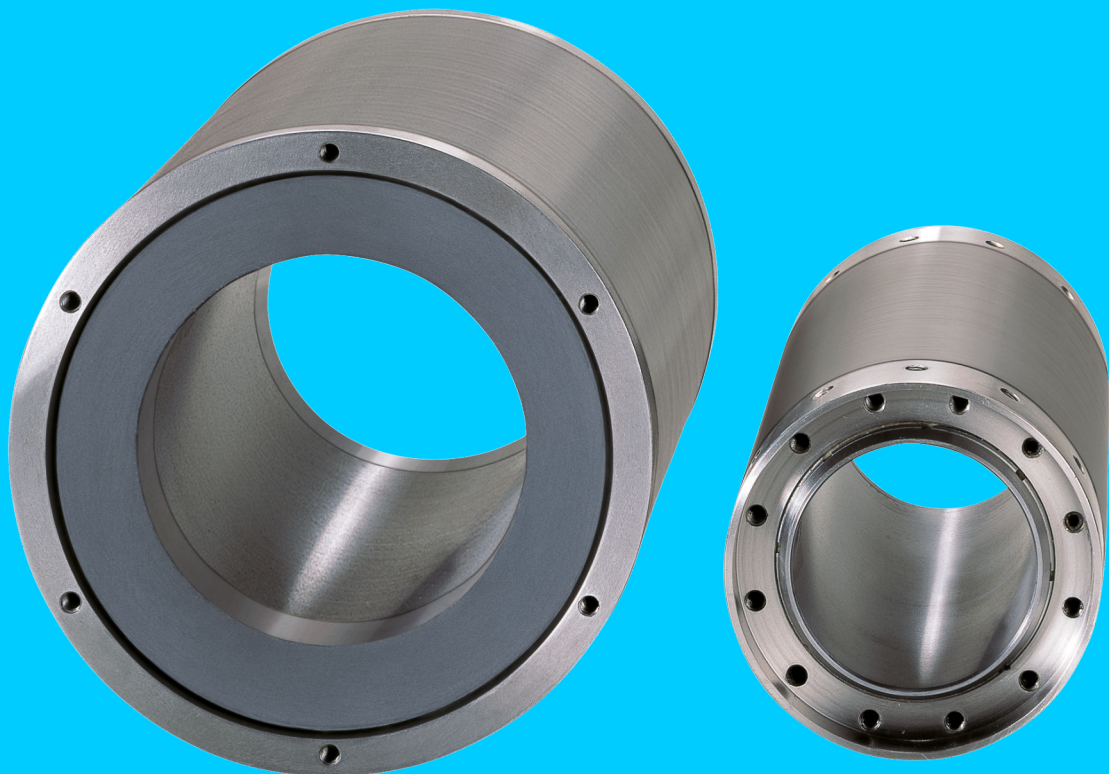


MBSxx2

Synchronous Spindle Motors



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1 Product presentation

1.1 Applications

New technologies with a high economic use, place increasing demands on the acceleration, speed and accuracy of motors.

MBS motors are high-speed synchronous kit motors of the latest generation and optimized for high torques at high speeds. They consist of a stator with a three-phase winding and a rotor with permanent magnets.

Thanks to the very high range of constant power, short run-up times and low rotor temperatures, these motors are particularly suited for applications in motor-driven spindles.

The innovative closed cooling system integrated in the motor reduces the effort for engineers and increases the cooling efficiency.

MBS motors from Rexroth are mainly used as direct drives in motor-driven spindles. The arrangement of the motor between the spindle main bearings enables a high rigidity of the motor-driven spindle. This means, for example, main spindle and C-axis operation can be realized with only one drive on grinding machines.

Motor-driven spindles are used for turning, milling and grinding in machine tools, transfer lines, machining centers and special machinery.

1.2 Basic features

Product	3~ PM Motor
Type	MBSxx2 consists of MSSxx2 and MRSxx2
Ambient temperature during operation	0 ... 40 °C
Protection class (EN 60034-5)	IP00
Cooling mode (EN 60034-6)	IC3W7, water cooling (EN 60034-6)
Installation altitude	0 ... 1000 m above NN (without derating)
Thermal class (EN 60034-1)	155 (F)
Electrical connection	Wires with open ends (3x power 2x KTY, 2x PTC) (Single motors with double wires)
Mechanical protection	Cover plate made of stainless steel for MSSxx2 on the outer circumference of the motor sides

Motor ends

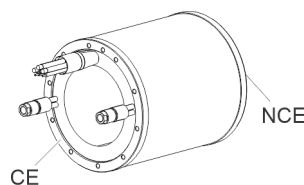


Fig. 1: MSS motor sides

CE Cable end / cable output side

NCE Non cable end / non-cable output side

1.3 Motor layout

Synchronous Kit Spindle Motors consist of a stator (MSSxx2) and a rotor (MRSxx2).

The stator bears the electrically active part of the motor. The plated iron pack carries the three-phase winding as well as the water cooling system and is encapsulated in a stainless steel housing with a plastic. The power connection and the connection of the temperature sensors are made via wires that are led out at the front.

The rotor consists of a steel sleeve that carries a laminated core with inserted (buried) permanent magnets.

The designation of the components is as follows:

- **MBSxx2:** Motor kit synchron 2. Generation
- **MSSxx2:** Motor stator synchron 2. Generation
- **MRSxx2:** Motor rotor synchron 2. Generation

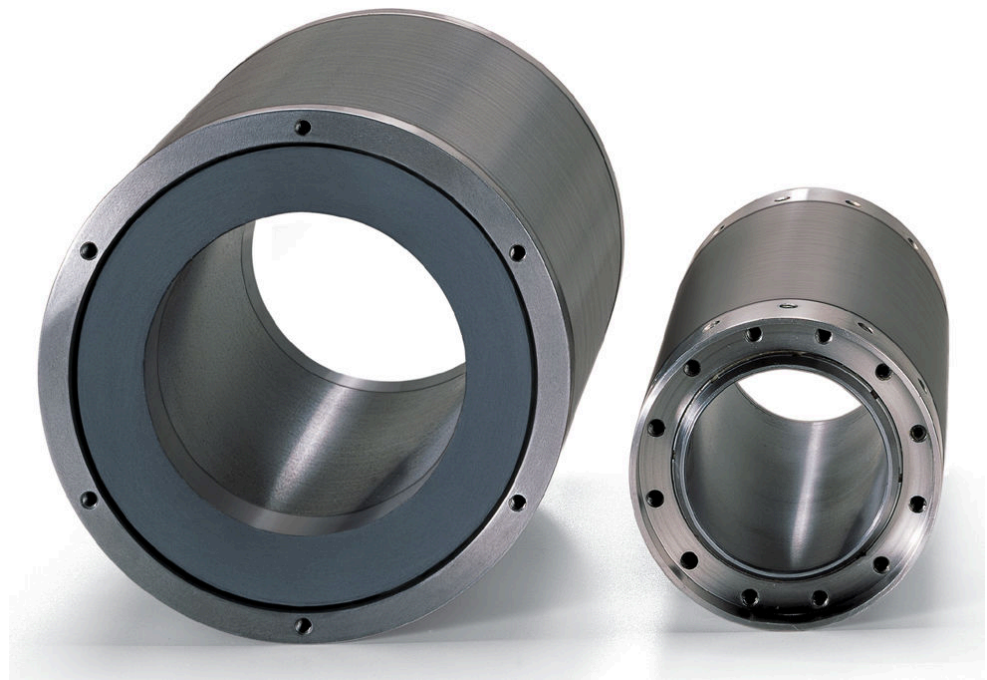


Fig. 2: Example of MSS stator (left) and MRS rotor (right)

1.4 Performance spectrum of motors

With the water-cooled MBSxx2 synchronous kit spindle motors, high speeds can be achieved with a high torque density. The available torque is from 7 Nm to 4500 Nm for speeds of 22,500 min⁻¹.

The following diagram gives an overview of the performance spectrum:

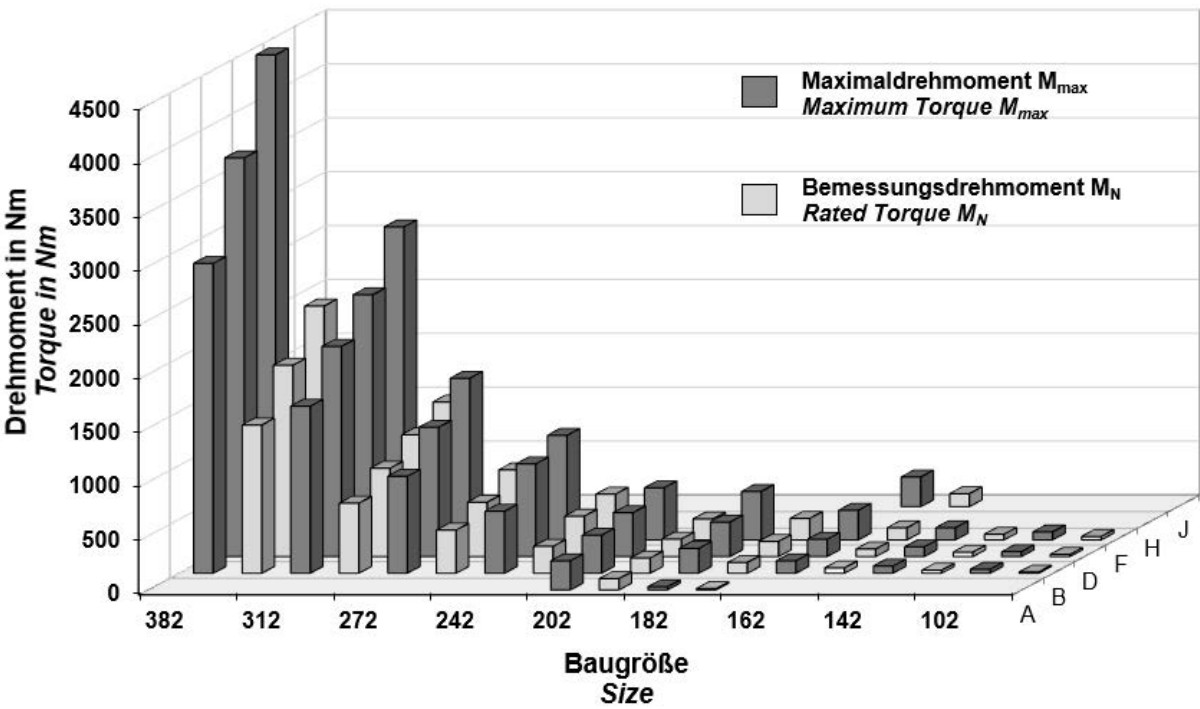


Fig. 3: MBSxx2 performance spectrum

1.5 About this documentation

1.5.1 Editions of this documentation

Table 1: Record of revisions

Edition	Release date	Notes
07	05/2024	Revision / supplement; Chapters “Technical data” and “Commissioning” amended
06	07/2019	Revision / supplement; Chapter 4 Technical data amended
05	04/2018	Revision / supplement; Chapter 4 in preparation
04	08/2015	Revision / supplement
03.1	03/2011	Update chapter 4 Technical data
03	06/2007	Revision / supplement
02	02/2005	Revision / supplement
01	07/2004	First edition

1.5.2 Document structure

This documentation includes safety-related guidelines, technical data and operating instructions. The following table provides an overview of the contents of this documentation.

Table 2: Chapter structure

Chapter	Title	Content
1	Introduction	Introduction to the product and reading instructions
2	Important instructions on use	Important safety instructions
3	Safety	

Chapter	Title	Content	
4	Technical data	Product description	for designers and project developers
5	Dimension sheets		
6	Type codes		
7	Accessories		
8	Connection technique		
9	Application instructions	Practice	for operating and maintenance personnel
10	Handling & transport		
11	Installation		
12	Operation		
13	Service & support	Additional information	
14	Index		

1.5.3 Presentation of information

Explanation of signal words and the safety alert symbol

The Safety Instructions in the available application documentation contain specific signal words (DANGER, WARNING, CAUTION or NOTICE) and, where required, a safety alert symbol (in accordance with ANSI Z535.6-2011).

The signal word is intended to draw your attention to the safety instructions and describes the seriousness of the danger.

The safety alert symbol (a triangle with an exclamation point), which precedes the signal words DANGER, WARNING and CAUTION, is used to alert the reader to personal injury hazards.

 DANGER	Non-compliance with this safety instructions will result in death or severe personal injury.
 WARNING	Non-compliance with this safety instructions can result in death or severe personal injury.
 CAUTION	Non-compliance with this safety instructions can result in moderate or minor personal injury.
NOTICE	Non-compliance with this safety instructions can result in material damage.

Table 3: Symbols

Symbol	Meaning
	Reference to supplementary documentation
	This note gives important information, which must be observed.
	Single, independent handling step
1. 2. 3.	Numbered instruction: The numbers show that the action steps must be taken one after the other.
	Warning against dangerous electric voltage.
	Warning against hot surfaces.
	Warning against rotating machine parts.
	Warning against overhead load.

Symbol	Meaning
	Warning against crushing hazard.
	Electrostatic sensitive devices.
	Access for persons with cardiac pacemaker forbidden.
	Do not carry along metal parts or clocks.
	Hammer scales are forbidden.

Markup

The following markups are used for a user-friendly text information representation:

 Reference to supplementary documentation



This note gives important information, which must be observed.

- Listings on the first level contain a bullet point
 - Listings on the second level contain a dash

➔ Handling instructions are specified in numbered lists. Please comply with the order of the handling instructions.

1.5.4 Further documentation

For project engineering of drive-systems with Bosch Rexroth motors, additional documentation referring to the used devices may be required.

Rexroth provides the complete product documentation in PDF format in the following ➔ [Bosch Rexroth Media Directory](#).

1.5.5 Standards

This documentation refers to German, European and international technical standards. Documents and sheets on standards are subject to copyright protection and may not be passed on to third parties by Rexroth. If required, please contact the authorized sales outlets. In Germany, contact:

BEUTH Verlag GmbH

Burggrafenstraße 6

10787 Berlin, Germany

Internet: ➔ <https://www.din.de/beuth>

1.5.6 Additional components

Documentation for external systems which are connected to Bosch Rexroth components are not included in the scope of delivery and must be ordered directly from the corresponding manufacturers.

1.5.7 Your feedback

Your experiences are an essential part of the improvement process of product and documentation. Please send your feedback to:

Bosch Rexroth AG

Dept. DC-AE/EPI5 (fs,mb)

Buergermeister-Dr.-Nebel-Straße 2

97816 Lohr am Main, Germany
E-Mail: dokusupport@boschrexroth.de

2 Safety instructions

2.1 Important directions on use

2.1.1 Intended use

Introduction

Bosch Rexroth products are designed and manufactured using the latest state-of-the-art-technology. The products are tested prior to delivery to ensure operational safety and reliability.

⚠ WARNING

Personal injury and property damage by using products incorrectly!

Failure to use our products in an unintended way may cause situations resulting in property damage and personal injury.

NOTICE

Inappropriate use

Bosch Rexroth, as the manufacturer, does not provide any warranty, assume any liability, or pay any damages for damage caused by products not being used as intended. Any risks resulting from the products not being used as intended are the sole responsibility of the user.

