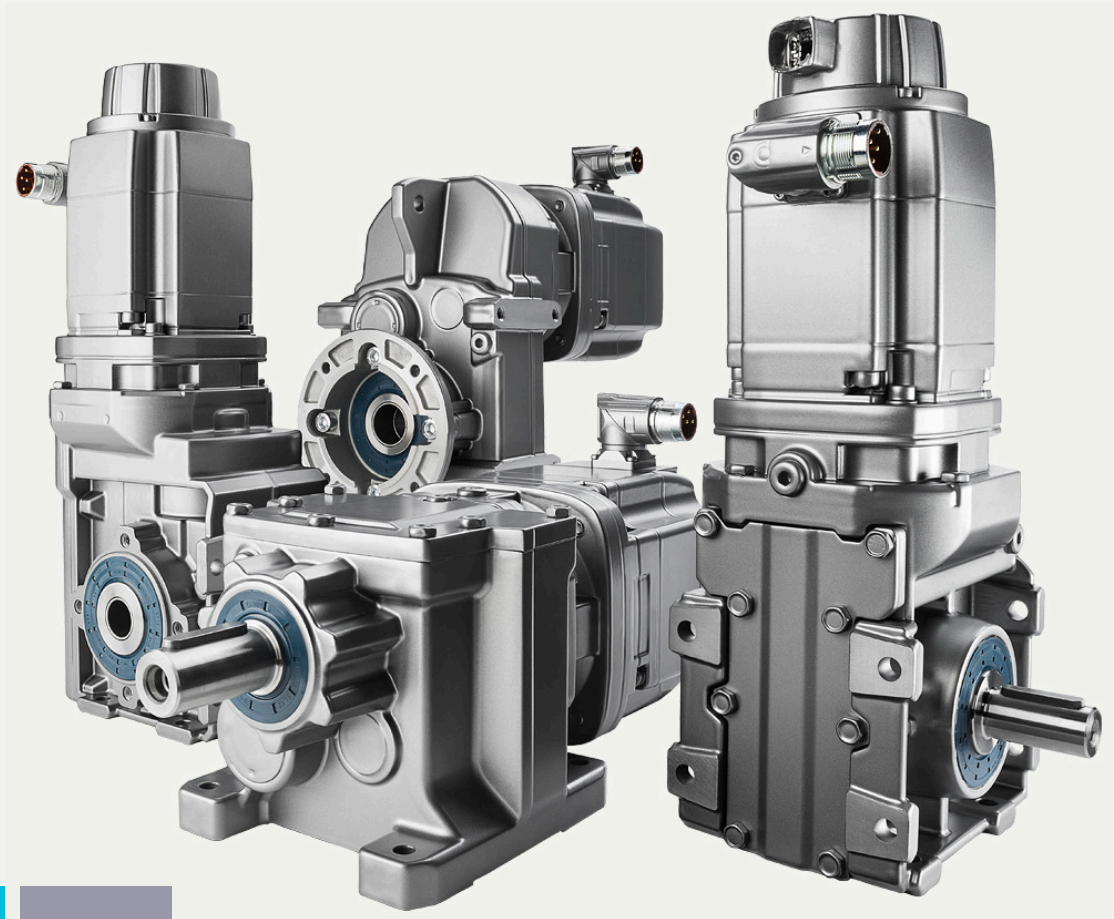
SIEMENS



Edition 12/2022

OPERATING INSTRUCTIONS

SIMOTICS

SIMOTICS S-1FG1 servo geared motors

Helical geared motors, parallel shaft geared motors, bevel geared motors and helical worm geared motors

www.siemens.com

SIEMENS

SIMOTICS

Drive technology SIMOTICS S-1FG1 servo geared motor

Operating Instructions

12/2022
A5E47360747B/RS-AC

Legal information

Warning notice system

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

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

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

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

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

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

Qualified Personnel

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

Proper use of Siemens products

Note the following:

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

Trademarks

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

Disclaimer of Liability

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

Siemens AG
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A5E47360747B/RS-AC
Ⓟ 03/2023 Subject to change

Table of contents

Introduction

1

1.1 About SIMOTICS

Description

SIMOTICS is the Siemens family of electric motors addressing the complete motor spectrum in Digital Industry.

1.2 About this manual

1.2.1 Content

Main changes in this edition

Supplements

- Mounting positions of individual frame sizes changed and C39A mounting positions added -> Mounting positions (Page 59)

Changes

- Chapter Introduction updated
- Intended use moved into the introduction -> Proper intended use (Page 17)
- Rating plate specifications of the servo geared motor adapted -> Rating plate data of the servo geared motor (Page 37)
- Table Enclosure material supplemented to include C39A -> Properties (Page 57)
- Chapter Recommended oil types revised -> Recommended oil types (Page 176)

Description

These Operating Instructions inform you about the motor and its components. You will learn how to handle the motor properly and safely from delivery to disposal:

- Transporting and storing
- Assembly and mounting
- Connecting
- Commissioning
- Checking
- Operation
- Troubleshooting
- Disassembling
- Disposal

To illustrate possible application areas for our products, typical use cases are listed in this product documentation and in the online help. These are purely exemplary and do not constitute a statement on the suitability of the respective product for applications in specific individual cases. Unless explicitly contractually agreed, Siemens assumes no liability for such suitability. Suitability for a particular application in specific individual cases must be assessed by the user, taking into account all technical, legal, and other requirements on a case-by-case basis. Always observe the descriptions of the technical properties and the relevant constraints of the respective product contained in the product documentation.

This documentation should be kept in a location where it can be easily accessed and made available to the personnel responsible.

Information regarding third-party products

Note

Recommendation relating to third-party products

This document contains recommendations relating to third-party products. Siemens accepts the fundamental suitability of these third-party products.

You can use equivalent products from other manufacturers.

Siemens does not accept any warranty for the properties of third-party products.

1.2.2 Text attributes

Description

The chapter describes how text features are marked in this document.

Operating instructions

Handling instructions with a specified sequence start with the word "Procedure":

The individual handling steps are numbered.

1. Execute the operating instructions in the specified sequence.

❒

The square indicates the end of the operating instruction.

Operating instructions without a specified sequence are identified using a bullet point:

- Execute the operating instructions.

Enumerations

- Enumerations are identified by a bullet point without any additional symbols.
  - Enumerations at the second level are hyphenated.

Notes

Notes are shown as follows:

Note

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

1.2.3 Target group

Description

These operating instructions are intended for:

- Fitters
- Commissioning engineers
- Machine operators
- Service and maintenance personnel
- Warehouse personnel
- Personnel decommissioning the motor
- Personnel disposing of the motor

1.2.4 Avoiding dangers

Description

Avoid dangers. Ensure safe, problem-free operation and a maximum service life:

- Before you start using the motor, you must read these Operating Instructions.
- Always follow the safety instructions and notices in these operating instructions.

The warning notice system is explained at the beginning of this document.

1.2.5 Standard scope

Description

This documentation describes the functionality of the standard scope. This scope may differ from the scope of the functionality of the system that is actually supplied. Please refer to the ordering documentation only for the functionality of the supplied drive system.

Further functions may be executable in the system, which are not explained in this documentation. However, there is no entitlement to these functions in the case of a new delivery or service.

This documentation does not contain all detailed information on all types of the product. Furthermore, this documentation cannot take into consideration every conceivable type of installation, operation and service/maintenance.

The machine manufacturer must document any additions or modifications they make to the product themselves.

1.2.6 Websites of third-party companies

Description

This document may contain hyperlinks to third-party websites. Siemens is not responsible for and shall not be liable for these websites and their content. Siemens has no control over the information which appears on these websites and is not responsible for the content and information provided there. The user bears the risk for their use.

1.3 SIMOTICS documentation

Description

Comprehensive documentation on SIMOTICS, SIMOGEAR and on the SINAMICS converter family are provided in Internet (https://support.industry.siemens.com/cs/ww/en/ps/13204/man).

You can display documents or download them in PDF and HTML5 format.

The documentation is divided into the following categories:

Table 1-1 SIMOTICS / SIMOGEAR / SINAMICS documentation

Information	Documentation class[1)]	Content	Target group
General information	Configuration Manual	Rules, guidelines, and tools for configuring products, systems, and plants. Also contains information on the operating and ambient conditions for hardware and software, the use of functions, as well as on circuit diagrams and terminal diagrams and the installation of software insofar as this is necessary for commissioning.	Planners, configuration engineers
Device information	Installation Instructions	All relevant information on setting up, installing and cabling, as well as the required dimensional drawings and circuit diagrams	Installation personnel, commissioning engineers, service and maintenance personnel
Basic information	Operating instructions	Comprehensive collection of all information necessary for the safe operation of products, plant/system parts and complete plants (IEC 82079)	Machine operators, plant operators
	Compact instructions	Essential contents of the operating instructions in a reduced and condensed form	Machine operators, plant operators
	Product Information	Information that only becomes known shortly before or even after start of delivery and is therefore not included in the associated user documentation	Planners, configuration engineers, technologists, installation personnel, constructors; commissioning engineers, machine operators, programmers, service and maintenance personnel
	Online help	Instructions for configuring, programming, and commissioning	Configuration engineers, programmers, commissioning engineers

1) Not all documentation classes are available for every SIMOTICS / SIMOGEAR / SINAMICS product.

1.4 Service and support

1.4.1 Siemens Industry Online Support on the Web

Description

The following is available via Siemens Industry Online Support (https://support.industry.siemens.com/cs/ww/en/), among others:

- Product support
- Global forum for information and best practice sharing between users and specialists
- Local contact persons via the contact person database (→ Contact)
- Information about field services, repairs, spare parts, and much more (→ Services)
- Search for product info
- Important topics at a glance
- FAQs (frequently asked questions)
- Application examples
- Manuals
- Downloads
- Compatibility tool
- Newsletters with information about your products
- Catalogs/brochures

1.4.2 Siemens Industry Online Support on the road

Description

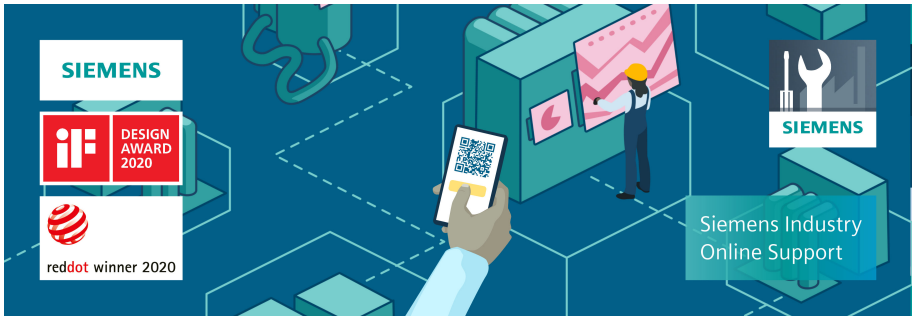


Figure 1-1 "Siemens Industry Online Support" app

The "Industry Online Support" app supports you in the following areas, for example:

- Resolving problems when executing a project
- Troubleshooting when faults develop
- Expanding a system or planning a new system

Furthermore, you have access to the Technical Forum and other articles that our experts have drawn up:

- FAQs
- Application examples
- Manuals
- Certificates
- Product announcements and much more

There is a Data Matrix code on the nameplate of your product. You can obtain technical information about the device if you scan the code using the "Industry Online Support" app (https://support.industry.siemens.com/cs/ww/en/sc/2067).

The app is available for Apple iOS and Android.

1.4.3 Feedback on the technical documentation

Description

We welcome your questions, suggestions, and corrections for this technical documentation. Please use the "Provide feedback" link at the end of the entries in Siemens Industry Online Support.

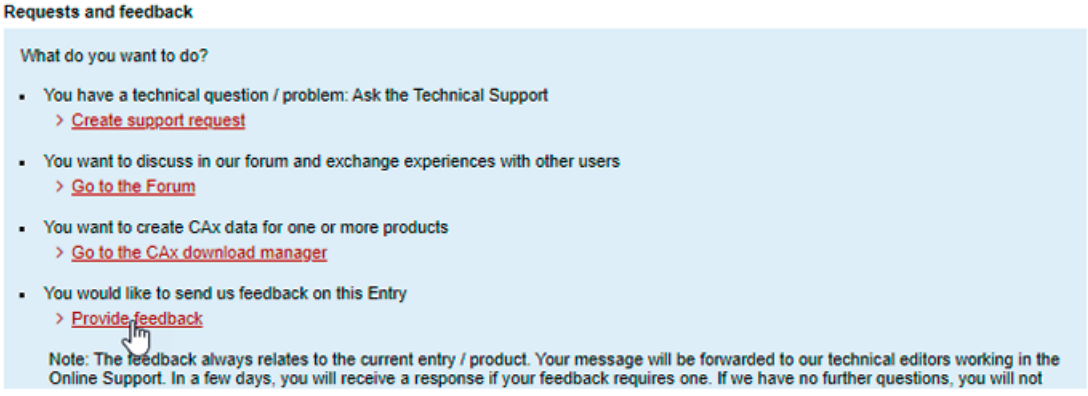


Figure 1-2 Requests and feedback

1.4.4 mySupport documentation

Description

With the "mySupport documentation" web-based system, you can compile your own individual documentation based on Siemens content and adapt this for your own machine documentation.

To start the application, click the "My Documentation" tile on the mySupport homepage (https://support.industry.siemens.com/cs/ww/en/my):

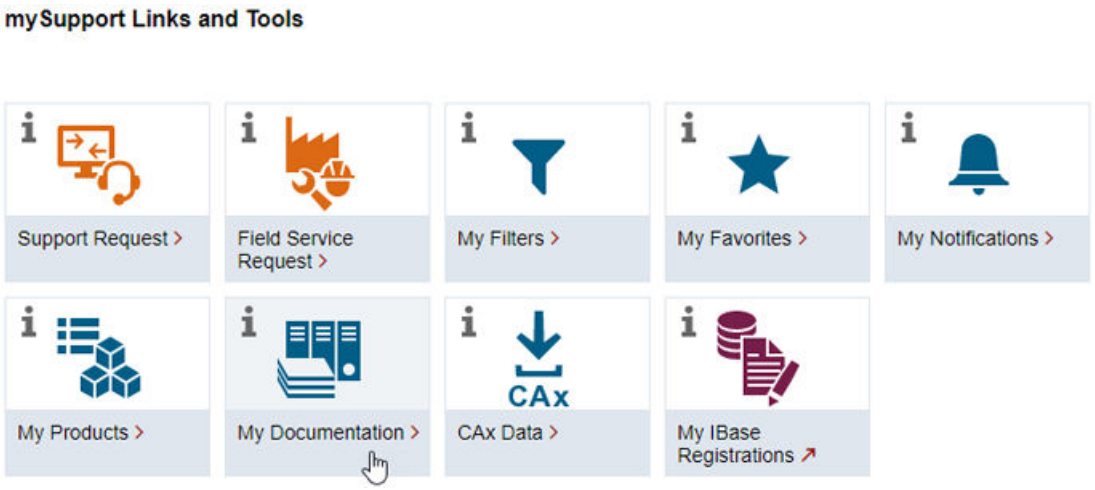


Figure 1-3 mySupport

The configured manual can be exported in the PDF or XML format.

Siemens content that supports the mySupport documentation can be identified by the "Configure" link.

1.4.5 Technical support

Description

Your routes to technical support (https://support.industry.siemens.com/cs/ww/en/sc/4868):

- Support Request (https://www.siemens.com/SupportRequest)
- Contact person database (https://www.automation.siemens.com/aspa_app?lang=en)
- "Industry Online Support" mobile app

The Support Request is the most important input channel for questions relating to products from Siemens Industry. This will assign your request a unique ticket number for tracking purposes. The Support Request offers you:

- Direct access to technical experts
- Recommended solutions for various questions (e.g. FAQs)
- Status tracking of your requests

Technical support also assists you in some cases via remote support (https://support.industry.siemens.com/cs/de/en/view/106665159) to resolve your requests. A Support representative will assist you in diagnosing or resolving the problem through screen transfer.

More information on the Support service packages is available on the Internet via the following address (https://support.industry.siemens.com/cs/ww/en/sc/4869).

1.4.6 Training

Description

SITRAIN – Digital Industry Academy offers a comprehensive range of training courses on Siemens industrial products – directly from the manufacturer, for all industries and use cases, for all knowledge levels from beginner to expert.

More information can be found on the Internet via the following address (https://www.siemens.com/sitrain).

1.4.7 Spare parts services

Description

By using the online spare parts service "Spares on Web", you ensure the smooth operation of your product. The spare parts service is aimed at the following:

- Improved spare parts inventories by balancing stock and spare parts on call
- Minimized downtimes during a plant standstill
- Reduced costs

More information can be found on the Internet via the following address (https://www.sow.siemens.com).

1.5 Important product information

Definition of terms

Terms	Definition
Servo geared motor, geared motor, motor-gearbox unit, 1FG1, SIMOTICS-1FG1	Product (unit) comprising motor and gearbox components
Motor, servomotor	Synchronous motor to drive the gearbox
Gearbox	Helical gearbox, parallel shaft gearbox, bevel gearbox or helical worm gearbox to transmit the motor speed and the motor torque
Input speed, input torque	Values on the motor side of the gearbox
Output speed, output torque	Values on the customer side of the gearbox

1.5.1 Proper intended use

⚠ WARNING

Unintended use of the servo geared motors

If you do not use the servo geared motors for their proper intended use, then there is a risk of death, severe injury and/or material damage.

- Only use the servo geared motors for their proper intended purpose.
- Ensure that the conditions at the installation site comply with all the rating plate data.
- Ensure the conditions at the installation site comply with the conditions specified in this documentation. When necessary, take into account deviations regarding approvals or country-specific regulations.

⚠ WARNING

Malfunction of active implants due to magnetic and electrical fields.

Electric motors represent a danger to people with active medical implants, e.g. heart pacemakers, who come close to these motors.

- If you are affected, stay a minimum distance of 300 mm from the servo geared motors (tripping threshold for static magnetic fields of 0.5 mT according to Directive 2013/35/EU).

If you wish to use special versions and design variants whose specifications vary from the servo geared motors described in this document, then contact your local Siemens office.

If you have any questions regarding the intended usage, please contact your local Siemens office.

The 1FG1 is designed for use in industrial and commercial facilities.

The 1FG1 is designed for operation in sheltered areas under normal climatic conditions, such as those found in production halls and areas.

For more detailed information, refer to Chapter "Ambient conditions (Page 31)"

The 1FG1 is only approved for converter operation.

Any other use of the 1FG1 is considered to be improper use.

Correct and intended use includes compliance with all of the specifications in the operating instructions.

Observe the data on the rating plate.

1.5.2 Predictable incorrect use

Predictable incorrect use

⚠ WARNING

Injuries due to incorrect use

If you use the motor other than how SIEMENS intended, then death or severe injury can occur. You destroy or damage the motor.

Misuse includes, for example

- Not complying with the operating instructions or the Configuration Manual
- Not observing the data on the rating plate
- Using the motor in hazardous zones
- Directly connecting the motor to the line supply
- Using the motor outside the permissible ambient conditions
- Using the motor as a generator
- Using the motor holding brake as an operating brake to reduce the motor speed
- Using the motor as a result of its size, its weight, its shape, or its material for applications other than those described in this manual

Fundamental safety instructions for the SIMOTICS documentation

2

2.1 Fundamental safety instructions

2.1.1 General safety instructions

⚠ WARNING

Electric shock and danger to life due to other energy sources

Touching live components can result in death or severe injury.

- Only work on electrical devices when you are qualified for this job.
- Always observe the country-specific safety rules.

Generally, the following steps apply when establishing safety:

1. Prepare for disconnection. Notify all those who will be affected by the procedure.
2. Isolate the drive system from the power supply and take measures to prevent it being switched back on again.
3. Wait until the discharge time specified on the warning labels has elapsed.
4. Check that there is no voltage between any of the power connections, and between any of the power connections and the protective conductor connection.
5. Check whether the existing auxiliary supply circuits are de-energized.
6. Ensure that the motors cannot move.
7. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems, or water. Switch the energy sources to a safe state.
8. Check that the correct drive system is completely locked.

After you have completed the work, restore the operational readiness in the inverse sequence.

⚠ WARNING

Electric shock due to connection to an unsuitable power supply

When equipment is connected to an unsuitable power supply, exposed components may carry a hazardous voltage. Contact with hazardous voltage can result in severe injury or death.

- Only use power supplies that provide SELV (Safety Extra Low Voltage) or PELV- (Protective Extra Low Voltage) output voltages for all connections and terminals of the electronics modules.

⚠ WARNING

Electric shock due to damaged motors or devices

Improper handling of motors or devices can damage them.

Hazardous voltages can be present at the enclosure or at exposed components on damaged motors or devices.

- Ensure compliance with the limit values specified in the technical data during transport, storage and operation.
- Do not use any damaged motors or devices.

⚠ WARNING

Electric shock due to unconnected cable shield

Hazardous touch voltages can occur through capacitive cross-coupling due to unconnected cable shields.

- As a minimum, connect cable shields and the conductors of power cables that are not used (e.g. brake cores) at one end at the grounded housing potential.

⚠ WARNING

Electric shock if there is no ground connection

For missing or incorrectly implemented protective conductor connection for devices with protection class I, high voltages can be present at open, exposed parts, which when touched, can result in death or severe injury.

- Ground the device in compliance with the applicable regulations.

⚠ WARNING

Arcing when a plug connection is opened during operation

Opening a plug connection when a system is operation can result in arcing that may cause serious injury or death.

- Only open plug connections when the equipment is in a voltage-free state, unless it has been explicitly stated that they can be opened in operation.

NOTICE

Property damage due to loose power connections

Insufficient tightening torques or vibration can result in loose power connections. This can result in damage due to fire, device defects or malfunctions.

- Tighten all power connections to the prescribed torque.
- Check all power connections at regular intervals, particularly after equipment has been transported.

NOTICE

Damage to equipment due to unsuitable tightening tools.

Unsuitable tightening tools or fastening methods can damage the screws of the equipment.

- Only use screw inserts that exactly match the screw head.
- Tighten the screws with the torque specified in the technical documentation.
- Use a torque wrench or a mechanical precision nut runner with a dynamic torque sensor and speed limitation system.
- Adjust the tools used regularly.

⚠ WARNING

Unexpected machine movement caused by radio devices or mobile phones

Using radio devices, cellphones, or mobile WLAN devices in the immediate vicinity of the components can result in equipment malfunction. Malfunctions may impair the functional safety of machines and can therefore put people in danger or lead to property damage.

- Therefore, if you move closer than 20 cm to the components, be sure to switch off radio devices, cellphones or WLAN devices.
- Use the "SIEMENS Industry Online Support app" only on equipment that has already been switched off.

⚠ WARNING

Unrecognized dangers due to missing or illegible warning labels

Dangers might not be recognized if warning labels are missing or illegible. Unrecognized dangers may cause accidents resulting in serious injury or death.

- Check that the warning labels are complete based on the documentation.
- Attach any missing warning labels to the components, where necessary in the national language.
- Replace illegible warning labels.

⚠ WARNING

Unexpected movement of machines caused by inactive safety functions

Inactive or non-adapted safety functions can trigger unexpected machine movements that may result in serious injury or death.

- Observe the information in the appropriate product documentation before commissioning.
- Carry out a safety inspection for functions relevant to safety on the entire system, including all safety-related components.
- Ensure that the safety functions used in your drives and automation tasks are adjusted and activated through appropriate parameterizing.
- Perform a function test.
- Only put your plant into live operation once you have guaranteed that the functions relevant to safety are running correctly.

Note

Important Safety instructions for Safety Integrated

If you want to use Safety Integrated functions, you must observe the Safety instructions in the Safety Integrated documentation.

⚠ WARNING

Active implant malfunctions due to electromagnetic fields

Electromagnetic fields (EMF) are generated by the operation of electrical power equipment, such as transformers, converters, or motors. People with pacemakers or implants are at particular risk in the immediate vicinity of this equipment.

- If this affects you, maintain the minimum distance to such equipment that is specified in the "Important product information" chapter.

⚠ WARNING

Active implant malfunctions due to permanent-magnet fields

Even when switched off, electric motors with permanent magnets represent a potential risk for persons with heart pacemakers or implants if they are close to converters/motors.

- If this affects you, maintain the minimum distance to such equipment that is specified in the "Important product information" chapter.
- When transporting or storing permanent-magnet motors always use the original packing materials with the warning labels attached.
- Clearly mark the storage locations with the appropriate warning labels.
- IATA regulations must be observed when transported by air.

⚠ WARNING

Injury caused by moving or ejected parts

Contact with moving motor parts or drive output elements and the ejection of loose motor parts (e.g. feather keys) out of the motor enclosure can result in severe injury or death.

- Remove any loose parts or secure them so that they cannot be flung out.
- Do not touch any moving parts.
- Safeguard all moving parts using the appropriate safety guards.

⚠ WARNING

Fire due to incorrect operation of the motor

When incorrectly operated and in the case of a fault, the motor can overheat resulting in fire and smoke. This can result in severe injury or death. Further, excessively high temperatures destroy motor components and result in increased failures as well as shorter service lives of motors.

- Operate the motor according to the relevant specifications.
- Only operate the motors in conjunction with effective temperature monitoring.
- Immediately switch off the motor if excessively high temperatures occur.

⚠ CAUTION

Burns and thermal damage caused by hot surfaces

Temperatures above 100 °C may occur on the surfaces of motors, converters, and other drive components.

Touching hot surfaces may result in burns. Hot surfaces may damage or destroy temperature sensitive parts.

- Ensure that temperature-sensitive parts do not come into contact with hot surfaces.
- Mount drive components so that they are not accessible during operation.

Measures when maintenance is required:

- Allow drive components to cool off before starting any work.
- Use appropriate personnel protection equipment, e.g. gloves.

2.1.2 Equipment damage due to electric fields or electrostatic discharge

Electrostatic sensitive devices (ESD) are individual components, integrated circuits, modules or devices that may be damaged by either electric fields or electrostatic discharge.

NOTICE

Equipment damage due to electric fields or electrostatic discharge

Electric fields or electrostatic discharge can cause malfunctions through damaged individual components, integrated circuits, modules or devices.

- Only pack, store, transport and send electronic components, modules or devices in their original packaging or in other suitable materials, e.g conductive foam rubber of aluminum foil.
- Only touch components, modules and devices when you are grounded by one of the following methods:
  - Wearing an ESD wrist strap
  - Wearing ESD shoes or ESD grounding straps in ESD areas with conductive flooring
- Only place electronic components, modules or devices on conductive surfaces (table with ESD surface, conductive ESD foam, ESD packaging, ESD transport container).

2.1.3 Security information

Siemens provides products and solutions with industrial security functions that support the secure operation of plants, systems, machines and networks.

In order to protect plants, systems, machines and networks against cyber threats, it is necessary to implement – and continuously maintain – a holistic, state-of-the-art industrial security concept. Siemens' products and solutions constitute one element of such a concept.

Customers are responsible for preventing unauthorized access to their plants, systems, machines and networks. Such systems, machines and components should only be connected to an enterprise network or the internet if and to the extent such a connection is necessary and only when appropriate security measures (e.g. firewalls and/or network segmentation) are in place.

For additional information on industrial security measures that may be implemented, please visit
https://www.siemens.com/industrialsecurity.

Siemens' products and solutions undergo continuous development to make them more secure. Siemens strongly recommends that product updates are applied as soon as they are available and that the latest product versions are used. Use of product versions that are no longer supported, and failure to apply the latest updates may increase customer's exposure to cyber threats.

To stay informed about product updates, subscribe to the Siemens Industrial Security RSS Feed under
https://www.siemens.com/cert.

Further information is provided on the Internet:

Industrial Security Configuration Manual (https://support.industry.siemens.com/cs/ww/en/view/108862708)

⚠ WARNING

Unsafe operating states resulting from software manipulation

Software manipulations, e.g. viruses, Trojans, or worms, can cause unsafe operating states in your system that may lead to death, serious injury, and property damage.

- Keep the software up to date.
- Incorporate the automation and drive components into a holistic, state-of-the-art industrial security concept for the installation or machine.
- Make sure that you include all installed products into the holistic industrial security concept.
- Protect files stored on exchangeable storage media from malicious software by with suitable protection measures, e.g. virus scanners.
- On completion of commissioning, check all security-related settings.

2.1.4 Residual risks of power drive systems

When assessing the machine or system-related risk in accordance with the respective local regulations (e.g. EC Machinery Directive), the machine manufacturer or system integrator must take into account the following residual risks emanating from the control and drive components of a drive system:

1. Unintentional movements of driven machine or system components during commissioning, operation, maintenance, and repairs caused by, for example,
   - Hardware faults and/or software errors in the sensors, control system, actuators, and connections
   - Response times of the control system and of the drive
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive contamination
   - Parameterization, programming, cabling, and installation errors
   - Use of wireless devices/mobile phones in the immediate vicinity of electronic components
   - External influences/damage
   - X-ray, ionizing radiation and cosmic radiation
2. Unusually high temperatures, including open flames, as well as emissions of light, noise, particles, gases, etc., can occur inside and outside the components under fault conditions caused by, for example:
   - Component failure
   - Software errors
   - Operation and/or environmental conditions outside the specification
   - External influences/damage

3. Hazardous shock voltages caused by, for example:
   - Component failure
   - Influence during electrostatic charging
   - Induction of voltages in moving motors
   - Operation and/or environmental conditions outside the specification
   - Condensation/conductive contamination
   - External influences/damage
4. Electrical, magnetic and electromagnetic fields generated in operation that can pose a risk to people with a pacemaker, implants or metal replacement joints, etc., if they are too close
5. Release of environmental pollutants or emissions as a result of improper operation of the system and/or failure to dispose of components safely and correctly
6. Influence of network-connected communication systems, e.g. ripple-control transmitters or data communication via the network
7. Motors for use in potentially explosive areas:
   When moving components such as bearings become worn, this can cause enclosure components to exhibit unexpectedly high temperatures during operation, creating a hazard in areas with a potentially explosive atmosphere.

For more information about the residual risks of the drive system components, see the relevant sections in the technical user documentation.

Description

3

Overview

The SIMOTICS S-1FG1 servo geared motor forms a single system comprising a mechanical gearbox and a compact, permanent-magnet synchronous motor. The available options, gearbox variants and encoders, together with the expanded product range, mean that the 1FG1 servo geared motors can be optimally adapted to any application. They therefore also satisfy the permanently increasing demands of state-of-the-art machine generations.

The servo geared motor can be combined with the SINAMICS S120 drive system to create a high-performance system with a high degree of functionality. The integrated encoder systems for speed and position control can be selected depending on the application.

The servo geared motors are designed for operation without external cooling and the heat is dissipated through the motor surface. The 1FG1 servo geared motors have a high overload capability.

3.1 Technical features and ambient conditions

3.1.1 Directives and standards

The chapter lists the standards and directives that are applicable for the motor and which the motor complies with.

Standards that are complied with

Note

The standards listed in this manual are not dated.

You can take the currently relevant and valid dates from the Declaration of Conformity.

The motors of the type series SIMOTICS S, SIMOTICS M, SIMOTICS L, SIMOTICS T, SIMOTICS A, called "SIMOTICS motor series" below, fulfill the requirements of the following directives and standards:

- EN 60034-1 - Rotating electrical machines – Dimensioning and operating behavior
- EN 60204-1 - Safety of machinery – Electrical equipment of machines; general requirements

Where applicable, the SIMOTICS motor series are in conformance with the following parts of EN 60034:

Feature	Standard
Degree of protection	EN 60034-5
Cooling [1)]	EN 60034-6
Type of construction	EN 60034-7
Connection designations	EN 60034-8
Noise levels [1)]	EN 60034-9
Temperature monitoring	EN 60034-11
Vibration severity grades [1)]	EN 60034-14

[1)] Standard part, e.g. cannot be used for built-in motors.

Relevant directives

The following directives are relevant for SIMOTICS motors.

European Low-Voltage Directive

SIMOTICS motors comply with the Low-Voltage Directive 2014/35/EU.

European Machinery Directive

SIMOTICS motors do not fall within the scope covered by the Machinery Directive.

However, the use of the products in a typical machine application has been fully assessed for compliance with the main regulations in this directive concerning health and safety.

European EMC Directive

SIMOTICS motors do not fall within the scope covered by the EMC Directive. The products are not considered as devices in the sense of the directive. Installed and operated with a converter, the motor - together with the Power Drive System - must comply with the requirements laid down in the applicable EMC Directive.

European RoHS Directive

The SIMOTICS motor series complies with the Directive 2011/65/EU regarding limiting the use of certain hazardous substances.

European Directive on Waste Electrical and Electronic Equipment (WEEE)

SIMOTICS motors comply with the 2012/19/EU directive on taking back and recycling waste electrical and electronic equipment.

European Directive 2005/32/EC defining requirements for environmentally friendly design of electric motors

The SIMOTICS motor series is not subject to Regulation (EC) No. 640/2009 for implementation of this directive.

European Directive 2009/125/EC defining ecodesign requirements of electric motors and speed controls

The SIMOTICS motor series is not subject to (EU) Regulation 2019/1781 for implementation of this directive.

Eurasian conformity

SIMOTICS motors comply with the requirements of the Russia/Belarus/Kazakhstan (EAC) customs union.

China Compulsory Certification

SIMOTICS motors do not fall within the scope covered by the China Compulsory Certification (CCC).

CCC negative certification (https://support.industry.siemens.com/cs/de/de/view/109769143)

Underwriters Laboratories

SIMOTICS motors are generally in compliance with UL and cUL as components of motor applications, and are appropriately listed.

Specifically developed motors and functions are the exceptions in this case. Here, it is crucial that you carefully observe the content of the quotation and that there is a UL or cUL mark on the rating plate!

Quality systems

Siemens employs a quality management system that meets the requirements of ISO 9001 and ISO 14001.

Certificates for SIMOTICS motors can be downloaded from the Internet at the following link:

Certificates for SIMOTICS motors (https://support.industry.siemens.com/cs/ww/de/ps/13347/cert)

China RoHS

SIMOTICS motors comply with the China RoHS.

You can find more information at:

China RoHS (https://support.industry.siemens.com/cs/de/de/view/109738670/en)

3.1.2 General technical features of the 1FG1 servo geared motor

Motor type	Permanent-magnet synchronous motor	
Magnet material	Rare-earth magnetic material	
Cooling	Natural cooling	
Total weight	See rating plate	
Insulation of the stator winding according to EN 60034-1 (IEC 60034-1)	Temperature class 155 (F) for a winding temperature of ΔT = 100 K at an ambient temperature of +40 °C	
Impulse voltage insulation class according to EN 60034-18-41 (IEC 60034-18-41)	IVIC: C	
Operating range	-15 °C to +40 °C, derating at higher temperatures	
Installation altitude according to EN 60034-1 (IEC 60034-1)	≤ 1000 m above sea level, otherwise power derating	
Degree of protection according to EN 60034-5 (IEC 60034-5)	IP65 The degree of protection only refers to the component motor. When selecting higher degrees of protection, take the equipping on the gearbox side into account. Protect the shaft outlet on the gearbox from contamination/splashwater. Protection against water alone is not adequate for liquids that contain oil, can creep and/or are aggressive. In such cases, protect the servo geared motor with a suitable cover.	
Temperature monitoring	Temperature sensor in the stator winding	
Paint finish	Anthracite (similar to RAL 7016)	
Sound pressure level L_{pA} (1 m) according to DIN EN ISO 1680, max. tolerance + 3 dB(A)	1FG1 ... - .. C SH 36 1FG1 ... - .. D SH 48 1FG1 ... - .. E SH 63 1FG1 ... - .. F SH 80 1FG1 ... - .. G SH 100	65 dB(A) 65 dB(A) 70 dB(A) 75 dB(A) 75 dB(A)
Built-in encoder systems for motors without DRIVE-CLiQ interface	• IC2048S/R incremental encoder sin/cos 1 Vpp, 2048 S/R [1] with C and D tracks for SH 36 to SH 100 • AM2048S/R absolute encoder 2048 S/R [1], multiturn, 4096 revolutions, with EnDat2.1 interface for SH 36 to SH 100 • Resolver, multipole (number of pole pairs corresponds to number of pole pairs of the motor) • AM25EN22 absolute encoder, 25-bit singleturn, 4096 revolutions, with EnDat2.2 interface for SH 48 to SH 100 • 2-pole resolver	

Integrated encoder systems for motors with DRIVE-CLiQ interface	• AS20DQI, 20-bit singleturn absolute encoder • AM20DQI absolute encoder 20-bit + 12-bit multiturn • AM20DQI with plug M17 • R15DQ resolver 15-bit • R14DQ resolver 14-bit
Connection	Connectors for signals and power, can be rotated
Holding brake	• PE holding brake (standard and with increased holding torque) • Spring-loaded brake (holding brake with increased energy capability)

[1] S/R = signals/revolution

3.1.3 Ambient conditions

You can classify the environmental conditions for stationary use at weather-protected locations, see standard DIN IEC 60721-3-3: 1995-09. The environmental effects and their limit values are defined in various classes in this standard.

You can assign the SIMOTICS S-1FG1 servo geared motors to climate class 3K4 with the exception of the environmental factor "condensation". Condensation is not permissible.

The following temperature ranges apply for naturally cooled and force-ventilation motors.

Table 3-1 **Environmental conditions based on climate class 3K4**

Environmental variable		Unit	3K4 class
a)	Low air temperature	°C	-15
b)	High air temperature	°C	+40
c)	Low relative humidity	%	5
d)	High relative humidity	%	95
e)	Low absolute humidity	g/m³	1
f)	High absolute humidity	g/m³	29
g)	Rate of temperature change[1]	°C/min	0.5
h)	Low air pressure[4]	kPa	70
i)	High air pressure[2]	kPa	106
j)	Solar radiation	W/m²	700
k)	Thermal radiation	-	-
l)	Air movement[3]	m/s	1.0
m)	Condensation	-	not permissible
n)	Wind-driven precipitation (rain, snow, hail, etc.)	-	-

Environmental variable		Unit	3K4 class
o)	Water (other than rain)	-	See degree of protection
p)	Formation of ice	-	-

1) Averaged over a period of 5 min

2) Conditions in mines are not considered.

3) A cooling system based on natural convection can be disturbed by unforeseen air movements.

4) The limit value of 70 KPa covers applications worldwide. (altitudes up to 3000 m)

Note

Installation instructions

1FG1 servo geared motors are not suitable for operation in hazardous areas.

Note

Additional data on the ambient conditions

Additional data on environmental conditions, such as ambient temperatures or conditions during transport and storage of the servo geared motors, is provided in the relevant chapters of this documentation.

3.1.4 Address of CE-authorized manufacturer

The CE Declaration of Conformity is held on file available to the competent authorities at the following address:

Siemens AG

Digital Industries

Motion Control

Industriestraße 1

DE-97616 Bad Neustadt a. d. Saale

Germany

3.2 Derating factors

All data refer to an ambient temperature of 40 °C and an installation altitude up to 1000 m above sea level. Under conditions other than those specified (ambient temperature > 40 °C or installation altitude > 1000 m above sea level), the permissible torques/powers must be determined using the factors shown in the following table.

Ambient temperatures and installation altitudes are rounded off to 5 °C or 500 m respectively.

Table 3-2 Power derating factors depending on the installation altitude and the ambient temperature

Installation altitude above sea level in m	Ambient temperature in °C				
	< 30	30 ... 40	45	50	55
1000	1.07	1.00	0.96	0.92	0.87
1500	1.04	0.97	0.93	0.89	0.84
2000	1.00	0.94	0.90	0.86	0.82
2500	0.96	0.90	0.86	0.83	0.78
3000	0.92	0.86	0.82	0.79	0.75
3500	0.88	0.82	0.79	0.75	0.71
4000	0.82	0.77	0.74	0.71	0.67

The factors refer to the static torque of the motor $M_{0.M}$. You must shift the S1 characteristic curve in parallel depending on the result of the factors applied.

At installation altitudes of 2000 m above sea level or higher, the voltage stress on the motors must be reduced accordingly based on the "Factors for reducing the maximum DC-link voltage" table (reciprocal values from EN 60664-1 Table A. 2).

