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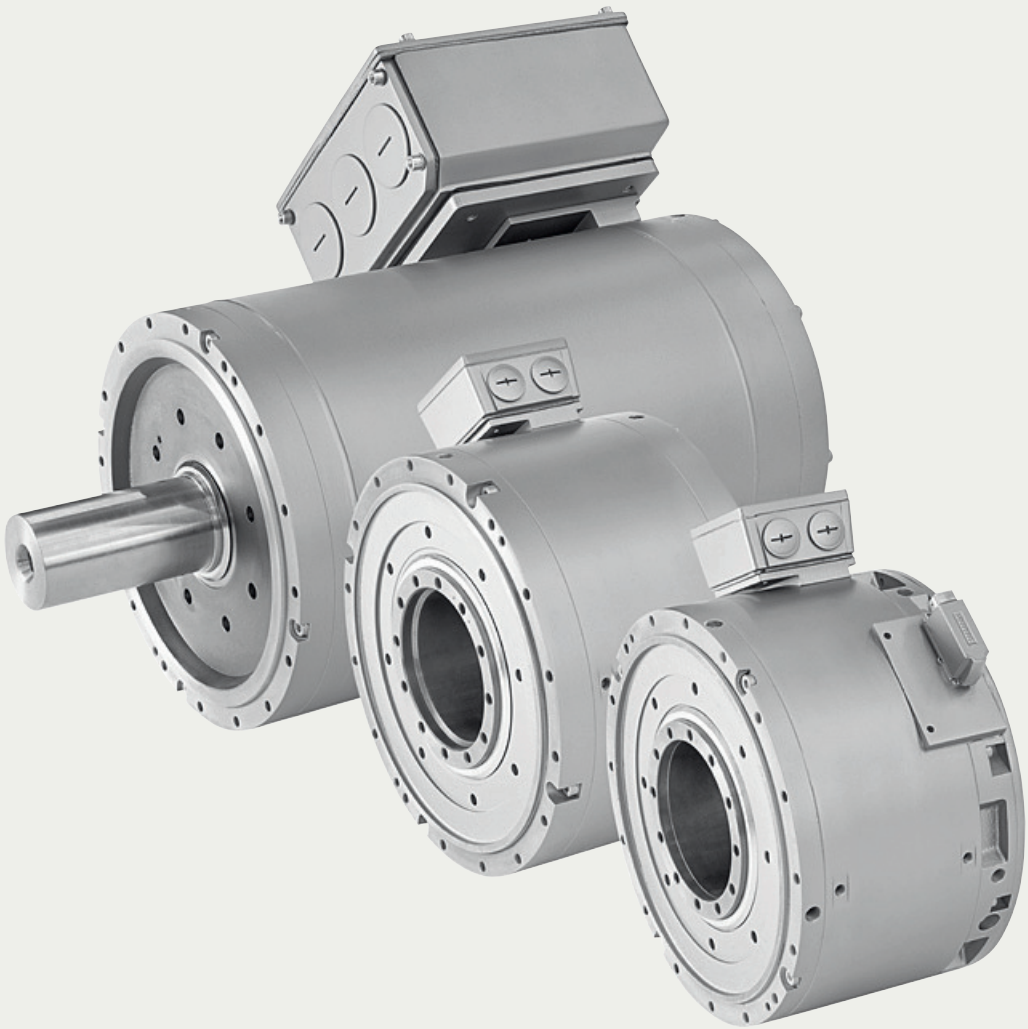

Edition 08/2022

OPERATING INSTRUCTIONS

SIMOTICS

Complete torque motors SIMOTICS T-1FW3

Drive technology

www.siemens.com/drives

SIEMENS

SIMOTICS

Drive technology
1FW3 complete torque motors

Operating Instructions

08/2022
A5E46027719B AB

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.

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A5E46027719B AB
Ⓟ 07/2022 Subject to change

Introduction

Target group

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

Avoiding dangers

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.

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

About this documentation

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:

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

This documentation describes the functionality of the product. The machine builder documents any modifications or changes to the product made by it.

This documentation cannot contain all of the detailed information on all of the product types. Moreover, this documentation cannot take into consideration every possible type of installation, operation, and maintenance.

Text features

In addition to the notes that you must observe for your own personal safety as well as to avoid material damage, in this document you will find the following text features:

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.

My support

Extensive assistance and more information can be found under the following link:

My Support Links and Tools (https://support.industry.siemens.com/cs/de/en/my)

You can individually compile your personal library, e.g. for your documentation based on Siemens content, and adapt it for your own machine documentation.

To do so, click "My Documentation".

Note

If you want to use this function, you must register once.

Later, you can log on with your login data.

You can create your own personal library under "mySupport" using the following procedure.

Precondition

You have registered for and logged on to "Siemens Industry Online Support", hereinafter referred to as "SIOS".

SIOS (https://support.industry.siemens.com/cs/de/en/)

Procedure for creating a personal library

1. Open SIOS and log on.
2. Enter the product you are looking for under "Search for product info" and press "Enter".
3. Select the doc. class you want, e.g. "Manual", under "Entry type".
4. Click on your desired manual under the entries.
5. Click on "Add to mySupport documentation".
6. Enter a title.
7. Press "OK".

❒

The selected manual can be found under "mySupport". To find further functions, click on the icon located to the right of the document.

In this way, you can create your own library and quickly access your documentation.

Provide feedback

Siemens strives continually to improve the quality of information provided in these operating instructions.

Your questions, suggestions and corrections of the technical documentation are welcome. For this purpose, use the "Send feedback" link in Siemens Industry Online Support at the end of an entry or send an e-mail to the following address: E-Mail (mailto:docu.motioncontrol@siemens.com)

Technical Support

If you have any technical questions, contact Technical support (https://support.industry.siemens.com/cs/de/en/).

To make a support request, proceed as follows:

Precondition

You have registered for and logged on to "Siemens Industry Online Support", abbreviated "SIOS".

SIOS (https://support.industry.siemens.com/cs/de/en/)

Procedure

1. Click on "Your direct way to the Support Request" or follow the link Support Request (https://support.industry.siemens.com/cs/de/en/my)

2. Follow the instructions in the online form.

❒

Websites of third parties

This publication contains hyperlinks to websites of third parties. Siemens does not take any responsibility for the contents of these websites or adopt any of these websites or their contents as their own, because Siemens does not control the information on these websites and is also not responsible for the contents and information provided there. Use of these websites is at the risk of the person doing so.

Table of contents

Fundamental safety instructions

1

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 you have a heart pacemaker or implant, maintain the minimum distance specified in chapter "Correct usage" from such motors.

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 you have a heart pacemaker or implant, maintain the minimum distance specified in chapter "Correct usage".
- 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 inadequate cooling

Inadequate cooling can cause the motor to overheat, resulting in smoke and fire. Possible consequences can be serious injury or death. This can also result in increased failures and reduced service lives of motors.

- Comply with the specified cooling requirements for the motor.

⚠ 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

Burn injuries caused by hot surfaces

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

- Mount the motor so that it is not accessible in operation.

Measures when maintenance is required:

- Allow the motor to cool down before starting any work.
- Use the appropriate personnel protection equipment, e.g. gloves.

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).

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 (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 (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.

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 installer 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 and/or software errors in the sensors, control system, actuators, and cables 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

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

Description

2

Standardized complete torque motors SIMOTICS T-1FW3

The SIMOTICS T-1FW3 complete torque motors are synchronous motors and designed as compact direct drives for operation on the SINAMICS S120 drive system.

These motors are

- water-cooled
- high-pole
- permanent-magnet-excited

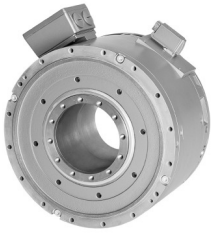
The type spectrum includes the three shaft heights 150, 200 and 280 in different shaft lengths.

Motors of shaft heights 150 and 200 you can install in the machine design. The stators and rotors of these motors have a flange with centering edges and tapped holes at the DE.

The SIMOTICS T-1FW3 complete torque motors are available with the following shaft versions:

- Hollow shaft
- Plug-on shaft with integrated shaft centering / stub shaft
- Solid shaft

Table 2-1 Shaft versions

Hollow shaft	Plug-on shaft	Stub shaft	Solid shaft
			
• Completely hollow shaft, e.g. for feeding coolant/ heat, measuring cables etc. • Motors with various lengths can be mounted on the machine shaft.	• Simple and quick installation as a result of the integrated shaft adapter with centering • Simple clamping element • Simple encoder replacement	• Simple encoder replacement • Rotor installation via flange, no integrated shaft centering as with plug-on shaft available	• "Classic" motor installation • Simple replacement of a geared motor with a SIMOTICS T-1FW3 complete torque motor without having to change the connection to the machine • Simple encoder replacement

General properties of the motors

- Compact design and low envelope dimensions
- High degree of stiffness
- High dynamic response (short acceleration times) and rotational accuracy
- Power range from 3 to 380 kW
- Rated torques from 100 to 7000 Nm
- Rated speeds from 150 to 1200 r/min
- Maximum speeds of up to 1800 r/min
- Hollow shaft, plug-on shaft / stub shaft or solid shaft
- Different encoder types for speed control and precision positioning
- Simple encoder replacement without requiring any readjustment for plug-on shafts / stub shafts and solid shafts

Special heavy duty version; Z-option L03

The SIMOTICS T-1FW3 complete torque motors in the special heavy duty version are particularly robust direct drives with the following properties:

- Compact design
- Stub shaft version
- High dynamic and precision
- Shock load permanently possible up to 10 g
- 200 % overload capability
- Rated speed up to 800 r/min
- Maximum speed up to 1380 r/min
- Rated torque up to 7000 Nm
- Maximum torque up to 11400 Nm
- Easy to integrate in the mechanical system and in the SINAMICS S120 drive system (DRIVE-CLiQ interface)

Figure 2-1 SIMOTICS T-1FW3 complete torque motors Heavy Duty with stub shaft

The type spectrum includes the shaft heights 200 and 280.

2.1 Use for the intended purpose

⚠ WARNING

Risk of death and material damage as a result of incorrect use

There is a risk of death, serious injury and/or material damage when direct drives or their components are used for a purpose for which they were not intended.

- Only use the motors for industrial or commercial plants and systems.
- Do not install the motors in hazardous zones if the motors have not been expressly and explicitly designed and authorized for this purpose. Carefully observe any special additional notes provided.
- Only use direct drives and their components for applications that Siemens has explicitly specified.
- Protect the motors against dirt and contact with aggressive substances.
- Ensure that the installation conditions comply with the rating plate specifications and the condition specifications contained in this documentation. Where relevant, take into account deviations regarding approvals or country-specific regulations.
- Contact your local Siemens office if you have any questions relating to correct use.
- If you wish to use special versions and design versions whose technical details vary from the motors described in this document, then you must contact your local Siemens office.

⚠ WARNING

Danger to life for wearers of active implants due to magnetic and electrical fields

Electric motors pose a danger to people with active medical implants, e.g. cardiac stimulators, who come close to the motors.

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

SIMOTICS T-1FW3 complete torque motors can be used for the following machine applications, for example:

- Main extruder drives
- Worm drives for injection molding machines
- Roll drive
- Winder
- Cross lapper
- Pull-roll drives for foil drawing machines
- Stretch, calender, casting and cooling rolls
- Dynamic positioning tasks, e.g. rotary tables, clocked conveyor belts
- Replacing hydraulic motors

- Roll drives in paper machines
- Cross-cutter drives for continuous material webs, e.g. paper, textiles, metal sheet
- Wire-drawing machines
- Chippers

⚠ WARNING

Injury and material damage by not observing machinery directive 2006/42/EC

There is a risk of death, serious injury and/or material damage if machinery directive 2006/42/EC is not carefully observed.

- The products included in the scope of delivery are exclusively designed for installation in a machine. Commissioning is prohibited until it has been fully established that the end product conforms with machinery directive 2006/42/EC.
- Observe all safety instructions and provide these safety instructions to the end user.

2.2 Technical features and environmental conditions

2.2.1 Directives and standards

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 component, e.g. cannot be applied to built-in motors

Relevant directives

The following directives are relevant for the SIMOTICS motor series.

European Low-Voltage Directive

The SIMOTICS motor series complies with the Low-Voltage Directive 2014/35/EU.

European Machinery Directive

The SIMOTICS motor series does 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

The SIMOTICS motor series does 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)

The SIMOTICS motor series complies 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 Regulation (EU) 2019/1781 for implementation of this directive.

Eurasian conformity

The SIMOTICS motor series complies with the requirements of the Russia/Belarus/Kazakhstan (EAC) customs union.

China Compulsory Certification

The SIMOTICS motor series does not fall within the scope covered by the China Compulsory Certification (CCC).

CCC negative certification (https://support.industry.siemens.com/cs/document/93013317/general-product-approval-ccc?dti=0&pnid=13308&lc=en-DE)

Underwriters Laboratories

The SIMOTICS motor series is 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 important that you carefully observe the contents of the quotation and that there is a cUL mark on the rating plate!

Quality systems

Siemens AG 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/en/ps/13347/cert)

You can obtain the UL-certificate for 1FW3 complete torque motors at the Internet address: UL certificate 1FW3 (https://support.industry.siemens.com/cs/ww/en/view/109767471)

China RoHS

The SIMOTICS motor series complies with the China RoHS.

You can find additional information at:

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

UKCA - United Kingdom Conformity Assessed

UK CA

The SIMOTICS motor series complies with the conformity requirements of England, Wales and Scotland.

2.2.2 Technical features

Table 2-2 Technical features

Feature	Permanent-magnet synchronous motor
Magnet material	Rare-earth magnetic material
Stator winding insulation (acc. to EN 60034-1)	Temperature class 155 (F) for a winding temperature rise of ΔT = 100 K for a cooling water intake temperature of +30 °C.
Installation altitude (to EN 60034-1)	For an installation altitude > 1000 m above sea level, the relevant data in the drive converter documentation must be carefully observed (secondary conditions/limitations).
Type of construction (acc. to EN 60034-7)	• Shaft height 150: IM B14, IM V18, IM V19 • Shaft height 200: IM B14, IM V18, IM V19 • Shaft height 280: IM B35, IM B34, IM B3, IM B5, IM V1, IM V3, IM V15, IM V35
Degree of protection (acc. to EN 60034-5)	• Hollow shaft: IP54 • Plug-on shaft / stub shaft: IP55, SH 280 IP54 • Solid shaft: IP55, SH 280 IP54
Cooling (acc. to EN 60034-6)	Water cooling
Thermal motor protection (acc. to EN 60034–11)	KTY 84 or Pt1000 temperature sensor in the stator winding
Paint finish	Anthracite grey similar to RAL 7016
2nd rating plate	Enclosed separately
Shaft version (acc. to DIN 748-3; IEC 60072-1)	Hollow shaft, plug-on shaft / stub shaft, solid shaft Details see Chapter "Shaft end and shaft versions (Page 53)" and "Dimension drawings"
Shaft and flange accuracy (acc. to DIN 42955; IEC 60072-1)	Tolerance class N (at normal running temperature)
Vibration severity (acc. to EN 60034-14)	Grade A is observed up to rated speed.
Sound pressure level (acc. to DIN EN ISO 1680)	Max. 73 dB(A) at 4 kHz rated pulse frequency at the nominal operating point

Feature	Permanent-magnet synchronous motor
Bearing version	• Roller bearings with permanent grease lubrication (bearing change interval = 20000h) • Standard DE fixed bearing; NDE floating bearing: Roller bearings with permanent grease lubrication (bearing change interval = 20000h) • DE no bearing can be selected
Mounting set	• Siemens torque arm • Clamping elements
Built-in encoder systems for motors without DRIVE-CLiQ interface	• Incremental encoder, sin/cos 1 V_{pp}, 2048 S/R[1)] with C and D tracks, encoder IC2048S/R[1)], belt-mounted • Absolute encoder 2048 S/R[1)] singleturn, 4096 revolutions multiturn, with EnDat interface, encoder AM2048S/R[1)]), belt-mounted or coaxially mounted at NDE • Multi-pole resolver, belt mounted
Built-in encoder systems for motors with DRIVE-CLiQ interface Belt-mounted	• Incremental encoder, 22-bit (resolution 4194304, internal encoder 2048 S/R[1)]) + commutation position, 11-bit, encoder IC22DQ • Absolute encoder 22 bit singleturn (resolution 4194304, in the encoder 2048 S/R[1)]) + 12 bit multiturn (traversing range 4096 revolutions), encoder AM22DQ • Resolver 15 bit (resolution 32768, internal, multi-pole), encoder R15DQ
Built-in encoder systems for motors with DRIVE-CLiQ interface Coaxially mounted at NDE	• Absolute encoder 24 bit singleturn (resolution 16777216), encoder AS24DQI • Absolute encoder 24 bit singleturn (resolution 16777216), + 12 bit multiturn (traversing range 4096 revolutions), encoder AM24DQI
Connection	• Terminal box for power cable • Connector for encoder signals and temperature sensors
Options	• Motor protection with PTC thermistor with 3 embedded temperature sensors for tripping • Version with/without encoder • Shaft cover at NDE for the hollow shaft version • Regreasing system • Special paint finish • Non-standard rated speeds (an inquiry is required) • Natural cooling on request • Special grease lubrication for low speeds • Heavy-duty version in shaft heights 200 and 280 • Cable entry plate with 3 × M63 × 1.5 for 1XB7-700 terminal box • Cable entry plate with 4 x M63 x 1.5 for 1XB7-712 terminal box • Sensor hole M8; DE and NDE • Manufacturer's test certificate • Clamping element • Siemens torque arm

[1)] S/R = Signals/Revolution

Dimension drawings

You can find the dimension drawings for the motors in the 1FW3 Configuration Manual.

2.2.3 Environmental conditions

Note

Unsuitable installation locations

The motors are not suitable for operation

- in salt-laden or corrosive atmospheres
- outdoors

The motors are designed for operation in covered areas, such as production facilities.

2.3 Derating factors

Derating for the maximum DC link voltage

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

Table 2-3 Factors for reducing the maximum DC link voltage

Installation altitude above sea level in m up to	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. This reduces the operating range in the torque-speed diagram.

Consider the reduced operating range when engineering your system.

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

Derating for the static torque

For derating factors for the static torque M_0 as a function of the cooling water inlet temperature, see the table in Section "Cooling (Page 43)".

Derating for cables

For derating factors for power and signal cables as a function of the ambient temperature, see the table in Section "Electrical connection (Page 130)".

2.4 Rating plate data

The rating plate refers to the technical data of the motor.

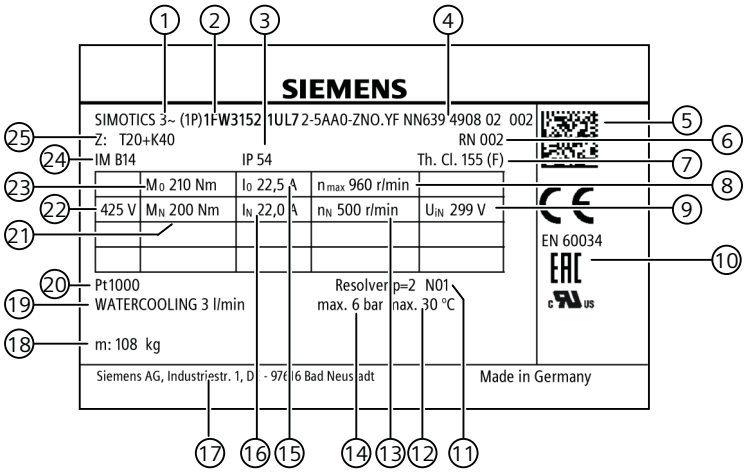


Table 2-4 Description of the rating plate data

Position	Description	Position	Description
1	Motor type	14	Maximum permitted pressure in the cooling circuit
2	Article No.	15	Stall current I_0
3	Degree of protection	16	Rated current I_N
4	Serial number	17	Production address
5	2D code, contains the motor data	18	Motor weight
6	Motor version	19	Cooling flow rate water cooling
7	Temperature class	20	Temperature sensor
8	Maximum speed n_{max}	21	Rated torque M_N
9	Induced voltage U_{iN} at rated speed n_N	22	Output voltage
10	Approvals/conformities	23	Static torque M_0
11	Code, encoder type and supplement to the encoder type	24	Type of construction
12	Cooling water intake temperature	25	Z options
13	Rated speed n_N		

2.5 Design

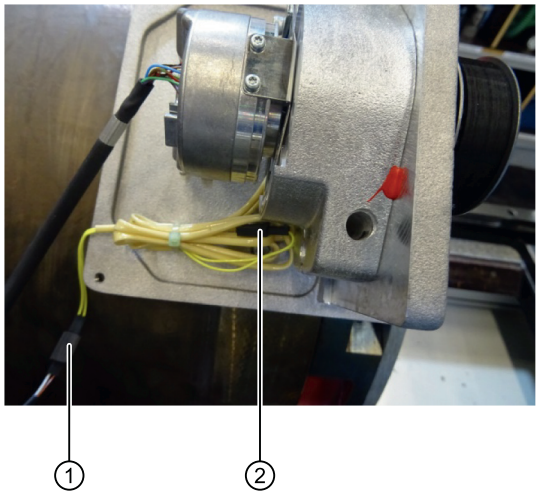
2.5.1 Thermal motor protection

NOTICE
Thermal motor damage Windings and bearings can be destroyed if the motor overheats. Further, if a motor overheats, this can demagnetize the permanent magnets. • Only operate the motors in conjunction with an effective temperature control.

Thermal motor protection with temperature sensors

The stator core has two temperature sensors to monitor the winding; one of these is a reserve.

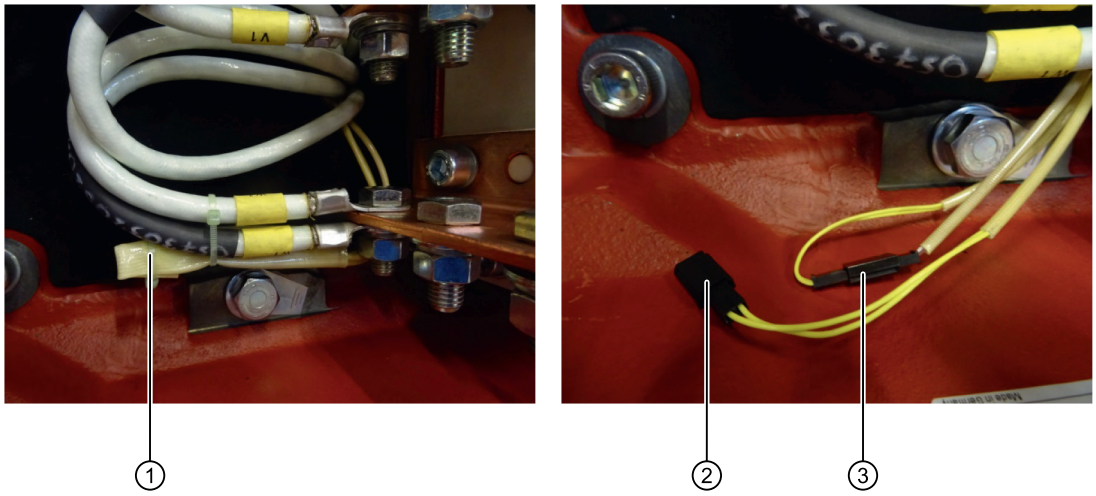
If you want to use the reserve temperature sensor, you must change the plug-in connection. The plug-in connection is at motors with encoder with belt drive in the encoder box. At all other motor versions the plug-in connection is in the terminal box. See the following pictures to this.



1 Connected temperature sensor with plug-in connector

2 Reserve temperature sensor with plug-in connector

Figure 2-2 Example: Connection in the encoder box



1 Reserve with plug-in connection in the insulating tubing

2 Reserve

3 Connected temperature sensor

Figure 2-3 Example: Connection in the terminal box

Two temperature sensor types are integrated:

KTY 84	Pt1000
Temperature sensors KTY 84 are ESD components. When delivered, they are short-circuited with a terminal.	Pt1000 temperature sensors are not ESD components.

Temperature sensors of the same type are always installed in one particular motor.

The type of temperature sensor installed is stamped on the rating plate.

Table 2-5 Features and technical data

Type	**KTY 84-130**	**Pt1000**
Resistance when cold (20 °C)	Approx. 580 Ω	Approx. 1090 Ω
Resistance when hot (100 °C)	Approx. 1000 Ω	Approx. 1390 Ω
Connection	Via signal cable	Via signal cable
Response temperature	Prewarning < 150 °C Alarm/trip at max. 170 °C ±5 °C	Prewarning < 150 °C Alarm/trip at max. 170 °C ±5 °C

The resistance change is proportional to the winding temperature change. The temperature characteristic is taken into account in the closed-loop control.

The following diagram shows the resistance characteristic as a function of the temperature for KTY 84-130 and Pt1000 temperature sensors.

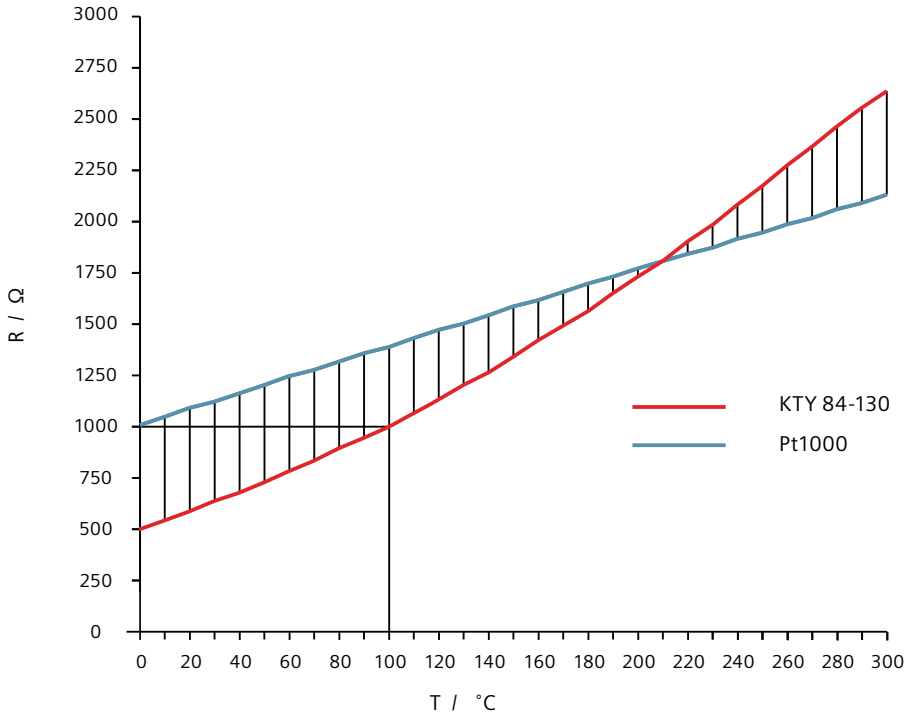


Figure 2-4 Comparison of KTY 84-130 and Pt1000 temperature sensors

The prewarning signal from the evaluation circuit in the SINAMICS drive converter can be externally evaluated.

You can find the designation of the interface for connecting the temperature sensors in Chapter "Connecting temperature sensors (Page 150)".

NOTICE
Destruction of the motor for a thermal critical load
A thermally critical load, e.g. high overload when the motor is stationary, can destroy the motor. • Employ additional protective measures, e.g. an overcurrent relay.

NOTICE
Destruction of the temperature sensor if the insulation resistance is tested improperly
If the test voltage is connected to only one temperature sensor terminal, the temperature sensor will be destroyed. • Short-circuit ends of the temperature sensor cables before applying the test voltage.

High short-term overload conditions require additional protective measures as a result of the thermal coupling time of the temperature sensor.

PTC thermistor (option)

For special applications (e.g. when a load is applied with the motor stationary or for extremely low speeds), additional temperature monitoring of all three motor phases using a PTC thermistor triplet makes sense.

Ordering options: order code A11.

The PTC connections are located on the signal terminal block in the power terminal box. A cable entry hole M16 x 1.5 on the terminal box is provided for the connection. Exceptions to this rule are motors with shaft heights of 150 and 200 with Sensor Module Integrated (SMI). In these motors, the PTCs are evaluated via the SMI. The following encoder variants use an SMI: "D" = IC22DQ, "F" = AM22DQ, "U" = R15DQ.

Table 2-6 Technical data for the PTC thermistor triplet

Designation	Description
Type	PTC thermistor triplet
Thermistor resistance (20 °C)	≤ 750 Ω
Resistance when hot (180 °C)	≥ 1710 Ω
Response temperature	180 °C
Connection	Via external evaluation unit
Note: PTC thermistors do not have a linear characteristic and are, therefore, not suitable to determine the instantaneous temperature. Characteristic to DIN VDE 0660 Part 303, DIN 44081, DIN 44082.	

You can find the designation of the interface for connecting the temperature sensors in Chapter "Connecting temperature sensors (Page 150)".

2.5.2 Encoders

WARNING

Uncontrolled motor motion as a result of incorrect adjustment

The encoders are adjusted in the factory for SIEMENS drive converters. Another encoder adjustment may be required when operating the motor with a third-party converter.

Incorrect adjustment of the encoder regarding motor EMF can lead to uncontrolled motion which can cause injury and material damage.

- Only replace an encoder and adjust it if you are appropriately qualified to do so.
- When a belt-driven encoder is replaced, adjust the position of the encoder system with respect to the motor EMF.
- You must re-reference the system when replacing an absolute encoder.

Note

Replacing a coaxially mounted encoder

When replacing a coaxially mounted encoder, you do not have to adjust the encoder system. The position with respect to the motor EMF is ensured using mechanical components.

Encoder selection and identification in the Article No.

The type of installed encoder can be identified at various positions of the Article No.

Table 2-7 Identification letter at the 9th position in the Article No.

Encoder type	9th position in the Article No.
Motors without DRIVE-CLiQ interfaces	
Incremental encoder, sin/cos 1 V_{pp}, 2048 S/R with C and D tracks, encoder IC2048S/R, belt mounted	A
Absolute encoder 2048 S/R singleturn, 4096 revolutions multiturn, with EnDat interface, encoder AM2048S/R, belt mounted or coaxially mounted at NDE	E
Multi-pole resolver (p = x), belt mounted	S
Motors with DRIVE-CLiQ interfaces	
Absolute encoder 24 bit singleturn (resolution 16777216), encoder AS24DQI	B
Absolute encoder 24 bit singleturn (resolution 16777216) + 12 bit multiturn (traversing range 4096 revolutions), encoder AM24DQI	C
Incremental encoder, 22-bit (resolution 4194304, internal 2048 S/R) + commutation position, 11 bit, encoder IC22DQ, belt-mounted	D
Absolute encoder 22 bit singleturn (resolution 4194304, internal 2048 S/R) + 12 bit multiturn (traversing range 4096 revolutions), encoder AM22DQ, belt-mounted	F
Resolver 15-bit (resolution 32.768, internal, multi-pole), R15DQ encoder, belt mounted	U
Encoderless	W

Identification at the 11th and 15th position in the Article No.

belt-driven encoder	11th position in the Article No. = 7 15th position in the Article No. = A or C
Coaxial encoder mounting	11th position in the Article No. = 6 15th position in the Article No. = H, M, P or S
Encoderless	11th position in the Article No. = 6 15th position in the Article No. = A or C for shaft hight 150 and 200; only A for shaft hight 280

Note

Safety Integrated Extended Functions

Certain Safety Integrated Extended Functions of the SINAMICS S120 drive system and the SINUMERIK Safety Integrated Functions require a suitable encoder.

At the following link you will find a PDF document with a list of motors from the Motion Control portfolio with and without DRIVE-CLiQ interface. Furthermore, this list contains individual encoders and measuring systems that you can use in conjunction with Safety Integrated:

Safety encoders (https://support.industry.siemens.com/cs/ww/en/view/33512621)

2.5.2.1 Encoder connection for motors with DRIVE-CLiQ interface

For motors with a DRIVE-CLiQ interface, the analog encoder signal is internally converted to a digital signal. There is no further conversion of the encoder signal in the drive system required. Motors with DRIVE-CLiQ interface simplify commissioning and diagnostics, as the motor and encoder system are identified automatically.

⚠ WARNING

Danger to life when using an incorrect encoder module

The DRIVE-CLiQ encoder contains motor and encoder-specific data and an electronic type plate. If you use an incorrect DRIVE-CLiQ encoder, this can result in death, severe injury and severe material damage.

- Only use the DRIVE-CLiQ encoder and the electronic type plate for the original motor.
- Do not mount the DRIVE-CLiQ encoder onto other motors.
- Do not replace a DRIVE-CLiQ encoder by a DRIVE-CLiQ encoder belonging to another motor.
- Only appropriately trained Siemens service personnel should replace DRIVE-CLiQ encoders.

NOTICE

Damage to components that are sensitive to electrostatic discharge

The DRIVE-CLiQ interface has direct contact to components that can be damaged/destroyed by electrostatic discharge (ESDS). Components that are sensitive to electrostatic discharge can be damaged if you touch the connections with your hands or with electrostatically charged tools.

- Carefully observe the information in Chapter "Equipment damage due to electric fields or electrostatic discharge (Page 16)".

Cables

For all encoder types (incremental encoder, absolute value encoder and Resolver) the same DRIVE-CLiQ cables you can use between the motor and converter.

Only use prefabricated cables from Siemens (MOTION-CONNECT), article number 6FX□002-□DC□□-□□□0.

For technical data and length code, refer to Catalog D21.4, Chapter "MOTION-CONNECT connection system".

2.5.2.2 Encoder connection for motors without DRIVE-CLiQ interface

For motors without an integrated DRIVE-CLiQ interface, the analog encoder signal in the drive system is converted into a digital signal. For these motors as well as external encoders, the encoder signals must be connected to SINAMICS S120 via Sensor Modules.

2.5.2.3 Incremental encoder sin/cos 1 Vpp

Description

This encoder senses relative movements and does not supply absolute position information. In combination with an evaluation logic, a zero point can be determined using the integrated reference mark, which can be used to calculate the absolute position.

The encoder outputs sine and cosine signals. These signals can be interpolated using evaluation logic (usually 2048x).

The direction of rotation can be evaluated using the encoder.

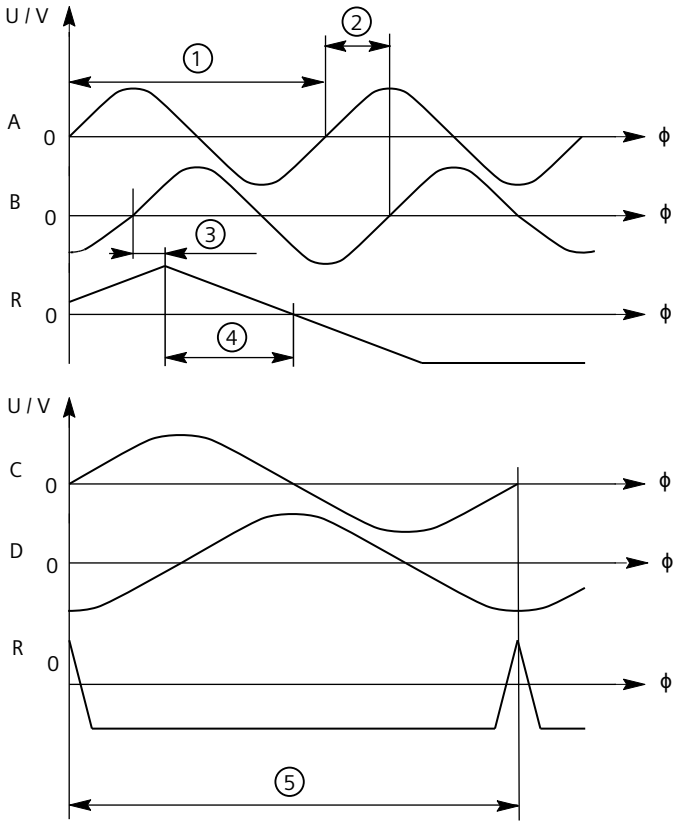
In the version with DRIVE-CLiQ interface, this evaluation logic is already integrated in the encoder.

Function and technical data

- Angular measuring system for the commutation
- Speed actual value sensing
- Indirect incremental measuring system for the position control loop
- One zero pulse (reference mark) per revolution

Table 2-8 Technical data for incremental encoders

Encoder type	9th position in the Article No.	Operating voltage	Max. current drain	A-B track: Resolution incremental (sin/cos periods per revolution)	C-D track: Rotor/ commutation position (sin/cos periods per revolution)	Angular error
without DRIVE-CLiQ interface						
Incremental encoder sin/cos 1 V_{pp}, 2048 S/R with C and D tracks	A	5 V ± 5 %	140 mA	2048 S/R (1 V_{pp})	1 S/R (1 V_{pp})	± 40"
with DRIVE-CLiQ interface						
Incremental encoder 22 bit resolution 4.194.304, internal 2048 S/R) + commutation position 11 bit	D	24 V	180 mA	4,194,304 (=22 bits)	2048 (= 11 bits)	± 40"



1 $360^{\circ}_{\text{electrical}} = 360^{\circ}_{\text{mechanical}} / 2048$

2 $90^{\circ}_{\text{electrical}}$

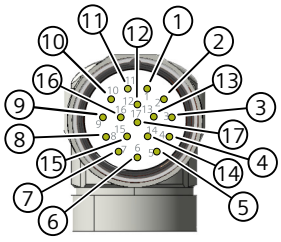
3 $45^{\circ}_{\text{electrical}}$

4 $180^{\circ}_{\text{electrical}}$ +/- $90^{\circ}_{\text{electrical}}$

5 $360^{\circ}_{\text{electrical}} = 360^{\circ}_{\text{mechanical}}$

Figure 2-5 Signal sequence and assignment for encoder IC2048S/R without DRIVE-CLiQ interface for a positive direction of rotation

Connection assignment for 17-pin signal connector

PIN No.	Signal	Diagram
1	A	
2	A*	
3	R	
4	D*	
5	C	
6	C*	
7	M encoder	
8	+1R1 (KTY 84) or 1R1 (Pt1000)	
9	–1R2 (KTY 84) or 1R2 (Pt1000)	
10	P encoder	
11	B	
12	B*	
13	R*	
14	D	
15 *)	M sense	
16 *)	P sense	
17	Not connected	

*) Cable break and voltage control

Cables

Only use prefabricated cables from Siemens (MOTION-CONNECT), article number 6FX□002-2CA31-□□□0, mating connector 6FX2003-0SU17 (socket).

For technical data and length code, refer to Catalog D21.4, Chapter "MOTION-CONNECT connection system".

2.5.2.4 Absolute encoders

Description of multiturn absolute encoders

This encoder outputs an absolute angular position between 0° and 360° in the specified resolution. An internal measuring gearbox enables the encoder to differentiate between 4096 revolutions.

Description, absolute value singleturn

This encoder outputs an absolute angular position between 0° and 360° in the specified resolution. Contrary to a multiturn absolute encoder, the encoder has no measuring gearbox and can therefore only supply the position value within one revolution.

Function and technical data

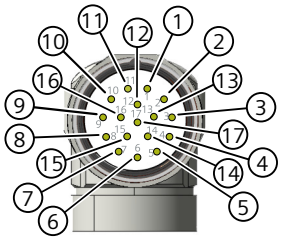
- Angular measuring system for the commutation
- Speed actual value sensing
- For single-turn encoders: indirect measuring system for absolute position sensing within a traversing range of 1 revolution
- For multi-turn encoders: indirect measuring system for sensing the absolute position within a traversing range of 4096 revolutions

Table 2-9 Technical specifications, absolute encoder

Encoder type	9th position in the Article No.	Operating voltage	Max. current consumption	Absolute resolution (single-turn)	Traversing-range (multi-turn)	A-B track: Resolution incremental (sin/cos periods per revolution)	Angular error
without DRIVE-CLiQ interface							
Absolute encoder 2048 S/R, (4096 revolutions, multi-turn, with EnDat interface 2.1	E	5 V ± 5 %	200 mA	---	4096 (= 12 bits)	2048 S/R (1 V_{pp})	± 40"
with DRIVE-CLiQ interface							
Absolute encoder, single-turn, 24 bit	B	24 V	110 mA	16777216 (= 24 bits)	---	---	± 40"
Absolute encoder 24 bit + 12 bit multiturn	C	24 V	110 mA	16777216 (= 24 bits)	4096 (= 12 bits)	---	± 40"
Absolute encoder single-turn 22 bit + 12 bit multi-turn	F	5 V ± 5 %	200 mA	4194304 (= 22 bits)	4096 (= 12 bits)	---	± 40"

Connection pin assignment for 17-pin flange socket with pin contacts

Table 2-10 Connection pin assignment, 17-pin flange socket

PIN No.	Signal	Diagram
1	A	
2	A*	
3	Data	
4	Not connected	
5	Clock	
6	Not connected	
7	M encoder	
8	+1R1 (KTY 84) or 1R1 (Pt1000)	
9	−1R2 (KTY 84) or 1R2 (Pt1000)	
10	P encoder	
11	B	
12	B*	
13	Data*	
14	Clock*	
15 *)	M sense	
16 *)	P sense	
17	Not connected	

*) Cable break and voltage control

Cables

Only use prefabricated cables from Siemens (MOTION-CONNECT), article number 6FX□002-2EQ10-□□□0, mating connector 6FX2003-0SU17 (socket).