Before using the products by Bosch Rexroth, the following condition precedent must be fulfilled so as to ensure that they are used as intended:

- Personnel that in any way uses our products must first read and understand the relevant safety instructions and be familiar with their appropriate use.
- Hardware products must be left in their original condition, i.e. no structural changes may be made. Software products must not be decompiled and their source code must not be changed.
- Damaged or defective products must not be installed or put into operation.
- It must be ensured that products are installed in compliance with all regulations specified in the documentation.

Prerequisites for proper and safe use of the motors are proper transport, appropriate storage, proper assembly and connection, careful maintenance, operation and overhaul.

Areas of use and application

Typical applications include, for example:

- Handling and mounting systems
- Packaging and food machines
- Printing and paper converting machines
- Machine tools

The motors have been exclusively designed for installation in industrial machinery. The motors have been designed and manufactured in compliance with the EU directives and harmonized standards specified in the following.

Standards	
EN 60034-1 EN 60034-1:2010 + Cor.:2010	Rating and performance behavior
EN 60034-5 EN IEC 60034-5:2020	Type of protection

Directives

2014/35/EU

Low voltage directive

The machine manufacturer must evaluate the electric and mechanic safety as well as environmental influences in the assembled state of the machine according to the Machine Directive 2014/35/EC EN 60204-1:2018 (Safety of machinery - Electrical equipment of machines -Part 1: General requirements).

The electrical installation must comply with the protection requirements of EMC Directive 2014/30/EU. The plant manufacturer is responsible for appropriate installation (for example: physical separation of signal and power cables, using shielded cables, ...). The EMC instructions of the converter manufacturer must be observed.

The machine may not be commissioned before conformity with these directives has been confirmed.

For application-specific use of motors, drive controllers with various levels of power, DC bus voltage and different interfaces are available. For regulation and controlling of motors, additional sensors like length measuring systems must be connected.

Before commissioning, every connected drive controller must be programmed according to the specified motor function for the specified application.



- The motors may only be operated under the assembly, mounting and installation conditions, in the normal position, and under the environmental conditions (temperature, degree of protection, humidity, EMC etc.) specified in this documentation.
- The motors may only be used with the accessories and attachments specified in this documentation. Components that are not explicitly specified must not be installed nor connected. The same applies for cables and lines.
- The device may only be operated in the explicitly specified configurations and combination of components and in compliance with the respective functional description of the software and firmware.

2.1.2 Unintended use

Any use of motors outside of the fields of application mentioned above or under operating conditions and technical data other than those specified in this documentation is considered as "non-intended use".

Do not use these motors, if

- the intended application range is not explicitly approved for Bosch Rexroth motors.
- the operating conditions do not comply with the specified ambient conditions. For example, they may not be operated under water, under extreme temperature fluctuations, under extreme maximum temperatures or in potentially explosive atmospheres.



These motors are not suited to be operated directly on the power supply.

Trademark right third parties

Comply with the trademark rights of third parties during assembly and use of single components delivered by Bosch Rexroth. For any infringement of the right, the customer is liable for the accruing damage.

2.2 Qualification of personnel

Any work with or on the described product may only done by qualified or skilled personnel. For the purpose of this manual, qualified personnel means persons who are familiar with transporting, installing, mounting, com-

commissioning and operating the components of the electrical drive and control system and the associated hazards and have an appropriate qualification for their job.

All persons working on, with or in the vicinity of an electrical system must be informed of the relevant safety requirements, safety guidelines and internal instructions EN 50110-1:2013.

2.3 Safety instructions for electric drive and control systems

2.3.1 Basic information

Using and passing on the safety instructions

Do not install and operate any components of the electric drive and control system before carefully reading all provided documents. These safety instructions and all other user instructions have to be read prior to working with these components. If you do not have the user documentation for the components, contact our Bosch Rexroth sales representative. Request the immediate delivery of these documents to the person or persons in charge of the safe operation of the components.

In the case of vending, rental and/or distribution of the components in any other form, include these safety instructions in the national language of the user.

Improper use of these components, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, could result in property damage, personal injury, electric shock or even death.

Requirements for safe use

Prior to initial commissioning of the components of the electric drive and control system, read the following instructions to avoid personal injury and/or property damage. You must comply with these safety instructions.

- In the case of damage due to non-compliance with the safety instructions, Bosch Rexroth shall not assume any liability.
- Prior to commissioning, read the operating, maintenance and safety instructions. If you are not able to sufficiently understand the language used in the application documentation, please contact and inform your vendor.
- Appropriate and professional transport, storage, assembly and installation, as well as thorough operation and maintenance, are the basis of correct and safe operation of the component.
- Only qualified personnel may use components of the electric drive and control system or work in its close proximity.
- Only use accessories and spare parts approved by Bosch Rexroth.
- Comply with the safety instructions and regulations of the country in which the components of the electric drive and control system are operated.
- Only use components of the electric drive and control system as intended. Please refer to chapter **Intended use**.
- The ambient and operating conditions specified in this application documentation have to be complied with.
- Applications for functional safety are only allowed if they are explicitly and unambiguously specified in the application documentation "Integrated Safety Technology". If this is not the case, these applications are excluded. Functional safety includes parts of the overall safety in which measures of risk reduction for personal safety depend on electric, electronic or programmable controls.

- The specifications contained in the application documentation regarding the use of the provided components are only application examples and recommendations.
- For their individual application, the machine manufacturer and the system installer have to
 - verify the applicability of the provided components and the specifications made for their use in this application documentation,
 - synchronize the applicability with the safety regulations and standards applicable for their application and to execute the required measures, modifications and additions.
- Commissioning of the provided components is prohibited until it has been established that the machine or the system in which the components are installed corresponds to the country-specific provisions, safety regulations and standards of the application.
- Operation is only allowed when complying with the national EMC regulations for the relevant application.
- For information about EMC-compliant installation, refer to the section on EMC in the relevant application documentation.
- The system or machine manufacturer is responsible for compliance with the limit values specified in the national regulations.
- The technical data, connection and installation conditions of the components are contained in the relevant application documentations and must be complied with.
- Country-specific laws and regulations must be observed.

Hazards due to incorrect use

- High electrical voltage and high operating current! Danger to life or serious personal injury due to electric shock!
- High electrical voltage due to incorrect connection! Danger to life or personal injury due to electric shock!
- Dangerous movements! Danger to life, serious personal injury or property damage due to unintended motor movements!
- Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electric drive systems!
- Risk of burns by hot housing surfaces!
- Risk of injury by improper handling! Personal injury by crushing, shearing, cutting, hitting!
- Risk of injury by improper handling of batteries!
- Risk of injury by improper handling of pressurized lines!

2.3.2 Instructions with regard to specific dangers

Protection against contact with electrical parts and housings



This section concerns components of the electric drive and control system with voltages of **more than 50 volts**.

Contact with parts conducting voltages above 50 volts can cause personal danger and electric shock. When operating components of the electric drive and control system, it is unavoidable that some parts of these components conduct dangerous voltage.

High electrical voltage! Danger to life, risk of injury by electric shock or serious personal injury!

- Only qualified persons are allowed to operate, maintain and/or repair the components of the electric drive and control system.
- Follow the general installation and safety regulations when working on power installations.
- Before switching on, the equipment grounding conductor must have been permanently connected to all electrical components in accordance with the connection diagram.
- Even for short measurements or tests, operation is only allowed with the equipment grounding conductor permanently connected to the specified points of the components.
- Before accessing electrical parts with voltage potentials higher than 50 V, disconnect electrical components from the mains or from the voltage source. Protect the electrical component against restart.
- Observe the following aspects in the case of electrical components:
Prior to touching an electrical component, always wait for **30 minutes** after switching off power in order for live capacitors to discharge. Before beginning to work, measure the electrical voltage of live parts to make sure that the equipment is safe to touch.
- Install the provided covers and safety devices for protection against contact prior to switch-on.
- Do not touch any electrical connection points of the components while power is turned on.
- Do not connect or disconnect live parts.
- Under certain conditions, electric drive systems can be operated at mains protected by residual-current-operated circuit-breakers sensitive to universal current (RCDs/RCMs).
- Secure built-in devices from penetrating foreign objects and water, as well as from direct contact, by providing an external housing, for example a control cabinet.

High housing voltage and high leakage current! Danger to life, risk of injury by electric shock!

- Prior to switching on and commissioning, ground or connect the electric drive and control system components to the equipment grounding conductor at the grounding points.
- Connect the equipment grounding conductor of the electric drive and control system components permanently to the main power supply at all times. The leakage current is greater than 3.5 mA.
- Establish an equipment grounding connection with a minimum cross section according to the table below. With an outer conductor cross section smaller than 10 mm² (8 AWG), the alternative connection of two equipment grounding conductors is allowed, each having the same cross section as the outer conductors.

Table 4: Minimum cross section of equipment grounding connection

Cross section of outer conductor	Minimum cross section of equipment grounding conductor Leakage current ≥ 3.5 mA	
	1 equipment grounding conductor	2 equipment grounding conductors
1.5 mm ² (AWG 16)	10 mm ² (AWG 8)	2 × 1.5 mm ² (AWG 16)
2.5 mm ² (AWG 14)		2 × 2.5 mm ² (AWG 14)
4 mm ² (AWG 12)		2 × 4 mm ² (AWG 12)

Cross section of outer conductor	Minimum cross section of equipment grounding conductor Leakage current ≥ 3.5 mA	
	1 equipment grounding conductor	2 equipment grounding conductors
6 mm ² (AWG 10)	16 mm ² (AWG 6)	2 × 6 mm ² (AWG 10)
10 mm ² (AWG 8)		-
16 mm ² (AWG 6)		-
25 mm ² (AWG 4)		-
35 mm ² (AWG 2)	25 mm ² (AWG 4)	-
50 mm ² (AWG 1/0)		-
70 mm ² (AWG 2/0)		-

Protective extra-low voltage as protection against electric shock

Protective extra-low voltage is used to connect devices with basic insulation at extra-low voltage circuits.

At components of an electric drive and control system provided by Bosch Rexroth, all connections and terminals with voltages up to 50 volts are PELV (**Protective Extra-Low Voltage**) systems. It is allowed to connect devices equipped with basic insulation, such as programming devices, PCs, notebooks, display units, to these connections.

Danger to life, risk of injury by electric shock! High electrical voltage by incorrect connection! If extra-low voltage circuits of devices containing voltages and circuits of more than 50 volts (e.g., the mains connection) are connected to Bosch Rexroth products, the connected extra-low voltage circuits must comply with the requirements for PELV (**Protective Extra-Low Voltage**).

Protection against dangerous movements

Dangerous movements can be caused by incorrect control of connected motors. In the following, the different reasons are listed:

- Improper or wrong wiring or cable connection
- Operating errors
- Incorrect parameter input prior to commissioning
- Malfunction of sensors and encoders
- Defective components
- Errors in the software or firmware

These errors can occur immediately after switch-on or after an undefined time of operation.

As far as possible, the monitoring functions in the components of the electric drive and control system rule out malfunction in the connected drives. Regarding personal safety, in particular the danger of personal injury and/or property damage, this alone cannot be relied upon to ensure complete safety. Until the implemented monitoring functions are active, it must be assumed in any case that faulty drive movements will occur. The faulty movements depend on the type of control and the operating state.

Dangerous movements! Danger to life, risk of injury, serious injury or property damage!

Prepare a **risk assessment** for the system or machine, with their specific conditions, in which the components of the electric drive and control system are installed.

As specified in the risk assessment, the user has to provide monitoring functions and higher-level measures in the system for personal safety. The safety regulations applicable to the system or machine have to be included. Unintended machine movements or other malfunctions are possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, personal injury and/or property damage:

- Keep free and clear of the machine's range of motion and moving machine parts. Prevent personnel from accidentally entering the machine's range of motion by using, for example:
 - Safety fences
 - Safety guards
 - Protective covering
 - Light barriers
- Make sure the safety fences and protective coverings are strong enough to resist maximum possible kinetic energy.
- Mount emergency stop switches in the immediate reach of the operator. Before commissioning, verify that the emergency stop equipment works. Do not operate the machine if the emergency stop switch is not working.
- Prevent unintended start-up. Isolate the drive power connection by means of OFF switches/OFF buttons or use a safe starting lockout.
- Make sure that the drives are brought to safe standstill before accessing or entering the danger zone.
- Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example,
 - mechanically securing the vertical axis,
 - adding an external braking/arrester/clamping mechanism or
 - ensuring sufficient counterweight for the axis.
- The standard equipment **motor holding brake** or an external holding brake controlled by the drive controller is **not sufficient to guarantee personal safety!**
- De-energize the components of the electric drive and control system using the master switch, and make sure they cannot be switched back on in the case of:
 - Maintenance and repairs
 - Cleaning work
 - Long service interruptions
- Avoid operating high-frequency, remote control and radio equipment in close proximity to components of the electric drive and control system and their supply leads. If the use of these devices cannot be avoided, check the machine or installation, at initial commissioning of the electric drive and control system, for possible malfunctions when operating such high-frequency, remote control and radio equipment in its possible positions of normal use. It might possibly be necessary to perform a special electromagnetic compatibility (EMC) test.

Protection against electromagnetic and magnetic fields during operation and mounting

Electromagnetic and magnetic fields!

Health hazard for persons with active implantable medical devices (AIMD) such as pacemakers or passive metallic implants.

- Hazards for the above-mentioned groups of persons by electromagnetic and magnetic fields in the immediate vicinity of drive controllers and the associated current-carrying conductors.
- Access to these areas can pose an increased risk to the above-mentioned groups of persons. They should seek advice from their attending doctor.
- If overcome by possible effects on above-mentioned persons during operation of drive controllers and accessories, remove the exposed persons from the vicinity of conductors and devices.

Protection against contact with hot parts

- Do not touch hot surfaces of, for example, braking resistors, heat sinks, supply units and drive controllers, motors, windings and laminated cores!
- According to the operating conditions, temperatures of the surfaces can be **higher than 60 °C (140 °F)** during or after operation.
- After having switched them off, allow the motors to cool down long enough before touching them. Cooling down may require **up to 140 minutes**. The time required for cooling down is approximately five times the thermal time constant specified in the technical data.
- After switching off chokes, supply units and drive controllers, wait **15 minutes** to allow them to cool down before touching them.
- Wear safety gloves or do not work at hot surfaces.
- For certain applications, and in accordance with the respective safety regulations, the manufacturer of the machine or system must take measures to avoid injuries caused by burns in the final application. Possible measures: warnings at the machine or system, guards (shieldings or barriers) or safety instructions in the application documentation.

Protection during handling and mounting

Risk of injury by improper handling! Personal injury by crushing, shearing, cutting, hitting!

- Comply with the relevant statutory regulations of accident prevention.
- Use suitable mounting and transport equipment.
- Avoid jamming and crushing by appropriate measures.
- Always use suitable tools. Use special tools if specified.
- Use lifting equipment and tools in the correct manner.
- Use suitable protective equipment (hard hat, safety goggles, safety shoes, safety gloves, for example).
- Do not stand under hanging loads.
- Immediately clean up any spilled liquids from the floor due to the risk of falling!