Table 3-3 Factors for reducing the maximum DC-link voltage

Installation altitude up to m above mean sea level	Factor
2000	1
3000	0.877
4000	0.775
5000	0.656
6000	0.588
7000	0.513
8000	0.444

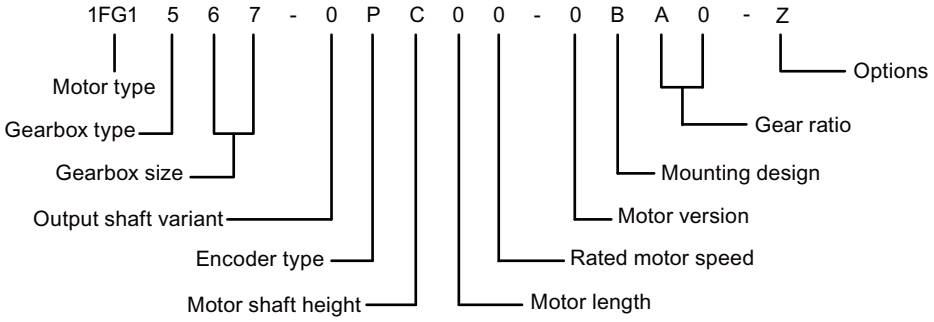
As the DC-link voltage is reduced, the converter output voltage also decreases.

Operation in a vacuum is not permissible because of the low dielectric strength and poor heat dissipation.

3.3 Structure of the Article No.

The following overview describes the structure of the article number.

The article number comprises a combination of digits and letters. You can find possible combinations in the Catalog D41 (https://support.industry.siemens.com/cs/ww/en/view/109747093).



Note

Note that not every theoretical combination is possible in practice.

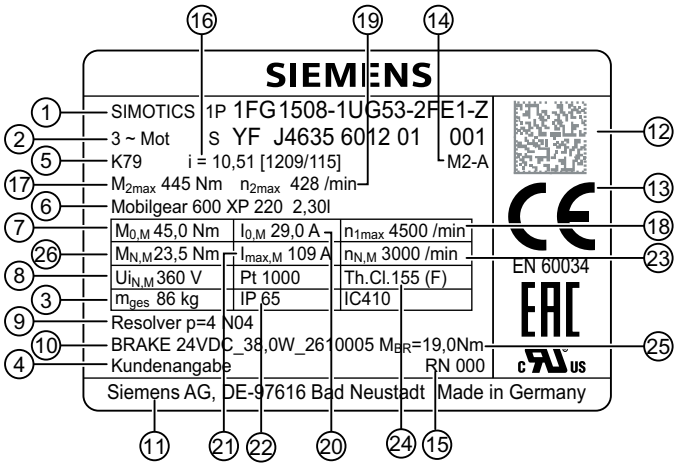
Structure of the article number

Description			Position of the article number																			
SIMOTICS S-1FG1 servo geared motors			**1**	**2**	**3**	**4**	**5**	**6**	**7**	**-**	**8**	**9**	**10**	**11**	**12**	**-**	**13**	**14**	**15**	**16**	**-**	**Z**
Servo helical geared motors																						
• 2-stage - gearbox type Z			**1**	**F**	**G**	**1**	**1**															
• 3-stage - gearbox type D			**1**	**F**	**G**	**1**	**2**															
Servo parallel shaft geared motors																						
• 2-stage - gearbox type FZ			**1**	**F**	**G**	**1**	**3**															
• 3-stage - gearbox type FD			**1**	**F**	**G**	**1**	**4**															
Servo bevel geared motors																						
• 2-/3-stage - gearbox type B/K			**1**	**F**	**G**	**1**	**5**															
Servo helical worm geared motors																						
• 2-stage - gearbox type C			**1**	**F**	**G**	**1**	**6**															
Gearbox size																						
Output shaft variants		Solid shaft standard type 1									**1**											
		Solid shaft standard type 2									**2**											
		Solid shaft standard type 3									**3**											
		Hollow shaft standard type 1									**5**											
		Hollow shaft standard type 2									**6**											
		Hollow shaft standard type 3									**7**											
		Hollow shaft, special shaft design - for more information see Chapter "Options"									**9**											
Encoder	With DRIVE-CLiQ	AS20DQI										**Q**										
		AM20DQI										**R**										
		AM20DQI with connector M17 - order number J4R - see Chapter "Options" in Catalog D41										**Z**										
		Resolver R14DQ										**P**										
		Resolver R15DQ										**U**										
	Without DRIVE-CLiQ	IC2048S/R										**A**										
		AM2048S/R, with EnDat2.1 for SH 36 ... SH 100										**E**										
		AM25EN22, with EnDat2.2 for SH 48 ... SH 100										**N**										
		Resolver, multi-pole										**S**										
		Resolver, 2-pole										**T**										
Motor shaft height		Motor shaft height 36											**C**									
		Motor shaft height 48											**D**									
		Motor shaft height 63											**E**									
		Motor shaft height 80											**F**									
		Motor shaft height 100											**G**									
Motor length		Motor length 0												**0**								
		Motor length 1												**1**								
		Motor length 2												**2**								
		Motor length 3												**3**								

Description		**Position of the article number**																		
SIMOTICS S-1FG1 servo geared motors		**1**	**2**	**3**	**4**	**5**	**6**	**7**	**-**	**8**	**9**	**10**	**11**	**12**	**-**	**13**	**14**	**15**	**16**	**-**	**Z**
	Motor length 4												**4**								
	Motor length 5												**5**								
	Motor length 6												**6**								
Rated motor speed	2000 r/min													**2**							
	3000 r/min													**3**							
	4500 r/min													**4**							
	6000 r/min													**6**							
Line voltage 200 ... 240 V 1 AC (DC link voltage 270 ... 330 V DC) in motor version CT (Compact)																**1**					
Line voltage 380 ... 480 V 3 AC (DC link voltage 510 ... 720 V DC) in motor version CT (Compact)																**2**					
Line voltage 200 ... 240 V 1 AC (DC link voltage 270 ... 330 V DC) in motor version HD (High Dynamic)																**3**					
Line voltage 380 ... 480 V 3 AC (DC link voltage 510 ... 720 V DC) in motor version HD (High Dynamic)																**4**					
Foot-mounted design																	**A**				
Foot/flange-mounted design - for flange-mounted design see Chapter "Options" in Catalog D41																	**B**				
Shaft-mounted design (torque arm)	• Only for servo bevel geared motors, 3-stage																**C**				
	• For other servo geared motors																**D**				
Flange-mounted design - for flange-mounted design see Chapter "Options" in Catalog D41																	**F**				
Housing flange-mounted design																	**H**				
Gear ratio																					
Options																					**Z**
Coded	Order code required - see Chapter "Options" in Catalog D41																				

3.4 Rating plate data of the servo geared motor

The rating plate (nameplate) contains the technical data applicable to the motor that has been delivered. A second rating plate is provided with the motor, and can be used for documentation purposes.



1	Product name, three-phase motor, Article No. (without order codes)	14	Mounting position and output side of the geared motor
2	Serial number (ID No., production number)	15	Revision number
3	Total weight of the geared motor	16	Gearbox ratio, number of teeth
4	Customer specification for Y84	17	Max. permissible output torque of the geared motor in a short-time duty cycle
5	Gearbox type	18	Max. permissible input speed of the gearbox in a short-time duty cycle
6	Gearbox oil/gearbox oil quantity	19	Max. permissible output speed of the gearbox in a short-time duty cycle
7	Static torque of the motor	20	Stall current of the motor
8	Induced voltage at rated motor speed	21	Maximum motor current
9	Encoder type	22	Degree of protection of motor
10	Brake type	23	Rated motor speed (independent of the gearbox)
11	Manufacturer's address, country of origin	24	Temperature class
12	DataMatrix code – serial number + Article No. (without order codes)	25	Braking torque (only for spring-loaded brake)
13	Certifications; EN 60034/UL/CE/EAC/CSA	26	Rated motor torque

3.5 Type designations of the gearbox

Table 3-4 Example of the type designation structure

Example	**F**	**D**	**A**	**D**	**S**	**89**
Gearbox type	F					
Transmission stage		D				
Shaft			A			
Fixing				D		
Connection					S	
Size						89

Table 3-5 Type designation key for the gearbox

Gearbox type		
(-)		Helical gearbox
B		Bevel gearbox, two-stage
K		Bevel gearbox, three-stage
F		Parallel shaft gearbox
C		Helical worm gearbox
Transmission stage		
Z		Two stage
D		Three stage
Type		
	Shaft	
	(-)	Solid shaft
	A	Hollow shaft
	Fixing	
	(-)	Foot-mounted design
	B	Foot/flange-mounted design
	F	Flange-mounted design (A type)
	Z	Housing flange (C type)
	D	Torque arm
	Connection	
	(-)	Feather key
	S	Shrink disk
	T	Hollow shaft with splines
	R	SIMOLOC assembly system

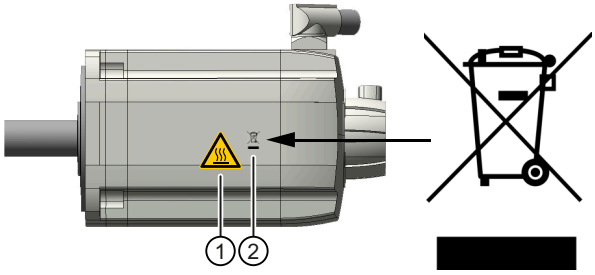
Gearbox designation at the 5th position of the Article No.

Gearbox type	Code letter	Number of stages	Code letter	Designation at the 5th position of the Article No.
Helical gearbox	-	Two stage	Z	1
Helical gearbox	-	Three stage	D	2
Parallel shaft gearbox	F	Two stage	Z	3
Parallel shaft gearbox	F	Three stage	D	4
Bevel gearbox	B/K	Two stage/three stage	(-)	5
Helical worm gearbox	C	Two stage	(-)	6

3.6 Mounting and options

3.6.1 Warning labels on the servo geared motor

The following warning labels are attached to the servo geared motor 1FG1:



① "Warning, hot surface" warning sign

② WEEE symbol

Dispose of the 1FG1 servo geared motor in compliance with WEEE directive 2012/19/EU.

Figure 3-1 Example

3.6.2 Cooling of the servo geared motor

The 1FG1 is naturally cooled.

The housing surface is sufficient for dissipating heat losses where there is free convection.

Note

Dust deposits prevent heat from being radiated.

Dust deposits prevent heat from being radiated and result in a high enclosure temperature.

- Keep the 1FG1 free of contamination, dust and other deposits.

The rated data of the 1FG1 only apply up to an ambient temperature of 40 °C (104 °F).

To ensure adequate heat dissipation of the 1FG1, maintain a minimum clearance of 100 mm from adjacent components on three lateral surfaces.

Contact Technical Support if the gearbox housing temperature exceeds a value of +80 °C.

3.6.3 Thermal motor protection

A temperature-dependent resistor is integrated in the stator winding as temperature sensor to monitor the motor temperature.

Table 3-6 Features and technical data

Type	Pt1000
Resistance in the cooled-down state (20 °C)	Approx. 1090 Ω
Resistance in the hot state (100 °C)	Approx. 1390 Ω
Connection	Via signal cable
Response temperature	Prewarning > 130 °C Alarm/disconnection > 145 °C ±5 °C *)

*) The temperature output value at encoder AM25EN22 with EnDat 2.2 interface does not directly correspond to the winding temperature. Observe the table below.

Winding temperature of the motor	Encoder output value
130 °C	Prewarning > 4452
145 °C	Alarm/shutdown > 4525

3.6.4 Holding brake

3.6.4.1 Properties

The holding brake is used to clamp the motor shaft when the motor is at a standstill. The holding brake is **not** a working brake to brake a rotating motor.

The holding brake can be implemented as a permanent magnet brake or a spring-loaded brake.

⚠ WARNING

Unintended movement of the system or machine

If you use the holding brake improperly, e.g. as a safety brake, or you ignore the number of operations of the brake, the braking effectiveness of the holding brake can be irreversibly reduced. This can result in unintended movement of the machine or system, which can result in severe injury or death.

- Strictly observe the permissible number of operating cycles.
- Operate the servo geared motor only in conjunction with an intact brake.

NOTICE
Faulty brake function due to inadmissible wear Inadmissible wear means that the braking function is no longer guaranteed. • Comply with the specified EMERGENCY STOP characteristics. • Avoid repeated brief acceleration of the servo geared motor against a holding brake that is still closed. For the drive control and/or the drive enable, consider the response times of the brakes and relay switching times.

Principle of operation

The holding brake operates according to the closed-circuit principle. It brakes when the current is interrupted and holds the servo geared motor.

When power is applied to the brake it opens and the servo geared motor is free to rotate.

In the event of a power failure or an Emergency Stop, the servo geared motor is braked from its actual speed down to standstill.

Note

Forbidden uses of the holding brake

The holding brake must not be used in hazardous areas/areas subject to firedamp.

Note

It is not possible to subsequently modify servo geared motors with or without holding brake.

Servo geared motors with a holding brake are longer by the length of the holding brake.

Setting up the brake

The rated holding brake voltage is 24 V DC +/- 10 %. Voltages outside this tolerance range can result in faults.

When setting up machines and systems (jog mode), carefully observe the technical data for the holding brakes provided in Chapter "Configuration Instructions" of Catalog D41.

3.6.4.2 Direct connection of the holding brake to SINAMICS devices

The holding brake in the servo geared motor is intended for direct connection to the SINAMICS converter using the MOTION CONNECT power cable with an integrated brake connection cable, see Chapter "Selecting and connecting the cables (Page 137) "

Since safe electrical isolation from the servo geared motor winding is guaranteed for the brake cable in the motor and the power cable is designed as an enforced insulation, no further protection circuits are required in this case.

3.6.4.3 Connection of the holding brake to an external power supply via contactor

You can control the holding brake via an external power supply.

The external power supply can be a Protective Extra Low Voltage (PELV) supply, as:

- safe electrical separation from the motor winding is guaranteed for the brake cable in the motor and
- the power cable has reinforced insulation

Note

The relay K1, located between coil and contact, must also have reinforced insulation to protect the internal logic voltage.

If you control the holding brake from an external power supply, you must protect the holding brake from voltage peaks using a protective circuit. See Fig. "Suggested circuit for the external power supply"

The protective circuit also ensures the specified switching times. See Table "Technical data for the holding brakes used"

To ensure that the brake opens correctly, a minimum voltage of 24 V DC -10 % must be applied to the connector on the motor side.

If the maximum voltage of 24 V DC +10 % is exceeded, then the brake can re-close.

When providing the voltage, take into account the voltage drop along the brake feeder cable.

You can approximately calculate the voltage drop Δ*V* for copper cables as follows:

ΔU / V = 0.042 • (*l*/*q*) • I_{Brake}

l= cable length in m
q = Brake conductor cross-section mm^2
I_{brake} = DC current of the brake in A

Note

Integrate a protective circuit in the feeder cable. In this way, you avoid switching overvoltages and possible influence of the system environment. See the following diagram

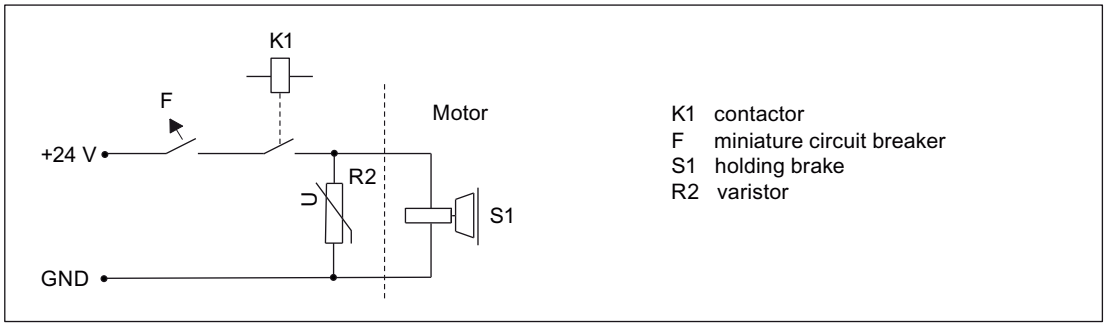


Figure 3-2 Suggested circuit for the external power supply with protective circuit

Table 3-7 Example: Electrical components for the suggested circuit

Electrical Component	Examples		
F	3RV10 miniature circuit breaker with current paths connected in series (possibly with mounted 3RV1901 auxiliary contact to provide a feedback signal to the drive)	or	5SX21 miniature circuit breaker (possibly with mounted auxiliary contact to provide a feedback signal to the drive).
K1	3RH11 contactor relay	or	3RT10 contactor
R2	SIOVS14K30 varistor (EPCOS)		

3.6.4.4 Permanent magnet brake

The permanent-magnet brake is one type of holding brake.

The magnetic field of the permanent magnets exerts a pulling force on the armature disk of the holding brake. This means that in the no-current condition, the brake is closed and the motor shaft is held (closed-circuit principle).

When 24 V DC rated voltage is applied to the brake, the current-carrying coil produces an opposing field. This neutralizes the force of the permanent magnets and the brake opens without any residual torque.

For the technical data, see Chapter "Configuring guide" in Catalog D41.

3.6.4.5 Spring-loaded brake

The spring-loaded brake is another type of holding brake.

Principle of operation

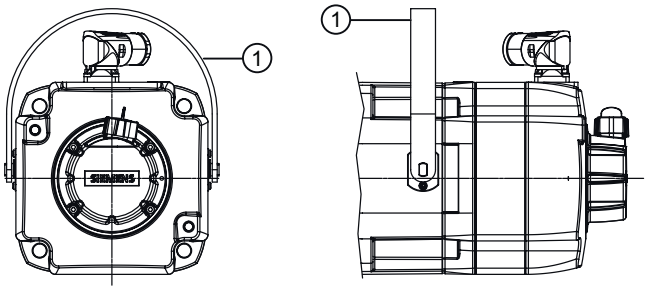
The spring-loaded brake is an electromagnetic device that uses the force of an electromagnetic field to release the braking effect created by the force of a compressed spring (electromagnetically opening system).

It also works according to the closed-circuit principle.

For the technical data, see Chapter "Configuring guide" in Catalog D41.

Manual brake release option

To release the braking torque, you can order the servo geared motor with spring-loaded brake optionally with manual brake release.



① Manual release lever

Figure 3-3 Spring-loaded brake with manual release lever

Manual brake release is the manual opening of the spring-loaded brake using a removable lever called the manual release lever. This releases the braking torque of the spring-operated brake.

Note

Permissibility of manually releasing the brake

Before use, check that manual brake release is permissible in your specific system.

⚠ WARNING

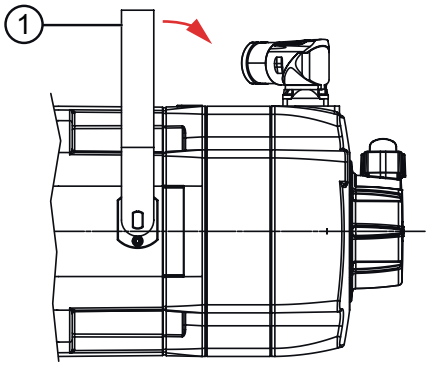
Unintended movement of the system or machine

Using the mechanical manual brake release, you can release the braking effect of the spring-loaded brake. Unintended movements of the machine or system can result in death or serious injuries.

- Mount the manual release lever so that it cannot be inadvertently actuated.
- Place the manual release lever in the vertical position to ensure the full effect of the brake. Remove the manual release lever.
- Mount the manual release lever first for releasing the spring-loaded brake.
- Carefully ensure that the machine or system cannot result in any injury when releasing the spring-loaded brake.
- Immediately shut down the machine or system if the manual release lever cannot be placed in the vertical position.
- Only restart the system when it is absolutely guaranteed that the manual brake release functions perfectly.
- In normal operation, remove the manual release lever.

Releasing the brake

Procedure



① Manual release lever

- Press the manual release lever toward the NDE. The spring-loaded brake is mechanically released.

You have deactivated the braking force.
❒

Securing the manual brake release

In the unactuated state, the manual release lever must be in the vertical position, see the diagram. Only in this position is the brake fully closed and the full braking effect ensured. The manual release lever can only be removed in the vertical position.

Procedure

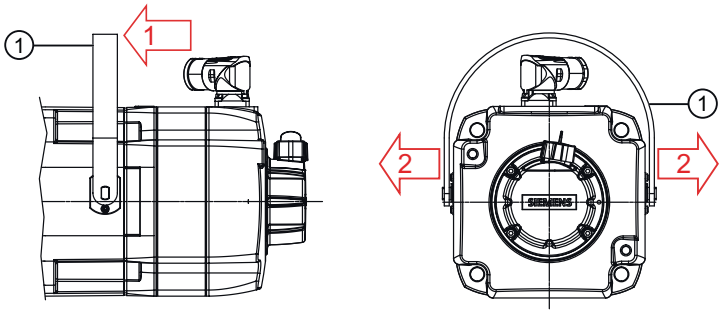


Figure 3-4 Removing the manual release lever of the spring-loaded brake

1. Place the manual release lever in the vertical position.
2. Remove the manual release lever.

You have secured the spring-loaded brake against unintended actuation.
❒

Mechanical air gap check

1FG1 with spring-loaded brake and the manual brake release option (K82) have an opening to check the mechanical air gap.

⚠ CAUTION

Danger of injury due to forcibly ejected particles

When opening the cover to check the air gap, loose particles can be forcibly ejected resulting in injury.

- Switch off the motor before you open screw plug ①.
- Only open the screw plug ① when the servo geared motor is at a standstill.
- Before switching the motor on again, close the cover used to check the air gap.

You can check the width of air gap s of the spring-loaded brake through the opening provided. The width of the air gap indicates the state of wear of the armature disk. The wider the air gap, the higher the armature disk wear.

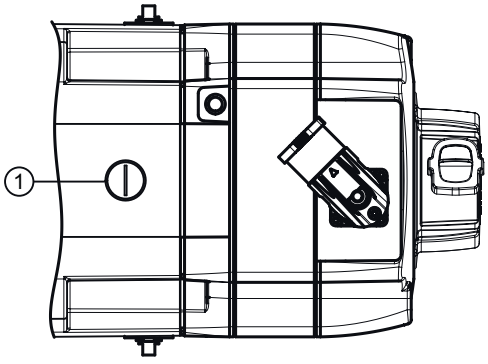
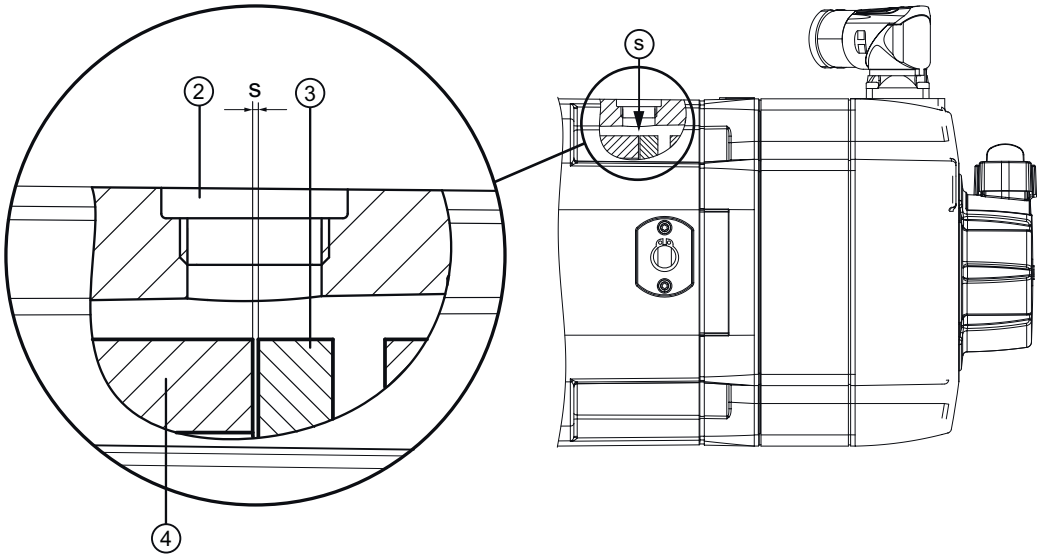


Figure 3-5 Top view



① Screw plug to check the mechanical air gap
② Opening to check the mechanical air gap
③ Armature disk
④ Brake housing
s Air gap

Figure 3-6 Side view

Monitoring wear for brake

Procedure

1. Switch off the servo geared motor.
2. Remove the screw for the opening to check the air gap.
3. Determine distance s between the brake housing and the armature disk using a feeler gauge.
4. Compare the determined width of the air gap with the values listed in the following table.

	1FG1□□□-□□F□□-□□□□	**1FG1□□□-□□G□□-□□□□**
Air gap s / mm in the new state	$0.20^{+0.03}$	$0.20^{+0.03}$
Maximum permissible air gap s_{max} / mm (at 70 % of the rated current)	0.44	0.70

You have checked the state of wear of the armature disk.
❒

The wear limit of the brake has been reached when the air gap reaches the value s_{max}.

You must replace the brake to ensure continued functional safety. You cannot adjust the brake.

Consult with your SIEMENS contact person.

3.6.5 Increased chemical resistance

SIMOTICS S-1FG1 servo geared motors are available in a version with increased chemical resistance. The corresponding order code is **N16**. The paint of these servo geared motors is resistant to numerous common cleaning agents and disinfectants.

Note

The resistance of the paint to cleaning agents and disinfectants used was verified by a material resistance test performed by ECOLAB Deutschland GmbH. You can find the corresponding certificate in the Internet at: Certificate (https://support.industry.siemens.com/cs/ww/en/view/58657336).

More information about the certificate is provided in Chapter "Certificate for the "PS Premium" painting system from ECOLAB (Page 191)".

The resistance only applies to painted parts. You must apply the appropriate protective measures for unpainted parts. Parts to be protected include:

- Hollow shafts
- Shafts with two shaft ends
- Plug-in design shafts and screws at the torque arm (if applicable)
- Screws at the attached protective cover - order number **G60**
- Manual brake release - order number **K82**
- Oil sight glass - order number **G34**
- Oil expansion unit - order number **G47**

Note

Before use, check the level of resistance of your complete unit.

Preparing for use

4

4.1 Shipping and packaging

Packing

1FG1 servo geared motors are delivered already assembled. If applicable, additional equipment is shipped in separate packaging.

- Please pay attention to the handling notes on the packaging when the servo geared motor is delivered

Table 4-1 Handling notes and their meaning

Icon	Meaning	Icon	Meaning
	Fragile (ISO 7000, No. 0621)		Keep in a dry place (ISO 7000, No. 0626)
	This way up (ISO 7000, No. 0623)		Do not stack (ISO 7000, No. 2403)

Scope of delivery of a servo geared motor

- When receiving the delivery, immediately check whether the scope of delivery matches the accompanying documents.

  Note

  Siemens will not accept any claims for missing or incorrect items submitted at a later date.

- Register a complaint about
  - any apparent transport damage with the transport company immediately
  - any apparent defects or missing components with the appropriate Siemens office immediately.

The safety instructions are included in the scope of delivery.

A second rating plate is included in the scope of delivery. You can use the second rating plate to specify the power data close to the servo geared motor.

Special versions and design variants may differ in the technical details and scope of delivery.

Note

Store the safety instructions so they are always accessible.

Unpacking the servo geared motor

NOTICE
Damage to the servo geared motor due to improper transport
Transport damage can impair the correct functioning of the servo geared motor.
Never commission faulty or defective servo geared motors.

- Check the servo geared motor for completeness and damage.
- Report any missing parts or damage immediately.
- Remove and dispose of the packaging material and transport fixtures in accordance with local regulations.

4.2 Transportation and storage

4.2.1 Transporting the servo geared motor

Note

Comply with the local regulations when transporting servo geared motors.

- Transport and store the servo geared motors in the original packaging.
- Use suitable load suspension devices when transporting and installing the servo geared motor.
- Transport the servo geared motor carefully.

Lifting and transporting the servo geared motor using a crossbar

⚠ WARNING

Injuries caused by falling servo geared motors

The threads for lifting eyebolts in the motor enclosure are not designed for carrying the entire servo geared motor.

If you lift the servo geared motor only using the lifting eyebolts in the motor enclosure, the lifting eyebolts can be ripped out of the threads and cause death or serious injury.

- For transport, screw the lifting eyebolts into the threads in the gearbox housing depending on the position.
- Use the threads for the lifting eyebolts in the motor enclosure only for position stabilization.
- Observe the maximum load of the lifting eyebolt as listed in the table below.

Transport the servo geared motor by the lifting eyes or lifting eyebolts in the gearbox housing.

Because they are designed only for the weight of the geared motor, it is not permissible to add additional loads to the lifting eyes and lifting eyebolts.

Use a crossbar for lifting and transporting the servo geared motor.

Procedure

1. For transport, screw the lifting eyes (lifting eyebolts) into the appropriate locations depending on the specific orientation of the servo geared motor. Use laminated washers.
2. Hook the crossbar into the lifting eyes (lifting eyebolts).

❒

Table 4-2 Maximum load of the lifting eyebolt on the gearbox

Thread size	m	d_3	Thread size	m	d_3
	kg	mm		kg	mm
M8	140	36	M20	1 200	72
M10	230	45	M24	1 800	90
M12	340	54	M30	3 200	108
M16	700	63	-	-	-

Setting the servo geared motor down

Procedure

1. Set the servo geared motor down on a firm, level surface.
2. Secure the servo geared motor against unintentional movement.

❒

4.2.2 Storing the servo geared motor

Storage

A protective coating must be applied to the free shaft ends, sealing elements and flange surfaces of the servo geared motor.

NOTICE
Bearing damage incurred at standstill If 1FG1 servo geared motors are stored incorrectly, bearing seizure damage can occur, e.g. brineling, as a result of vibration. • Comply with the storage instructions.

Storage conditions

Please observe the warning instructions on the packaging and labels.

Store the 1FG1 servo geared motor in a dry, dust-free and vibration-free indoor area.

Maintain the following values:

- $v_{rms} < 0.2$ mm/s
- Max. temperatures: -15 °C to 70 °C
- Mean relative humidity < 75 %

Long-term storage

Note

In the case of storage in transit over 6 months, special arrangements must be made for preservation.

- Please contact Technical Support.

The storage facility must satisfy the following conditions if you store the servo geared motor for longer than six months:

- 1FG1 servo geared motors must be protected against extreme weather conditions.
- The storage area must be free of corrosive gases.
- The storage area must be free of any vibration ($v_{rms} < 0.2$ mm/s).
- According to EN 60034-1, the temperature must be in the range -15 °C to 70 °C.
- The relative humidity must be less than 60%.

Check the correct state of the servo geared motor every six months.

- Check the servo geared motor for any damage.
- Perform any necessary maintenance work.
- Check the state of the desiccant and replace when necessary.
- Record the preservation work so that all preservation coating can be removed from the servo geared motor prior to commissioning.

Features and mounting positions of the servo geared motors

5

5.1 Properties

The servo geared motor is supplied with 2 or 3 gear stages.

The servo geared motor is suitable for various mounting positions.

NOTICE
Gearbox damage due to incorrect oil level For different mounting positions, an incorrect oil level can cause gearbox damage. • Maintain the correct oil level in the respective mounting positions.

Gearbox housing

Depending on the size, the gearbox housings are manufactured out of die-cast aluminum or cast iron.

Table 5-1 Housing material

Gearbox type	Size				
	19/29	39	39A	49	from 59
Helical gearbox D/Z	Aluminum	Aluminum		Cast iron	Cast iron
Parallel shaft gearbox F	Aluminum	Cast iron		Cast iron	Cast iron
Bevel gearbox B	Aluminum	Aluminum		Aluminum	Cast iron
Bevel gearbox K	Aluminum	Cast iron		Cast iron	Cast iron
Helical worm gearbox C	Aluminum		Aluminum	Cast iron	Cast iron

Intermeshing parts of the gearbox

The intermeshing parts are hardened and ground.

For the helical worm gearbox, the worm is hardened and ground. The gear is manufactured from high-quality bronze.

The bevel gear stage of the bevel gearbox is lapped in pairs.

Gearbox lubrication

The intermeshing parts are supplied with adequate lubricant by means of splash lubrication.

Gearbox shaft bearings

All shafts are mounted in rolling bearings. The rolling bearings are lubricated using splash lubrication or oil-spray lubrication. Bearings that are not supplied with lubricant are sealed and grease-lubricated.

Gearbox shaft sealing rings

The shaft sealing rings on the output side prevent lubricant from escaping from the housing at the shaft outlet and prevent contamination from entering the housing.

The optimum use of the seals depends on the ambient conditions and the lubricant being used.

Radial shaft sealing ring

A high-quality radial shaft sealing ring is used as standard seal. The ring is provided with an additional dust lip to protect against the ingress of dirt and contamination from outside.

Seal for a longer service life (optional)

The radial shaft sealing ring with dust lip has an intermediate axial seal towards the inside of the gearbox. The intermediate axial seal has a sine-shaped sealing lip that protects the sealing ring from dirt and contamination.

Seal to handle increased environmental stress (optional)

This seal is equipped with an additional fiber disk. In addition to the longer service life, the disk also provides increased protection against higher environmental stress as a result of moisture and dust.

Noise

The geared motors are certified for a wide range of installation and operating conditions. These conditions, e.g. rigid or vibration-insulated foundation design, can to some extent influence the noise emission considerably.

The circumferential velocity of the motor pinion has a significant influence on the additional servo geared motor noise level. This is the reason that higher speeds or low transmission ratios result in higher noise levels.

Note

External noise

Noise that is not generated by the servo geared motor, but emitted from it, is not take into consideration.

Noise emitted by the driven load is not taken into consideration.

5.2 Mounting positions

NOTICE
Gearbox damage due to incorrect mounting position Incorrect mounting positions result in inadequate lubrication of the servo geared motors. Inadequate lubrication can cause gearbox damages. • Only operate the servo geared motor in the mounting position specified on the rating plate.

Note

The servo geared motors with gearbox sizes 19 and 29 are lubricated for life. These gearboxes have no openings for checking the oil level.

Mounting positions M2 and M4 are equipped with a vent valve.

C29 has a vent valve in all mounting positions.

Table 5-2 Symbols - Oil valves

Symbol	Meaning
	Identifying marking of vent plug
	Identifying marking for ventilation, opposite side
	Identifying marking for oil level plug
	Identifying marking for oil level, opposite side
	Identifying marking for oil drain plug
	Identifying marking for oil drain, opposite side

Table 5-3 Symbols - Supplements

Symbol	Meaning
A, B	Output side A, output side B
②	2-stage gearbox
③	3-stage gearbox
① ... ④	Position of the connection plug

5.2.1 Helical geared motor (2 stage and 3 stage: Z and D)

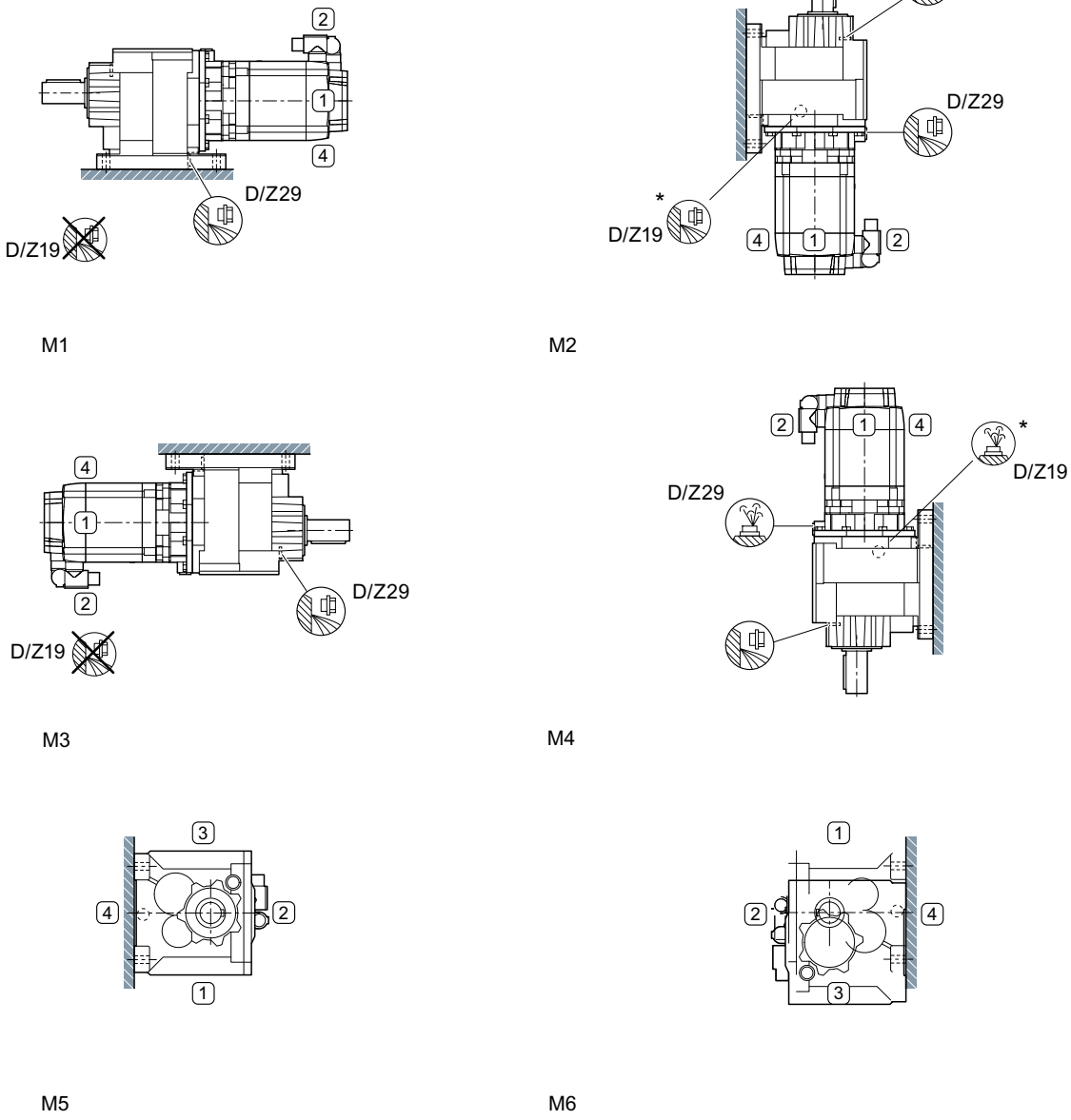


Figure 5-1 Mounting positions for servo helical geared motors Z and D, foot-mounted design, frame sizes 19 - 29, 2 stage and 3 stage