For technical data and length code, refer to Catalog D21.4, Chapter "MOTION-CONNECT connection system".

2.5.2.5 Multi-pole resolver

Description

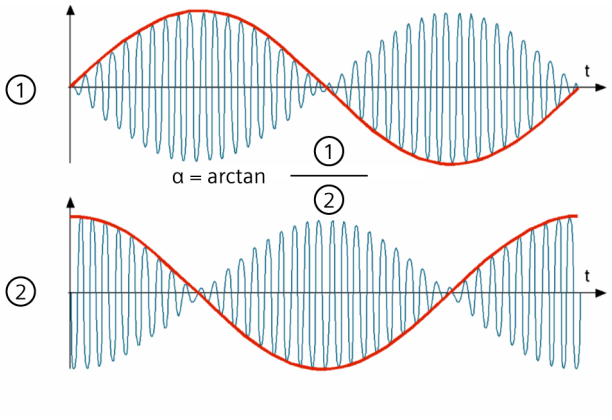
The number of sine and cosine periods per revolution corresponds to the number of pole pairs of the resolver. Resolvers can detect relative motion. The absolute position within one resolver output signal period can be determined.

Function and technical data

- Angular measuring system for the commutation
- Speed actual value sensing
- Indirect incremental measuring system for the position control loop

Table 2-11 Technical specifications, resolvers

Properties	**8-pole (for SH 200)**	**4-pole (for SH 150 and SH 280)**
Excitation voltage	+ 5 V_{rms} to + 13 V_{rms}	
Excitation frequency	4 kHz to 10 kHz	
Current consumption	< 80 mA_{rms}	
Angular error, peak-to-peak (mech.)	< 4'	< 10'
Electrical transformation ratio	0.5	



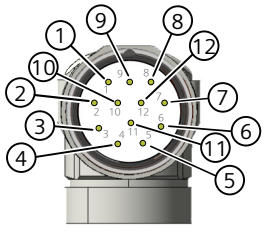
1 $U_{sinetrack}$

2 $U_{cosinetrack}$

Figure 2-6 Output signals, resolver

Connection pin assignment for 12-pin flange socket with pin contacts

Table 2-12 Connection pin assignment, 12-pin flange socket

PIN No.	**Signal**	**Fig.**
1	S2	
2	S4	
3	Not connected	
4	Not connected	
5	Not connected	
6	Not connected	
7	R2	
8	+1R1 (KTY 84) or 1R1 (Pt1000)	
9	–1R2 (KTY 84) or 1R2 (Pt1000)	
10	R1	
11	S1	
12	S3	

Cables

Only use prefabricated cables from Siemens (MOTION-CONNECT), article number 6FX□002-2CF02-□□□0, mating connector 6FX2003-0SU12 (socket).

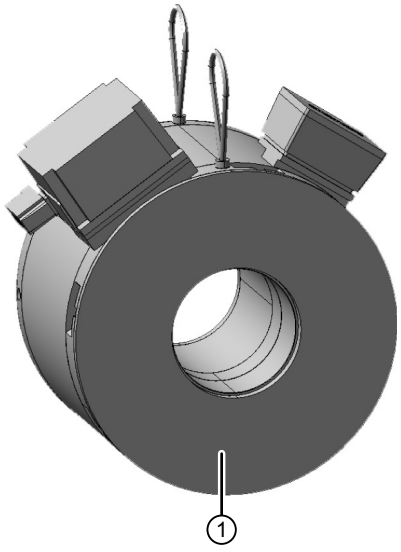
For technical data and length code, refer to Catalog D21.4, Chapter "MOTION-CONNECT connection system".

2.5.2.6 Encoder with belt drive

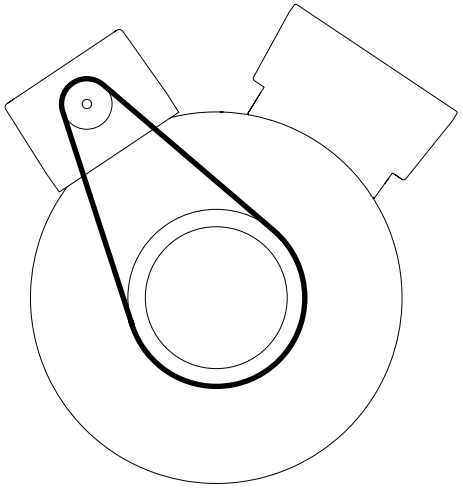
The encoder in the encoder box (on the stator side) is coupled via a belt. This means, for example, the hollow shaft can be used to route media. Gear ratio, see the table "Ratio" in this Chapter.

Note

Only qualified personnel may replace a belt. To do this, a device is required to measure the belt tension.



1 Cover for the toothed belt



Schematic diagram of the toothed belt drive

For the "hollow shaft" version, the encoder can be driven by a toothed belt. 11th position in the Article No. = 7. The gear ratio is in accordance with the table "Gear ratio".

Table 2-13 Ratio

Shaft height	*i*	Remarks
1FW315□	-3.5	The encoders are connected to the motor shaft through a belt drive (toothed belts). The sign for the gear ratio is negative due to the reverse direction of rotation of the encoder with respect to the motor.
1FW320□	-3.5	
1FW328□	-5	

2.5.2.7 Coaxial encoder mounting

Coaxial encoder mounting is available for high dynamic requirements and the highest precision. The encoder module can be easily replaced without requiring readjustment.

Further information can be found in Chapter "Replacing an encoder (Page 179)."

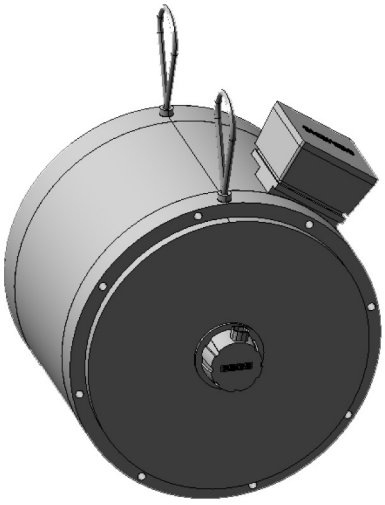


Figure 2-7 1FW3 with coaxially mounted encoder

2.5.2.8 Motor version without encoder

To connect the temperature sensors, use the separate terminal in the terminal box. The terminal box has a cable entry for this purpose.

You can find further information about connecting the temperature sensors in Chapter "Connecting temperature sensors (Page 150)"

2.5.3 Water cooling

⚠ WARNING

Defective work on the cooling circuit

Defective work on the cooling circuit can cause injury and/or damage to property.

- Only qualified personnel may assemble, install, and commission the cooling circuit.
- Perform installation or service work on the cooling circuit only when the system is de-energized.

Note

Cooling circuit

Only closed and semi-open cooling circuits are permissible for motors.

Equipotential bonding

WARNING

Electric shock as a result of incorrectly routing the cooling water pipes

If electrically conductive cooling water pipes come into contact with live parts, this can cause an electric shock leading to death or severe injury.

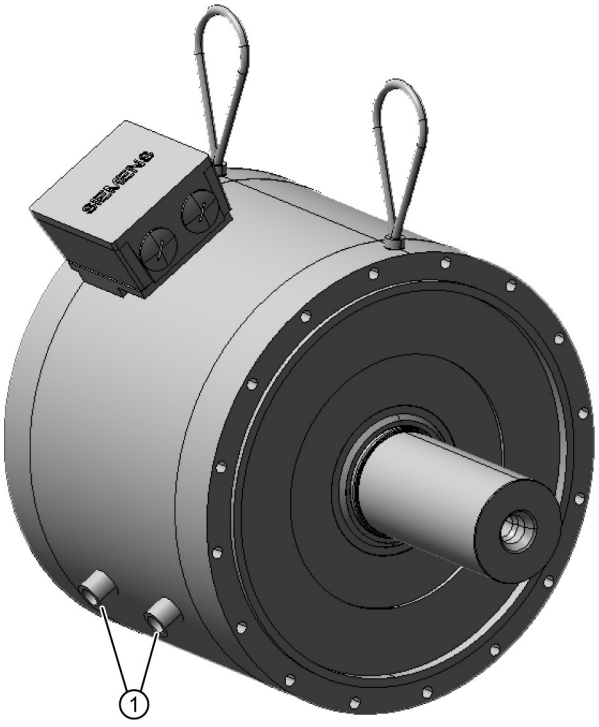
- Ensure adequate insulation.
- Securely fasten the pipes.

- Provide all components in the cooling system (motor, heat exchanger, piping system, pump, pressure equalization tank, etc.) with equipotential bonding.
- Implement the equipotential bonding using a copper rail or finely stranded copper cable with the appropriate conductor cross-sections.

Connecting the water cooling

The motor can only be operated in a closed or semi-open cooling-water circuit with a cooling unit.

The motor is connected to the cooling circuit using two female threads on the circumference of the motor. The intake and discharge lines can be connected to either.



1 Ports for the water cooling

Notes on setting up the cooling circuit

- Use pipes and fittings made of brass, stainless steel, or plastic. Galvanized pipes and fittings are not permitted.

  Note

  If you use different materials in the cooling circuit, pay attention to the electrochemical series. That is the reason why zinc must not be used in cooling water circuits.

- To ensure mechanical decoupling, the devices should be connected using hoses.
- Install a filter (100 µm) against contamination in the flow line of the cooling circuit.
- If various components are connected in the cooling circuit, if required, compensate the pressure.
- If necessary, limit the flow rate with a flow restrictor. Install the flow restrictor downstream of the motor. It must not be installed directly in front of the inlet because it may cause cavitation.

Table 2-14 Technical data relating to water cooling

Cooling water connection	1FW315☐	G 1/2"
	1FW320☐	
	1FW328☐	G 1"
Maximum pressure at the intake/maximum permissible pressure in the cooling circuit		6 bar
Minimum cooling water inlet temperature		$T_{cooling} > T_{ambient}$ - 5 K
Maximum cooling water inlet temperature, without derating		≤ 30 °C, higher values will cause derating

You can find the values for the cooling water flow and pressure drop between the intake and outlet for the minimum cooling water flow in Table "Cooling power to be dissipated".

Note

Avoid cavitation

In continuous operation, the pressure drop across a converter or motor must not exceed 0.2 MPa (2 bar).

Note

Avoid condensation

Cooling water temperatures that are lower than the ambient temperature tend to result in increased water condensation. The difference between the cooling water inlet temperature and the ambient temperature must therefore not exceed a maximum of 5 K (Kelvin).

- Select the cooling water inlet temperature such that condensation does not form on the surface of the motor: $T_{cooling} > T_{ambient}$ - 5 K.
- Additionally shut off the coolant supply if the motor is to remain at a standstill for a long time.

Lowering the inlet temperature of the cooling water by 5 K relative to the ambient temperature permits a relative humidity of up to approx. 75 % for the temperatures in the "Derating factors" table below. Condensation does not then occur. Deviations from these values are provided by the Mollier diagram.

- If the relative humidity is higher than 75 %, you will have to raise the inlet temperature of the cooling water further.
- If the actual relative humidity is lower than 75 %, you can lower the inlet temperature of the cooling water further.

Table 2-15 Derating factors

Cooling water inlet temperature	≤ 30 °C	35 °C	40 °C	45 °C
Derating factor	1.00	0.97	0.95	0.92

The factors refer to the static torque M_0. You shift the S1 characteristic in parallel.

Note

Cooling water inlet temperatures > 45 °C

Contact your local Siemens office for cooling water inlet temperatures > 45 °C.

The following data are required to answer your inquiry about derating due to increased ambient temperatures:

- Ambient temperature in °C
- Absolute air humidity in g/m³ or relative air humidity in %
- Shaft temperature of the driven machine in °C

Coolant specification

As coolant, use only water that complies with the "water specification for coolant."

Note

Use deionized water with reduced conductivity (5 ... 10 µS/cm) as the coolant.

Table 2-16 Coolant water specifications

	Quality of the water used as coolant for motors with aluminum, stainless steel tubes + cast iron or steel jacket
Chloride ions	< 40 ppm, can be achieved by adding deionized water.
Sulfate ions	< 50 ppm
Nitrate ions	< 50 ppm
pH value	6 ... 9 (for aluminum 6 ... 8)
Electrical conductivity	< 500 µS/cm
Total hardness	< 170 ppm
Dissolved solids	< 340 ppm
Size of entrained particles	< 100 µm
Corrosion protection	0.2% to 0.25% inhibitor, Nalco TRAC100 (previously 0GE056)
Anti-freeze protection	When required, 20% to 30% Antifrogen N (made by Clariant)

1) Derating is not required for an anti-freeze protection concentration < 30%. Inhibitor is not required if an Antifrogen N concentration > 20% is ensured.

The values specified for the water as a coolant are the requirements for a closed cooling circuit. Not all of the specified concentrations will occur in the water at the same time.
When necessary, contact your water utility for the values.

Note

Inhibitor is not required if an Antifrogen N concentration > 20% is ensured.

Derating is not required for antifreeze protection components < 30 %.

Other coolants (e.g. cooling-lubricating medium, water-oil mixtures with 10% oil and higher) can reduce the power of the motor.

Note

Power reduction when using a different coolant

Derating is required for water-oil mixtures with more than 10% oil.

If there is a risk of frost, preventive measures must be taken for operation, storage, and transportation.

- Replenish antifreeze for operation (see Table "Coolant water specifications").

Note

- Avoid mixing different antifreeze products.
- Use and dose the antifreeze according to the manufacturer’s specifications.

Biocide

Note

Compatibility of coolant additives

Biocides and Antifrogen N must not be mixed.

Cooling powers to be dissipated and the cooling flow rate

The values specified in the table "Cooling power to be dissipated" refer to a cooling-water temperature of +30 °C and S1 duty.

The cooling power to be dissipated specified in the table refers to the highest power loss to be dissipated for the particular shaft height for a maximum temperature difference between cooling water intake/cooling water discharge of 10 K.

Table 2-17 Cooling power to be dissipated

Motor type	Cooling power to be dissipated at n_N in kW	Pressure loss Δp in bar	Cooling flow rate V in l/min
SH 150 Standard			
1FW3150-1	1.4	0.1	2.0
1FW3152-1	1.6	0.1	3.0
1FW3154-1	2.3	0.2	4.5
1FW3155-1	2.7	0.1	5.5
1FW3156-1	3.4	0.2	7.0
SH 200 Standard			
1FW3201-1	1.7	0.1	3.0
1FW3202-1	2.3	0.2	4.0
1FW3203-1	3.4	0.1	5.0
1FW3204-1	3.9	0.1	6.0
1FW3206-1	5.5	0.3	8.0
1FW3208-1	8.4	0.6	10.0
SH 200 High Speed			
1FW3201-3	2.9	0.2	3.5
1FW3202-3	4.2	0.4	5.0
1FW3203-3	5.4	0.1	6.5
1FW3204-3	6.7	0.2	8.0
1FW3206-3	8.8	0.5	10.5
1FW3208-3	10.9	1.0	13.0
SH 280 Standard			
1FW3281-2	7.9	0.5	11.0
1FW3283-2	9.0	0.7	13.0
1FW3285-2	12.8	0.7	16.0
1FW3287-2	15.7	0.8	20.0
SH 280 High Speed			

Motor type	Cooling power to be dissipated at n_N in kW	Pressure loss Δp in bar	Cooling flow rate V in l/min
1FW3281-3	8.6	0.5	11.0
1FW3283-3	10.3	0.7	13.0
1FW3285-3	13.8	0.7	16.0
1FW3287-3	18.9	0.8	20.0

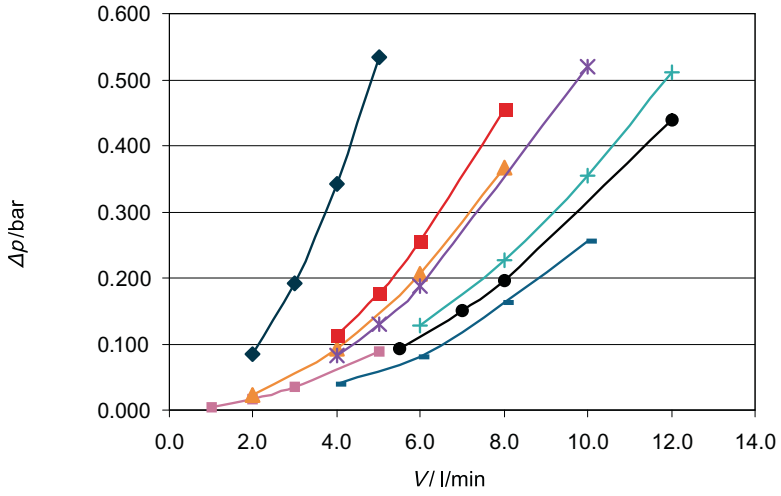


Figure 2-8 Flow rate for SH 150

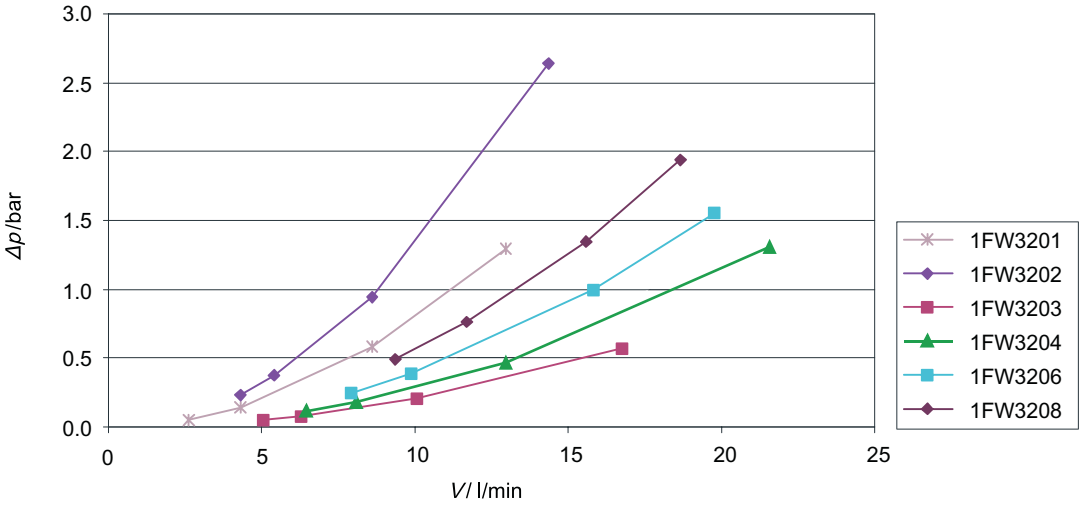


Figure 2-9 Flow rate for SH200

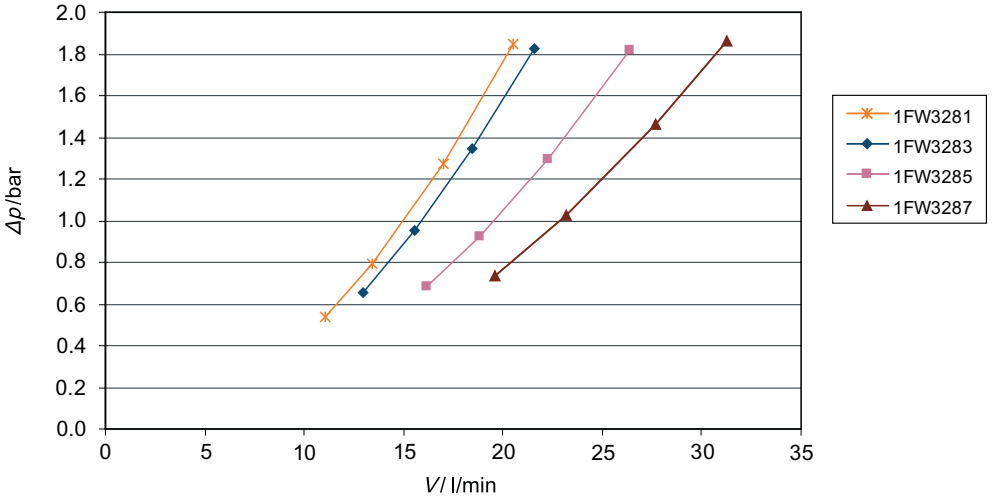


Figure 2-10 Flow rate for SH280

Coolant volume of the motor

Table 2-18 Coolant volume of the motor

Length (7th position in the Article No.)	Coolant volume of the motor (liters)				
	1FW315			1FW320	1FW328
	Hollow shaft	Plug-on shaft	Solid shaft		
0	0.23	0.11	0.11	-	-
1	-	-	-	0.33	2.24
2	0.38	0.30	0.30	0.60	-
3	-	-	-	0.80	3.23

Length (7th position in the Article No.)	Coolant volume of the motor (liters)				
	1FW315			1FW320	1FW328
	Hollow shaft	Plug-on shaft	Solid shaft		
4	0.57	0.57	0.57	1.20	-
5	0.73	0.61	0.61	-	4.10
6	0.86	0.73	0.73	1.79	-
7	-	-	-	-	5.12
8	-	-	-	2.55	-

Avoid additional heat entry

NOTICE

Demagnetization of the magnets due to additional heating of the shaft

If the motor is additionally heated through the shaft of the customer application, the magnets may become demagnetized. The following measures, for example, can be taken to avoid additional heat influx into the motor through the customer application:

- Reduce the temperature of the shaft of the customer application.
- Thermally insulate the shaft of the customer application from the motor.
- Reduce the temperature of the medium channeled through the hollow motor shaft by the customer application.
- Reduce the power.
- Use a larger motor.
- Contact "Technical Support" for assistance.

2.5.4 Braking resistors (armature short-circuit braking)

Function description

For transistor PWM converters, when the DC link voltage values are exceeded or if the electronics fails, then electrical braking is no longer possible. If the drive which is coasting down, can represent a potential hazard, then the motor can be braked by short-circuiting the armature. Armature short-circuit braking should be initiated at the latest by the limit switch in the traversing range of the feed axis.

The friction of the mechanical system and the switching times of the contactors must be taken into account when determining the distance that the feed axis takes to come to a complete stop. In order to avoid mechanical damage, mechanical stops should be located at the end of the absolute traversing range.

For servomotors with integrated holding brake, the holding brake can be simultaneously applied to create an additional braking torque – however, with some delay.

NOTICE
Damage to the converter If an armature short-circuit contactor is energized or de-energized before the converter pulses are canceled, then the contactor contacts can burn and the converter can be destroyed. • You must always ensure that the converter pulses are first canceled and this actually implemented.

WARNING
Operational braking not functioning If the brake is not connected to the setpoint input intended for the purpose, then the brake is not controlled and the motor will not be braked. • For operational braking, connect the brake via the setpoint input. Observe the information in the converter configuration manual.

For electrical braking using armature short-circuit of the stator, consult the documentation of the drive system being used.

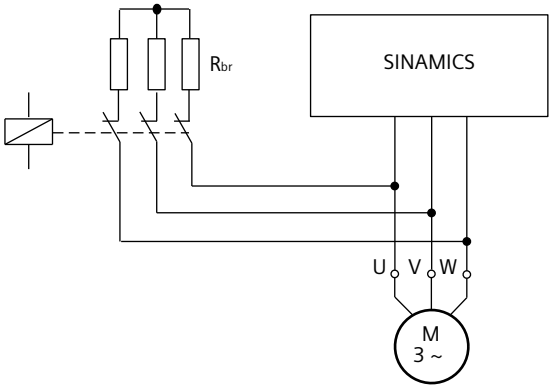


Figure 2-11 Circuit (schematic) with brake resistors

Further information

Further information is provided in the appropriate chapters of the Configuration Manual.

2.5.5 Mechanical properties of the motors

2.5.5.1 Shaft end and shaft versions

The complete torque motor 1FW3 can be ordered with 3 different shaft versions:

- Hollow shaft
- Plug-on shaft / stub shaft
- Solid shaft

Note

C-shaft *)

The C-shaft is a hollow through-shaft. The data for the hollow shaft mentioned in this document also applies to the C-shaft.

*) C-shaft = Hollow shaft for inner clamping element, 15th position in the Article No.

The DE shaft end is cylindrical in accordance with DIN 748-3 (IEC 60072-1).

Table 2-19 Hollow shaft / stub shaft

Frame size	Flange centering edge d_i / mm
1FW315☐	153 H7
1FW320☐	153 H7
1FW328☐	250 H7

Table 2-20 Plug-on shaft

Frame size	Flange centering edge d_i / mm	Support d_i / mm
1FW315☐	153 H7	70 H6
1FW320☐	153 H7	85 H6
1FW328☐	250 H7	110 H7

Table 2-21 Solid shaft

Frame size	Shaft length l / mm	Shaft diameter d / mm
1FW315☐	140	65 m6
1FW320☐	170	90 m6
1FW328☐	210	120 m6

The shaft version "solid shaft" can be ordered with a plain shaft end or with keyway (according to DIN 6885-1).

Note

Shaft cover at NDE for the "hollow shaft" version

If the hollow through-shaft is not used by the customer and must be sealed at the NDE for touch protection reasons, the motor can be supplied with a shaft cover at the NDE. Ordering options: Order code T20.

See the dimension drawings for further details.

Direction of rotation

The positive direction of rotation is clockwise when viewing the drive end (flange side).

2.5.5.2 Degree of protection

The degree of protection is defined according to EN 60034-5 (e.g. IP55).

The degree of protection is stamped on the rating plate.

The combination of letters and numbers has the following significance:

- IP = International Protection
- 1st digit = protection against the ingress of foreign bodies
  - "5" means complete protection against contact and protection against the ingress of dust in damaging quantity
- 2nd digit = protection against water
  - "5" means protection against water jets aimed at the enclosure from every direction.

Cooling lubricants containing oil with creepage, which can also be aggressive, are mainly used in machine tools and transfer machines. Protection against water alone is not sufficient. Covers must protect motors against cooling lubricants that contain oil, can creep and/or are corrosive.

The motor shaft seal must correspond to the selected motor protection type.

Table 2-22 Degree of protection of the 1FW3 complete torque motors

Motor	Shaft version		
	Hollow shaft	Plug-on shaft / stub shaft	Solid shaft
1FW315☐	IP54	IP55	IP55
1FW320☐ Standard	IP54	IP55	IP55
1FW320☐ High Speed	-	IP55	IP55
1FW328☐ Standard	IP54	IP54	IP54
1FW328☐ High Speed	IP54	IP54	IP54

2.5.5.3 Bearing version

The bearings for the complete torque motors are greased for life and designed for a minimum ambient temperature in operation of -15 °C.

Table 2-23 Bearing designation

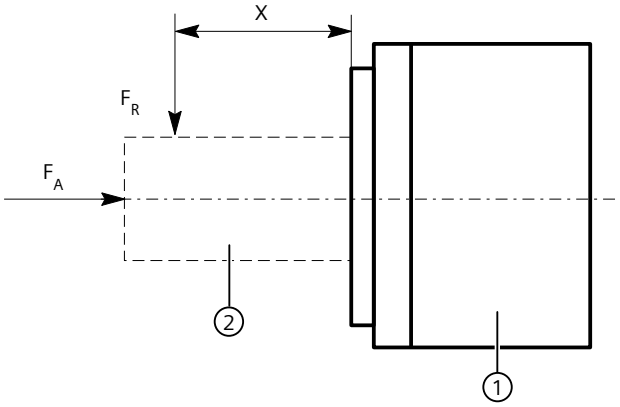
Shaft version	**Basis bearing designation**		
	SH 150	**SH 200**	**SH 280**
Hollow shaft DE (fixed bearing)	61838	61838	61864
Hollow shaft NDE (floating bearing)	61832	61832	61856
Plug-on shaft DE (fixed bearing)	61838	61838	61864
Plug-on shaft NDE (floating bearing)	6213	6020	6230
Solid shaft DE (fixed bearing)	6215	6220	6230
Solid shaft NDE (floating bearing)	6213	6020	6230
Stub shaft DE, option L03 (fixed bearing)	-	61838	61864
Stub shaft NDE, option L03 (floating bearing)	-	6020	6230

You can find further information about the bearings in Chapter "Bearing change intervals (Page 175)".

2.5.5.4 Radial and axial forces

Point of application of radial forces F_R at the torque motor

- for average operating speeds
- for a nominal bearing change interval of 20000 h



1 Complete torque motor

2 Shaft

Dimension X in mm: Distance between the point of application of force F_R and the shaft shoulder of the torque motor

Radial force F_R in N

Axial force F_A in N

Figure 2-12 Point of application of radial force F_R and axial force F_A

NOTICE

Running inaccuracy and premature bearing failure

With the types of construction IM V3, IM V19 and IM V35, the force imposed by the weight of the rotor and/or the force imposed by the weight of the customer attachment may impermissibly reduce or even nullify the spring work force of the DE bearing.

As a consequence, the specified running accuracy cannot be maintained. Furthermore, the bearings could fail prematurely.

- Get help from Technical Support. See Chapter "Introduction" for the contact information.

NOTICE

Premature bearing damage

Bearings can be prematurely damaged, if force transmission elements apply too much load to the shaft end as a result of radial forces.

- When using mechanical transmission elements, ensure that the maximum limit values specified in the radial force diagrams are not exceeded.

Note

Bearing design and validity of the axial force diagram

When using the axial force diagram, observe the maximum permissible radial force.

When the bearing is designed, the motor operating speed must be rounded-off according to the next-higher speed curve.

Hollow shaft (1FW315❑, 1FW320❑, 1FW328❑)

Radial force diagram for 1FW315❑ hollow shaft

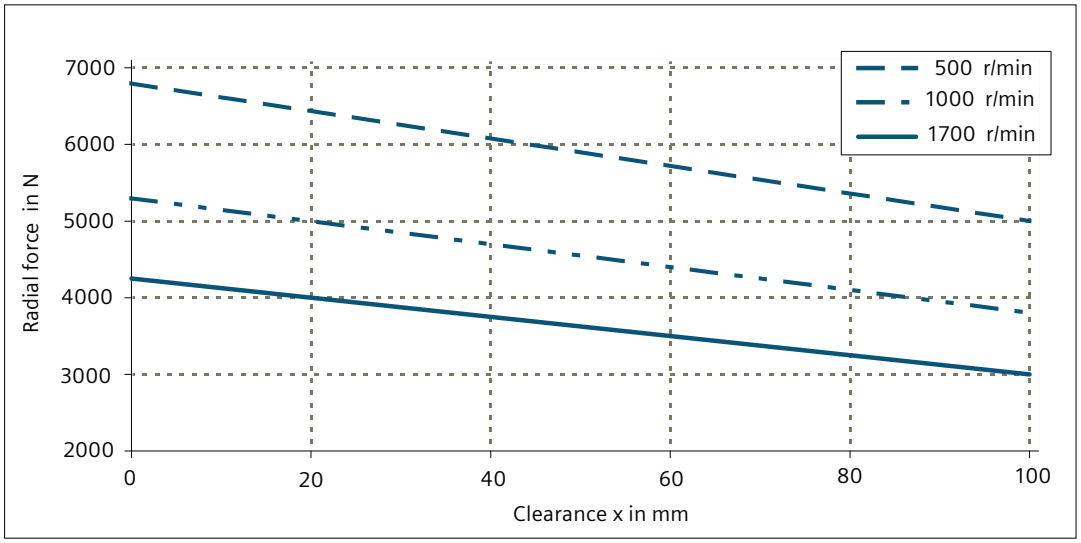


Figure 2-13 Radial force diagram for 1FW315❑, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW315❑ hollow shaft

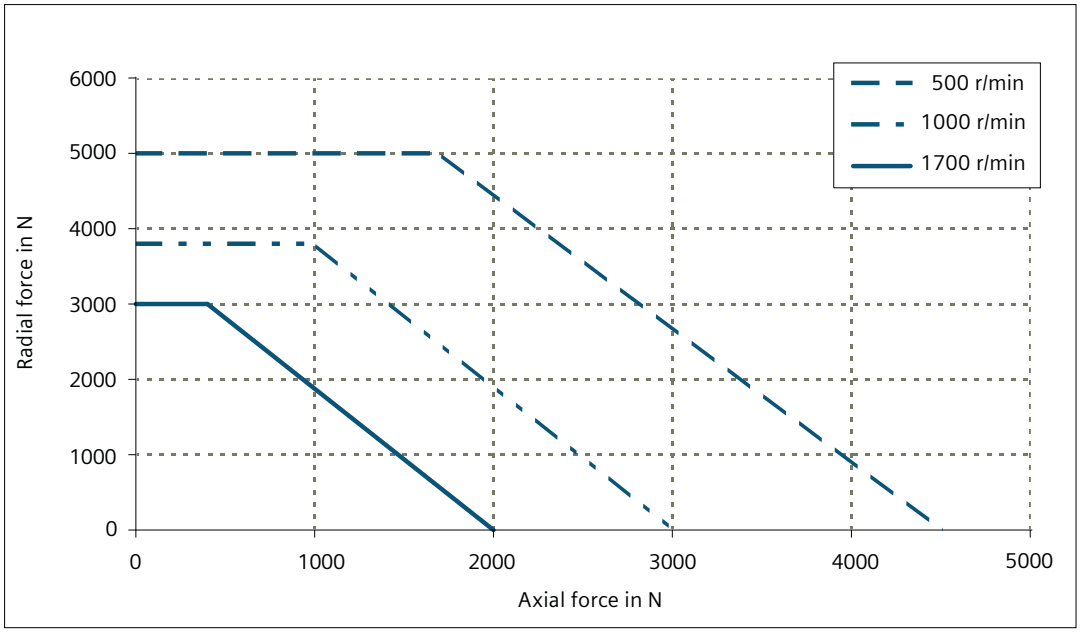


Figure 2-14 Permissible axial force as a function of radial force for 1FW315❑

Radial force diagram for 1FW320❑ hollow shaft

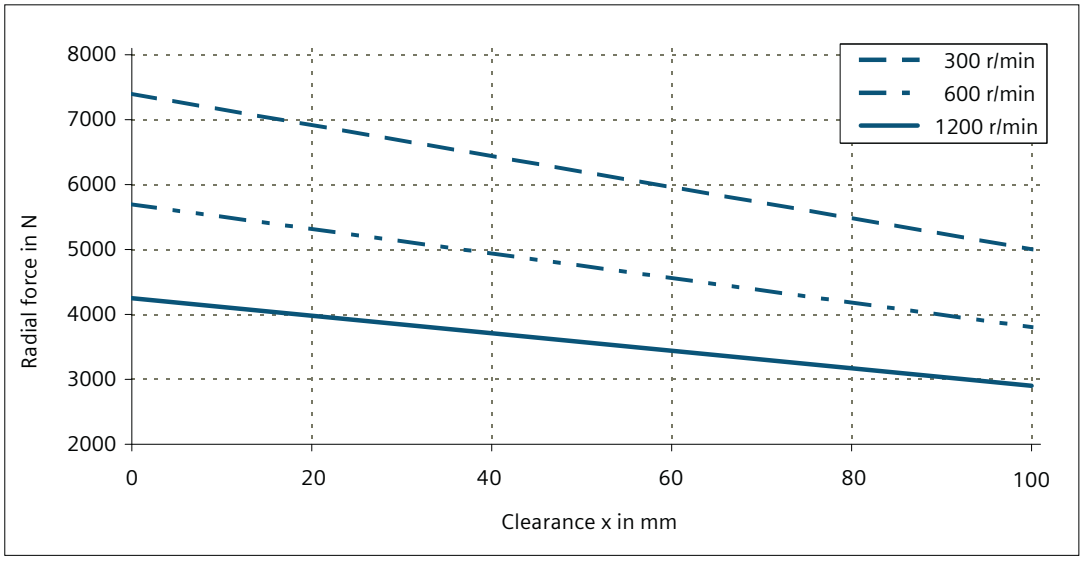


Figure 2-15 Radial force diagram for 1FW320❑, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW320❑ hollow shaft

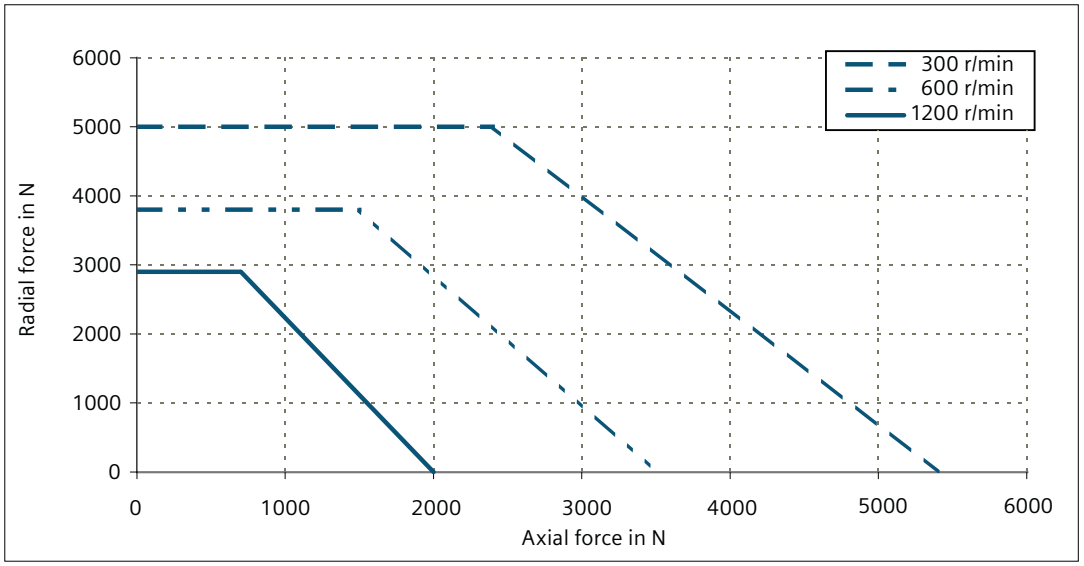


Figure 2-16 Permissible axial force as a function of radial force for 1FW320❑

Radial force diagram for 1FW328❑ hollow shaft

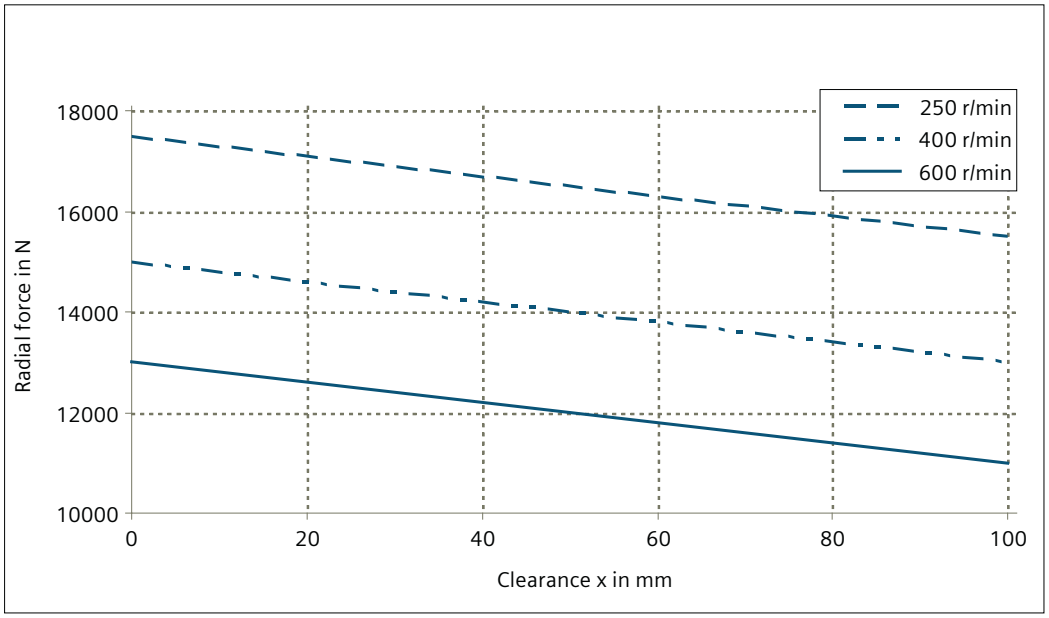


Figure 2-17 Radial force diagram for 1FW328❑, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW328❑ hollow shaft

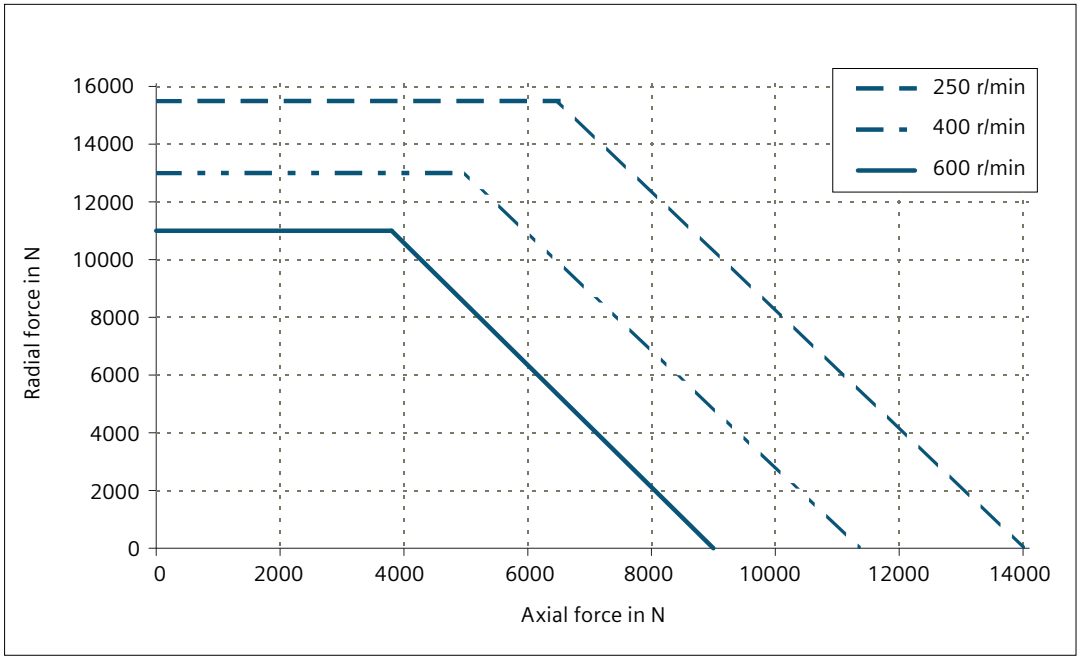


Figure 2-18 Permissible axial force as a function of radial force for 1FW328❑

Plug-on shaft / stub shaft (1FW315❑, 1FW320❑)

Note

Using a torque arm

For plug-on mounting (shaft mounting) we recommend that a Siemens torque arm is used (See Chapter "Siemens torque arm (Page 84)").