Battery safety

Batteries consist of active chemicals in a solid housing. Therefore, improper handling can cause injury or property damage. Risk of injury by improper handling!

- Do not attempt to reactivate low batteries by heating or other methods (risk of explosion and cauterization).
- Do not attempt to recharge the batteries since this may cause leakage or explosion.



- Do not throw batteries into open flames.
- Do not disassemble any batteries.
- When replacing the battery/batteries, do not damage the electrical parts installed in the devices.
- Only use the battery types specified for the product.

Environmental protection and disposal! The batteries contained in the product are considered dangerous goods during land, air, and sea transport (risk of explosion) in the sense of the legal regulations. Dispose of used batteries separately from other waste. Comply with the national regulations of your country.

Protection against pressurized systems

According to the information given in the Project Planning Manuals, motors and components cooled with liquids and compressed air can be partially supplied with externally fed, pressurized media, such as compressed air, hydraulics oil, cooling liquids and cooling lubricants. Improper handling of the connected supply systems, supply lines or connections can cause injuries or property damage.

Risk of injury by improper handling of pressurized lines!

- Do not attempt to disconnect, open or cut pressurized lines (risk of explosion).
- Comply with the respective manufacturer's operating instructions.
- Before dismantling lines, relieve pressure and empty medium.
- Use suitable protective equipment (safety goggles, safety shoes, safety gloves, for example).
- Immediately clean up any spilled liquids from the floor due to the risk of falling!



Environmental protection and disposal! The agents (e.g., fluids) used to operate the product might not be environmentally friendly. Dispose of agents harmful to the environment separately from other waste. Comply with the national regulations of your country.

Explanation of signal words and the safety alert symbol

The safety instructions in the available application documentation contain specific signal words (DANGER, WARNING, CAUTION, NOTICE) and, where required, a safety alert symbol (in accordance with ANSI Z535.6-2011).

The signal word is intended to draw the reader's attention to the safety instruction and describes the hazard severity.

The safety alert symbol (a triangle with an exclamation point), which precedes the signal words DANGER, WARNING and CAUTION, is used to alert the reader to personal injury hazards.

 DANGER	Non-compliance with this safety instruction will result in death or serious personal injury.
 WARNING	Non-compliance with this safety instruction can result in death or serious personal injury.
 CAUTION	Non-compliance with this safety instruction can result in moderate or minor personal injury.
NOTICE	Non-compliance with this safety instruction can result in property damage.

2.4 Product- and technology-dependent safety instructions

2.4.1 Protection from electric voltage

Work required on the electric system may only be carried out by skilled electricians. Tools for electricians (VDE tools) are absolutely necessary.

Before working:

- Enable.
- Secure against reactivation.
- Ensure de-energization.
- Ground and short-circuit.
- Cover or shield any adjacent live parts.

After completing the job, cancel the measures in reverse order.

Dangerous voltage occurs during operation! Danger to life, risk of injury by electric shock!

- Before start-up, connect the protective conductors on all electric components according to the connection plan.
- Operation, even for short measuring purposes is only allowed with fixed connected protective conductor on the specified points of the components.

2.4.2 Protection from mechanical danger

Dangerous movements! Danger to life, risk of injury, heavy injury or material damage.

- Do not stay within the motion zone of the machine. Avoid unauthorized access into the danger zone.
- Additionally secure vertical axes to prevent them from sinking or descending after having shutdown the motor, for instance as follows:
 - Mechanically lock the vertical axis,
 - providing an external braking / catching / clamping device, or
 - ensure sufficient weight compensation of the axes.

Only using the serially delivered **motor holding brake** or an external holding brake activated by the drive controller **is not suitable for personal protection!**

Rotating parts! Danger to life, risk of injury, heavy injury or material damage.

- Secure key and/or transmission elements against ejection.
- Install covers on dangerous rotating machine parts before start-up.

2.4.3 Protection against dangerous movements

Dangerous movements can be caused by faulty control of connected motors. Some common examples are:

- Improper or wrong wiring or cable connection
- Operator errors
- Wrong input of parameters before commissioning
- Malfunction of sensors and encoders
- Defective components
- Software or firmware errors

These errors can occur immediately after equipment is switched on or even after an unspecified time of trouble-free operation.

The monitoring functions in the components of the electric drive and control system will normally be sufficient to avoid malfunction in the connected drives. Regarding personal safety, especially the danger of injury and/or property damage, this alone cannot be relied upon to ensure complete safety. Until

the integrated monitoring functions become effective, it must be assumed in any case that faulty drive movements will occur. The extent of faulty drive movements depends upon the type of control and the state of operation.

Dangerous movements! Danger to life, risk of injury, heavy injury or material damage.

A **risk assessment** must be prepared for the installation or machine, with its specific conditions, in which the components of the electric drive and control system are installed.

As a result of the risk assessment, the user must provide for monitoring functions and higher-level measures on the installation side for personal safety. The safety regulations applicable to the installation or machine must be taken into consideration. Unintended machine movements or other malfunctions are possible if safety devices are disabled, bypassed or not activated.

To avoid accidents, injury and/or property damage:

- Keep free and clear of the machines range of motion and moving machine parts. Prevent personnel from accidentally entering the machines range of motion by using, for example:
 - Safety fences
 - Safety guards
 - Protective coverings
 - Light barriers
- Make sure the safety fences and protective coverings are strong enough to resist maximum possible kinetic energy.
- Mount emergency stopping switches in the immediate reach of the operator. Before commissioning, verify that the emergency stopping equipment works. Do not operate the machine if the emergency stopping switch is not working.
- Prevent unintended start-up. Isolate the drive power connection by means of OFF switches/OFF buttons or use a safe starting lockout.
- Make sure that the drives are brought to safe standstill before accessing or entering the danger zone.
- Additionally secure vertical axes against falling or dropping after switching off the motor power by, for example,
 - Mechanically lock the vertical axis,
 - providing an external braking / catching / clamping device, or
 - ensure sufficient weight compensation of the axes.
- Only using the serially delivered **motor holding brake** or an external holding brake activated by the drive controller **is not suitable for personal protection!**
- Disconnect electrical power to the components of the electric drive and control system using the master switch and secure them from reconnection ("lock out") for:
 - Maintenance and repair work
 - Cleaning of equipment
 - Long periods of discontinued equipment use
- Prevent the operation of high-frequency, remote control and radio equipment near components of the electric drive and control system and their supply leads. If the use of these devices cannot be avoided, check the machine or installation, at initial commissioning of the electric drive and control system, for possible malfunctions when operating such high-fre-

quency, remote control and radio equipment in its possible positions of normal use. It might possibly be necessary to perform a special electromagnetic compatibility (EMC) test.

2.4.4 Protection against magnetic and electromagnetic fields

Magnetic and electromagnetic fields are created in the direct environment of live conductors or permanent magnets of electro motors and are a serious danger for certain persons. The machine operator must sufficiently protect personnel working in these areas from possibly occurring damage by suitable measures (e.g. warning notes, protective clothes, designation of the danger zone).

Electro magnetic and magnetic fields!

Observe the country-specific regulations. For Germany, please observe the specifications of the occupational insurance association BGV B11 and BGR B11 regarding "electromagnetic fields".

Danger for persons with active body aids or passive metallic implants and for pregnant women.

- For persons with active body aids (like heart pacemakers), passive metallic implants (like hip prosthesis) and pregnant women possible hazards exist due to electromagnetic or magnetic fields in direct environment of electric drive and control components and the corresponding live conductors. Access into these areas can be dangerous for these persons:
 - Areas, in which components of electrical drive and control systems and corresponding live conductors are mounted, activated or operated.
 - Areas in which motor parts with permanent magnets are stored, repaired or assembled.
- Above mentioned persons must contact their attending physician before entering these areas.
- Please observe the valid industrial safety regulations for plants which are fitted with components of electrical drive and control systems and corresponding live conductors.

Risk of destruction of sensitive parts! Data loss!

- Keep watches, credit cards, check cards and identity cards and all ferromagnetic metal parts, such as iron, nickel and cobalt away from permanent magnets.

Crushing hazard of fingers and hand due to heavy attractive forces of the magnets!

The attractive forces of the permanent magnets influence all magnetizable materials. Especially in an area < 100 mm, the attractive forces rise. Loose or not fastened components made of magnetizable materials can abruptly and inadvertently attracted with the permanent magnets.

- Extreme caution during handling of motor components with permanent magnets. Do never underestimate strong attractive forces.
- Never work alone.
- Use personal safety equipment (e.g. protective gloves, protective glasses).
- Do not unpack several motor components with permanent magnets or directly place them side by side at your working space.

- Unpack single motor components with permanent magnets immediately prior mounting and mount them immediately.
- Do not bring magnetized or magnetizable materials in the area of permanent magnets. If using magnetizable tools cannot be avoided, hold on the tool very tight, move carefully and observe the attractive force effect of the permanent magnets.

Behavior in the case of accidents with permanent magnets

During work with permanent magnets, the following emergency tools must be ready to use in the case of an accident to release impacted body parts (like fingers, hands, arms a.s.o.):

- Hammer (3-5kg) made of non-magnetized material like brass
- Minimum 2 wedges with approx. 10 - 15 ° lip angles made of non-magnetized material like brass, wood or similar to impact driving into the cutting slit.

In the case of an accident:

- Keep calm!
- If the machine is live, immediately de-energize (emergency button).
- Give first aid or request appropriate help (e.g. emergency doctor).
- Separate inherent parts via emergency tools to loose clamped body parts, like fingers, hand, foot, for example.
 - Therefore, beat the wedges with a hammer into the cutting slit to free the caught body parts.

2.4.5 Protection during handling and assembly

Motor components with permanent magnetsPermanent magnets (e.g. secondary parts of a synchronous linear motor or rotor of a synchronous kit motor) create very strong attractive forces from ferromagnetic parts like further motor components with permanent magnets or parts of iron, nickel or cobalt.

Please observe the safety notes about strong attractive forces of permanent magnets under ➔ [Chapter 2.4.4 Protection against magnetic and electromagnetic fields on page 28](#).

The attractive forces of the permanent magnets influence all magnetizable materials. Especially in an area < 100 mm, the attractive forces rise. Surrounding components can abruptly and inadvertently be attracted by the permanent magnets. Apart from crushing hazard, even the danger of chipping recalcitrant material, causing eye injury, exists.

Use the origin package of the motor components for transport and storage only. The origin package of Rexroth is constructed in such a way that the motor components with the permanent magnets are positioned within the package with suitable distance, providing that the package is correctly used.

Observe the following instructions during unpacking and handling.

- Instruct the personal with regard to the danger.
- Use personal safety equipment (e.g. protective gloves, protective glasses).
- Store all components in its origin package until assembly and for transport.
- Do only work on clean working spaces in which no ferromagnetic parts exist.
- If possible, use non-magnetic tools, e.g. made from aluminum or brass.
- Remove only one motor component from the package and secure it on your working space against slipping, rolling away.

Instruct all participating persons about the dangers and if necessary, expand the preliminary instructions.

Store the original package of the motor components with permanent magnets

Store the original package for later use.

In the case of reuse, ensure a good readability of the safety notes on the package. They must not be paste over!

Risk of injuries due to improper handling! Bodily injury due to crushing, scissors, cutting, punching!

- Observe the instructions on the package.
- Store the motor components with permanent magnets in the original package, only.
- Do not internally store or transport the motor components unpacked.
- Observe the accident prevention regulations.
- Use suitable assembly and transport equipment.
- Prevent clamping and squeezing by means of suitable measures.
- Use suitable tools, if necessary use special tools.
- Properly use lifting devices and tools.
- Use suitable safety equipment (like protective helmets, protective glasses, safety shoes, protective gloves).
- Never walk under hanging loads.
- Immediately remove spill on the ground, otherwise risk of falling!

2.4.6 Protection against burns

Risk of burns due to hot motor surfaces!

- Avoid contact with hot motor surfaces. **Temperatures may rise over 60 °C.**
- Allow the motors to cool down long enough before touching them.
- Temperature-sensitive components may not come into contact with the motor surface. Ensure appropriate mounting distance of connection cables and other components.

2.4.7 Protection against pressurized systems

According to the information given in the Project Planning Manuals, motors and components cooled with liquids and compressed air can be partially supplied with externally fed, pressurized media, such as compressed air, hydraulics oil, cooling liquids and cooling lubricants. Improper handling of the connected supply systems, supply lines or connections can cause injuries or property damage.

Risk of injury by improper handling of pressurized lines!

- Do not attempt to disconnect, open or cut pressurized lines (risk of explosion).
- Observe the respective manufacturer's operating instructions.
- Before dismounting lines, relieve pressure and empty medium.
- Use suitable protective equipment (safety goggles, safety shoes, safety gloves, for example).
- Immediately remove spill on the ground, otherwise risk of falling!



Environmental protection and disposal! The agents (e.g., fluids) used to operate the product might not be environmentally friendly. Dispose of agents harmful to the environment separately from other waste. Observe the national regulations of your country.

2.4.8 Electrostatic sensitive devices (ESD)

The motors contain parts which underlie an electrostatic danger. These components, especially temperature sensors of the motor winding can be destroyed by improper use.

Avoid, e.g. direct contact of open wires or contacts of the connection cable of temperature sensors without being electrostatically discharged or grounded.



Remark

Do suitable ESD protective measures before you handle imperiled components (e.g. ESD protective clothes, wristlets, conductive floor, grounded cabinets and working surfaces).

3 Technical data

3.1 Definition



All relationships and data described in the following sections may only apply if exclusively stators and rotors of the same size are combined (e.g. MSS102B with MRS102B).

3.1.1 Operation modes

Rexroth motors are documented according to the test criteria and measuring methods of EN 60034-1:2010 + Cor.:2010. The technical data specified refer to operation mode S1 (continuous operation) with liquid cooling and water as cooling medium.

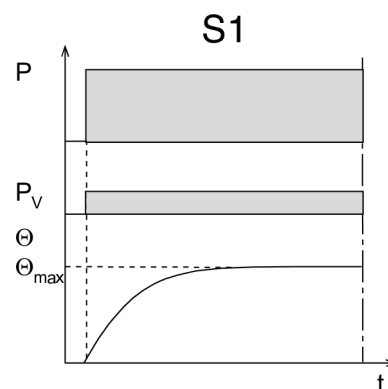


Fig. 4: S1 operation mode according to EN 60034-1

P Load
 P_V Electric losses
 Θ Temperature
 Θ_{max} Highest temperature (stator)
t Time

3.1.2 Operating behavior

The following sample characteristic curve explains the operating behavior of the motors, based on the motor data sheet information. The reference value for the motor characteristic curves is a DC bus voltage of 540 V_{DC}.



Bosch Rexroth provides you with the following tools for drive design or for generating characteristic curves for motor/controller combinations

– Rexroth IndraSize

The design program for Rexroth electric drive components simplifies the design of intelligent Rexroth drives.

IndraSize combines the layout of all usual drive mechanisms with a description of branch-specific technology functions and typical types of applications.