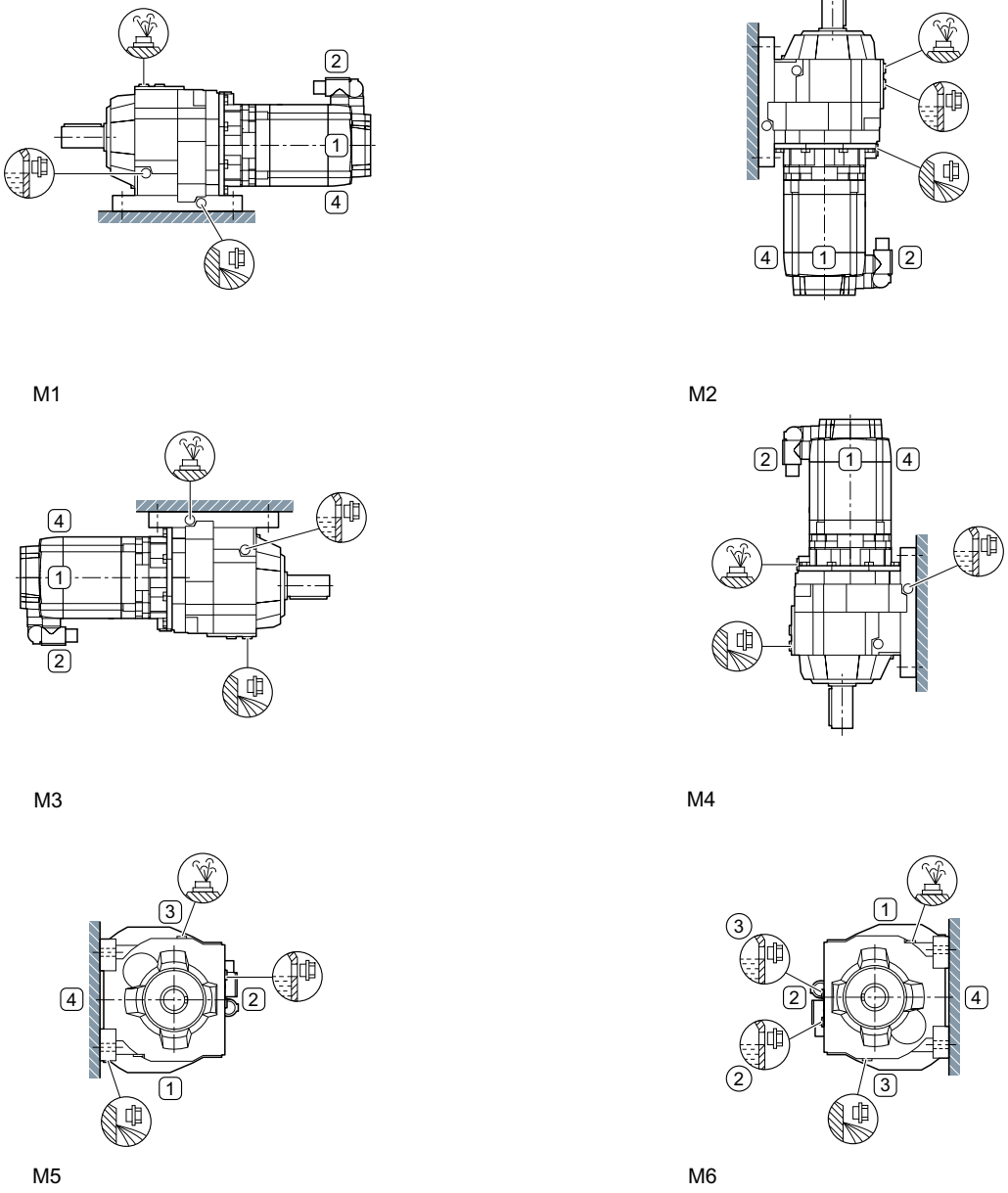
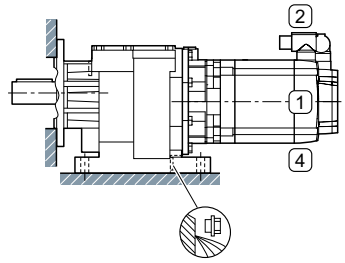
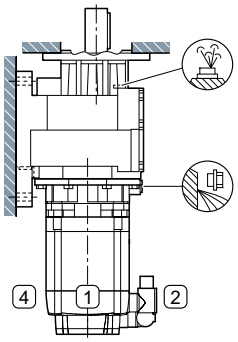


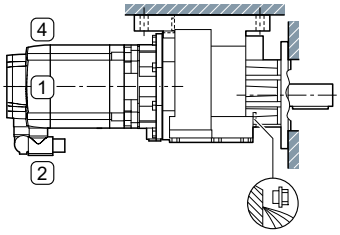
Figure 5-2 Mounting positions for servo helical geared motors Z and D, foot-mounted design, frame sizes 39 - 129, 2 stage and 3 stage



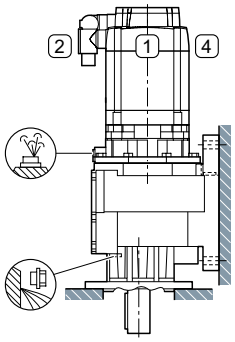
M1



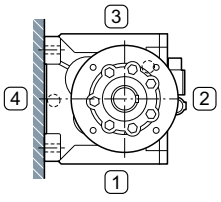
M2



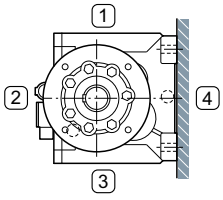
M3



M4

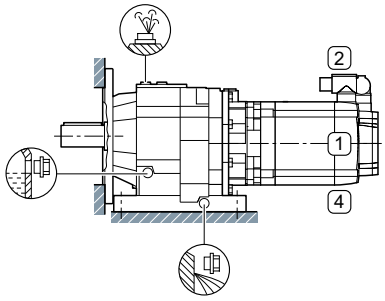


M5

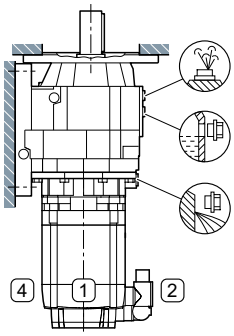


M6

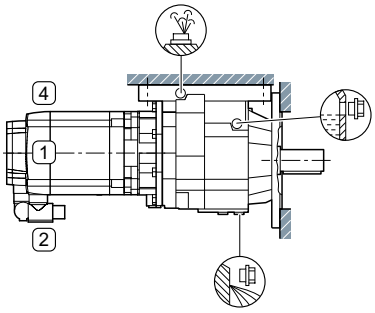
Figure 5-3 Mounting positions for servo helical geared motors ZB and DB, foot-mounted and flange-mounted designs, frame sizes 29, 2 stage and 3 stage



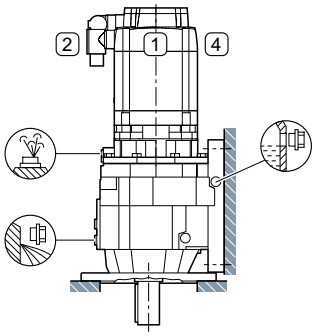
M1



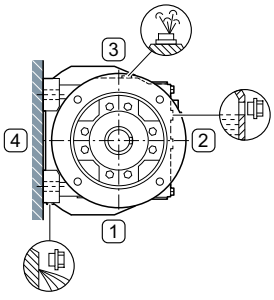
M2



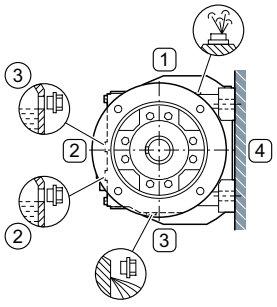
M3



M4



M5



M6

Figure 5-4 Mounting positions for servo helical geared motors ZB and DB, foot-mounted and flange-mounted designs, frame sizes 39 - 89, 2 stage and 3 stage

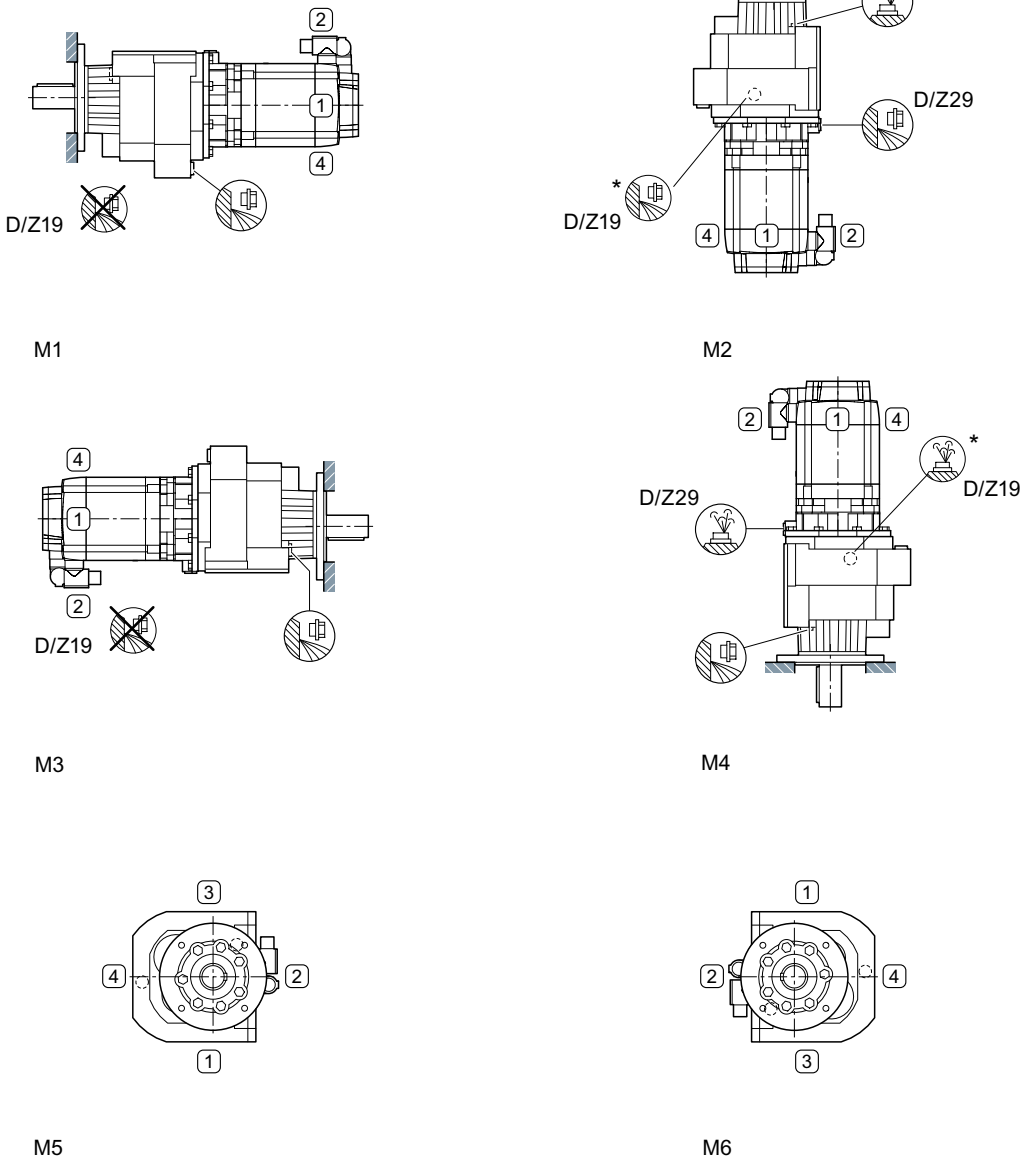
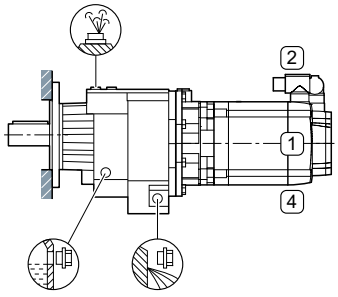
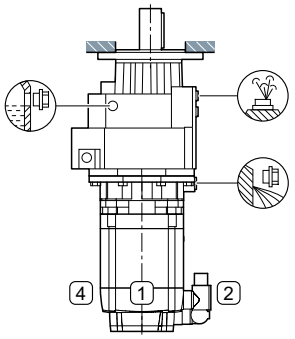


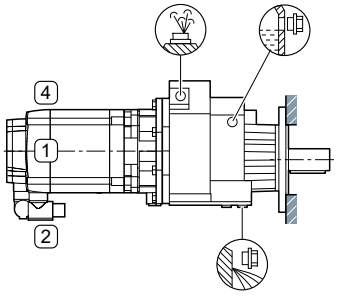
Figure 5-5 Mounting positions for servo helical geared motors DF and ZF (flange-mounted design) or DZ and ZZ (housing flange design), frame sizes 19 - 29, 2 stage and 3 stage



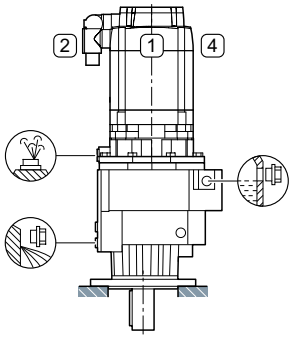
M1



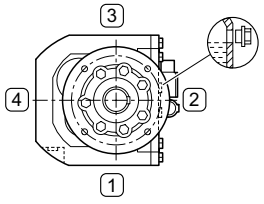
M2



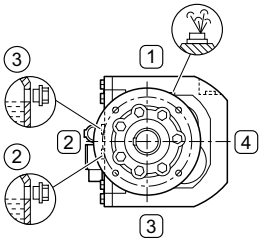
M3



M4

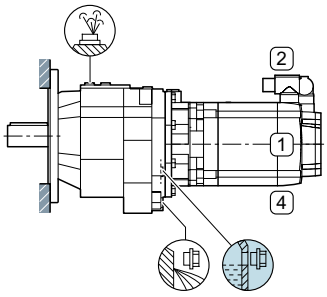


M5

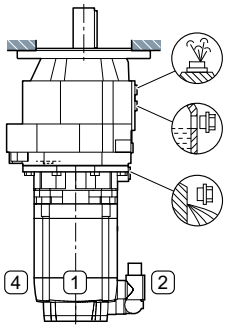


M6

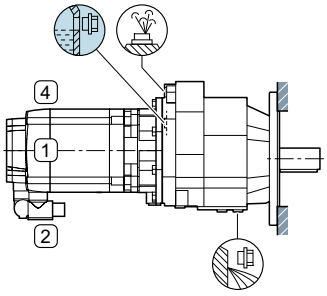
Figure 5-6 Mounting positions for servo helical geared motors DF and ZF (flange-mounted design) or DZ and ZZ (housing flange design), frame size 39, 2 stage and 3 stage



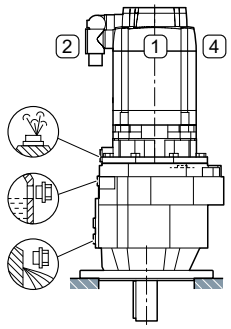
M1



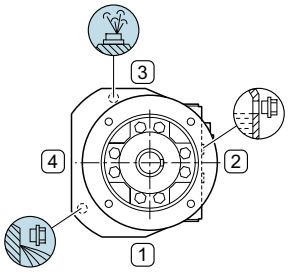
M2



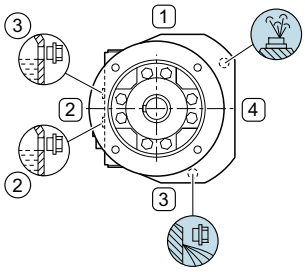
M3



M4



M5



M6

Figure 5-7 Mounting positions for servo helical geared motors DF and ZF (flange-mounted design) or DZ and ZZ (housing flange design), frame sizes 49 - 129, 2 stage and 3 stage

5.2.2 Parallel shaft geared motor (2 stage and 3 stage: FZ and FD)

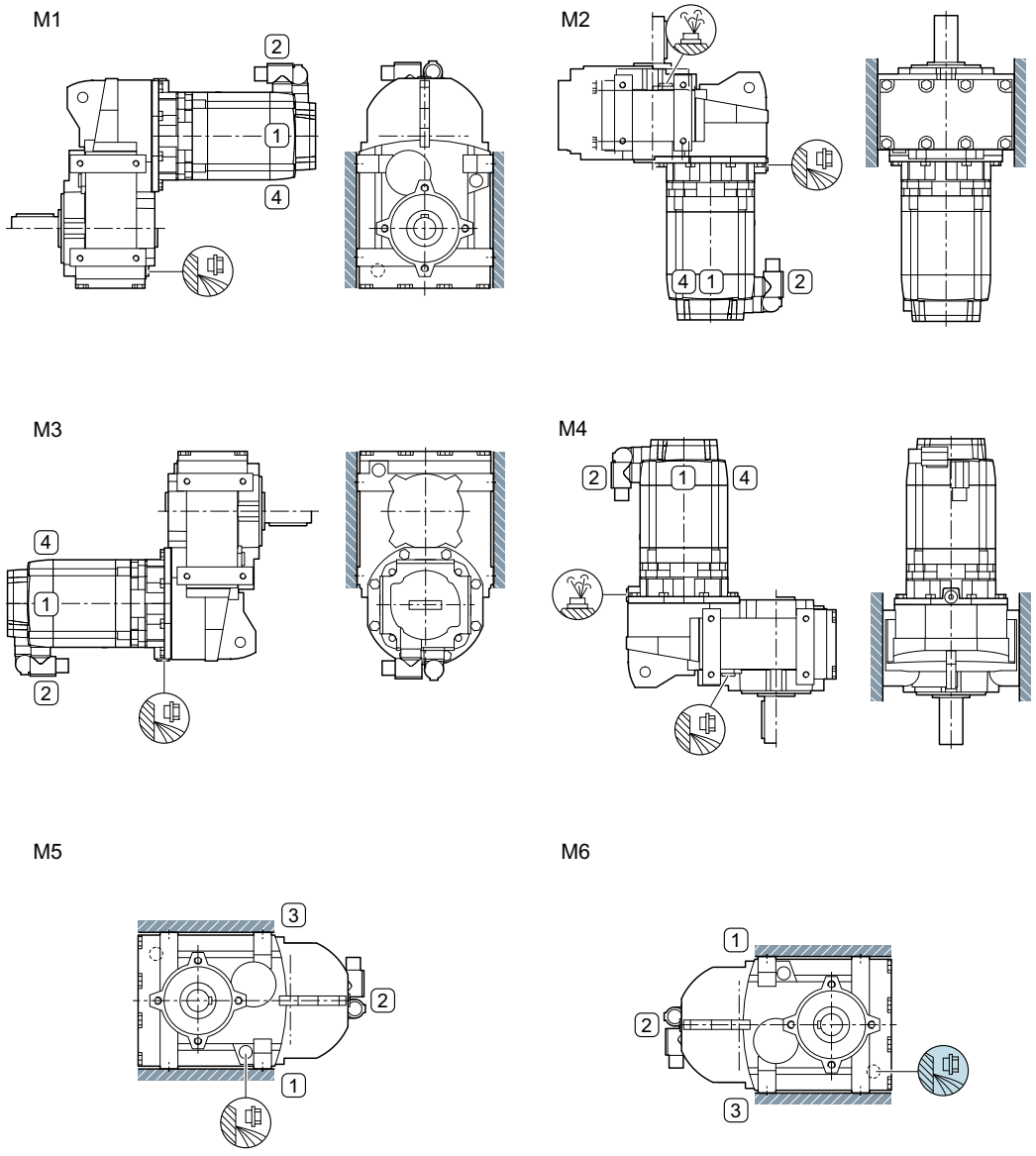


Figure 5-8 Mounting positions for servo parallel shaft geared motors FZ and FD, foot-mounted design, frame size 29, 2 stage and 3 stage

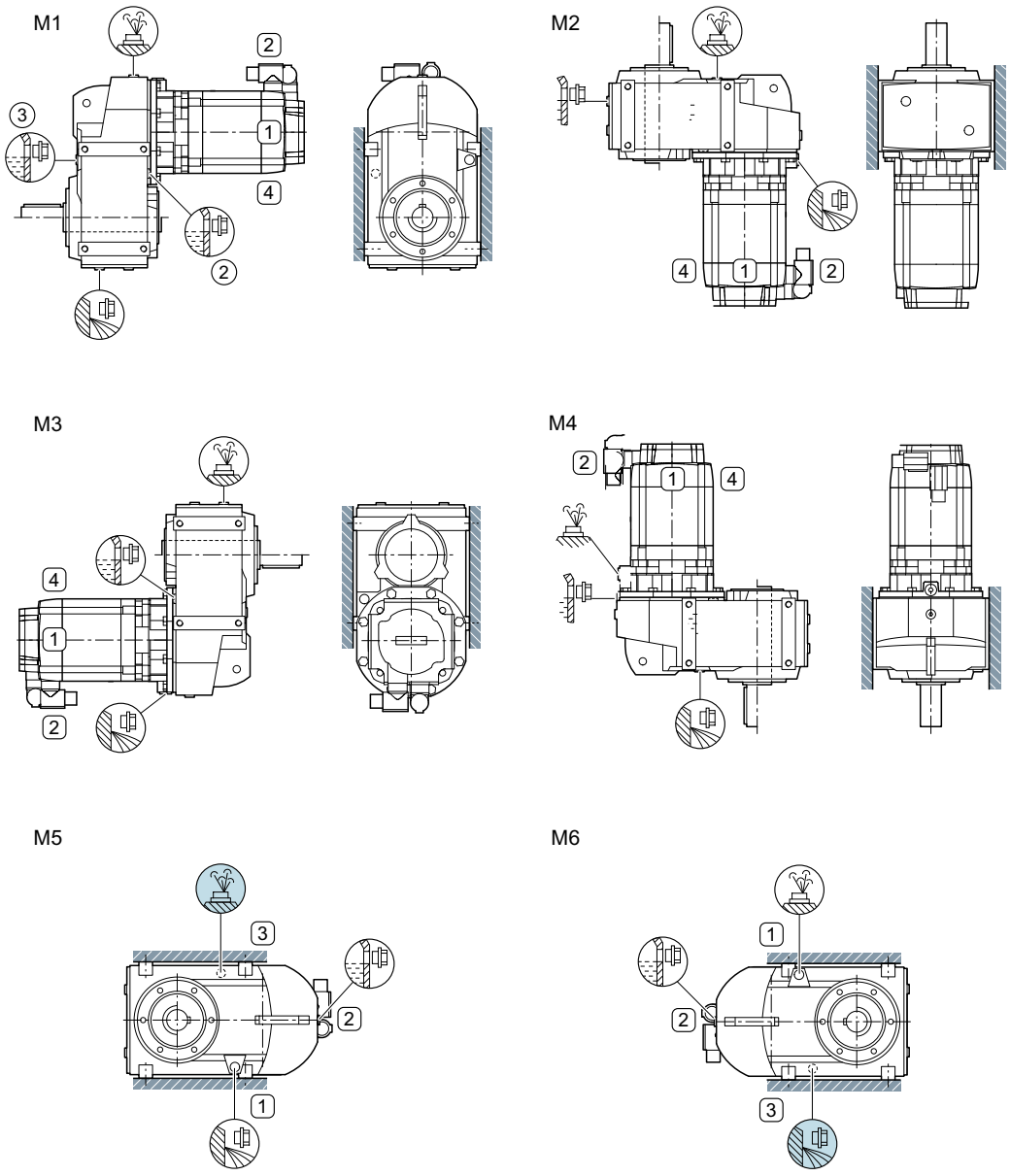


Figure 5-9 Mounting positions for servo parallel shaft geared motors FZ and FD, foot-mounted design, frame size 39 - 129, 2 stage and 3 stage

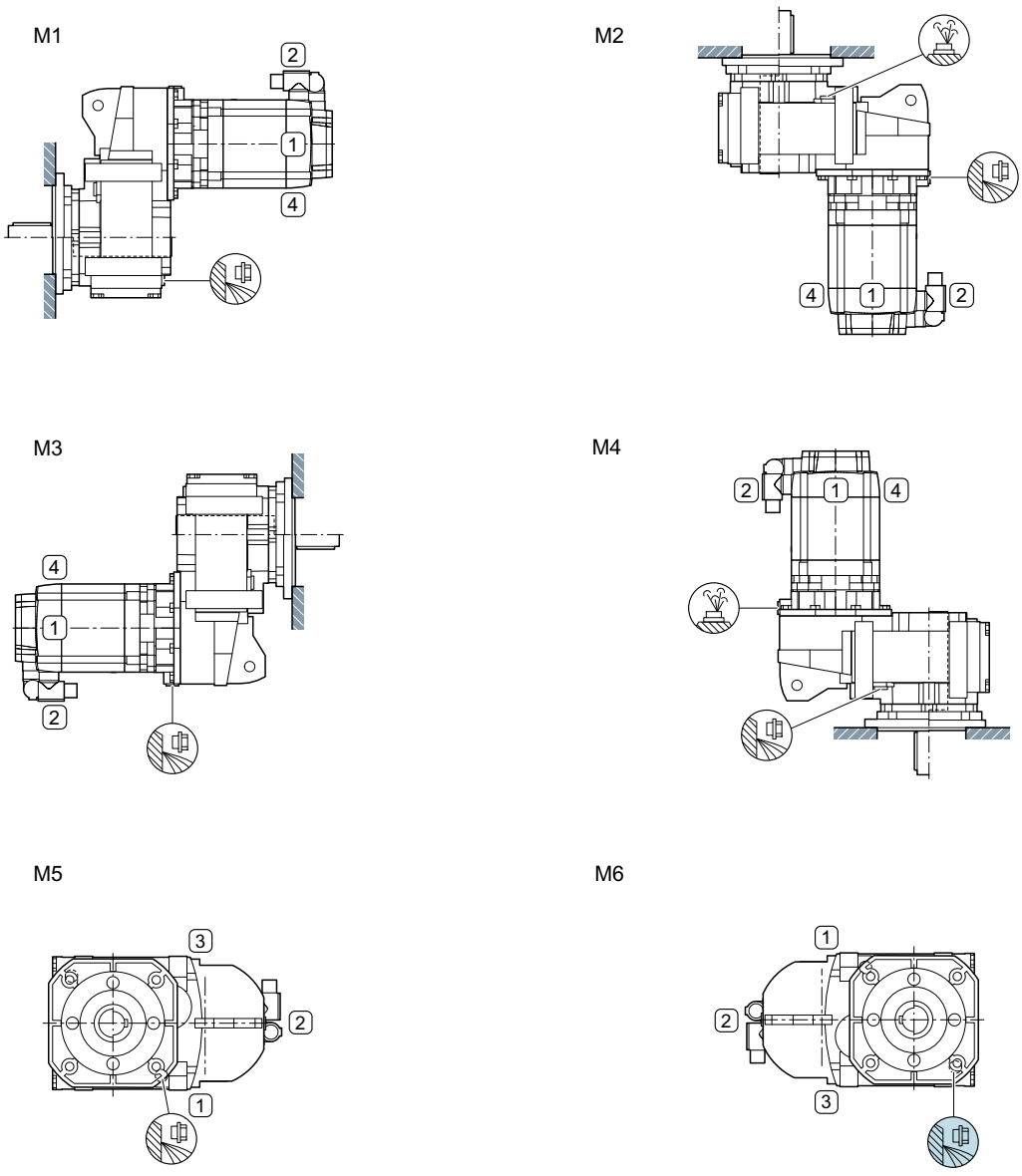


Figure 5-10 Mounting positions for servo parallel shaft geared motors FZ.F and FD.F (flange-mounted design) and FZ.Z and FD.Z (housing flange design), frame size 29, 2 stage and 3 stage

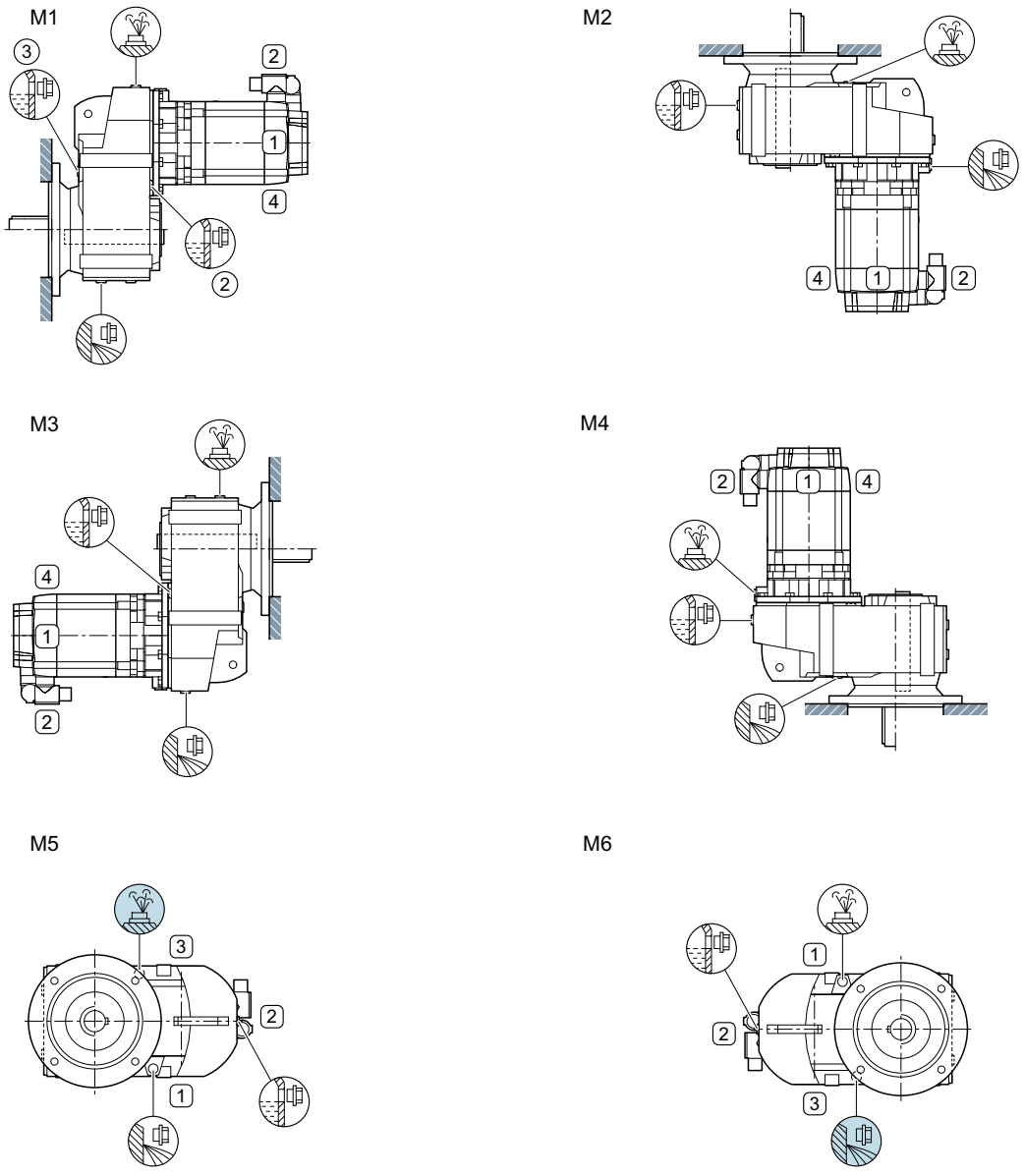
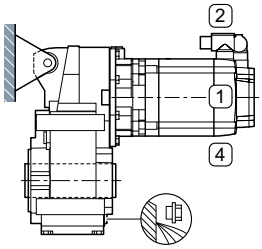
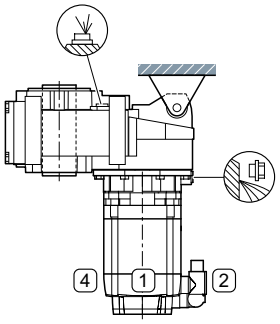


Figure 5-11 Mounting positions for servo parallel shaft geared motors FZ.F and FD.F (flange-mounted design) and FZ.Z and FD.Z (housing flange design), frame sizes 39 - 129, 2 stage and 3 stage

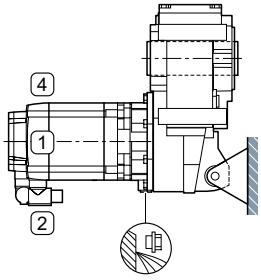
M1



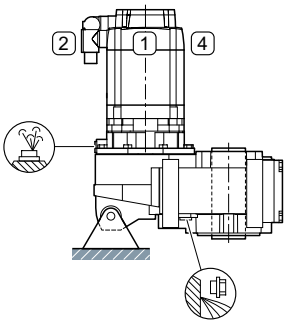
M2



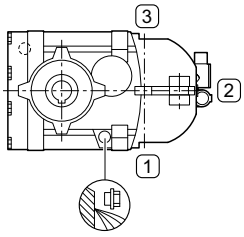
M3



M4



M5



M6

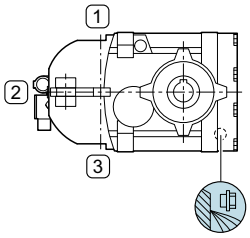


Figure 5-12 Mounting positions for servo parallel shaft geared motors FZAD and FDAD, shaft-mounted design, frame size 29, 2 stage and 3 stage

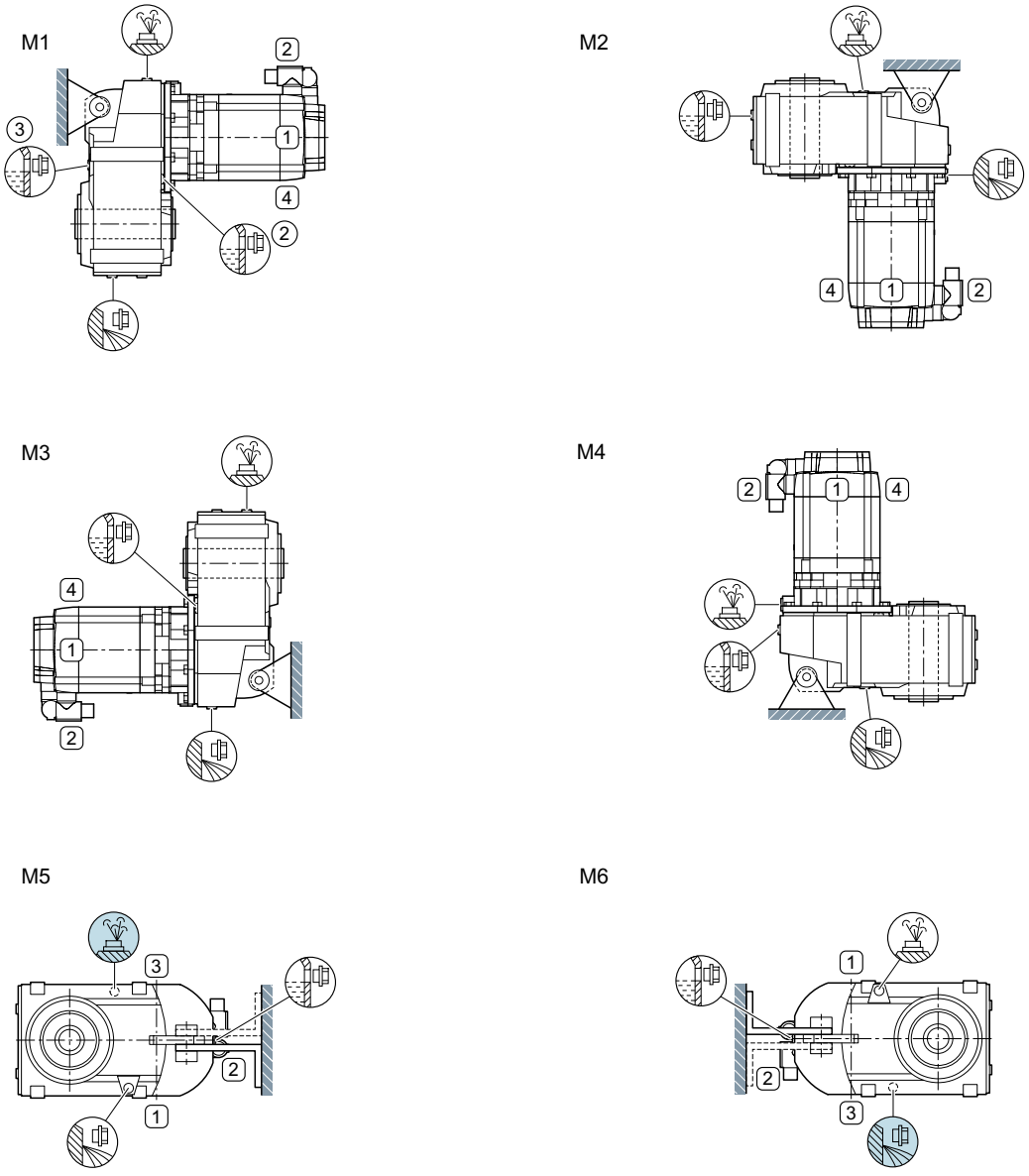


Figure 5-13 Mounting positions for servo parallel shaft geared motors FZAD and FDAD, shaft-mounted design, frame sizes 39 - 129, 2 stage and 3 stage

5.2.3 Bevel geared motor (2 stage and 3 stage: B and K)

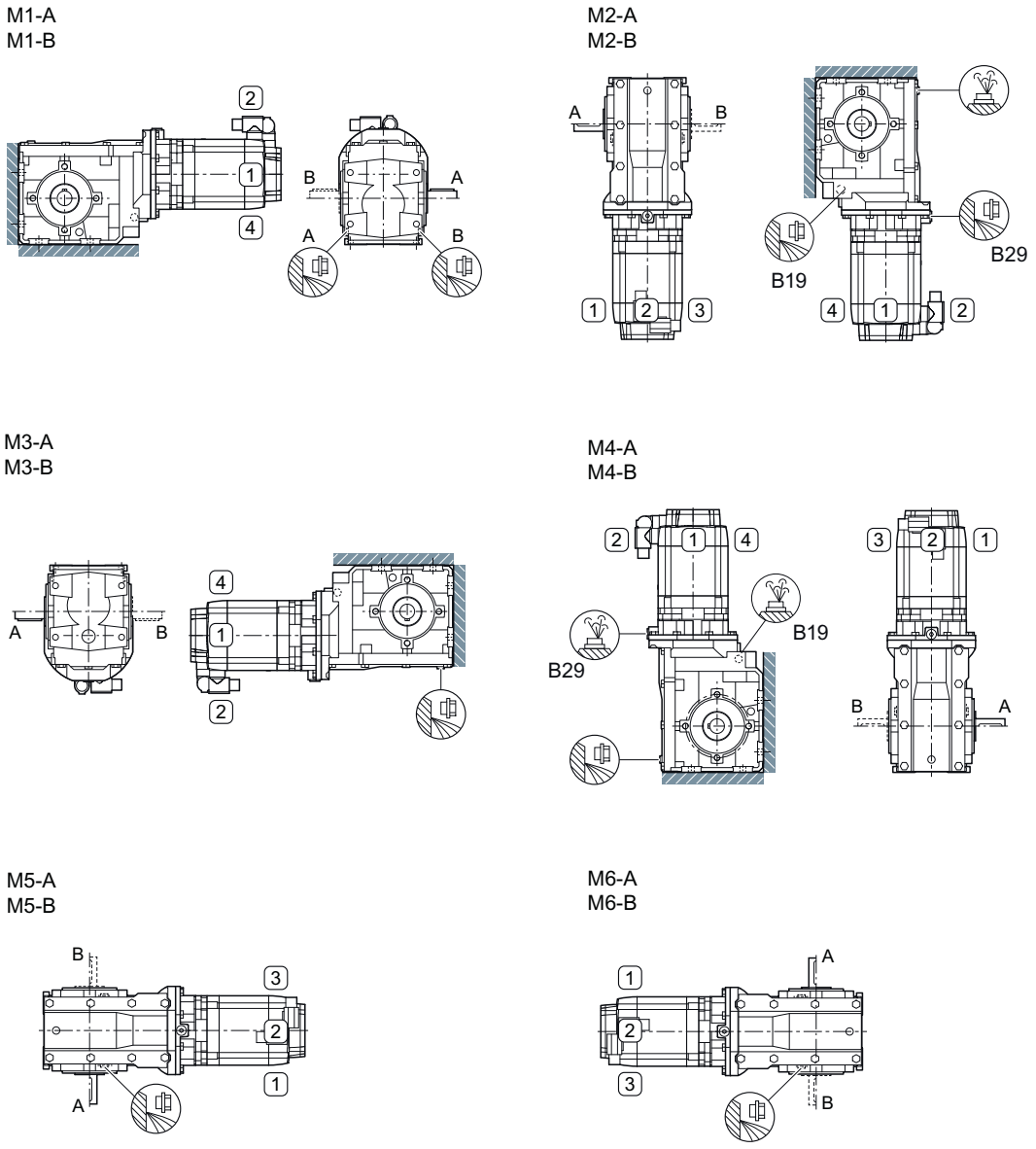


Figure 5-14 Mounting positions for servo bevel geared motor B, foot-mounted design, frame sizes 19 - 29, 2 stage