Radial force diagram for 1FW315❑ plug-on shaft / stub shaft

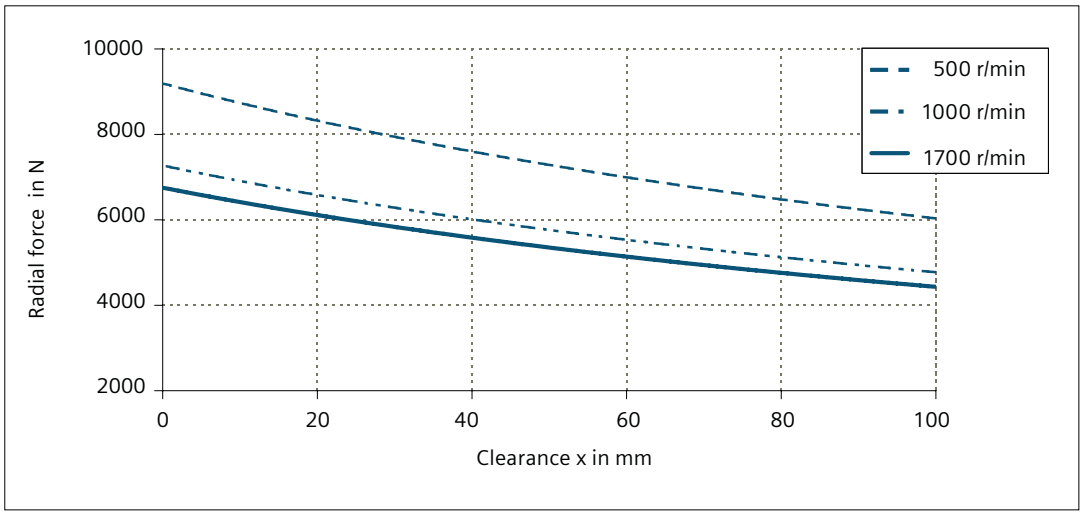


Figure 2-19 Radial force diagram for 1FW315❑, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW315❑ plug-on shaft / stub shaft

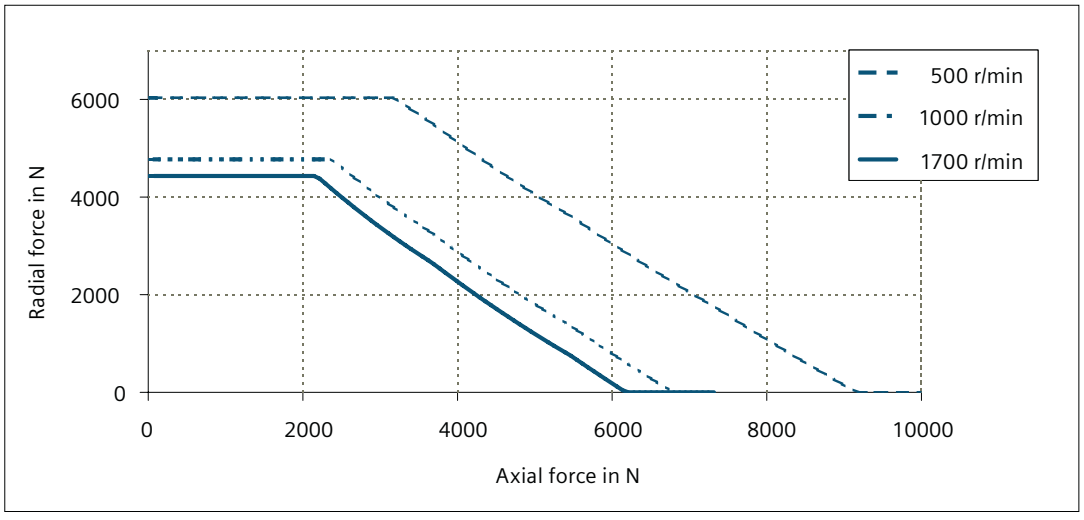


Figure 2-20 Permissible axial force as a function of radial force for 1FW315❑ (20000 h)

Radial force diagram for 1FW315❑ plug-on shaft / stub shaft

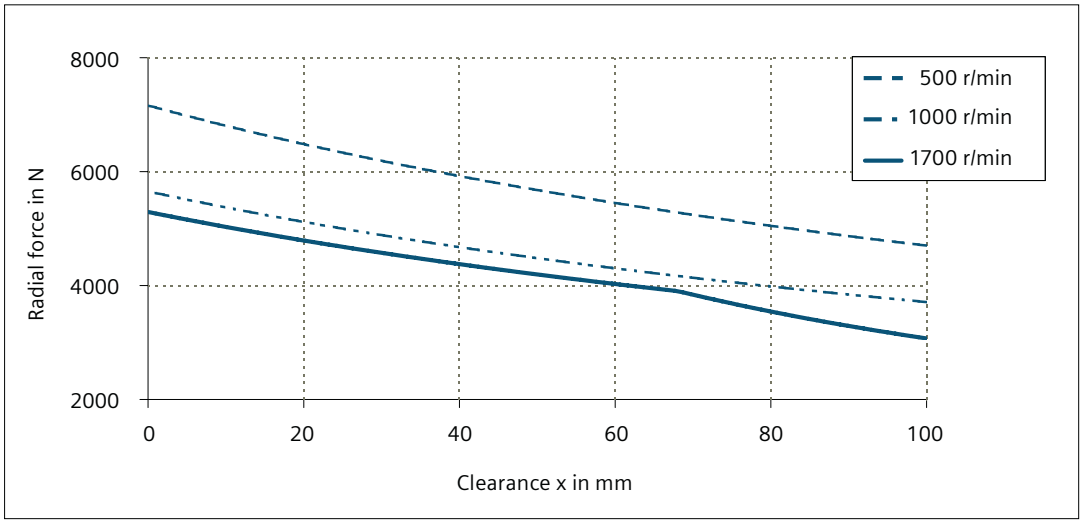


Figure 2-21 Radial force diagram for 1FW315❑, with nominal bearing change interval of 60000 h

Axial force diagram for 1FW315❑ plug-on shaft / stub shaft

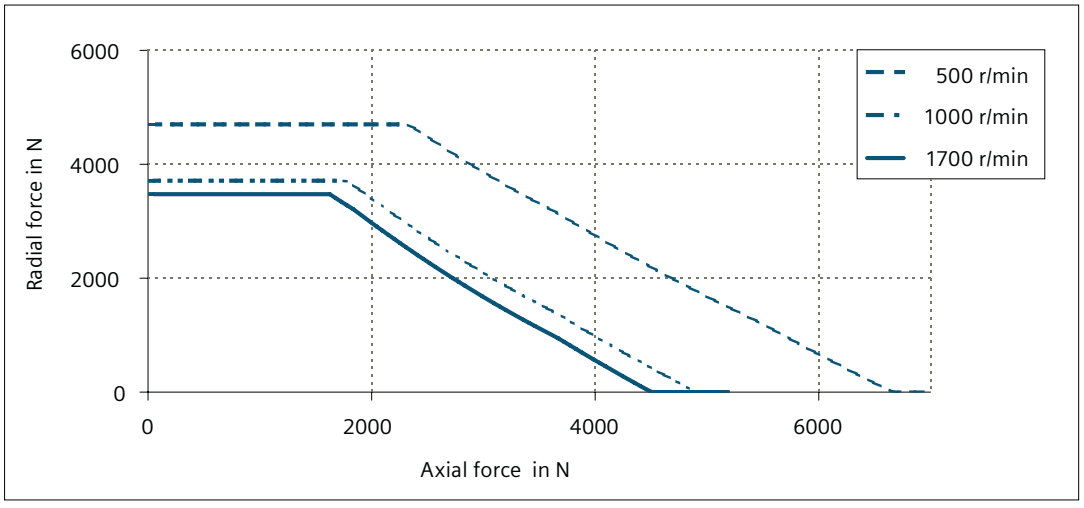


Figure 2-22 Permissible axial force as a function of radial force for 1FW315❑ (60000 h)

Radial force diagram for 1FW320❑ plug-on shaft / stub shaft

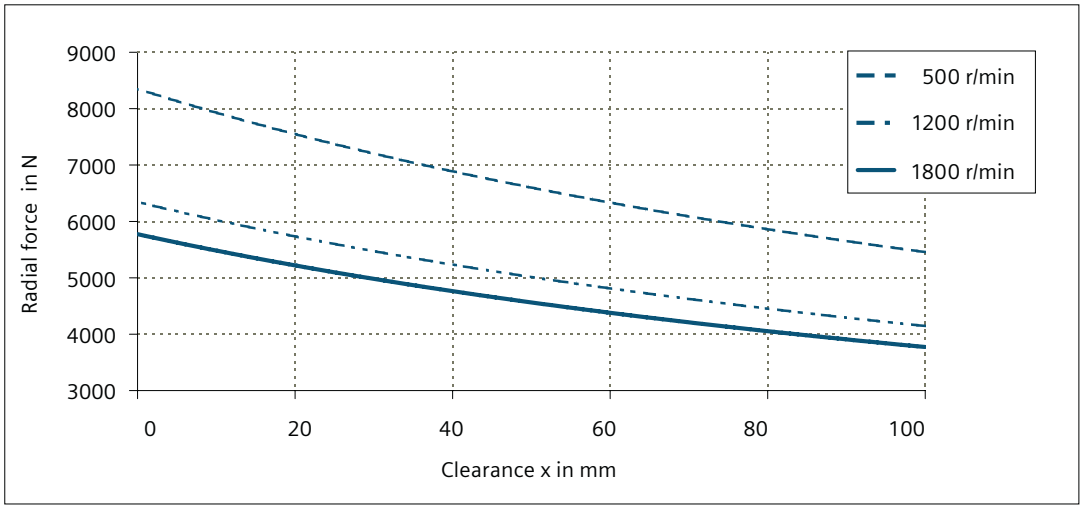


Figure 2-23 Radial force diagram for 1FW320❑, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW320❑ plug-on shaft / stub shaft

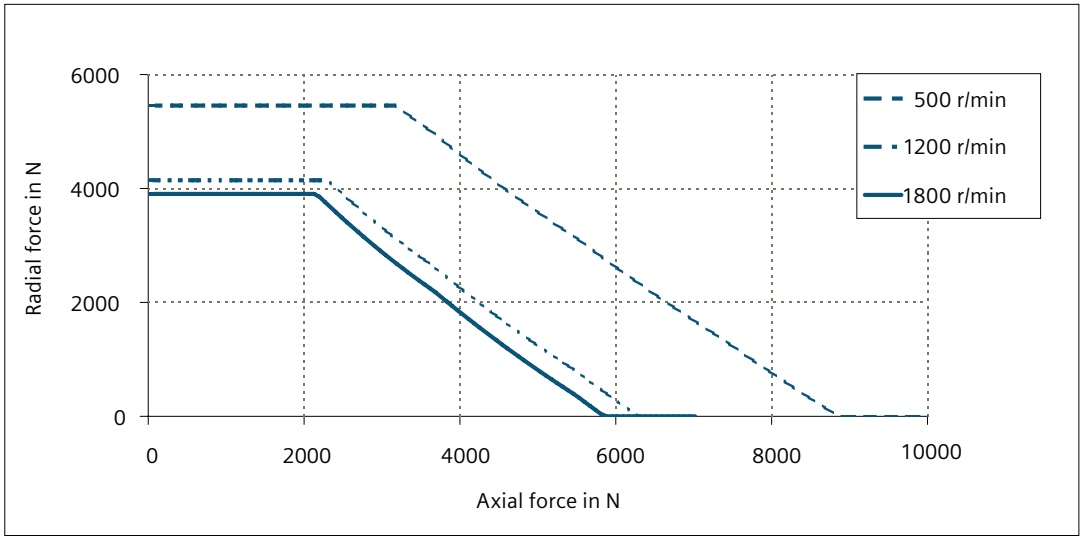


Figure 2-24 Permissible axial force as a function of radial force for 1FW320❑ (20000 h)

Radial force diagram for 1FW320❑ plug-on shaft / stub shaft

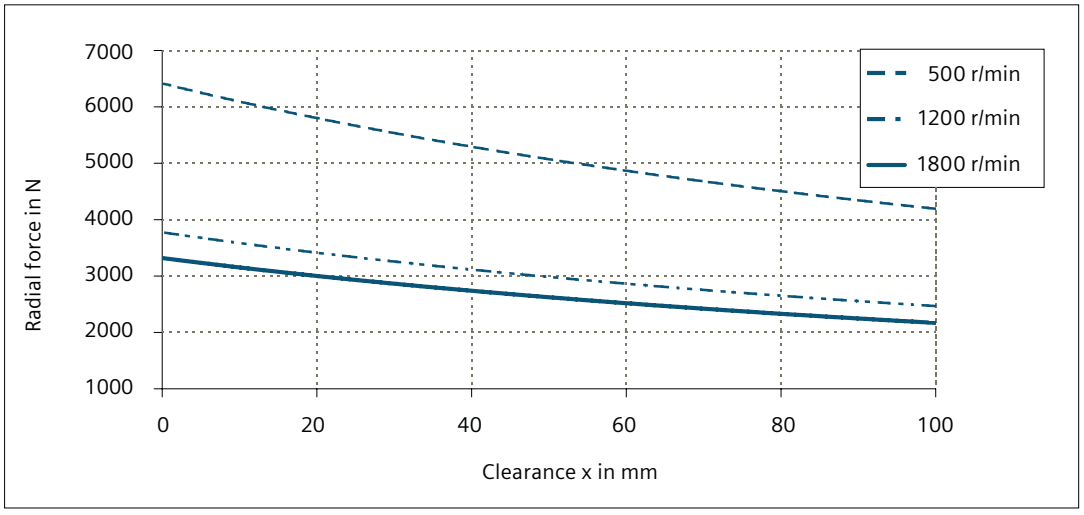


Figure 2-25 Radial force diagram for 1FW320❑, with nominal bearing change interval of 60000 h

Axial force diagram for 1FW320❑ plug-on shaft / stub shaft

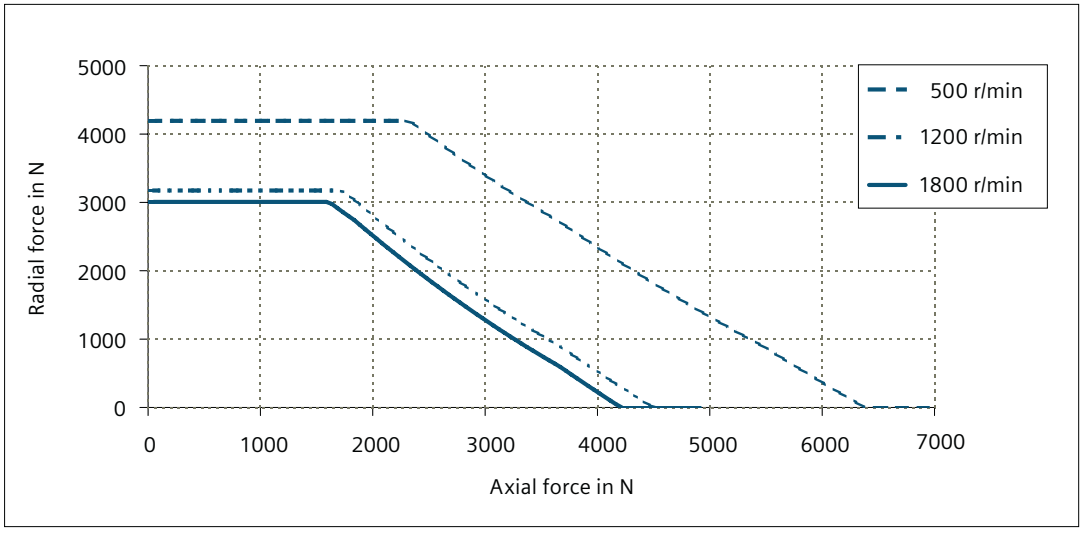


Figure 2-26 Permissible axial force as a function of radial force for 1FW320❑ (60000 h)

For motors 1FW328❑ plug-on shaft

Note

1FW328 motors with plug-on shaft (shaft-mounted design) must be mounted using a torque arm.

Solid shaft (1FW315❑, 1FW320❑, 1FW328❑)

Radial force diagram for 1FW315❑ solid shaft

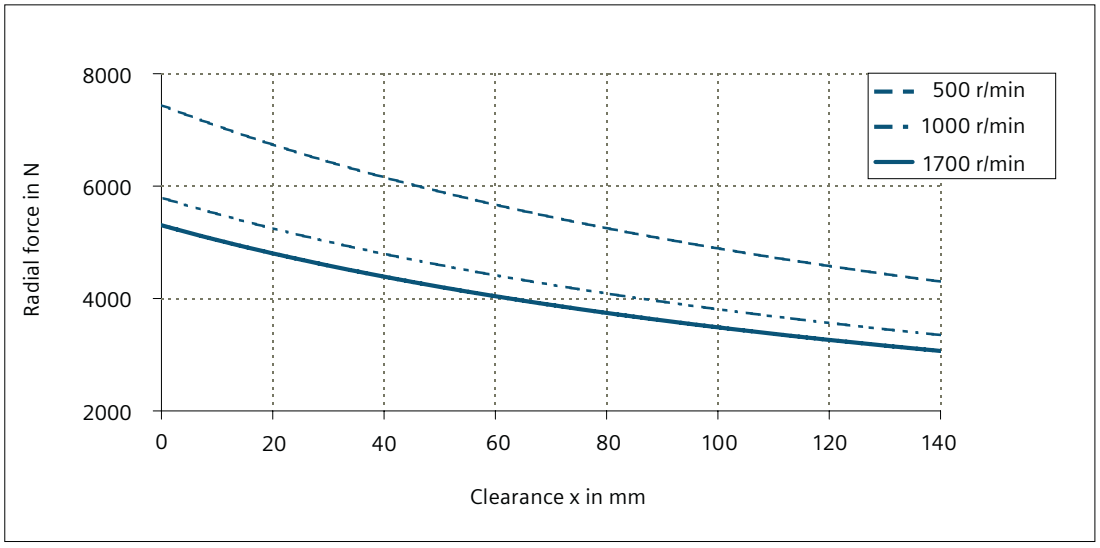


Figure 2-27 Radial force diagram for 1FW315❑, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW315❑ solid shaft

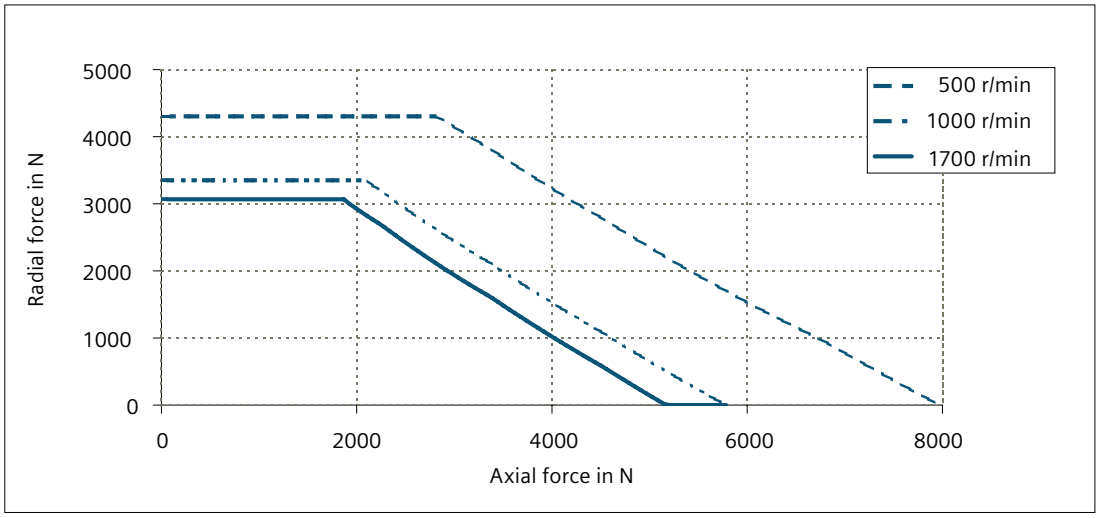


Figure 2-28 Permissible axial force as a function of radial force for 1FW315❑ (20000 h)

Radial force diagram for 1FW315❑ solid shaft

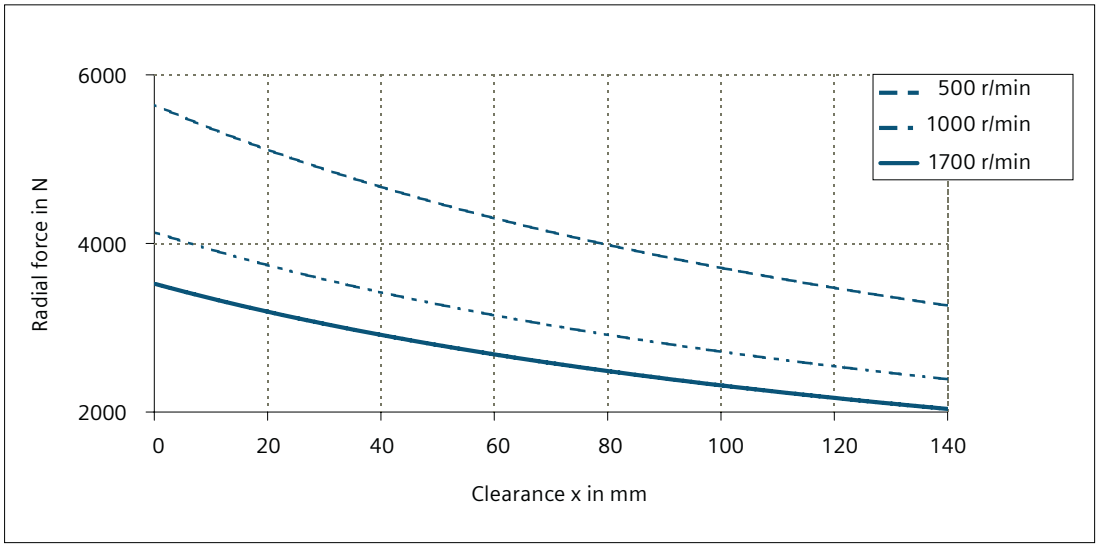


Figure 2-29 Radial force diagram for 1FW315❑, with nominal bearing change interval of 60000 h

Axial force diagram for 1FW315❑ solid shaft

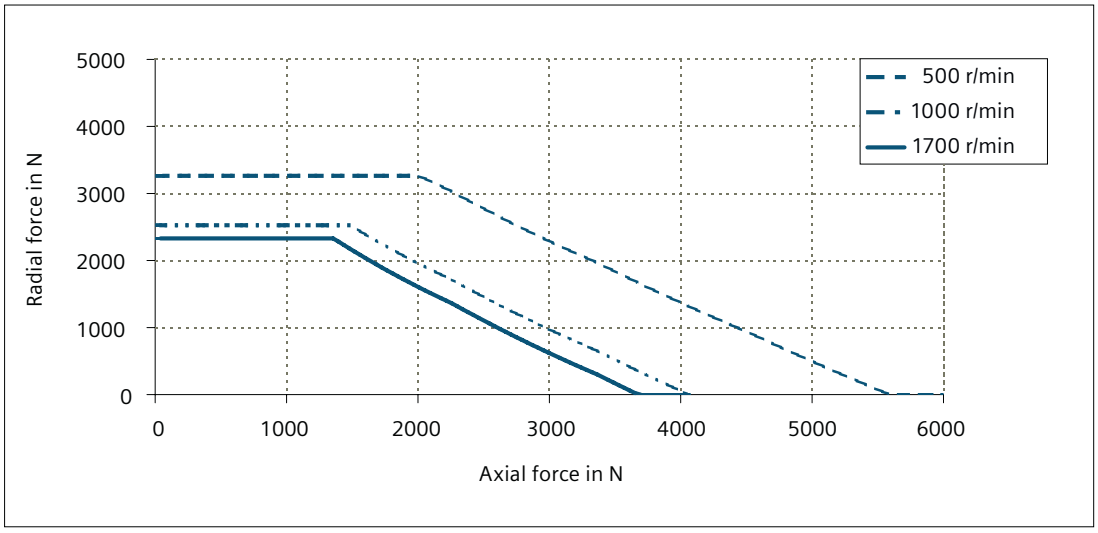


Figure 2-30 Permissible axial force as a function of radial force for 1FW315❑ (60000 h)

Radial force diagram for 1FW320❑ solid shaft

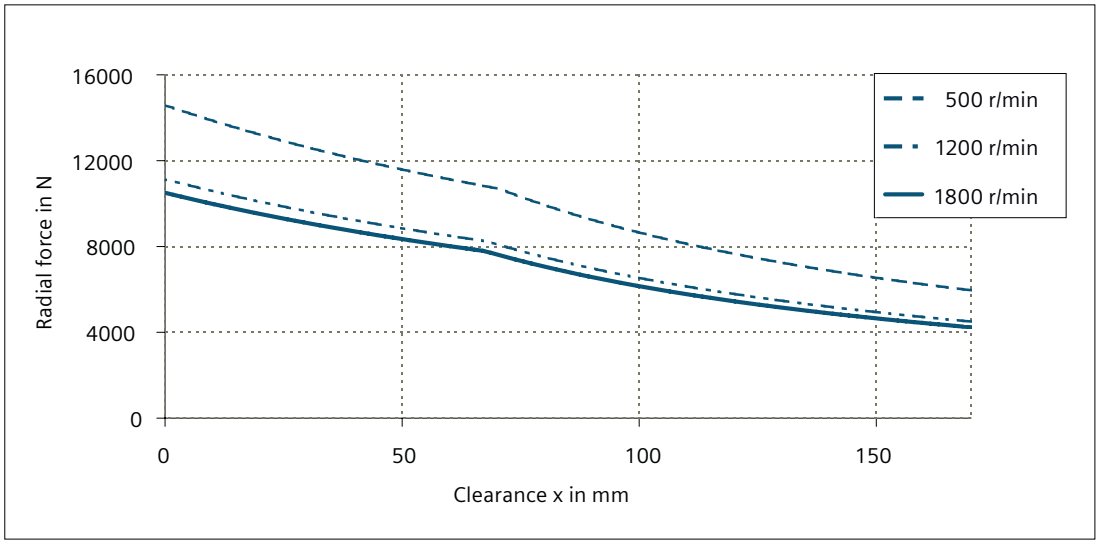


Figure 2-31 Radial force diagram for 1FW320❑, with nominal bearing change interval of 20000 h

Axial force diagram for 1FW320❑ solid shaft

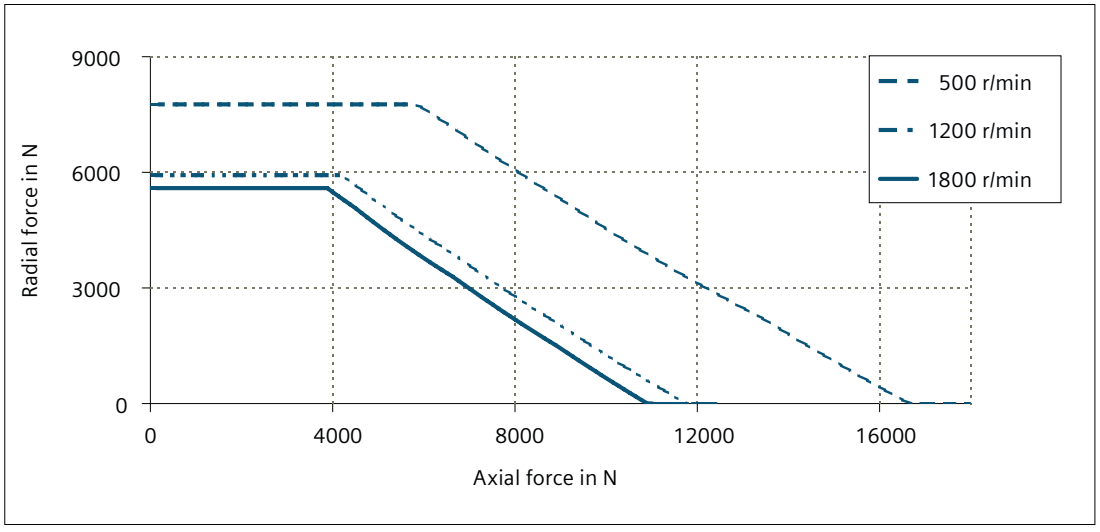


Figure 2-32 Permissible axial force as a function of radial force for 1FW320❑ (20000 h)

Radial force diagram for 1FW320❑ solid shaft

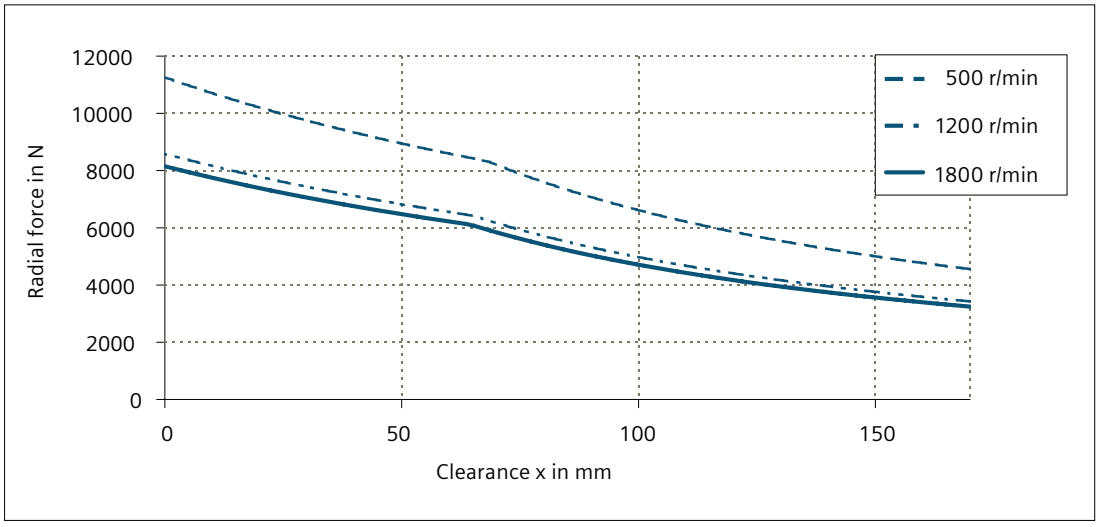


Figure 2-33 Radial force diagram for 1FW320❑, with nominal bearing change interval of 60000 h

Axial force diagram for 1FW320❑ solid shaft

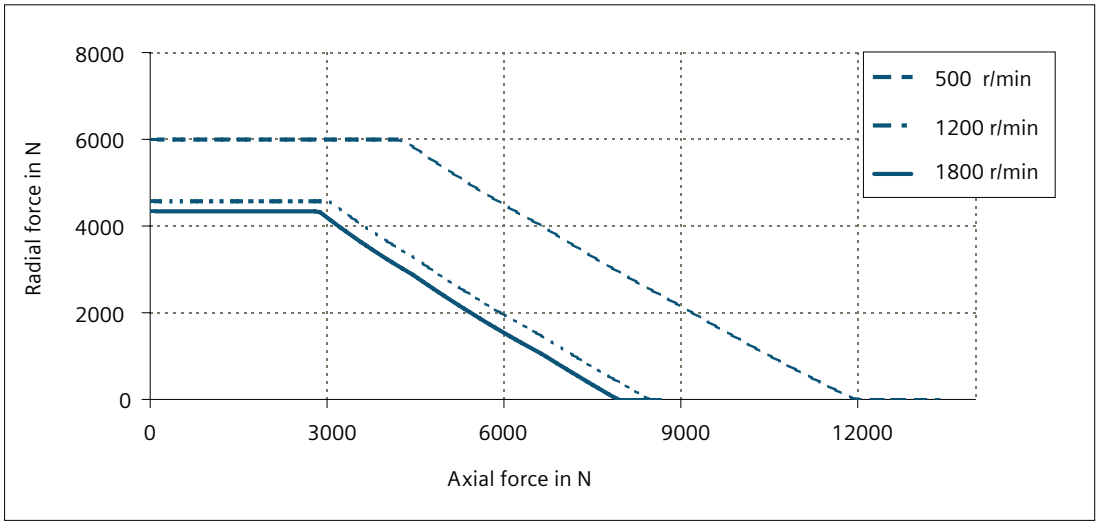


Figure 2-34 Permissible axial force as a function of radial force for 1FW320❑ (60000 h)

Radial force diagram for 1FW328❑ solid shaft

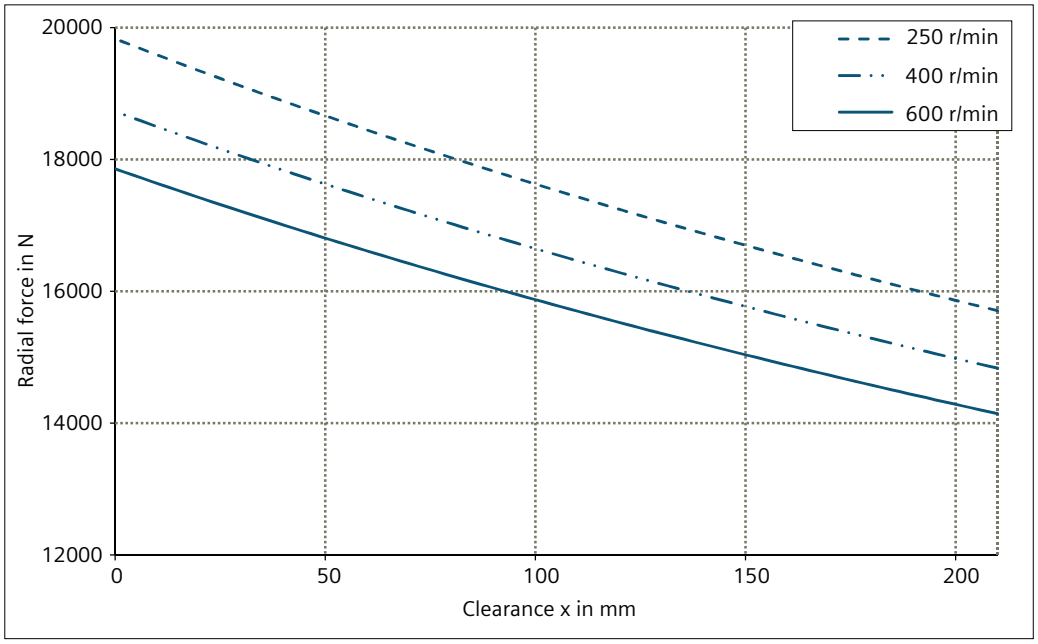


Figure 2-35 Radial force diagram for 1FW328❑, with nominal bearing change interval of 40000 h

Axial force diagram for 1FW328❑ solid shaft

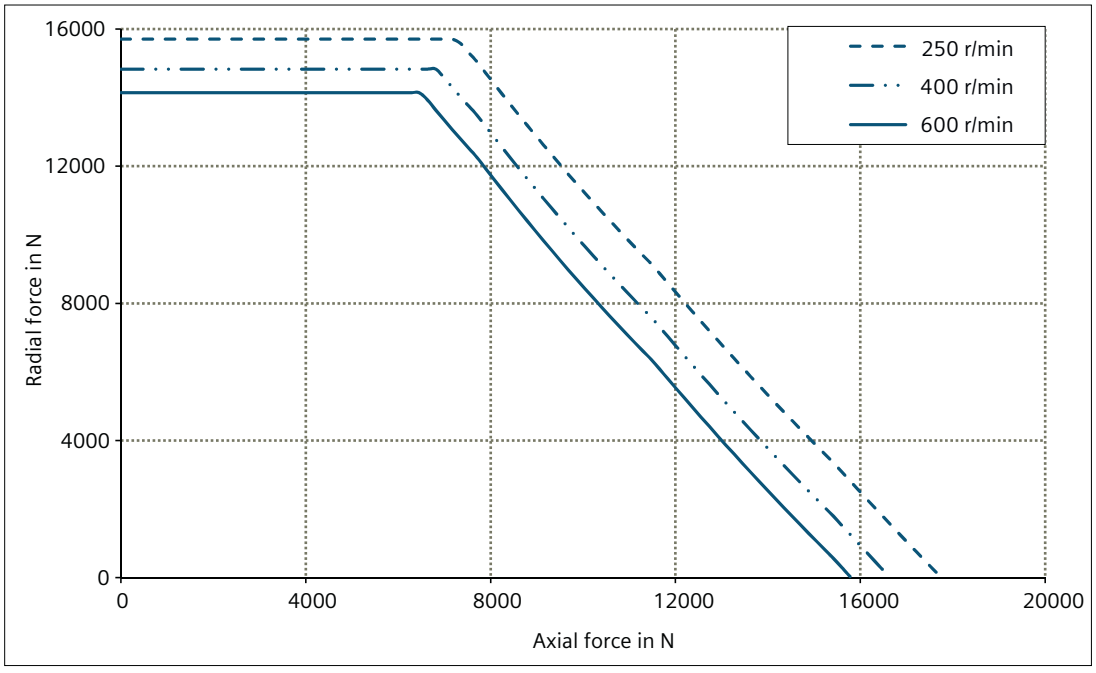


Figure 2-36 Permissible axial force as a function of radial force for 1FW328❑ (40000 h)

2.5.5.5 Balancing

Requirements placed on the balancing process for mounted components

Motors with hollow shaft and plug-on shaft must be balanced in the factory without any mounted components. Motors with solid shaft are balanced according to DIN ISO 21940-32.

In addition to the balance quality of the motor, the vibration quality of motors with mounted output elements is essentially determined by the balance quality of the mounted component.

If the motor and mounted component are separately balanced before they are assembled, then the process used to balance the output element must be adapted to the motor balancing type.

A distinction should be made between the following balancing types for solid shafts:

- Half-key balancing (an "H" is stamped on the shaft face)
- Smooth shaft end (no keyway)

The balancing type is coded in the order designation.

Special requirements

If special requirements are placed on the smooth running operation of the machine, we recommend that the motor together with the output components is completely balanced. In this case, balancing should be carried out in two planes of the output component.

2.5.5.6 Vibration reponse

The motors conform to vibration severity grade A in accordance with EN 60034-14.

The specified values refer to the motor only. The vibration behavior as a result of the mounting can result in increased values at the motor.

The vibration severity grade is maintained up to the rated speed (n_N).

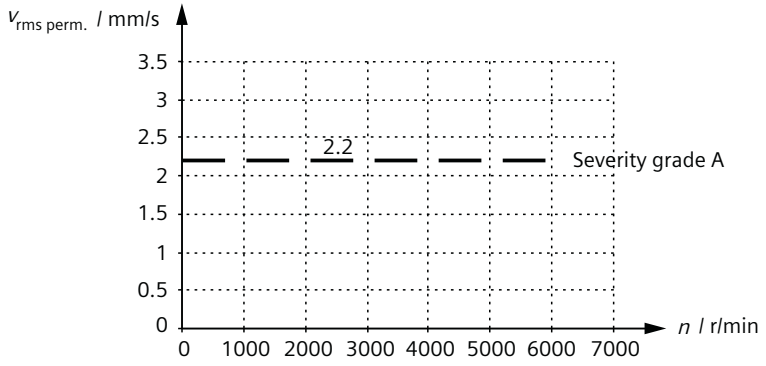


Figure 2-37 Vibration severity grade

Monitoring drive components via vibration signals

"Condition-monitoring-ready"-components

"Condition-monitoring-ready"-components in the drive train are monitoring at any time via vibration signals the drive components to avoid unexpected plant downtimes.

A change in the vibration response is an early indication of imminent damage. Condition-monitoring-ready motors are equipped with boreholes for inserting vibration sensors. This allows you to position vibration sensors optimally and install condition monitoring systems.

