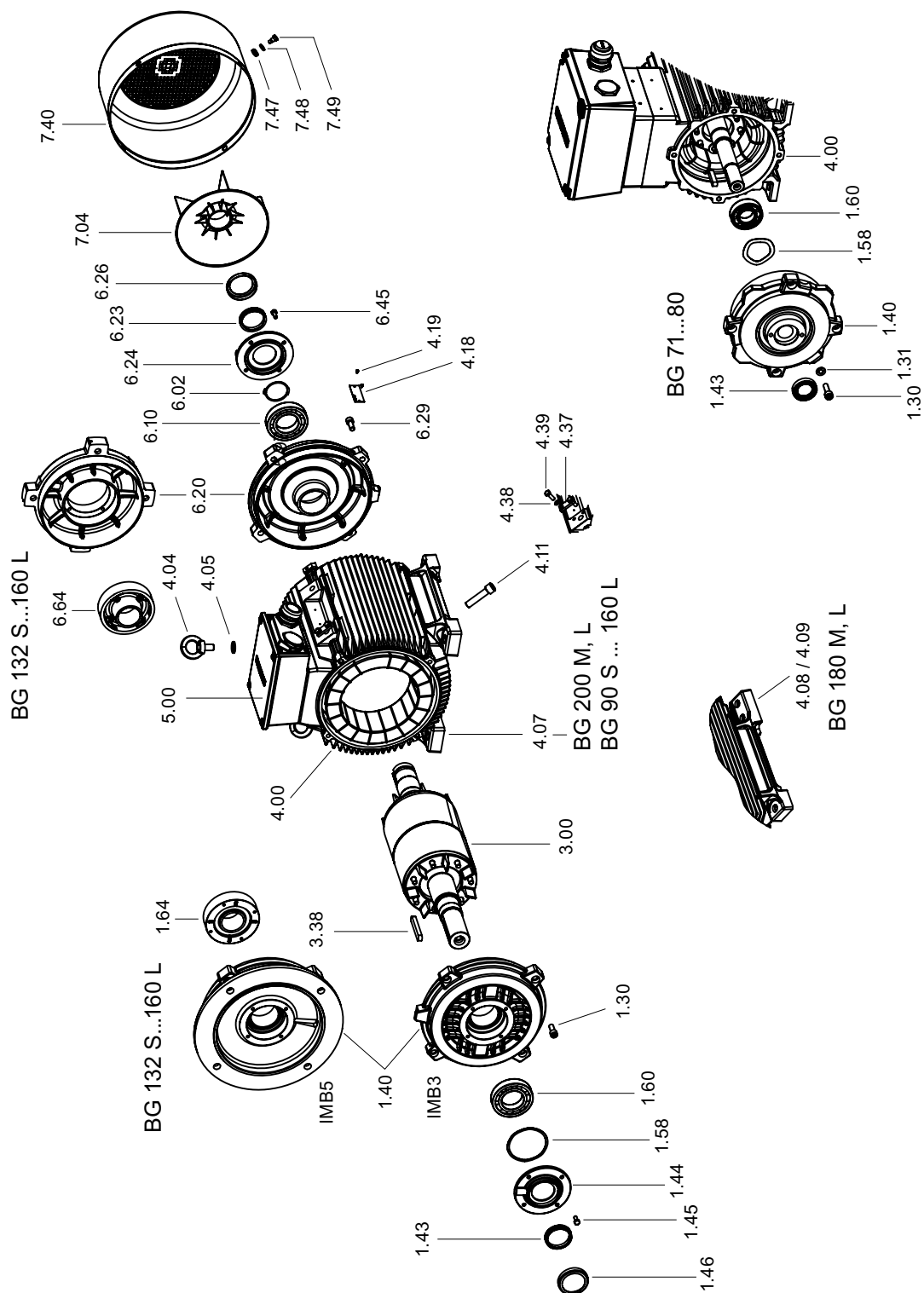
8.4.4 1MA6180...200



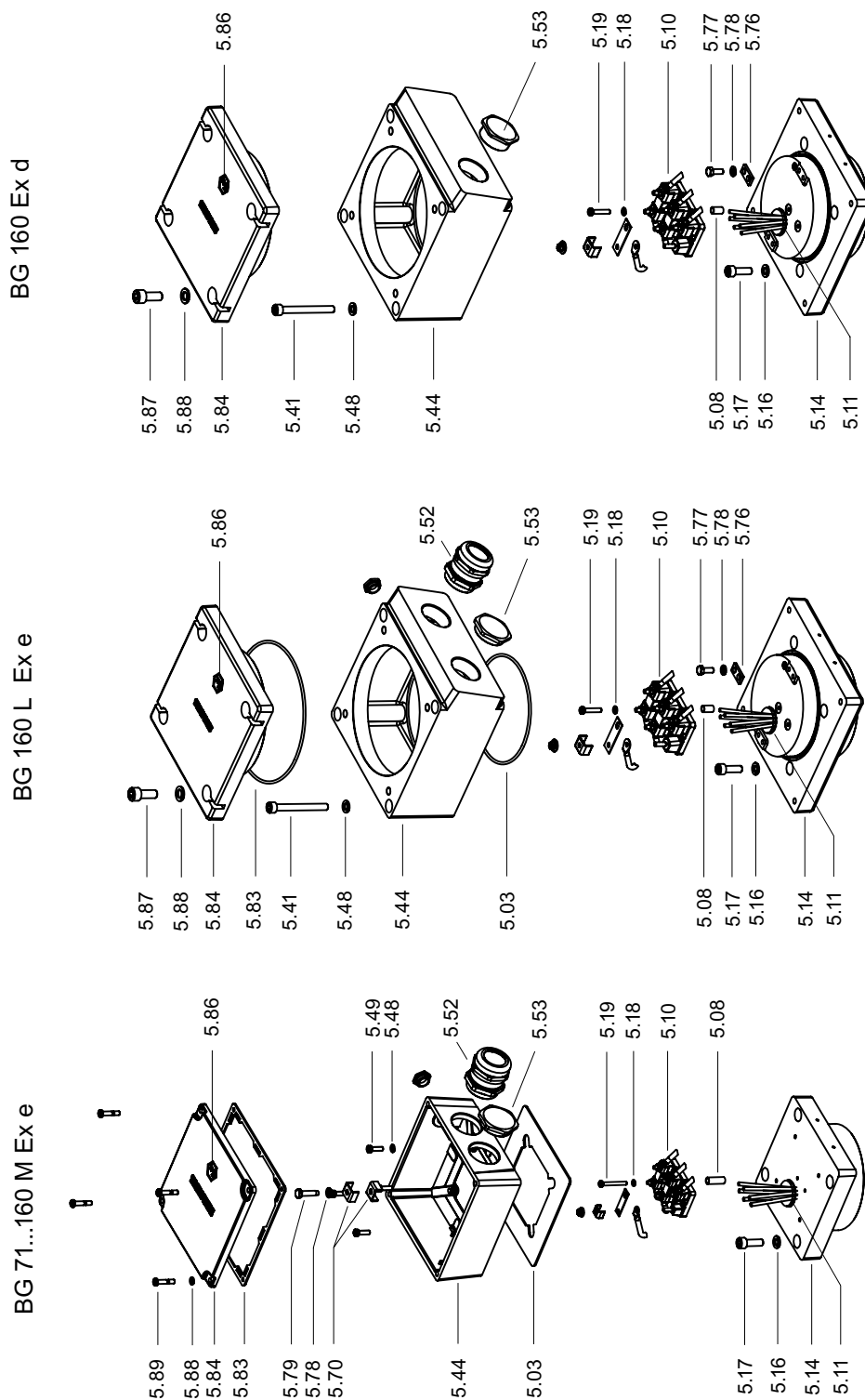
8.4.5 Terminal box 1MA6180...200



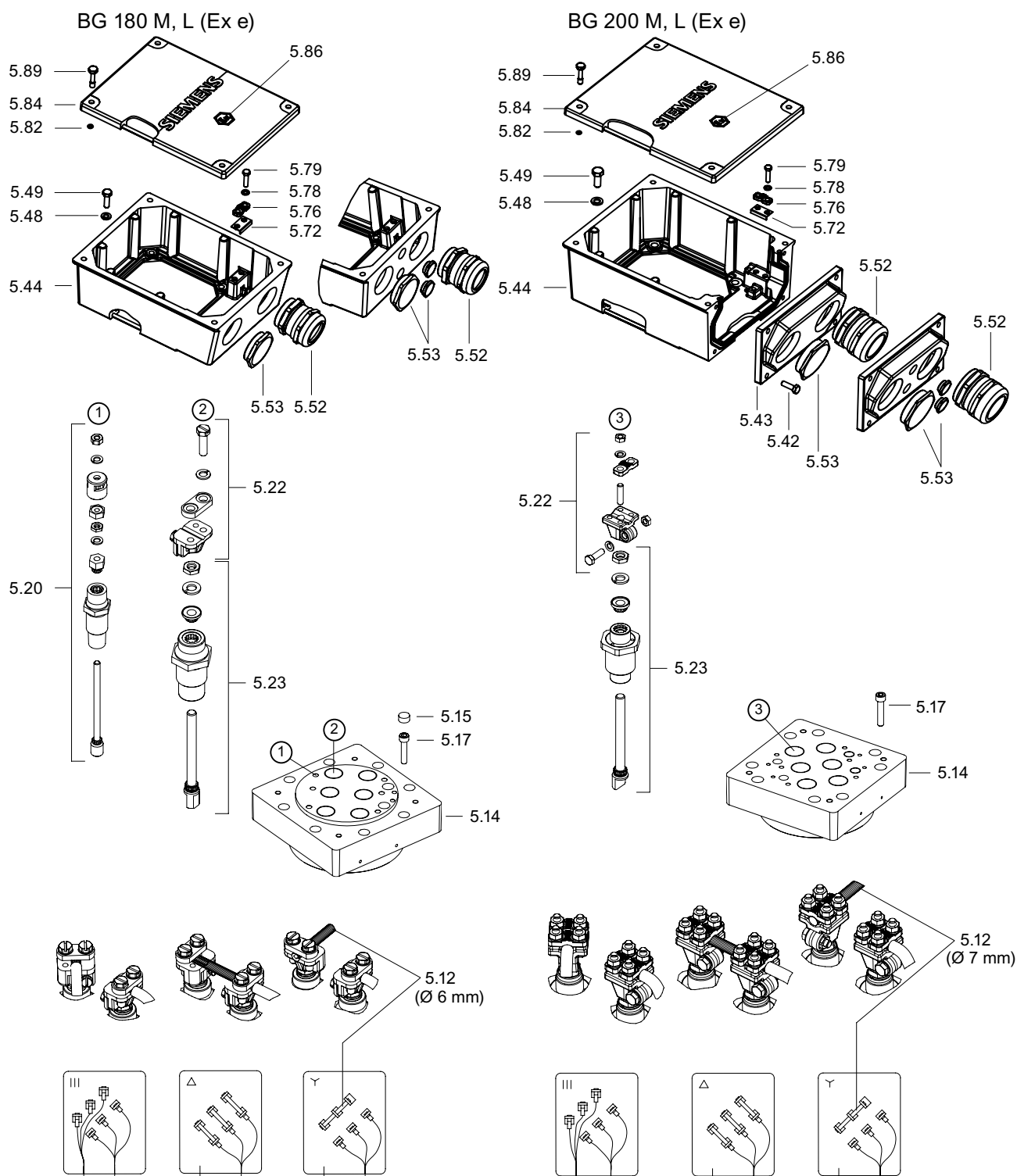
8.4.6 1MJ6070...200



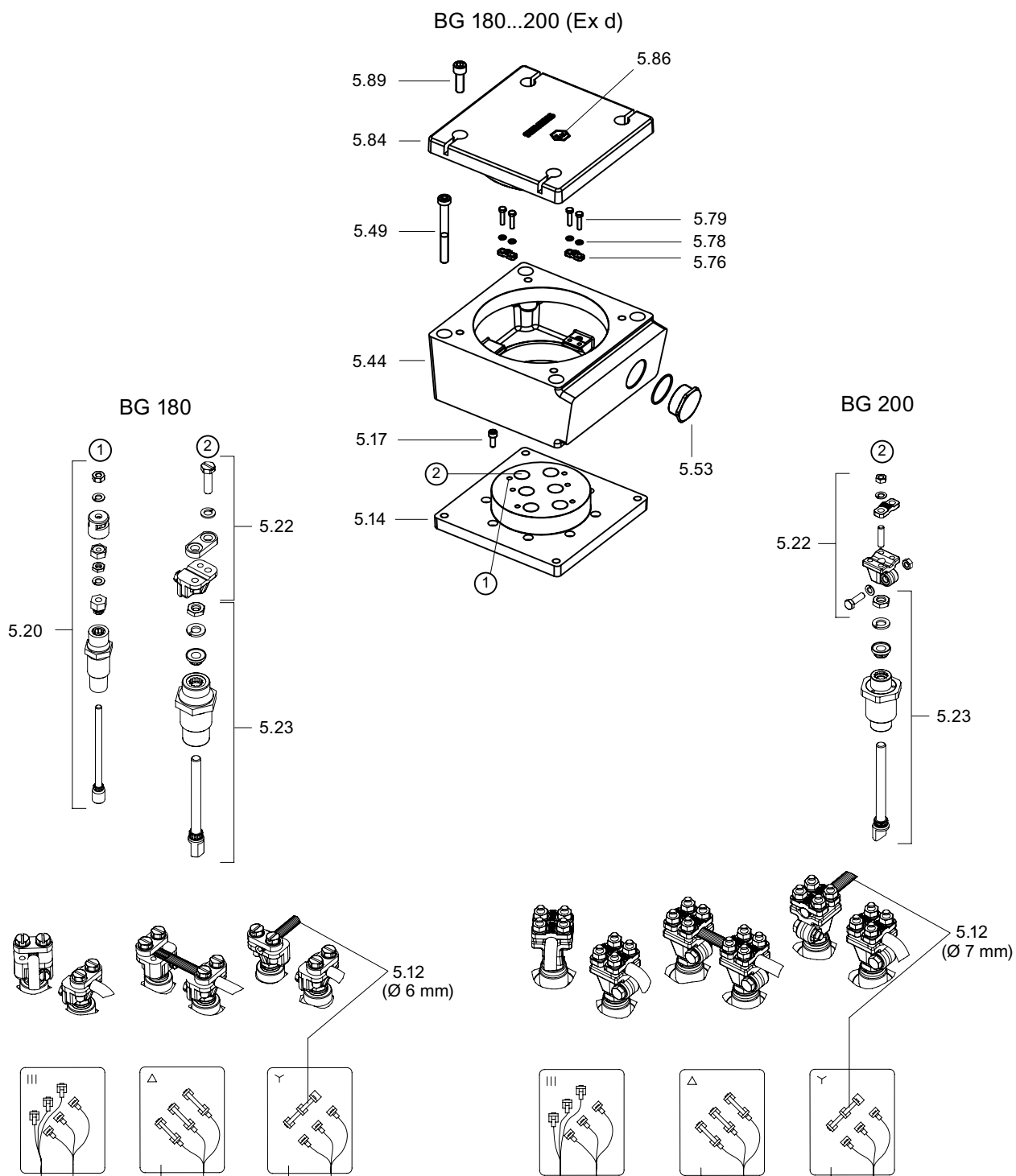
8.4.7 Terminal box 1MJ6070...160



8.4.8 Terminal box 1MJ6180...200 (Ex e)



8.4.9 Terminal box 1MJ6180...200 (Ex d)



Notes

9

Appendix

A.1 Directory

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

Glossary

AS

Drive end (DE)

BA

Operating instructions

BG

Frame size

CSA

Canadian Standard Association

CSA E

Canadian Standard Association Energy Efficiency Verification

CT

Coolant temperature

DE

Drive end (D end of shaft)

EMC

Electromagnetic compatibility

Ex

Codes for explosion-protected equipment

F code

Balanced with whole featherkey (full)

H code

Balanced with half featherkey (half)

IC

International Cooling (standard)

IM

International mounting - Basic type of construction

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"

Order No.: 56107000002008

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