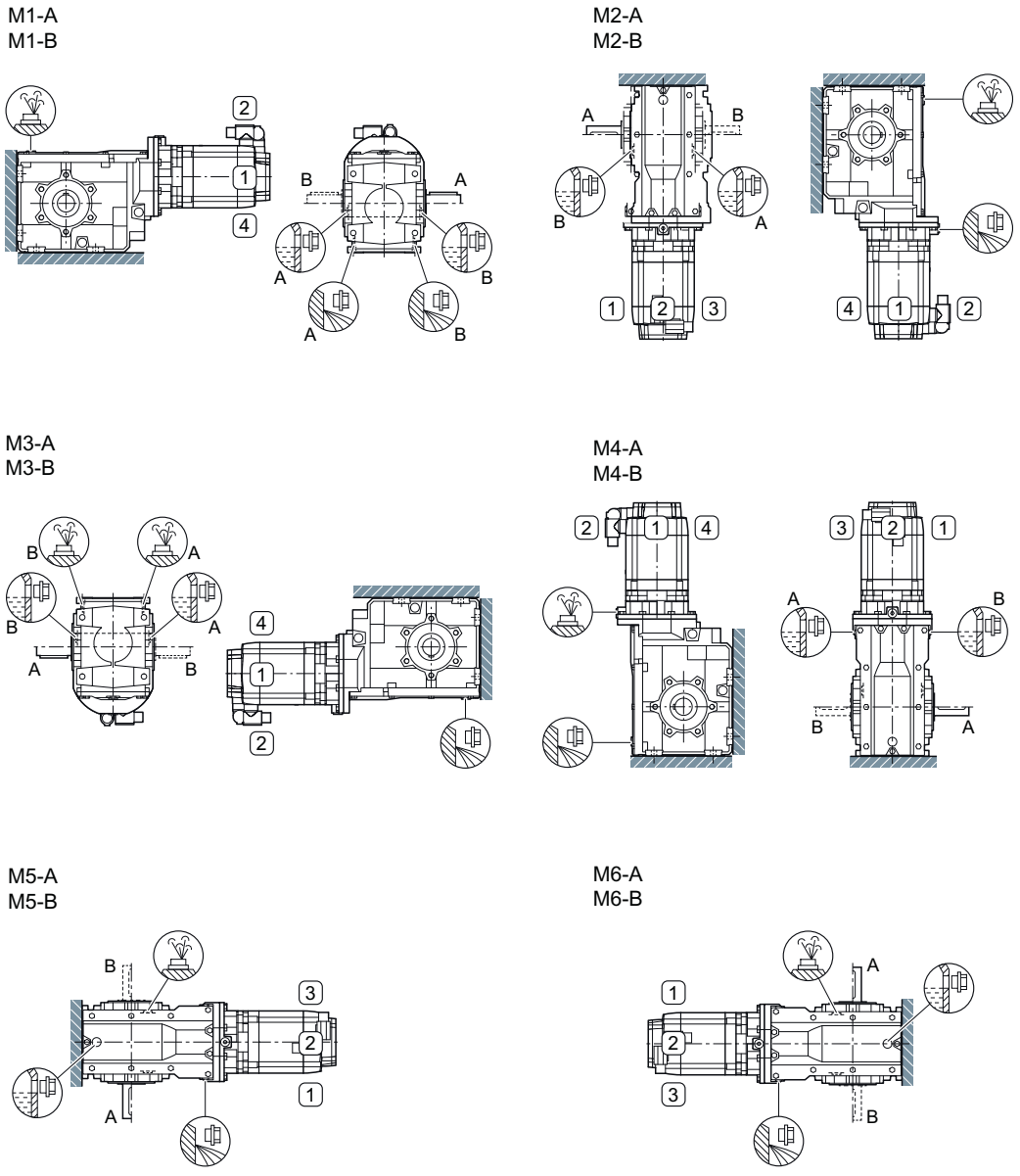


Figure 5-15 Mounting positions for servo bevel geared motor B, foot-mounted design, frame sizes 39 - 49, 2 stage

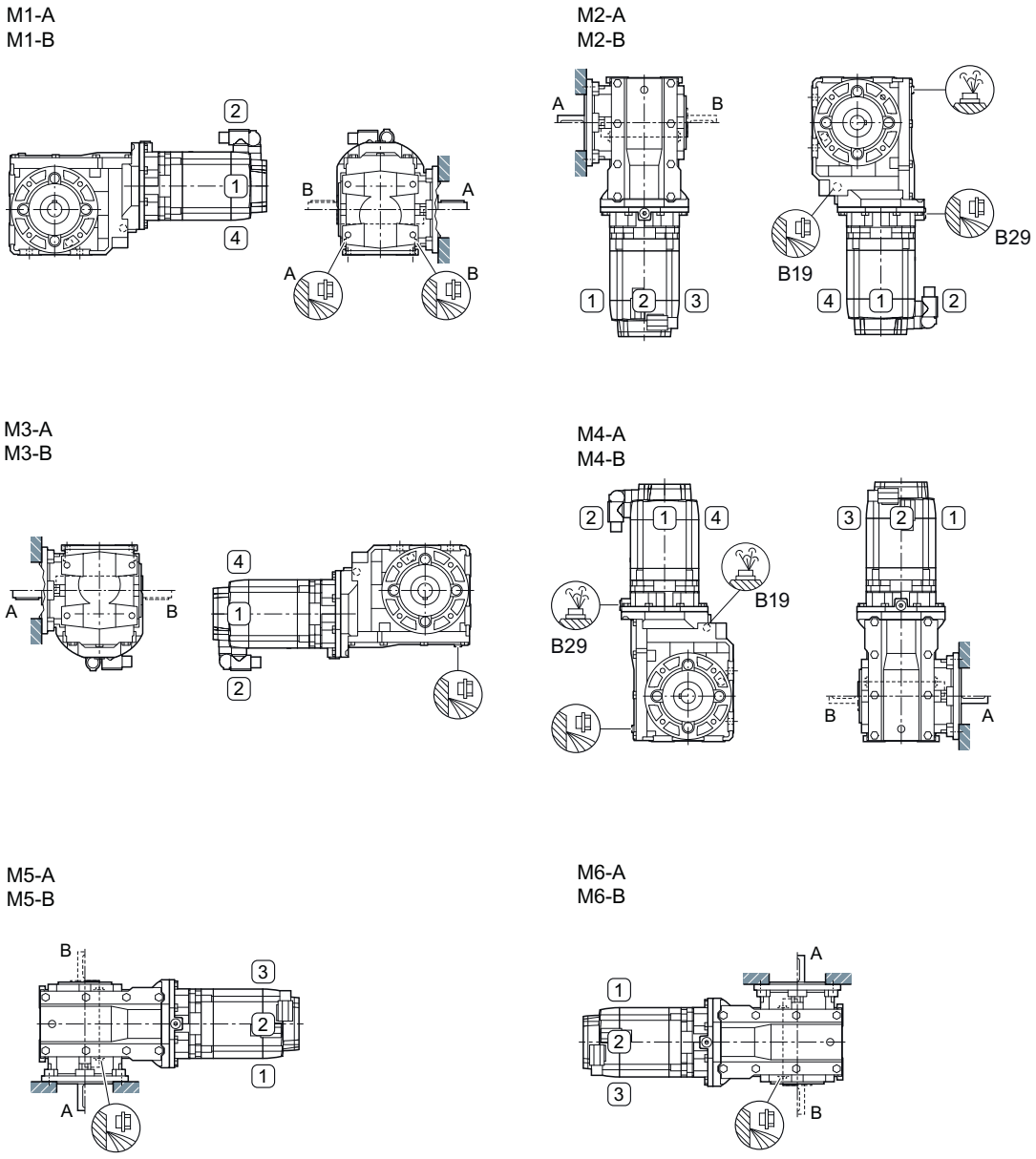


Figure 5-16 Mounting positions for servo bevel geared motor B.F (flange-mounted design) or B.Z (housing flange design) frame sizes 19 - 29, 2 stage

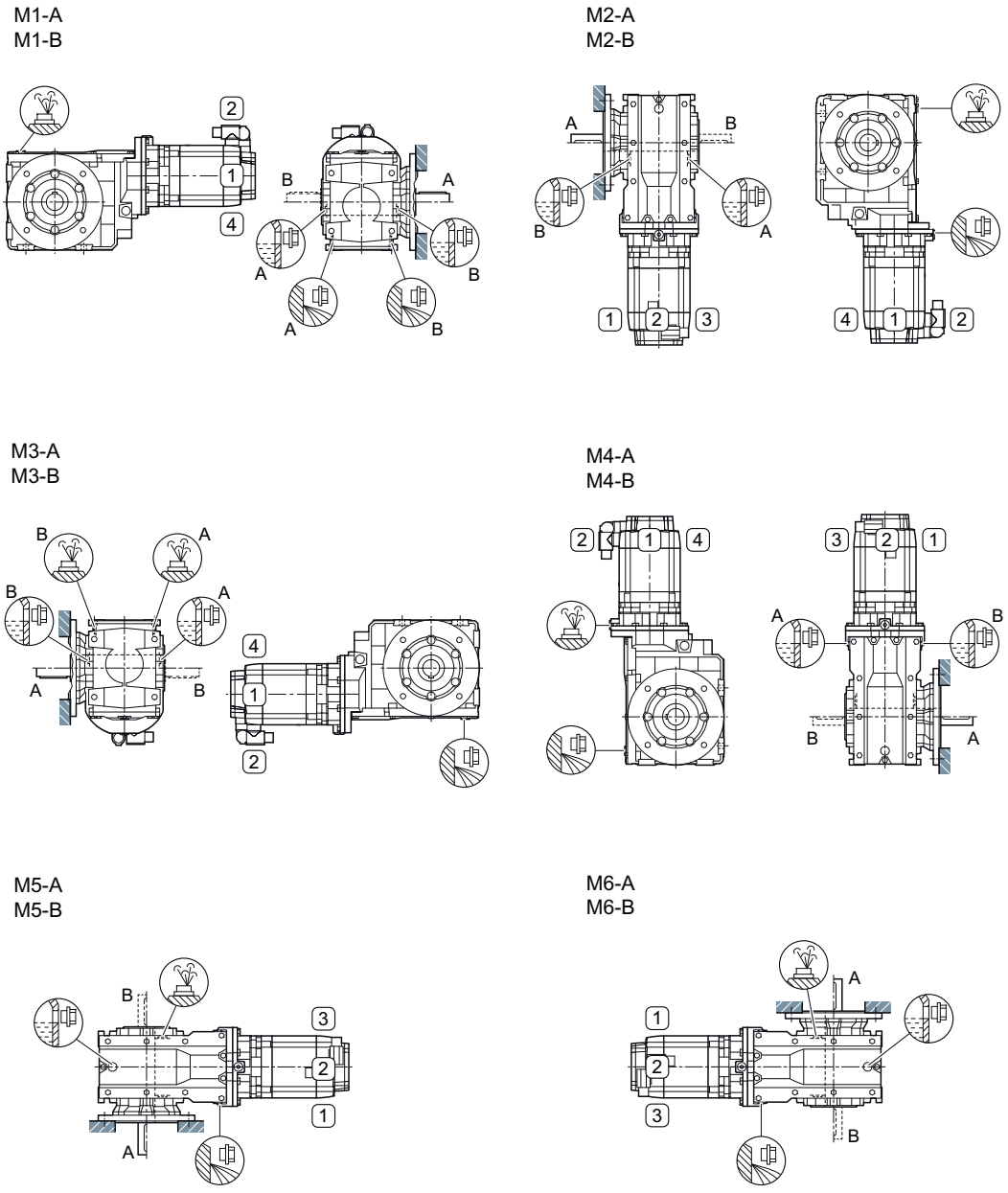


Figure 5-17 Mounting positions for servo bevel geared motor B.F (flange-mounted design) or B.Z (housing flange design), frame sizes 39 - 49, 2 stage

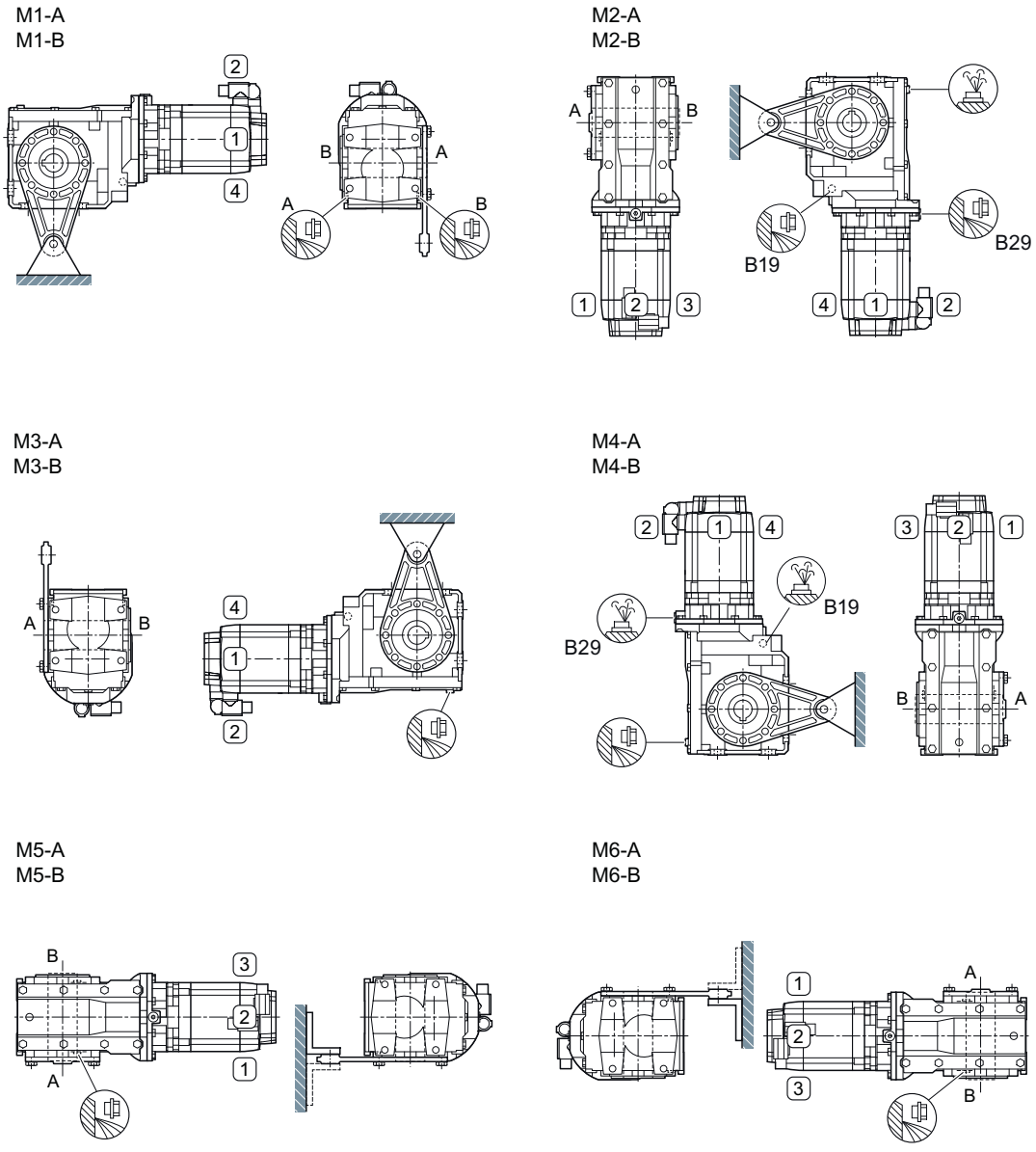


Figure 5-18 Mounting positions for servo bevel geared motors BAD, shaft-mounted design, frame sizes 19 - 29, 2 stage

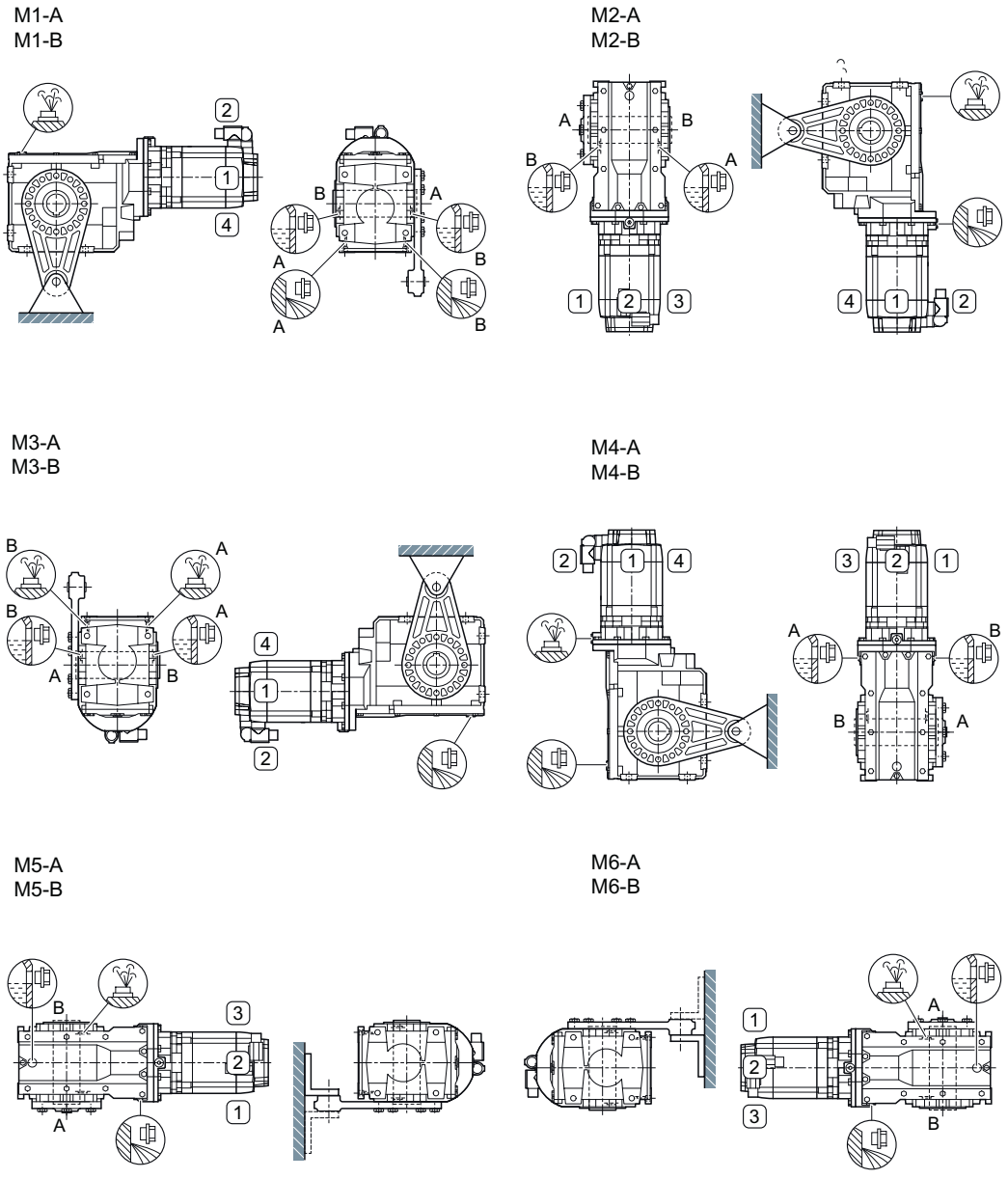


Figure 5-19 Mounting positions for servo bevel geared motors BAD, shaft-mounted design, frame sizes 39 - 49, 2 stage

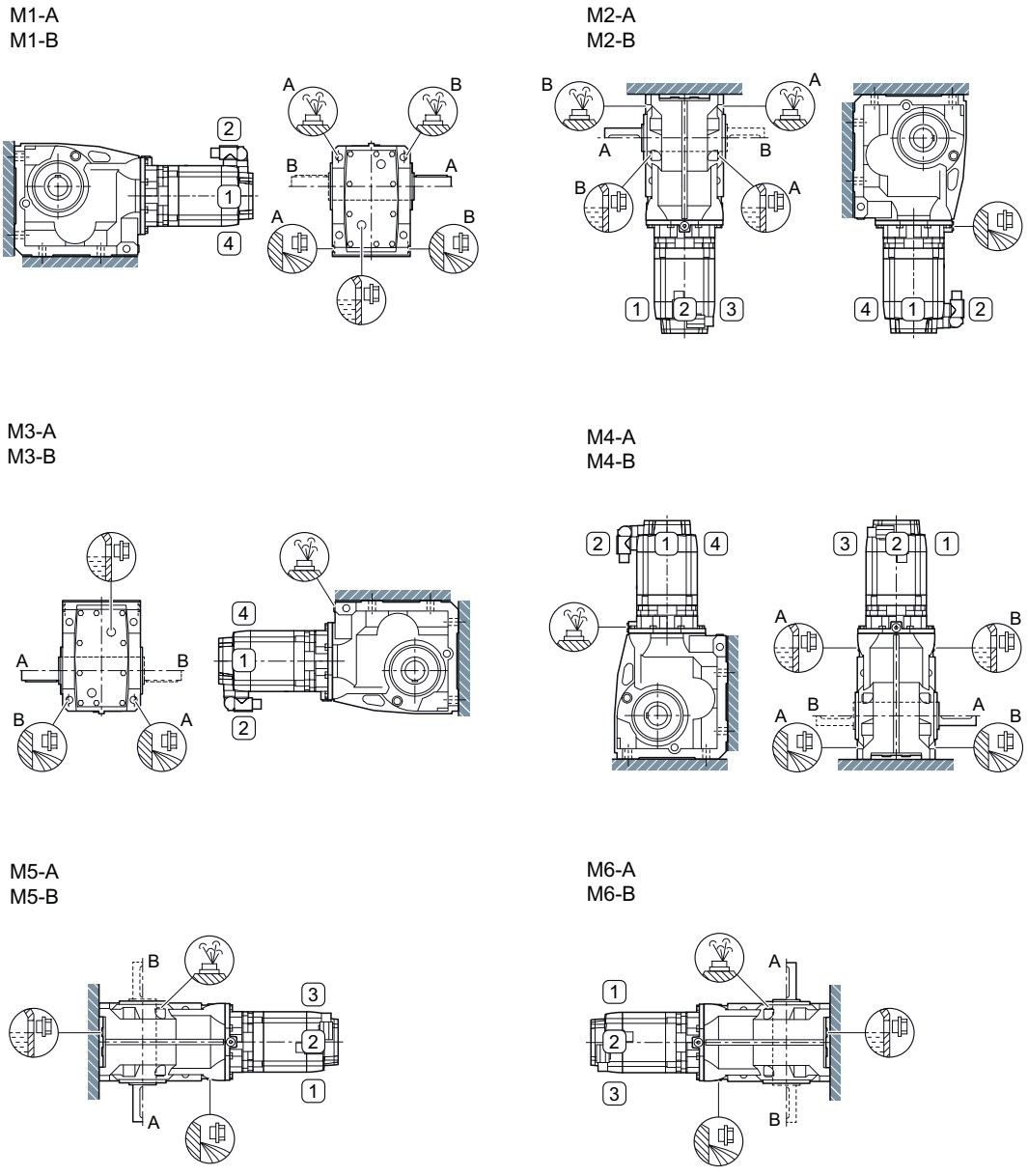


Figure 5-20 Mounting positions for servo bevel geared motor K, foot-mounted design, frame sizes 39 - 149, 3 stage

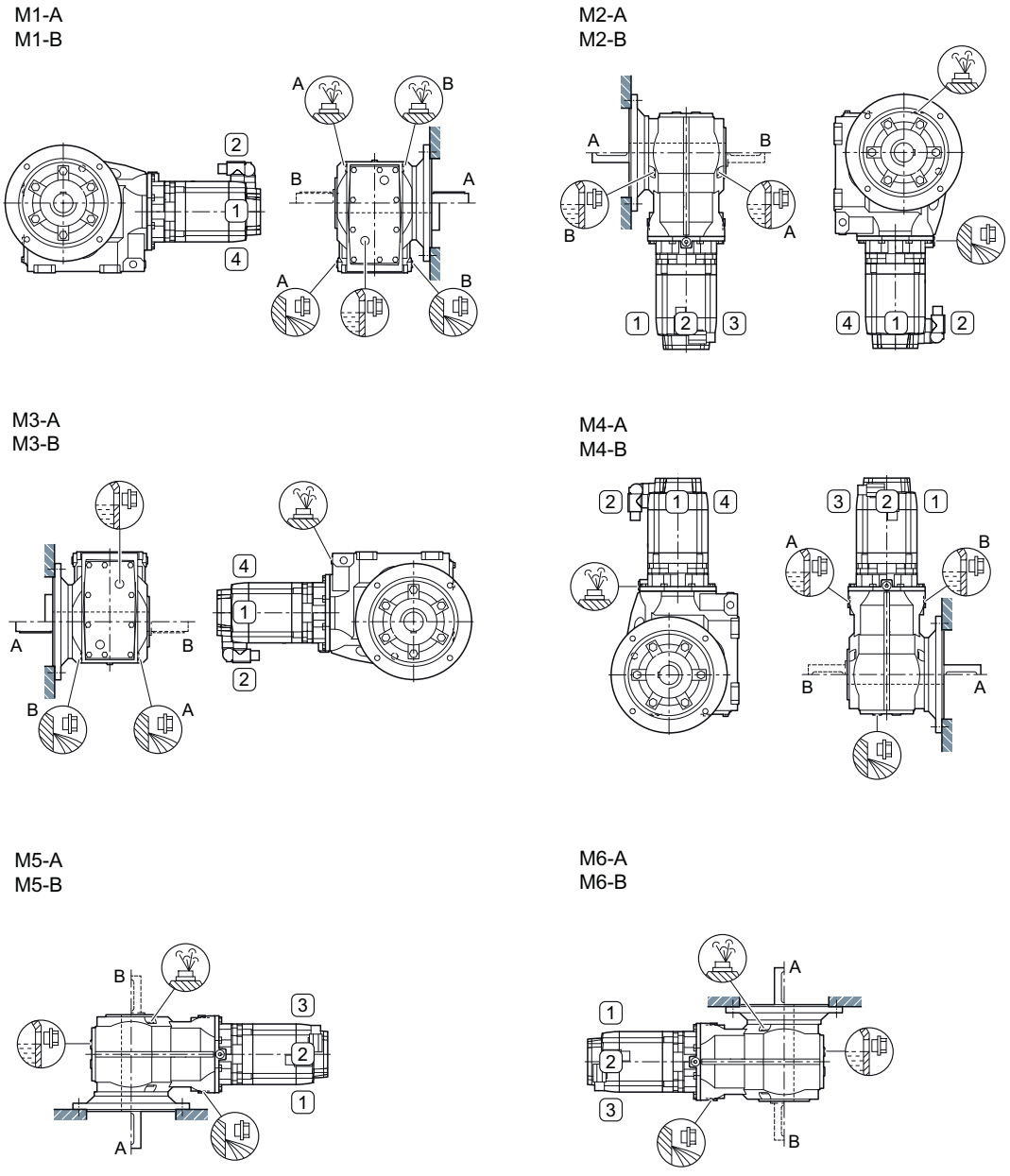


Figure 5-21 Mounting positions for servo bevel geared motor K.F (flange-mounted design) and KAZ (housing flange design), frame sizes 39 - 149, 3 stage

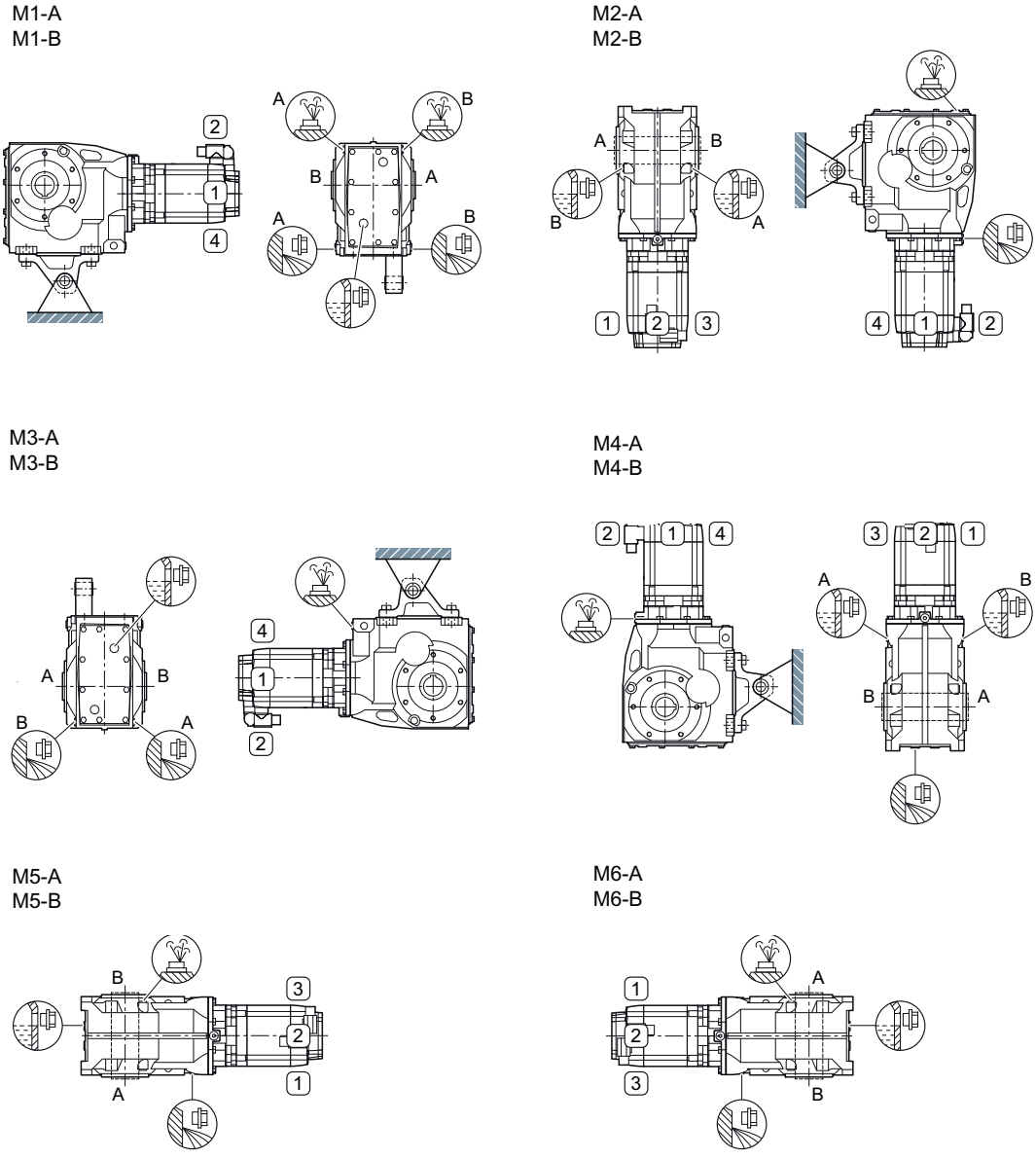


Figure 5-22 Mounting positions for servo bevel geared motor KAD, shaft-mounted design, frame sizes 39 - 149, 3-stage

5.2.4 Helical worm geared motor

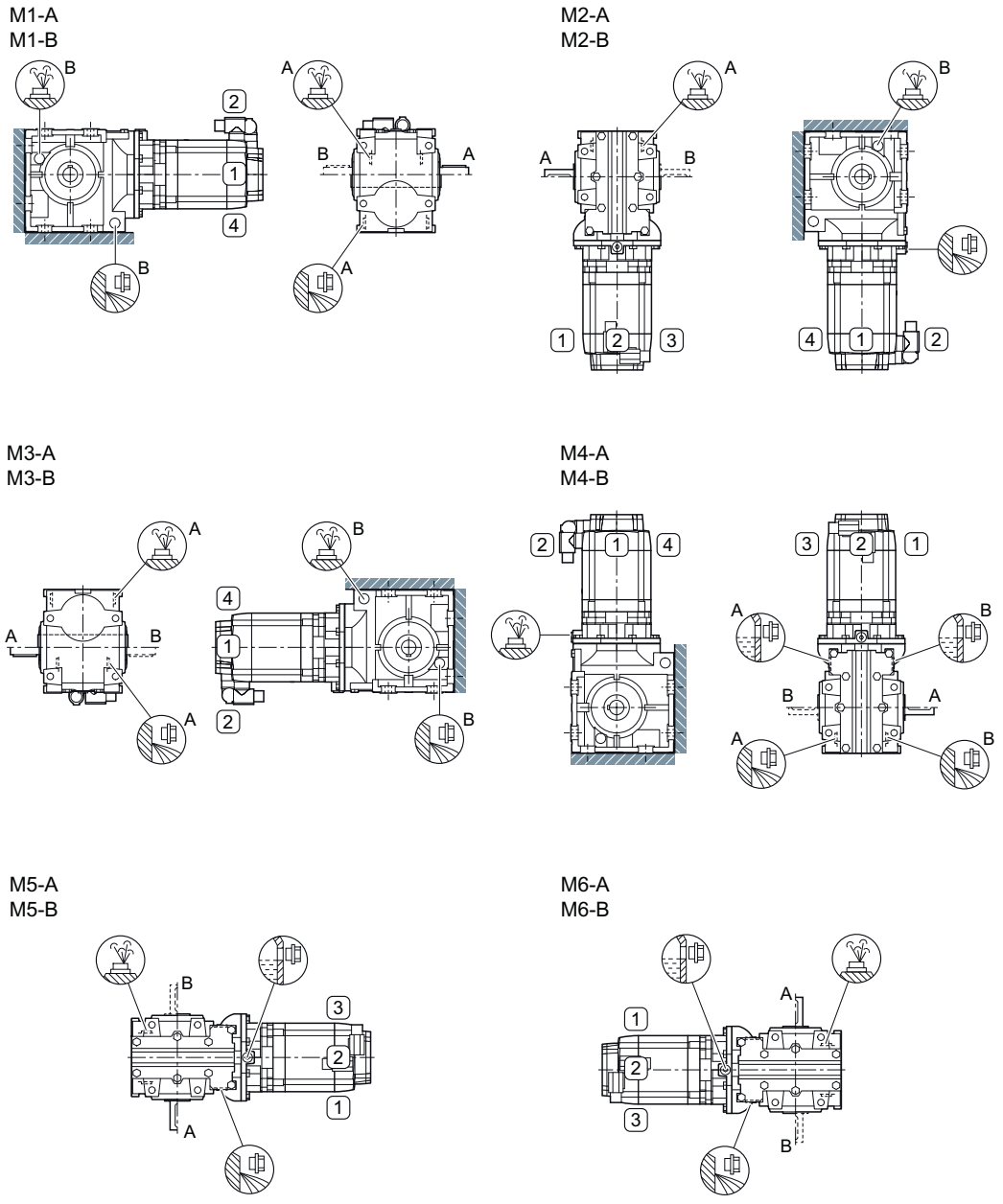


Figure 5-23 Mounting positions for servo helical worm geared motor C, foot-mounted design, size 29, 2 stage

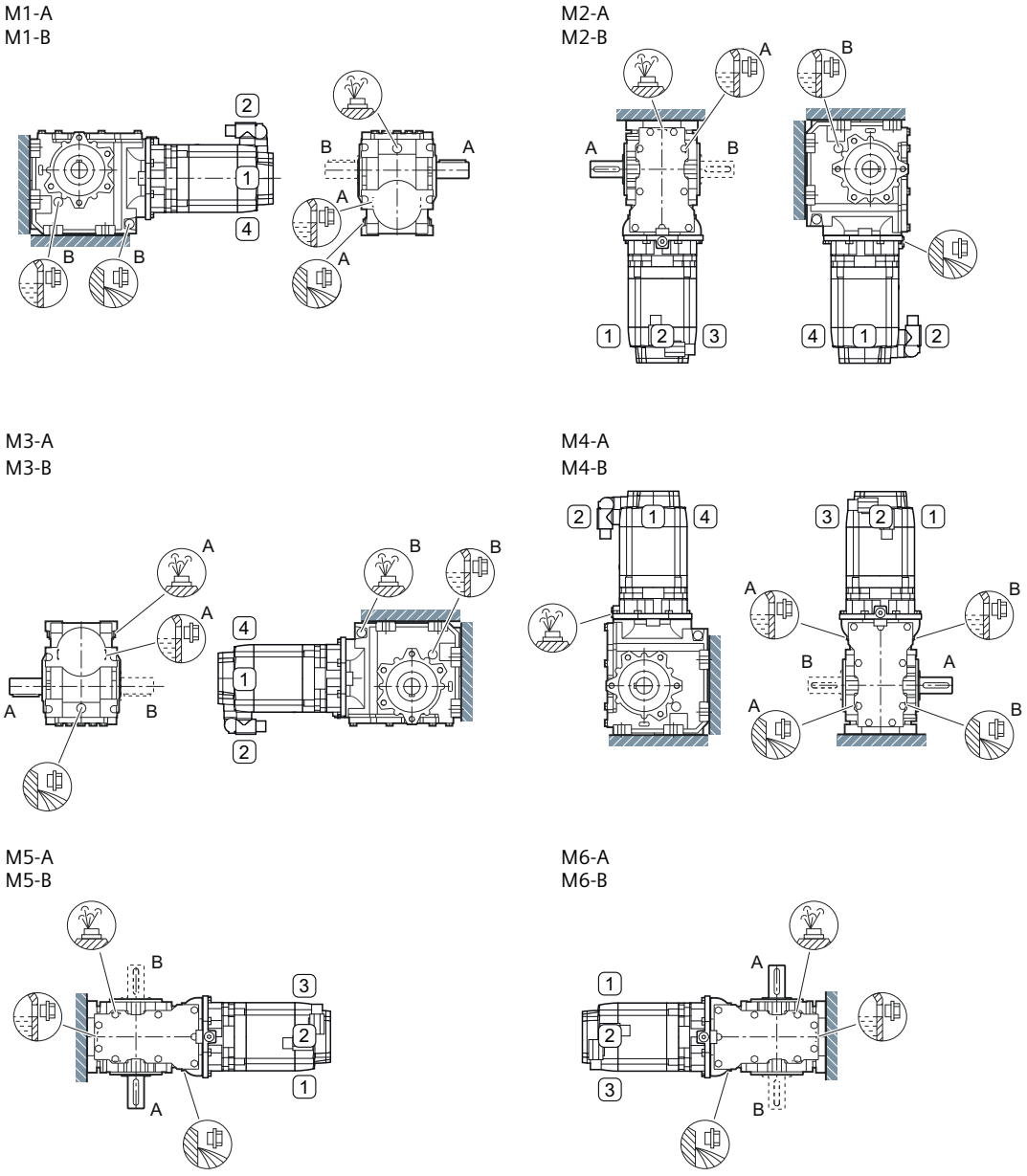


Figure 5-24 Mounting positions for servo helical worm geared motors C., foot-mounted design, frame size 39A, 2 stage

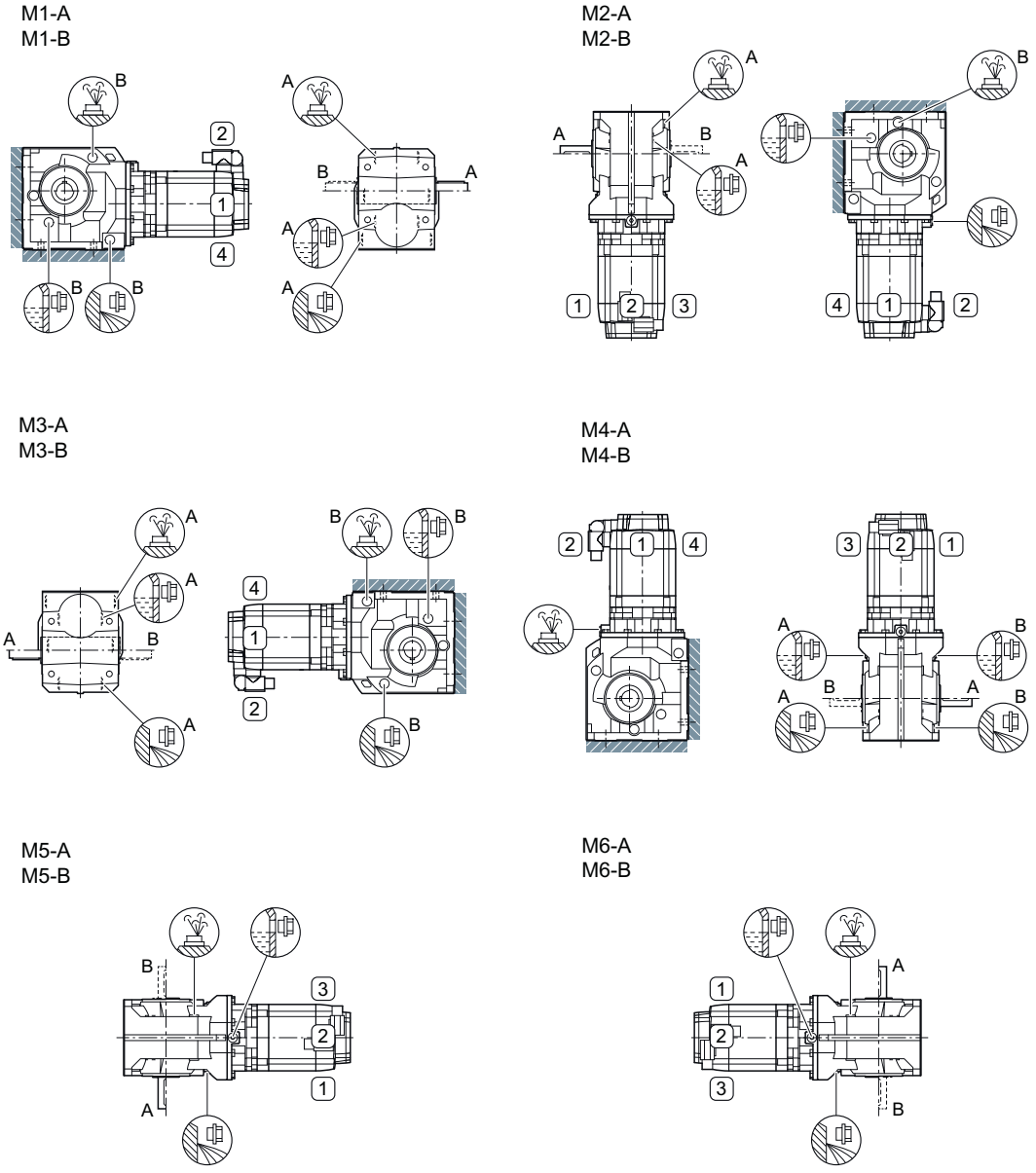


Figure 5-25 Mounting positions for servo helical worm geared motors C, foot-mounted design, frame sizes 49 - 89, 2 stage