For further information about the Siemens condition monitoring system follow this link:

SIPLUS CMS (https://new.siemens.com/global/en/products/automation/products-for-specific-requirements/siplus-cms.html?_sm_au_=iVV514PkqnSJ0nfft2tQvK032Hv7C)

Motors with option G50

On motors with option G50, you can, for example, monitor the vibration severity at the ball bearing using sensors. Information how to mount the sensors are in chapter "Mounting vibration sensors (Z-option G50) (Page 119)".

Bearing

The ball pass frequencies of the ball bearings are stated on the bearing data labeling plate. You will find the bearing data labeling plate near the rating plate. Read out the bearing natural frequencies from the QR code on the bearing data labeling plate.

Depending on the evaluation unit you use, you will be able to detect the specific frequencies listed below.

The abbreviations have the following meaning:

BPFO: Ball Pass Frequency of Outer ring

BPFI: Ball Pass Frequency of Inner ring

BSF: Ball Spin Frequency

FTF: Fundamental Train Frequency

2.5.5.7 Vibration response 1FW3 Heavy Duty (Z option L03)

Table 2-24 Shock load 1FW3 Heavy Duty (Z option L03)

	Vibration acceleration a_{peak}
Max. permissible radial shock load	100 m/s^2
Max. permissible axial shock load	50 m/s^2

Evaluate the vibration acceleration as a peak value in the time domain in a frequency band extending from 0 up to 2000 Hz. The measurement must be made at the DE flange (based on DIN ISO 10816).

Appropriately adapt the measuring range if it is expected that noticeable vibration levels are excited above 2000 Hz (e.g. as a result of gear tooth meshing frequencies). This does not alter the maximum permissible values.

2.5.5.8 Noise emission

In operation, 1FW3 motors can reach the following measuring-surface sound-pressure level Lp(A):

Max. 73 dB(A) at 4 kHz rated pulse frequency at the nominal operating point

Note

Sound-pressure level when reducing the pulse frequency

When the pulse frequency is reduced, a significantly higher sound pressure level can occur.

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

⚠ WARNING

Hearing damage

Hearing damage may occur if the motor exceeds a sound pressure level of 70 dB (A) due to the type of mounting or pulse frequency.

- Reduce the sound pressure level by implementing sound damping and/or soundproofing measures.

2.5.5.9 Paint finish

The 1FW3 complete torque motors are shipped with an anthracite gray paint finish (similar to RAL 7016).

Option: Special paint finish.

Preparation for use

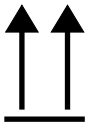
3

3.1 Shipping and packaging

The drive systems are put together on an individual basis.

Pay attention to the handling notes on the packaging in which the motor is delivered.

Table 3-1 Handling notes and their meaning

Symbol	Meaning	Symbol	Meaning
	Fragile (ISO 7000, No. 0621)		Keep dry (ISO 7000, No. 0626)
	Top (ISO 7000, No. 0623)		Do not stack (ISO 7000, No. 2402)

Checking the delivery for completeness

- Upon receipt of the delivery, check immediately whether the items delivered match the accompanying documents.

  Note

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

- Report any visible transportation damage to the delivery company immediately.
- Report any visible defects or missing items to the competent Siemens office immediately.

The delivery includes a second rating plate (type plate). The second rating plate can be used to post the motor data additionally in the vicinity of the motor.

The additional rating plate (type plate) is

- in the terminal box for motors with terminal boxes
- in the safety data sheet for motors with power connectors.

The supplementary sheets with the safety instructions are part of the scope of supply.

Note

Keep the sheets with the safety instructions in an accessible location at all times.

Scope of delivery

The following is included in the scope of delivery:

- Motor (in the shaft heights that can be ordered, 1FW315x, 1FW320x or 1FW328x)
- Rating plate (type plate)
- Circuit diagram
- Safety information and instruction leaflet

The URL to download the operating instructions is provided on the instruction leaflet. The rating plate enclosed as a loose item with the delivery ensures that the motor data can also be kept on or near the machine or system.

Note

The cooling system for a closed cooling water circuit is not included in the scope of delivery.

3.2 Transporting and storing

3.2.1 Transporting

⚠ WARNING

Danger to life when lifting and transporting

Incorrect execution, unsuitable or damaged devices and equipment can result in severe injury and/or material damage.

- Lifting devices, forklift trucks and load suspension equipment must comply with country-specific, local requirements.
- Pay attention to the lifting capacity of the hoisting gear. Do not attach any additional loads. Take the weight of the motor from the rating plate.
- To hoist the motor, use suitable cable-guidance or spreading equipment (particularly if additional components are mounted in or on the motor).
- After the motor has been placed down, ensure that it cannot roll.

NOTICE

Damage to the motor caused by incorrect lifting

The motor can be damaged if you incorrectly use lifting equipment.

- Use a cross beam when lifting and transporting the motor using the cable slings provided.

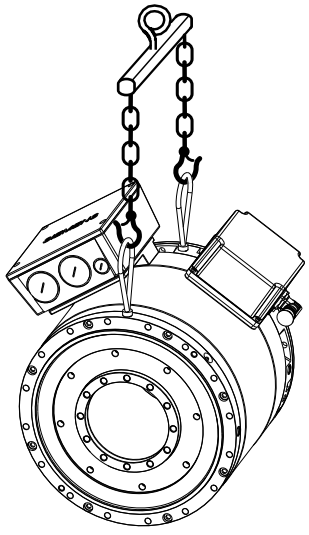


Figure 3-1 Lifting and transporting the motor with a cross beam

If you do not immediately commission a motor after it has been delivered, it must be stored in a dry, dust-free room that is not subject to vibration, see Chapter "Storing (Page 76)".

Transporting a motor that has already been in operation

Procedure

If you want to transport a motor that has already been in operation, proceed as follows:

1. Allow the motor to cool down.
2. Remove the connections on the customer side.
3. Empty the motor of any cooling water and purge it carefully with air.
4. Transport and lift the motor using the cable slings and a cross beam.

The motor is ready to be transported now.

❒

3.2.2 Storing

Note

Replacing roller bearings

- Even if the motor was stored for more than three years under favorable conditions (i.e. in a dry, dust-free room that is not susceptible to vibration), you must replace the bearings.
- If the motor was stored under unfavorable conditions, you must replace the bearings after approx. 18 months.

Storing indoors

NOTICE
Bearing damage when not in use If the motors are stored incorrectly, bearing damage can occur (e.g. brinelling) - for example, as a result of vibration. • Observe the instructions for putting into storage.

The motors can be stored indoors for up to 2 years without any restrictions on the specified bearing service life at temperatures from 5 °C up to 40 °C.

- Apply a preservation agent to bare, external components. For example, use Tectyl if this has not already been carried out in the factory.
- Store the motor in an area that fulfills the following requirements:
  - The storage area must be dry, dust-free, frost-free and vibration-free (v_{rms} < 0.2 mm/s). Relative humidity should be less than 60%.
  - The storage space must be well ventilated.
  - The storage space must provide protection against extreme weather conditions.
  - The air in the storage area must not contain any harmful gases.

- Protect the motor against shocks and humidity.
- Make sure that motor is covered properly.
- Avoid contact corrosion.

Storing the motor after use

When you place the motor in storage after use, drain the cooling water ducts and purge them with air so that they are completely empty.

Ensure that the remaining water can drain.

Long-term storing

Note

Maximum storage time up to two years

The storage time affects the properties of the roller bearing grease.

- Store the motor for up to two years at 5 °C to 40 °C.

Note

In the case of intermediate storage lasting over 6 months, special measures must be applied for preservation.

- Contact Technical Support.

If you store the motor for longer than six months, the storage area must meet the following conditions:

- The motor must be protected against extreme weather conditions.
- The air must be free of corrosive gases.
- The storage area must be free of vibration (v_{rms} < 0.2 mm/s)
- In accordance with EN 60034-1, the temperature must lie in the range 5 °C up to 40 °C.
- The relative humidity of the air must be less than 60%.

Check the correct state of the motor every six months.

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

Condensation

The following ambient conditions encourage the formation of condensation:

- Significant fluctuations of the ambient temperature,
- Direct sunshine,
- High air humidity during storage.

Avoid these ambient conditions.

Use a desiccant in the packaging.

Mounting

4

4.1 Safety notes for mechanical mounting

⚠ WARNING

Danger to life from permanent magnet fields

Torque motor rotors are equipped with strong permanent magnets. This is the reason that when the motors are open there are **strong magnetic fields** and **high magnetic forces of attraction**. The permanent magnets in the motors represents a danger for people with active medical implants, who come close to the motors. This is also the case when the motor is switched off. Examples of active implants include: Heart pacemakers, metal implants, insulin pumps. Further, people that have magnetic or electrically conductive implants are at risk.

- If you are such a person (with heart pacemaker or implant) then keep a minimum distance of 300 mm from an opened motor.

⚠ WARNING

Danger to life when incorrectly mounting the motor

If you incorrectly mount the motor then there is a risk of severe injury and material damage.

- Only carry out mounting and maintenance work at the motor if you are appropriately qualified to do so.
- Only work on the motor when the plant/system is in a no-voltage condition.
- Use the cable slings provided when transporting the motors.
- Thoroughly clean the connection flange of corrosion protection agent. Use commercially available solvents to do this.
- Rotate the output elements by hand. Remove the cause of possible grinding noise or contact the manufacturer.
- Use only spare parts approved by the manufacturer.
- Ensure that the conditions at the installation site match the permissible ambient conditions (e.g. temperature, installation altitude).
- It is forbidden to use motors in hazardous zones unless they are explicitly designed for these zones.

⚠ WARNING

Danger to life due to electric shock

As a result of the permanent magnets in the rotor, when the motors rotate a voltage is induced. If you use defective cable ports, you could suffer an electric shock.

- Do not touch the cable ports.
- Connect the motor cable ports correctly, or insulate them properly.

NOTICE

Thermal damage to temperature-sensitive parts

The motors can have surface temperatures of over +100° C. Temperature-sensitive parts in contact with the motor or attached to the motor can be damaged. Temperature-sensitive parts include cables and electronic components, for example.

- Never attach temperature-sensitive parts to the motor.
- Ensure that no temperature-sensitive parts are in contact with the motor.

NOTICE

Data loss due to strong magnetic fields

If you are located close to the rotor, any magnetic or electronic data storage media as well as electronic devices that you might be carrying could be damaged.

- Do not wear or carry any magnetic or electronic data storage media (e.g. credit cards, USB sticks, floppy disks) and no electronic devices (e.g. watches) if you are close to a rotor!

4.2 Avoid overdetermined bearing system

The torque motors are complete motors equipped with deep-groove ball bearings.

NOTICE

Motor bearing damage caused by overdetermined shaft bearings

An overdetermined bearing system can result in immediate bearing damage or significantly reduce the bearing change interval.

- Comply with the maximum permissible radial and axial forces.
- Mount the motor so that the bearing system is not overdetermined by the machine bearings on the customer side.

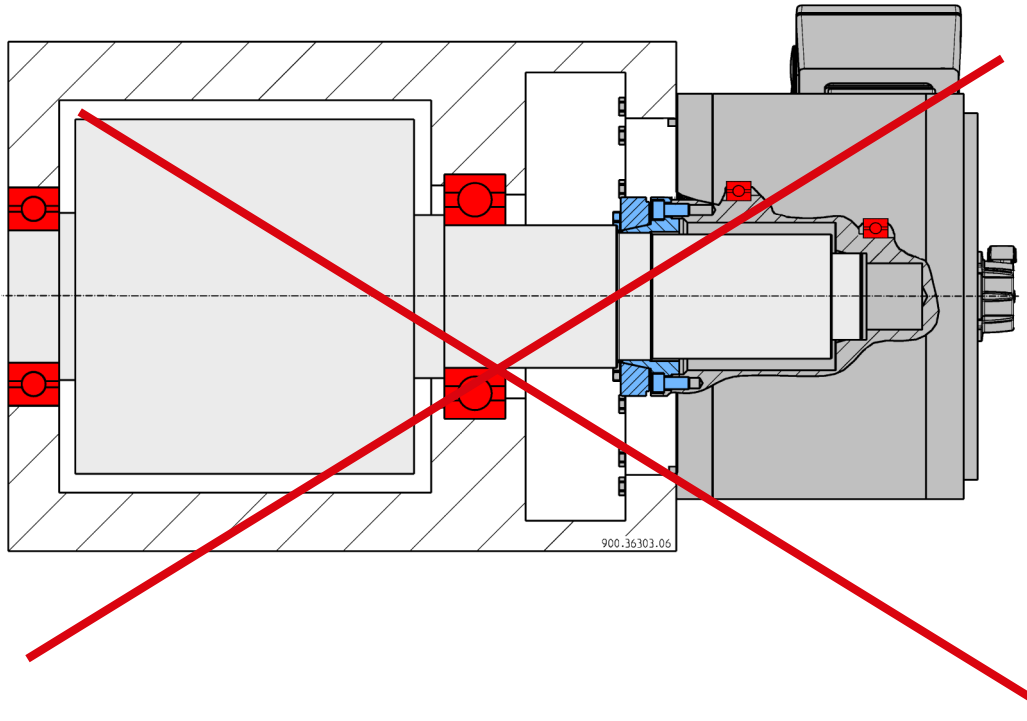


Figure 4-1 Overdetermined bearing of a shaft

4.3 Mounting the motor frame

Mounting the motor frame to the machine on the customer's side

You can mount the motor enclosure of the complete 1FW3 torque motor to the customer's machine corresponding to the following table:

Table 4-1 Types of construction

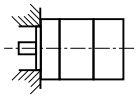
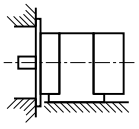
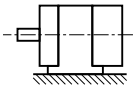
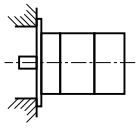
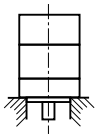
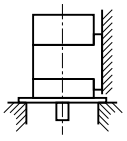
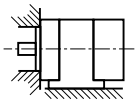
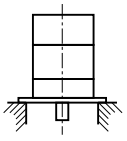
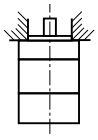
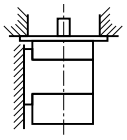
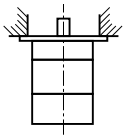
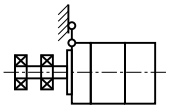
Type of construction	Designation	Type of construction	Designation	Type of construction	Designation	Type of construction	Designation
1FW315□ / 1FW320□ with hollow shaft, plug-on shaft / stub shaft or solid shaft		1FW328□ with hollow shaft / stub shaft		1FW328□ with solid shaft / stub shaft		1FW320□-□□□□5 / 1FW328□-□□□□5 with stub shaft (Z option L03)	
	IM B14		IM B35		IM B3		IM B5
	IM V18		IM V15		IM B34		IM V1
	IM V19		IM V35	-	-		IM V3
1FW315 / 1FW320 / 1FW328 with plug-on shaft							
		Plug-on mounting with torque arm (not standardized)					

Table 4-2 Mounting the motor frame via flange assembly

Shaft height	Type of construction	Holes at the DE housing flange	Pitch circle diameter
150	IM B14, IM V18/19	12 x M10	295 mm
200	IM B14, IM V18/19	16 x M10	380 mm
200	IM B5, IM V1/3 (with Z option L03)	16 x ∅ 13 mm	500 mm
280	IM B35, IM V15/35	24 x ∅ 13 mm	532 mm
280	IM B5, IM V1/3	24 x ∅ 13 mm	532 mm
280	IM B5, IM V1/3 (with Z option L03)	24 x ∅ 17.5 mm	650 mm
280	IM B34	8 x M20	525 mm

Connecting the rotor to the drive shaft

You can connect the rotor of the 1FW3 motor to the customer drive shaft either using a flange or a clamping element:

Shaft height	Threaded hole at the rotor DE (face side)	Tensioning elements in the inner diameter of the rotor
150	12 x M12, 24 mm deep, pitch circle diameter Ø 170 mm	Inside diameter, 153 mm H7
200	12 x M12, 24 mm deep, pitch circle diameter Ø 170 mm	Inside diameter, 153 mm H7
280	24 x M16, 34 mm deep, pitch circle diameter Ø 280 mm	Inside diameter 250 mm H7

Note

Maintain the permissible clamping ranges.

Maintain the permissible surface pressure.

Preconditions for smooth, vibration-free operation

Preconditions for smooth, vibration-free operation include:

- A stable foundation design
- Precise motor alignment.

Comply with the following mounting instructions:

- Ensure a stiff mounting design, especially when flange mounting high-speed motors. As a consequence, you shift the natural mounting frequency above the maximum rotational frequency.
- Align the motors using shims under the mounting feet. This avoids deforming/distorting the motor. Use the fewest possible shims.
- To securely fix the motor and transfer the drive torque, use bolts with property class 8.8.

4.4 Plug-on installation

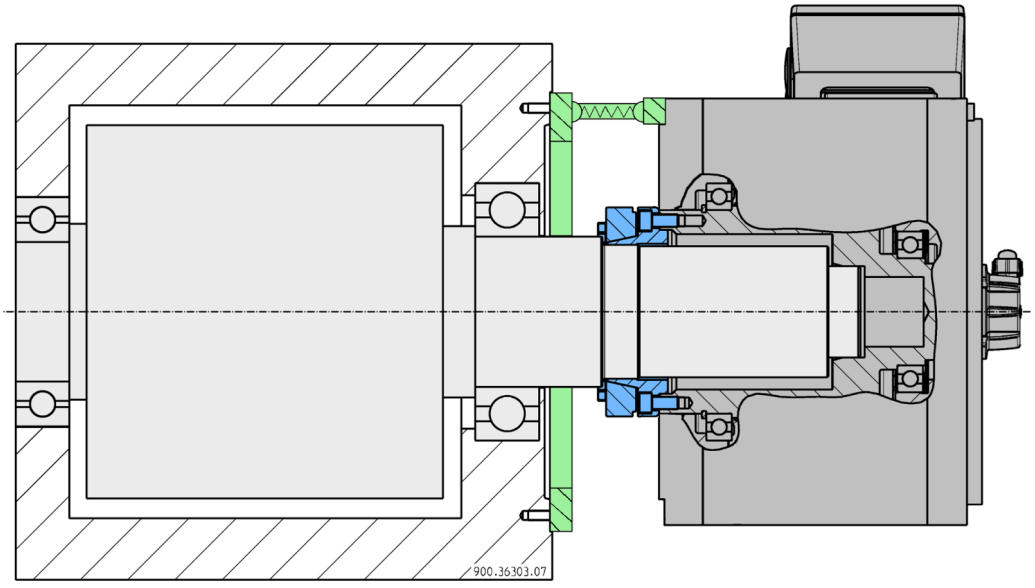


Figure 4-2 Decoupling the stator from the machine base using a torque arm (schematic representation)

For shaft mounting, the motor weight is solely carried by the shaft extension of the driven machine.

The mounting to the motor frame cannot accept any cantilever forces and therefore does not support the motor.

- Adequately dimension the shaft extension and the machine bearings.

The natural bending frequency can be shifted as a result of the lower stiffness of the mounting to the motor frame.

- Avoid operating with a rotational frequency in the range of the natural bending frequency.

4.4.1 Siemens torque arm

Option T32

In Chapter "Avoid overdetermined bearing system (Page 81)", it explains that it is not permissible that the customer's machine bearings overdetermine the bearing of a shaft.

One possible solution is the Siemens torque arm.

Advantage: Torque arms ensure a torsionally-rigid motor connection in a radial direction and balance axial tolerances and misalignments. This reduces the bearing load. A bearing service life of up to 60,000 h (with the exclusion of 1FW328) can be achieved for motors with regreasing irrespective of the radial force diagram.

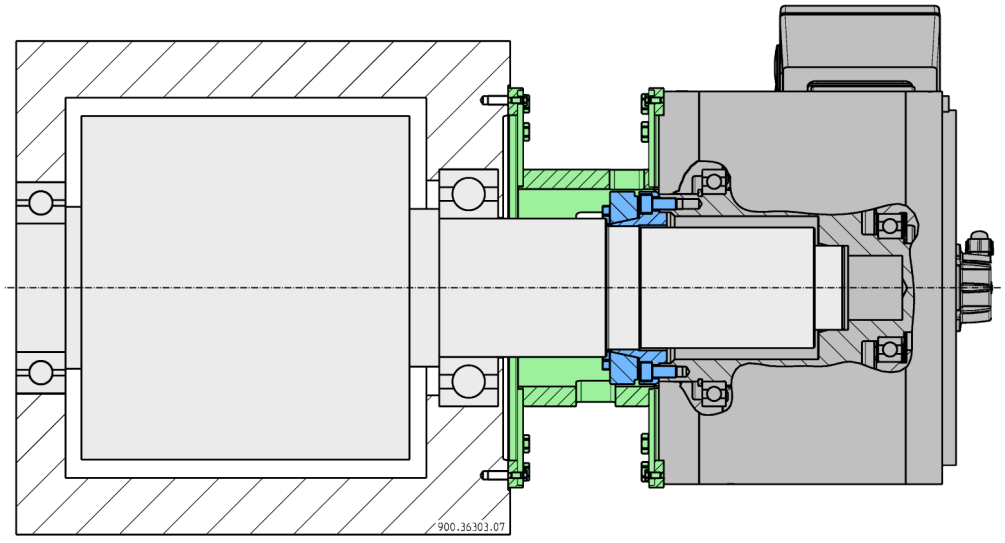


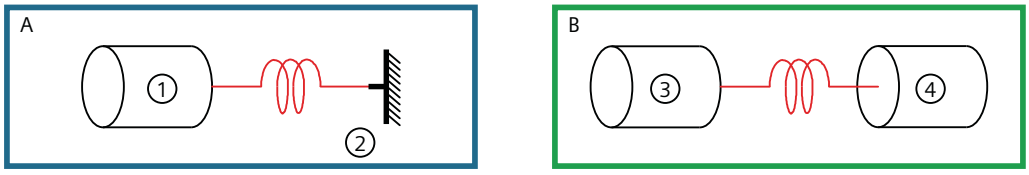
Figure 4-3 Schematic representation of the Siemens torque arm

- When designing the mounting assembly you must ensure that a possible (thermal) expansion of the shaft extension remains in a range less than 0.1 mm.
- Before mounting, the motor must only be stored prisms. This rules out that the mounting flange of the Siemens torque arm is subject to inadmissibly high cantilever forces.
- The motor can be vertically mounted when using Siemens torque arms. When attaching the torque arms it must be ensured that there is no axial deformation or distortion.

Regarding this, refer to Chapter "Bearing change intervals (Page 175)".

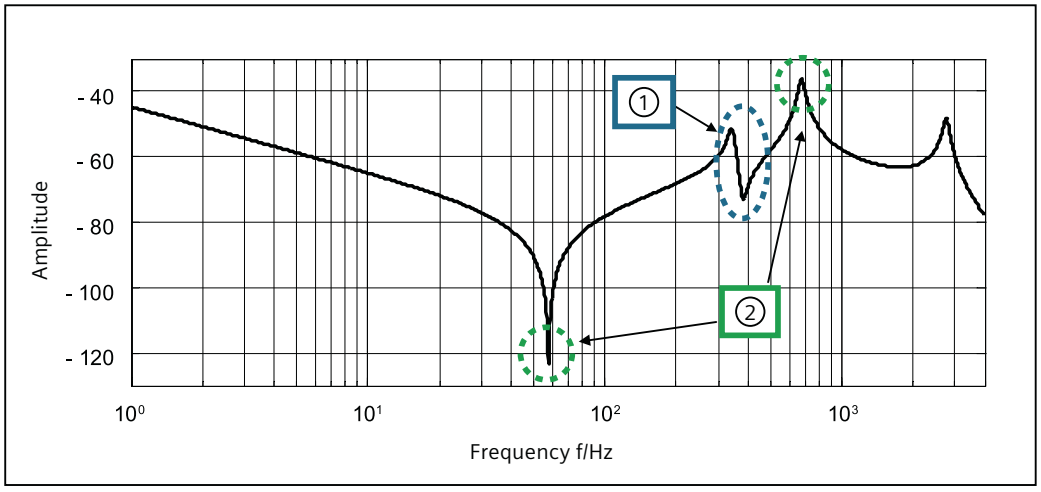
Influence of the torque arm on the speed control loop

By connecting the stator through a flexible element, with respect to the machine foundation, the stator represents an additional system that can oscillate (see Fig A), in addition to the two-mass system comprising the load and rotor (see Fig. B).



① Stator
② Machine bed
③ Load
④ Rotor

The influence of the Siemens torque arm is shown qualitatively in the following diagram. The two-mass oscillating system comprising motor and load still dominates the system response; however, coupling the stator through the Siemens torque arm is manifested in the form of additional resonance effects, which must be dampened by the closed-loop control.



① Mass oscillating system, stator - machine bed (Fig. A)
② Mass oscillating system, load - rotor (Fig. B)

Figure 4-4 Speed control loop – influence of the Siemens torque arm

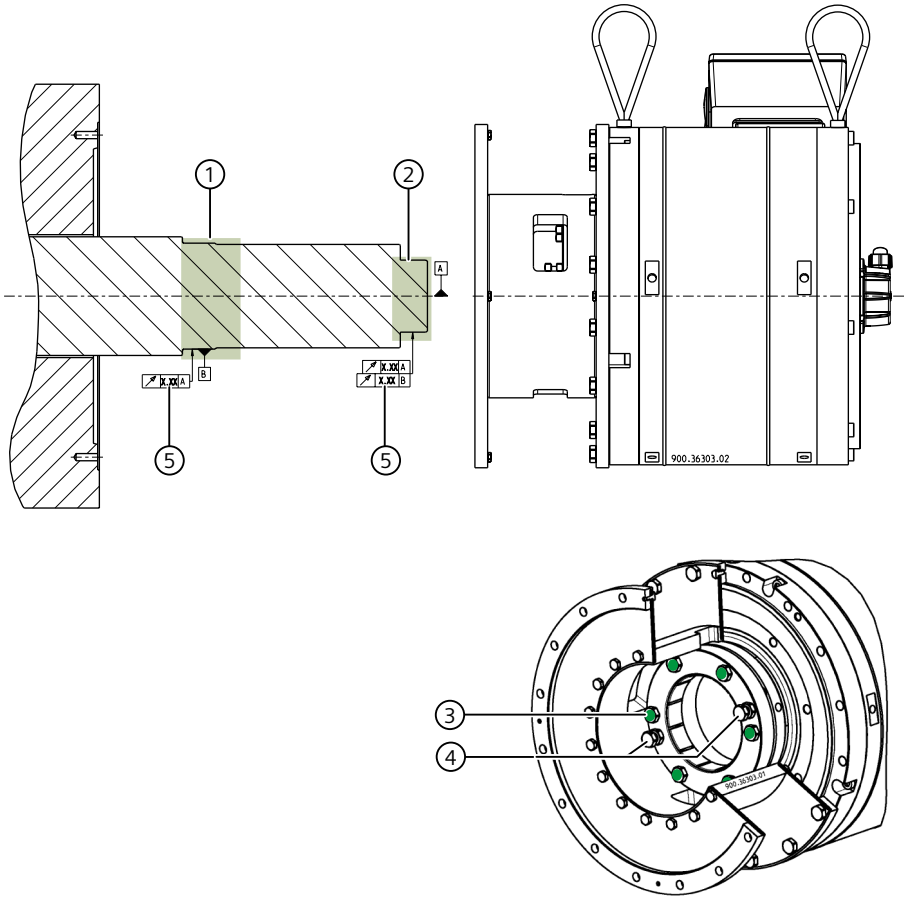
Table 4-3 Resonant frequency, stator coupling

Motor	Resonant frequency to be expected / Hz	Note
1FW315☐		Depending on the particular application, the resonant frequency can be up to 20% higher.
1FW3150	650	
1FW3151	624	
1FW3152	583	
1FW3153	562	
1FW3154	537	
1FW3155	498	
1FW3156	464	
1FW320☐		
1FW3201	340	
1FW3202	310	
1FW3203	290	
1FW3204	260	
1FW3206	240	
1FW3208	220	
1FW328☐		
1FW3281	183	
1FW3283	172	
1FW3285	159	
1FW3287	145	

Mounting sequence, Siemens torque arm with clamping element

Procedure

1. Check the rotor and prepare the shaft seat:



1 Clamping seat: must be free of any lubricant
2 Centering seat: Apply assembly paste, e.g. Molykot
3 Clamping screws (all of the screws shown in green in this diagram)
4 Forcing-off screws: Remain for removal, tightened as when originally delivered
5 The values are in the dimension drawings in this chapter

Figure 4-5 As delivered state and preparations for mounting

2. Axially slide the motor onto the customer's flange:

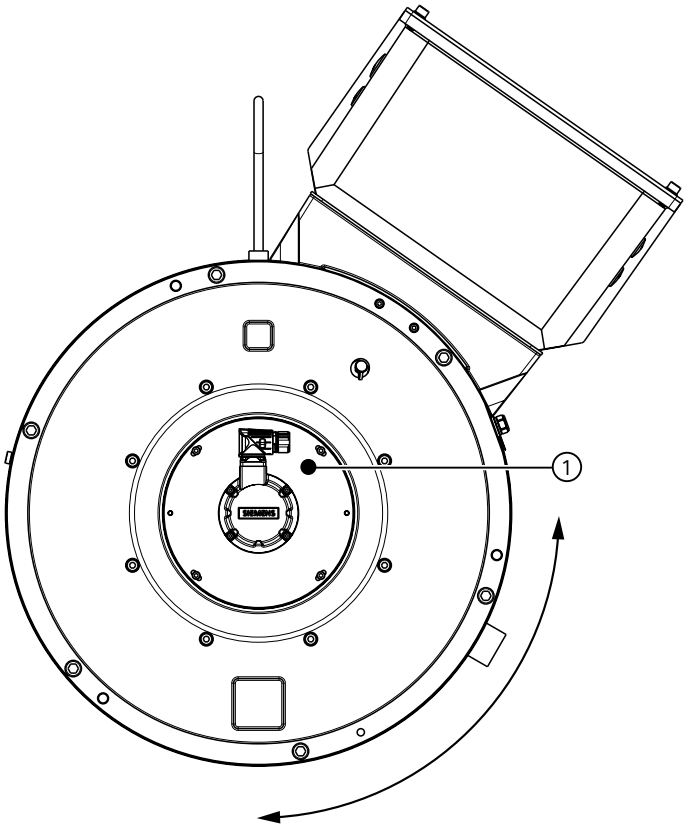
- The motor is slid onto the shaft extension and is in the correct axial position when the torque arm is located on the machine-side flange. The motor is **not** axially positioned on the shaft side.
- Tighten the clamping screws of the ring clamping element according to the mounting instructions "Mounting sequence, clamping elements, option +Q30" in Chapter "Shaft-side clamping element (Page 94)".
- You can rotate the motor using the shaft extension so that you can easily access the screws.

⚠ WARNING

Risk of injury caused by the motor falling

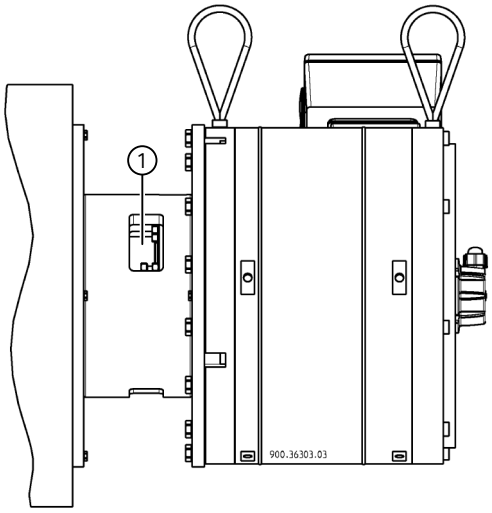
The motor center gravity is outside the motor axis.

- While it is being mounted, ensure that the motor cannot unintentionally drop.



1 Center of gravity outside the motor axis

Figure 4-6 Center of gravity

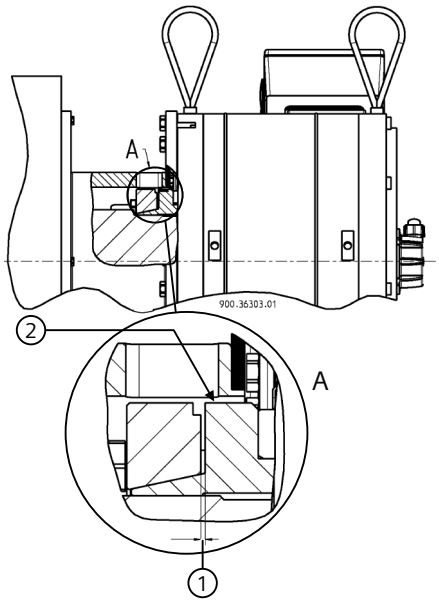


1 3 window to tighten the screws

Figure 4-7 Pre-mounting

3. Check the gap in the clamping element, and if required, measure the motor alignment (run out):

- The gap between the two clamping element parts must be able to be identified around the complete circumference.
- In order to achieve a higher smooth running quality, you can check the alignment of the motor to the machine at the surface shown. If the deviation is too high, then alignment is possible by tightening the clamping screws.
- For further information on checking, see the mounting instructions "Mounting sequence, clamping elements of option +Q30" in Chapter "Shaft-side clamping element (Page 94)".



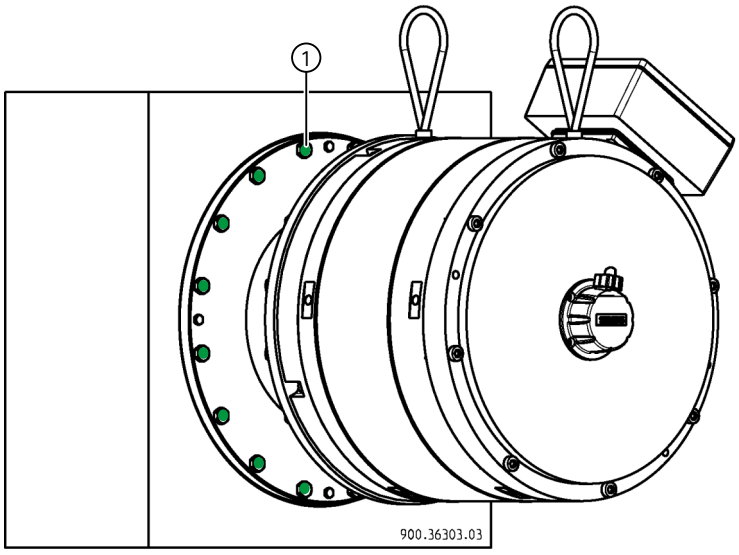
1 Gap

2 Measurement with respect to the machine axis when rotating

Figure 4-8 Check

4. Mounting the Siemens torque arm:

After successfully carrying out steps 1 – 3, screw the Siemens torque arm to the machine.



1 Mounting screws (all of the screws shown in green in this diagram)

Figure 4-9 Final mounting

The motor has been mounted.

❒

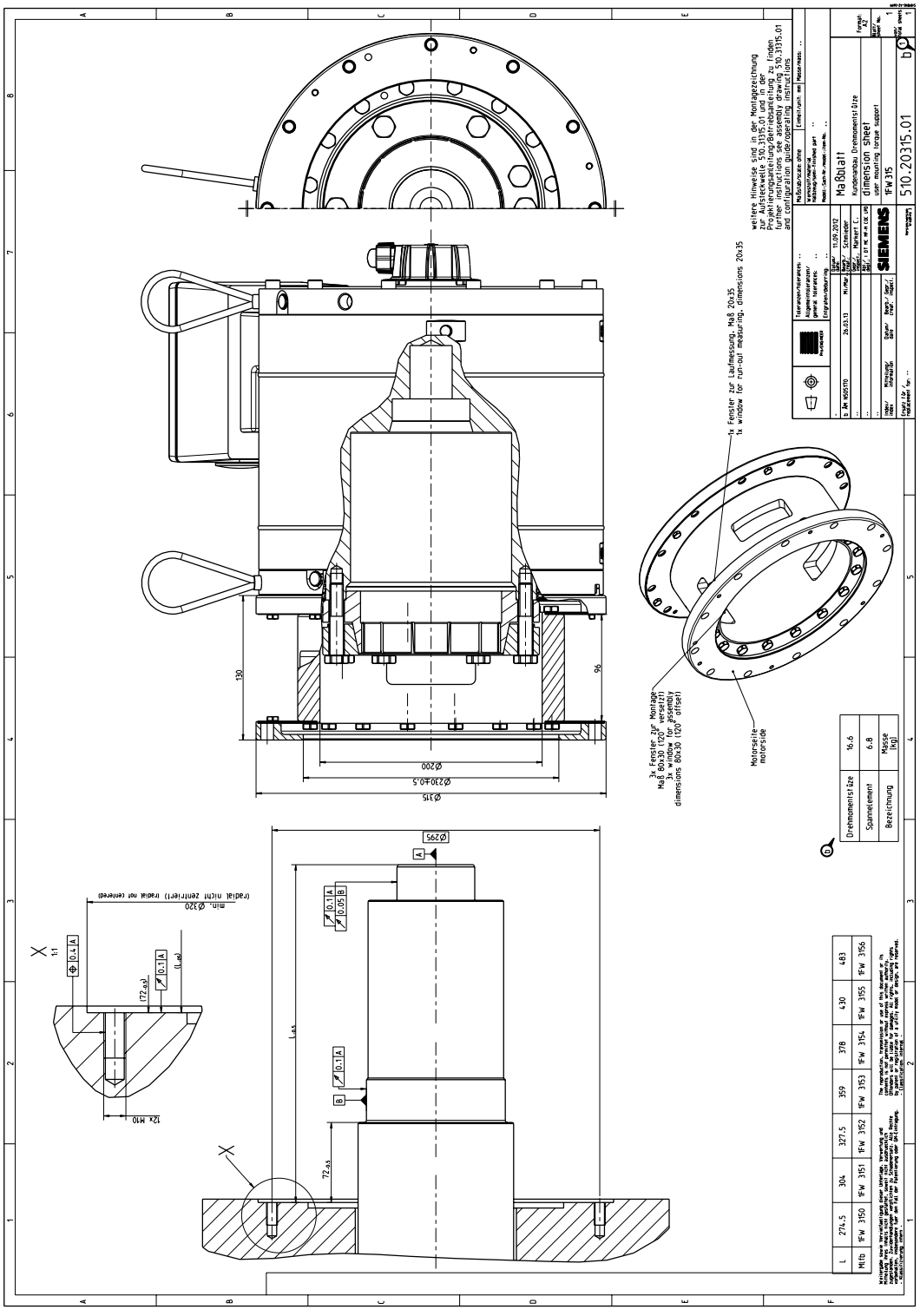


Figure 4-10 1FW3150 Siemens torque arm, dimension drawing 510.20315.01

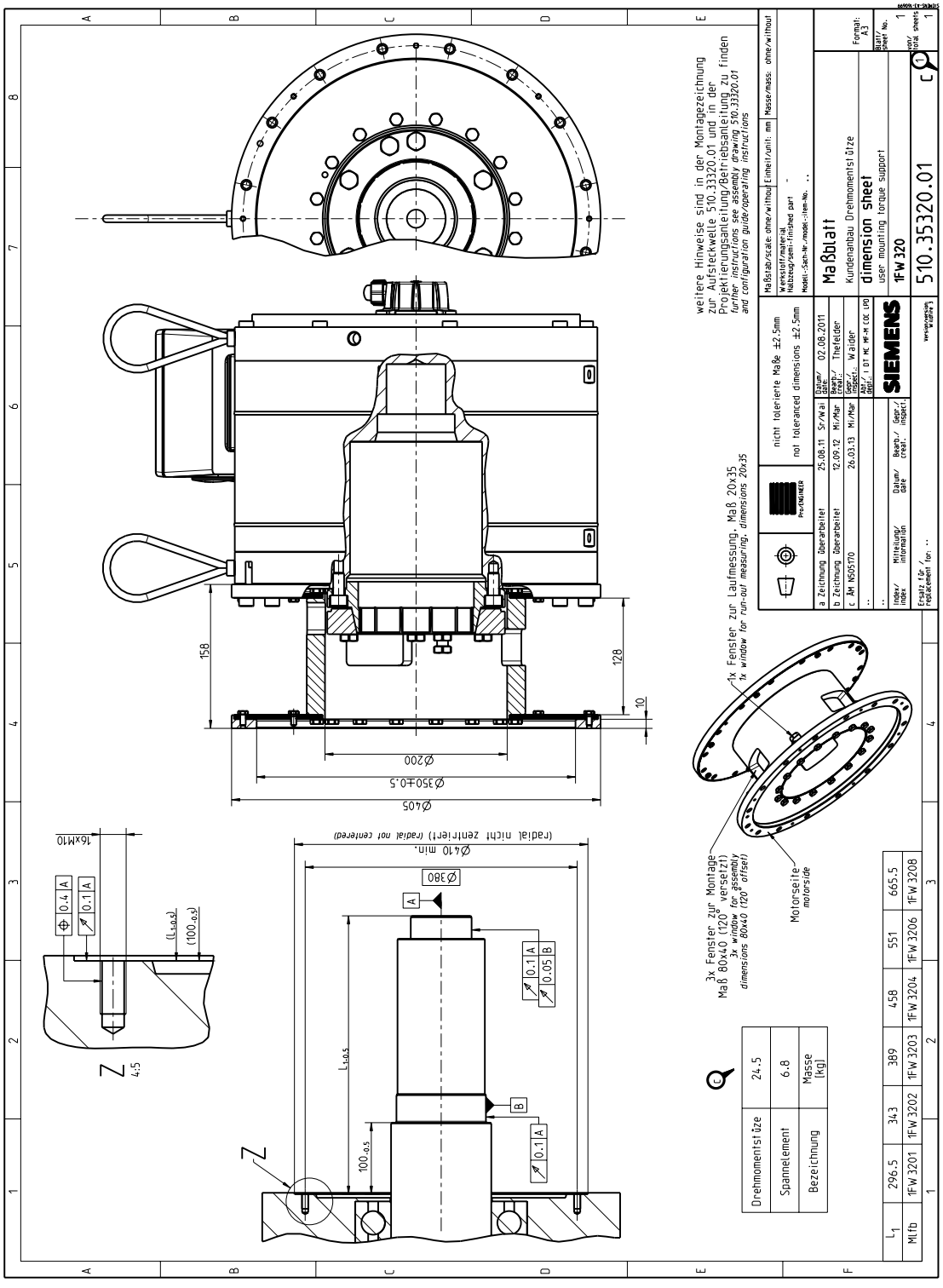


Figure 4-11 1FW320 Siemens torque arm, dimension drawing 510.35320.01

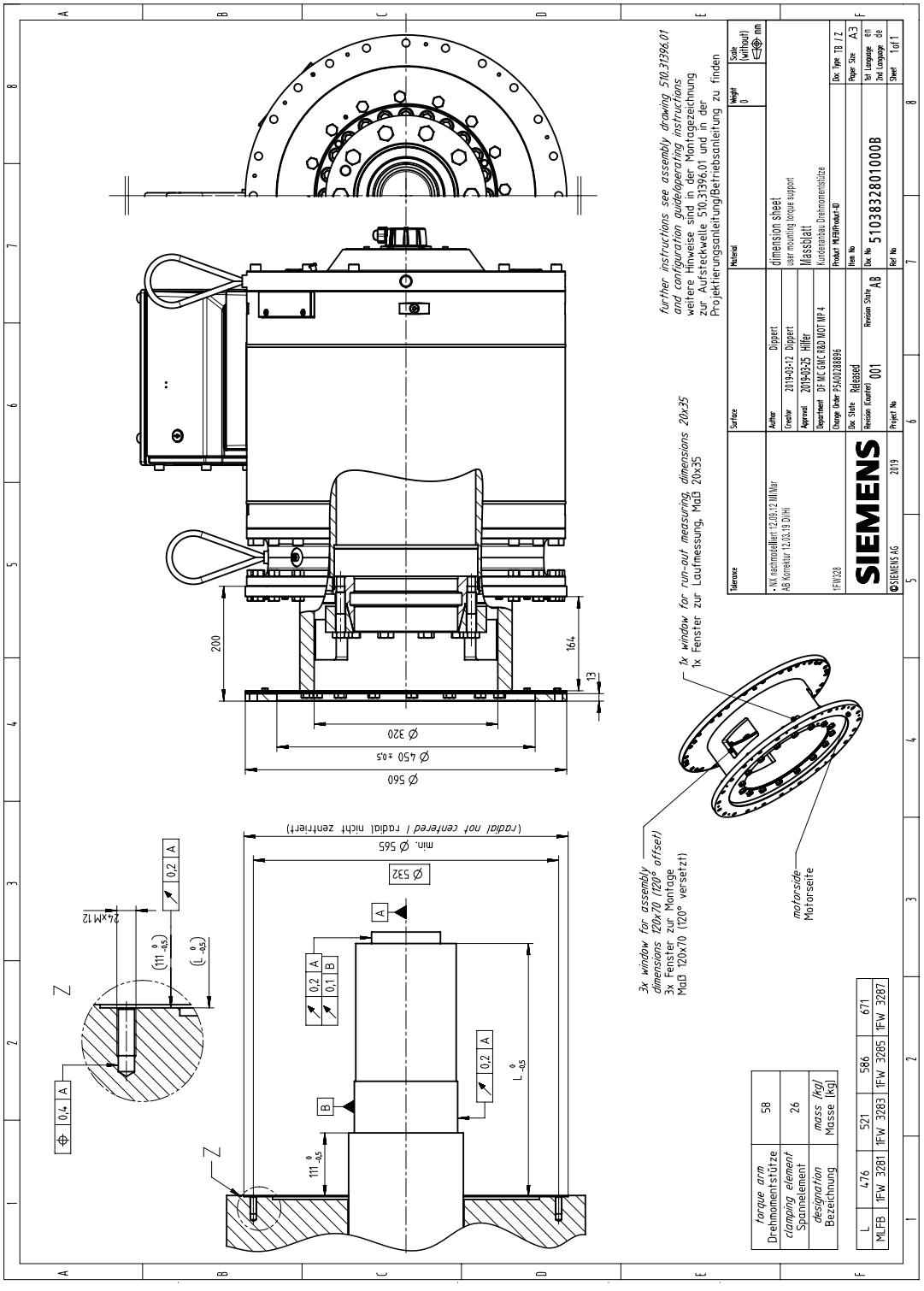


Figure 4-12 1FW328 Siemens torque arm, dimension drawing 510.38328.01

4.4.2 Shaft-side clamping element

Various mounting options using clamping elements are shown in this Chapter.