Free program under:

➔ www.boschrexroth.com/indrasize

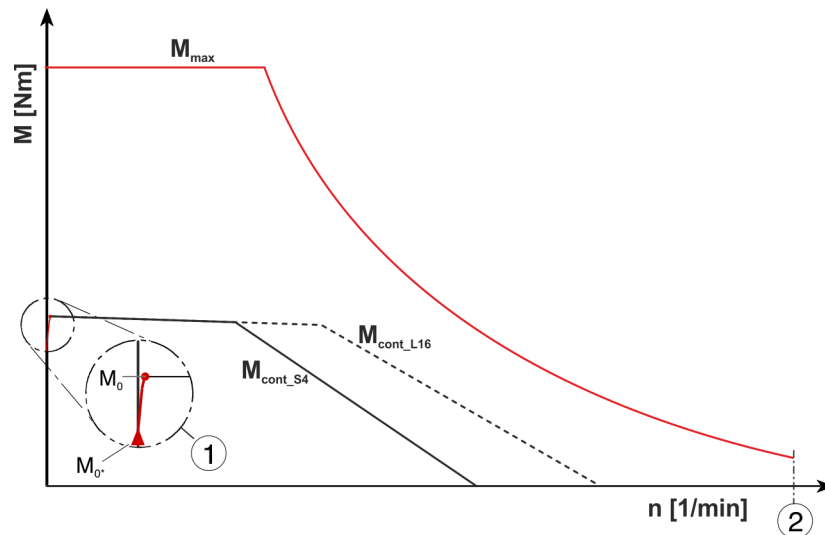


Fig. 5: Characteristic curves of motor (example)

- ① When using the motor in this operating range, observe the notes under [Chapter Motor temperature monitoring](#)
- ② Maximum speed
- M_0 Torque for speeds $n \sim 0$ Hz but $n > 0.1$ Hz
- M_{0^*} To avoid damaged winding in standstill operation, limit the current or the operation duration. The following applies: $M_{0^*} = M_0/\sqrt{2}$
- $M_{\max}$ Maximum torque
- $M_{\text{cont_S4}}$ Continuous torque as a function of the PWM frequency of the power electronics and the installation mode of the rotor. S4 = Installation mode S $\Rightarrow$ Standard-Motor / PWM 4 $\Rightarrow$ 4 kHz.
- $M_{\text{cont_L16}}$ Continuous torque as a function of the PWM frequency of the power electronics and the installation mode of the rotor. L16 = installation mode L $\Rightarrow$ large spindle / PWM 16 $\Rightarrow$ 16 kHz.

The maximum torque $M_{\max}$ is available up to the velocity $n_{M_{\max}}$. There, the specified voltage limit is reached due to the DC bus voltage. However, as the speed increases, the induced voltage of the motor continues to rise. This leads to a speed-dependent reduction in the maximum torque, as the motor control voltage is reduced due to the constant DC link voltage.

The permanently available torque depends on various boundary conditions. The thermal limit of the stator winding is relevant. At this limit, the motor can be loaded with standstill current I_0 . As the speed increases, the rotor losses in particular, but also the iron losses in the stator, increase. The current must therefore be reduced above a certain speed in order to reduce copper losses and avoid thermal overload.

Please observe the notes about thermal load of motors in [Chapter 8.6](#).

Installation mode rotor

The amount of heat that can be dissipated via the rotor depends on the thermal coupling (mounting type) of the rotor to the machine shaft. Increasing the heat capacity of the rotor allows the standstill torque to be called up continuously even at higher speeds.

In order to describe the thermal connection of the rotor in rough categories, the following is defined:

Table 5: Installation mode rotor

Installation mode	Motor layout	Notes
S	Standard motor	Installation mode "S" represents a regular motor assembly, such as a servomotor.
M	Standard spindle	Installation mode "M" is among installation mode "S" and "L".
L	Large spindle	With installation mode "L", the rotor shaft is at least 3x as long as the MRSxx2 kit component.
Spindle	L _{Spindle} / L _{MRS}	
① Standard motor	1 ... 2	
② Standard spindle	2 ... 3	
③ Large spindle	> 3	

PWM switching frequency

Both stator and rotor losses are dependent on the harmonics generated in the current and thus on the pulse width modulation (PWM) frequency. The higher this is, the lower the harmonics and thus the losses. With an increase of the PWM switching frequency, the losses are reduced and higher speeds can be run permanently.

Conversion to DC bus voltage 750 V_{DC}

For deviating connection or DC bus voltages, the specified characteristic curves can be converted according to the existing voltages.

Example:

$$\eta_{(U_{DC,neu})} = \frac{U_{DC,neu}}{540V} \cdot \eta_{nenn}$$

Fig. 6: Conversion example

$$M_{max750V} = M_{max} = \text{constant} \quad M_{nenn750V} = M_{nenn} = \text{constant}$$

$$\eta_{max750V} = \frac{750V}{540V} \cdot \eta_{max} \quad \eta_{nenn750V} = \frac{750V}{540V} \cdot \eta_{nenn}$$

Fig. 7: Example conversion to DC bus voltage 750V_{DC}

3.1.3 Parameters

Unless otherwise specified, the values specified in the data sheets are r.m.s. values according to DIN EN 60034-1. Reference value 540 V_{DC} DC bus voltage.

Table 6: Stator characteristics

Designation	Symbol	Unit	Description
Standstill torque	M_0	Nm	Torque for speeds $n \sim 0$ Hz but $n > 0.1$ Hz.
Standstill current	I_0	A	For standstill torque M_0 , required phase current of the motor.
Torque at maximum continuous output	M_{opt}	Nm	Torque available at maximum available power $P_{D,opt}$ in operating mode S1 (continuous operation) depending on the rotor attachment (→ Tab. 5) and the PWM frequency of 16 kHz. $M_{D,opt}$ is not displayed in the motor characteristic curves.
Current at maximum continuous power	I_{opt}	A	Phase current (effective value) of the motor under load with torque at maximum continuous power $P_{D,opt}$.
Maximum continuous output	P_{opt}	kW	Maximum continuous output at speed n_{opt} at rotor attachment L (→ Tab. 5) and a PWM frequency of 16 kHz.
Optimum speed	n_{opt}	1/min	Speed at which the maximum continuous power $P_{D,opt}$ is reached.
Maximum torque	M_{max}	Nm	Maximum torque available at maximum current I_{max} .
Maximum current	I_{max}	A	Maximum current of the motor at M_{max} .
Maximum speed (electrical)	n_{max}	1/min	Maximum permissible speed of the motor. Normally restricted by mechanical factors such as centrifugal forces or bearing stress.
Power wire cross-section	A	mm ²	Rated according to DIN VDE 0298-4 and laying type B2 according to DIN IEC 60204-1 with conversion factor for Rexroth cables at 40 °C ambient temperature. The power wire cross section that is specified in the data sheets can vary depending on the selected type of connection - plug or terminal box.
Torque constant at 20 °C	$K_{M,0}$	Nm/A	Ratio of generated torque M_0 to motor phase current I_0 at winding overtemperature 100 K.
Voltage constant at 20 °C	$K_{EMK,1000}$	V/min ⁻¹	Root-mean-square value of the induced motor voltage at a motor temperature of 20 °C and 1000 revolution per minute.
Winding resistance at 20 °C	R_{12}	Ohm	Measured winding resistance among two strands.
Winding inductance	L_{12}	mH	Measured inductance between two strands.
Winding inductivity (across)	L_q	mH	Cross inductance
Winding inductivity longitudinal	L_d	mH	Longitudinal inductance
Leakage capacitance	C_{ab}	nF	Capacitance of short-circuited power connections U, V, W against the motor housing.
Brake resistance	R_{Brems}	Ohm	The use of a braking resistor prevents an impermissibly high voltage in the DC link in the field weakening range when the motor spins out at high speeds. Brake resistance for using Rexroth controllers (see → Chapter 8.10 Energy feedback absorption on page 209.

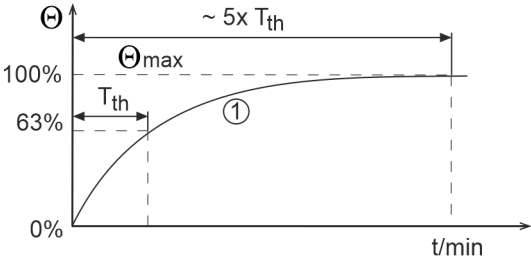
Designation	Symbol	Unit	Description
Thermal time constant	T_{th}	min	Duration of the temperature rise to 63 % of the final temperature of the stator under load with rated torque in S1 operation and liquid cooling.  Fig. 8: Thermal time constant ① Chronological course of the winding temperature Θ_{max} Max. winding temperature T_{th} Thermal time constant
Stator mass	m_{stat}	kg	Mass of the stator.
Number of pole pairs	p	-	Quantity of pole pairs of the motor.
Power dissipation	P_V	kW	Power loss in operation mode S1 (continuous operation) at nominal velocity v_N .
Coolant inlet temperature	T_{in}	°C	Allowed cooling inlet temperature. The coolant inlet temperature should be maximum 5°C lower than the existing ambient temperature T_{um}. In case of a higher temperature difference, danger of condensation!
Allowed coolant-temperature rise for P_V	ΔT_{max}	K	Temperature difference between coolant inlet and outlet temperature during operation with liquid cooling (coolant water) and rated power loss P_V .
Required coolant flow for P_V	Q_{min}	l/min	Required coolant flow for compliance with the specified motor torque.
Pressure drop at Q_{min}	Δp	bar	Pressure loss within the internal coolant circuit of the motor Q_{min} .
Volume of coolant duct	V_{cool}	l	Coolant volume of the motor.
Maximum permissible inlet pressure	p_{max}	bar	Maximum permitted inlet pressure of the liquid cooling on the motor with coolant water.
Warning temperature (winding)	T_{warn}	°C	Temperature in °C at which the Bosch Rexroth control unit issues a warning.
Shutdown temperature (winding)	T_{abst}	°C	Maximum operating temperature of the motor winding in °C. Here, the temperature model of the Bosch Rexroth controllers switches the motor off.

Table 7: Characteristics of rotor

Designation	Symbol	Unit	Description
Moment of inertia of rotor	J_{rot}	kgm ²	Moment of inertia of the rotor without bearing and motor encoder.
Rotor mass	m_{rot}	kg	Mass of the rotor
Maximum speed of rotor	$n_{max,mech}$	min ⁻¹	Mechanic maximum speed of the rotor.

3.2 IndraSize

By using the IndraSize software, drive controllers, motors and mechanic gearboxes can be easily sized. The engineering tool covers the entire range of Rexroth drives and motors. Calculate the characteristic curves for your application by using the sizing and calculation tool IndraSize: www.boschrexroth.com/IndraSize

3.3 General technical data

The data specified in [Tab. 8](#) apply for all motor sizes. In this context, however, the comments on the individual items in Chapter “Application notes” must be observed.

Table 8: General technical data

Designation	Symbol	Unit	MSSxx2	MRSxx2
Ambient temperature during operation (see also Chapter 8.1 Environmental conditions during operation on page 188)	T_{um}	°C	0 ... +40	
Allowed transport temperature	T_T	°C	See Chapter 10.2.2 Transport instructions on page 228 .	
Allowed storage temperature	T_L	°C	See Chapter 10.2.3 Storage instructions on page 230 .	
Allowed coolant inlet temperature (see also Chapter Coolant inlet temperature)	T_{in}	°C	+10 ... +40	/
Allowed coolant-temperature for P_V	ΔT_{max}	K	10	/
Maximum allowed coolant input pressure	p_{max}	bar	6	/
Thermal class according to EN 60034-1:2010 + Cor.:2010	-	-	155	/
Warning temperature (winding)	T_{warn}	°C	145	/
Shutdown temperature (winding)	T_{abst}	°C	155	/
Degree of protection MSS and MRS according to EN IEC 60034-5:2020	-	-	IP00	
E-file number	-	-	E341734	
RoHS conformity according to EC guidelines 2011/65/EG	-	-	RoHS conform	

3.4 Frame size 102

3.4.1 Data sheet MSS102

Table 9: Technical data MSS102

Designation	Symbol	Unit	MSS102B	MSS102D	MSS102F	
			-0800-F	-0800-F	-0300-F	-0800-F
Standstill torque ¹⁾	M_0	Nm	10.7	20	32	26
Continuous current at standstill	I_0	A	16.9	24	15.3	43
Torque at maximum continuous output ²⁾	M_{opt}	Nm	7.1	13.3	30.2	17.3

Designation	Symbol	Unit	MSS102B	MSS102D	MSS102F	
			-0800-F	-0800-F	-0300-F	-0800-F
Current at maximum continuous power	I _{opt}	A	11.2	16.0	14.4	28.6
Maximum continuous output ³⁾	P _{opt}	kW	7.4	13.9	10.6	18.0
Optimum speed ⁴⁾	n _{opt}	min-1	9950	9950	3350	9950
Maximum torque ⁵⁾	M _{max}	Nm	36.7	45	75	68
Maximum current	I _{max}	A	52	69	35	100
Maximum speed (electrical) ⁶⁾	n _{max}	min-1	22,500	22,500	18,000	22,500
Power wire cross-section	A	mm ²	2.5	4.0	1.5	10.0
Torque constant at 20 °C ⁷⁾	K _{M,0}	Nm/A	0.633136	0.8	2.1	0.6
Voltage constant at 20 °C ⁸⁾	K _{EMK,1000}	V/1000 min-1	48.55	55.4	156	53
Winding resistance at 20 °C	R ₁₂	Ohm	0.76	0.64	2.68	0.30
Winding inductance	L ₁₂	mH	6.4	5.7	22.6	2.5
Winding inductivity longitudinal	L _d	mH	2.35	1.28	5.67	0.64
Winding inductivity across	L _q	mH	4.65	4.3	16.6	1.8
Leakage capacitance of the component	C _{ab}	nF	1.95	2.93	4.80	4.80
Brake resistance	R _{Brems}	Ohm	6.3	17.5	12.9	4.42
Thermal time constant	T _{th}	min	1.3	1.6	1.6	1.6
Stator mass	m _{Stat}	kg	5.8	7.2	11.2	11.2
Number of pole pairs	p	-	3			
Details about liquid cooling						
Power dissipation	P _v	kW	1.089	1.3	1.6	2.4
Required coolant flow for P _v	Q _{min}	l/min	3	3	2.5	4
Pressure drop at Q _{min}	Δp	bar	1.4	1.4	0.7	0.7
Volume of coolant duct	V _{kuehl}	l	0.018	0.024	0.035	0.035
1...8) Tolerance ± 5%						
Latest amendment: 2024-03-18						

3.4.2 Data sheet MRS102

Table 10: Technical data MRS102B

Designation	Symbol	Unit	MRS102B-1N-0046	MRS102B-2N-0035
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.003	0.003
Rotor mass	m_{rot}	kg	2.5	3.2
Maximum speed (mechanical)	$n_{max,mech}$	min ⁻¹	22,500	22,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 11: Technical data MRS102D

Designation	Symbol	Unit	MRS102D-1N-0046	MRS102D-2N-0035
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.004	0.004
Rotor mass	m_{rot}	kg	3.4	4.4
Maximum speed (mechanical)	$n_{max,mech}$	min ⁻¹	22,500	22,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 12: Technical data MRS102F