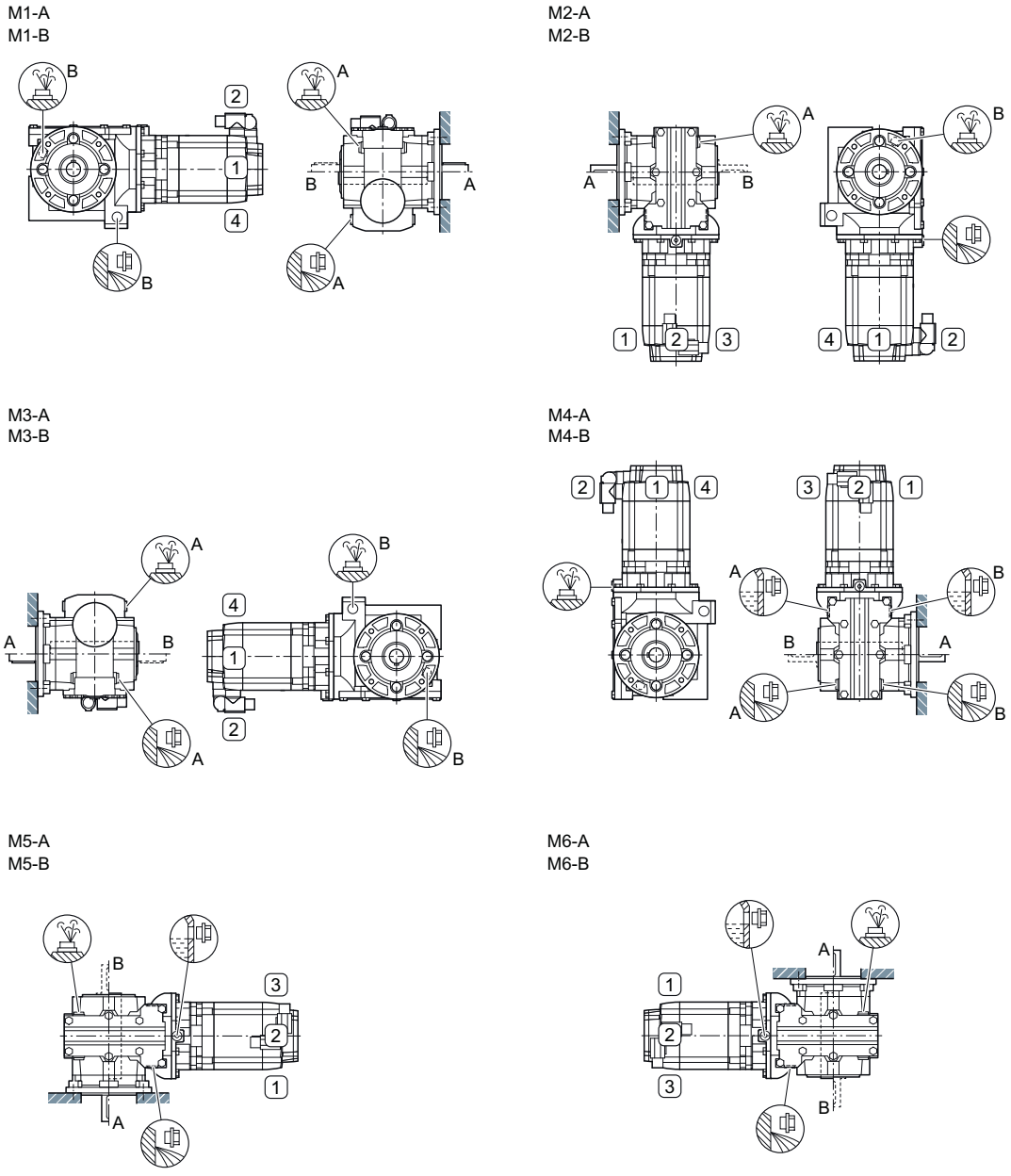
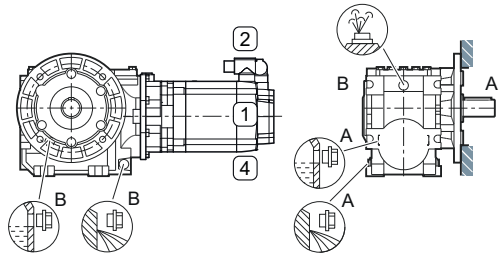
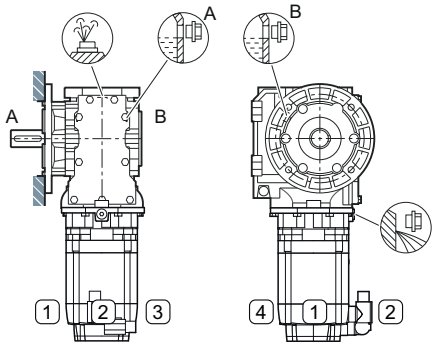


Figure 5-26 Mounting positions for servo helical worm geared motor CF (flange design) and CAZ (housing flange design), frame size 29, 2 stage

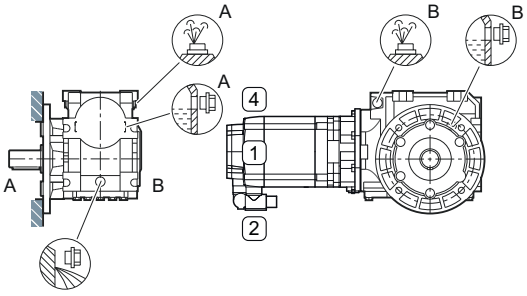
M1-A
M1-B



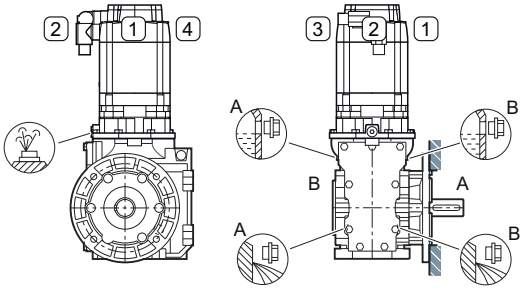
M2-A
M2-B



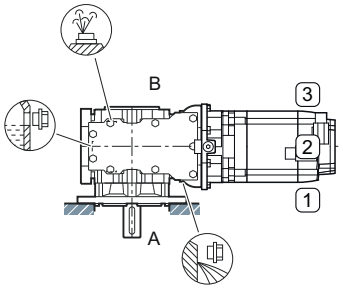
M3-A
M3-B



M4-A
M4-B



M5-A
M5-B



M6-A
M6-B

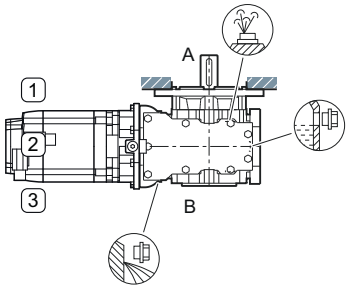


Figure 5-27 Mounting positions for servo helical worm geared motor CF (flange design) and CAZ (housing flange design), frame size 39A, 2 stage

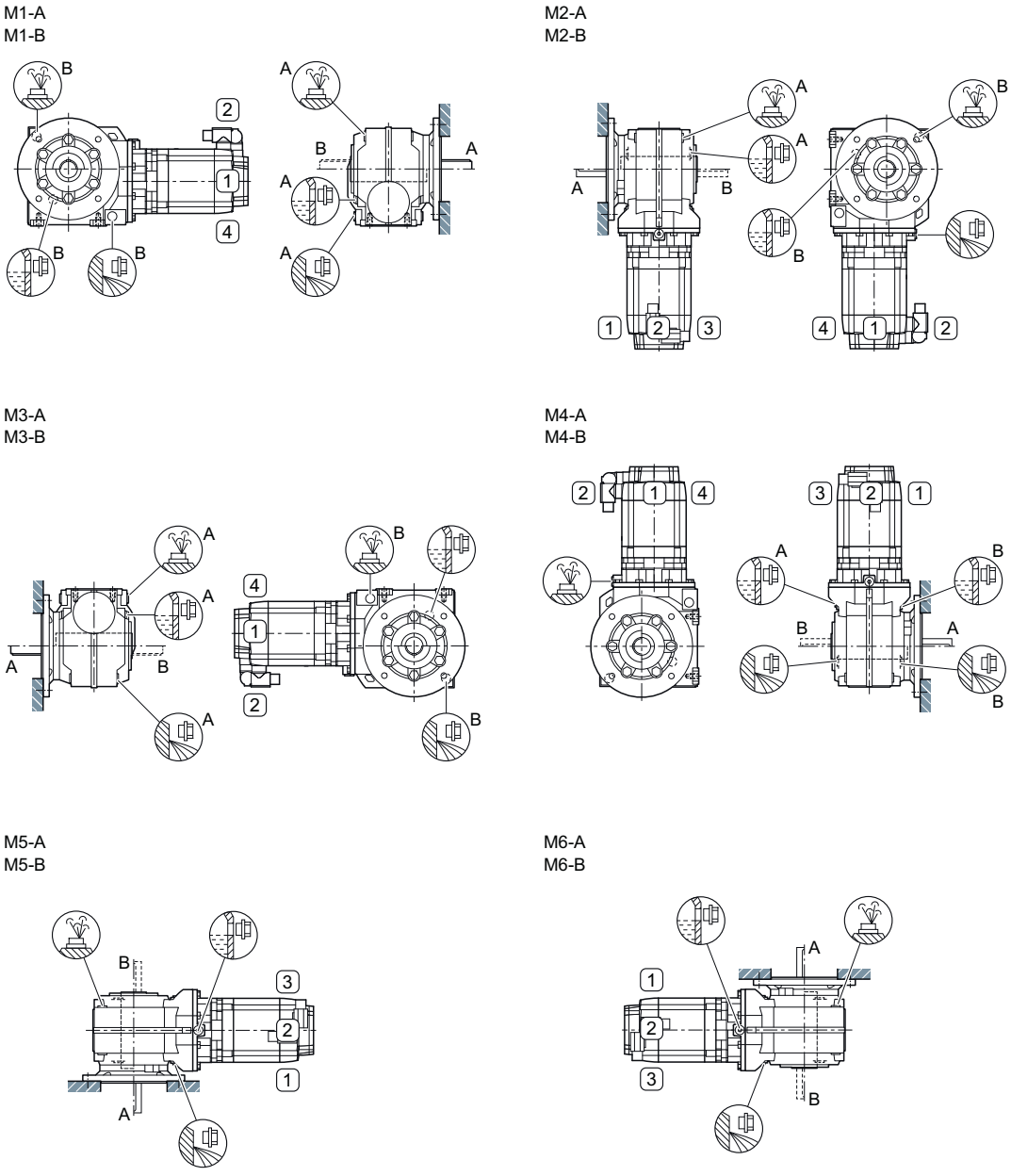


Figure 5-28 Mounting positions for servo helical worm geared motor CF (flange design) and CAZ (housing flange design), frame size 49 - 89, 2 stage

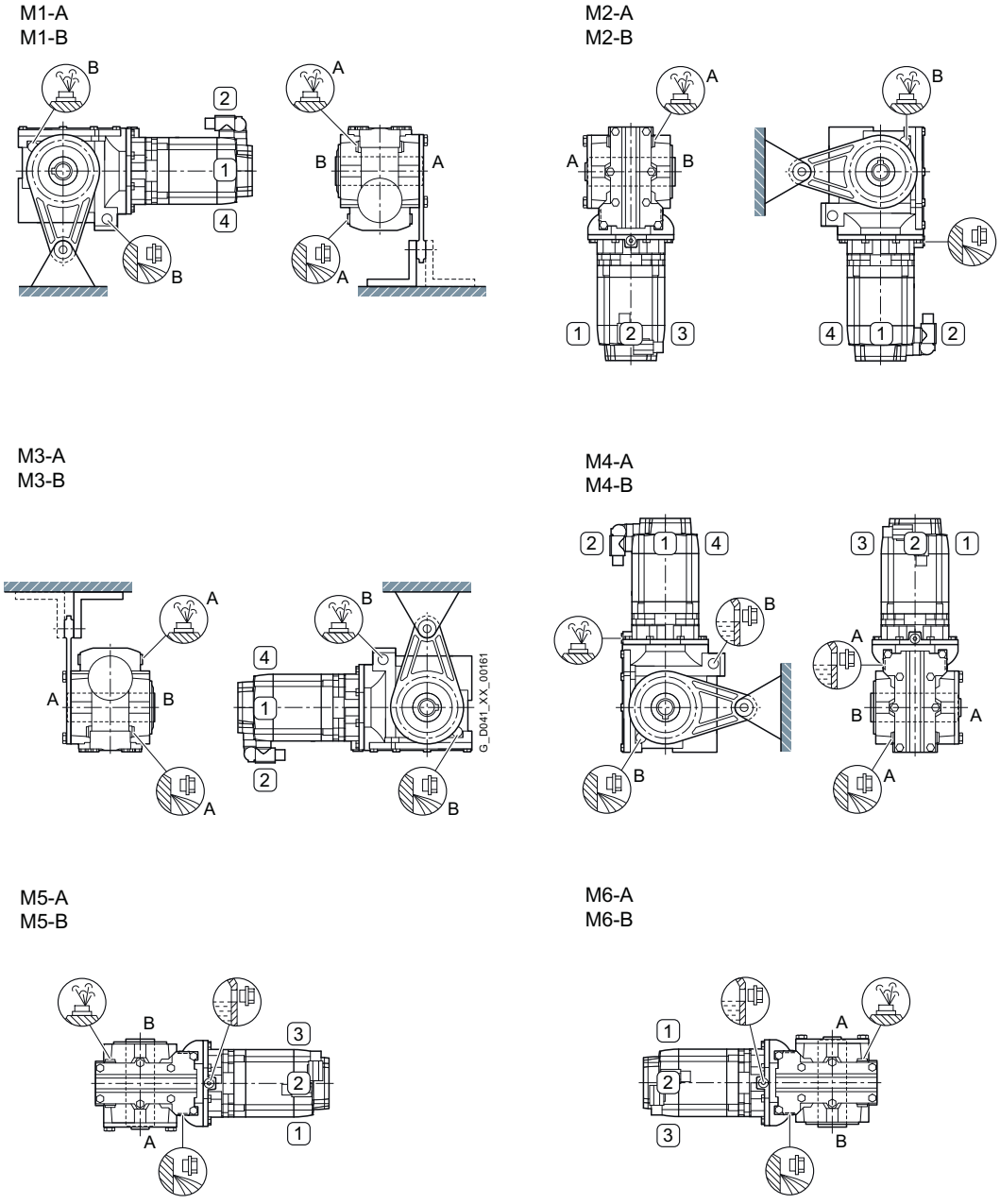


Figure 5-29 Mounting positions for servo helical worm geared motor CAD, shaft-mounted design, frame size 29, 2 stage

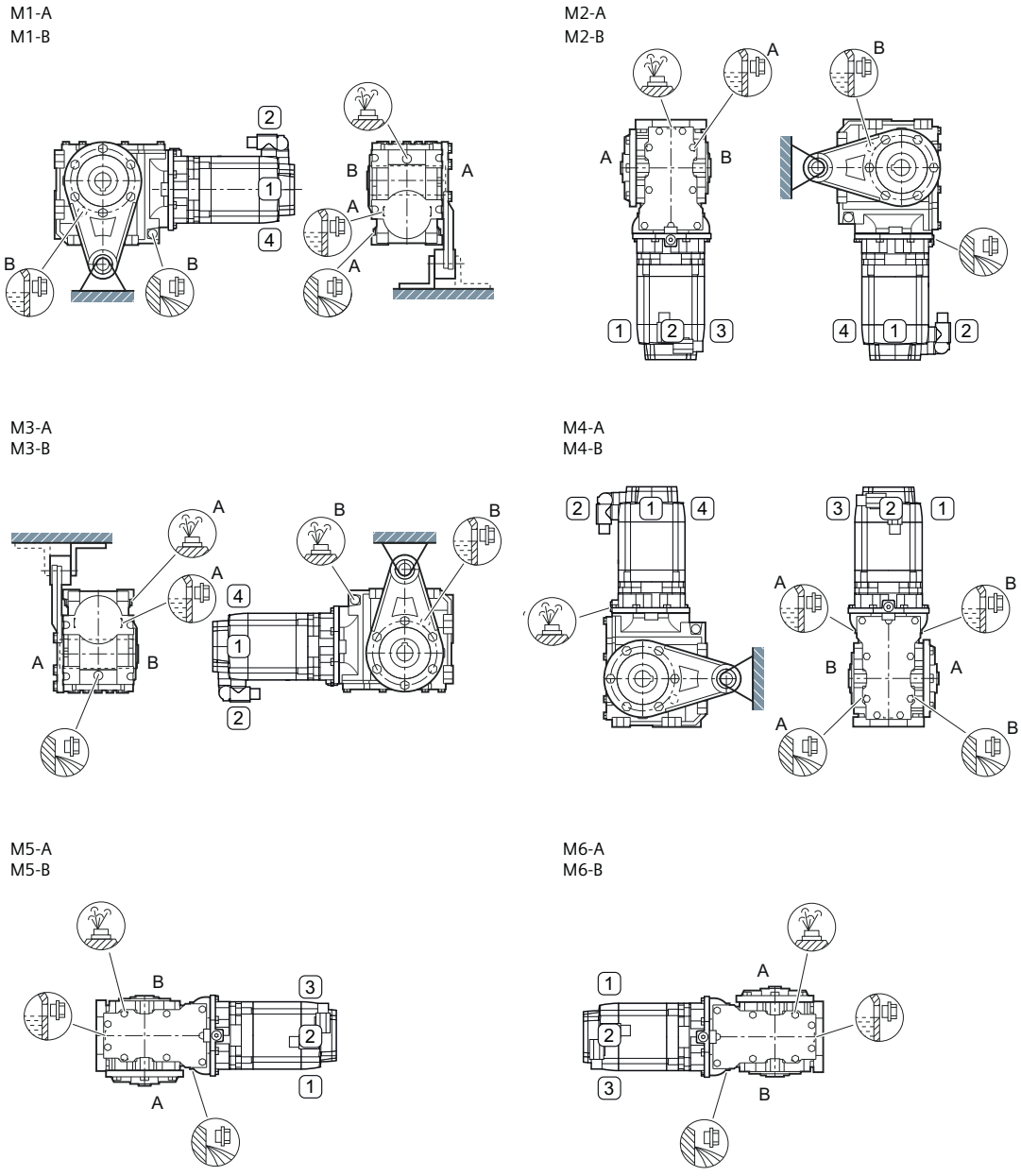


Figure 5-30 Mounting positions for servo helical worm geared motor CAD, shaft-mounted design, frame size 39A, 2 stage

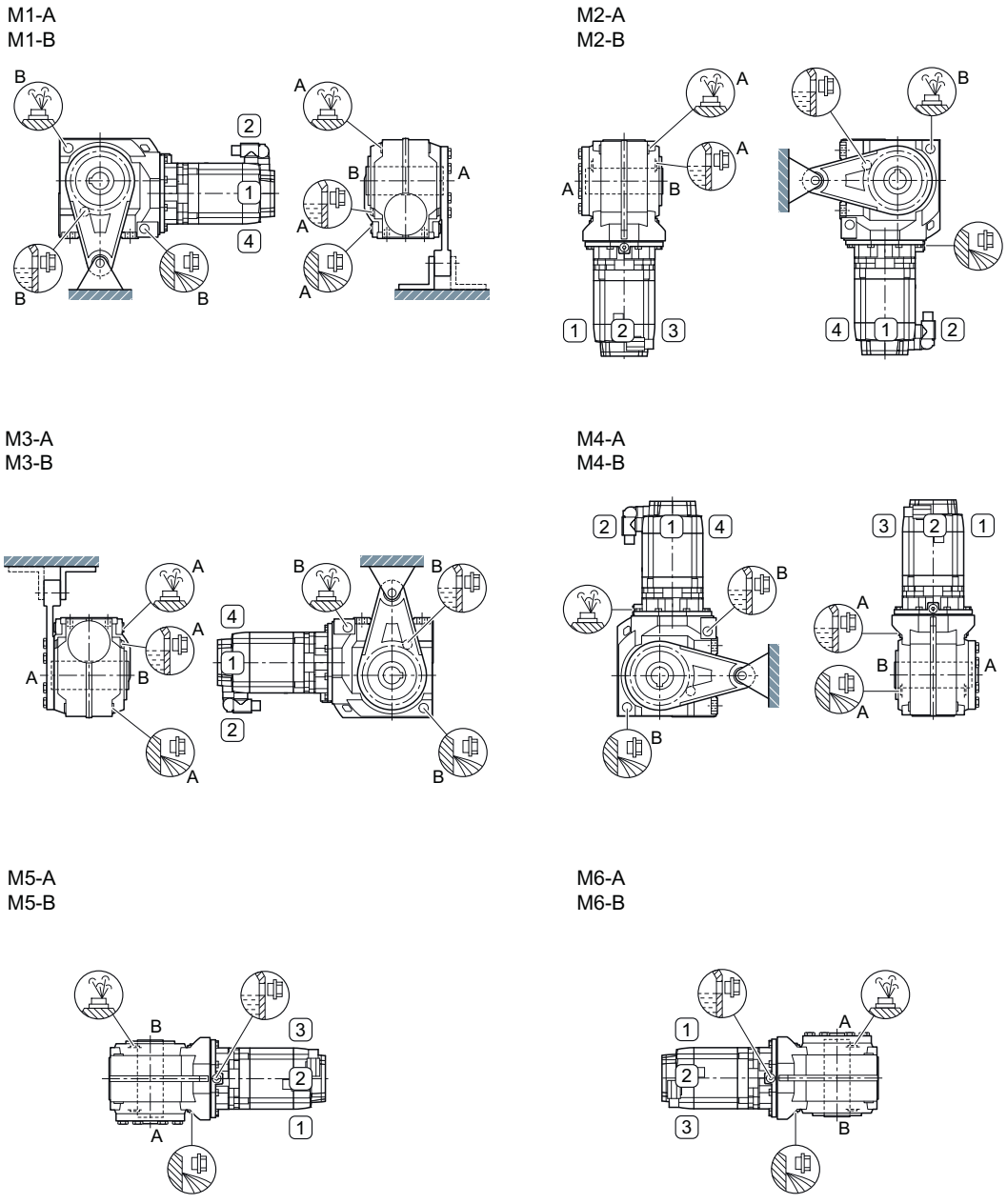


Figure 5-31 Mounting positions for servo helical worm geared motor CAD, shaft-mounted design, frame sizes 49 - 89, 2 stage

Mounting and assembly

6

6.1 Safety instructions

⚠ WARNING

Danger of the servo geared motor down due to incorrect transport and/or lifting

Due to incorrect transport and/or lifting, the servo geared motor can fall and cause death, severe injury and/or damage to property.

- Lifting devices, ground conveyors, and load suspension equipment must comply with requirements.
- The maximum capacity of the lifting equipment and the load suspension device must correspond to the weight of the servo geared motor (see the rating plate).
- Do not attach any additional loads to the lifting equipment.
- To hoist the servo geared motor, use suitable cable-guidance or spreading equipment, particularly if the servo geared motor is equipped with built-on assemblies.
- The servo geared motor must not be lifted or transported by means of the power connector or signal connector.
- Do not stand in the slewing range of hoisting gear or under suspended loads.

⚠ WARNING

Active implant malfunctions due to permanent-magnet fields

Even when switched off, electric motors with permanent magnets pose a potential risk for persons with heart pacemakers or implants if they are close to converters/motors.

- If you have a heart pacemaker or implant, maintain a minimum distance of 300 cm.
- When transporting or storing permanent magnet motors always use the original packing materials with the warning labels attached.
- Clearly mark the storage locations with the appropriate warning labels.
- Carefully observe IATA regulations when transporting by air.

⚠ WARNING

Risk of injury due to freely rotating parts

Contact with rotating parts can result in serious or fatal injuries.

- Do not touch any rotating parts.
- Mount a cover cap or protective cover over freely rotating parts.

⚠ WARNING

Unpredictable movement of the system as a result of inactive safety functions

Inactive safety functions or safety functions that have not been appropriately adapted can result in inadvertent movement of the system and can result in death or serious injury.

- Observe the information in the associated product documentation before installation.
- Switch off the system before starting any work.
- Bring the system into a no-load condition.
- Secure the system so that it cannot be inadvertently switched on again.

NOTICE

Destruction of gearbox components and bearings due to welding

When carrying out welding work at a servo geared motor, parts may be inadvertently welded together as a result of the temperatures that occur at the motor.

- Do not carry out any welding work on the servo geared motor.
- Do not use the servo geared motor as a grounding point when carrying out welding work.

NOTICE

Overheating caused by solar radiation

Overheating of the servo geared motor due to exposure to strong sunlight.

Provide suitable protection equipment such as covers or roofs. Avoid heat accumulation.

NOTICE

Malfunction resulting from foreign objects

The company operating the unit must ensure that no foreign objects impair the function of the servo geared motor.

NOTICE

Damaged components impair the correct function of the servo geared motor

The correct functioning of the servo geared motor can no longer be guaranteed if any components are damaged.

Do not install or mount any damaged parts or components.

NOTICE

Violation of the maximum permissible oil sump temperature

The oil sump temperature can be exceeded if the temperature monitoring equipment is incorrectly set.

An alarm must be output when the maximum permissible oil sump temperature is reached.

The servo geared motor must be switched off when the maximum permissible temperature is exceeded. A machine can come to a standstill if the servo geared motor is shut down.

NOTICE

Thermal damage to temperature-sensitive parts

Some parts of the electrical motor enclosure can reach temperatures that exceed 100 °C. If temperature-sensitive parts, for instance electric cables or electronic components, come into contact with hot surfaces then these parts can be damaged.

- Ensure that no temperature-sensitive parts come into contact with hot surfaces.

6.2 Installation check list

Note

Required checks

The checklists below do not purport to be complete. It may be necessary to perform additional checks and tests in accordance with the situation specific to the particular installation site.

Assemble the servo geared motor as described in the following chapters of the operating instructions.

Thoroughly familiarize yourself with the safety instructions and observe the checklists below before starting any work.

Table 6-1 Checklist (1) - general checks

Check	OK
Are all of the necessary components of the configured drive line-up available, correctly dimensioned, installed and connected?	
Are the environmental conditions in the permissible range?	

Table 6-2 Checklist (2) - checks regarding the mechanical system

Check	OK
Is the servo geared motor free of visible damage?	
Have the mounting surfaces (e.g. flange, shaft) on the customer machine and on the servo geared motor been cleaned?	
Are the mounting surfaces free of corrosion?	
Do the mounting dimensions (e.g. shaft diameter, shaft length, true run) on the customer machine meet the specification?	
Is the supplied mounting paste available for mounting the 1FG1 with hollow shaft or with splined shaft?	
Is the point of power transmission between the customer's hollow shaft and the geared hollow shaft free of grease, mounting paste and other contamination when mounting the 1FG1 with shrink disks or SIMOLOC connection? (See chapter Mounting or removing the hollow shaft with shrink disk (Page 108) or Installing or removing the SIMOLOC connection (Page 112))	

6.3 Installation instructions

Note

Technical data stamped on the housing of the servo geared motor

- Carefully note the technical data stamped on the rating plates of the servo geared motor.

- Comply with the data on the rating plate, as well as the warning and information plates on the servo geared motor.
- Check the permissible environmental conditions at the installation site, e.g. temperature, installation altitude.
- It is strictly prohibited to use the motors in hazardous zones.
- Thoroughly clean the shaft end to remove any corrosion protection agent. Use commercially available solvents.
- Ensure sufficient cooling (see Chapter "Cooling (Page 40)").
- If the motor is installed vertically with the end of the shaft facing up, carefully ensure that no liquid can enter the upper bearing.
- After installation, remove the lifting eyes or tighten them.

Tightening torques for fixing screws

The general tolerance for the tightening torque is 10 %. The tightening torque is based on a friction coefficient of μ = 0.14.

Table 6-3 Tightening torque for fixing screws

Thread size	Tightening torque for property class in Nm		
	8.8	**10.9**	**12.9**
M4	3	4	5
M5	6	9	10
M6	10	15	18
M8	25	35	41
M10	50	70	85
M12	90	120	145
M16	210	295	355
M20	450	580	690
M24	750	1000	1200
M30	1 500	2 000	2 400

Tightening torques for screw plugs and valves

The installation tools to be used include a torque wrench or pneumatic or impact power screwdriver with automatic switch-off.

Table 6-4 Tightening torque for screw plugs and valves

Pipe thread according to DIN ISO 228 Part1	**Tightening torque for brass screws**	**Tightening torque for ferrous metal screws**
	Tolerance +/- 10 % in Nm	**Tolerance +/- 12.5 % in Nm**
d1	**Housing, gearbox cover**	**Housing, gearbox cover**
G 1/8 A	8	10
G 1/4 A	10	10
G 3/8 A	24	35
G 1/2 A	32	-
G 3/4 A	60	85

Note

The values listed in the table "Tightening torque for screw plugs and valves" also apply to all completely metal valves, e.g. oil drain valves, vent valves.

Plastic vent filters and oil sight glasses must be tightened "hand tight".

6.4 Installing a servo geared motor with foot mounting

NOTICE

Servo geared motor damage resulting from impermissible housing loads on uneven mounting footprints

If the servo geared motor is put under stress when tightening the fixing screws, this can result in functional faults and gearbox damage.

- Carefully ensure that the mounting footprint is flat.
  The following degrees of unevenness are the maximum permissible for the mounting footprint:
  - Servo geared motors up to frame size 89: 0.1 mm
  - Servo geared motors from frame size 109 and higher: 0.2 mm
- Clean the mounting footprint before starting any work.

- Calculate the foundation for the servo geared motor in accordance with the weight and torque. Take account of the forces acting on the servo geared motor.
- Ensure that the foundation for the servo geared motor is torsionally rigid.
- Construct the foundation in such a way that no resonance vibration occurs and no vibration is transmitted from adjacent foundations.
- If the servo geared motor is fastened to a concrete foundation, use foundation blocks for the appropriate recesses.
- Align and grout the slide rails into the foundation.
- Align the servo geared motor carefully and without offset with the units on the input and output side. Take into account the elastic deformation due to operating forces.
- Prevent shift from external forces due to lateral impact.
- Use stud bolts or headless screws of property class 8.8 or higher for foot mounting. Observe the tightening torque.

Table 6-5 Thread size of the fixing screws

Thread size	Helical gearbox D/Z	Parallel shaft gearbox FD/FZ	Bevel gearbox B, K	Helical worm gearbox C
	Size			
M8	19, 29, 39	29, 39	B19, B29, B39	29
M10	-	49	B49, K39, K49	39, 49
M12	49, 59, 69	69, 79	K69, K79	69
M16	79, 89	89, 109	K89	89
M20	109	129	K109	-
M24	129	-	K129	-
M30	-	-	K149	-

6.5 Flange mounting a servo geared motor

Note

Siemens AG recommends an anaerobic adhesive to enhance the friction lock between flange and mounting footprint.

Table 6-6 Thread size of the fixing screws

Thread size	Flange	Helical gearbox D/Z	Parallel shaft gearbox FD/FZ	Bevel gearbox B, K	Helical worm gearbox C
		Size			
M6	A120	19, 29, 39	29	B19, B29	29
M8	A140, A160	19, 29, 39, 49, 59	29, 39	B29, B39, K39	39
M10	A200	39, 49, 59, 69	49	B39, B49, K49	49, 69
M12	A250, A300	59, 69, 79, 89	69, 79, 89	K69, K79, K89	89
M16	A350	89	109	K109	-
M16	A450	109, 129	129	K129, K149	-

For flange-mounted servo geared motors, use screws/nuts with property class 8.8.

Comply with the following exceptions:

Table 6-7 Property class of the fixing screw for FF/FAF and KF/KAF

Parallel shaft gearbox	Bevel gearbox	Flange	Motor shaft heights				
			36	48	63	80	100
In a flange-mounted design			Property class, screw/nut				
F.F/F.AF39	K.F/KAF39	A160	**8.8**	**8.8**	**10.9**	**10.9**	-
F.F/F.AF49	K.F/KAF49	A200	**8.8**	**8.8**	**8.8**	**8.8**	**10.9**
F.F/F.AF69	K.F/KAF69	A250	**8.8**	**8.8**	**8.8**	**8.8**	**8.8**
F.F/F.AF79	K.F/KAF79	A250	**8.8**	**8.8**	**8.8**	**8.8**	**8.8**
F.F/F.AF89	K.F/KAF89	A300	-	-	**8.8**	**8.8**	**8.8**
F.F/F.AF109	K.F/KAF109	A350	-	-	**8.8**	**8.8**	**8.8**
F.F/F.AF129	K.F/KAF129	A450	-	-	-	**8.8**	**8.8**
-	K.F/KAF149	A450	-	-	-	-	**8.8**

Table 6-8 Property class of the fixing screw/nut for DZ/ZZ and DF/ZF

Gearbox size	Flange	Property class
19, 29, 39	A120	10.9 [1)]
49	A140	10.9
59	A160	
69	A200	
79	A250	
89	A300	
109, 129	A350	

1) Use suitable washers under the screw head/nut

6.6 Installing the servo geared motor in a foot or flange-mounted design

NOTICE
Malfunctions or gearbox damage resulting from impermissible housing loads caused by incorrectly installed add-on elements
Incorrectly installed add-on elements can cause malfunctions or gearbox damage as a result of impermissible loads of the gearbox housing.
Install the add-on elements in such a way that the gearbox is not subjected to stress.

Fasten the servo geared motor only on the flange or the foot mounting for force and torque transmission.

The second mounting option (foot or flange) is intended for add-on elements that do not transmit any force, e.g. protection covers with an intrinsic weight of up to max. 30% of the weight of the gearbox.

6.7 Attaching drive or output elements to the gearbox shaft

NOTICE
Damage to shaft sealing rings caused by heating When mounting input and output elements using heat treatment, shaft sealing rings can be damaged due to overheating. • Use thermal shields to protect shaft sealing rings against overheating above 100 °C due to radiated heat.

Observe the installation or operating instructions when installing.

Unless otherwise specified, heat up the input and output drive elements either inductively, using an open-flame torch or in an oven.

Use the centering holes in the shaft end faces.

Use a pulling-on device to attach input or output elements.

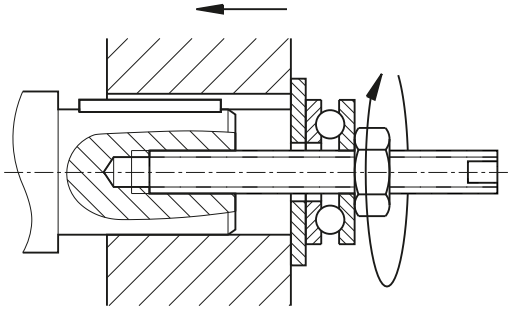
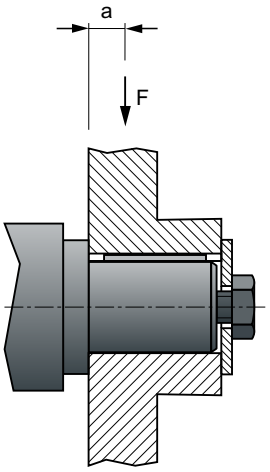
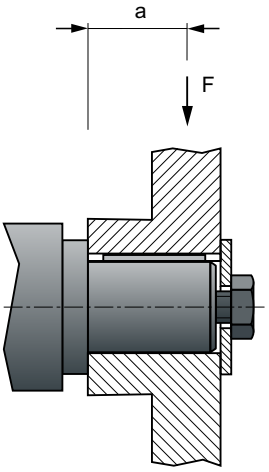


Figure 6-1 Example of a pulling-on device

Attach the input and output elements in such a way as to minimize the stress on shafts and bearings from transverse forces.

Table 6-9 Stress applied to shafts and bearings

Optimal	Unfavorable
	
Low stress applied to shafts and bearings	High stress applied to shafts and bearings

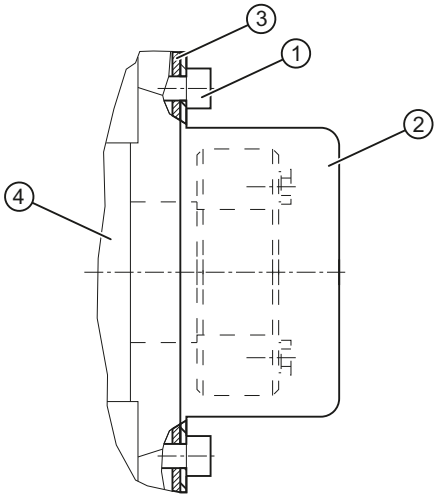
Procedure

1. Use either petrol ether or solvent to remove the anti-corrosion protection from the shaft ends and flanges, or remove the applied protective skin.
2. Heat the input or output elements, if provided.
3. Slide the drive input and output elements onto the shafts.
4. Secure the input or output elements, if provided.

❒

6.8 Mounting the protective cover

The protective cover of the hollow shaft is supplied as a mounting set.



① Screw with washer
② Protective cover
③ Flat seal/O-ring
④ Gearbox housing

Figure 6-2 Mounted protective cover for hollow shaft

Procedure

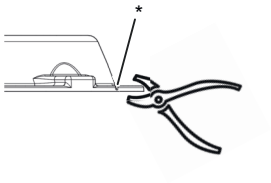
1. Mount the output shaft.
2. Use a suitable cleaning agent to clean the mounting surface of the protective cover ② on the gearbox.
3. Position the flat seal or the O-ring ③.
4. Apply medium-strength adhesive, e.g. Loctite 243 to the screws ①.
5. Place the washers on the screws ①.
6. Screw on the protective cover ②.
7. Protect all remaining bare areas with a suitable permanent corrosion protection agent.

❒

Protective cover (supplied loose)

When using the plastic protective cover for gearbox F49, the cover must first be brought into the correct shape.

When using the plastic protective cover for other gearboxes, it is not necessary to bring the cover into the required shape; in this case, start with Point 2.



* Preset breaking point

Figure 6-3 Preset breaking point for F49

1. F49: Break the cover at the preset breaking point (see diagram)
2. Mount the output shaft.
3. Use a suitable cleaning agent to clean the mounting surface of the protective cover ② on the gearbox.
4. Ensure that the O-ring or flat seal ③ is correctly seated.
5. Screw on the protective cover ② with a tightening torque of 10-15 Nm.
6. Protect all remaining bare areas with a suitable permanent corrosion protection agent.

❒

6.9 Installing and removing the shaft-mounted gearbox

NOTICE
Bearing damage due to stress on the hollow shaft A bent or stressed hollow shaft can cause bearing damage. • Mount the servo geared motor in such a way that the hollow shaft is aligned with the machine shaft. • Mount the hollow shaft without axial and radial stresses.