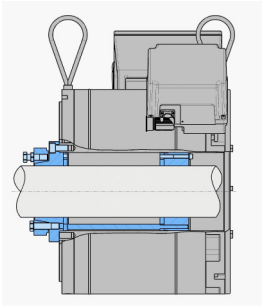
Note

The stub shaft is not intended for shaft-mounted design.

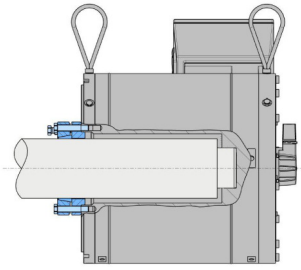
Siemens AG in cooperation with RINGSPANN GmbH has developed various clamping system solutions to ensure secure, friction-locked connection of torque motors to cylindrical machine shafts - with the following objectives.

- Safely and reliably transmitting the torque
- Precisely centering the torque motor on the machine shaft
- Avoid inadmissible deformation to the torque motor components
- No distortion caused by different temperature changes in the torque motor and in the machine shaft
- Simple mounting
- Simple removal, even after longer periods of operation

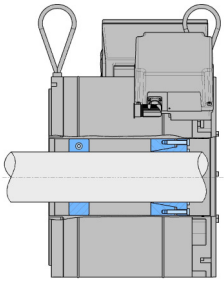
Mounting using suitable clamping elements is explained in the following.



Hollow shaft with option, clamping element and centering part
1FW315□-□□□□□-□□A□ + Q30
1FW320□-□□□□□-□□A□ + Q30
You can find details in Chapter "Hollow shaft with option +Q30 (Page 102)"

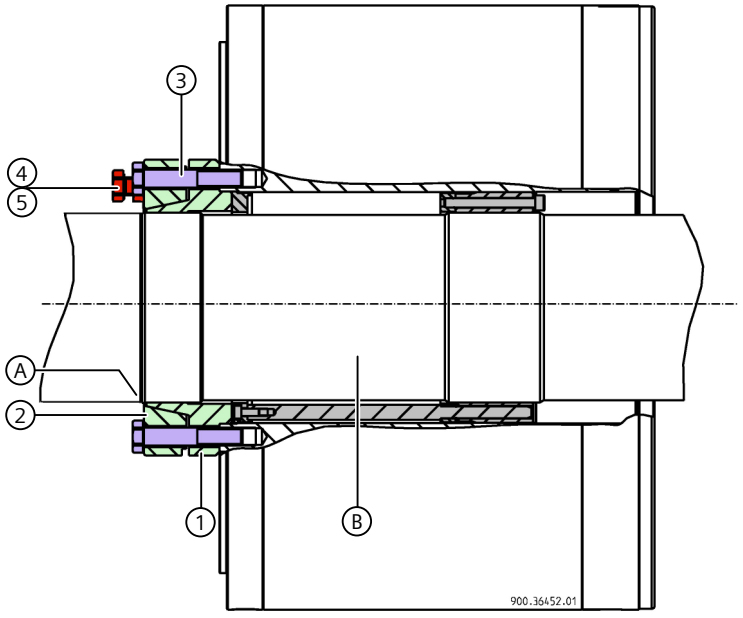


Plug-on shaft with clamping element
1FW3□□□-□□□□□-□□S□ + Q30
You can find details in Chapter "Plug-on shaft with option +Q30 (Page 98)"



Hollow shaft with inner clamping element from the Ringspann company
1FW315□-□□□□□-□□C□
1FW320□-□□□□□-□□C□
You can find details in Chapter "Hollow shaft, inner clamping element (Page 104)"

Mounting the clamping elements of option +Q30



A Shaft shoulder
2 Tapered ring
B Shaft journal
5 Lock nut
1 Tapered sleeve
3 Clamping screw
4 Forcing-off screw

Procedure

1. Using the clamping element (possibly with centering sleeve), mount the motor at the intended position on the shaft extension.
2. Using screws (3) clamp the tapered ring (2) onto the tapered sleeve (1). Initially tighten all screws diagonally so that they are hand tight (5 to 8 Nm).
3. Then tighten all of the screws (3) diagonally using a torque wrench. When doing this, the screw may only be tightened through a maximum of ¼ of a turn. Repeat this operation until all of the the screws are tightened with the specified torque using a torque wrench. When doing this, comply with the specified torques. Then check that the motor runs true.

Shaft height	150	200	280
Torque / Nm	127	127	210

4. Then check the gap between the tapered sleeve (1) and tapered ring (2) and between the tapered sleeve (1) and the forcing-off screws (4). There must be a minimum gap of 0.1 mm around the complete circumference. If this minimum gap does not exist, then there is a risk that the clamping element will not fulfill its function (excessively low joint interference and therefore inadequate torque transmission).
   Causes could be for hollow shaft extension:
   - excessively low wall thickness, or
   - excessively low diameter of the clamping seat

The clamping elements have been mounted.

❒

Options to optimize the smooth running characteristics of the mounting

You can check that the system runs true during procedures 2 and 3. You align the motor by specifically tightening the screws (3). If the clamping screw (3) is over-proportionally tightened, then at this position the motor is lifted off from the shaft extension.

If, after tightening to the final torque, the true running check indicates an excessively high deviation, then release all of the clamping screws (3) and repeat tightening procedures 2 and 3 - checking the true running and tightening the clamping screws as required (3).

Removing

Procedure

If, when removing the clamping element, after removing the clamping screws (3) the tapered ring (2) cannot be released, then proceed as follows:

1. Release the lock nut (5) and turn this until it comes into contact with the head of the forcing-off screw (4).
2. Rotate the forcing-off screws (4) in the tapered ring (2) until they are in contact with the tapered sleeve (1).
3. Screw in the forcing-off screws (4) one after the another through ¼ of a turn until the tapered ring is released.

The tapered ring has been released.

❒

If the motor cannot be released from the shaft extension, for an appropriate shaft extension design, use the forcing-off screws to press the tapered ring until it comes into contact with the shaft shoulder. The motor is pressed from the shaft extension by turning the forcing-off screws further (4).

When reusing the clamping element, turn the forcing-off screws back and secure them using the lock nuts (5).

When certain requirements exist, e.g.

- different diameter
- restricted mounting space
- thermal insulation
- electrical isolation

regarding the shaft-side connection of the motor, RINGSPANN GmbH can provide support when selecting a suitable clamping system for your particular application. Contact:

RINGSPANN GmbH	Phone +49 (0) 6172 275 0
Schaberberg 30-34	Internet: http://www.ringspann.de
D-61348 Bad Homburg	

4.4.2.1 Plug-on shaft with option +Q30

Available for motors 1FW315☐, 1FW320☐ and 1FW328☐ with plug-on shaft (15th position in the Article No. = S)

Support at the DE with the seat integrated in order to facilitate centered mounting.

When the shaft journal is implemented according to dimension drawings 510.31315.01/510.33320.01/510.31396.01, then it is also possible to disassemble using forcing-off screws.

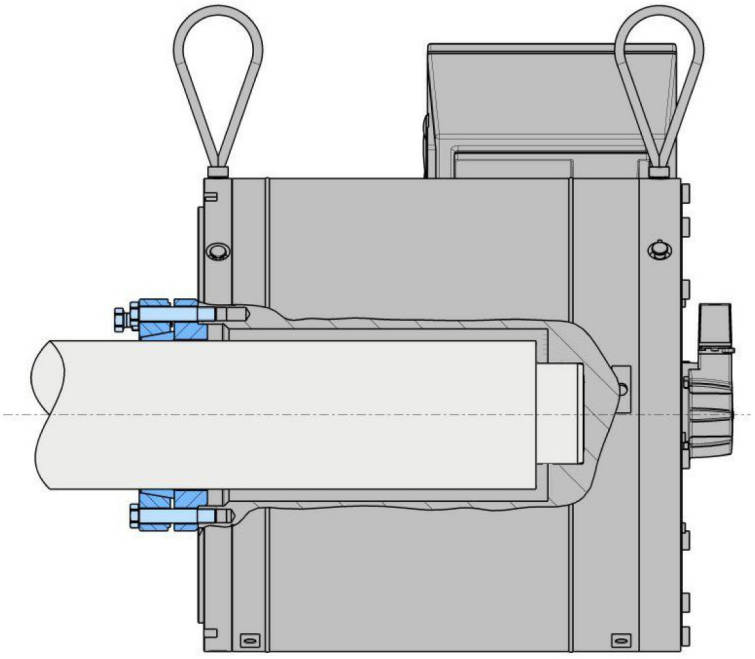


Figure 4-13 Plug-on shaft clamping element

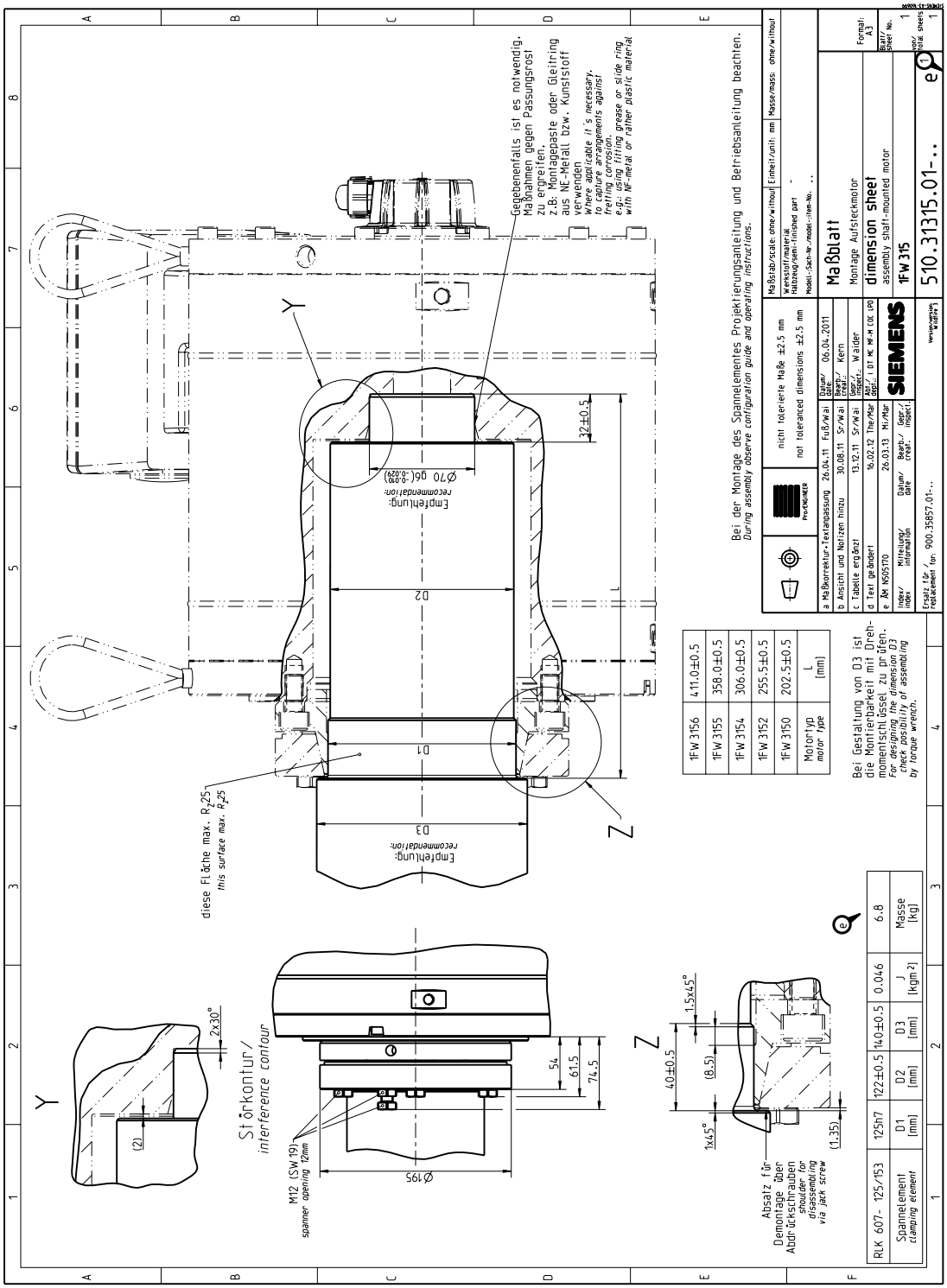


Figure 4-14 Dimension drawing, mounting plug-on motor 1FW315

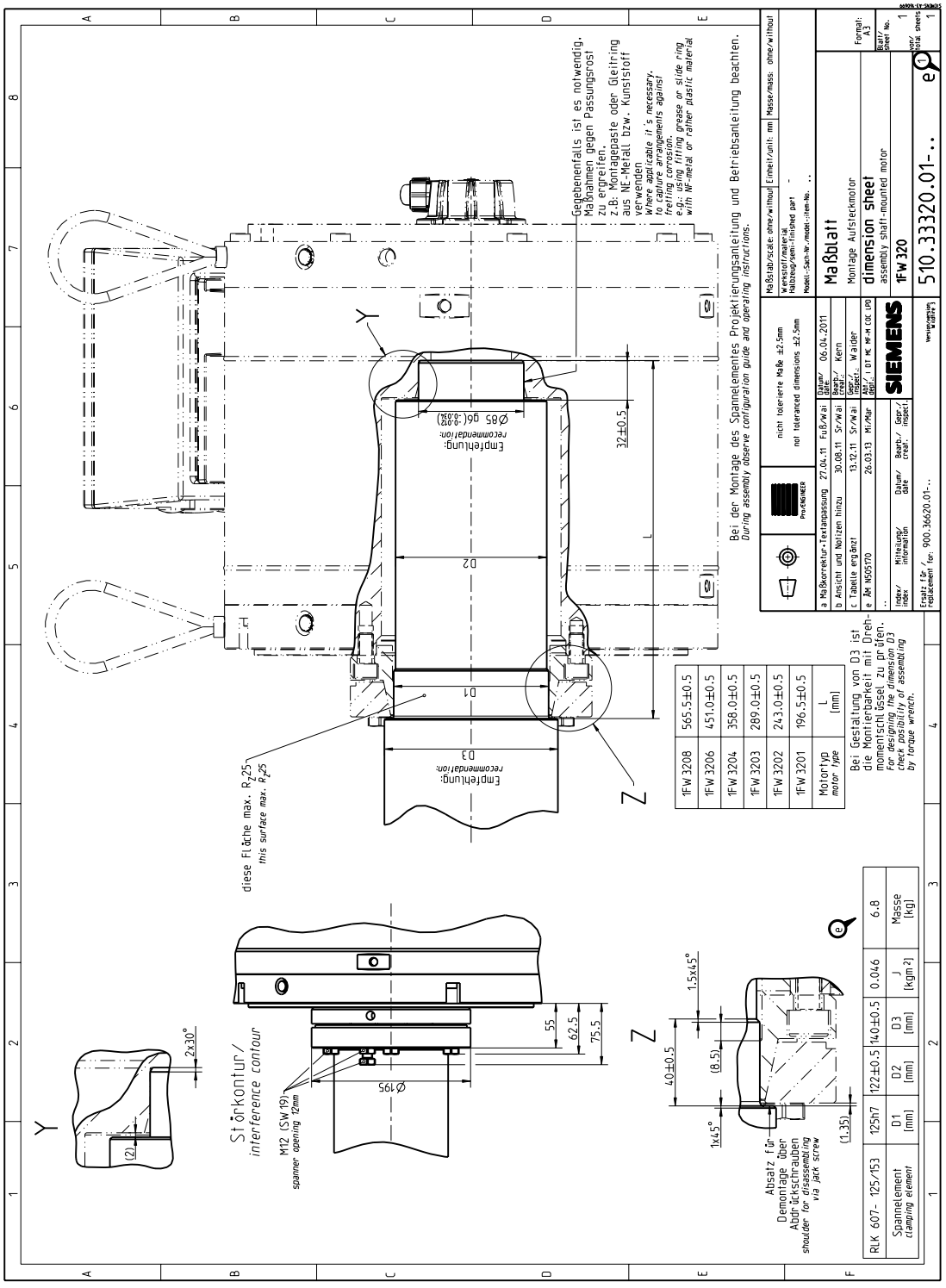


Figure 4-15 Dimension drawing, mounting plug-on motor 1FW320

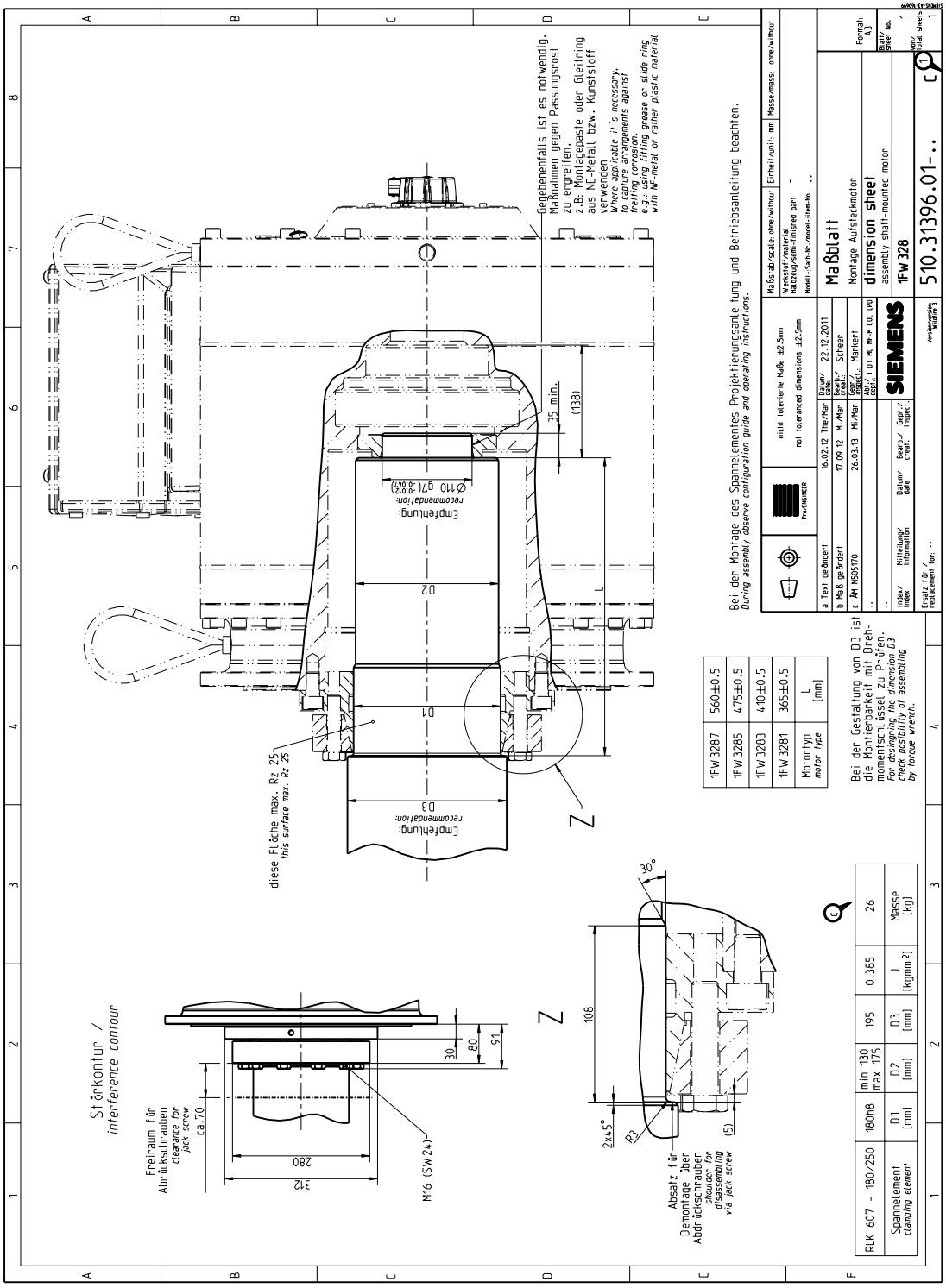
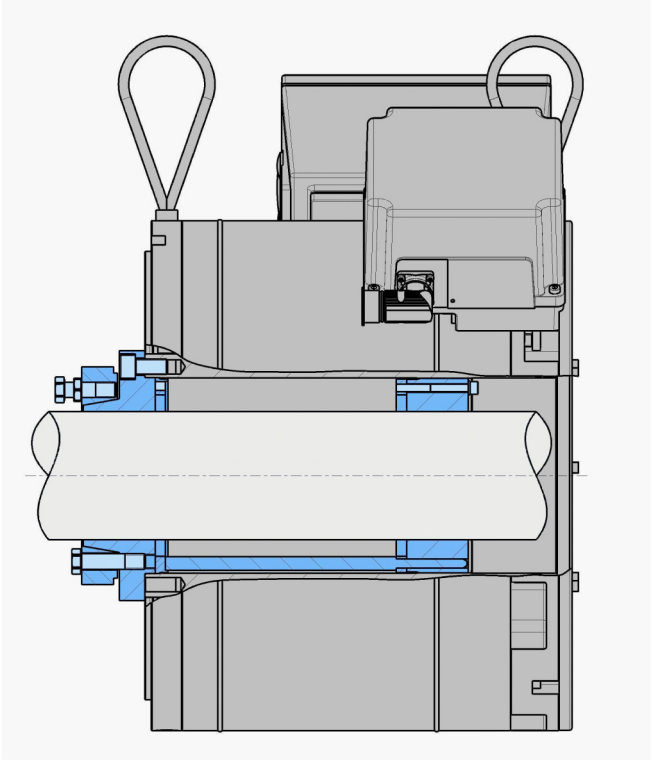


Figure 4-16 Dimension drawing, mounting plug-on motor 1FW328

4.4.2.2 Hollow shaft with option +Q30

1FW315□-□□□□□-□□A□
1FW320□-□□□□□-□□A□

- Harmonized clamping system
- For hollow shafts through which hot or cold media are routed
- Axial mounting space is required at the DE
- Mounted only from the DE or alternatively, in two parts from DE/NDE
- Torque transmission to the customer shaft (h8 fit) via a flanged clamping element at the DE
- Supported at the NDE using an aluminum ring to guarantee centered mounting and to prevent any inadmissible wobbling motion.



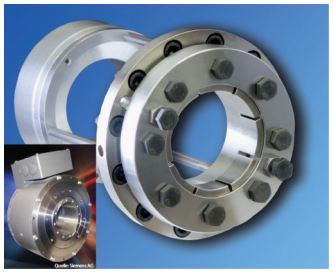
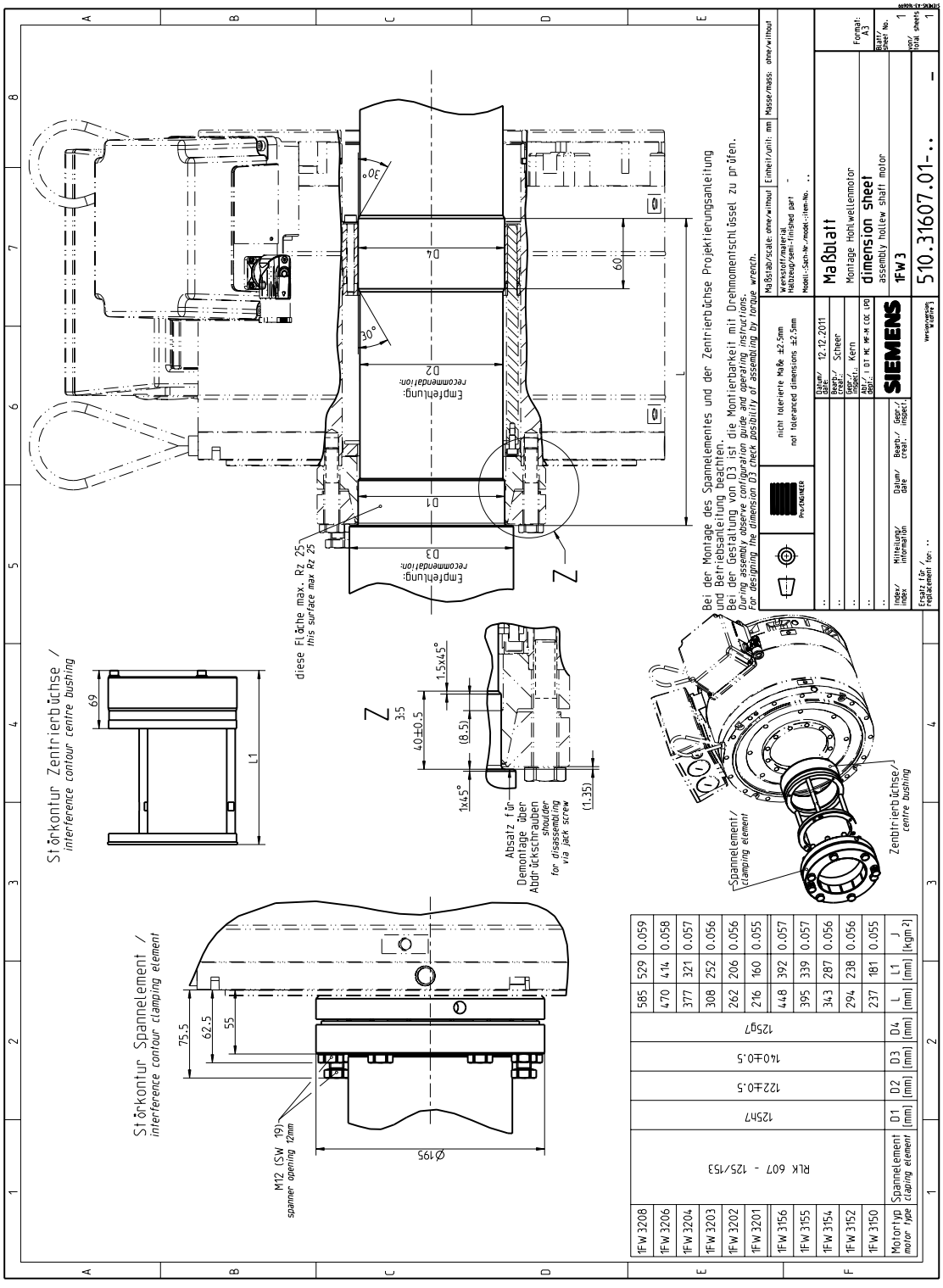


Figure 4-17 Outer clamping system



Motortyp / motor type	Spannelement / clamping element	D1 [mm]	D2 [mm]	D3 [mm]	D4 [mm]	L [mm]	L1 [mm]	J [kgm²]
1FW3150	RLK 607 - 125/153	125h7	122±0.5	140±0.5	125g7	237	181	0.055
1FW3152						294	238	0.056
1FW3154						343	287	0.056
1FW3155						395	339	0.057
1FW3156						448	392	0.057
1FW3201						216	160	0.055
1FW3202						262	206	0.056
1FW3203						308	252	0.056
1FW3204						377	321	0.057
1FW3206						470	414	0.058
1FW3208						585	529	0.059

Figure 4-18 Dimension drawing hollow shaft with clamping element

4.4.2.3 Hollow shaft, inner clamping element

1FW315□-□□□□□-□□**C**□
1FW320□-□□□□□-□□**C**□

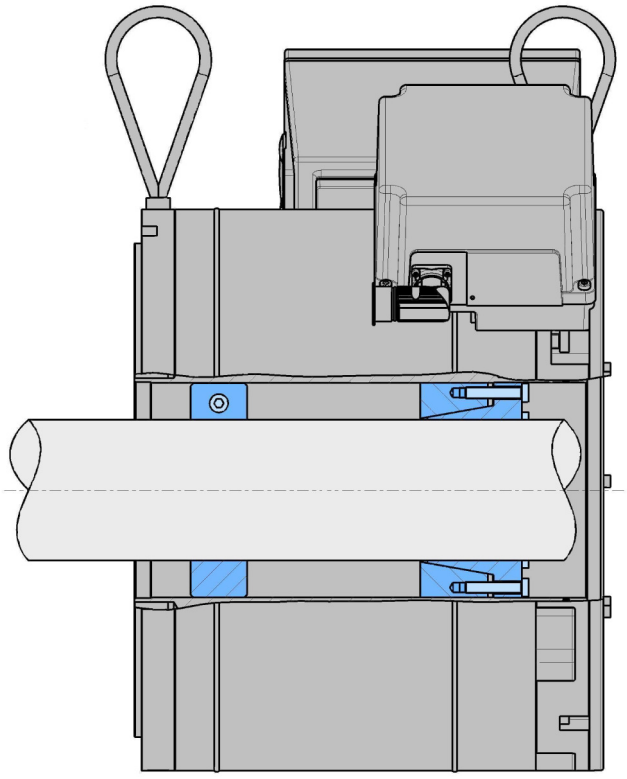
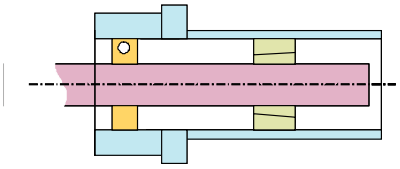
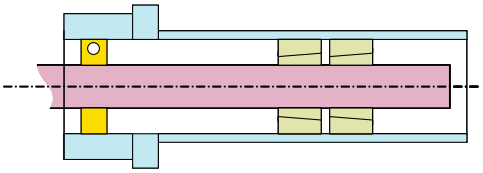


Figure 4-19 Inner clamping system

- Available for 1FW315□ and 1FW320□ with special shaft (15th position in the Article No. = C)
- RINGSPANN RTM 134.1
- Torque transmission to the customer shaft (h8 fit) via the clamping element located in the hollow shaft NDE
- Supported at the DE using an aluminum ring to guarantee centered mounting and to prevent any inadmissible wobbling motion
- Compact mounting at the machine is possible as no axial mounting space is required at the DE and the device is completely mounted from the NDE.

Table 4-4 Clamping sets required to transmit the torque

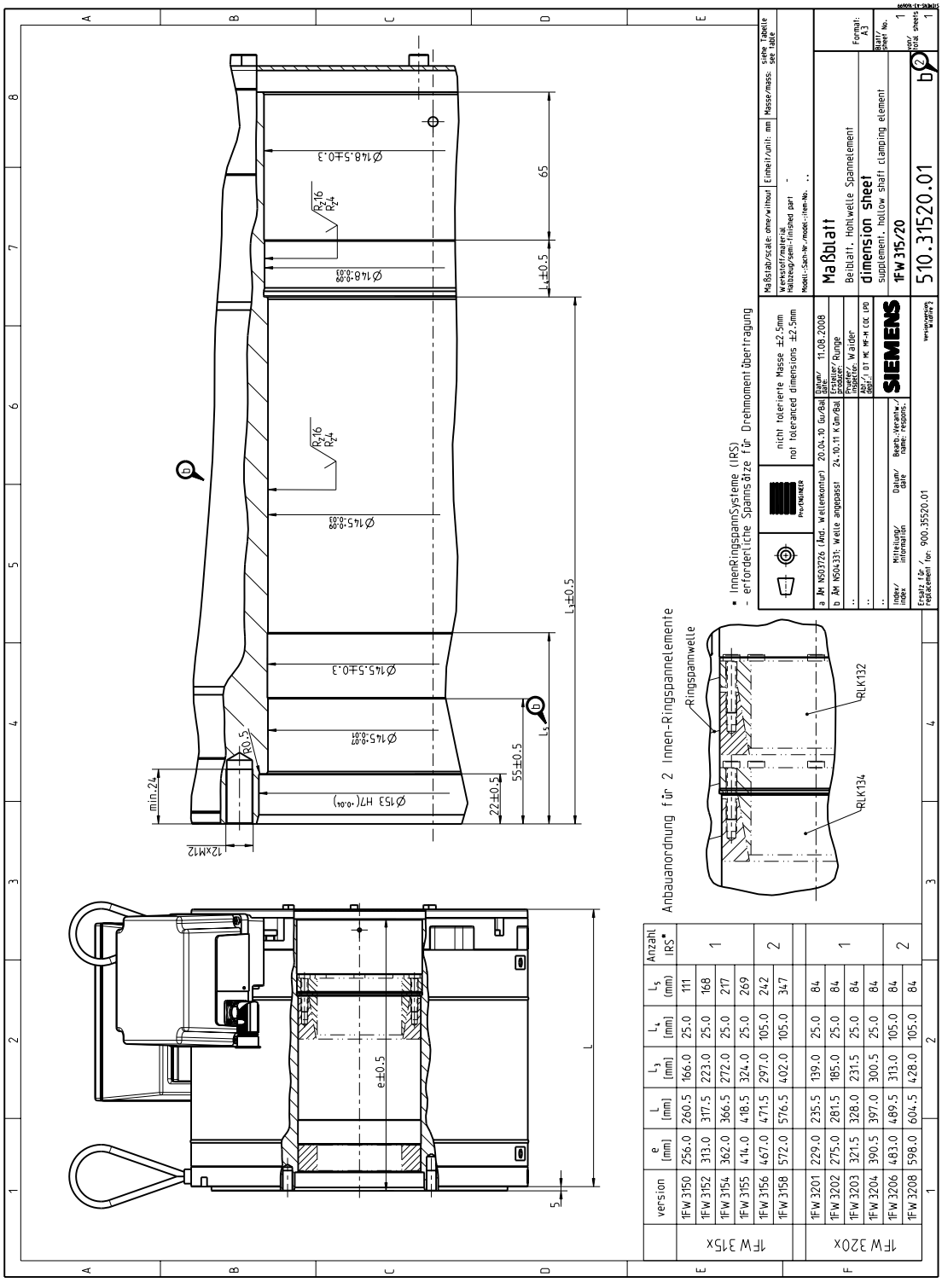
1FW3150....1FW3155 1FW3201....1FW3204	1FW3156 1FW3206....1FW3208
	
One clamping set is sufficient	Two clamping sets are required to transmit the torque

Technical Support RINGSPANN GmbH

RINGSPANN GmbH can support you when selecting a suitable clamping system for your application.

RINGSPANN GmbH
Schaberberg 30-34
D-61348 Bad Homburg

Phone +49 (0) 6172 275 0
Internet: http://www.ringspann.de



	version	e (mm)	L (mm)	L3 (mm)	L4 (mm)	L5 (mm)	Anzahl IRS*	
1FW315x	1FW 3150	256.0	260.5	166.0	25.0	111	1	E
	1FW 3152	313.0	317.5	223.0	25.0	168		
	1FW 3154	362.0	366.5	272.0	25.0	217		
	1FW 3155	414.0	418.5	324.0	25.0	269		
	1FW 3156	467.0	471.5	297.0	105.0	242	2	
	1FW 3158	572.0	576.5	402.0	105.0	347		
1FW320x	1FW 3201	229.0	235.5	139.0	25.0	84	1	F
	1FW 3202	275.0	281.5	185.0	25.0	84		
	1FW 3203	321.5	328.0	231.5	25.0	84		
	1FW 3204	390.5	397.0	300.5	25.0	84		
	1FW 3206	483.0	489.5	313.0	105.0	84	2	
	1FW 3208	598.0	604.5	428.0	105.0	84		

Figure 4-20 Dimension drawing hollow shaft clamping element

4.5 Coupling mounting

Advantage: Simple design, a standard motor can be used.

Disadvantage: As a result of its function, a coupling must be flexible and therefore has a negative impact on the positive characteristics and features of a directly driven load. The coupling reduces the drive train stiffness.

NOTICE
Premature bearing damage Bearings can be prematurely damaged, if force transmission elements apply too much load to the shaft end as a result of radial forces. • When using mechanical transmission elements, ensure that the maximum limit values specified in the radial force diagrams are not exceeded.