Designation	Symbol	Unit	MRS102F-1N-0046	MRS102F-2N-0035
Moment of inertia of rotor ¹⁾	J_{Rot}	$\text{kg} \cdot \text{m}^2$	0.006	0.0051
Rotor mass	m_{rot}	kg	5.3	6.8
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min ⁻¹	22,500	22,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

3.4.3 Motor characteristic curves MSS102 Frame lengths "B"

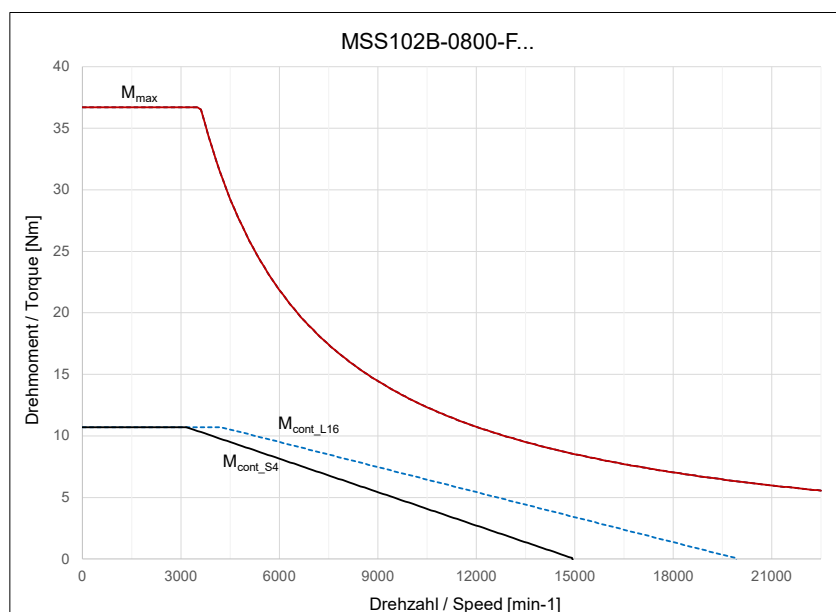


Fig. 9: Motor characteristic curve MSS102B-0800-F_

Frame lengths "D"

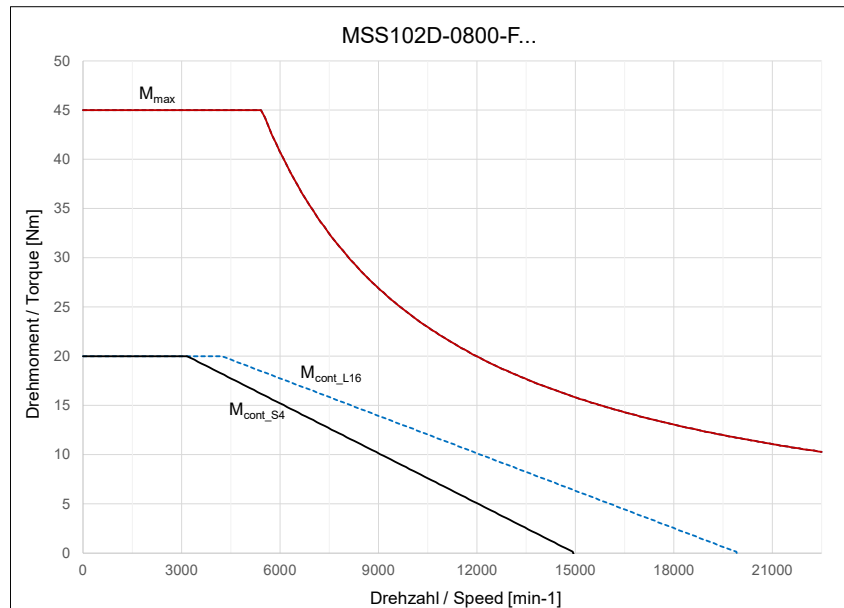


Fig. 10: Motor characteristic curve MSS102D-0800-F_

Frame lengths "F"

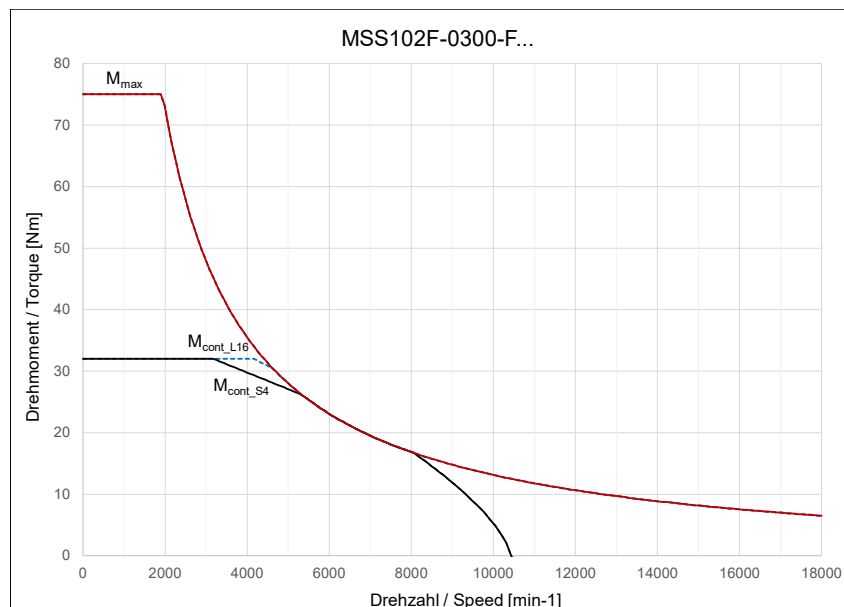


Fig. 11: Motor characteristic curve MSS102F-0300-F_

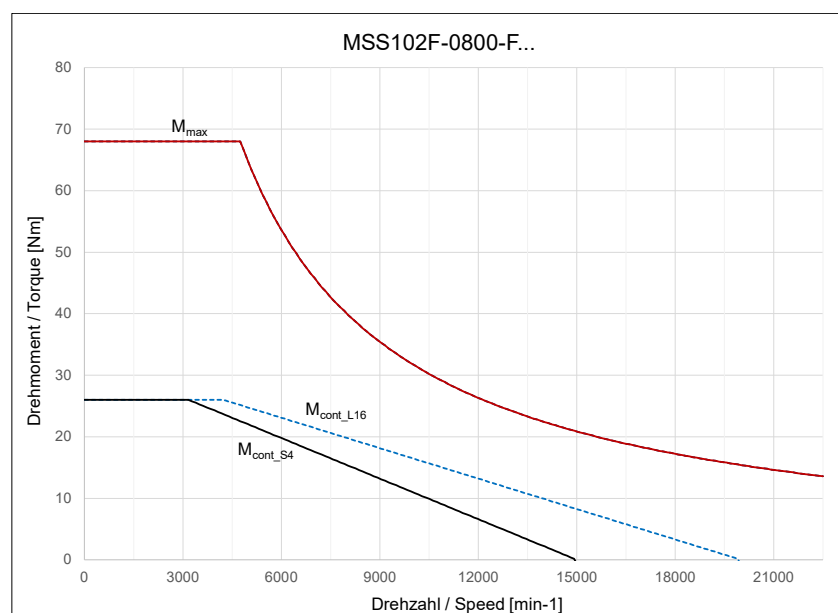


Fig. 12: Motor characteristic curve MSS102F-0800-F_

3.5 Frame size 142

3.5.1 Data sheet MSS142

Table 13: Technical data MSS142

Designation	Symbol	Unit	MSS142B	MSS142D	MSS142F
			-0700-F		
Standstill torque ¹⁾	M_0	Nm	40.0	56.0	72.0
Continuous current at standstill	I_0	A	45	65	84.0
Torque at maximum continuous output ²⁾	M_{opt}	Nm	23.3	32.7	41.3
Current at maximum continuous power	I_{opt}	A	26.2	37.9	48.2
Maximum continuous output ³⁾	P_{opt}	kW	17.1	23.9	30.3
Optimum speed ⁴⁾	n_{opt}	min-1	7,000	7,000	7,000
Maximum torque ⁵⁾	M_{max}	Nm	71.5	100	128.5
Maximum current	I_{max}	A	100	140	180
Maximum speed (electrical) ⁶⁾	n_{max}	min-1	19,000	19,000	19,000
Power wire cross-section	A	mm ²	10.0	16.0	25.0
Torque constant at 20 °C ⁷⁾	$K_{M,0}$	Nm/A	0.888	0.86	0.86
Voltage constant at 20 °C ⁸⁾	$K_{EMK,1000}$	V/1000 min-1	55.3	53.6	53.6
Winding resistance at 20 °C	R_{12}	Ohm	0.232	0.156	0.148
Winding inductance	L_{12}	mH	3.4	2.6	2.43
Winding inductivity longitudinal	L_d	mH	1.4	1.0	0.78
Winding inductivity across	L_q	mH	1.6	1.5	1.16

Designation	Symbol	Unit	MSS142B	MSS142D	MSS142F
			-0700-F		
Leakage capacitance of the component	C _{ab}	nF	4.24	5.94	7.5
Brake resistance	R _{Brems}	Ohm	7.8	6.6	2.93
Thermal time constant	T _{th}	min	1.6	1.6	1.6
Stator mass	m _{Stat}	kg	9.6	16	21
Number of pole pairs	p	-	4		
Details about liquid cooling					
Power dissipation	P _v	kW	1.5	2.1	2.7
Required coolant flow for P _v	Q _{min}	l/min	4	4	4
Pressure drop at Q _{min}	Δp	bar	1.4	1.9	1.4
Volume of coolant duct	V _{kuehl}	l	0.028	0.036	0.043
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

3.5.2 Data sheet MRS142

Table 14: Technical data MRS142B

Designation	Symbol	Unit	MRS142B-1N-0058	MRS142B-2N-0050
Moment of inertia of rotor ¹⁾	J _{Rot}	kg * m ²	0.011	0.011
Rotor mass	m _{rot}	kg	5.5	6.4
Maximum speed (mechanical)	n _{max,mech}	min-1	19,000	19,000
1) Tolerance +/- 10%				
Latest amendment: 2018-12-18				

Table 15: Technical data MRS142D

Designation	Symbol	Unit	MRS142D-1N-0058	MRS142D-2N-0050
Moment of inertia of rotor ¹⁾	J _{Rot}	kg * m ²	0.014	0.014
Rotor mass	m _{rot}	kg	7.2	8.4
Maximum speed (mechanical)	n _{max,mech}	min-1	19,000	19,000
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 16: Technical data MRS142F

Designation	Symbol	Unit	MRS142F-1N-0058	MRS142F-2N-0050
Moment of inertia of rotor ¹⁾	J _{Rot}	kg * m ²	0.017	0.017
Rotor mass	m _{rot}	kg	8.9	10.4
Maximum speed (mechanical)	n _{max,mech}	min-1	19,000	19,000
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

3.5.3 Motor characteristic curves MSS142

Frame lengths “B”

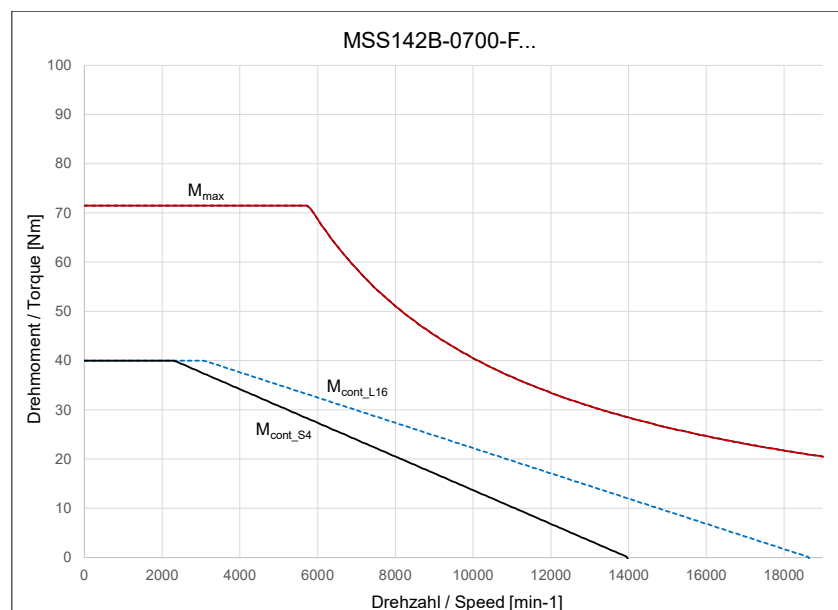


Fig. 13: Motor characteristic curve MSS142B-0700-F_

Frame lengths “D”

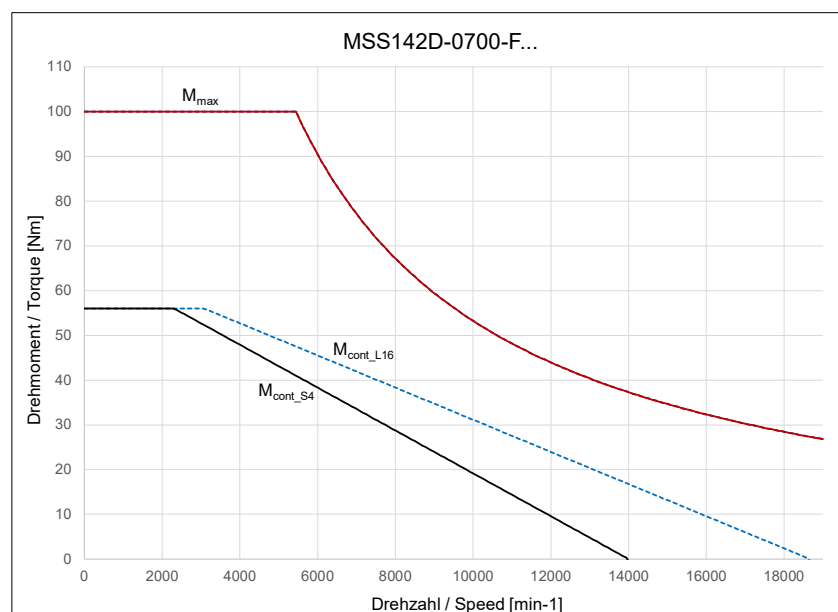


Fig. 14: Motor characteristic curve MSS142D-0700-F_

Frame lengths "F"