Note

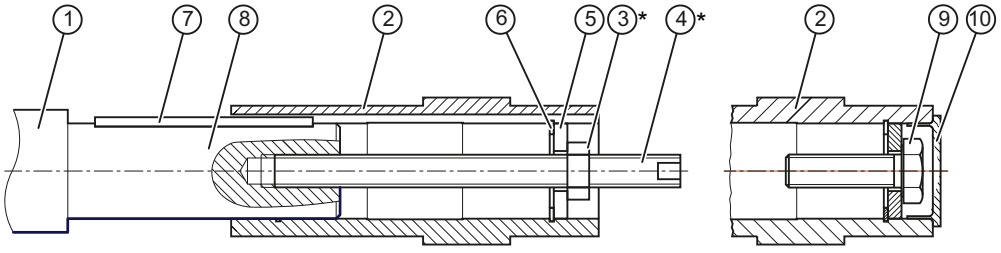
Prevent rusting on the contact surfaces by applying the enclosed mounting paste or a suitable greasing agent.

Note

Observe the permissible concentricity tolerance of the cylindrical shaft end of the machine shaft to the housing axle according to DIN 42955.

6.9.1 Mounting or removing the hollow shaft with feather key

Mounting the hollow shaft with feather key



* Not included in the scope of delivery

①	Machine shaft	⑥	Locking ring
②	Hollow shaft	⑦	Feather key
③	Hexagon nut	⑧	Assembly paste
④	Leadscrew	⑨	Screw
⑤	Disk	⑩	Sealing caps

Figure 6-4 Mounting the hollow shaft with feather key

Instead of the nut and threaded spindle shown in the diagram, other types of equipment such as hydraulic lifting equipment may be used.

Procedure

1. Use petrol ether or a solvent to remove the anti-corrosion agent from the shaft ends and flanges.
2. Check the seats or edges of the hollow and machine shafts for damage. Contact Technical Support if you identify any damage.
3. Apply the mounting paste provided ① to the machine shaft ⑧. Apply the paste uniformly.
4. Pull on the servo geared motor using the disk ⑤, threaded spindle ④ and nut ③. Support is provided by the hollow shaft ②.
5. Replace the nut ③ and the threaded spindle ④ with a setscrew. Tighten the bolts ⑨ to the specified torque.
6. Close the open hollow shaft end using a sealing cap ⑩.

❒

Table 6-10 Tightening torque for setscrews

Thread size	M5	M6	M8	M10	M12	M16	M20	M24	M30
Tightening torque in Nm	5	8	8	14	24	60	120	200	400

Removing the hollow shaft with parallel key

⚠ WARNING

Injuries if the servo geared motor falls

A servo geared motor that falls when being removed can cause severe or fatal injuries.

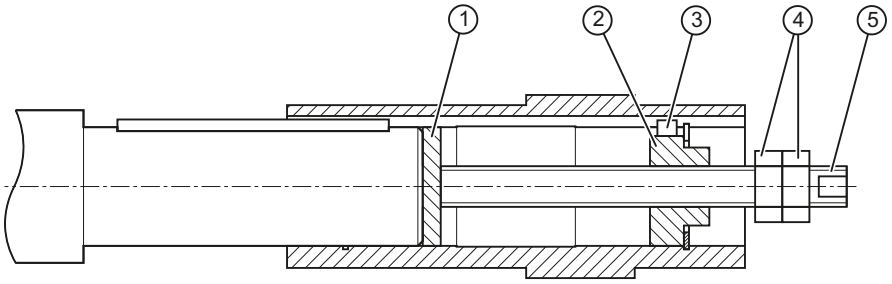
- Before removing the servo geared motor, secure it using an adequately dimensioned load suspension device to prevent it from falling.
- Before driving out the machine shaft, fasten adequately dimensioned load suspension devices to the servo geared motor.
- Slightly pre-tension the load suspension device so that the servo geared motor does not drop onto it when the plug-in shaft is released.

NOTICE

Damage to bearings and housing through impermissible forces when removing

Inadmissible forces can occur when removing the hollow shaft via the gearbox housing, and can damage the bearings and housing.

Remove the hollow shaft without stressing it or skewing it.



Item ① to item ⑤ are not included in the scope of delivery.

① Disk
② Threaded block
③ Feather key
④ Hexagon nut
⑤ Leadscrew

Figure 6-5 Removing the hollow shaft with parallel key

Procedure

1. Remove the axial locking element from the hollow shaft.
2. Drive out the machine shaft using the disk ①, threaded block ②, feather key ③, threaded spindle ⑤ and hexagon nuts ④.

❒

Suggested design for the threaded block and disk

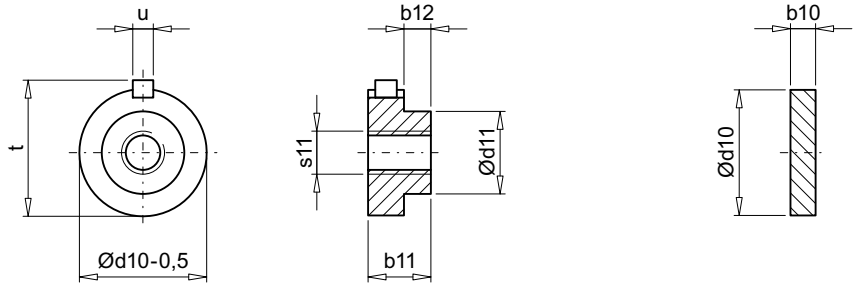


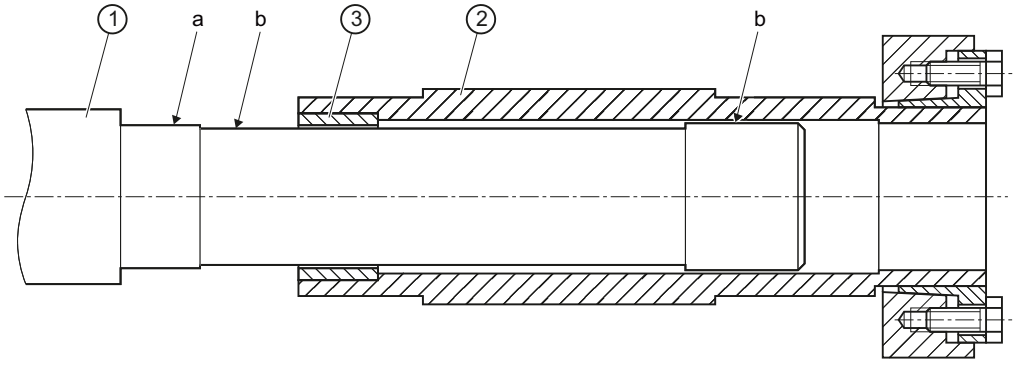
Table 6-11 Dimensions for the threaded block and disk

Gearbox	Size	Hollow shaft Ø	b10	b11	b12	d10	d11	s11	t_{max}	u
		mm	mm	mm	mm	mm	mm	mm	mm	mm
B	19	20	3	15	10	19.9	10	M6	22.5	6
B, C	29	20	3	15	10	19.9	10	M6	22.5	6
B, F	29	25	3	15	10	24.9	16	M10	28	8
C	39	25	3	15	10	24.9	16	M10	28	8
B, K, F, C		30	6	15	10	29.9	18	M10	33	8
B		35	6	15	10	34.9	24	M12	38	10
B		40	6	15	10	39.9	28	M16	43	12

Gearbox	Size	Hollow shaft Ø	b10	b11	b12	d10	d11	s11	t_{max}	u
		mm	mm	mm	mm	mm	mm	mm	mm	mm
C	49	30	6	15	10	29.9	18	M10	33	8
K, F, C		35	6	15	10	34.9	24	M12	38	10
B		40	6	15	10	39.9	28	M16	43	12
K, F, C	69	40	6	20	9	39.9	28	M16	43	12
C		45	6	20	9	44.9	36	M16	48	14
K, F	79	40	6	20	9	39.9	28	M16	43	12
K, F, C	89	50	7	20	10	49.9	36	M16	53.5	14
C		60	7	20	10	59.9	45	M20	64	18
K, F	109	60	10	24	14	59.9	45	M20	64	18
K, F	129	70	10	24	14	69.9	54	M20	74.5	20
K	149	90	10	24	14	89.9	72	M20	95	25

6.9.2 Mounting or removing the hollow shaft with shrink disk

Mounting the hollow shaft with shrink disk



a Greased
b Absolutely grease-free
① Machine shaft
② Hollow shaft
③ Bushing

Figure 6-6 Mounting the hollow shaft with shrink disk

Procedure

1. Use petrol ether or a solvent to remove the anti-corrosion agent from the shaft ends and flanges.
2. Check the seats or edges of the hollow and machine shafts for damage. Contact Technical Support if you identify any damage.
3. Mount the servo geared motor with the shrink disk shaft onto the machine shaft ①. Carefully ensure the correct position and that the shrink disk seat completely covers the machine shaft ①.

❒

Mounting the shrink disk

NOTICE
Risk of deforming the hollow shaft when tightening the clamping screws Tightening the clamping screws before inserting the machine shaft can cause plastic deformation of the hollow shaft. 1. Install the machine shaft. 2. Tighten the clamping screws.

NOTICE
Danger of overloading the individual screws The screws can be damaged if the maximum tightening torque is exceeded. Do not exceed the maximum tightening torque for the clamping screw.

Note

The shrink disk is delivered ready for installation.

Do not dismantle it before the initial fitting.

Note

The machine shaft material must comply with the following criteria in order to safely and reliably transfer the forces and torques:

Elastic limit $Re \geq 360\ N/mm^2$

Modulus of elasticity: Approx. $206\ kN/mm^2$

Note

The hollow shaft is axially secured on the machine shaft by means of a shrink disk connection.

Note

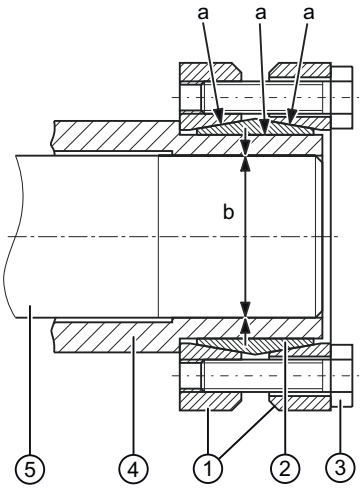
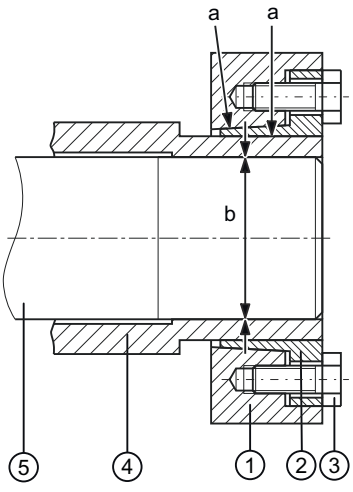
The force transmission point between the hollow shaft and the machine shaft must be free of any lubricants.

- Clean the bore of the hollow shaft and the machine shaft to remove any grease and other lubricants.
- Do not use impure solvents and dirty cleaning cloths.
- Do not use assembly paste at the force transmission point between the hollow shaft and the machine shaft.

Note

Apply a thin layer of grease to the shrink disk seat on the hollow shaft.

Table 6-12 Mounting the shrink disk

Frame sizes 19 - 69:	**Frame sizes 79 - 149:**
Tighten the clamping screws ③.	It is crucial that the end faces of the outer ring ① and inner ring ② are flush with one another. If they are not flush with one another when fitting, check the tolerance of the plug-in shaft.
	

a	Greased
b	Absolutely grease-free
①	Outer ring
②	Inner ring
③	Clamping screw
④	Hollow shaft
⑤	Machine shaft

Procedure

1. Push the shrink disk onto the hollow shaft.
   - 3-part shrink disk up to the end stop for frame sizes 19 - 69.
   - 2-part shrink disk flush with the shaft end for frame sizes 79 - 149.
2. Tighten the clamping screws ③ handtight initially.
3. Align the shrink disk so that the clamping flanges are completely parallel with one another.
4. Use the torque wrench to turn each of the clamping screws ③ equally by 1/6 revolution (not crosswise), repeating this procedure several times. Do not exceed the maximum tightening torque.
5. Attach the rubber cover or protection cover included in the scope of supply, see Mounting the protective cover (Page 103).

❒

Table 6-13 Tightening torque for the clamping screw

Gearbox size	Thread size	Property class	Tightening torque
			Nm
19, 29	M5	10.9	5
39, 49, 69	M6	10.9	12
79, 89	M8	12.9	35
109, 129	M10	12.9	70
149	M12	12.9	121

Pulling off the shrink disk

Procedure

1. Release the clamping screws ③ one after the other by a ¼ turn each time using a wrench. Do not completely remove the screws.
2. Withdraw the shrink disk from the hollow shaft.

❒

Note

Frame sizes 79 - 149:
If the outer ring does automatically release from the inner ring, insert some of the clamping screws into the adjacent neighboring forcing-off threads.

Cleaning and lubricating shrink disks

Note

Contaminated shrink disks must be cleaned and regreased prior to fitting.

Loosened shrink disks do not have to be dismantled and re-greased before being refitted.

Procedure

1. Only grease the inner sliding surfaces of the shrink disks. To do this, use a solid lubricant with a friction coefficient of μ = 0.04.
2. Use a paste containing MoS_2 to grease the screws, applying the paste to the thread and underneath the head.

❒

Table 6-14 Lubricants for shrink disks

Lubricant	Sold as	Manufacturer
Molykote 321 R (lubricant paint)	Spray	DOW Corning
Molykote spray (powder spray)		
Molykote G Rapid	Spray or paste	
Molykombin UMFT 1	Spray	Klüber Lubrication
Unimily P5	Powder	
Aemasol MO 19 P	Spray or paste	A. C. Matthes

6.9.3 Installing or removing the SIMOLOC connection

NOTICE

Damage to individual screws by exceeding the tightening torque

Clamping screws ④ and ⑩ can be damaged if the maximum tightening torque is exceeded.

Do not exceed the maximum tightening torque for clamping screws ④ and ⑩.

Note

Do not apply any lubricant at the point of force transmission between the hollow shaft and the machine shaft.

The point of force transmission between the hollow shaft and the machine shaft must be free of greasing agents.

- Clean the bore of the hollow shaft and the machine shaft to remove any grease and other lubricants.
- Do not use impure solvents and dirty cleaning cloths.
- Do not use assembly paste at the force transmission point between the hollow shaft and the machine shaft.

Note

The SIMOLOC connection fastens the hollow shaft axially on the machine shaft.

Note

Oil the locating hole for the tapered bushing ⑨ and bronze bushing ② in the hollow shaft ⑥ lightly with the oil provided.

Oil type of the provided oil: CLP VG 68 DIN 51517-3

Note

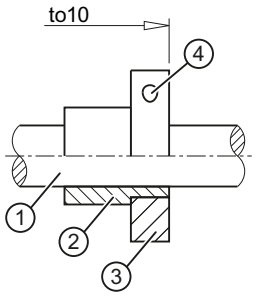
Place the pressure ring ⑤ at the correct position as in the delivery state.

Note

Before SIMOLOC assembly, mount the torque arms ⑦ onto the gearbox.

Installing the SIMOLOC connection

4. + 5.



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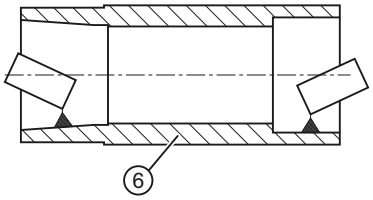

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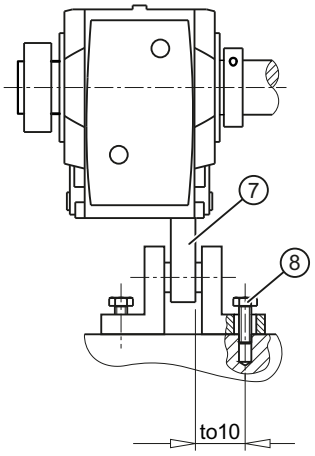
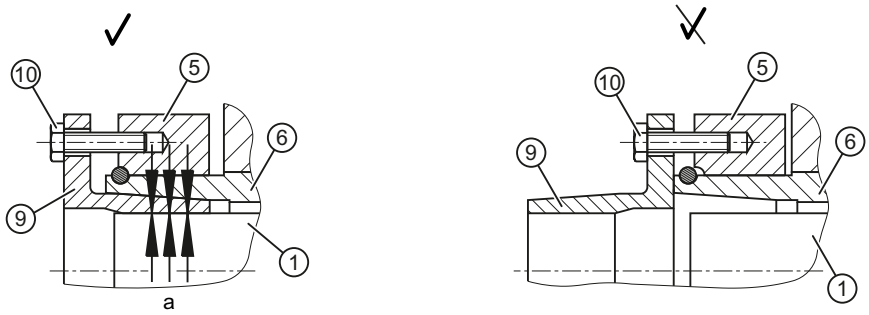


9. + 10.



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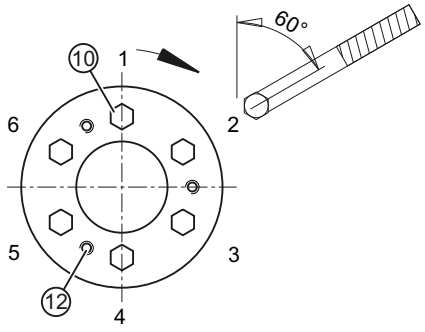

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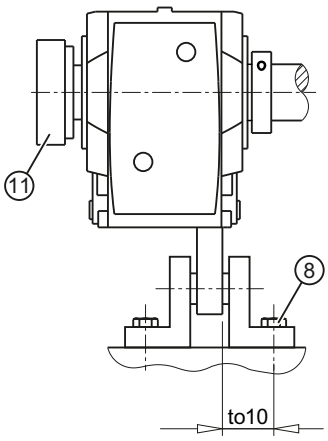


a Absolutely grease-free
① Machine shaft
② Bronze bushing
③ Clamping ring
④ Clamping screw for the clamping ring
⑤ Pressure ring
⑥ Hollow shaft
⑦ Torque arm
⑧ Screw
⑨ Tapered bushing
⑩ Clamping screw for the tapered bushing
⑪ Protection cover / cover cap
⑫ Threaded hole for the clamping screw ⑩ during disassembly

Figure 6-7 Installing the SIMOLOC connection

Procedure

1. Attach the torque arm ⑦ to the gearbox. See Torque arms with shaft-mounted gearboxes (Page 118)
2. Remove the anti-corrosion agent using white spirit or a solvent:
   - at the shaft ends of the machine shaft ①
   - at the clamping ring ③
   - at the bronze bushing ②.
3. Check the seats or edges of the hollow shaft ⑥ and the machine shaft ① for damage. Immediately report any damage to Technical Support.
4. Place the clamping ring ③ on the bronze bushing ②.
5. Position the bronze bushing ② with the clamping ring ③ on the machine shaft ①. Carefully comply with the tightening torque of the clamping screw ④ and the tolerance dimension to 10.
6. Oil lightly the locating holes in the hollow shaft ⑥ for the tapered bushing ⑨ and bronze bushing ②.
   Remove any excessive oil using a clean cloth.
7. Push the gearbox with the installed torque arm ⑦ on the machine shaft ① against the clamping ring ③.
8. Tighten the torque arm ⑦ with the screws ⑧ only slightly because the gearbox must have some play for the subsequent mounting.
9. Place the pressure ring ⑤ at the correct position.
   If the pressure ring ⑤ is not located at the correct position, bring it ⑤ into the correct position by tightening the clamping screws ⑩ with turned tapered bushing ⑨.
10. Place the tapered bushing ⑨ on the machine shaft ①.
11. Use the torque wrench to tighten each of the clamping screws ⑩ equally (not crosswise), repeating this procedure several times. Do not exceed the maximum tightening torque for clamping screw ⑩.
12. Tighten the bolts ⑧ of the torque arm fastening. See Torque arms with shaft-mounted gearboxes (Page 118)
13. Attach the rubber cover or protection cover ⑪ included in the scope of delivery.
    See Mounting the protective cover (Page 103)

❒

Table 6-15 Tolerance dimension, clamping screw ④ tightening torque

Gearbox type	Size	Tolerance dimension to10	Thread size ④	Tightening torque
		mm	Property class 8.8	Nm
F, B, C	19, 29	0.6 ... 2.1	M6	10
F, B, K, C	39	0.7 ... 2.2		
F, B, K, C	49	0.8 ... 2.6		

Gearbox type	Size	Tolerance dimension to10	Thread size ④	Tightening torque
		mm	Property class 8.8	Nm
F, K, C	69	0.7 ... 2.5	M8	35
F, K	79	1.4 ... 3.2		
F, K, C	89	1.5 ... 3.4		

Table 6-16 Clamping screw ⑩ tightening torque

Gearbox type	Size	Thread size ⑩	Tightening torque
		Property class 12.9	Nm
F, B, C	19, 29	M5	10
F, B, K, C	39		
F, B, K, C	49	M6	16
F, K, C	69		
F, K	79	M8	38
F, K, C	89		

Dismantling a SIMOLOC connection

⚠ WARNING

Danger to life due to falling servo geared motor

A servo geared motor that falls when being removed can cause severe or fatal injuries.

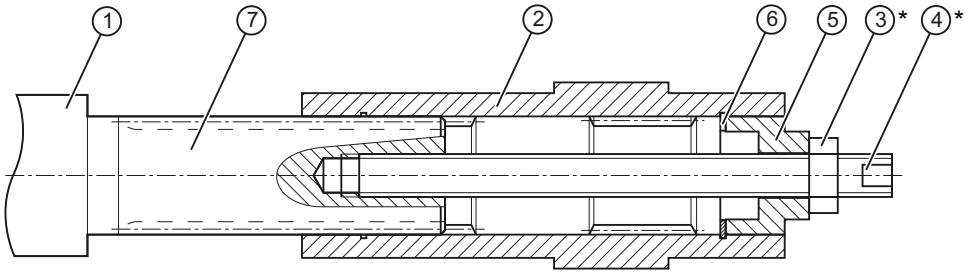
- Before removing the servo geared motor, secure it using an adequately dimensioned load suspension device to prevent it from falling.
- Before driving out the machine shaft, fasten adequately dimensioned load suspension devices to the servo geared motor.
- Slightly pre-tension the load suspension device so that the servo geared motor does not drop onto it when the plug-in shaft is released.

Procedure

1. Release all screws ⑩.
2. Completely remove the screws.
3. Screw the bolts ⑩ into the threaded holes ⑫.
4. Use the torque wrench to tighten each of the screws ⑩ equally (not crosswise), repeating this procedure several times. Do not exceed the maximum tightening torque for screw ⑩. Repeat the task until the tapered bushing ⑨ has been freed.
5. Remove screws ⑩.
6. Remove the tapered bushing ⑨.
7. Lower the gearbox from the machine shaft ①.

❒

6.9.4 Mounting the hollow shaft with splines



* Not included in the scope of delivery
① Machine shaft
② Hollow shaft
③ Hexagon nut
④ Leadscrew
⑤ Disk
⑥ Locking ring
⑦ Assembly paste

Figure 6-8 Mounting the hollow shaft with splines

Instead of the nut and threaded spindle shown in the diagram, you can also use hydraulic lifting equipment.

Procedure

1. Use petrol ether or a solvent to remove the anti-corrosion agent from the shaft ends and flanges.
2. Check the seats or edges of the hollow and machine shafts for damage.
   Immediately report any damage to Technical Support.
3. Apply the mounting paste ⑦ to the machine shaft ①.
   Apply the paste uniformly.
4. Pull on the servo geared motor using the disk ⑤, threaded spindle ④ and nut ③.
   The hollow shaft ② supports the servo geared motor.
5. Replace the nut ③ and the threaded spindle ④ with a setscrew.
   Tighten the screw with the specified torque.

❒

Table 6-17 Tightening torque for setscrews

Thread size	M5	M6	M8	M10	M12	M16	M20	M24	M30
Tightening torque in Nm	5	8	8	14	24	60	120	200	400

6.9.5 Torque arms with shaft-mounted gearboxes

The torque arm should absorb the reaction torque and the weight of the servo geared motor.

NOTICE
Machine damage caused by excessive play Excessive backlash of the torque arm can cause hazardous torque surges, and therefore damage the machine. • Mount the torque arm in such a way that excessively high constraining forces do not occur, e.g. due to the driven shaft running out-of-true.

NOTICE
Gearbox damage due to impermissible stress on the gearbox resulting from incorrect installation Incorrectly mounting the torque arm can stress the gearbox housing and damage the gearbox. • Mount the torque arm so that it is free of any stress.

NOTICE
Damage to the rubber elements caused by solvent Solvents, oils, greases and fuels damage rubber elements. • Carefully ensure that solvents, oils, greases and fuels do not come into contact with the rubber elements.

Mounting torque arms on parallel shaft gearboxes

We recommend using pretensioned, damping rubber elements.

Mounting elements such as brackets, screws, nuts, etc. are not included in the scope of delivery.

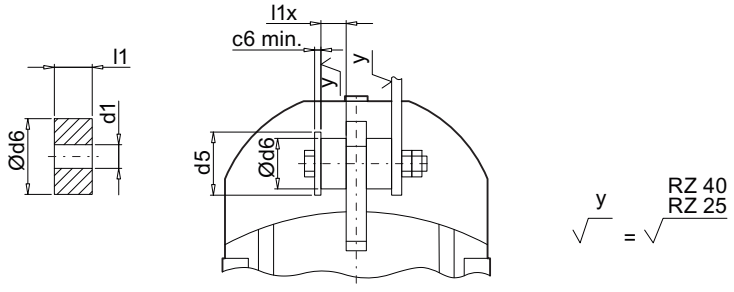


Figure 6-9 Mounting suggestion for torque arms on F.29 - F.149

Table 6-18 Mounting dimension of the torque arm

Size	Rubber buffer				Disk	
	Unten-sioned	Tensioned				
	l1	l1x	d6	d1	d5	$c6_{min}$
	mm	mm	mm	mm	mm	mm
29	15	14.0	30	10.5	40	4
39		13.5				
49	20	18.5	40	12.5	45	6
69		18.5			50	
79		17.5				
89	30	28	60	21	75	8
109		27.5				
129	40	37.5	80	25	100	10
149		36.5				

Procedure

1. Use the washers according to the table above.
2. Use two nuts to secure the screw connection (lock nuts).
3. Tighten the bolts until the rubber buffers are pretensioned to the dimension l1x.

❒

Mounting torque arms on bevel gearboxes and helical worm gearboxes

NOTICE
Machine damage caused by inadmissible load due to incorrect installation
Incorrectly mounting the torque arm can stress the gearbox housing and damage the machine.
Mount the torque arm bushing so that it is supported on both sides.

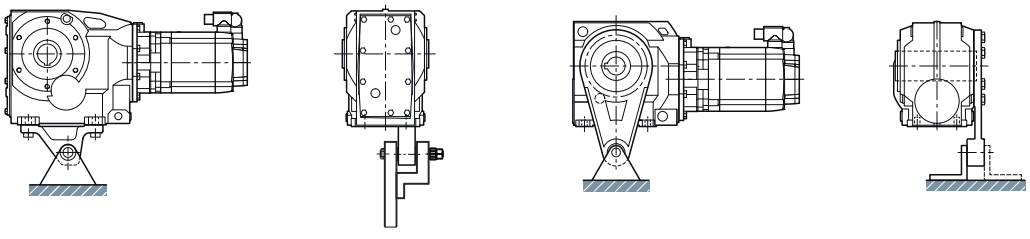


Figure 6-10 Mounting suggestion for torque arm on foot and flange

The torque arm can be fitted in various positions, depending on the hole circle pitch.

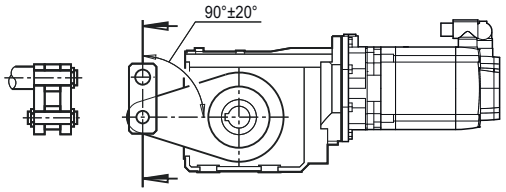


Figure 6-11 Toggle lever design

For a toggle lever design, derive the force in the range of 90° ± 20°.

Procedure

1. Clean the contact surfaces between the housing and the torque arm.
2. Tighten the bolts to the specified torque.

❒

Table 6-19 Tightening torque for screws of property class 8.8

Thread size	M6	M8	M10	M12	M16	M20	M24	M36
Tightening torque in Nm	10	25	50	90	210	450	750	2 600

6.10 Mounting the oil expansion unit

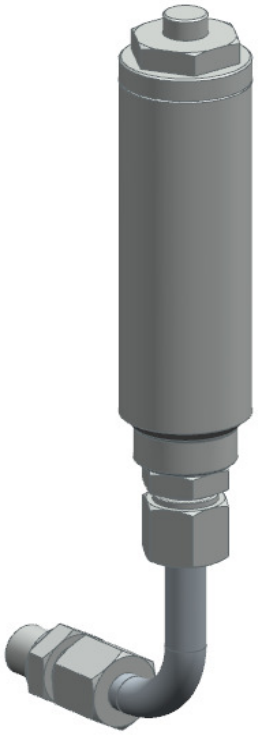
The oil expansion unit equalizes changes in the oil volume caused by temperature fluctuations in operation.

The oil expansion unit is required:

- for high drive speeds
- in mounting position M4 (motor at the top)

The size of the oil expansion unit provided depends on the gearbox.

Table 6-20 Oil expansion unit and the corresponding gearbox

Unit size	Size 1	Size 2
		
Unit volume	0.05 l	1.5 l
Gearbox size	FZ 39 - 89 K 39 - 109 B 39 - 49 C 69 – 89	FZ.129 K 129 - 149

Note

Selecting the oil expansion unit

Contact the Siemens Service Center for final selection of the oil expansion unit.

The unit is supplied as a mounting kit.

Note

Attaching the oil expansion unit before commissioning

Before commissioning the servo geared motor, replace the vent valve that is already installed with the oil expansion unit that is provided.

Mounting the oil expansion unit, size 1

Note

When unscrewing the vent valve, prevent contamination and corrosive substances from the atmosphere entering the gearbox.

Procedure

1. Completely unscrew the vent valve with transport lock.
2. Screw in the completely preassembled oil expansion unit.
3. Align the oil expansion unit so that it is vertical.

❒

Note

Replace the vent valve of the unit yearly.

Mounting the oil expansion unit, size 2

The unit is supplied as a mounting kit. The installation is described in the Compact Installation Instructions KA 2530-1 provided.

Note

Replace the vent valve of the unit yearly.

6.11 Vibration response

Vibration stress

To ensure a perfect function and to comply with the servo geared motor specification 1FG1 (particularly the bearing service life) the vibration values listed in the following table must not be exceeded.

Table 6-21 Vibration values

Vibration velocity / V_{rms} to ISO 10816	Max. 4.5 mm/s
Axial vibration acceleration a_{peak} axial	25 m/s^2
Radial vibration acceleration a_{peak} radial	50 m/s^2

Select the measurement points according to ISO 10816-1 Section 3.2. The vibration values must not exceed the specified limits at any measuring point.

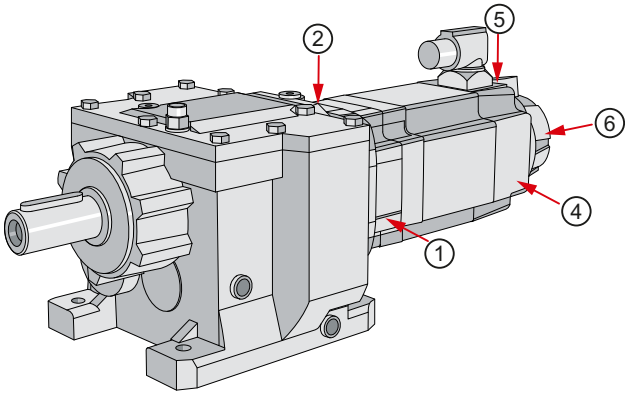


Figure 6-12 Measurement points on geared motors

The vibration acceleration is evaluated in the frequency band from 10 to 2000 Hz. The maximum peak value in the time range is considered.

To evaluate the vibration velocity, the measuring equipment must fulfill the requirements of ISO 2954.

Connecting 7

7.1 Safety instructions

⚠ DANGER

Electric shock and danger to life due to other energy sources

Touching live parts results in an electric shock that could lead to death or severe injuries.

- Only work on electrical equipment if you are appropriately qualified.
- When carrying out any work, always observe the country-specific safety rules.

Generally, six steps must be followed when establishing safety:

1. Prepare for shutdown and notify all those who will be affected by the procedure.
2. Disconnect the machine from the supply so that it is in a no voltage condition.
   - Switch off the machine.
   - Wait until the discharge time specified on the warning labels has elapsed.
   - Check that there is a no-voltage condition from phase conductor to phase conductor and phase conductor to protective conductor.
   - Check that every auxiliary circuit is in a no-voltage condition.
   - Ensure that the motors cannot move.
3. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems or water.
4. Isolate or neutralize all hazardous energy sources by closing switches, grounding or short-circuiting or closing valves, for example.
5. Take measures to prevent energy sources from being reconnected.
6. Ensure that the correct machine is completely interlocked.

After you have completed the work, restore the operational readiness by following the above steps in the reverse order.

⚠ WARNING

Electric shock caused by hazardous voltage when connected to inadequately grounded line supplies

In the case of a fault, connecting a motor to an inadequately grounded line supply can result in an electric shock, which can lead to death, severe injuries and motor damage.

- Connect motors, as part of the drive system, to TN and TT line systems with a grounded neutral point or to IT line systems.
- Ensure that the SINAMICS devices and motors are compatible with the RCD according to EN 61800-5-1 before you connect the devices and motors to the line supply using fault current RCDs.
- For line supplies with grounded line conductor, e.g. TT line systems, use an isolating transformer with grounded neutral point (on the secondary side) between the line supply and the drive system, so that the motor insulation is not overstressed.
- When connected to IT line systems, a monitoring device must signal the first fault between an active part and ground. Remove this fault immediately.

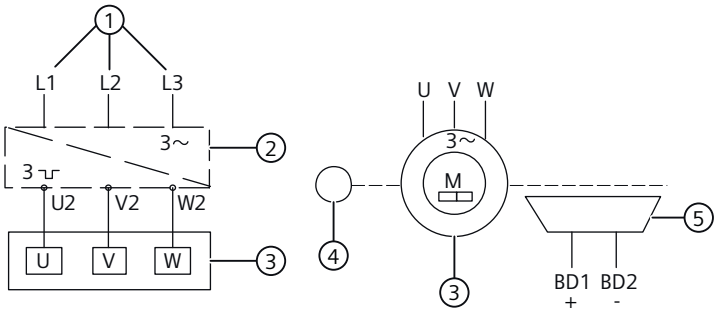
7.2 Permissible line system types

In combination with the drive system, the motors are permitted for operation on the following line supplies.

TN and TT line systems with grounded neutral point	IT line systems	Line supplies with grounded line conductor
	When operated on IT line systems, the first fault between an active part and ground must be signaled using an appropriate monitoring device. According to IEC 60364-4-41, remove the first fault as quickly as practically possible.	For line supplies with **grounded line conductor** use an isolating transformer with grounded neutral point (on the secondary side) between the line supply and the drive system. In this way, you avoid inadmissibly stressing the motor insulation. TT line systems with grounded line conductor are predominantly used, which means that you must use an isolation transformer.

7.3 Circuit diagram

Description



1	Feeder cable	4	Encoder
2	Power Module	5	Brake
3	Motor		

Figure 7-1 Circuit diagram

7.4 System integration

7.4.1 Connection notes

7.4.1.1 Motor connection

Description

NOTICE
Destruction of the motor if it is directly connected to the three-phase line supply
The motor will be destroyed if it is directly connected to the three-phase line supply. • Only operate the motors with the appropriately configured converters.

NOTICE
Damage to electronic components as a result of electrostatic discharge
Electrostatically sensitive devices (ESD) can be damaged or destroyed by electrostatic discharge. • Observe the ESD protection measures. • Only grounded personnel with grounded tools may touch the component connections. • Heed the EMC information provided by the manufacturer of the converter.

- The manufacturer of the plant/machine is responsible for the ensuring that the installation is performed correctly.
- Observe the data on the rating plate and the circuit diagrams.
- Adapt the connecting cables to the type of use and the voltages and currents that occur.
- Use prefabricated cables from SIEMENS (not in the scope of delivery). These cables reduce installation costs and increase operational reliability (see the Product Information).
- Make sure that the inside of the connector is clean and free of cable cuttings and moisture.
- Check that the degree of protection is complied with at the seals and sealing surfaces of the connectors.
- Secure connecting cables against torsion, tensile and compressive strain, and protect them against kinking. It is not permissible to subject the connector to continuous force.

Description

The current-carrying capacity of PVC/PUR-insulated copper cables is specified for routing types B1, B2 and C under continuous operating conditions in the table with reference to an ambient air temperature of 40° C. For other ambient temperatures, the values must be corrected by the factors from the "Derating factors" table.

Cable cross-section and current-carrying capacity

Cross-section	Current-carrying capacity rms; AC 50/60 Hz or DC for routing type		
mm²	*B1* / A	*B2* / A	*C* / A
Electronics (according to EN 60204-1)			
0.20	-	4.3	4.4
0.50	-	7.5	7.5
0.75	-	9	9.5
Power (according to EN 60204-1)			
0.75	8.6	8.5	9.8
1.00	10.3	10.1	11.7
1.50	13.5	13.1	15.2
2.50	18.3	17.4	21
4	24	23	28
6	31	30	36
10	44	40	50
16	59	54	66
25	77	70	84
35	96	86	104
50	117	103	125

Cable cross-section and current-carrying capacity

Derating factors for power and signal cables

Ambient air temperature [°C]	Derating factor according to EN 60204-1, Table D1
30	1.15
35	1.08
40	1.00
45	0.91
50	0.82
55	0.71
60	0.58

Derating factors for power and signal cables

7.4.1.2 Rotating the connector at the motor

Power connectors and signal connectors can be rotated to a limited extent.

Use a suitable socket connector to rotate the angle plug.

Unscrew and open the socket connector completely to avoid damaging the pin contacts.

For encoders with integrated Sensor Modules (DQI) the cable outlet towards the top is fixed and cannot be changed.

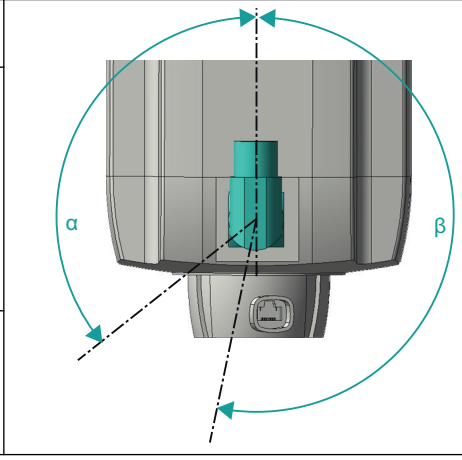
Note

Rotating the connectors

- Do not exceed the permissible range of rotation.
- To ensure the degree of protection, do not rotate more than 10 times.
- Rotate the connector using a mating connector that matches the connector thread. Rotate sensor modules by hand only. Use of tools is not permissible.