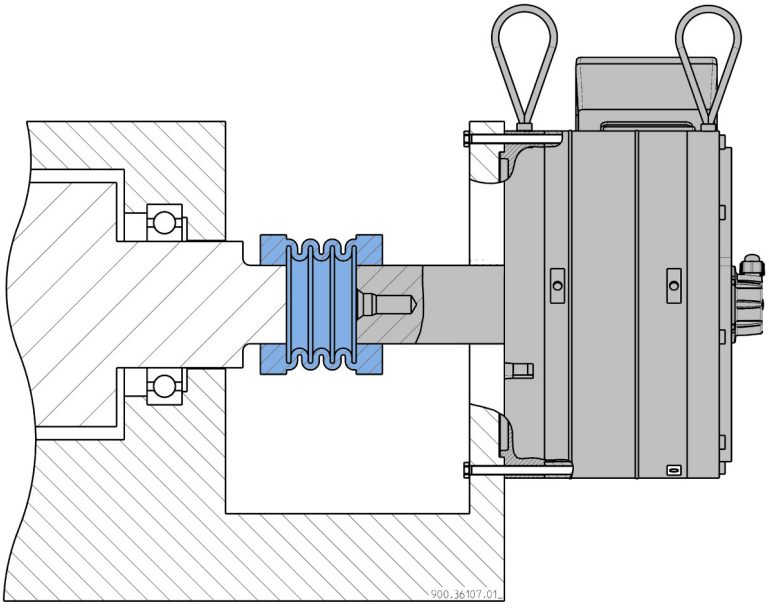


Figure 4-21 Decoupling the machine shaft from the motor shaft using a coupling

4.6 No bearings at the DE

Option "No DE bearings" is designated with a "3" at the 16th position of the article number.

1FW3□□□-□□□□□-□□□**3**

Properties

- Stiff rotor and stator mounting for the "hollow shaft" and "plug-on shaft" versions
- Only a few mounting components are required
- Provides the possibility of mounting bearing modules to absorb increased process forces
- Not available for solid shaft versions (15th position in the Article No.: "H" and "M")

Note

- Avoid any radial overdetermination of the remaining bearing at the NDE; this must be verified by making the appropriate calculation.
- Comply with the mounting conditions, see dimension drawing 609.30284.01, no DE bearings.
- Limit the axial temperature expansion of the machine shaft as specified in dimension drawing 609.30284.01, DE without bearings
- Dimension drawing 609.30284.01, DE without bearings refers to the mounted state. Dimension "L" in the dimension drawing can be higher at a motor when originally shipped
- The motor shaft creates a radial force as a result of this bearing type. Take into account the radial force in the customer's machine design, see the following table.
- Only operate the motor when it is mounted.

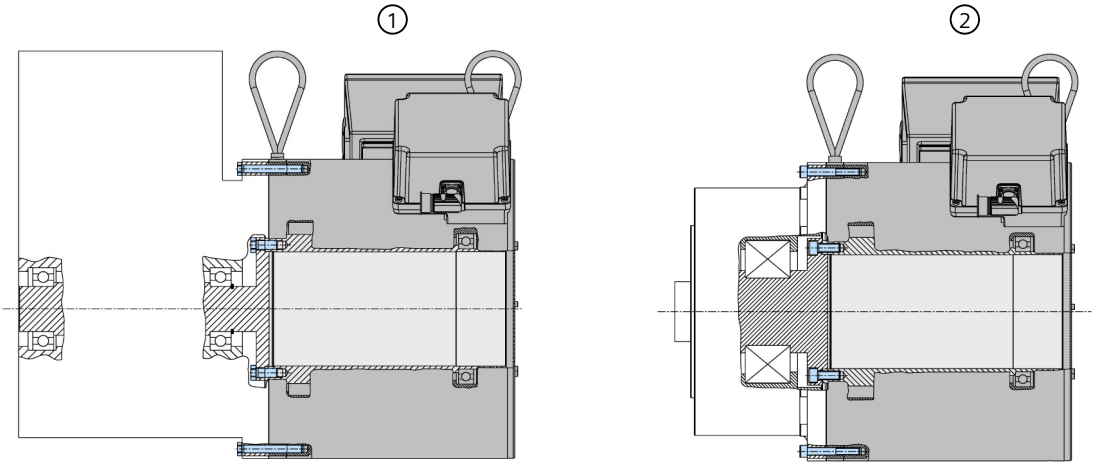
Frame size	Radial force / N
1FW315□	800
1FW320□	2000
1FW328□	4100

Note

Torque motors shall not be used without bearings and/or similar mountings. By installing/usage of option 1FW3xxx-xxxxx-xxx3 (motor without bearing) Customer bears the full responsibility to comply with the aforesaid precondition. In connection with option 1FW3xxx-xxxxx-xxx3 (motor without bearing) Siemens does not grant any warranty and shall not be liable with respect to any claims arising out of or relating to the combination with or incorporation into the motor with any other product, component or machine; customer shall hold Siemens harmless against any third party claim thereof.

If you have any questions regarding the general conditions, contact the Siemens Service Center.

Mounting examples



1 Siemens must be consulted (regarding overdetermination)

2 For bearing module with increased radial/axial force load

Figure 4-22 Mounting examples for motors with no bearings at the DE

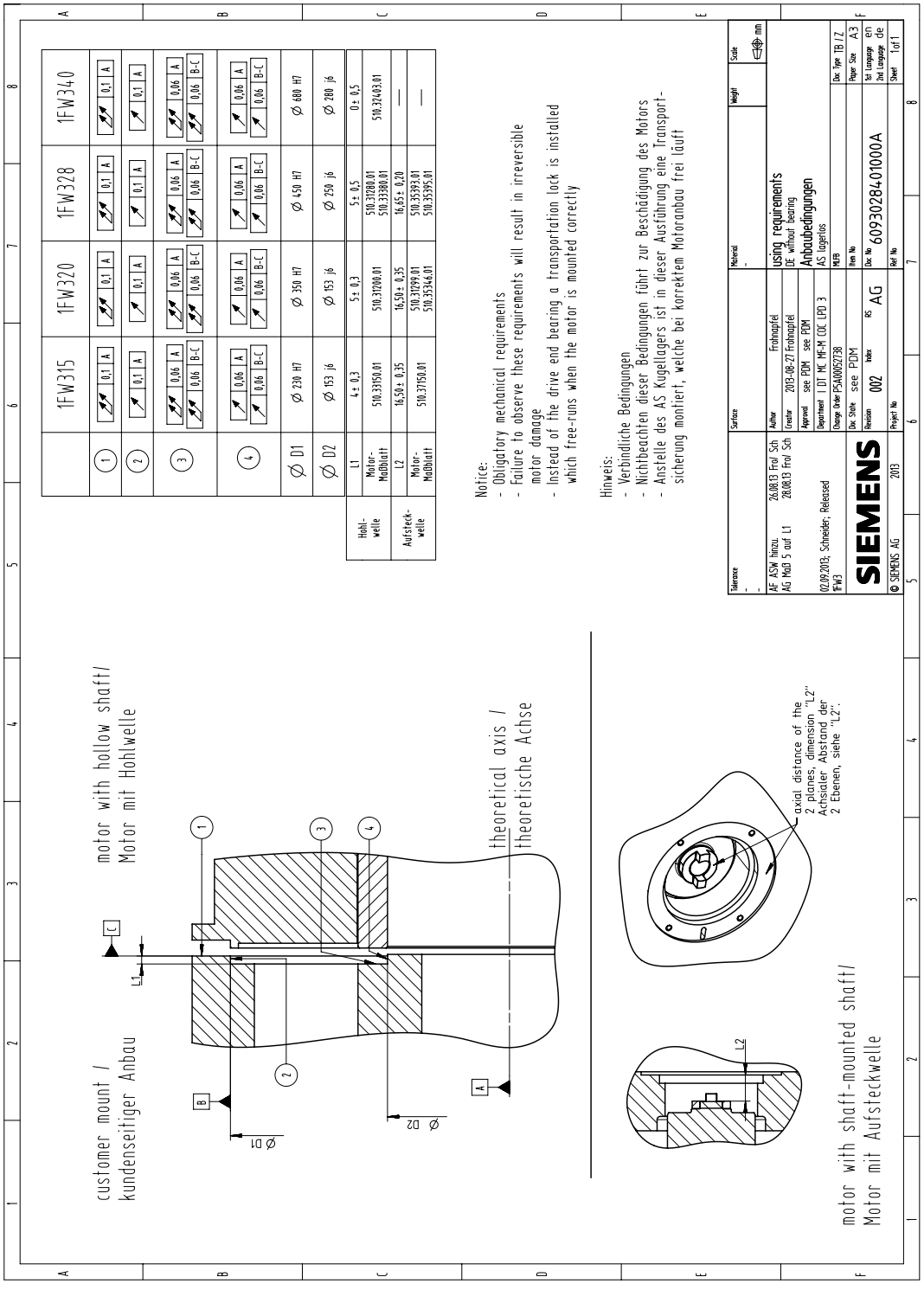
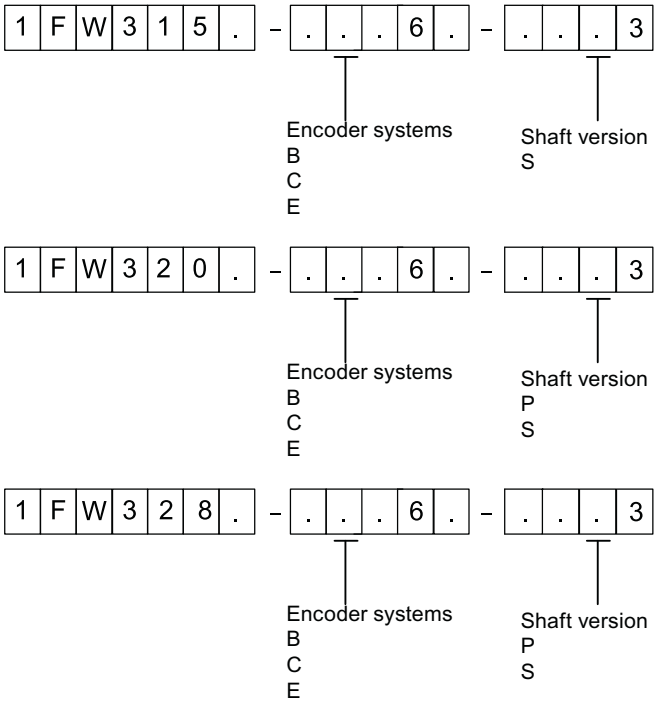


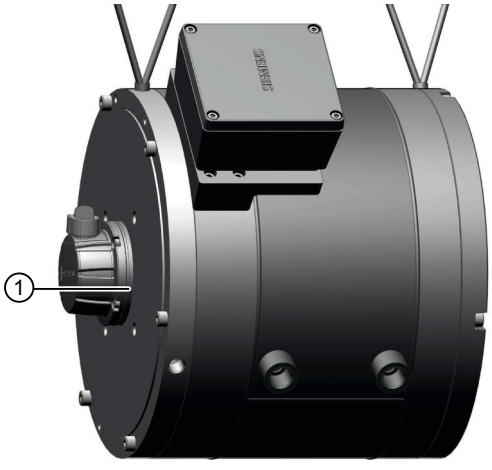
Figure 4-23 Dimension drawing, no bearings at the DE

4.7 Plug-on shaft and DE without bearings



Mounting instructions

The motor is shipped with a transport ring at the NDE. The transport ring is located between the encoder and the bearing shield. The transport ring prevents the motor shaft from coming into contact with the encoder. See the diagram below



1 Transport ring

Figure 4-24 Transport ring for motors without bearing

Procedure

1. Before mounting the motor, remove the encoder including the transport ring according to the following description "Removing/mounting the encoder".
2. When mounting the motor, ensure the axial position of the motor shaft through the open encoder space according to dimension drawing 609.30284.01.

   Note

   Comply with the mounting conditions

   In order to ensure that the motor operates properly, comply with the mounting conditions according to dimension drawing 609.30284.01. The sum of all of the tolerances of the mounting must not exceed the tolerances listed under L_2.
   These include, for example:
   - Positioning the motor shaft when mounting
   - Shifting the customers shaft
   - Thermal expansion of the customer's shaft
3. After the motor has been mounted, the motor or the rotor must be axially fixed in its position. Now mount the encoder according to the subsequent description "Removing/mounting the encoder".

The motor has been mounted.

❒

4.8 Removing/mounting the encoder

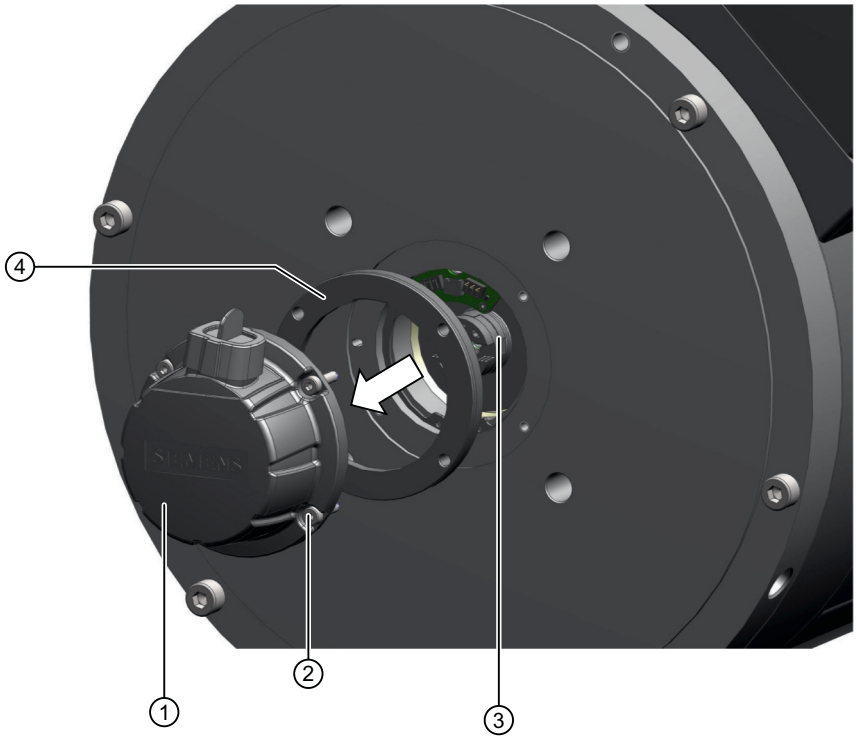
NOTICE
Destruction of components sensitive to electrostatic discharge Electronic modules contain components that can be destroyed by electrostatic discharge. These components can be damaged or destroyed if they are not handled properly. • Carefully observe the instructions in Chapter "Equipment damage due to electric fields or electrostatic discharge (Page 16)".

Procedure

Proceed the following to remove and mount the encoder:

1 Removing

1. Bring the motor into a no-voltage condition.
2. Withdraw the encoder cable.

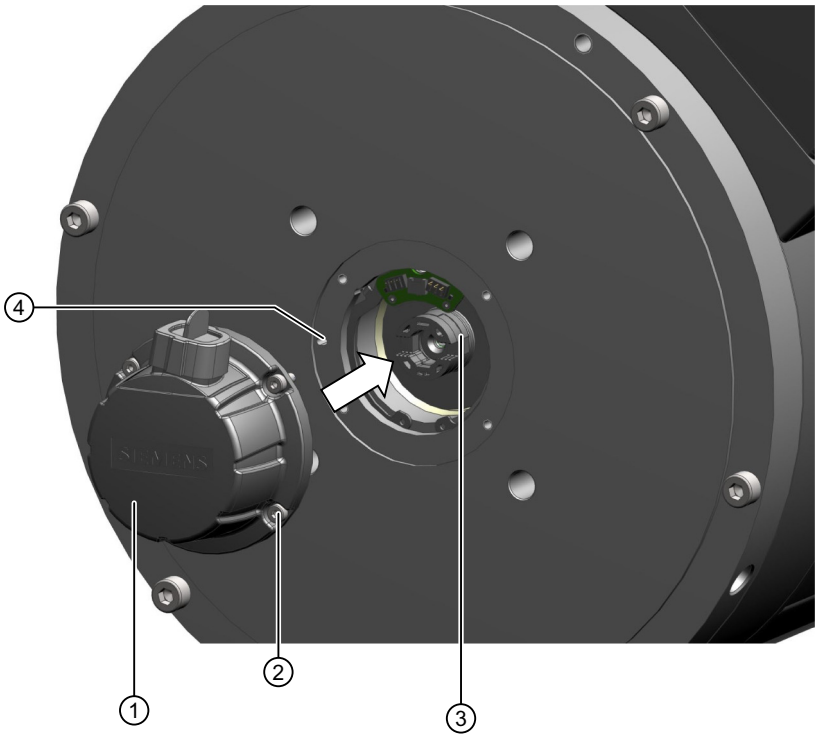


1 Encoder
2 Four fixing screws
3 Coupling element
4 Transport ring

3. Release the four fastening screws for the encoder.
4. Remove the encoder, the transport ring and the coupling element.

2 Mounting

1. Attach the coupling element to the coupling hub of the motor shaft.
2. Align the coupling hub at the encoder to the couplings element in the motor. The encoder with coupling hub can only be inserted at a specific position.



1 Encoder
2 Four fixing screws
3 Coupling element
4 Elongated hole to position the encoder

3. Insert the encoder at this position. Inserting the coupling involves blind assembly.
4. Rotate the inserted encoder, so that the positioning pin of the encoder latches into the elongated hole in the bearing shield.
5. Fasten the encoder using the four fastening screws provided (tightening torque: 2 to 3 Nm).

3 Absolute adjustment

Note

Only absolute encoders need to be adjusted.

When you adjust an absolute encoder (referencing), its actual value is compared once with the machine zero point and then set to valid.

The actual adjustment status of an absolute encoder is shown in the following machine data:

For SINUMERIK	For SINAMICS
MD34210 §MA_ENC_REFP_STATE (absolute encoder status)	p2507 (absolute encoder adjustment status)

- Adjust the encoder as described in the instructions in the associated Function Manual.

The motor is now ready for operation again.

❒

For detailed information about replacing an encoder, see Chapter "Maintenance (Page 171)".

4.9 Natural frequency when mounted

The motor is an oscillating system with a design-dependent natural frequency, which is higher than the specified maximum speed.

When the motor is mounted onto a machine, a new system, which is capable of vibration, is created with modified natural frequencies. These can lie within the motor speed range.

This can result in undesirable vibrations in the mechanical drive transmission.

Note

Motors must be carefully mounted on adequately stiff foundations or bedplates. Additional elasticities of the foundation/bedplates can cause resonance effects of the natural frequency at the operating speed and, therefore, result in inadmissibly high vibration values.

The magnitude of the natural frequency when the motor is mounted depends on various factors and can be influenced by the following points:

- Mechanical transmission elements (gearboxes, belts, couplings, pinions, etc.)
- Stiffness of the machine design to which the motor is mounted
- Stiffness of the motor in the area around the foot or customer flange
- Motor weight
- Machine weight and the weight of the mechanical system in the vicinity of the motor
- Damping properties of the motor and the driven machine
- Installation type/position (IM B14, IM V18/19, IM B35)
- Motor weight distribution, i.e. length, shaft height

4.10 Vibration resistance

The following factors influence the system vibrational behavior at the site of installation:

- Output elements
- Mounting situation
- Alignment and installation
- Effects of external vibration

As a consequence, motor vibration values can increase.

It may be necessary that you completely balance the rotor together with the output element.

Observe the specified vibration values at the specified motor measuring points. In this way you guarantee perfect function and long service life of the motor.

Table 4-5 Maximum permissible radial vibration values, based on ISO 10816 [1)]

Vibration frequency	Vibration values
< 6.3 Hz	Vibration displacement s ≤ 0.16 mm
6.3 - 250 Hz	Vibration velocity v_{rms} ≤ 4.5 mm/s
> 250 Hz	Vibration acceleration a ≤ 10 m/s²

Table 4-6 Max. permissible axial vibration values[1)]

Vibration velocity	Vibration acceleration
v_{rms} = 4.5 mm/s	a_{peak} = 2.25 m/s²

1) Both values must be maintained simultaneously.

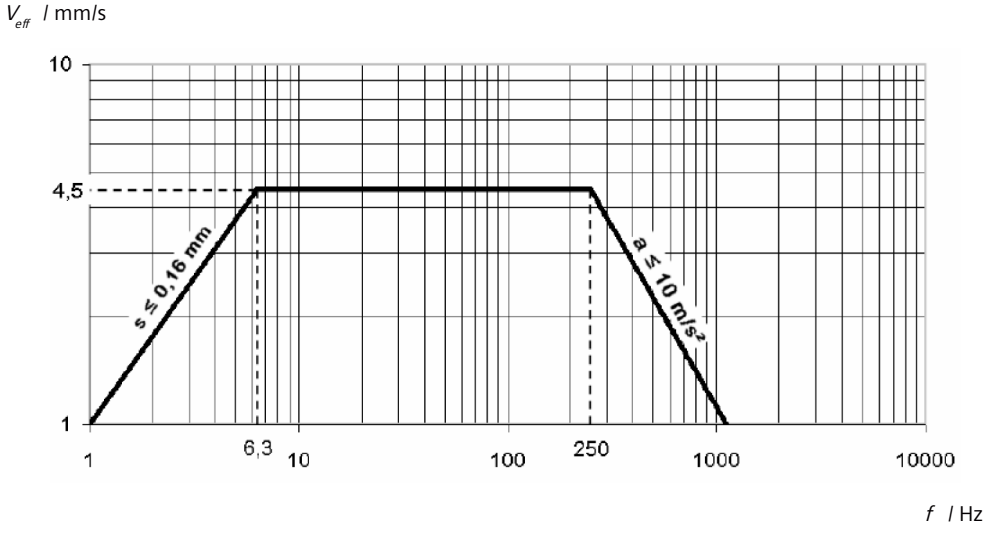


Figure 4-25 Max. permissible vibration velocity, taking into account the vibration displacement and vibration acceleration

To evaluate the vibration velocity, the measuring equipment must meet the requirements of ISO 2954. Evaluate the vibration acceleration as a peak value in the time domain in a frequency band extending from 10 up to 2000 Hz.

Appropriately adapt the measuring range if it is expected that noticeable vibration levels are excited above 2000 Hz (e.g. as a result of gear tooth meshing frequencies). This does not alter the maximum permissible values.

4.11 Mounting vibration sensors (Z-option G50)

The end shield and the adapters of the motors are equipped with M8 sensor boreholes for screwing in vibration sensors.

Depending on the motor type, adapters are supplied for the M8 sensor connection. For this and further information, see the following figure "Position and dimensions of the sensor boreholes for the vibration sensors".

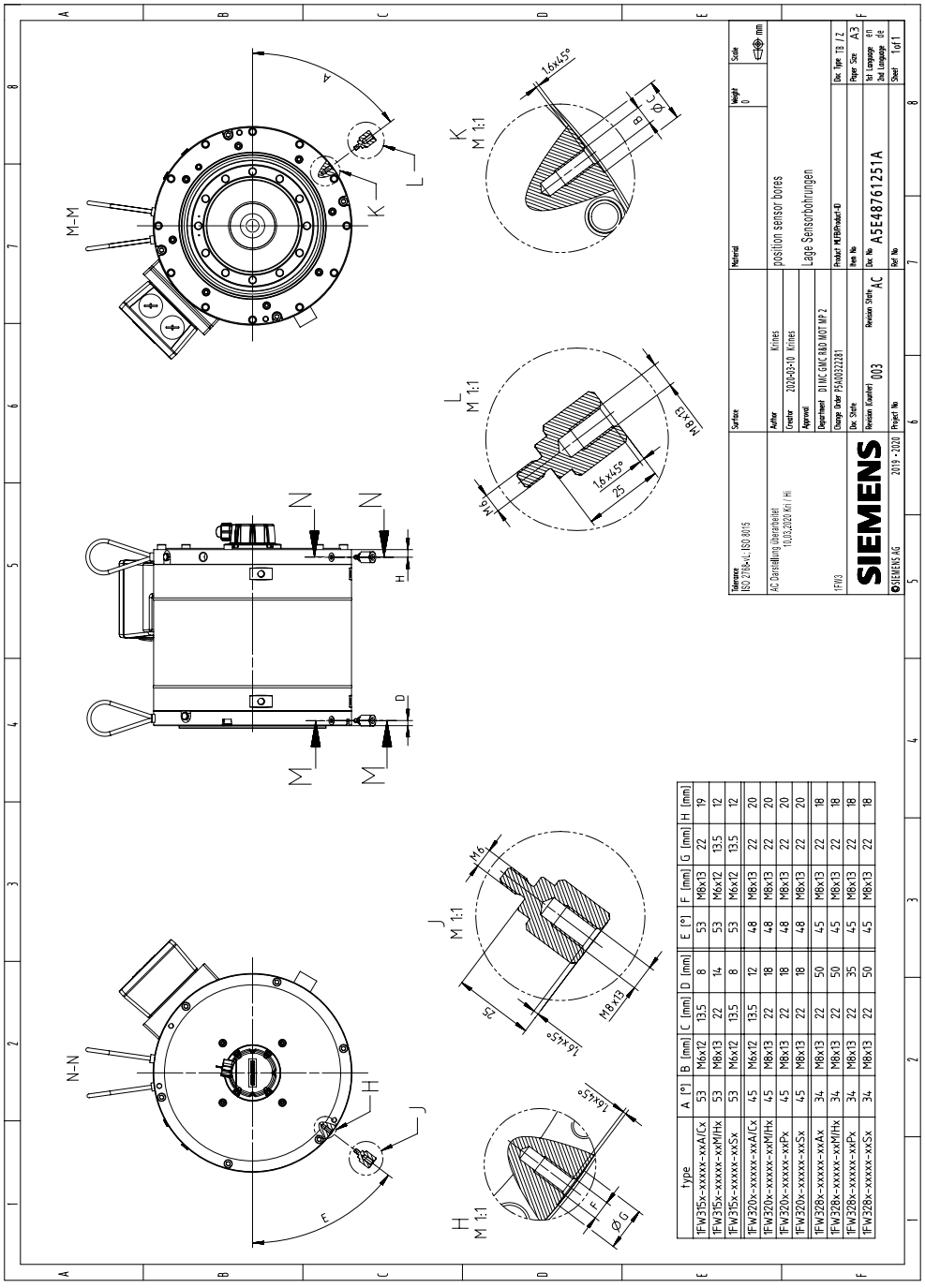
The adapters are fastened in pairs on the lifting eye. Where applicable, mount the adapter on the motor.

Remove the screw plugs before mounting the adapters.

You do not always need both adapters. Dispose of unnecessary adapters and screws in the proper manner.

Observe a maximum permissible tightening torque of 3 Nm when screwing the vibration sensors into the adapter.

The adapters protrude beyond the mounting flange of the motor and produce geometric interference. If geometric interference occurs, remove the adapters and use the M6 sensor holes.



Type	A (°)	B (mm)	C (mm)	D (mm)	E (°)	F (mm)	G (mm)	H (mm)
1FW315x-xxxxx-xxA/Cx	53	M6x12	13.5	8	53	M8x13	22	19
1FW315x-xxxxx-xxM/Hx	53	M8x13	22	14	53	M6x12	13.5	12
1FW315x-xxxxx-xxSx	53	M6x12	13.5	8	53	M6x12	13.5	12
1FW320x-xxxxx-xxA/Cx	45	M6x12	13.5	12	48	M8x13	22	20
1FW320x-xxxxx-xxM/Hx	45	M8x13	22	18	48	M8x13	22	20
1FW320x-xxxxx-xxPx	45	M8x13	22	18	48	M8x13	22	20
1FW320x-xxxxx-xxSx	45	M8x13	22	18	48	M8x13	22	20
1FW328x-xxxxx-xxAx	34	M8x13	22	50	45	M8x13	22	18
1FW328x-xxxxx-xxM/Hx	34	M8x13	22	50	45	M8x13	22	18
1FW328x-xxxxx-xxPx	34	M8x13	22	35	45	M8x13	22	18
1FW328x-xxxxx-xxSx	34	M8x13	22	50	45	M8x13	22	18

Figure 4-26 Position and dimensions of the sensor holes for the vibration sensors

4.12 Heavy duty (Z option L03)

Mounting

A flange is used for mounting.

Table 4-7 Flange mounting

	Description for SH 200	Description for SH 280
Bolt ISO 898-1[1)]	M12	M16
Washer ISO 7092	ISO 7092-12-300 HV	ISO 7092-16-300 HV (d2 = 30)
Tightening torque	120 Nm	300 Nm

[1)] Use screws of property class 10.9

Note

Screw locking

You must secure all screws as a result of the vibration and shock load.

Shaft adaptation

- A rigid connection between the motor and customer shaft is not permissible.
- Avoid distortion or overdetermining the bearings by precisely aligning the motor.
  Axial and radial forces are not allowed.
- In operation, avoid any additional axial shock load to the motor shaft.
- Design the shaft adaptation so that there are no axial and radial forces (straight gearing with splined shaft) and the appropriate play.
  Axial and radial forces are not allowed.

4.13 Mounting the output elements

Balancing

The rotors are balanced dynamically. The motors are equipped with a smooth shaft as standard. For shaft extensions with feather key, the balancing method is marked at the DE of the shaft extension with "H" (= half key balancing).

Pushing on the output elements

- Make sure that the balancing method for the output element is correct! The output elements must be balanced to balance quality grade G2.5 to ISO 1940. Rotary forces that exceed this are not permissible. Note that rotary forces can also occur with coupling output.
- If the output element is shorter than the feather key with balancing method "H", the section of the feather key that protrudes from the shaft contour and output element must be removed to maintain the balance quality.
- Fit/remove the output elements only by means of suitable equipment:
  - Use the threaded hole in the shaft extension (front).
  - If necessary, heat up the output element.
  - When removing output elements, use a washer to maintain the centering in the shaft extension.

⚠ WARNING

Danger to life if rotating output elements have no guard

Exposed rotating output elements can result in severe injury.

- Cover all exposed output elements using an appropriate guard.

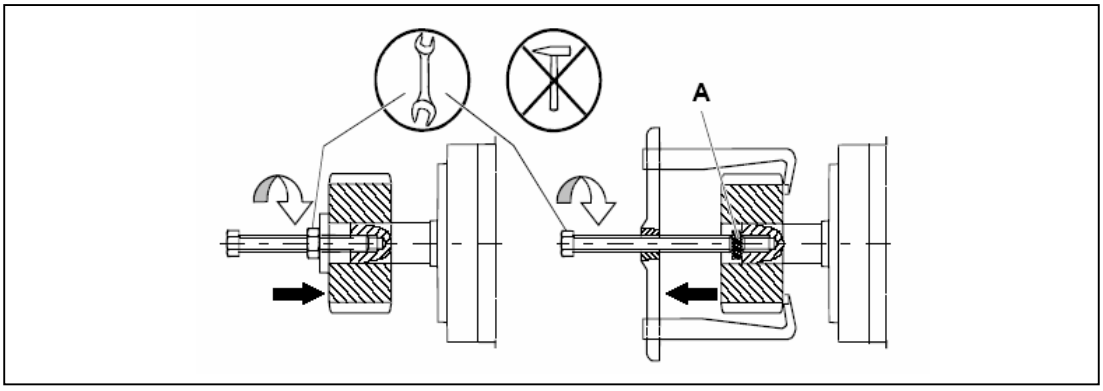


Figure 4-27 Fitting/removing output elements; A = intermediate washer (for maintaining the centering in the shaft extension)

Motor without output element

⚠ WARNING

Danger to life if feather keys are flung out

The feather key in a shaft is only secured during transport to prevent it from falling out. An open feather key sitting in the shaft will be flung out in operation.

Death or serious injury can result.

- Remove an open feather key sitting in the shaft, or secure it so that it cannot be flung out.
- For balancing type "H", shorten the feather key by about half.

Note

Type of balancing

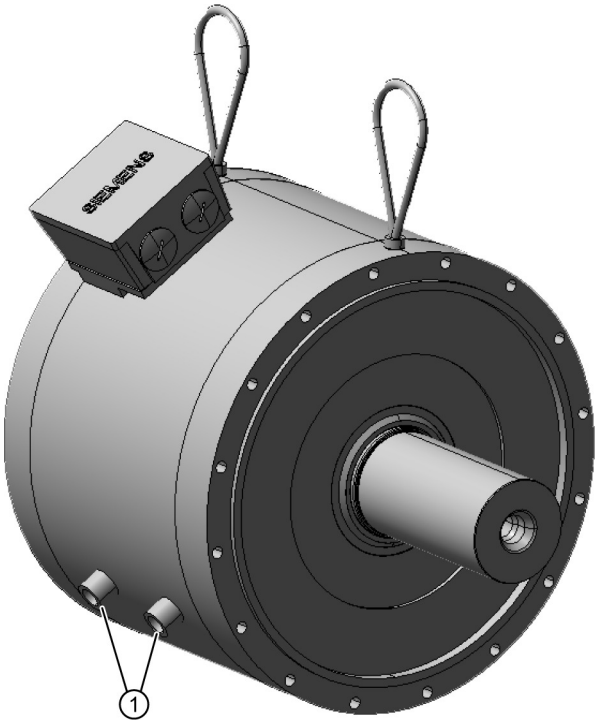
In the case of shaft extensions with feather keys, the type of balancing is also stamped on the rating plate next to the CE mark.

4.14 Mechanically connecting the water cooling system

The inlet and outlet sockets for the cooling water supply are situated on the cooling jacket at the drive end and the non-drive end.

Procedure

1. Make sure that the cooling water fulfills the required cooling water specification, see Chapter "Water cooling (Page 43)".
2. Make sure that the appropriate volume of cooling water is available, see the rating plate (type plate).



1 Water cooling connections

3. Screw the cooling water pipes into the female threads.
   - G 1/2" for 1FW315☐ and 1FW320☐
   - G 1" for 1FW328☐

   The inlet and outlet can be selected as required. Recommended: Intake at the NDE.
   To ensure mechanical decoupling, the devices should be connected by means of hoses.
4. Ensure that the maximum permissible operating pressure does not exceed 6 bar.

The water cooling system has been connected.

❒

Connection

5

5.1 Safety notes for electrical connections

⚠ WARNING

Risk of electric shock

There is a risk of electric shock if you incorrectly establish an electrical connection.

- Only work on the electrical connection if you are appropriately qualified to do so.
- Carry out all work at the motor with the system in a no-voltage condition.
- Connect the motor according to the circuit diagram provided.
- In the motor terminal box, ensure that the connecting cables are connected so that there is electrical isolation between the cables and the terminal box cover.
- Ensure that the terminal box is tight and sealed.

⚠ WARNING

Electric shock as a result of defective connecting cables

Using defective connecting cables can result in an electric shock. Further, material damage can occur, e.g. as a result of fire.

- When installing the motor, make sure that the connecting cables
  - are not damaged
  - are not under tension
  - cannot come into contact with any rotating parts.
- Maintain the permissible bending radii.
- Do not use the cables to hold the motor.
- Do not pull on the motor cables.

⚠ WARNING

Risk of electric shock as a result of residual voltages

There is a risk of electric shock if hazardous residual voltages are present at the motor connections. Even after switching off the power supply, active motor parts can have a charge exceeding 60 µC. In addition, even after withdrawing the connector 1 s after switching off the voltage, more than 60 V can be present at the free cable ends.

- Wait for the discharge time to elapse.

⚠ WARNING

Danger to life due to electric shock

As a result of the permanent magnets in the rotor, when the motors rotate a voltage is induced. If you use defective cable ports, you could suffer an electric shock.

- Do not touch the cable ports.
- Connect the motor cable ports correctly, or insulate them properly.

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.

⚠ WARNING

Danger of severe injuries caused by unexpected movements of the motor

Rotating and unexpected motor movement may cause death, serious injury and/or property damage.

- Never work in the vicinity of rotating parts for a switched-on machine.
- Keep persons away from rotating parts and areas where there is a danger of crushing.

NOTICE

Damage to components that are sensitive to electrostatic discharge

The DRIVE-CLiQ interface has direct contact to components that can be damaged/destroyed by electrostatic discharge (ESD). Encoder systems and temperature sensors are components that can be destroyed by electrostatic discharge (ESD).

Components that are sensitive to electrostatic discharge can be damaged if you touch the connections with your hands or with electrostatically charged tools.

- Carefully observe the information in Chapter "Equipment damage due to electric fields or electrostatic discharge (Page 16)".

5.2 Permissible line systems

In combination with the SINAMICS S120 drive system, the motors are generally approved for operation on TN and TT line supply systems - with grounded neutral point - and on IT line supply systems.

If you operate the drive system on IT line supply systems, then you must provide a protective device that shuts down the drive system when a ground fault occurs.

If you operate the motor with grounded line conductor, then you must use an isolating transformer with grounded neutral point (on the secondary) between the line supply and the drive system. In this way you avoid inadmissibly stressing the motor insulation.

5.3 Circuit diagram of the motor

The circuit diagram of the motor looks like this:

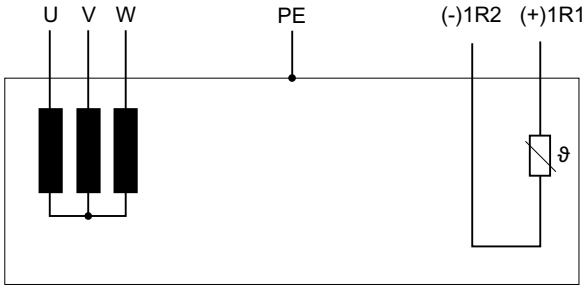
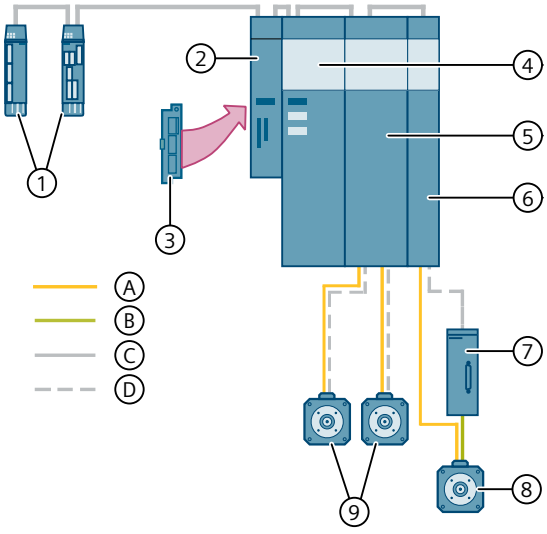


Figure 5-1 Circuit diagram of the motor

5.4 SINAMICS drive I/Os



1	Terminal Module	8	Motors without DRIVE-CLiQ interface
2	Control Unit	9	Motors with DRIVE-CLiQ interface
3	Operator control unit	A	MOTION-CONNECT power cable
4	Smart Line or Active Line Module	B	MOTION-CONNECT signal cable
5	Double Motor Module	C	DRIVE-CLiQ signal cable
6	Motor Module	D	MOTION-CONNECT DRIVE-CLiQ signal cable
7	Sensor Module		

Figure 5-2 SINAMICS S120 system overview

The complete torque motors can be operated in 4 quadrants. They can be connected to a controlled or uncontrolled infeed unit.

5.5 Connecting-up information

Note

The system compatibility is only guaranteed if shielded power cables are used, the shield is connected to the metal motor terminal box through the largest possible surface area (using metal EMC cable glands) so that a good electrical connection is established.

Shields are part of the protective grounding concept.

- Ground open or unused conductors - or electric cables that can be touched. Contact the shields with ground potential over the greatest possible surface area. Connect the open-circuit motor cables to the terminals provided for this purpose. Open-circuit cables carry capacitive charges and can result in malfunctions.
- Use EMC cable glands. The cable glands are screwed into the threaded holes of the terminal box.
- Close and seal unused threads with a metal plug.

Pre-assembled cables offer many advantages over cables assembled by customers themselves. In addition to having the security of knowing that prefabricated cables function perfectly and are high quality products, there are also some associated cost benefits.

- Use the power and signal cables from the MOTION-CONNECT family.
- Do not exceed the maximum permissible cable lengths.

You can find information on the technical data of the cables in the Catalog, Chapter "MOTION-CONNECT connection system".

Cable installation

- Use shielded power and signal cables.
- Connect the shield of power cables to the metal motor terminal box through the largest possible surface area using metal EMC cable glands so that a good electrical connection is established.
- In exceptional cases, you can use twisted motor cables or three-conductor cables with additional ground conductor.
- Only remove insulation from the cable ends so that the insulation reaches up to the cable lug, terminal, or conductor end sleeve.
- Avoid protruding wire ends.
- Arrange the conductors freely in the terminal box so that the protective conductor has excess length, and the insulation of the cable conductors is not damaged. Ensure that the connecting cables are strain relieved.
- Use cable lugs appropriate for the dimensions of the terminal board connections and the line cable cross-section.
- Secure connecting cables against twisting, tensile and compressive strain, and protect them against kinking. It is not permissible to subject cables to continuous force.
- Maintain the specified minimum air clearance.

Table 5-1 Minimum air clearance

Max. terminal voltage	< 600 V	< 1000 V
Minimum air clearance	5.5 mm	8 mm

- Tighten the screwed electrical connections with the specified tightening torques:

Table 5-2 Tightening torques

Thread Ø	M4	M5	M6	M8	M10	M12	M16
Tightening torque (Nm)	0.8 ... 1.2	1.8 ... 2.5	2.7 ... 4	5.5 ... 8	9 ... 13	14 ... 20	27 ... 40

Note

Route signal cables separately away from power cables so that they are not influenced, e.g as a result of interference.