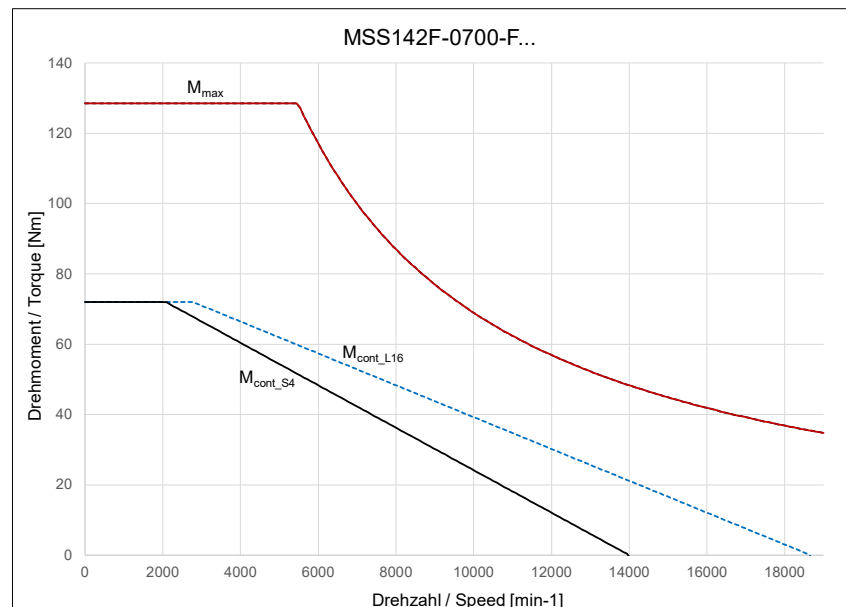


Fig. 15: Motor characteristic curve MSS142F-0700-F_

3.6 Frame size 162

3.6.1 Data sheet MSS162

Table 17: Technical data MSS162B/-D

Designation	Symbol	Unit	MSS162B		MSS162D
			-0200-F	-0400-F	-0400-F
Standstill torque ¹⁾	M_0	Nm	50	50	70
Continuous current at standstill	I_0	A	25	42	64.0
Torque at maximum continuous output ²⁾	M_{opt}	Nm	48.8	32.3	66.8
Current at maximum continuous power	I_{opt}	A	24.4	27.1	61.1
Maximum continuous output ³⁾	P_{opt}	kW	11.3	20.3	31.9
Optimum speed ⁴⁾	n_{opt}	min-1	2210	6,000	4,560
Maximum torque ⁵⁾	M_{max}	Nm	115	115	160
Maximum current	I_{max}	A	65.5	110	170.0
Maximum speed (electrical) ⁶⁾	n_{max}	min-1	8000	16,500	16,500
Power wire cross-section	A	mm ²	4.0	10.0	16.0
Torque constant at 20 °C ⁷⁾	$K_{M,0}$	Nm/A	2	1.03	1.09
Voltage constant at 20 °C ⁸⁾	$K_{EMK,1000}$	V/1000 min-1	180	90	90
Winding resistance at 20 °C	R_{12}	Ohm	1.15	0.29	0.24
Winding inductance	L_{12}	mH	23.6	5.6	5.0
Winding inductivity longitudinal	L_d	mH	5.06	1.04	1.04

Designation	Symbol	Unit	MSS162B		MSS162D
			-0200-F	-0400-F	-0400-F
Winding inductivity across	L _q	mH	5.1	3.1	2.7
Leakage capacitance of the component	C _{ab}	nF	2.5	2.50	3.87
Brake resistance	R _{Brems}	Ohm	26.0	5.56	5.57
Thermal time constant	T _{th}	min	1.6	1.6	1.6
Stator mass	m _{Stat}	kg	22	22	28.1
Number of pole pairs	p	-	4		
Details about liquid cooling					
Power dissipation	P _v	kW	1.0	0.550	0.9
Required coolant flow for P _v	Q _{min}	l/min	1.5	2	3
Pressure drop at Q _{min}	Δp	bar	1	1.6	1.6
Volume of coolant duct	V _{kuehl}	l	0.056	0.056	0.071
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

Table 18: Technical data MSS162F/-J

Designation	Symbol	Unit	MSS162F-	MSS162J	
			0310-F	-0200-F	-0500-F
Standstill torque ¹⁾	M ₀	Nm	90.0	120	100
Continuous current at standstill	I ₀	A	64.0	45.7	106.0
Torque at maximum continuous output ²⁾	M _{opt}	Nm	86.9	116.2	63.2
Current at maximum continuous power	I _{opt}	A	61.8	44.3	67.0
Maximum continuous output ³⁾	P _{opt}	kW	31.2	27.5	52.7
Optimum speed ⁴⁾	n _{opt}	min-1	3430	2260	7960
Maximum torque ⁵⁾	M _{max}	Nm	200	275	275
Maximum current	I _{max}	A	170.0	128.0	282.0
Maximum speed (electrical) ⁶⁾	n _{max}	min-1	15,500	10,000	16,500
Power wire cross-section	A	mm ²	16.0	16.0	35.0
Torque constant at 20 °C ⁷⁾	K _{M,0}	Nm/A	1.406	2.626	0.972
Voltage constant at 20 °C ⁸⁾	K _{EMK,1000}	V/1000 min-1	110	171	64.4
Winding resistance at 20 °C	R ₁₂	Ohm	0.224	0.46	0.085
Winding inductance	L ₁₂	mH	4.8	10.4	0.63
Winding inductivity longitudinal	L _d	mH	1.1	2.5	0.4
Winding inductivity across	L _q	mH	3.45	7.5	1.07
Leakage capacitance of the component	C _{ab}	nF	5.24	6.28	6.28
Brake resistance	R _{Brems}	Ohm	4.83	6.1	3.48
Thermal time constant	T _{th}	min	1.6	1.6	1.6
Stator mass	m _{Stat}	kg	28.2	46.1	46.1
Number of pole pairs	p	-	4		
Details about liquid cooling					
Power dissipation	P _v	kW	1.6	2.18	2.18
Required coolant flow for P _v	Q _{min}	l/min	3	4	4

Designation	Symbol	Unit	MSS162F-	MSS162J	
			0310-F	-0200-F	-0500-F
Pressure drop at $Q_{\min}$	Δp	bar	1.1	1.6	1.6
Volume of coolant duct	V_{kuehl}	l	0.086	0.109	0.109
1...8) Tolerance $\pm 5\%$					
Latest amendment: 2024-03-18					

3.6.2 Data sheet MRS162

Table 19: Technical data MRS162B

Designation	Symbol	Unit	MRS162B-1N-0068	MRS162B-2N-0060
Moment of inertia of rotor ¹⁾	J_{Rot}	$\text{kg} \cdot \text{m}^2$	0.014	0.016
Rotor mass	m_{rot}	kg	6.9	8.1
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min-1	16,500	16,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 20: Technical data MRS162D

Designation	Symbol	Unit	MRS162D-1N-0068	MRS162D-2N-0060
Moment of inertia of rotor ¹⁾	J_{Rot}	$\text{kg} \cdot \text{m}^2$	0.018	0.02
Rotor mass	m_{rot}	kg	8.8	10.2
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min-1	16,500	16,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 21: Technical data MRS162F

Designation	Symbol	Unit	MRS162F-1N-0068	MRS162F-2N-0060
Moment of inertia of rotor ¹⁾	J_{Rot}	$\text{kg} \cdot \text{m}^2$	0.022	0.024
Rotor mass	m_{rot}	kg	10.6	12.4
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min-1	16,500	16,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 22: Technical data MRS162J

Designation	Symbol	Unit	MRS162J-1N-0068	MRS162J-2N-0060
Moment of inertia of rotor ¹⁾	J_{Rot}	$\text{kg} \cdot \text{m}^2$	0.028	0.03
Rotor mass	m_{rot}	kg	13.4	15.6
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min-1	16,500	16,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

3.6.3 Motor characteristic curves MSS162

Frame lengths "B"

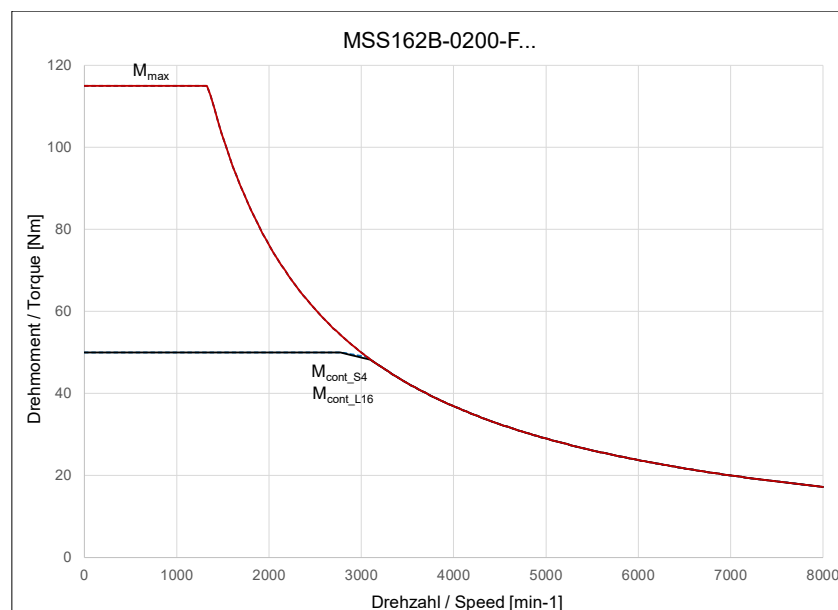


Fig. 16: Motor characteristic curve MSS162B-0200-F_

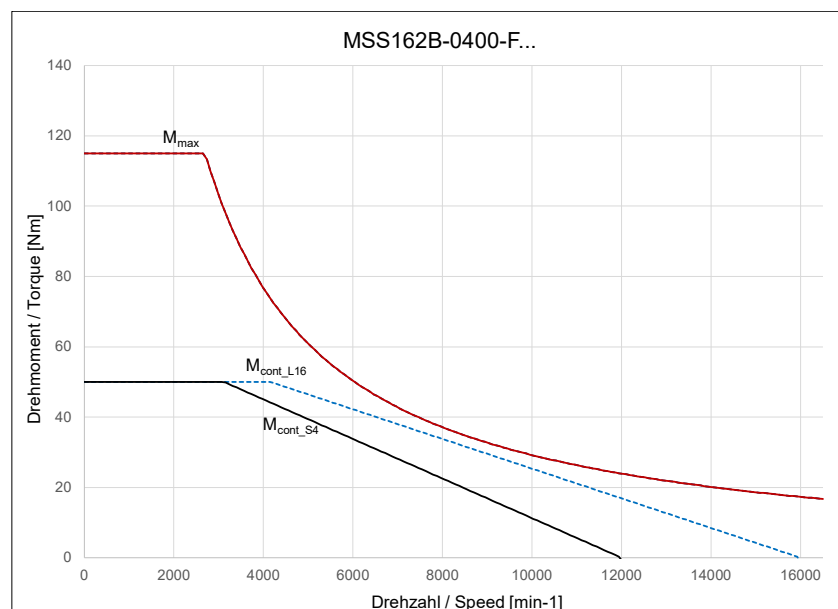


Fig. 17: Motor characteristic curve MSS162B-0400-F_

Frame lengths "D"

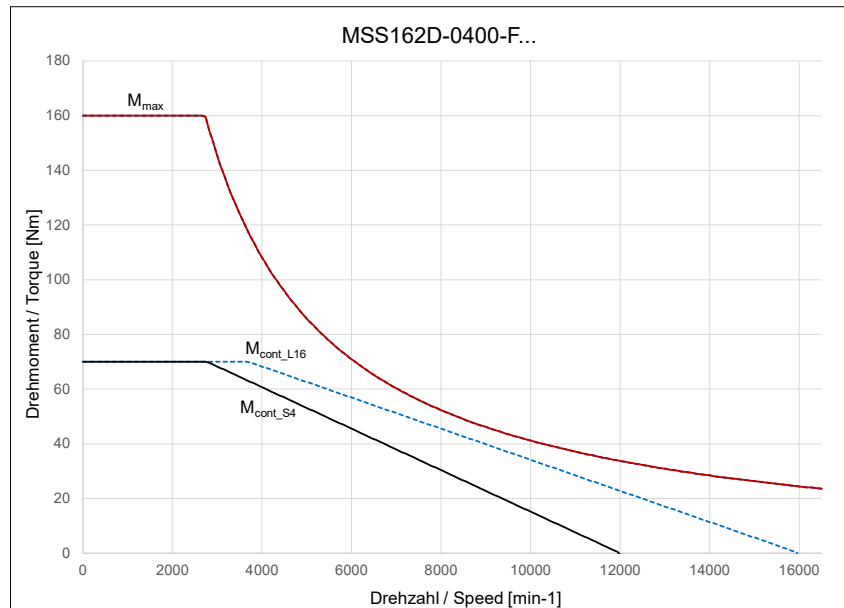


Fig. 18: Motor characteristic curve MSS162D-0400-F_

Frame lengths "F"

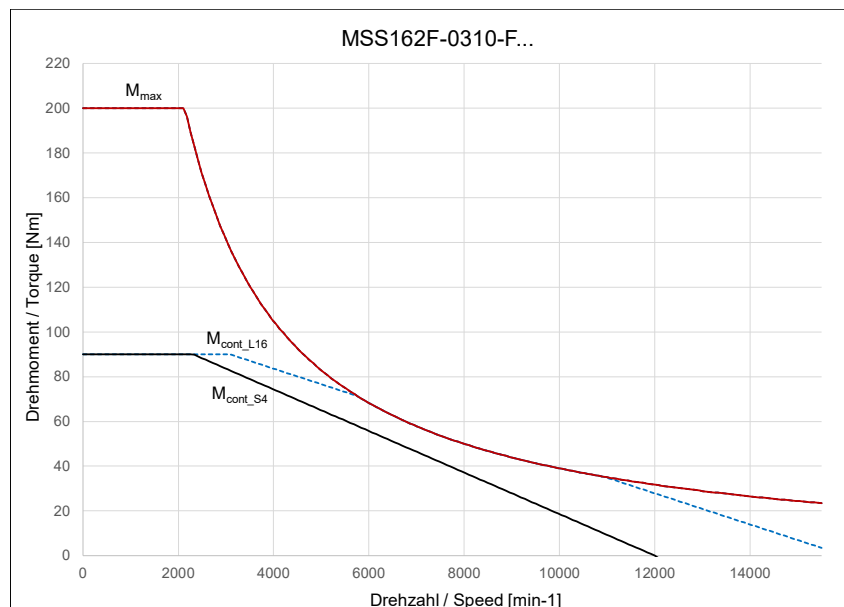


Fig. 19: Motor characteristic curve MSS162F-0310-F_

Frame lengths "J"