Ability to rotate the power connector on motors with DRIVE-CLiQ interface 1FG1□□□-□□X□□-□□□□; X = C, D, E, F, G

Table 7-1 Rotation range of the power connector

Motor	Angle α	Angle β	Connector size	Drawing
1FG1□□□-□□C□□	122°	208°	M23	
1FG1□□□-□□D□□ 1FG1□□□-□□E□□ 1FG1□□□-□□F□□ 1FG1□□□-□□G□□	135°	195°	M23	
1FG1□□□-□□F□□ 1FG1□□□-□□G□□	195°	140°	M40	

Ability to rotate the connectors on motors without a DRIVE-CLiQ interface and on motors with a DRIVE-CLiQ interface via Sensor Modules1FG1□□□-□□X□□-□□□□; X = C, D, E,F,G

Table 7-2 Rotation range of the power connector

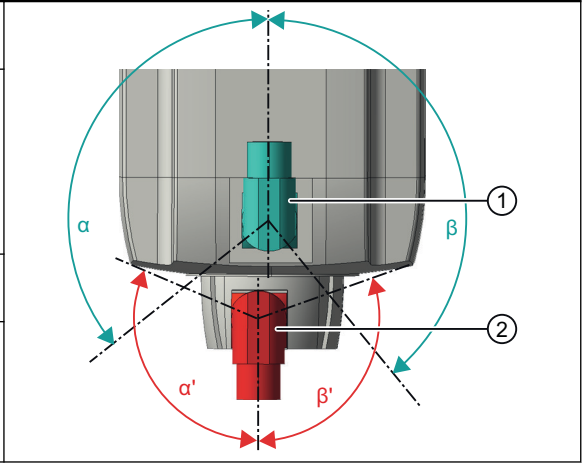
Motor	Angle α	Angle β	Connector size	Drawing
1FG1□□□-□□C□□	122°	158°	M23	
1FG1□□□-□□D□□ 1FG1□□□-□□E□□ 1FG1□□□-□□F□□	135°	140°	M23	
1FG1□□□-□□G□□	135°	195°	M23	
1FG1□□□-□□F□□ 1FG1□□□-□□G□□	195°	140°	M40	

Table 7-3 Rotation range of the signal connector

Motor	with DRIVE-CLiQ via Sensor Module		connector without DRIVE-CLiQ		Drawing
	Angle α´	Angle β´	Angle α´	Angle β´	
1FG1□□□-□□C□□	130°	120°	160°	135°	See Table, "Power connectors"
1FG1□□□-□□D□□	145°	135°	145°	135°	
1FG1□□□-□□E□□	110°	110°	150°	135°	
1FG1□□□-□□F□□ 1FG1□□□-□□G□□	90°	90°	90°	90°	

Table 7-4 Max. torque when rotating

Connectors	Max. torque when rotating
Power connector M23	12 Nm
Power connector M40	20 Nm
Signal connector (without DRIVE-CLiQ)	12 Nm
Signal connector (with DRIVE-CLiQ)	8 Nm

7.4.1.3 Routing cables in a damp environment

Description

Note

If the motor is mounted in a humid environment, the power and signal cables must be routed as shown in the following figure.

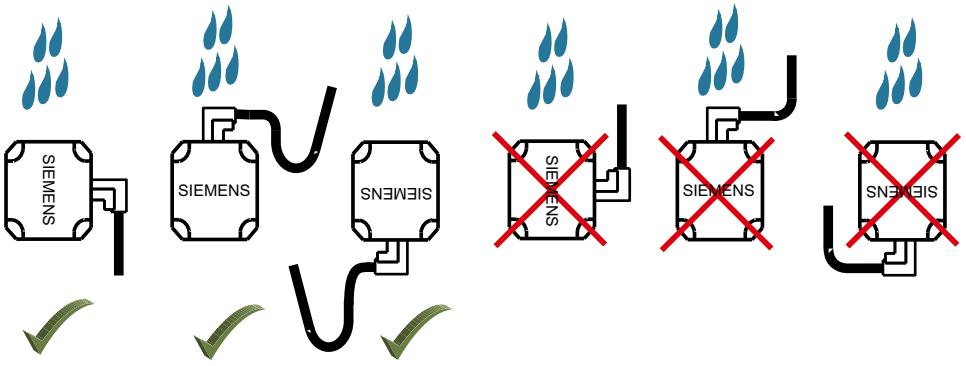
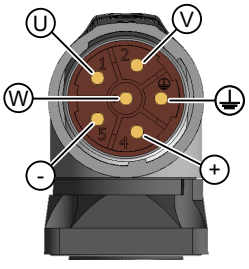
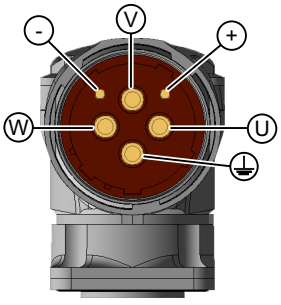


Figure 7-2 Routing cables in a damp environment

7.4.2 Power connection

Design of the power connectors

The 1FG1 is equipped with the following power connectors depending on the size and power rating.

Round connector M23	Round connector M40
	
Brake connection 24 V: "+" = BD1+; "-" = BD2-	

The power connectors can be rotated within a certain range.

More precise information about the equipping of the motors and the angles of rotation is provided in Chapter "Rotating the connector at the motor (Page 130)".

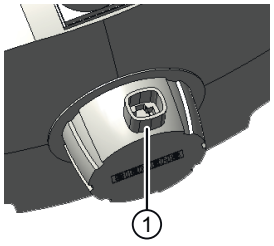
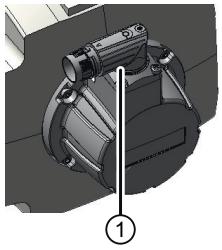
7.4.3 Signal connection

7.4.3.1 Motors with DRIVE-CLiQ interface

Motors designed for SINAMICS drive systems have an integrated encoder and temperature evaluation system as well as an electronic rating plate.

The motors are connected to the converter system via a DRIVE-CLiQ interface.

We recommend the following two variants for the DRIVE-CLiQ connection:

10-pin RJ45 socket	Round connector M17
	
1 10-pin RJ45 socket	1 round connector M17

The DRIVE-CLiQ interface supplies the motor encoder via the integrated 24 V DC supply. The DRIVE-CLiQ interface transfers the motor encoder and temperature signals and the electronic rating plate data, e.g. a unique identification number, rating data (voltage, current, torque) to the Control Unit.

Motors with a DRIVE-CLiQ interface can be connected to the associated Motor Module via a MOTION-CONNECT cable. The connection of the MOTION-CONNECT cable at the motor has degree of protection IP67.

NOTICE
Damage to electronic components as a result of electrostatic discharge The Sensor Module is in direct contact with electrostatic sensitive devices that can be damaged or destroyed by electrostatic discharge (ESD). • Carefully observe ESD protective measures (see Equipment damage due to electric fields or electrostatic discharge (Page 24)). • Only grounded personnel with grounded tools may touch the component connections. • Comply with the EMC information provided by the manufacturer of the converter.

The motor and the Motor Module are connected via a MOTION-CONNECT cable, see Instructions for handling the RJ45 connector (Page 140)

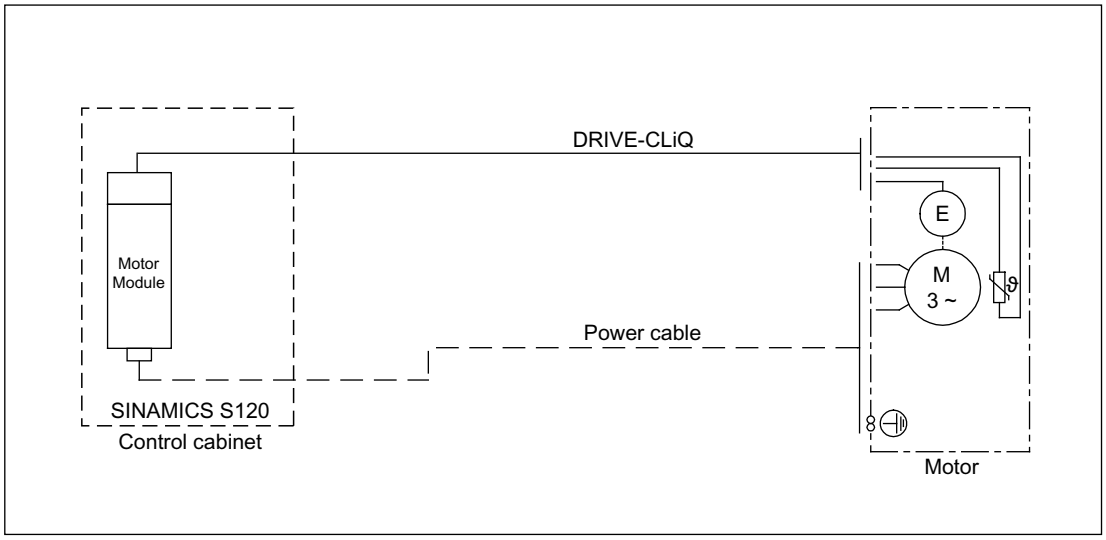
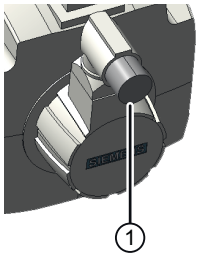


Figure 7-3 Encoder interface with DRIVE-CLiQ

7.4.3.2 Motors without a DRIVE-CLiQ interface

If a motor is not equipped with a DRIVE-CLiQ interface, the speed encoder and temperature sensor are connected via a signal connector.



① Signal connector

Figure 7-4 Motor with a signal connector

Motors without DRIVE-CLiQ require a Sensor Module Cabinet (SMC) for operation with a SINAMICS S120 drive system. The motor is connected to the SMC via a signal cable. The SMC is connected to the motor via a MOTION-CONNECT cable.

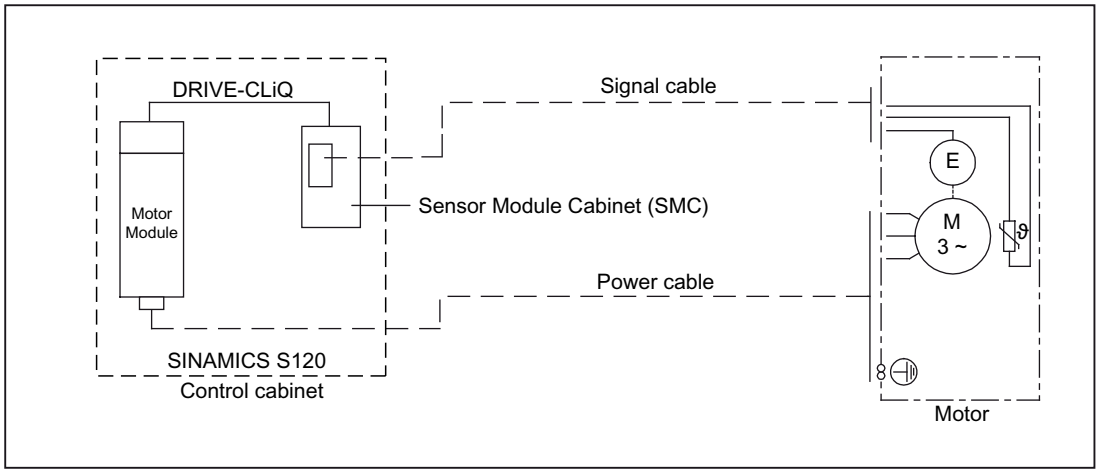
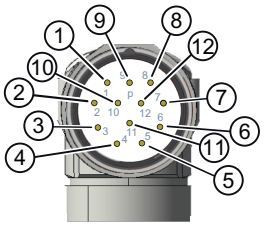
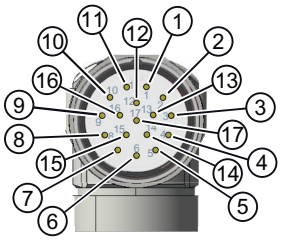
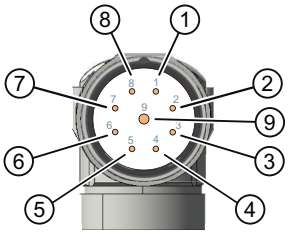


Figure 7-5 Encoder interface without DRIVE-CLiQ

7.4.3.3 Design of the signal connectors

Pin assignment, 12-pin signal connector M23	Pin assignment, 17-pin signal connector M23		Pin assignment, 9-pin signal connector M23
			
Resolver	Incremental encoder sin/cos 1 Vpp	Absolute encoder with EnDat2.1	Absolute encoder with EnDat2.2
1 = S2	1 = A	1 = A	1 = clock
2 = S4	2 = A*	2 = A*	2 = clock*
3 = not connected	3 = R	3 = data	3 = U_p
4 = not connected	4 = D*	4 = not connected	4 = 0 V
5 = not connected	5 = C	5 = clock	5 = data
6 = not connected*	6 = C*	6 = not connected	6 = data*
7 = R2	7 = M encoder	7 = M encoder	7 = U_p sensor
8 = +1R1	8 = +1R1	8 = +1R1	8 = 0 V sensor
9 = -1R2	9 = -1R2	9 = -1R2	9 = not connected
10 = R1	10 = P encoder	10 = P encoder	
11 = S1	11 = B	11 = B	
12 = S3	12 = B*	12 = B*	
	13 = R*	13 = data*	
	14 = D	14 = clock*	
	15 = M sensor	15 = M sensor	

Pin assignment, 12-pin signal connector M23	Pin assignment, 17-pin signal connector M23		Pin assignment, 9-pin signal connector M23
	16 = P sensor	16 = P sensor	
	17 = not connected	17 = not connected	

7.4.4 Connecting-up a converter

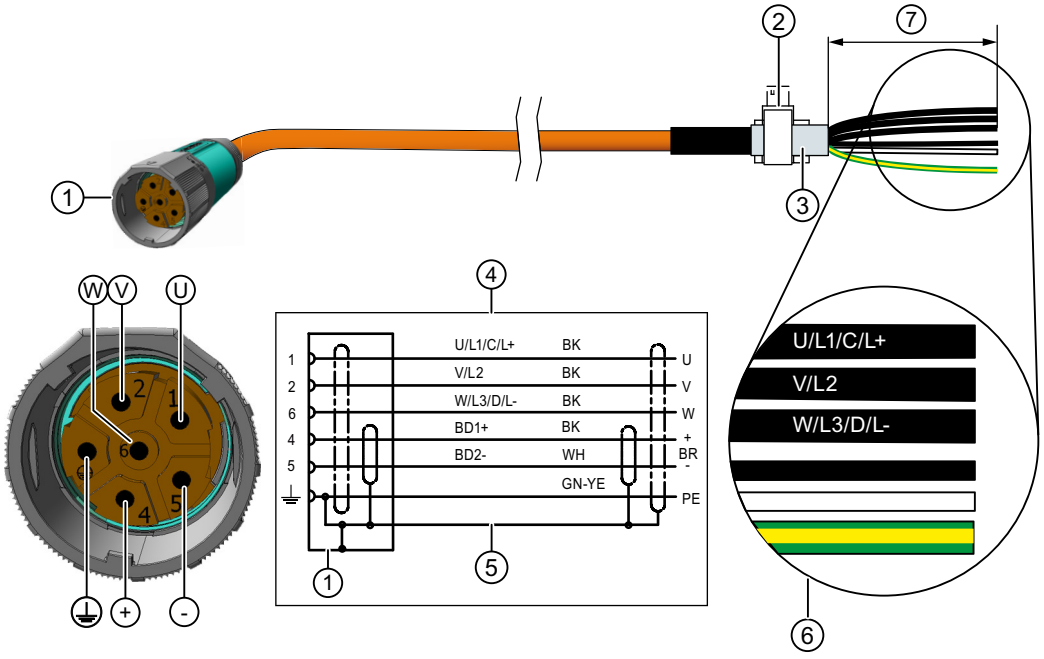
7.4.4.1 Selecting and connecting the cables

- To connect the motor to a converter, use MOTION-CONNECT cables or shielded connecting cables.

Note

The cable shielding should be braided and must have a high electrical conductivity. Braided shields made of copper or aluminum are well suited.

Connection diagram for the motor connected to the S120 Power Module and Motor Module Booksize and Compact for connector size M23



1 SPEED-CONNECT connector, size M23

2 Terminal for the cable shield

3 Cable shield

4 Connection diagram

U, V, W = power cables, 1.5 mm^2, each cable separately shielded

BD1+ and BD2- = brake cable without lettering, 1.5 mm^2, common shield

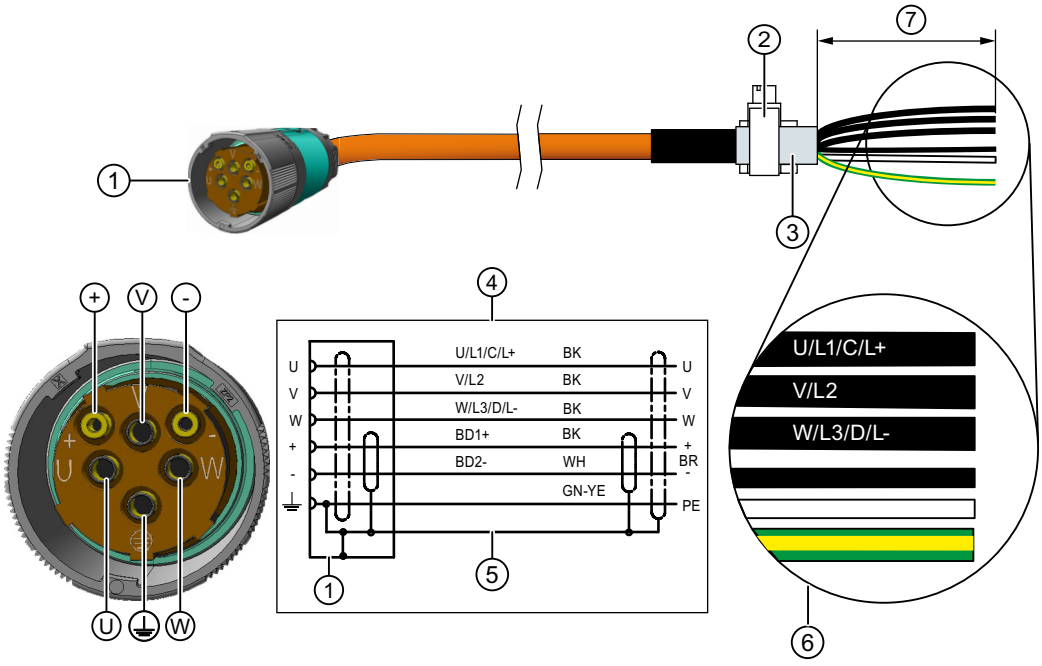
PE = protective conductor

5 Cable shield

6 Conductor designations

7 Recommended length of the cable ends: 105 mm

Connection diagram for the motor connected to the S120 Power Module and Motor Module Booksize and Compact for connector size M40



1 SPEED-CONNECT connector, size M40

2 Terminal for the cable shield

3 Cable shield

4 Connection diagram

U, V, W = power cables, 1.5 mm^2, each cable separately shielded

BD1+ and BD2- = brake cable without lettering, 1.5 mm^2, common shield

PE = protective conductor

5 Cable shield

6 Conductor designations

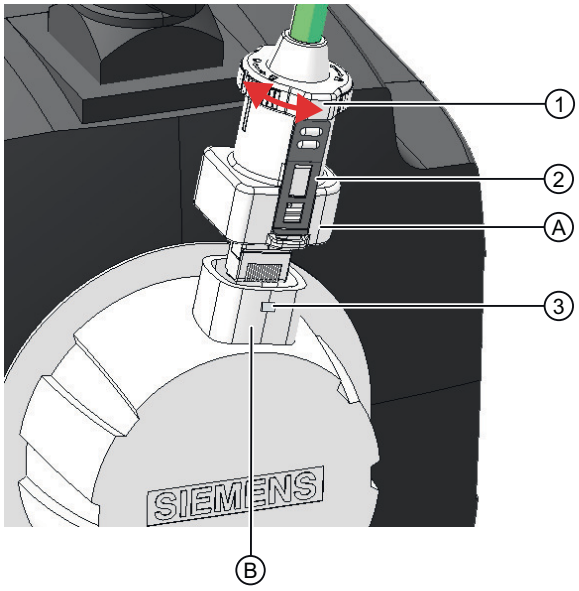
7 Recommended length of the cable ends: 105 mm

Notes for connecting up the cable shield

- Connect the cable shield at both ends, at the motor and at the converter.
- Keep unshielded cable ends as short as possible.
- Ensure a connection through a large surface area so that high-frequency currents are suitably discharged. Establish a 360° connection at the converter and at the motor, for instance using EMC cable glands at the cable entries.

7.4.4.2 Instructions for handling the RJ45 connector

The DRIVE-CLiQ connection method with the RJ45 connector has the following components:



A	DRIVE-CLiQ plug with RJ45 plug
B	DRIVE-CLiQ socket with RJ45 socket
①	Rotatable locking ring
②	Tabs (2, opposite each other)
③	Latches (2, opposite each other)

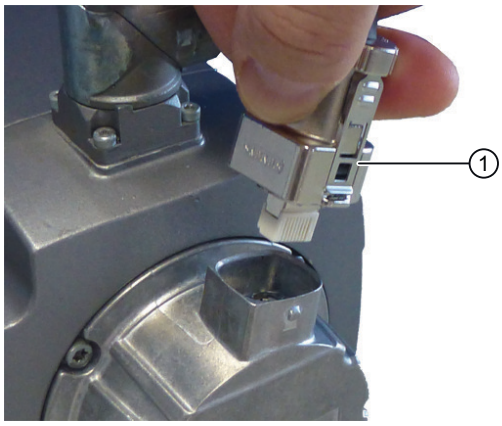
Insertion of the RJ45 connector

Procedure

1. Check whether the locking ring of the connector is in the "locked" position.
   If not, turn the locking ring clockwise into the "locked" position.

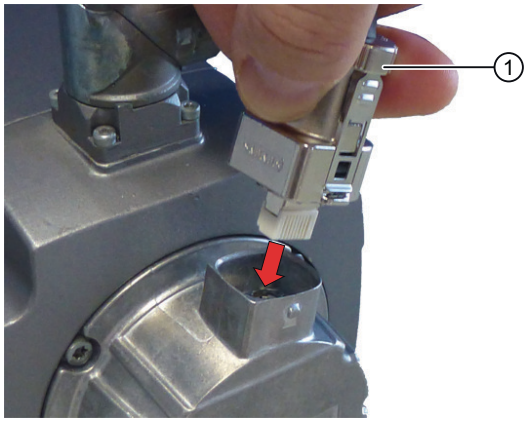
   Note

   In the "locked" position, the tabs are flush against the connector.



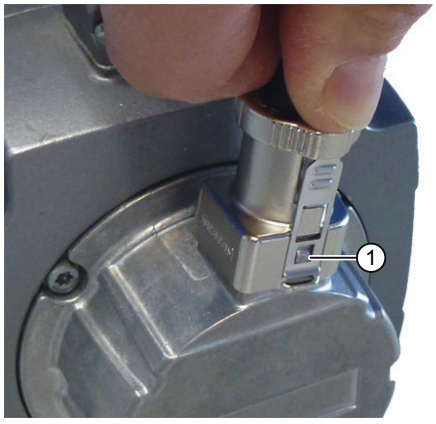
① Locking ring in the "locked" position

2. Insert the connector into the RJ45 socket of the Sensor Module.



① The locking ring remains in the "locked" position.

3. Check that the two tabs are engaged in both latches on the socket and that the connector cannot be pulled out.



① Both tabs must engage in both latches.

The correct DRIVE-CLiQ connection is made when

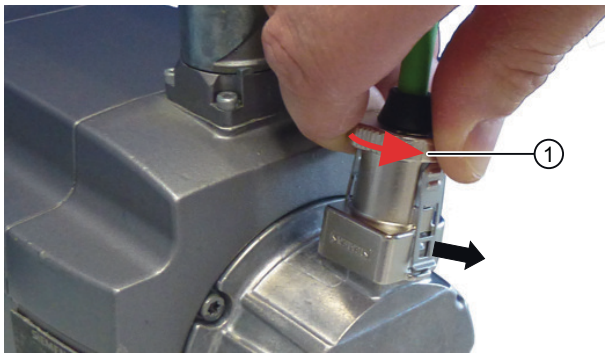
- the locking ring is in the "locked" position,
- both tabs are engaged in both latches.

You have now made a DRIVE-CLiQ connection.
❒

Removal of the RJ45 connector

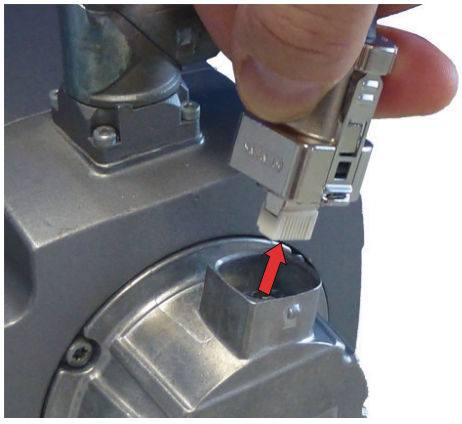
Procedure

1. Turn the locking ring of the connector counterclockwise into the "unlocked" position.



① Turn the locking ring counterclockwise.
→ Both tabs are pressed away by the latches.

2. Check that the two tabs are disengaged from the latches.
3. Pull the connector out of the RJ45 socket of the Sensor Module.



You have now released the DRIVE-CLiQ connection.
❒

7.4.4.3 Handling the quick-action locking

The motors are equipped with SPEED-CONNECT connectors.

Using SPEED-CONNECT, you can also connect cables with quick-release lock to the motor connector just the same as conventional cables with screw connectors (with full thread).

Note

We recommend cables with SPEED-CONNECT, as these are easier to handle.

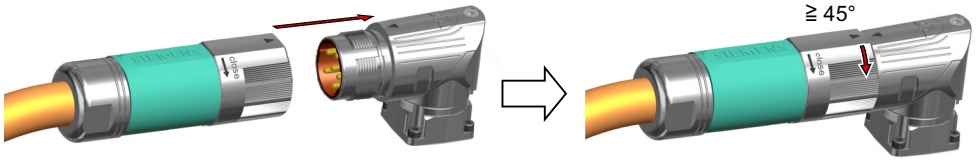
Establishing a SPEED-CONNECT connection

Procedure

Note

- Screw the connector tight by hand only.
- Do not use any wrenches or similar tools.

1. Ensure that the union nut of the SPEED-CONNECT connector is rotated to the end stop in the direction of the "open" arrow.
2. Align the SPEED-CONNECT connectors so that the triangles on the upper side of the connector are located opposite to one another.



3. Insert the power connector completely into the socket at the motor.
4. Turn the union nut by hand through at least 45° in the "close" direction (position A) or up to the end stop (position B).

A Minimum interlock

B Maximum interlock up to the end stop

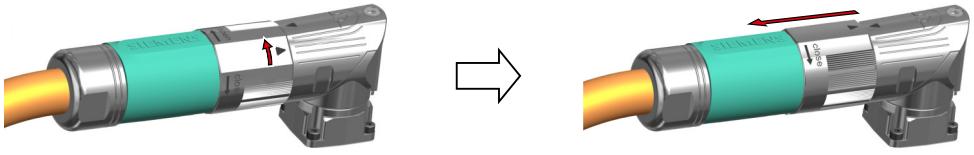
Note

A secure connection is only guaranteed from position A onward.

❒

Releasing a SPEED-CONNECT connection

Procedure



1. Turn the union nut of the SPEED-CONNECT connector in the "open" direction to the end stop. The triangles on the upper side of the connector must be located opposite to one another.
2. Withdraw the connector.

Note

Withdraw at the connector and not at the cable.

❒

Commissioning

8

8.1 Safety instructions

⚠ WARNING

Electric shock caused by hazardous voltage when connected to inadequately grounded line supplies

In the event of a fault, a motor connected to an inadequately grounded line supply can result in an electric shock, which can lead to death, severe injuries and motor damage.

- Connect motors, as part of the drive system, to TN and TT line systems with a grounded neutral point or to IT line systems.
- Ensure that the SINAMICS devices and motors are compatible with the RCD according to EN 61800-5-1 before you connect the devices and motors to the line supply using fault current RCDs.
- For line supplies with grounded line conductor, e.g. TT line systems, use an isolating transformer with grounded neutral point (on the secondary side) between the line supply and the drive system, so that the motor insulation is not overstressed.
- When connected to IT line systems, a monitoring device must signal the first fault between an active part and ground. Remove this fault immediately.

⚠ WARNING

Electric shock caused by hazardous voltage when testing the insulation resistance

High voltages can be present at the terminals during the measurement and immediately afterwards, which can cause an electric shock and lead to death or critical injuries if the terminals are touched.

- Work on electric power installations is only carried out by trained technicians.
- Before you begin measuring the insulation resistance, carefully read the operating manual for the insulation resistance meter you are going to use.
- Never touch the terminals when making measurements or immediately after the measurement.
- When the line feeder cables are connected, carefully check that the line voltage cannot be applied.

⚠ WARNING

Risk of injury when the converter unintentionally starts

Inadvertent starting of the converter can result in serious or fatal injuries.

- Ensure that the converter is not inadvertently started.
- Attach a warning plate at the location of the switch.

⚠ WARNING

Injuries caused by rotating shaft ends and parts that are flung out

Rotating shaft ends, and therefore parts that are flung off, can result in serious or fatal injuries.

- Secure rotating output elements using the appropriate safety guards.
- Secure loose parts, e.g. feather keys to prevent them from being flung off.

⚠ WARNING

Injuries caused by machine movement and loose objects

Machine movement and loose objects, which can fall or be flung out, can cause severe injury or result in fatal injuries.

- Ensure that the machine has been completely installed and all the setting work completed.
- Ensure that nobody is at risk before switching on the machine.
- Before switching on, check that there are no loose objects in or on the machine that could fall off or be flung off.

⚠ CAUTION

Burns when touching hot surfaces

In operation, the motor enclosure reaches high temperatures, which can cause burns if touched.

- Do not touch any hot surfaces.
- Allow the motor to cool down before carrying out any work.
- Use the appropriate personnel protection equipment, e.g. gloves.

NOTICE

Thermal damage to temperature-sensitive parts

Some parts of the electric motor enclosure can reach temperatures exceeding 100 °C. If temperature-sensitive parts, e.g. electric cables or electronic components, come into contact with hot surfaces, these parts could be damaged.

- Ensure that temperature-sensitive parts do not come into contact with hot surfaces.

NOTICE

Damage when the maximum speed is exceeded

Maximum speed n_{1max} is the highest permissible operating speed. The maximum speed is stamped on the rating plate (nameplate).

Impermissible speeds can damage the 1FG1 motor.

- Ensure that the maximum permissible operating speed is not exceeded. Implement this using a suitable closed-loop control or activate the speed monitoring function in the drive.

NOTICE

Damage manifested by uneven running or abnormal noise.

Improper handling during transport, storage or installation can damage the servo geared motor. Servo geared motor damage can manifest itself by uneven running or abnormal noise.

If you operate a damaged servo geared motor, this can damage the winding or bearings and could even destroy the complete system.

- Switch off the servo geared motor in case of uneven running or abnormal noise.
- Identify the cause.

8.2 Checklists for commissioning

Note

Required checks

The checklists below do not claim to be complete. It may be necessary to perform additional checks and tests in accordance with the situation specific to the particular installation site.

Before commissioning the system, check that it is properly installed and connected.

Commission the drive system according to the operating instructions of the converter being used.

Checklists before commissioning 1FG1 servo geared motors

Before starting any work, thoroughly familiarize yourself with the safety instructions and observe the following checklists.

Table 8-1 Checklist (1) - General checks

Check	OK
Are all the necessary components of the configured drive line-up available, correctly dimensioned, installed and connected?	
When operating 1FG1 servo geared motors on the SINAMICS S120 drive system, is the following, up-to-date SINAMICS documentation available? • SINAMICS S120 Commissioning Manual • Getting Started S120 • S120 Function Manual • S120/150 List Manual	
If the 1FG1 servo geared motor is operated on the SINAMICS S120 drive system: Were the contents of the Chapter "Checklists for commissioning SINAMICS S" in the SINAMICS S120 Commissioning Manual complied with?	
Is the motor type to be commissioned known? (e. g. 1FG1 _ _ _ – _ _ _ _ _ – _ _ _ _)	
Are the environmental conditions in the permissible range?	

Table 8-2 Checklist (2) - mechanical system checks

Check	OK
Is the geared motor free of any visible damage?	
Has the vent valve been mounted appropriately for the mounting position?	
Has the transport lock of the vent valve been removed?	
Have all touch protection measures for moving and live parts been installed and activated?	
Has the geared motor been mounted and aligned appropriately for the mounting position?	

Check	OK
Have all fixing screws, connecting elements, and electrical connections been tightened with the specified torques and properly attached?	
Do the operating conditions correspond to the data specified on the rating plate?	
Are the shaft sealing rings free of damage, assembly paste and other contamination?	

Table 8-3 Checklist (3) - electrical system checks

Check	OK
Are minimum insulation resistance values maintained?	
Have the grounding and equipotential bonding connections been correctly established?	
Is the maximum permissible input speed of the gearbox n_{1max} maintained when operated on a converter?	

Table 8-4 Checklist (4) - monitoring devices check

Check	OK
Has it been ensured that speeds higher than the maximum permissible drive speed of the servo geared motor n_{1max} cannot be reached?	
Have all available supplementary devices for the motor monitoring been correctly connected and are they functioning correctly?	

Table 8-5 Checklist (6) - optional brake checks

Check	OK
Does the brake open when the operating voltage is connected?	
Does the brake open and close correctly?	

Table 8-6 Checklist (7) - oil level checks

Check	OK
Does the oil level in the gearbox correspond to the specified level in this installation position?	

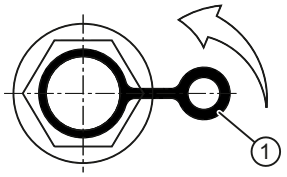
Table 8-7 Checklist (8) - rolling bearing checks

Check	OK
For servo geared motors that were stored, were the storage conditions according to Chapter "Storage" and the bearing replacement intervals according to Chapter "Bearing replacement intervals" complied with?	

8.3 Preparing commissioning

Procedure

1. Remove the transport lock of the vent valve, if applicable.



① Transport lock. Remove in the direction of the arrow.

Figure 8-1 Vent valve with securing clip

2. Check the oil level in the gearbox, and correct it if necessary. See Checking and changing lubricants (Page 171)

Note

For gearboxes with long-term preservation and gearboxes supplied completely filled with oil.

We recommend a complete oil change after a storage time longer than 24 months.

3. Mount an oil expansion unit. See Mounting the oil expansion unit (Page 121)

❒

8.4 Commissioning procedure

Procedure

- Ensure that the converter is correctly parameterized.
- When commissioning the servo geared motor, use the appropriate commissioning tool, e.g. "Drive ES" or "STARTER".
- Follow the steps specified by the commissioning tool.

❒

8.5 Switching on and switching off

Note
EMERGENCY OFF

To avoid accidents, familiarize yourself with the EMERGENCY OFF function before you switch on the system.

The servo geared motor is switched on and off at the converter.

- For more information on this topic, see the chapter in the operating instructions for the converter.

Switching on

Requirement

- Ensure that the converter is correctly parameterized.
- Check that sufficient heat is dissipated from the servo geared motor.

Procedure

1. Switch on the servo geared motor from the converter.
2. Observe any uneven running and abnormal noise of the servo geared motor.
3. Check the function of the safety equipment.
4. Check as to whether the servo geared motor achieves the required parameters.

❒

Switching off

- Switch off the servo geared motor from the converter.

Operation

9

9.1 Safety instructions

⚠ WARNING

Injuries caused by motion of the servo geared motor and loose objects

Machine movement and loose objects, which can fall or be flung out, can cause severe injury or result in fatal injuries.

- Ensure that the servo geared motor has been completely installed and all of the setting work completed.
- Ensure that nobody is at risk before switching on the machine.
- Before switching on, check that there are no loose objects in or on the servo geared motor that could fall off or be flung off.
- Before switching on, carefully check that all safety guard covers are installed and all safety equipment functions correctly.

NOTICE

Thermal damage to temperature-sensitive parts

Some parts of the electric motor enclosure can reach temperatures exceeding 100 °C. If temperature-sensitive parts, e.g. electric cables or electronic components, come into contact with hot surfaces, these parts could be damaged.

- Ensure that temperature-sensitive parts do not come into contact with hot surfaces.

NOTICE

Damage when the maximum speed is exceeded

Maximum speed n_{1max} is the highest permissible operating speed. The maximum speed is stamped on the rating plate (nameplate).

Impermissible speeds can damage the gearbox of the servo geared motor.

- Ensure that the maximum permissible operating speed is not exceeded. Implement this using a suitable closed-loop control or activate the speed monitoring function in the drive.

NOTICE

Damage when the maximum torque is exceeded

Maximum torque M_{2max} is the maximum permissible torque. The maximum torque is specified on the rating plate (nameplate).

Impermissible torques can result in gearbox damage.

- Configure the control so that the maximum torque is not exceeded.

NOTICE
Damage manifested by uneven running or abnormal noise. Improper handling during transport, storage or installation can damage the servo geared motor. Servo geared motor damage can manifest itself by uneven running or abnormal noise. If you operate a damaged servo geared motor, this can damage the winding or bearings and could even destroy the complete system. • Switch off the servo geared motor in case of uneven running or abnormal noise. • Identify the cause.

9.2 Switching on and switching off

Note

EMERGENCY OFF

To avoid accidents, familiarize yourself with the EMERGENCY OFF function before you switch on the system.

The servo geared motor is switched on and off at the converter.

- For more information on this topic, see the chapter in the operating instructions for the converter.

Switching on

Requirement

- Ensure that the converter is correctly parameterized.
- Check that sufficient heat is dissipated from the servo geared motor.

Procedure

1. Switch on the servo geared motor from the converter.
2. Observe any uneven running and abnormal noise of the servo geared motor.
3. Check the function of the safety equipment.
4. Check as to whether the servo geared motor achieves the required parameters.

❒

Switching off

- Switch off the servo geared motor from the converter.

9.3 Operation

While the servo geared motor is operational, ensure that the specified parameters are strictly maintained.

Carefully ensure the following:

- The power consumption lies in the specified range.
- Cooling is ensured.
- The servo geared motor does not generate any abnormal noise.
- The servo geared motor does not overheat.
- The sealing air intake functions, assuming it is available.

Note

Strictly comply with maintenance intervals.

Strictly comply with the maintenance intervals specified for the servo geared motor (see Chapter Service and maintenance (Page 165)).

NOTICE
Damage manifested by uneven running or abnormal noise. Improper handling during transport, storage or installation can damage the servo geared motor. Servo geared motor damage can manifest itself by uneven running or abnormal noise. If you operate a damaged servo geared motor, this can damage the winding or bearings and could even destroy the complete system. • Switch off the servo geared motor in case of uneven running or abnormal noise. • Identify the cause.

In operation, check the servo geared motor for:

- Excessive operating temperature
- Changes in gearbox noise
- Possible leaks at the gearbox housing and shaft seals.

9.4 Measures for longer non-operational periods

NOTICE
Damage due to improper storage The servo geared motor can be damaged if it is not stored properly. • If the servo geared motor is not operational for longer periods of time, preserve it by means of anti-corrosion protection and ensure that it remains dry (e.g. appropriate drying agents). • When recommissioning the servo geared motor after it has been out of service for a longer period of time, carry out the measures recommended in Chapter "Commissioning".

- Store the servo geared motor according to the instructions in chapter Storing the servo geared motor (Page 54).
- Refer to the section Switching on and switching off (Page 154) before recommissioning.

Faults

10

Note

If faults occur during the warranty period that require corrective maintenance for the geared motor, only Technical Support can carry out this corrective maintenance.

Contact Technical Support if faults occur without a clearly identifiable cause after the warranty period has elapsed.

Have the following information ready if you need help from the Technical Support:

- Rating plate data
- Nature and extent of the fault
- Suspected cause

Note

Damage to the servo geared motor caused by faults

- Correct the cause of the fault as specified in the remedial measures section.
- Repair any damage to the machine/motor.

Note

When operating the servo geared motor with a converter, please also refer to the operating instructions of the frequency converter if electrical faults occur.

- If changes occur with respect to normal operation or faults, determine the cause using table "Possible faults".
- If you have identified the cause, attempt to resolve the fault using table "Key for fault causes and remedial measures".
- Observe the relevant chapter in the documentation associated with the components of the complete drive system
- Never disable protection equipment or devices, even in test operation.