Outer protective conductor or potential bonding conductor

Note

For 1FW328□ and for 1FW3204-3* / 1FW3206-3* / 1FW3208-3*, there is an additional connection point on the housing to connect an outer protective conductor or potential bonding conductor.

Connect-up the ground conductor

The ground conductor cross-section must be in full conformance with the installation regulations, e.g. acc. to EN 60204-1.

For motors with a rated power > 100 kW, also connect the ground conductor to the motor enclosure. A threaded hole is provided at the motor housing to connect the grounding conductor. The connection point is suitable for connecting flexible conductors with cable lugs or flat straps with the appropriately prepared end.

When establishing a connection, note the following:

- The connecting surfaces must be absolutely bare and protected with a suitable anti-corrosion agent, e.g. acid-free Vaseline.
- Place a washer under the screw head.
- Observe the tightening torque for the locking screw. See table "Tightening torques".

Table 5-3 Tightening torques

Screw	Tightening torque
M10	28 ... 42 Nm
M12	46 ... 70 Nm

Motor and cable protection

NOTICE
Damage due to cable overload If the electrical power is transferred using several cables connected in parallel, if one of the cable fails, this can overload the other motor cables. • Provide each of the individual cables with an overcurrent protection device.

After connecting up, check the following:

- Is the inside of the terminal box clean and free of the remains of cables?
- Have all of the terminal screws been appropriately tightened?
- Are the minimum air clearances maintained?
- Have the cable entries been correctly sealed?
- Have unused cable entries been sealed and the sealing elements screwed in?
- Are all of the sealing surfaces OK?

Current-carrying capacity for power and signal cables

The current-carrying capacity of PVC/PUR-insulated copper cables is specified for routing types B1, B2, C and E 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 Table "Derating factors".

Table 5-4 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**	**E / A**
Electronics (according to EN 60204-1)				
0.20	-	4.3	4.4	4.4
0.50	-	7.5	7.5	7.8
0.75	-	9	9.5	10
Power (according to EN 60204-1)				
0.75	8.6	8.5	9.8	10.4
1.00	10.3	10.1	11.7	12.4
1.50	13.5	13.1	15.2	16.1
2.50	18.3	17.4	21	22
4	24	23	28	30
6	31	30	36	37
10	44	40	50	52
16	59	54	66	70

Cross-section	Current-carrying capacity rms; AC 50/60 Hz or DC for routing type			
mm²	B1 / A	B2 / A	C / A	E / A
25	77	70	84	88
35	96	86	104	110
50	117	103	125	133
70	149	130	160	171
95	180	165	194	207
120	208	179	225	240
Power (according to IEC 60364-5-52)				
150	-	-	259 [1)]	276[1)]
185	-	-	296 [1)]	315[1)]
> 185	Values must be taken from the standard			

[1)] Extrapolated values

Table 5-5 Derating factors for power and signal cables

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

5.6 Motor connection

Power connection

Connect the motor in a terminal box to the converter in accordance with Chapter "Power connection (Page 135)".

Signal connection

Establish the signal connection by means of the signal connector or the DRIVE-CLiQ interface.

Information about connecting signals through signal connectors is provided in Chapter "Motors without DRIVE-CLiQ interface (Page 146)".

The DRIVE-CLiQ interface is described in Chapter "Motors with DRIVE-CLiQ interface (Page 141)".

For motor versions without encoder, you have to connect the temperature sensor to a terminal in the terminal box. You can find information on this in Chapter "Connecting temperature sensors (Page 150)".

5.7 Power connection

NOTICE
Thermal cable damage Cables can be thermally damaged if they are not suitable to conduct the current required. • Carefully observe the current which the motor draws for your particular application! Adequately dimension the connecting cables according to EN 60204-1 (see table "Cable cross section and current-carrying capacity").

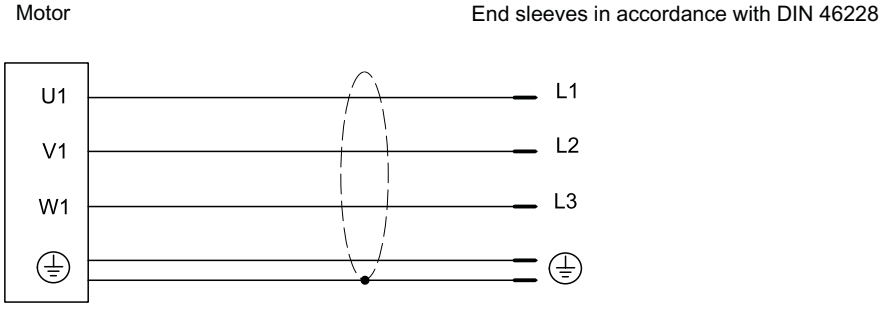
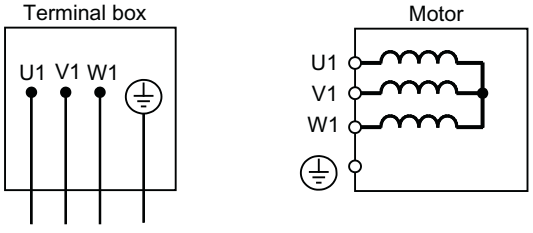


Figure 5-3 Power cable

Terminal box connection

The type designation of the mounted terminal box as well as details for connecting-up the line feeder cables can be taken from Table "Cable cross-sections (Cu) and outer diameter of the connecting cables in the standard version". A circuit diagram to connected-up the motor winding is provided in the terminal box when the motors are shipped.



Y circuit: supply voltage 400 V / 480 V

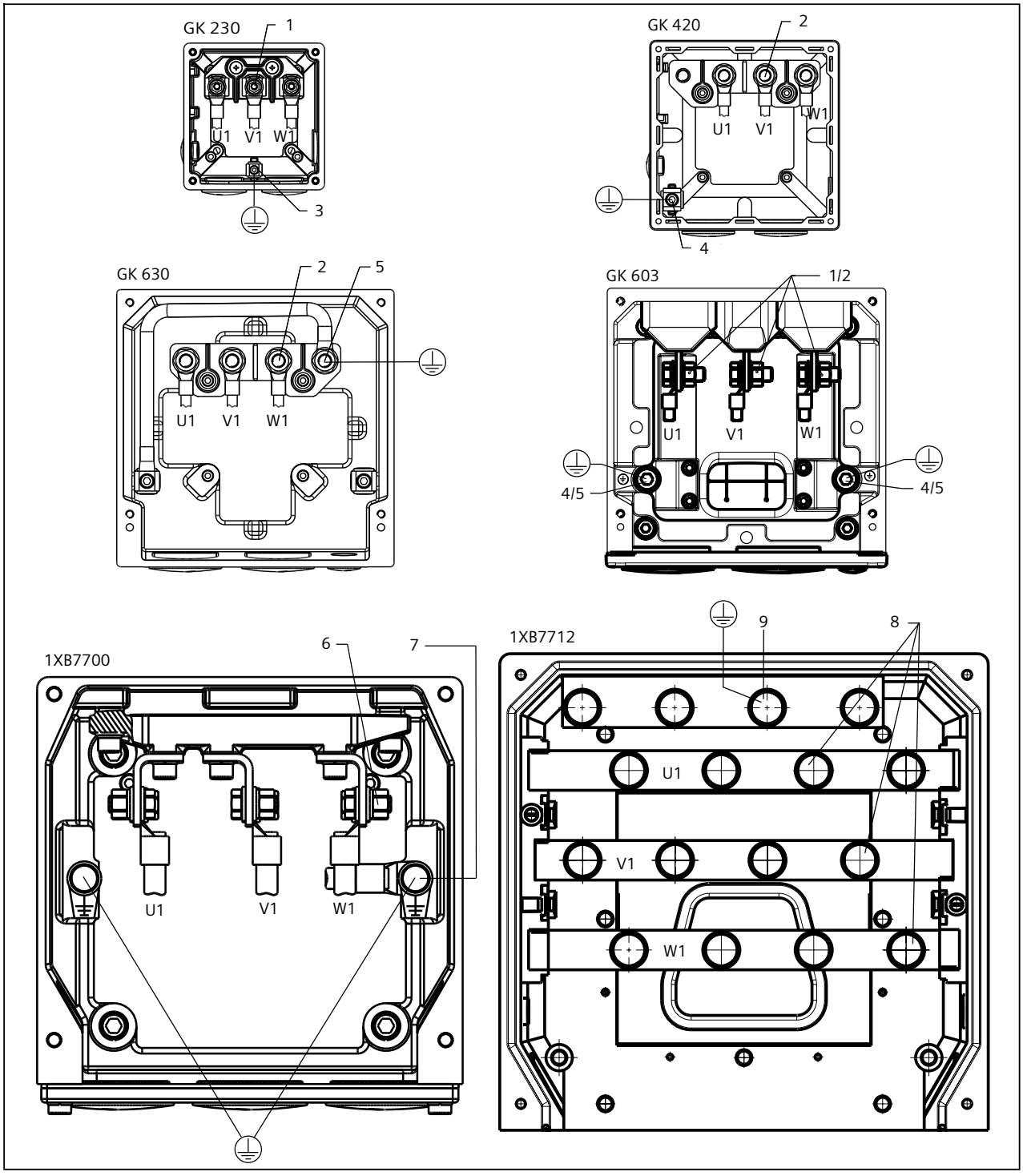
Figure 5-4 Circuit diagram

Terminal boxes

Note

Cable outlet direction

If the direction of the cable outlet is not changed correctly, this can damage the connecting cables. The direction of the cable outlet must not be changed since this renders all warranty claims invalid.



No.	Description	No.	Description	No.	Description
1	Connecting studs 3 x M5	4	M6 grounding screw	7	Grounding screws 2 x M12
2	Connecting studs 3 x M10	5	M10 grounding screw	8	Connecting studs 12 x M16
3	M4 grounding screw	6	Connecting studs 3 x M12	9	Grounding screws 4 x M16

Figure 5-5 Terminal assignment in the terminal boxes

Fabricating power cables

Cut the power cable conductors corresponding to the connections in the terminal box.

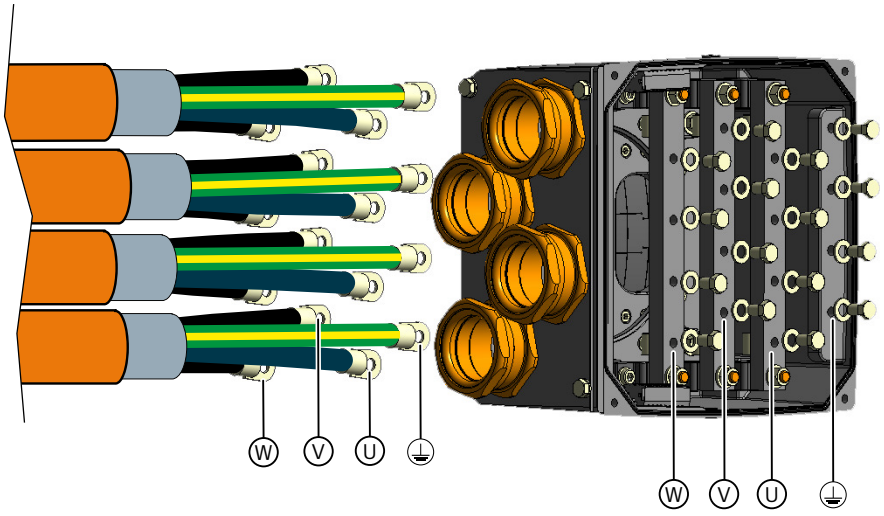


Figure 5-6 Example of adapted conductor lengths for connection in the terminal box

Table 5-6 Cable cross-sections (Cu) and outer diameter of the connecting cables in the standard version

Shaft height	Option [6]	Maximum permissible terminal current I	Terminal box type	Terminal bolt diam. in mm	Thread for cable entry	Cable entry max. diam. / width A/F in mm	Max. conductor cross-section [1] in mm²	Conductor diam. in mm
150	w/o	I ≤ 50 A	GK 230	5	2 x M32 x 1.5	46 / 40	2 x 16	11 - 24
	w/o	50 A < I < 105 A	GK 420	10	2 x M40 x 1.5	60 / 55	2 x 35	19 - 31
	w/o	105 A < I < 260 A	GK 630	10	2 x M50 x 1.5	68 / 60	2 x 50	27 - 38
	M02 [1]	I ≤ 260 A	GK 603	5 / 10	2 x M63 x 1.5	81 / 75	2 x 50	11 - 38
200	w/o [5]	I ≤ 50 A	GK 230	5	2 x M32 x 1.5	46 / 40	2 x 16	11 - 24
	w/o	50 A < I < 105 A	GK 420	10	2 x M40 x 1.5	60 / 55	2 x 35	19 - 31
	w/o [4]	105 A < I ≤ 260 A	GK 630	10	2 x M50 x 1.5	68 / 60	2 x 50	27 – 38
	M02 [1]	I ≤ 260 A	GK 603	5 / 10	2 x M63 x 1.5	81 / 75	2 x 50	11 – 38
	P01 [2]	260 A < I ≤ 470 A	1XB7-700	12	3 x M63 x 1.5	92 / 81	3 x 95	39 – 52
	w/o	260 A < I ≤ 470 A	1XB7-700	12	3 x M75 x 1.5	92 / 81	3 x 120	41 – 56

Shaft height	Option [6]	Maximum permissible terminal current I	Terminal box type	Terminal bolt diam. in mm	Thread for cable entry	Cable entry max. diam. / width A/F in mm	Max. conductor cross-section [1] in mm²	Conductor diam. in mm
280	P01 [2]	I ≤ 470 A	1XB7-700	12	3 x M63 x 1.5	92 / 81	3 x 95	39 – 52
	w/o	I ≤ 470 A	1XB7-700	12	3 x M75 x 1.5	92 / 81	3 x 120	41 - 56
	P04 [3]	470 A < I ≤ 710 A	1XB7-712	16	4 x M63 x 1.5	92 / 81	4 x 95	39 - 52
	w/o	470 A < I ≤ 830 A	1XB7-712	16	4 x M75 x 1.5	105 / 95	4 x 120	41 - 56

[1] Option M02: Terminal box GK 603 with removable front plate

[2] Option P01: Cable entry plate 3 x M63 x 1.5 for terminal box 1XB7-700

[3] Option P04: Cable entry plate 4 x M63 x 1.5 for terminal box 1XB7-712

[4] 1FW3206-3❑P supplied as standard with 1XB7-700. Terminal box GK 630 is possible on request.

[5] 1FW3201-3❑P supplied as standard with GK420

[6] You must order the options separately.

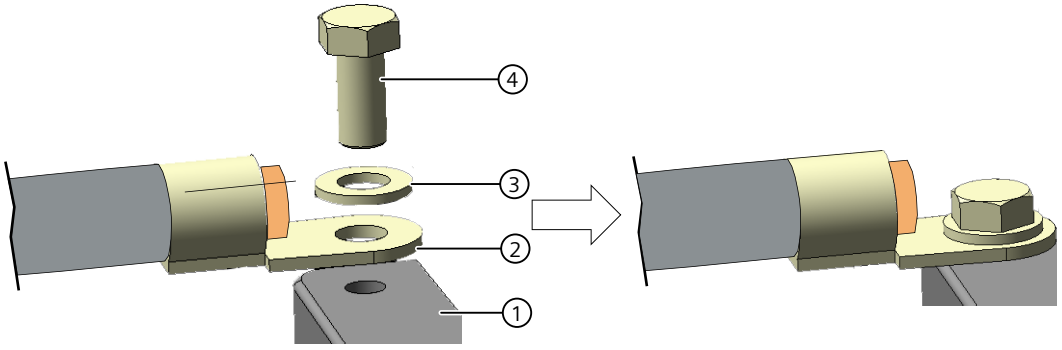
Note

MOTION-CONNECT 500 power cables are available up to a cross-section of 120 mm² and MOTION-CONNECT 800PLUS up to 50 mm².

The listed cables are UL and/or CSA approved.

The approvals can be taken from the current catalog in Chapter "MOTION-CONNECT connection system".

Cable connection design



1 Contact rail
2 Cable lug
3 Washer
4 Bolt

Connect the cable according to the example shown.

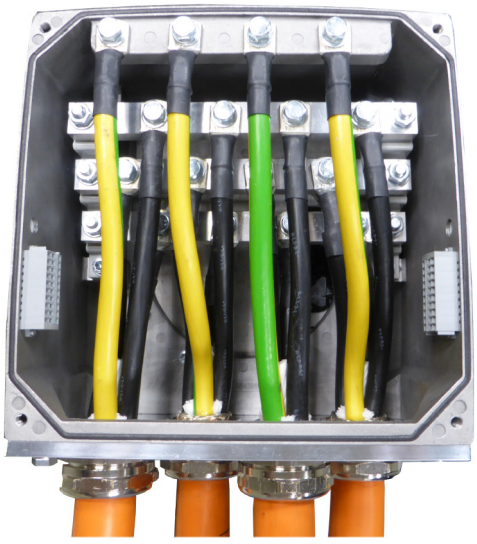
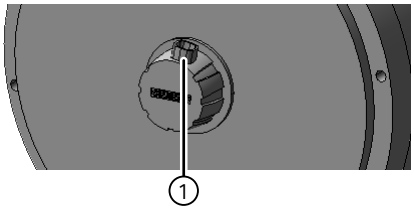


Figure 5-7 Example of a terminal box with correctly connected cables

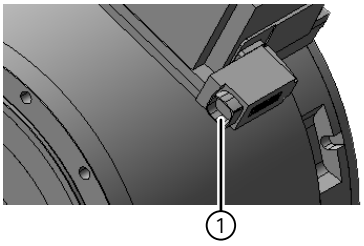
Close the terminal box.

5.8 Motors with DRIVE-CLiQ interface

Motors designed for SINAMICS drive systems are equipped with an internal Sensor Module, which contains an encoder and temperature evaluation system as well as an electronic rating plate. The Sensor Module is installed in place of the signal connector and is equipped with a 10-pin RJ45plus socket, This RJ45plus socket is known as DRIVE-CLiQ interface. The pin assignment is independent of the encoder inside the motor.



DRIVE-CLiQ interface for solid shaft and plug-on shaft



DRIVE-CLiQ interface for hollow shaft

Note

The Sensor Module is in direct contact with electrostatically-sensitive components. Neither hands nor tools that could be electrostatically charged should come into contact with the connections.

The Sensor Module can be rotated through approx. 180°. The torsional torque is between 4 and 8 Nm.

- Only rotate Sensor Modules by hand. Use of tools is not permissible.

The signal connection between the motor and Motor Module is established by means of a MOTION-CONNECT DRIVE-CLiQ cable.

- Insert the MOTION-CONNECT DRIVE-CLiQ cable connector until the spring catches latch engage.

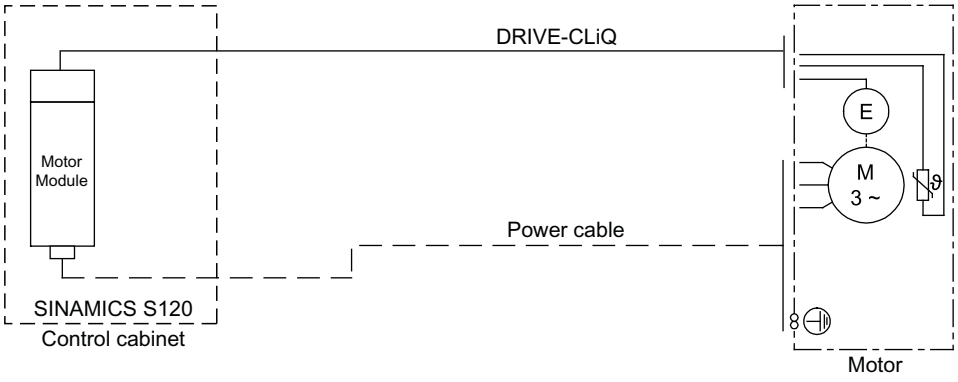
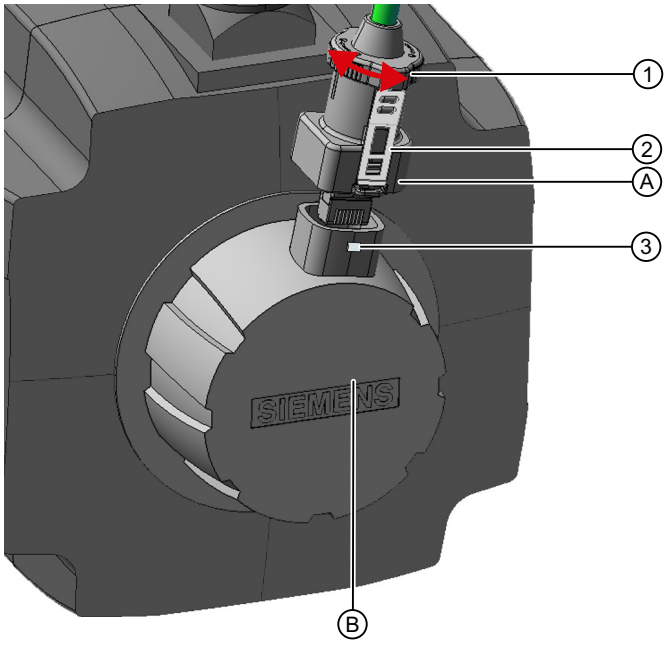


Figure 5-8 Connecting encoders using the DRIVE-CLiQ interface

5.9 Notes regarding 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	Spring catches (2, opposite each other)
3	Lugs (2, opposite each other)

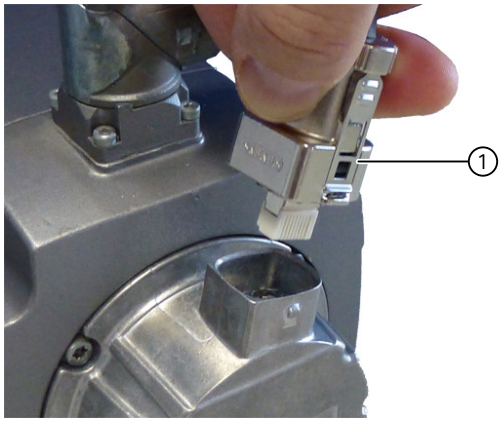
Insertion

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.

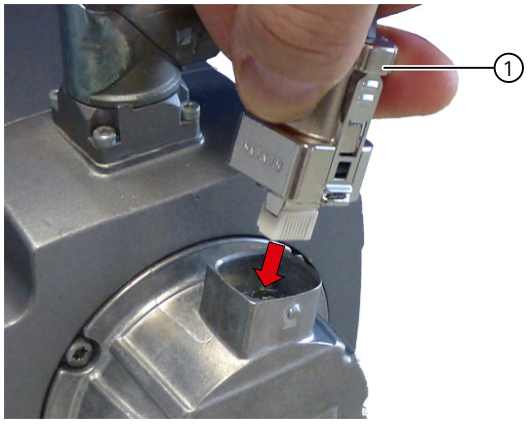
   Note

   In the "locked" position, the spring catches are flush against the connector.



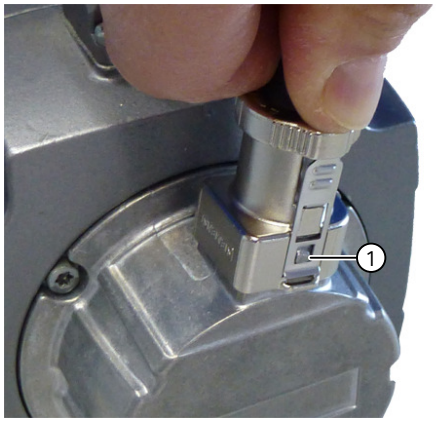
1 Locking ring in the "locked" position

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



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

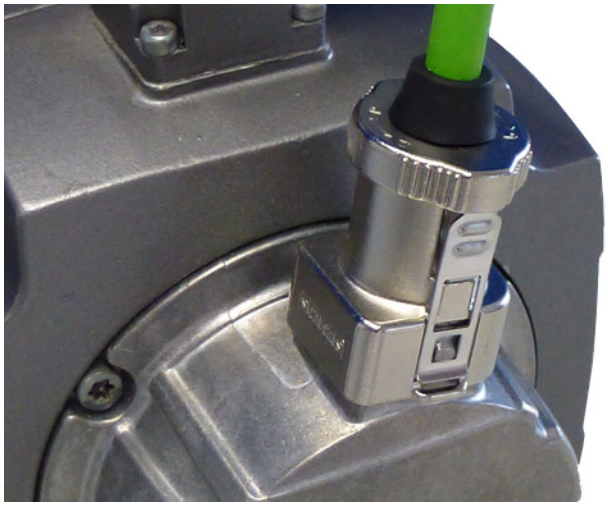
3. Check that the two spring catches are engaged in both lugs on the socket and that the connector cannot be withdrawn.



1 Both spring catches must engage in both lugs.

The correct DRIVE-CLiQ connection is made when

- the locking ring is in the "locked" position,
- both spring catches are engaged in both lugs.



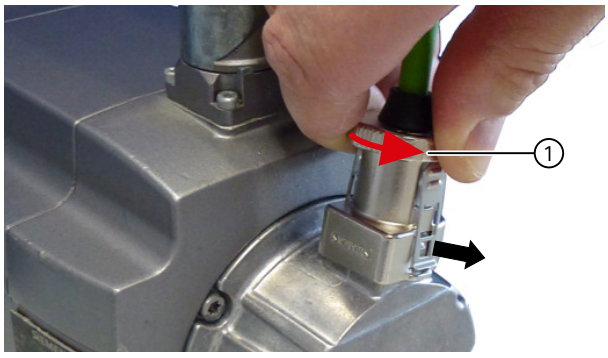
You have made a DRIVE-CLiQ connection.

❒

Removal

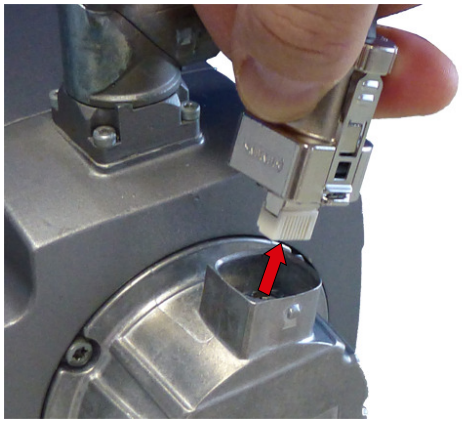
Procedure

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



1 Turn the locking ring counterclockwise.
→ Both spring catches are pressed away from the lugs.

2. Check that the two spring catches are disengaged from the lugs.
3. Pull the connector out of the RJ45 socket of the Sensor Module.

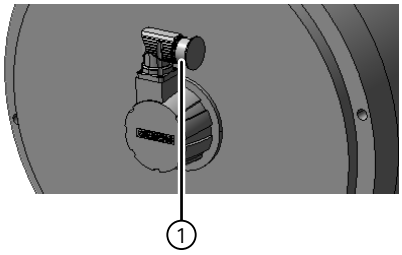


You have released the DRIVE-CLiQ connection.

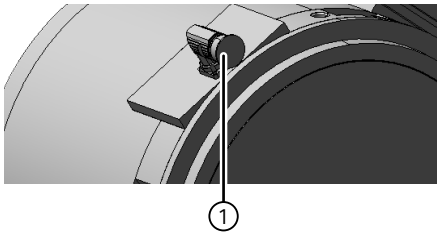
❒

5.10 Motors without a DRIVE-CLiQ interface

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

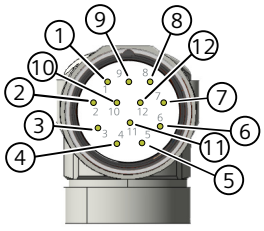
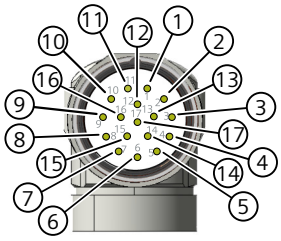


Signal connector for solid shaft and plug-on shaft



Signal connector for hollow shaft

1 signal connector

PIN assignment, signal connector 12 pin	PIN assignment, signal connector 17 pin	
		
Resolver	Incremental encoder sin/cos 1 V_{pp}	Absolute encoder
1 = S2	1 = A	1 = A
2 = S4	2 = A*	2 = A*
3 = not connected	3 = R	3 = data
4 = not connected	4 = D*	4 = not connected
5 = not connected	5 = C	5 = clock
6 = not connected*	6 = C*	6 = not connected
7 = R2	7 = M encoder	7 = M encoder
8 = +1R1 (KTY 84) or 1R1 (Pt1000)	8 = +1R1 (KTY 84) or 1R1 (Pt1000)	8 = +1R1 (KTY 84) or 1R1 (Pt1000)
9 = -1R2 (KTY 84) or 1R2 (Pt1000)	9 = -1R2 (KTY 84) or 1R2 (Pt1000)	9 = -1R2 (KTY 84) or 1R2 (Pt1000)
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 sense	15 = M sense
	16 = P sense	16 = P sense
	17 = not connected	17 = not connected

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

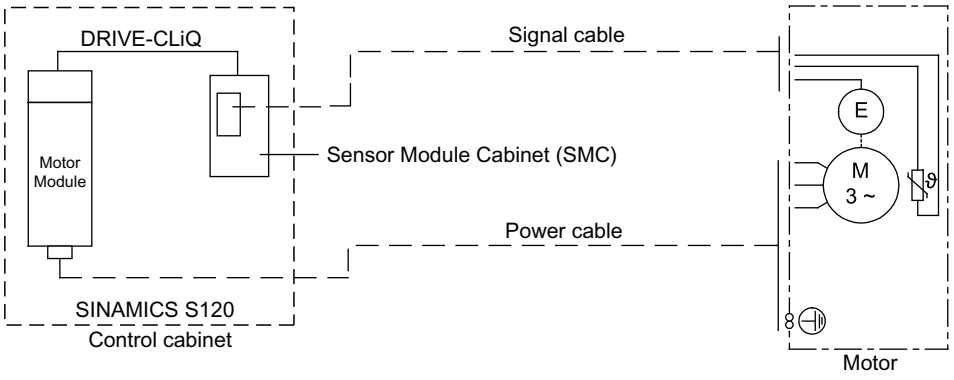


Figure 5-9 Encoder interface without DRIVE-CLiQ

5.11 Rotating the connector at the motor

Signal connector and integrated Sensor Module can be rotated to a limited extent.

Note

Observe the following when rotating the connectors:

- Do not exceed the permissible range of rotation.
- In order to maintain the degree of protection, max. 10 rotations are permissible.
- Keep to the maximum rotating torque. See Table "Maximum rotating torques that occur".
- Only rotate the connector with a mating connector that matches the connector thread.
- Secure the connection cables against tensile and bending stress.
- Secure the connector against rotating further.
- It is not permissible to subject the connector to continuous forces.

Table 5-7 Maximum rotating torques that occur

Connector	Max. rotating torques that occur / Nm
Signal connector	8
Integrated Sensor Module	8

Signal cable

The manufacturer mounts the plug-in connection for the signal cable (at the encoder terminal box).

- When connecting the connector, insert the coding groove into the socket connector until it is flush and tighten the screw cap by hand as far as it will go.

5.12 Connecting the temperature sensor on motors without DRIVE-CLiQ

Connect the temperature sensor to the signal connector together with the speed encoder signal. See also Chapter "Motors without a DRIVE-CLiQ interface (Page 146)".

For motor versions without an encoder, use the cable gland as well as the terminal in the terminal box for connection. See also Chapter "Connecting temperature sensors (Page 150)".

5.13 Connecting temperature sensors

Motor versions with 3x PTC

For special applications (e.g. when a load is applied with the motor stationary or for extremely low speeds), the temperature of all of the three motor phases must be additionally monitored using a 3 x PTC thermistor triplet (option A11).

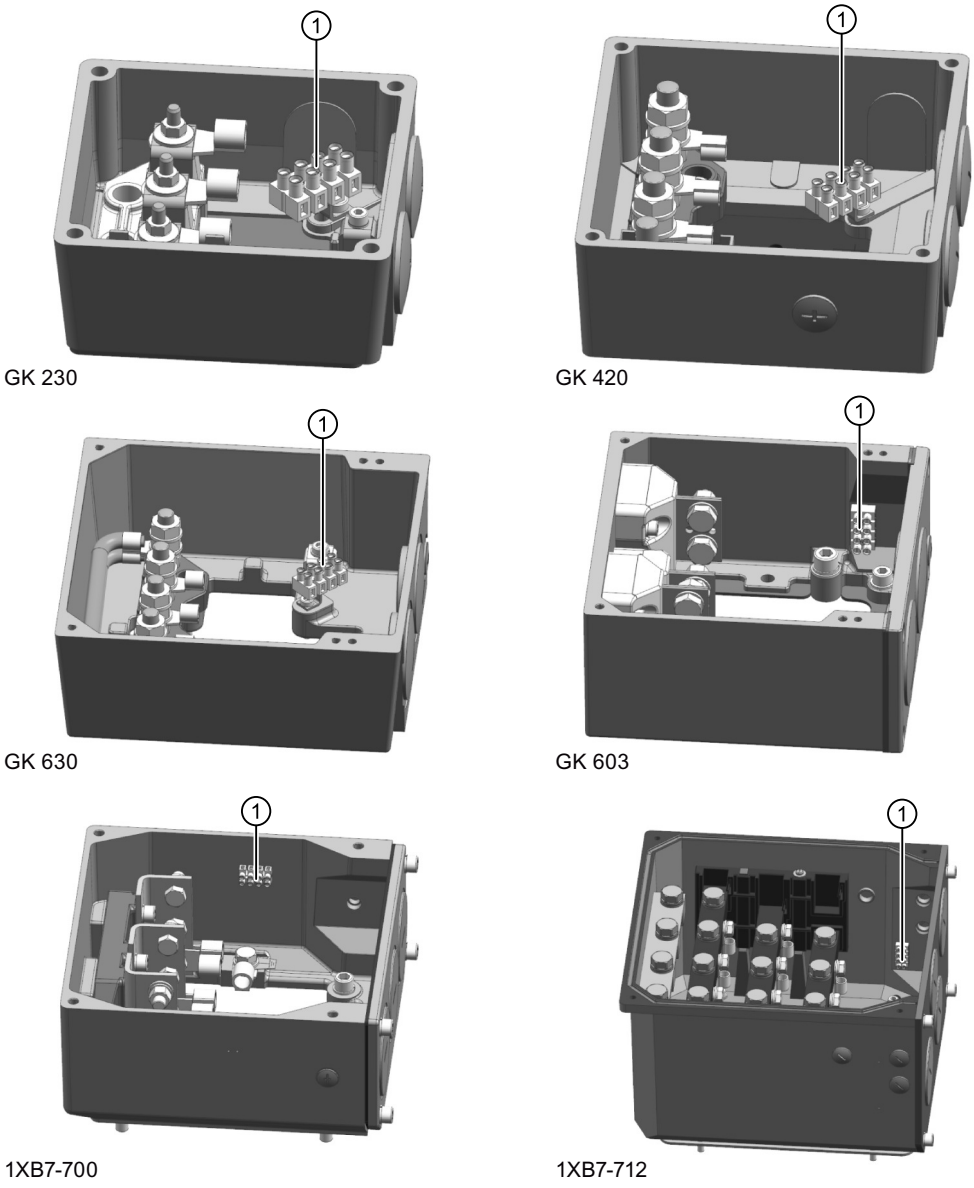
For motors without SMI (encoder without DRIVE-CLiQ interface and encoder with DQI encoder) and for motors with shaft height 280, the PTC thermistor triplet must be evaluated via an external trip unit (this is not included in the scope of delivery).

This means that the sensor cable is monitored for wire breakage and short-circuit by this unit. The motor must be switched into a no-torque condition when the response temperature is exceeded.

For motors of shaft heights 150 and 200 with SMI (encoder variants "D" = IC22DQ, "F" = AM22DQ, "U" = R15DQ), the PTC thermistor triplet is evaluated in the SMI and transmitted to the drive via DRIVE-CLiQ.

Note

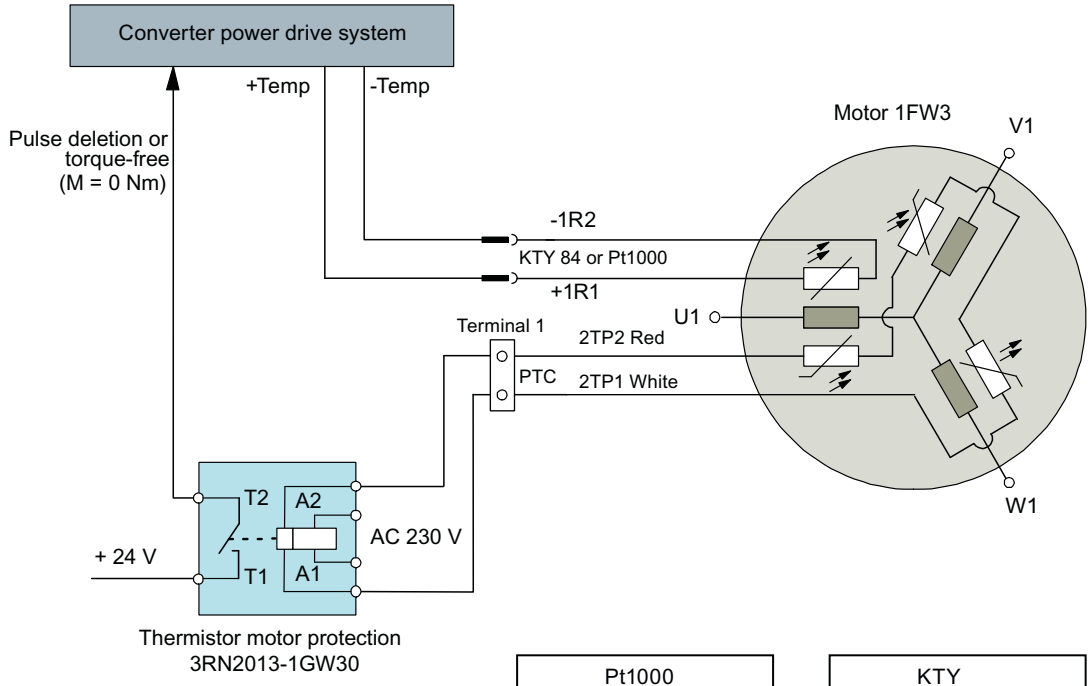
The PTC thermistors do not have a linear characteristic and are, therefore, not suitable to determine the instantaneous temperature. PTC characteristic to DIN VDE 0660 Part 303, DIN 44081, DIN 44082.



1 Terminal

Figure 5-10 Connection for 3 x PTC

Connection schematic for temperature sensors



Pt1000	
1R1	Yellow
1R2	Yellow

KTY	
+1R1	Brown
-1R2	White

Notes
- KTY 84: Ensure correct polarity.
- Pt1000/PTC*): Polarity-neutral
- Shutdown circuit: Check the shutdown circuit carefully to ensure that it correctly shuts down before the motor is actually commissioned.

*) PTC as option A11

Figure 5-11 Connection schematic for temperature sensors (without SMI)

5.14 Routing cables in a damp environment

Note

Routing cables in humid/moist environments

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

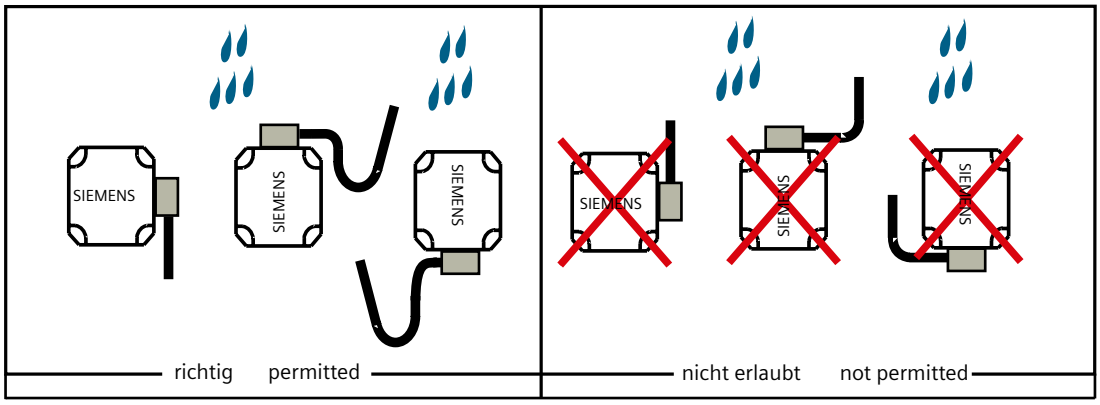


Figure 5-12 Principle of cable routing in a wet/moist environment

5.15 Shielding, grounding, and equipotential bonding

Important notes regarding shielding, grounding and equipotential bonding

The correct installation and connection of the cable shields and protective conductors is of crucial importance, not only for personal safety but also for noise emission and noise immunity.

⚠ WARNING

Risk of electric shock!

Hazardous touch voltages can be present at unused cores and shields if they have not been grounded or insulated.

- Connect the cable shields to the respective housings through the largest possible surface area. Use suitable clips, clamps or screw couplings to do this.
- Connect unused conductors of shielded or unshielded cables and their associated shields to the grounded enclosure potential at one end as minimum.
  Alternatively:
  Insulate conductors and their associated shields that are not used. The insulation must be able to withstand the rated voltage.