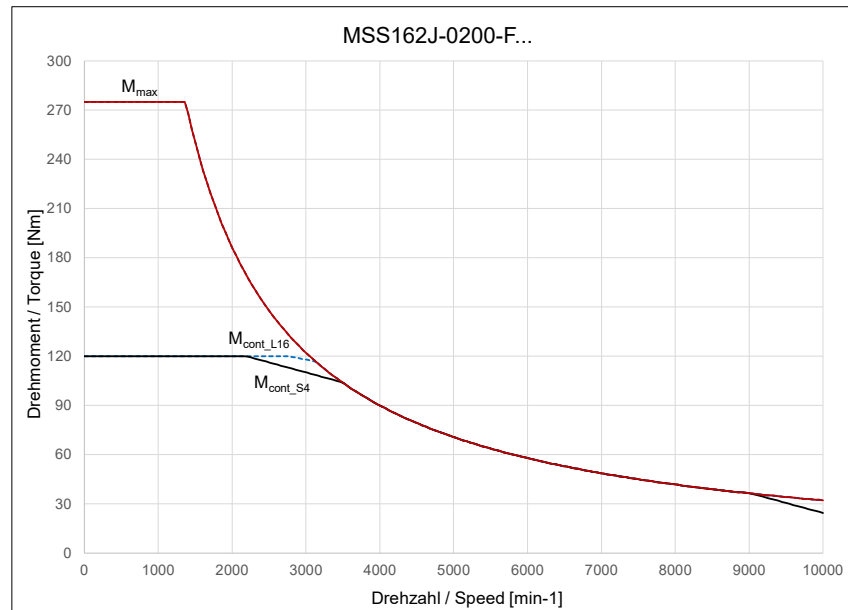


Fig. 20: Motor characteristic curve MSS162J-0200-F_

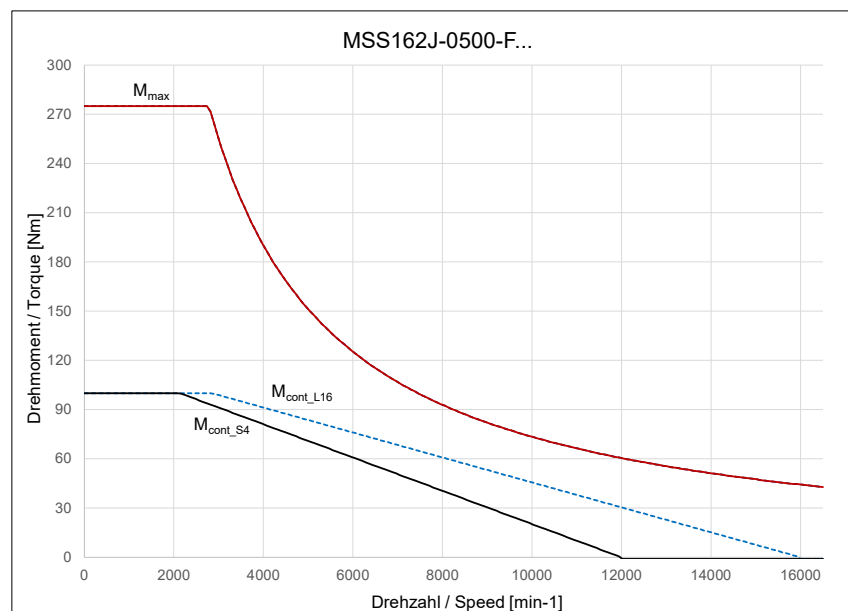


Fig. 21: Motor characteristic curve MSS162J-0500-F_

3.7 Frame size 182

3.7.1 Data sheet MSS182

Table 23: Technical data MSS182A/-B

Designation	Symbol	Unit	MSS182A		MSS182B
			-0100-F	-0250-F	-0280-F
Standstill torque ¹⁾	M ₀	Nm	12	12	100
Continuous current at standstill	I ₀	A	3.7	5	64.0
Torque at maximum continuous output ²⁾	M _{opt}	Nm	11.4	11.7	97.0
Current at maximum continuous power	I _{opt}	A	3.5	4.9	62.1
Maximum continuous output ³⁾	P _{opt}	kW	1.3	3.4	31.3
Optimum speed ⁴⁾	n _{opt}	min-1	1090	2770	3080
Maximum torque ⁵⁾	M _{max}	Nm	30	30	230
Maximum current	I _{max}	A	11	15	170.0
Maximum speed (electrical) ⁶⁾	n _{max}	min-1	6,000	12,000	12,000
Power wire cross-section	A	mm ²	1.0	1.0	16.0
Torque constant at 20 °C ⁷⁾	K _{M,0}	Nm/A	3.02	2.3	1.56
Voltage constant at 20 °C ⁸⁾	K _{EMK,1000}	V/1000 min-1	297	141	113
Winding resistance at 20 °C	R ₁₂	Ohm	15.4	4.1	0.26
Winding inductance	L ₁₂	mH	274.2	59	6.2
Winding inductivity longitudinal	L _d	mH	56	15	1
Winding inductivity across	L _q	mH	128	34	3.6
Leakage capacitance of the component	C _{ab}	nF	1.00	0.60	4.21
Brake resistance	R _{Brems}	Ohm	93.1	52.4	4.34
Thermal time constant	T _{th}	min	1.6	1.6	1.6
Stator mass	m _{Stat}	kg	6.9	6.9	32.1
Number of pole pairs	p	-	4		
Details about liquid cooling					
Power dissipation	P _v	kW	0.27	0.47	1.05
Required coolant flow for P _v	Q _{min}	l/min	3	3	3
Pressure drop at Q _{min}	Δp	bar	0.36	0.2	1.6
Volume of coolant duct	V _{kuehl}	l	0.019	0.019	0.065
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

Table 24: Technical data MSS182D/-F

Designation	Symbol	Unit	MSS182D-	MSS182F	
			0260-F	-0200-F	-0550-F
Standstill torque ¹⁾	M ₀	Nm	125	200	115
Continuous current at standstill	I ₀	A	65.0	71.0	118.9
Torque at maximum continuous output ²⁾	M _{opt}	Nm	121.5	192.3	92.0
Current at maximum continuous power	I _{opt}	A	63.2	68.3	95.1
Maximum continuous output ³⁾	P _{opt}	kW	36	44.9	70.6

Designation	Symbol	Unit	MSS182D-	MSS182F	
			0260-F	-0200-F	-0550-F
Optimum speed ⁴⁾	n _{opt}	min-1	2830	2230	7330
Maximum torque ⁵⁾	M _{max}	Nm	320	450	190
Maximum current	I _{max}	A	200.0	200.0	170
Maximum speed (electrical) ⁶⁾	n _{max}	min-1	12,000	12,000	13,500
Power wire cross-section	A	mm ²	16.0	16.0	2 x 25.0
Torque constant at 20 °C ⁷⁾	K _{M,0}	Nm/A	1.923	2.82	0.967213
Voltage constant at 20 °C ⁸⁾	K _{EMK,1000}	V/1000 min-1	130	160	70.1
Winding resistance at 20 °C	R ₁₂	Ohm	0.25	0.35	0.055
Winding inductance	L ₁₂	mH	6.4	8.8	1.23
Winding inductivity longitudinal	L _d	mH	1	4.2	0.4
Winding inductivity across	L _q	mH	2.6	7.5	1.2
Leakage capacitance of the component	C _{ab}	nF	5.42	11.3	18.8
Brake resistance	R _{Brems}	Ohm	3.77	3.28	3.57
Thermal time constant	T _{th}	min	1.6	1.6	1.6
Stator mass	m _{Stat}	kg	38.9	43.5	43.5
Number of pole pairs	p	-	4		
Details about liquid cooling					
Power dissipation	P _v	kW	1.10	1.50	2.8
Required coolant flow for P _v	Q _{min}	l/min	3	4	4
Pressure drop at Q _{min}	Δp	bar	1.6	1.6	0.828
Volume of coolant duct	V _{kuehl}	l	0.08	0.11	0.11
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

3.7.2 Data sheet MRS182

Table 25: Technical data MRS182A

Designation	Symbol	Unit	MRS182A-1N-0085
Moment of inertia of rotor ¹⁾	J _{Rot}	kg * m ²	0.0089
Rotor mass	m _{rot}	kg	2.7
Maximum speed (mechanical)	n _{max,mech}	min-1	13,500
1) Tolerance +/- 10%			
Latest amendment: 2019-07-01			

Table 26: Technical data MRS182B

Designation	Symbol	Unit	MRS182B-1N-0085	MRS182B-2N-0075
Moment of inertia of rotor ¹⁾	J _{Rot}	kg * m ²	0.031	0.035
Rotor mass	m _{rot}	kg	9.6	11.5
Maximum speed (mechanical)	n _{max,mech}	min-1	13,500	13,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 27: Technical data MRS182D

Designation	Symbol	Unit	MRS182D-1N-0085	MRS182D-2N-0075
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.039	0.043
Rotor mass	m_{rot}	kg	11.8	14.2
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min-1	13,500	13,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 28: Technical data MRS182F

Designation	Symbol	Unit	MRS182F-1N-0085	MRS182F-2N-0075
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.053	0.059
Rotor mass	m_{rot}	kg	16.3	19.6
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min-1	13,500	13,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

3.7.3 Characteristic curves of motor MSS182 Frame length "A"

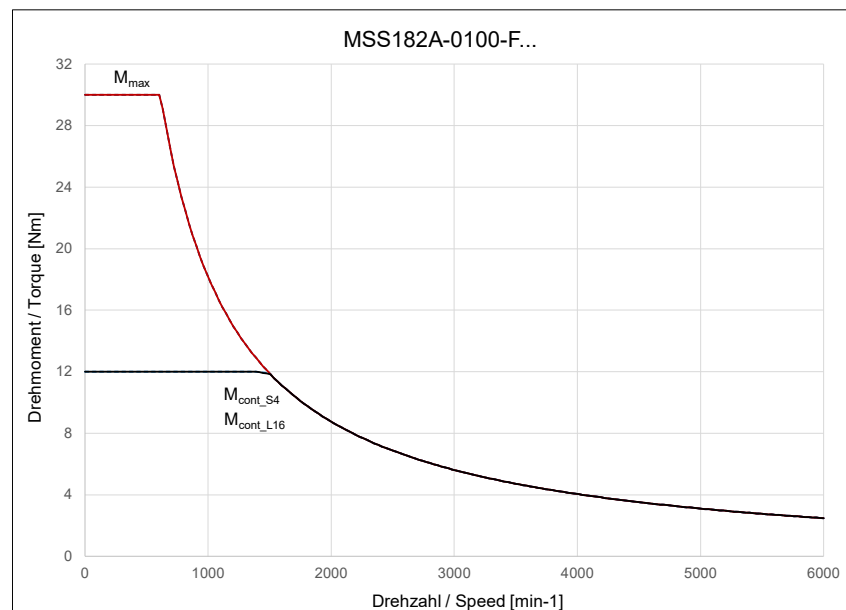


Fig. 22: Motor characteristic curve MSS182A-0100-F_

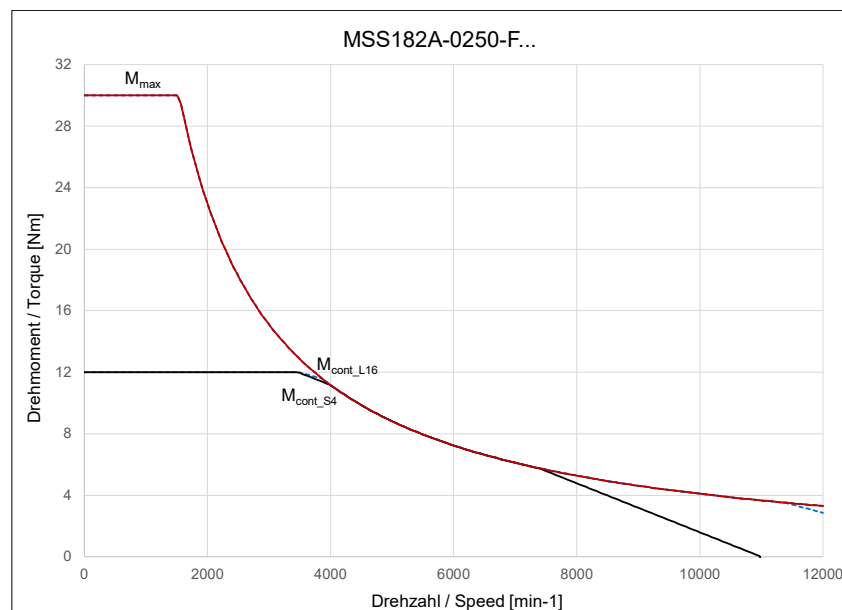


Fig. 23: Motor characteristic curve MSS182A-0250-F_
Frame lengths “B”

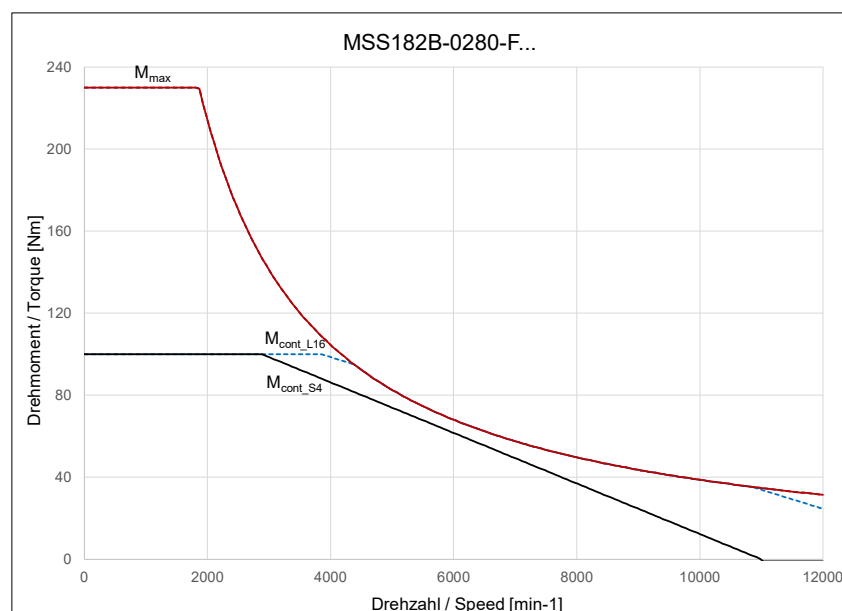


Fig. 24: Motor characteristic curve MSS182B-0280-F_

Frame lengths "D"

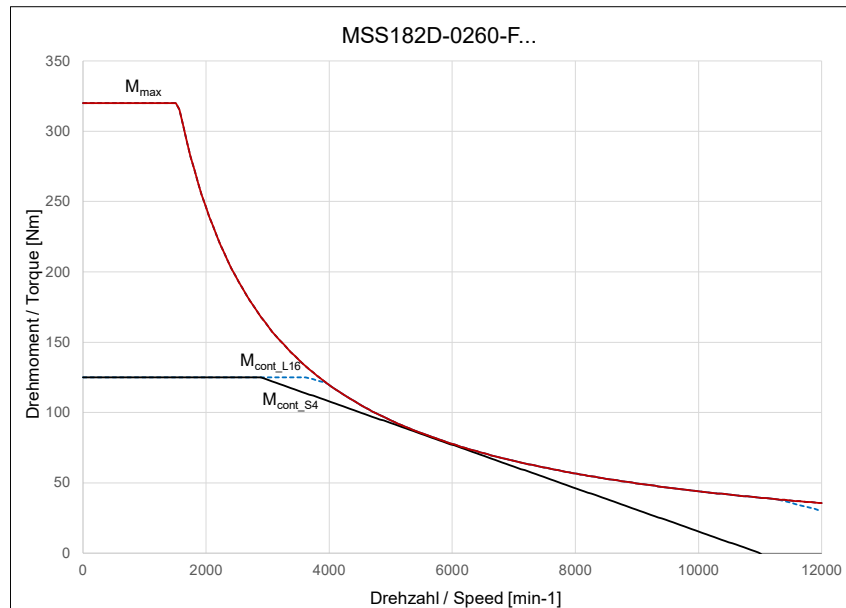


Fig. 25: Motor characteristic curve MSS182D-0260-F_

Frame lengths "F"