Table 10-1 Possible 1FG1 servo geared motor faults

Fault	Fault cause (see key table)						
Geared motor only starts with difficulty or not at all	A	B	F	S	GA	GR	
Droning motor noise on starting / in operation	A	F					
Unusual noises on the gearbox	A	GA	GB	GC	GD	GE	GH
Unusual converter noise	L	GC	GE				
Uneven running	J	K					
Significant motor temperature rise in no-load operation	D	I					
Significant motor temperature rise under load	A	C	J				

Fault	Fault cause (see key table)						
Significant motor temperature rise of individual winding sections	F						
Gearbox overheating	I	GA	GR	GS	GC		
Vibration	O	P	Q				
Oil escapes.	GA	GI	GK	GL	GM	GN	GO
Oil leak at the gearbox vent	GA	GP					
Output shaft does not turn when the motor is running.	GT						
Excessive play on drive input and output	GU	GV					

Table 10-2 Key to causes of faults and remedial measures

No.	Fault cause	Remedial measures
A	Overload	Reduce the load.
B	Interruption of a phase in the feeder cable/ motor winding	Check the converter and supply cables/measure the winding resistances and insulation resistances, carry out corrective maintenance after consultation with the manufacturer
C	Interruption of a phase in the feeder cable after switching on	Check the converter and supply cables/check the winding resistances.
D	Converter output voltage too high, frequency too low	Check the converter settings, perform an automatic motor identification.
F	Winding short circuit or phase short circuit in stator winding	Measure the winding resistances and insulation resistances, repair after consultation with the manufacturer
I	Deposits obstruct heat dissipation	Clean the surface of the drives. Ensure that the cooling air can flow in and out unobstructed.
J	Insufficient shielding for motor and/or encoder cable	Check the shielding and grounding.
K	Drive controller gain too high	Adjust the closed-loop controller.
L	Rotating parts are grinding	Establish the cause and readjust the parts.
	Foreign bodies in the motor	Return the motor to the manufacturer for repair.
	Bearing damage	Return the motor to the manufacturer for repair.
N	Rotor out of round, shaft bent	Contact the manufacturer.
O	Poor alignment	Align the machine group, check the coupling.
P	Coupled machine out of balance	Rebalance the coupled machine.
Q	Shocks from the coupled machine	Inspect the coupled machine.
R	Uneven gearbox running	Repair the gearbox.
S	Motor brake is not released	Check brake circuit/connection
GA	Incorrect oil level for the installation position used and / or incorrect venting position.	Check the mounting position (Page 59) and the oil level (Page 171).
GB	Foreign bodies in the oil (irregular noise).	Checking the oil quality (Page 173), Changing oil (Page 173)
GC	Excessive bearing play and / or bearing defective.	Check the bearing and replace if necessary.
GD	Defective gearing.	Check the gearing and replace if necessary.
GE	Fixing screws loose.	Tighten the screws, Thread sizes and tightening torques for fastening bolts (Page 170)

No.	Fault cause	Remedial measures
GH	Damage due to blockage during commissioning.	Notify Technical Support.
GI	Gearbox leaks.	Checking the gearbox for leaks (Page 181). Seal the gearbox
GK	Overpressure due to lack of venting.	Mount the venting as appropriate for the mounting position (Page 59).
GL	Overpressure due to soiled venting.	Replacing the vent valve (Page 184)
GM	Shaft sealing rings defective.	Replace the shaft sealing rings.
GN	Cover / flange screws loose.	Tighten the screws (Page 170). Continue to monitor the gearbox.
GO	Surface sealing defective (e.g. on cover, flange).	Reseal.
GP	Frequent cold starts during which the oil foams up.	Notify Technical Support.
GR	Incorrect oil being used (e.g. incorrect viscosity).	Check the oil quality, change the oil (Page 181) and flush the gearbox (Page 175)
GS	Oil is too old.	Check the date of last oil change. If required, change the oil (Page 173).
GT	Force flow interrupted by breakage in gearbox.	Notify Technical Support.
GU	Positive locking connection knocked out due to overload.	Notify Technical Support.
GV	Flexible elements worn (e.g. on couplings).	Replace flexible elements.

If the fault still cannot be resolved after taking the measures listed above, please contact the manufacturer or the Siemens Service Center.

Service and maintenance 11

11.1 Safety instructions

Contact the manufacturer if there are any uncertainties, specifying the motor type and serial number.

⚠ WARNING

Electric shock from touching live parts

Touching live parts results in an electric shock that can lead to death or severe injuries.

- Only work on electrical equipment if you are appropriately qualified.
- Always comply with the local national safety regulations when working on electrical equipment.

Generally, six steps must be followed when establishing safety:

1. Prepare for shutdown and notify all those who will be affected by the procedure.
2. Disconnect the servo geared motor from the line supply.
   - Switch off the servo geared motor.
   - Wait until the discharge time specified on the warning labels has elapsed.
   - Check that there is a no-voltage condition from phase conductor to phase conductor and phase conductor to protective conductor.
   - Check that every auxiliary circuit is in a no-voltage condition.
   - Ensure that the motors cannot move.
3. Lock the SIMOTICS motors so that they cannot make any inadvertent motion, which would generate a voltage at the terminals.
4. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems or water.
5. Isolate or neutralize all hazardous energy sources, for example by closing switches, grounding or short-circuiting, or closing valves.
6. Take measures to prevent energy sources from being reconnected.
7. Carefully ensure that the machine is completely locked and that you have the right machine.

After you have completed the work, restore operational readiness by performing the above steps in the reverse order.

⚠ WARNING

Slipping on leaked oil

Leaked oil can result in slipping or falling and cause severe or fatal injuries.

- Prevent oil from leaking
- Remove any leaked oil immediately using a binding agent for oil or similar.
- Eliminate the risk of slipping at the dangerous location.
- Mark the dangerous location.

⚠ WARNING

Injuries when the converter unintentionally starts

Unintentional starting of the converter can result in death or serious injuries.

- Ensure that the converter cannot be inadvertently started.
- Attach a warning plate at the location of the switch.

⚠ CAUTION

Risk of burns due to hot surfaces

Some parts of the enclosure of electrical machines can reach temperatures exceeding 100 °C. Touching components when the machine is in operation can cause burns.

- Do not touch parts of the enclosure while the machine is in operation or immediately after machine operation.
- Allow parts of the enclosure to cool down before starting any work.

⚠ CAUTION

Risk of burns due to hot oil that escapes

Escaping hot oil can cause burns.

- Before starting any work, allow the oil to cool down to below 30 °C.

⚠ CAUTION

Chemical burns and irritation caused by chemical cleaning agents

Chemical cleaning agents can be caustic or emit dangerous fumes. When coming into contact with the skin or when inhaling fumes there is risk of injury due to chemical burns on the skin and in the respiratory tract and the skin can become irritated.

- When cleaning, make sure that appropriate methods of extracting fumes are in place and that you wear the appropriate personal protective equipment (e.g. gloves, goggles, respiratory filters).
- When using chemical cleaning agents, observe the instructions for use and any warnings provided in the relevant safety data sheet. Chemical cleaning agents must be suitable for use with the parts and components of the machine, particularly where plastic components are concerned.

⚠ CAUTION

Injuries caused by foreign bodies and dust that have been started up when working with compressed air

When cleaning using compressed air, this can stir up dust, metal chips and cleaning agents, therefore leading to injuries.

- When cleaning using compressed air, ensure that you use suitable extraction equipment and wear protective equipment such as safety goggles, protective suit, etc.

⚠ WARNING

Injuries when lifting and transporting

Incorrect lifting and transport operations, as well as devices and equipment that are unsuitable or damaged can result in death, severe injury and/or material damage.

- Lifting devices, transport vehicles and load suspension devices must comply with requirements.
- The load carrying capacity of the lifting equipment and the load suspension device must correspond to the weight of the servo geared motor (see the rating plate).
- Do not attach any additional loads to the lifting equipment.
- To hoist the servo geared motor, use suitable cable-guidance and/or spreading equipment, particularly if the motor is equipped with mounted parts and components.
- Servo geared motors must not be lifted or transported using the power connector or signal connector.
- Do not stand in the slewing range of hoisting gear or under suspended loads.

⚠ WARNING

Injuries caused by falling servo geared motors

The threads for lifting eyebolts in the motor enclosure are not designed for carrying the entire servo geared motor.

If you lift the servo geared motor only using the lifting eyebolts in the motor enclosure, the lifting eyebolts can be ripped out of the threads and cause death or serious injury and result in death or severe injuries.

- For transport, screw the lifting eyebolts into the threads in the gearbox housing depending on the position.
- Use the threads for the lifting eyebolts in the motor enclosure only for position stabilization.
- Observe the maximum load of the lifting eyebolt as listed in the table below.

⚠ WARNING

Injuries as a result of suspended loads

When transporting, movement of the servo geared motor can result in injuries.

- Only use hoisting gear and load suspension devices that are in perfect condition and have been designed for the weight of the servo geared motor.
- Never stand under suspended loads or in their slewing range.
- After the servo geared motor has been placed down, ensure that it cannot roll.

11.2 Inspection and maintenance

General

Carry out maintenance work, inspections and revisions at regular intervals in order to be able to identify faults at an early stage and remove them.

Note

Inspection if there are faults or unusual conditions

Unusual conditions or faults that represent overstressing of the motor, e.g. overload or short-circuit, can result in consequential damage to the machine.

Immediately perform an inspection when faults or exceptional conditions occur.

Maintenance measures, inspection/maintenance intervals, intervals

The maintenance intervals depend on the operating conditions.

- Adapt the maintenance intervals to match the local conditions, such as pollution/dirt, switching frequency, load, etc.
- Perform the following maintenance measures as specified in the table.

Maintenance and repair of the geared motor can be performed by Siemens Service Centers throughout the world.

On this topic, contact your personalSIEMENS contact persons (http://www.siemens.com/industry/contact)

NOTICE
Improper maintenance
Service and maintenance must only be performed by properly authorized qualified personnel.
Use only original SIEMENS parts.

Table 11-1 Maintenance measures after operating times or intervals

Operating tines and intervals	Measure	Description of the work
Commissioning		
3 hours	Check that fastening bolts on gearboxes and add-on elements are securely tightened. Check that covers and plugs are securely fastened.	Checking tightness of fastening bolts (Page 182)

Operating tines and intervals	Measure	Description of the work
1 day	Checking the oil level.	Checking the oil level (Page 171)
	Check the housing temperature.	Cooling of the servo geared motor (Page 40)
	Monitor and check the geared motor for unusual noise, vibrations, and changes.	Contact your personalSIEMENS contact persons (http://www.siemens.com/industry/contact) if you identify any abnormalities
	Check the gearbox for leaks.	Checking the gearbox for leaks (Page 181)
Operation		
Daily; if possible, more frequently during operation.	Monitor and check the geared motor for unusual noise, vibrations, and changes.	Contact your personalSIEMENS contact persons (http://www.siemens.com/industry/contact) if you identify any abnormalities
Monthly	Check the housing temperature.	Cooling of the servo geared motor (Page 40)
	Check the gearbox for leaks.	Checking the gearbox for leaks (Page 181)
Every 3 000 operating hours, or at least every 6 months.	Checking the oil level.	Checking the oil level (Page 171)
	Check the oil quality.	Checking the oil quality (Page 173)
	Clean the gearbox.	Cleaning the servo geared motor (Page 182)
	Check the rubber buffer of the torque arms.	Torque arms with shaft-mounted gearboxes (Page 118)
	Check the corrosion protection and repair, if necessary	
Once a year.	Replace the vent valve, if present.	Replacing the vent valve (Page 184)
Every 10 000 operating hours, or at the latest after 2 years	Changing the oil and the rolling bearing grease in the gearbox	Changing oil (Page 173) Change the rolling bearing grease
Every 10 000 operating hours, or at the latest after 2 years	Check the fixing screws of gearboxes and mounted elements to ensure that they are tight. Check the covers and blanking plugs to ensure that they are firmly attached.	Checking tightness of fastening bolts (Page 182)
	Changing the oil and the rolling bearing grease in the gearbox [1)]	Changing oil Change the rolling bearing grease
After 25 000 operating hours	Replacement of the motor bearings, the encoder and the shaft sealing ring on the motor side	On this topic, contact your personalSIEMENS contact persons (http://www.siemens.com/industry/contact)

Operating tines and intervals	Measure	Description of the work
When required	Change the gearbox bearing	Bearing replacement interval
	Replace the shaft sealing ring on the output side	Check the gearbox for leaks

[1] When using synthetic oils, the intervals can be doubled. The data specified is valid for an oil temperature of +80 °C. For oil change intervals for other temperatures, see diagram "Guide values for oil change intervals" in Chapter "Service life of lubricants" .

11.2.1 Thread sizes and tightening torques for fastening bolts

The general tolerance for the tightening torque is 10 %. The tightening torque is based on a friction coefficient of μ = 0.14.

Table 11-2 Tightening torques for fixing screws

Thread size	Tightening torque for property class in Nm		
	8.8	10.9	12.9
M4	3	4	5
M5	6	9	10
M6	10	15	18
M8	25	35	41
M10	50	70	85
M12	90	120	145
M16	210	295	355
M20	450	580	690
M24	750	1000	1200

11.2.2 Bearing replacement interval

The bearings are subject to wear and must be replaced after a specific number of operating hours.

Note

Bearing replacement interval dependent on operating conditions

Bearing replacement intervals can be extended if the motor is operated under favorable conditions, e.g. low or medium speeds, low radial forces (transverse forces), vibration load.

Challenging operating conditions, e.g. high vibration/shock loads, frequent reversing operation, reduce the bearing replacement intervals t_{LW} by up to 50 %.

In the case of operating conditions specified by the operating company, the bearing service life for the bearings in the gearbox can be calculated with the help of the SIZER engineering tool.

If there are no specifications, replace the bearings in the gearbox when you detect changes in the vibration and noise characteristics.

With medium loads, replace the motor bearings, the shaft sealing ring on the motor side, and the encoder after 25 000 operating hours.

11.2.3 Checking and changing lubricants

11.2.3.1 Checking the oil level

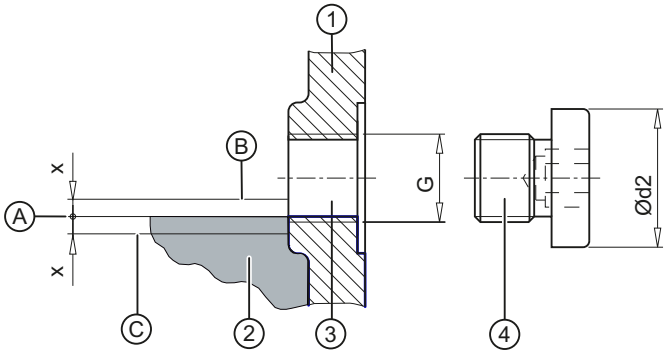
Note

Check the oil level at operating temperature

If the temperature rises, the volume of the gearbox oil increases.

In the case of greater temperature differences and filling quantities, the volume can vary by several liters.

- Check the oil level approximately 30 minutes after switching off the converter and while it is still slightly warm.



① Gearbox panel
② Gearbox oil
③ Oil level bore hole
④ Sealing plug
A Specified oil level
B Maximum oil level
C Minimum oil level

Figure 11-1 Oil level in the gearbox

Minimum and maximum permissible oil level

Minimum permissible oil level: C = A - x

Maximum permissible oil level: B = A + X

Oil level hole	Ø d2	Maximum permissible deviation x	Tightening torque
	mm	mm	Nm
G 1/8"	14	2.5	10
G 1/4"	18	3	10
G 3/8"	22	4	25
G 3/4"	32	7	50

Procedure

1. Switch off the power supply to the converter.
2. Unscrew the oil level plug.

Figure 11-2 Identifying marking for oil level plug

→ Oil escapes if the maximum fill level is above the plug hole.

Note

Use a suitable vessel to collect any escaping oil.

3. Check the oil level in accordance with fill level x.
4. Top up the oil level if necessary and check it again.
5. Check the state of the sealing ring on the sealing element. Replace the sealing element if the sealing ring is damaged.
6. After checking, seal the gearbox immediately using the sealing element.

You have now checked the oil level in the gearbox housing.
❒

11.2.3.2 Checking the oil level using the oil sight glass (optional)

If there is an oil sight glass, the oil level ① must be in the center of the sight glass when the oil is cool.

The oil level ① of hot oil is above the center of the sight glass. The oil level ① of cold oil is below the center of the sight glass.

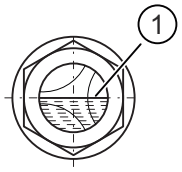


Figure 11-3 Oil level in the oil sight glass

Top up the oil level ① if necessary, and check it again.

11.2.3.3 Checking the oil quality

You detect changes to the oil by its appearance.

Fresh clean oil is clear, has a typical smell and a color specific to the particular product.

Clouding or a flocculent appearance indicates water and / or contamination.
A dark or black color indicates residue, serious thermal decomposition or contamination.

Procedure

1. Allow the geared motor to run for a short time. Wear and contaminant particles are visible in the oil shortly after shutting down.
2. Bring the converter into a no-voltage condition.
3. Unscrew the vent plug or oil level plug.

 Vent plug marking	 Oil level plug marking

4. Remove some oil, using a suction pump and a flexible hose, for example.
5. Check the state of the sealing ring on the sealing element. When required, replace the sealing ring.
6. Seal the gearbox with the sealing element.
7. Check the oil for the changes described above. Change the oil immediately if you determine any changes, see Chapter "Changing the oil (Page 173)".

❒

11.2.3.4 Changing the oil

Safety instructions

NOTICE
Gearbox damage due to mixing of different oils Mixing different oils can damage the gearbox by forming deposits or foam, changing the viscosity, or reducing corrosion protection. • Use gearbox oils of the same type and from the same manufacturer. If you use other oils, have the manufacturer confirm that the new oil is compatible with the remaining volume of used oil. • Change the oil completely. • If you use other oil types, flush the gearbox with the new oil. • Avoid contaminating the new oil.

NOTICE

Damage to the gearbox caused by incorrect oil quantities

The incorrect oil quantity can damage the gearbox depending on the mounting position.

- Install the geared motors only in the prescribed mounting position.
- Regulate the oil level in accordance with the oil level plug. The oil level must not be below the specified fill level.
- Prevent any contamination from getting into open oil bore holes.
- Carefully close the oil bore holes after regulating the oil level.

Note

When changing the oil, use the same oil type as that given on the information plate on the gearbox if possible.

Draining the oil

Note

Change the oil when warm because oil that is too cold is difficult to remove fully.

Operate the gearbox for 15 to 30 minutes for it to warm up, if necessary.

Procedure

1. Bring the converter into a no-voltage condition.
2. Unscrew the vent plug.

Figure 11-4 Vent plug marking

3. Place a suitable and sufficiently large receptacle below the oil drain plug.

Figure 11-5 Oil drain plug marking

4. Unscrew the oil drain plug. Drain all the oil into the receptacle.
5. Check the state of the sealing ring on the sealing element. If the sealing ring is damaged, replace the sealing element with a new one.
6. After draining the oil, seal the gearbox immediately using the sealing element.

❒

Flushing the gearbox when changing between incompatible oils

Note

Polyglycol oil has a higher density than mineral oil. Polyglycol oil sinks to the bottom in the gearbox and mineral oil floats on the surface.

This makes it extremely difficult to drain the mineral oil from the gearbox.

Note

After the second flush, we recommend that an appropriate analysis institute checks the quality of the flushed fluid.

Procedure

1. After the oil has been drained, wipe the gearbox clean of any remaining mineral oil using a lint-free cloth.
2. Unscrew the vent plug.

Figure 11-6 Vent plug marking

3. Completely fill the gearbox with flushing oil, using a filter (filter mesh max. 25 µm).
   For the flushing oil, use the new oil or one that is compatible with the new oil and is less expensive.
4. Operate the gearbox for 15 to 30 minutes at a low load level.
5. Place a suitable and sufficiently large receptacle below the oil drain plug.
6. Unscrew the oil drain plug.
   Drain all the oil into the receptacle.

Figure 11-7 Oil drain plug marking

7. After flushing, seal the gearbox immediately using the sealing element.
8. Repeat this step for the second flushing.

❒

Filling in oil

Note

The required oil quantity is specified in Chapter "Oil quantities (Page 181)".

Procedure

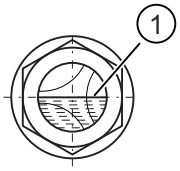
1. Unscrew the vent plug.

Figure 11-8 Vent plug marking

2. Refill the gearbox with the required quantity of fresh oil. Use a filler filter with mesh of max. 25 µm.

Figure 11-9 Oil filling opening marking

3. Check the oil level.

 Oil level plug marking	 Oil level in the oil sight glass

4. Top up the oil level if necessary and check it again.
5. Check the state of the sealing ring on the sealing element. If the sealing ring is damaged, replace the sealing element with a new one.
6. After filling with oil, seal the gearbox immediately using the sealing element.
7. Screw in the vent plug.

❒

11.2.3.5 Recommended oil types

The released and recommended lubricants are listed in the Table NT 7300 (https://support.industry.siemens.com/cs/ww/en/view/109753864).

NOTICE
Gearbox damage caused by mixing different oils Mixing different oils damages the gearbox as deposits or foam are formed, the viscosity is changed or corrosion protection reduced. • Use gearbox oils of the same type and from the same manufacturer. If you use other oils, the manufacturer must confirm that the new oil is compatible with the remaining volume of used oil. • Completely change the oil. • If you use other oil types, flush the gearbox using the new oil. • Avoid contaminating the new oil.

Note

These recommendations are not a guarantee of the lubricant quality provided by your supplier. Every lubricant manufacturer is responsible for the quality of its own product.

Note

As standard, the lubricants and shaft seals are matched with each other corresponding to the prevailing operating conditions.

Please contact Technical Support for any questions relating to:

- Change in the operating conditions
- Using a different oil grade
- Using new shaft seals

The manufacturer's specification of the oil filled in the factory is specified on the gearbox rating plate.

Carefully comply with the safety instructions when using another oil grade or manufacturer.

The oils used comply with the following minimum requirements according to DIN 51517-3.

Order code, oil	Designation according to DIN 51502
K06	CLP ISO VG 220
K07	CLP ISO PG VG 220
K08	CLP ISO PG VG 460
K11	CLP H1 ISO VG 460
K12	CLP ISO PAO VG 220

CLP = mineral oil

CLP PG = polyglycol oil

CLP PAO = poly alpha olefin oil

CLP H1 = physiologically safe oil (USDA-H1 approval)

11.2.3.6 Change the roller bearing grease

The rolling bearings are lubricated in the factory with the greases listed in the table.

Table 11-3 Rolling bearing grease and shaft sealing ring grease

Field of application	Ambient temperature	Manufacturer	Type
Standard	-40 °C to +80 °C	Klüber Fuchs	Petamo GHY 133 N Renolit CX-Tom 15[1)]
Foodstuff-compatible for the food industry	-30 °C to +60 °C	Castrol	Optileb GR UF 1 NSF H1
Biologically degradable, for agriculture, forestry and water industries	-35 °C to +60 °C	Fuchs	Plantogel 2 S
[1)] Rolling bearing grease based on a semi-synthetic base oil			

- Renew the grease quantify for grease-lubricated bearings with each oil change.
- Clean the bearing before filling the bearing with fresh lubricant.

In the case of bearings on the output shaft or intermediate shafts, the grease quantity must fill 2/3, and in the case of bearings on the input side, 1/3 of the space between the rolling elements.

Note

Consult with your personal Siemens contact person (http://www.siemens.com/industry/contact) if you have any questions.

11.2.3.7 Service life of the lubricants

Note

The intervals between changes become shorter in the case of deviations from the permissible operating conditions, e.g. high ambient temperatures, high relative humidity, and aggressive ambient media.

- Contact Technical Support to determine the individual interval for changing the lubricant.

Note

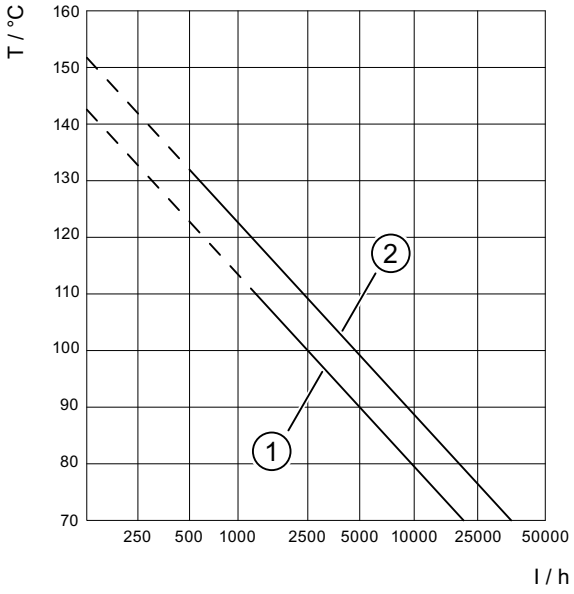
Oil sump temperatures above +80 °C can reduce service life. A temperature increase by 10 K halves the service life by the amount as shown in the figure titled "Guide values for oil change intervals".

For a +80 °C oil sump temperature, when observing the properties specified by Siemens AG, the following service life can be expected:

Table 11-4 Service life of the oils

Oil grade	Usage time
Mineral oil	10000 operating hours or 2 years [1]
Biodegradable oil	
Physiologically safe oil according to USDA-H1/-H2	
Synthetic oil	20000 operating hours or 4 years [1]

[1] Depending on what occurs first



① Mineral oil
② Synthetic oil
T Oil bath steady-state temperature in °C
I Oil change interval in operating hours in h

Figure 11-10 Guide values for oil change intervals

Grease service life of rolling bearing greases

Rolling bearings and the clearance in front are filled with sufficient grease.

Under approved operating conditions and ambient temperatures, regreasing is not required.

We recommend that the grease in the bearings is also renewed when the oil or shaft sealing rings are replaced.

11.2.3.8 Recommended lubricants

⚠ WARNING

Used lubricants only have conditional approval

The used lubricants are not or only conditionally approved for use in the foodstuff or pharmaceutical industry.

Use only lubricants with USDA (United States Department of Agriculture) H1 / H2 approval for deployment in the foodstuff or pharmaceutical industry.

The released and recommended lubricants are listed in the table NT 7300 (https://support.industry.siemens.com/cs/ww/en/view/109753864).

NOTICE
Increased operating temperatures impair the lubricity of the gearbox oil
Increased operating temperatures impair the lubricating property of the gearbox oil.
If the gearbox housing temperature exceeds a value of +80 °C, contact Technical Support.

Note

As standard, the lubricants and shaft seals are harmonized and coordinated with one another corresponding to the prevailing operating conditions.

Contact Technical Support for:

- Change of the operating conditions
- Change in oil grade
- Deployment of new shaft seals.

Note

The lubricants used are not at all or only conditionally biodegradable. If biologically degradable lubricants are required, use only gearbox lubricants with the appropriate classification listed in the table NT 7300.

Note

These recommendations are not a guarantee of the lubricant quality provided by your supplier. All lubricant manufacturers are responsible for the quality of their own products.

The oil viscosity is decisive for the oil selection (ISO VG class). The viscosity is specified on the rating plate of the gearbox. The viscosity class indicated applies for the contractually agreed operating conditions.

In the case of different operating conditions, contact Technical Support.

Use an approved gearbox lubricant from chapter "Recommended oil types (Page 176)". These oils have been tested and satisfy the requirements.

Note

Before use, check that the selected lubricating oil is still recommended by Siemens.

Consult your Siemens representative, if applicable.

11.2.3.9 Oil quantities

Safety guidelines

NOTICE
Damage to the gearbox caused by incorrect oil quantities Incorrect oil quantities can cause gearbox damage. • Check the oil level before commissioning.

Note

You can find detailed information about oil quantities at DT Configurator (http://www.siemens.com/dtconfigurator).

11.2.4 Checking the gearbox for leaks

Note

Shaft sealing rings are subject to natural wear. The service life depends on the application conditions.

We recommend that shaft sealing rings are included in periodic maintenance and servicing work on the system.

Note

Due to the inherent principle of operation, oil mist can escape from a vent valve or labyrinth seal.

Small quantities of oil or grease can escape at the shaft sealing ring during the run-in period of 24 hours.

If significant leaks occur, or if a leak persists after the run-in period, then replace the shaft sealing ring. This prevents follow-on damage.

Table 11-5 Description and measures

Status	Description	Measures	Notes
Film of moisture on the shaft sealing ring	Film of moisture as a result of the inherent principle of operation (apparent leakage)	Remove using a clean cloth and continue to observe.	No fault present. The sealing ring dries as operation continues.
Leakage at the shaft sealing ring	Identifiable small trickle, formation of drops, also after the run-in period.	Replace the shaft sealing ring.	During the run-in period, the shaft sealing ring beds into the shaft. A visible track can be seen on the shaft. Optimum preconditions for a perfect seal are obtained after the run-in period.

11.2.5 Cleaning the servo geared motor

NOTICE

Damage due to increased housing temperatures resulting from dust deposits

Dust deposits prevent heat dissipation, increase the housing temperature of the servo geared motor, and can cause damage.

- Remove dirt and dust from the geared motor.

NOTICE

Damage caused by the ingress of water resulting from cleaning with high-pressure cleaning equipment

If you clean the geared motor with high-pressure cleaning equipment, seals may be damaged, water can penetrate into the geared motor, and the geared motor can be damaged.

- Do not use high-pressure cleaning equipment to clean the geared motor.
- When cleaning, do not use any tools with sharp edges.

Switch off the power supply to the converter prior to cleaning.

11.2.6 Checking tightness of fastening bolts

Note

Replace unusable headless screws with headless screws of the same design and property class.

- Switch off the power supply to the converter.
- Check all fixing screws for tightness using a torque wrench.
  You will find the permissible torques in chapter Thread sizes and tightening torques for fastening bolts (Page 170)

11.3 Corrective maintenance

The Siemens Service Center in Bad Neustadt a. d. Saale handles or organizes the maintenance/ repair of servo geared motors along with other regional service and repair workshops.

Contact your regional sales person about this.

11.3.1 Replacing the vent valve

To ensure fault-free functioning, renew the vent valve once a year.

When replacing, prevent dirt and damaging atmospheres from entering the gearbox.

If too much oil is contained in the gearbox, oil will escape from the vent valve.
Correct the oil quantity and replace the vent valve.

11.3.2 Replacing an encoder

You can replace a defective encoder.

The procedure for replacing an encoder is described in Service manual replacing an encoder (https://support.industry.siemens.com/cs/ww/en/view/99457853).

Decommissioning and disposal 12

12.1 Safety instructions

Removing a servo geared motor from a machine

⚠ WARNING

Electric shock from touching live parts

Touching live parts results in an electric shock that can lead to death or severe injuries.

- You can only work on electrical equipment if you are appropriately qualified.
- Always comply with the local national safety regulations when working on electrical equipment.

Generally, 6 steps must be followed when establishing safety:

1. Prepare for disconnection. Notify all those who will be affected by the procedure.
2. Disconnect the machine from the supply so that it is in a no voltage condition.
   - Switch off the machine.
   - Wait until the discharge time specified on the warning labels has elapsed.
   - Check that there is a no-voltage condition from phase conductor to phase conductor and phase conductor to protective conductor.
   - Check that every auxiliary circuit is in a no-voltage condition.
   - Ensure that the motors cannot move.
3. Lock the SIMOTICS motors so that they cannot make any inadvertent motion, which would generate a voltage at the terminals.
4. Identify all other dangerous energy sources, e.g. compressed air, hydraulic systems or water.
5. Isolate or neutralize all hazardous energy sources by closing switches, grounding or short-circuiting or closing valves, for example.
6. Take measures to prevent energy sources from being reconnected.
7. Carefully ensure that the machine is completely locked and that you have the right machine.

After you have completed the work, restore readiness for operation by following the above steps in the reverse order.

⚠ WARNING

Slipping on leaked oil

Leaked oil can result in slipping or falling and cause death or severe injury.

- Prevent oil from leaking
- Remove any leaked oil immediately using a binding agent for oil or similar.
- Eliminate the risk of slipping at the dangerous location.
- Mark the dangerous location.

⚠ CAUTION

Risk of burns due to hot surfaces

Some parts of the enclosure of electrical machines can reach temperatures exceeding 100 °C. Touching components when the machine is in operation can cause burns.

- Do not touch parts of the enclosure while the machine is in operation or immediately after machine operation.
- Allow parts of the enclosure to cool down before starting any work.

⚠ CAUTION

Risk of burns due to hot oil that escapes

Escaping hot oil can cause burns.

- Before starting any work wait until the oil has cooled down to below 30 °C.

⚠ CAUTION

Chemical burns and irritation caused by chemical cleaning agents

Chemical cleaning agents can be caustic or emit dangerous fumes. If these come into contact with skin or if you inhale the fumes, this can cause injuries, e.g. chemical burns on the skin or respiratory passages or skin irritation.

- When cleaning, make sure that appropriate methods of extracting fumes are in place and that you wear the appropriate personal protective equipment (e.g. gloves, goggles, respiratory filters).
- When using chemical cleaning agents, carefully comply with the instructions for use and any warnings provided in the relevant safety data sheet. Chemical cleaning agents must be suitable for use with the parts and components of the machine, particularly where plastic components are concerned.

⚠ WARNING

Serious injuries caused by falling machine parts.

The machine comprises heavy individual components. When removing the servo geared motor, these components can fall. This can result in death or severe injuries and/or material damage.

- Secure the machine components being removed to prevent them falling.

⚠ WARNING

Injuries as a result of suspended loads

When being removed and transported, the servo geared motor can cause injury as a result of its movement.

- Only use hoisting gear and load suspension devices that are in perfect condition and have been designed for the weight of the servo geared motor.
- Pay careful attention to potential movement when the servo geared motor is released.
- Never stand under suspended loads or in their slewing range.
- After the servo geared motor has been placed down, ensure that it cannot roll.

⚠ CAUTION

Injuries caused by liquids when draining and environmental pollution

When draining, liquids can cause injuries such as burns, chemical burns, irritation. Spilt oil can make floor surfaces slippery and pollute the environment.

- Allow the liquid to cool down.
- Use a sufficiently large collection container.
- Avoid liquids coming into contact with the skin. Wear the appropriate personnel protection equipment, e.g. safety goggles, gloves.
- Have materials on hand to remove leaked liquids and prevent areas from becoming slippery.

12.2 Decommissioning

12.2.1 Preparing for dismantling

Disassembling a geared motor must be performed and/or supervised by qualified personnel with appropriate expert knowledge.

Contact a certified waste disposal organization in your vicinity. Clarify what is expected in terms of the quality of disassembling the geared motor and provision of the components.

Removing a servo geared motor from a machine

Procedure

1. Disconnect all electrical connections.
2. Remove all liquids such as oil.
3. Disconnect all supply lines.
4. Release the geared motor fastening elements.
5. Transport the geared motor to a suitable location for storage and dismantling.

❒

12.2.2 Dismantling the motor

Note

The rotor in a motor containing permanent magnets must only be removed by the manufacturer.

Contact the Siemens Service Center (https://support.industry.siemens.com/cs/ww/en/).

12.3 Disposal

Recycling and disposal

For environmentally-friendly recycling and disposal of your old device, please contact a company certified for the disposal of waste electrical and electronic equipment, and dispose of the old device as prescribed in the respective country of use.

Appendix

A

A.1 Certificate for the "PS Premium" painting system from ECOLAB

ECOLAB®

Ecolab Deutschland GmbH
P.O. Box 13 04 06
D-40554 Düsseldorf

has executed on behalf of

SIEMENS Aktiengesellschaft

Industry Sector
DT MC MF-M

Industriestraße 1
97615 Bad Neustadt a. d. Saale
Germany

Material compatibility tests

with the following cleaning and disinfection products:
P3-topax 12, P3-topax 19, P3-topax 686, P3-topax 56, P3-topax 58, P3-topactive 200, P3-topactive 500, P3-topax 990, P3-oxonia active 150 and **deionised water.**

We herewith certify that
Coating PS Premium
is compatible with the above mentioned Ecolab products under given conditions - see next page.

Düsseldorf, 24th November 2011

Ecolab Deutschland GmbH

i.V.

Thomas Wershofen
Manager Corporate Service RD&E
Center of Excellence EMEA
Food & Beverage Division

i. A.

Karin Uhlenbrock
Service Engineer RD&E
Center of Excellence EMEA
Food & Beverage Divsion

Deutsche Bank AG, Düsseldorf
Konto 2 272 276 BLZ 300 700 10
IBAN: DE38 3007 0010 0227 2276 00
BIC: DEUTDEDD
USt-ID-Nr DE 814914835
Gesellschaft mit beschränkter Haftung Sitz: Düsseldorf
Handelsregister: AG Düsseldorf, HRB 28757
Vorsitzender des Aufsichtsrates: Ralf Ebel
Geschäftsführung: Alfred Stöhr, Ralph Gichtbrock

Ecolab Deutschland GmbH Reisholzer Werftstr. 38-42 D-40589 Düsseldorf

Figure A-1 Certificate_option_N16_page1

ECOLAB

The certificate for the coating PS Premium based on:

- documented test procedure for material compatibility
- defined product specification
- a standardized cleaning plan

Test procedure

Soaking test:
- Partly soaked into test mediums

Test time :
- 7 days

Test contents:
- pH-value of solutions: 1,5 – 13,0
- Ingredients:
  e.g. caustic, phosphoric acid, peroxyacetic acid,
  hydrogen peroxide, sodium hypochlorite, alkyl amine acetate

Evaluation:
- Estimation after appr. 7 days regeneration
- Estimation of degradation of coatings according to DIN EN ISO 4628-1 and estimation of decorative changing (colour and gloss level)
- Key
  (+) no changing
  (o) minor changing possible, decorative nature only
  (-) changing possible by long term use

The coating PS Premium was tested with the following products:

Alkaline and chlorinated alkaline foam cleaning products			
P3-topax 12	3%	40°C	+
P3-topax 19	5%	40°C	o
P3-topax 686	5%	40°C	+

Acidic foam cleaning products			
P3-topax 56	5%	40°C	+
P3-topax 58	5%	40°C	+

TFC-cleaner			
P3-topactive 200	4%	40°C	+
P3-topactive 500	4%	40°C	+

Disinfection products			
P3-topax 990	5%	23°C	o
P3-oxonia active 150	1%	23°C	+

DI-water	-	40°C	+

Product specification:

P3-topax 12
Mild alkaline foam cleaning product
P3-topax 19
Alkaline foam cleaning product
P3-topax 686
Chlorinated alkaline foam cleaning product
P3-topax 56
Foam cleaning product based on phosphoric acid
P3-topax 58
Foam cleaning product based on organic acids

P3-topactive 200
Alkaline thin film cleaner
P3-topactive 500
Acidic thin film cleaner
P3-topax 990
Foam disinfection product based on alkyl amine acetate
P3-oxonia active 150
Disinfection product based on peroxyacetic acid and hydrogen peroxide
DI-water
Deionised water

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Geschäftsführung: Alfred Stöhr, Ralph Gichtbrock

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Figure A-2 Certificate_option_N16_page2

A.2 ECOLAB cleaning recommendation

ECOLAB

"Cleaning Recommendation"

SIEMENS AG, Industry Sector, DT MC MF-M

Coating PS Premium

Cleaning & Disinfection

EUROPE

Application:	Typical residues:
Foam / TFC Cleaning and disinfection	Organic and inorganic residues
Specific application area:	**General information:**
Removal of residues of the Food & Beverage Industry	Coating PS Premium for servomotors

Cleaning frequency: tbd

Cleaning Procedure & Chemicals	%	°C	min.	Notes
Pre-rinse Water	-	40-50	tbd	Low pressure pre-rinse with water to remove rough residues.
Foam Cleaning /Thin Film Cleaning P3-topax .... or P3-topactive	1-5	20-40	10 - 30	Concentration, application time and application temperature depends on foam cleaning product and TFC-product as well. For product application please see also the information from the product data sheet
Intermediate Rinse Water	-	40-50	tbd	Use water of drinking quality. Low pressure rinse thoroughly with fresh water of drinking quality until all product residues are removed.
Foam Disinfection /Thin Film Disinfection P3-topax .... or P3-topactive...	1-3	RT	10-30	Concentration, application time and application temperature depends on foam disinfection product and TFC-product as well. Use biocides safely. Always read the label and product information before use.
Final Rinse Water	-	40-50	tbd	Use water of drinking quality. Low pressure rinse thoroughly with fresh water of drinking quality until all product residues are removed.

For any assistance do not hesitate to contact your responsible Ecolab service.

Important additional remarks!

Due to the diversity of materials and applications the information given above represents only a non binding guideline and is not intended to supersede the manufacturers specifications, limitations and recommendations. It is compulsory to follow the manufacturers limitations, especially concerning pH and temperature stability of the materials. The cleaning process should be individually optimized.

Figure A-3 ECOLAB cleaning recommendation for option N16

More information

Siemens:
www.siemens.com/simotics

Industry Online Support (service and support):
www.siemens.com/online-support

Industry Mall:
www.siemens.com/industrymall

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Scan the QR code for more information about SIMOTICS.