Further, unshielded or incorrectly shielded cables can lead to faults in the drive – particularly the encoder – or in external devices, for example.

Electrical charges that are the result of capacitive cross coupling are discharged by connecting the cores and shields.

NOTICE

Device damage as a result of leakage currents for incorrectly connected protective conductor

High leakage currents may damage other devices if the motor protective conductor is not directly connected to the power module.

- Connect the motor protective conductor (PE) directly at the power unit.

NOTICE

Device damage as a result of leakage currents for incorrect shielding

High leakage currents may damage other devices if the motor power cable shield is not directly connected to the power module.

- Connect the power cable shield at the shield connection of the power module.

Note

Apply the EMC installation guideline of the converter manufacturer. For Siemens converters, this is available under document order No. 6FC5297-☐AD30-0☐P☐.

NOTICE

Bearing currents/rotor ground currents

Bearing currents/rotor ground currents cause premature wear of the bearings, increased noise levels and vibrations.

- Avoid bearing currents/rotor ground currents by ensuring a good metallic connection between the motor and the customer's machine (enclosure and shaft). If you are unable to ensure a good metallic connection, contact your local Siemens office.
- Only use shielded power and signal cables. Connect the cable shields at both ends to the respective housings through the largest possible surface area.
  You can find further information on the Internet at the following link: Bearing Currents in Converter Driven Induction Motors (https://support.industry.siemens.com/cs/document/22159801/bearing-currents-in-converter-driven-induction-motors?dti=0&pnid=13204&lc=en-WW)

Commissioning

6

6.1 Safety instructions for commissioning

⚠ WARNING

Risk of electric shock as a result of residual voltages

There is a risk of electric shock if hazardous residual voltages are present at the motor connections. Even after switching off the power supply, active motor parts can have a charge exceeding 60 µC. In addition, even after withdrawing the connector 1 s after switching off the voltage, more than 60 V can be present at the free cable ends.

- Wait for the discharge time to elapse.

⚠ WARNING

Danger to life due to electric shock

As a result of the permanent magnets in the rotor, when the motors rotate a voltage is induced. If you use defective cable ports, you could suffer an electric shock.

- Do not touch the cable ports.
- Connect the motor cable ports correctly, or insulate them properly.

⚠ WARNING

Danger of severe injuries caused by unexpected movements of the motor

Rotating and unexpected motor movement may cause death, serious injury and/or property damage.

- Never work in the vicinity of rotating parts for a switched-on machine.
- Keep persons away from rotating parts and areas where there is a danger of crushing.

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.

NOTICE

Thermal motor damage

Windings and bearings can be destroyed if the motor overheats. Further, if a motor overheats, this can demagnetize the permanent magnets.

- Only operate the motors in conjunction with an effective temperature control.

WARNING

Danger to life when the cooling system bursts

The motor will overheat if it is operated without cooling. When cooling water enters the hot motor, this immediately and suddenly generates hot steam that escapes under high pressure. This can cause the cooling water system to burst, resulting in death, severe injury and material damage.

- Never operate the motor without cooling.
- Only commission the cooling water circuit when the motor is in a cool condition.

NOTICE

Motor overheating without water cooling

If the cooling water supply fails or the motor is operated for a short time without cooling water, this can cause it to overheat. This can result in material damage or destroy the motor completely.

- Only operate the motor with the cooling water supply switched on and in a fully functional state.
- Monitor the permissible water intake temperatures.
- It is important that you clarify the situation with your local Siemens office if the motor is to be operated without water cooling.

6.2 Check lists for commissioning

Note

Checks that are required

The lists 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 system.

- Before commissioning the system, check that it is properly installed and connected.
- Commission the cooling circuit before performing the electrical commissioning.
- Commission the drive system according to the operating instructions of the converter or inverter being used.
- Thoroughly familiarize yourself with the safety instructions.
- Check the drive using the subsequent checklists 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 manufacturer's documentation for the system components (e.g. drive system, encoder, cooling system, brake) and the "SIMOTICS T-1FW3 complete torque motors" Configuration Manual available?	
If the 1FW3 motor is to be operated with a SINAMICS S120 drive system: Is the following current SINAMICS documentation available? • SINAMICS S120 Commissioning Manual • Getting Started S120 • S120 Function Manual • S120/150 List Manual	
If the 1FW3 motor is to be operated with a SINAMICS S120 drive system: Was the Chapter "Checklists for commissioning SINAMICS S" in the SINAMICS S120 Commissioning Manual carefully observed?	
Is the motor type to be commissioned known? (e.g. 1FW3 _ _ _ – _ _ _ _ _ – _ _ _ _)	
Are the environmental conditions in the permissible range?	
Do the mode and the performance data for operation of the motors match the data on the rating plate (type plate)?	
Do the converter setting data match the data on the rating plate (type plate)?	

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

Check	OK
Have all touch protection measures for moving and live parts been implemented?	
Has the motor been correctly mounted and aligned?	

Check	OK
Can you rotate the rotor without it touching the stator?	
Do the operating conditions correspond to the data specified on the rating plate (type plate)?	
Are all mounting screws, connecting elements, and electrical connections tight and properly attached?	
Are the output elements suitable and correctly set for the application conditions?	

Table 6-3 Checklist (3) - checks regarding the water cooling

Check	OK
Has the cooling water supply been connected and is it ready for operation?	
Is the cooling water circulation (flow rate, temperature) in compliance with the specifications?	
Are the cooling pipes clean and free of any pollution? If required flush the cooling pipes before connecting the motors and converters to the cooling circuit so that the motors and converter are not polluted.	

Table 6-4 Checklist (4) - checks regarding the electrical system

Check	OK
Is the inside of the terminal box clean and free of any cable remains.	
Have all of the terminal screws been appropriately tightened?	
Are the minimum air clearances maintained?	
Are the cable entries correctly sealed?	
Have unused cable entries been sealed and the sealing elements screwed in?	
Are all of the sealing surfaces OK?	
Has the motor been connected so that it rotates in the specified direction?	
Have the minimum insulation resistance values been maintained?	
Have the grounding and equipotential bonding connections been correctly established?	

Table 6-5 Checklist (5) - checking the monitoring devices and equipment

Check	OK
Using the control and speed monitoring function is it absolutely ensured that the maximum permissible speed is complied with? See rating plate (type plate)	
Have all supplementary motor monitoring devices been correctly connected and are they working properly?	

Table 6-6 Checklist (6) - checking the roller bearings

Check	OK
Are the roller bearings OK?	
For motors that were stored, were the storage conditions according to the "Storage" section and the bearing replacement intervals according to the "Bearing replacement intervals" section complied with?	

6.3 Checking the insulation resistance

After long storage or shutdown periods, you must check the insulation resistance of the windings with respect to ground using a DC voltage.

⚠ WARNING

Danger to life due to electric shock

During and immediately after the measurement, the terminals are in some cases at hazardous voltage levels, which can lead to death when touched.

- Never touch the terminals when making measurements or immediately after the measurement.
- Check the connected supply feeder cables to ensure that the line supply voltage is not connected and cannot be connected.

Note

Before you begin measuring the insulation resistance, read the operating manual for the insulation resistance meter you are going to use.

Always measure the insulation resistance of the winding to the motor enclosure when the winding temperature is between 20 and 30°C.

When measuring, wait until the final resistance value is reached. This will take approximately one minute.

Limit values

The table below specifies the measuring circuit voltage as well as the limit values for the minimum insulation resistance and the critical insulation resistance with a rated motor voltage of U_N < 2 kV:

Table 6-7 Stator winding insulation resistance at 25 °C

	Rated voltage V_N < 2 kV
Measurement voltage	500 V (at least 100 V)
Minimum insulation resistance with new, cleaned, or repaired windings	10 MΩ
Critical specific insulation resistance after a long operating time	0.5 MΩ/kV

Note the following:

- Windings that are essentially like new have an insulation resistance of between 100 ... 2000 MΩ, possible also higher values.
  If the insulation resistance is close to the minimum value, this could be due to humidity and/or an accumulation of dirt.
- The insulation resistance of the motor winding can drop during the course of its service life due to ambient and operational effects. You can calculate the critical insulation resistance for a winding temperature of 25° C by multiplying the rated voltage (kV) by the specific critical resistance value (0.5 MΩ/kV);
  Example: Critical resistance for a rated voltage (U_N) of 0.6 kV:
  0.6 kV x 0.5 MΩ/kV = 0.3 MΩ

Note

Cleaning and/or drying the windings when reaching critical insulation resistance

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

After drying cleaned windings note that the insulation resistance is lower for a warm winding. The insulation resistance can only be correctly determined when measured for a winding that has been cooled down to room temperature (approx. 20 ... 30 °C).

Note

Measured value of the insulation resistance close to the critical value

If the measured value is close to the critical value, the insulation resistance must be subsequently checked at suitably regular intervals.

The values apply for measurements performed at a winding temperature of 25 °C.

6.4 Switching on

- Before you switch on the motor, ensure that the parameters of the frequency converter have been assigned correctly.
- Use a commissioning tool, e.g. "Drive ES" or "STARTER".

NOTICE

Uneven running or abnormal noise

The motor can be damaged by improper handling during transport, storage or when being installed. If you operate a damaged motor, this can damage the winding or bearings and could even destroy the complete system.

- Switch off the motor in case of uneven running or abnormal noise.
- As the machine runs down, identify the cause.

NOTICE

Damage when the maximum speed is exceeded

The maximum speed n_{max} is the highest permissible operating speed. The maximum speed is specified on the rating plate.

If speed n_{max} is exceeded, this can damage the bearings, press fits, etc.

- Ensure that the system cannot be controlled so that it reaches higher speeds. Appropriately design the control, or activate the speed monitoring function in the drive.

Operation 7

7.1 Safety instructions for operation

The motors are designed for operation with a cooling water supply. The motor must always be connected to the cooling water supply when in operation.

⚠ WARNING

Danger to life when the cooling system bursts

The motor will overheat if it is operated without cooling. When cooling water enters the hot motor, this immediately and suddenly generates hot steam that escapes under high pressure. This can cause the cooling water system to burst, resulting in death, severe injury and material damage.

- Never operate the motor without cooling.
- Only commission the cooling water circuit when the motor is in a cool condition.

NOTICE

Motor overheating without water cooling

If the cooling water supply fails or the motor is operated for a short time without cooling water, this can cause it to overheat. This can result in material damage or destroy the motor completely.

- Only operate the motor with the cooling water supply switched on and in a fully functional state.
- Monitor the permissible water intake temperatures.
- It is important that you clarify the situation with your local Siemens office if the motor is to be operated without water cooling.

NOTICE

Damage due to condensation

Condensation can form in the machine as a result of major fluctuations in the ambient temperature, direct solar radiation or a high degree of air humidity.

If the stator winding is damp, its insulation resistance decreases. This results in voltage flashovers, which can destroy the winding. Condensation can also cause the inside of the motor to rust.

- Observe the permitted ambient conditions.

⚠ WARNING

Danger to life as a result of opened or removed covers

Rotating or live parts represent potential hazards Covers have, for example, the following functions:

- Protection against contact with live parts
- Protection against contact with rotating parts
- Ensure the motor degree of protection
- Ensure the correct air guidance to achieve effective cooling

If you open or remove these covers in operation, this can result in death, severe injury or material damage.

- Keep these covers closed in operation.

⚠ WARNING

Faults while the motor is operational

Examples of faults that indicate functional impairments are:

- Higher power consumption
- Changed temperatures
- Vibration
- Unusual noise
- Unusual smells
- Response of the monitoring devices

Faults while the motor is operational can result in death, severe injury or material damage.

- Immediately inform the maintenance personnel.
- If in doubt, shut down the motor immediately, taking into account the plant-specific safety regulations.

7.2 Non-operational periods

Measures for stationary motors that are ready for operation

- Operate the motor regularly, at least once a month, in the event of longer non-operational periods.

NOTICE
Damage due to improper storage The motor can be damaged if it is not stored properly. • If the motor is out of service for extended periods of time, apply suitable anti-corrosion, preservation, and drying measures.

- For lengthy non-operational periods carefully read the notes in Chapter "Storing (Page 76)".
- When recommissioning after long non-operational periods, perform the checks and measures listed in Chapter "Commissioning (Page 157)".
- Observe Chapter "Switching on and switching off (Page 168)" before switching on to recommission the system.

7.3 Switching on and switching off

Note

EMERGENCY SWITCHING OFF

To avoid accidents, inform yourself about the EMERGENCY SWITCHING OFF function before you switch on the system.

The motor is switched on and off at the frequency converter.

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

Switching on

Precondition

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

Procedure

1. Switch on the motor at the frequency converter.
2. Observe any uneven running and abnormal noise of the motor.
3. Check the function of the safety equipment.
4. Check whether the motor reaches the required parameters.

You have now switched on the motor.
❒

Measures during switching off

- When switching off the motor, refer to the operating instructions for the frequency converter.
- Switch off the motor at the converter.
- Switch off the cooling water supply if the standstill period is expected to be lengthy.

7.4 Faults

If there are deviations from normal operation or if faults occur, initially proceed according to the following list.

While doing so, observe the relevant chapters in the documentation associated with the components of the complete drive system.

⚠ WARNING

Danger to life caused by non-functioning protective devices and equipment

If protective devices and equipment are not functioning, this can result in death, severe injury or material damage.

- Never immobilize or deactivate protective devices and equipment. This also applies when testing the system.
- Only work with functioning protective devices and equipment.

NOTICE

Damage to the machine caused by faults

- Remove the cause of the fault according to the remedial measures.
- Resolve/rectify, if possible, any damage to the machine/motor.

Note

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

Table 7-1 Possible faults

Fault	Cause of fault (see table)														
Motor does not start	A	B			E										
Motor starts slowly	A		C		E	F									
Humming noise when starting			C		E	F									
Humming noise during operation	A		C		E	F									
High temperature rise in no-load operation				D			G	H							
High temperature rise when under load	A		C				G	H							
High temperature rise of individual winding sections					E	F									
Uneven running									J	K					
Grinding sound, running noise											L				
Radial vibrations												M	N	O	
Axial vibrations														O	
Water is leaking															S

Table 7-2 Table "Fault causes and remedial measures"

No.	Cause of fault	Remedial measures
A	Overload	Reduce load
B	Interruption of a phase in the supply cable	Check frequency converter and supply cables
C	Interruption of a phase in the supply cable after switching on	Check frequency converter and supply cables
D	Converter output voltage too high, frequency too low	Check the frequency converter settings, perform automatic motor identification
E	Stator winding incorrectly connected	Check winding connection
F	Winding short circuit or phase short circuit in stator winding	Measure the winding resistances and insulation resistances, repair after consultation with manufacturer
G	Cooling water not connected/switched off	Check cooling water connection / switch on cooling water
	Water connection/pipes defective	Locate leak and seal; if necessary consult manufacturer
H	Cooling water flow rate too low	Increase cooling water flow rate
	Inlet temperature too high	Set correct inlet temperature
J	Insufficient shielding for motor and/or encoder cable	Check the shielding and grounding
K	Drive controller gain too high	Adjust the controller
L	Rotating parts are grinding	Determine cause and adjust parts
	Foreign bodies in the motor	Send to manufacturer for repair
	Bearing damage	Send to manufacturer for repair
M	Rotor not balanced	Decouple rotor and rebalance
N	Rotor out of true, shaft bent	Consult the manufacturer
O	Poor alignment	Align motor set
S	Cooling water pipes/water connection defective	Locate leak and seal as necessary or consult the manufacturer

If the fault still cannot be resolved after taking the measures stated above, contact the manufacturer or the Siemens Service Center. For contact data, see "Technical Support" in Chapter "Introduction".

Maintenance 8

8.1 Safety instructions related to maintenance

⚠ WARNING

Risk of injury as a result of undesirable rotary motion

If, with the motor switched on, you work in the rotational range of the motor, and the motor undesirably rotates, this can result in death, injury and/or material damage.

- Always switch off the motor before working in the rotational range of the motor. Ensure that the motor is in a completely no-voltage condition.

⚠ WARNING

Danger to life due to electric shock

As a result of the permanent magnets in the rotor, when the motors rotate a voltage is induced. If you use defective cable ports, you could suffer an electric shock.

- Do not touch the cable ports.
- Connect the motor cable ports correctly, or insulate them properly.

⚠ WARNING

Risk of electric shock as a result of residual voltages

There is a risk of electric shock if hazardous residual voltages are present at the motor connections. Even after switching off the power supply, active motor parts can have a charge exceeding 60 µC. In addition, even after withdrawing the connector 1 s after switching off the voltage, more than 60 V can be present at the free cable ends.

- Wait for the discharge time to elapse.

⚠ WARNING

Danger to life when the cooling system bursts

The motor will overheat if it is operated without cooling. When cooling water enters the hot motor, this immediately and suddenly generates hot steam that escapes under high pressure. This can cause the cooling water system to burst, resulting in death, severe injury and material damage.

- Never operate the motor without cooling.
- Only commission the cooling water circuit when the motor is in a cool condition.

⚠ CAUTION

Risk of burns when hot cooling water escapes

There is a risk of burns caused by escaping hot cooling water and steam if you open the cooling circuit of a motor that was previously in operation.

- Do not open the motor cooling circuit until the motor has cooled down.

8.2 Repair

If you are unclear about anything relating to maintenance work, consult the manufacturer, specifying the motor type and serial number, or arrange for the maintenance work to be carried out by one of the Siemens Service Centers.

Have a Siemens Service Center carry out the repair of the motor. For contact data, see "Technical Support" in Chapter "Introduction".

Service and Support (https://wse02.siemens.com/content/P0002282/englisch/SitePages/Home.aspx).

8.3 Inspection and maintenance

8.3.1 Maintenance intervals

General

Regularly carry out maintenance work, inspections and revisions/overhauls in order to identify and resolve faults at an early stage - before these result in subsequent damage.

⚠ WARNING

Faults or unusual conditions

Faults or unusual conditions when operating the motor can result in death, severe injury or material damage.

Electrical or mechanical stress placed on the three-phase motor, such as overload, short circuit, etc. can damage it. This includes, short-circuit or overload, for example.

- Immediately perform an inspection when faults or exceptional conditions occur.

Operating conditions, maintenance intervals

Only general maintenance intervals can be specified here as a result of the different operating situations.

- Maintenance intervals should, therefore, be scheduled to suit the local conditions (pollution/dirt, switching frequency, load, etc.).
- Perform the following measures after the appropriate operating times or at the specified intervals.

Table 8-1 Measures after an operating time

Operating time	Measure
Every 20,000 h	Coaxial encoder mounting: Replace the encoder and coupling (see Chapter "Replacing an encoder (Page 179)") Encoder via belt drive: Replace the encoder, auxiliary encoder bearings and toothed belts (see repair centers)
See table "Bearings with regreasing system (for 1FW315x, 1FW320x and 1FW328x, optional) in Chapter "Bearing replacement intervals".	Replace the motor bearings, the shaft sealing ring and for encoders with belt drive, the toothed belt pulley (see repair centers)

Repair centers

Note

Authorized motor repair centers

The following activities (particularly replacing parts) can only be performed by authorized motors repair centers:

- Replacing the encoder, auxiliary encoder bearings and toothed belts
- Replacing motor bearings, shaft sealing ring and toothed-belt pulley

In the event of a fault, contact the OEM/regional sales. They will then coordinate the appropriate authorized workshops.

Additional regional motor repair centers will be successively authorized in order to minimize downtimes and to be able to perform repairs quickly, at a favorable price and with a high quality standard.

For contact data of the Siemens Service Center, see "Technical Support" in Chapter "Introduction".

8.3.2 Bearing change intervals

Bearing lifetime and regreasing interval

The bearings for the complete torque motors are greased for life and designed for operation at a minimum ambient temperature of - 15 °C.

Note

Bearings without regreasing system

For bearings without regreasing system (SH 150 and SH 200), we recommend that the bearings are replaced after approx. 20000 operating hours for an ambient temperatures up to a maximum of 40°C, or after 5 years (after delivery) at the latest.

The bearing lifetime is reduced by 50 % when motors are mounted vertically. This is the reason that we recommend that a regreasing system is used when motors are mounted vertically.

Option +K40 "Regreasing system"

A regreasing system is:

- Standard for 1FW328□ and 1FW320□-□□□65-□□P0-Z L03
- Option for 1FW315□ and 1FW320□

If the 1FW3 is equipped with regreasing system (bevel lubricating nipple) for the DE and NDE bearings, then the bearing change interval increases according to the table "Bearings with

regreasing system". Comply with the regreasing intervals and ensure that the temperature does not exceed a maximum of 40 °C.

Table 8-2 Bearing change interval and regreasing

	SH 150	**SH 200**	**SH 280**
Bearing change interval with permanent grease lubrication, horizontal mounting position	20,000 h at max. 40 °C ambient temperature	20,000 h at max. 40 °C ambient temperature	---
Regreasing	Option +K40 See table "Bearings with regreasing system"	Option +K40 See table "Bearings with regreasing system"	Regreasing in the standard See table "Bearings with regreasing system"

Table 8-3 Bearings with regreasing system (optional for 1FW315❑ and 1FW320❑)

Motor	**Bearing change interval with regreasing / h**	**Regreasing intervals / h**
1FW315❑ Hollow shaft	40000	10000
1FW315❑ Plug-on shaft	60000	10000
1FW315❑ Stub shaft	40000	10000
1FW315❑ Solid shaft	60000	10000
1FW320❑ Hollow shaft	40000	10000
1FW320❑ Plug-on shaft	60000	10000
1FW320❑ Stub shaft	40000	10000
1FW320❑ Solid shaft	60000	10000
1FW328❑-2 Hollow shaft, n_N = 150 r/min, n_N = 250 r/min	40000	10000
1FW328❑-3 Hollow shaft, n_N = 400 r/min	40000	8000
1FW328❑-3 Hollow shaft, n_N = 600 r/min	40000	8000
1FW328❑-3 Hollow shaft, n_N = 800 r/min	40000	8000
1FW328❑-2/3 Plug-on shaft	40000	8000
1FW328❑-2/3 Stub shaft	40000	8000
1FW328❑-2 Solid shaft, n_N = 150 r/min, n_N = 250 r/min	40000	10000
1FW328❑-3 Solid shaft, n_N = 400 r/min	40000	8000
1FW328❑-3 Solid shaft, n_N = 600 r/min	40000	8000
1FW328❑-3 Solid shaft, n_N = 800 r/min	40000	8000

Table 8-4 Bearing grease

	Standard grease	Option +V07 "Special grease for low speeds"
Bearing grease designation	Klüberquiet BQH 72-102	LGHB 2
Manufacturer	Klüber Lubrication München KG	SKF AG
Contact	https://www.klueber.com	https://www.skf.com

Note

Specified grease quantity

For motors with the option +K40 "regreasing system", the required grease quantity is stated on the bearing data labeling plate.

Note

Vertical mounting position

The regreasing interval is reduced to 50% and therefore the bearing replacement interval when motors are mounted vertically.

Note

Selection of bearing grease for oscillating or reversing motor movements

For oscillating or reversing motor movements, depending on the application, you need a special grease, which you can obtain on request. If necessary, you must comply with other bearing change intervals and regreasing intervals than those specified in this manual.

⚠ WARNING

Danger to life as a result of parts of the body being drawn in and crushed

Operational motors can draw in body parts, crush them or cause other injuries.

- Only lubricate bearings if there is absolutely no risk to personnel.
- When working on an operational motor only wear clothes and accessories that cannot be drawn in.
- Take the appropriate measures so that your hair cannot be pulled in by the motor,
- Only regrease the bearings at the slowest speed that can be adjusted

Regreasing

Procedure

1. Set the lowest possible speed.
2. Grease the bearings at the lowest possible speed with the specified amount of grease.

You have greased the bearings.

❒

The recommended re-lubricating intervals relate to normal loads:

- Operation at speeds in accordance with the rating plate data
- Low-vibration operation, see Chapter "Vibration resistance (Page 117)"
- Use of the specified roller bearing greases

Option +V07 "Special grease for low speeds"

For option +V07 "Special grease for low speeds", for shaft heights 150 and 200, you require option K40 "Relubrication device". Motors of shaft height 280 are equipped with a relubrication device as standard. You do not require option K40 for these motors.

For motors with an average speed smaller than 100 r/min, you need the option +V07.

You can calculate the average operating speed n_m by the following formula:

$$n_m = \frac{n_1 t_1 + n_2 t_2 + \ldots n_n t_n}{100}$$

Formula symbol	Unit	Description
$t_1 \ldots t_n$	%	Time percentage of the bearing load
$n_1 \ldots n_n$	r/min	Operating speed

You therefore calculate an average speed from the different speeds according to their time percentages.

Special versions

Unfavorable factors (e.g. effects of mounting/installation, speeds, special modes of operation or high mechanical loads) may require special measures.

Contact your local Siemens office, specifying the prevailing general conditions.

8.3.3 Checking the cooling water

- Check the level and discoloration or turbidity of the cooling water at least once a year.
- Every year check whether the cooling water still has the permissible specification.
- If cooling water is lost for closed or semi-open circuits top up the system using a prepared mixture of deionized water and inhibitor or Antifrogen N.

8.4 Replacing an encoder

Removing/mounting the encoder

NOTICE

Electrostatically sensitive devices

Electronic modules contain components that can be destroyed by electrostatic discharge. When incorrectly handled, these components can be easily destroyed.
Carefully observe the instructions in Chapter "Equipment damage due to electric fields or electrostatic discharge (Page 16)", in order to avoid material damage.

8.4.1 Replacing an encoder for motors with DRIVE CLiQ

Replacing a programmed encoder

You can order a new programmed encoder through the Siemens Service Center by quoting the article number and serial number.

⚠ WARNING

Danger to life resulting from uncontrolled motion due to incorrect motor data

For the SINAMICS S120 drive system up to Version 4.2, when the encoder is replaced, it must be ensured that the new encoder contains the motor data that match the motor.
Malfunctions will occur if you install an encoder of the wrong type or one that was programmed for another motor. This can result in injury and/or material damage.

- Always replace a faulty encoder with another encoder of the same type. It is not permissible to retrofit a motor with a different encoder type.
- Use an already programmed encoder.

Procedure

1. Replace the encoder* programmed for this motor as described in Chapter "Mechanically replacing an encoder (Page 181)".
2. Switch on the motor.

You have replaced the encoder.

❒

*) With absolute encoders, the encoder position information must be adjusted to the machine's mechanical system (absolute encoder adjustment)

Replacing an non-programmed encoder

For the SINAMICS S120 drive system from Version 4.3, you can use encoders that have not been programmed.

⚠ WARNING

Danger to life resulting from uncontrolled motion due to incorrect motor data

Malfunctions will occur if you install an encoder of the wrong type or one that was programmed for another motor. This can result in injury and/or material damage.

- Only replace a defective encoder with another encoder of the same type has not been programmed.
- Ensure that an encoder that has not been written to is programmed with the correct motor data.

Ensure the following before installing the encoder.

- The replacement encoder is of the same type as the defective encoder.
- The encoder is not programmed. The encoder was not used in another motor or was completely cleared of data.

Procedure

1. Replace the encoder* programmed for this motor as described in Chapter "Mechanically replacing an encoder (Page 181)".
2. Switch on the motor. → After the drive / control has powered up, you see Alarm "1840 – Found component with no motor data".
3. Subsequently program the encoder.

You have replaced the encoder.

❒

*) With absolute encoders, the encoder position information must be adjusted to the machine's mechanical system (absolute encoder adjustment)

Programming the encoder

Programming an encoder involves importing the electronic motor rating plate.

Note

Saving the data of the electronic rating plate

From SINAMICS / SINUMERIK SW version 4.3, the encoder data is automatically saved when you commission the motor. You do not need to save it manually.

Note

The encoder data (electronic motor rating plate) must be installed later on a non-preprogrammed encoder with a DRIVE-CLiQ interface. Up until then, the motor control issues alarm "1840".

For a new commissioning - or if the motor is used for another application - then the motor data are otherwise no longer available.

Program the encoder using the service manual "Replacing an encoder for 1FK7 G2 and 1FT7" (https://support.industry.siemens.com/cs/document/99457853/replacing-an-encoder-for-simotics-s-1fk7-g2-s-1fg1-and-s-1ft7?dti=0&pnid=13308&lc=en-WW).

If you have any questions, contact your local Siemens office.

8.4.2 Mechanically replacing an encoder

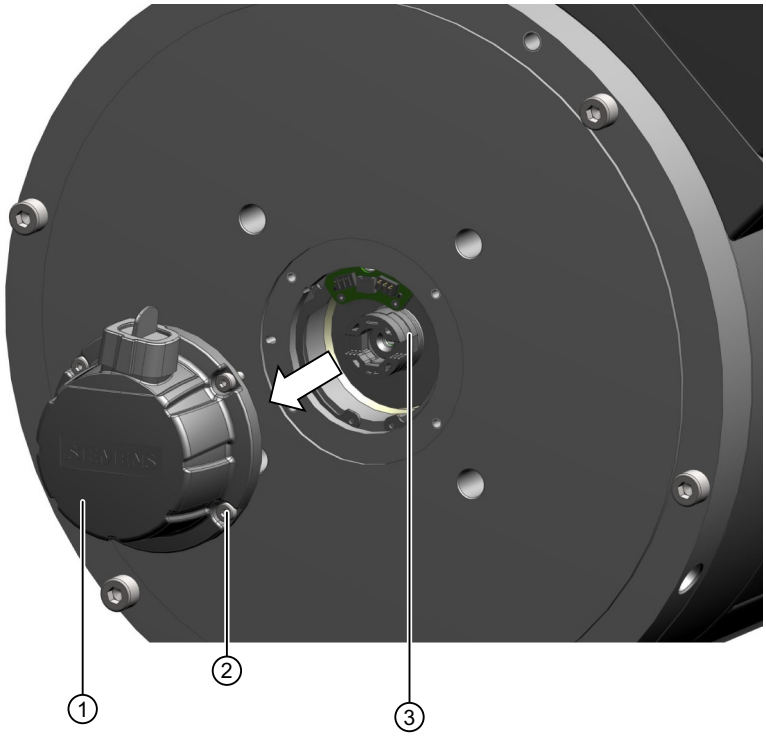
Procedure

Note

If you need to replace several encoders, you should always do so one at a time. This will avoid confusion and rule out programming errors.

1 Removal

1. Disconnect the motor.
2. Disconnect the encoder cable.



1 Encoder module
2 Four fixing screws
3 Coupling element

3. Remove the four fastening screws of the encoder.
4. Remove the encoder and the coupling element.

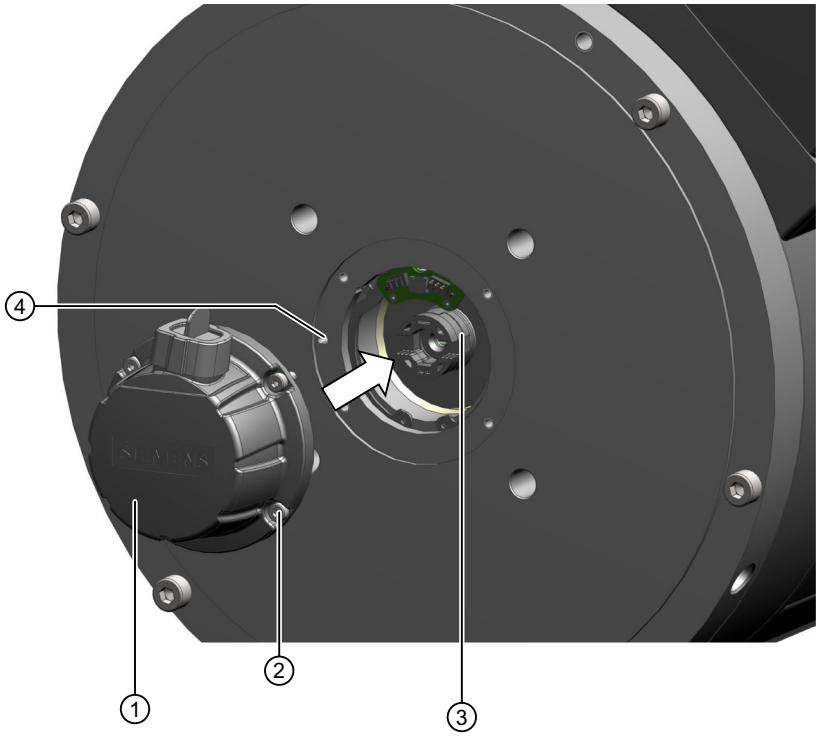
Note

Replacing the coupling element

When replacing the encoder, you must always install the new coupling element provided.

2 Installing

1. Attach the coupling element to the coupling hub of the motor shaft.
2. Align the coupling hub at the encoder to the coupling element in the motor. The encoder with coupling hub can only be inserted at a specific position.



1 Encoder module
2 Four fixing screws
3 Coupling element
4 Elongated hole to position the encoder

3. Insert the encoder at this position. Inserting the coupling involves blind assembly.
4. Rotate the inserted encoder, so that the positioning pin of the encoder latches into the elongated hole in the bearing shield.
5. Fasten the encoder using the four fixing screws provided (tightening torque: 2 Nm to 3 Nm).

⚠ WARNING

Danger of death if the encoder is not properly installed or the safety devices do not work

If the encoder or any other parts of the machine are not properly installed or any of safety devices and equipment do not operate, this could result in death or injury.

- Make sure all parts of the machine are correctly installed and connected.
- Make sure all safety devices are switched on again and working correctly.

Switch on the system.

3 Absolute encoder adjustment

Note

Only absolute encoders need to be adjusted.

When you adjust an absolute encoder, its actual value is compared once with the machine zero point and then set to valid.

- Adjust the encoder as described in the associated Function Manual.

You have replaced the encoder.

❒

Decommissioning and disposal

9

9.1 Safety instructions

⚠ WARNING

Danger to life due to permanent magnet fields

The permanent magnets of rotors generate strong magnetic fields and forces of attraction. The motor permanent magnets represents a danger for people with active medical implants, who come close to the motors. Examples of such implants include: Heart pacemakers, metal implants, insulin pumps. Further, people that have magnetic or electrically conductive implants are at risk.

- If you are such a person (with heart pacemaker or implant) then keep a minimum distance of 300 mm from an opened motor.
- Only the Siemens Service Center should remove the rotor.

NOTICE

Data loss due to strong magnetic fields

If you are located close to the rotor, any magnetic or electronic data storage media as well as electronic devices that you might be carrying could be damaged.

- Do not wear or carry any magnetic or electronic data storage media (e.g. credit cards, USB sticks, floppy disks) and no electronic devices (e.g. watches) if you are close to a rotor!

⚠ WARNING

Danger to life caused by falling machine parts

The machine partially comprises heavy individual components. When removing the machine, these components can fall. This can result in death, serious injury or material damage.

- Secure the machine components that are being released so that they cannot fall.

⚠ WARNING

Injury as a result of suspended loads

When being dismantled and transported, the motor can cause injury as a result of its movement.

- Only use perfectly functioning hoisting and load suspension equipment dimensioned to carry the motor load.
- Pay careful attention to possible movement when the motor is released.
- Do not stand under suspended loads or in their slewing range.
- When placing down the motor, 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. Use suitable personnel protection equipment, e.g. protective eyewear, gloves.
- Have materials on hand to soak up leaked liquids and prevent areas from being slippery.

9.2 Decommissioning

Removing the motor

The motor must only be removed by qualified personnel with the appropriate technical know-how.

Contact a certified waste disposal organization in your vicinity.

Procedure

1. Disconnect all of the electrical connections
2. Remove all liquids such as oil, water.
3. Release all of the supply lines
4. Remove all cables.
5. Remove the fixing elements from the motor.
6. Transport the motor to a suitable location for storage.

Refer also to the information in Chapter "Maintenance (Page 171)".

You have removed the motor.

❒

Note

Dismantling the motor

The motor must be dismantled by an authorized company or the manufacturer.

9.3 Disposal

Send the motor to an authorized company for dismantling and disposal - or send the complete motor back to the manufacturer.

Recommendations for the environmentally-friendly disposal of the components and materials are provided in the following.

Comply with local disposal regulations.

⚠ WARNING

Injury or material damage if not correctly disposed of

If you do not correctly dispose of direct drives or their components (especially components with permanent magnets), then this can result in death, severe injury and/or material damage.

- Ensure that direct drives and their associated components are correctly disposed of.

Components

- Complete demagnetization of the components that contain permanent magnets
- Components that are to be recycled should be separated into:
  - Electronics scrap (e.g. encoder electronics, Sensor Modules)
  - Electrical scrap (e.g.motor windings, cables)
  - Scrap iron (e.g. laminated cores)
  - Aluminum
  - Insulating materials

Process materials and chemicals

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

- Oil
  Dispose of the spent oil as special waste in accordance with the spent oil ordinance.
- Grease
- Solvents
- Cleaner solvent
- Paint residues

Do not mix solvents, cleaner solvents and paint residues.

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 Description of terms

Rated torque M_N

Thermally permissible continuous torque in S1 duty at the rated motor speed.

Rated speed n_N

The characteristic speed range for the motor is defined in the speed-torque diagram by the rated speed.

Rated current I_N

RMS motor phase current for generating the particular rated torque. Specification of the RMS value of a sinusoidal current.

Braking torque $M_{br\ rms}$

$M_{br\ rms}$ corresponds to the average braking torque for armature short-circuit braking that is achieved through the upstream braking resistor R_{opt}.

Braking resistance R_{opt}

R_{opt} corresponds to the optimum resistance value per phase that is switched in series external to the motor winding for the armature short-circuit braking function.

DE

Drive end

Cyclic inductance L_D

The cyclic inductance is the sum of the air gap inductance and leakage inductance relative to the single-strand equivalent circuit diagram. It consists of the self-inductance of a phase and the coupled inductance to other phases.

Torque constant k_T (value for a 100 K average winding temperature rise)

Quotient obtained from the static torque and static current.

Calculation: $k_T = M_{0,\ 100K} / I_{0,\ 100K}$

Note

This constant is not applicable when configuring the necessary rated and acceleration currents (motor losses!).

The steady-state load and the frictional torques must also be included in the calculation.

Electrical time constant T_{el}

Quotient obtained from the rotating field inductance and winding resistance. $T_{el} = L_D/R_{ph}$

Maximum speed n_{max}

The maximum permissible operating speed n_{max} is the lesser of the maximum mechanically permissible speed and the maximum permissible speed at the converter.

Maximum torque M_{max}

Torque that is generated at the maximum permissible current.

The maximum torque is briefly available for high-speed operations (dynamic response to quickly changing loads).

The maximum torque is limited by the closed-loop control parameters. If the current is increased, then the rotor will be de-magnetized.

Max. current $I_{max, RMS}$

This current limit is only determined by the magnetic circuit. Even if this is briefly exceeded, it can result in an irreversible de-magnetization of the magnetic material. Specification of the RMS value of a sinusoidal current.

Maximum permissible speed (mechanical) $n_{max\ mech.}$

The maximum mechanically permissible speed is $n_{max\ mech}$. It is defined by the centrifugal forces and frictional forces in the bearing.

Maximum permissible speed at converter $n_{max\ Inv}$

The maximum permissible speed during operation on a converter is $n_{max\ Inv}$. This is calculated by means of the voltage induced in the motor and the voltage strength of the converter.

Mechanical time constant T_{mech}

The mechanical time constant is obtained from the tangent at a theoretical ramp-up function through the origin.

$T_{mech} = 3 \cdot R_{ph} \cdot J_{mot}/k_T^2$ in s

J_{mot} = Servomotor moment of inertia in kgm^2

R_{ph} = Phase resistance of the stator winding in Ω

k_T = Torque constant in Nm/A

NDE

Non-drive end

Number of poles 2p

Number of magnetic north and south poles on the rotor. p is the number of pole pairs.

Voltage constant k_E (value at 20° C rotor temperature)

Value of the induced motor voltage at a speed of 1000 r/min and a rotor temperature of 20°C.

The phase-to-phase RMS motor terminal voltage is specified.

SMI

Sensor Module Integrated

Static torque M_0

Thermal limit torque at motor standstill corresponding to a utilization according to 100 K. At n = 0, this can be output for an unlimited length of time. M_0 is always greater than the rated torque M_N.

Static current I_0

Motor phase current for generating the particular static torque. Specification of the RMS value of a sinusoidal current.

Thermal time constant T_{th}

Defines the increase in the motor frame temperature when the motor load is suddenly increased (step function) to the permissible S1 torque. The motor has reached 63% of its final temperature after T_{th}.

Moment of inertia J_{mot}

Moment of inertia of rotating motor parts.

Shaft torsional stiffness c_T

This specifies the shaft torsional stiffness from the center of the rotor laminated core to the center of the shaft end.

Winding resistance R_{ph} at 20°C winding temperature

The resistance of a phase at a winding temperature of 20° C is specified. The winding has a star circuit configuration.

Efficiency η_{opt}

Maximum achievable efficiency along the S1 characteristic or below the S1 characteristic without field weakening current.

A.2 Document identification number Configuration Manual

The document identification number for the Configuration Manual SIMOTICS T-1FW3 complete torque motors for SINAMICS S120 is:

- A5E46027705B (English)
- A5E46027705A (German)

More information

Siemens:
www.siemens.com/simotics

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www.siemens.com/online-support

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