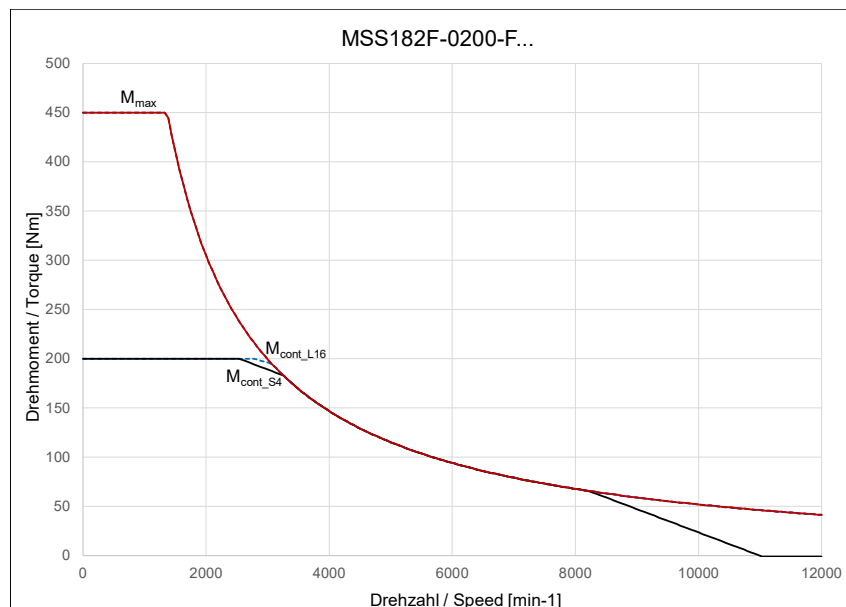


Fig. 26: Motor characteristic curve MSS182F-0200-F_

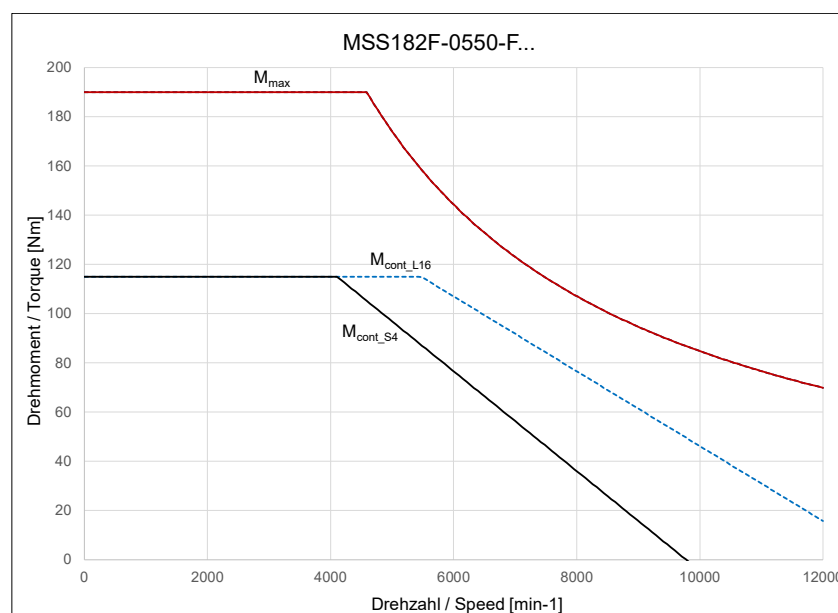


Fig. 27: Motor characteristic curve MSS182F-0550-F_

3.8 Frame size 202

3.8.1 Data sheet MSS202

Table 29: Technical data MSS202A/-B

Designation	Symbol	Unit	MSS202A	MSS202B	
			-0200-F	-0150-F	-0210-F
Standstill torque ¹⁾	M_0	Nm	105	141	128
Continuous current at standstill	I_0	A	45	46	52
Torque at maximum continuous output ²⁾	M_{opt}	Nm	102.8	136	125.6
Current at maximum continuous power	I_{opt}	A	44.1	44.4	51.0
Maximum continuous output ³⁾	P_{opt}	kW	23.8	23.5	29.6
Optimum speed ⁴⁾	n_{opt}	min-1	2210	1650	2,250
Maximum torque ⁵⁾	M_{max}	Nm	270	353	320
Maximum current	I_{max}	A	130	128	144
Maximum speed (electrical) ⁶⁾	n_{max}	min-1	11,000	8200	11,500
Power wire cross-section	A	mm ²	10.0	10.0	16.0
Torque constant at 20 °C ⁷⁾	$K_{M,0}$	Nm/A	2.3	3.1	2.5
Voltage constant at 20 °C ⁸⁾	$K_{EMK,1000}$	V/1000 min-1	156.0	208.0	166.8
Winding resistance at 20 °C	R_{12}	Ohm	0.33	0.41	0.266
Winding inductance	L_{12}	mH	6.8	8.8	5.6
Winding inductivity longitudinal	L_d	mH	1.23	1.64	1.4
Winding inductivity across	L_q	mH	2.5	3.3	2.85

Designation	Symbol	Unit	MSS202A	MSS202B	
			-0200-F	-0150-F	-0210-F
Leakage capacitance of the component	C _{ab}	nF	4.39	5.86	5.86
Brake resistance	R _{Brems}	Ohm	6.6	5.25	3.87
Thermal time constant	T _{th}	min	1.6	1.6	1.6
Stator mass	m _{Stat}	kg	25	40.7	40.7
Number of pole pairs	p	-	5		
Details about liquid cooling					
Power dissipation	P _v	kW	1.185	1.3	1.3
Required coolant flow for P _v	Q _{min}	l/min	3	3	3
Pressure drop at Q _{min}	Δp	bar	1.6	1.6	1.6
Volume of coolant duct	V _{kuehl}	l	0.051	0.063	0.063
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

Table 30: Technical data MSS202D/-F

Designation	Symbol	Unit	MSS202D		MSS202F
			-0170-F	-0360-F	-0120-F
Standstill torque ¹⁾	M ₀	Nm	163	136	194
Continuous current at standstill	I ₀	A	53	102	45.9
Torque at maximum continuous output ²⁾	M _{opt}	Nm	160.3	125.0	186.7
Current at maximum continuous power	I _{opt}	A	52.1	93.8	44.2
Maximum continuous output ³⁾	P _{opt}	kW	31.4	55.1	26.0
Optimum speed ⁴⁾	n _{opt}	min-1	1870	4210	1,330
Maximum torque ⁵⁾	M _{max}	Nm	407	333	484
Maximum current	I _{max}	A	147	197	125
Maximum speed (electrical) ⁶⁾	n _{max}	min-1	9300	12,500	6600
Power wire cross-section	A	mm ²	16.0	35.0	16.0
Torque constant at 20 °C ⁷⁾	K _{M,0}	Nm/A	3.1	1.7	4.3
Voltage constant at 20 °C ⁸⁾	K _{EMK,1000}	V/1000 min-1	208.5	113.8	275.9
Winding resistance at 20 °C	R ₁₂	Ohm	0.32	0.1	0.43
Winding inductance	L ₁₂	mH	6.9	2.06	9.6
Winding inductivity longitudinal	L _d	mH	1.5	0.93	4.65
Winding inductivity across	L _q	mH	3.06	1.9	8
Leakage capacitance of the component	C _{ab}	nF	7.32	7.32	10.25
Brake resistance	R _{Brems}	Ohm	4.9	4.34	3.04
Thermal time constant	T _{th}	min	1.6	1.6	2
Stator mass	m _{Stat}	kg	37.6	37.6	63.7
Number of pole pairs	p	-	5		
Details about liquid cooling					
Power dissipation	P _v	kW	1.60	1.6	2.10
Required coolant flow for P _v	Q _{min}	l/min	4	4	4
Pressure drop at Q _{min}	Δp	bar	1.6	1.6	1.6

Designation	Symbol	Unit	MSS202D		MSS202F
			-0170-F	-0360-F	-0120-F
Volume of coolant duct	V_{kuehl}	l	0.076	0.076	0.101
1...8) Tolerance $\pm 5\%$					
Latest amendment: 2024-03-18					

3.8.2 Data sheet MRS202

Table 31: Technical data MRS202A

Designation	Symbol	Unit	MRS202A-1N-0096	MRS202A-2N-0085
Moment of inertia of rotor ¹⁾	J_{Rot}	$\text{kg} \cdot \text{m}^2$	0.05	0.055
Rotor mass	m_{rot}	kg	12.8	14.6
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min-1	12,500	12,500
1) Tolerance $\pm 10\%$				
Latest amendment: 2019-07-01				

Table 32: Technical data MRS202B

Designation	Symbol	Unit	MRS202B-1N-0096	MRS202B-2N-0085
Moment of inertia of rotor ¹⁾	J_{Rot}	$\text{kg} \cdot \text{m}^2$	0.064	0.07
Rotor mass	m_{rot}	kg	16.2	19.0
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min-1	12,500	12,500
1) Tolerance $\pm 10\%$				
Latest amendment: 2019-07-01				

Table 33: Technical data MRS202D

Designation	Symbol	Unit	MRS202D-1N-0096	MRS202D-2N-0085
Moment of inertia of rotor ¹⁾	J_{Rot}	$\text{kg} \cdot \text{m}^2$	0.077	0.084
Rotor mass	m_{rot}	kg	19.6	23.0
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min-1	12,500	12,500
1) Tolerance $\pm 10\%$				
Latest amendment: 2019-07-01				

Table 34: Technical data MRS202F

Designation	Symbol	Unit	MRS202F-1N-0096	MRS202F-2N-0085
Moment of inertia of rotor ¹⁾	J_{Rot}	$\text{kg} \cdot \text{m}^2$	0.104	0.114
Rotor mass	m_{rot}	kg	26.9	31.2
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min-1	12,500	12,500
1) Tolerance $\pm 10\%$				
Latest amendment: 2019-07-01				

3.8.3 Characteristic curves of motors MSS202A/-B Frame length: "A"

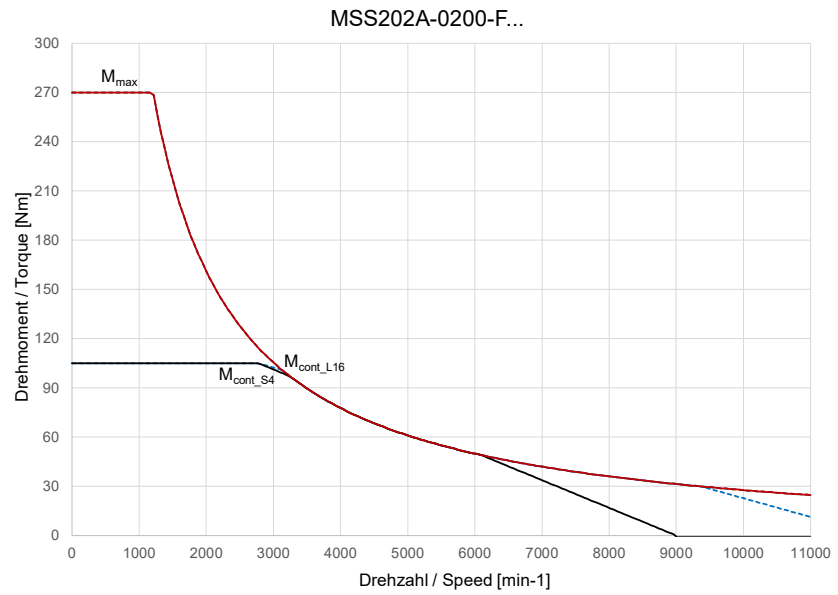


Fig. 28: Motor characteristic curve MSS202A-0200-F_

Frame lengths "B"

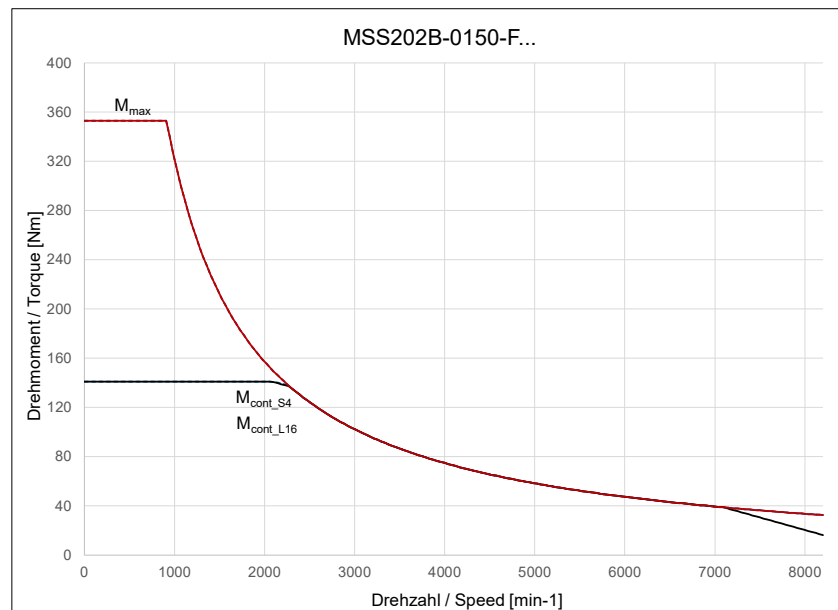


Fig. 29: Motor characteristic curve MSS202B-0150-F_

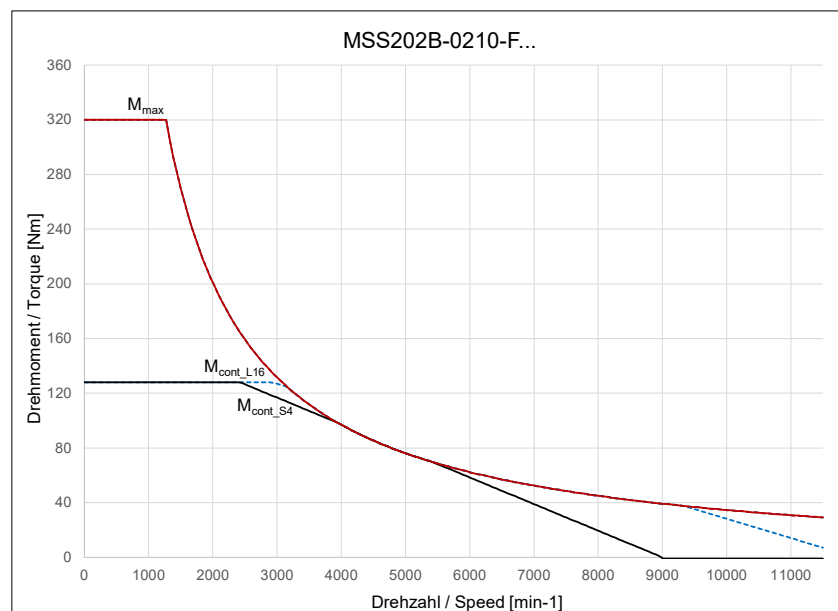


Fig. 30: Motor characteristic curve MSS202B-0210-F_

Frame lengths "D"

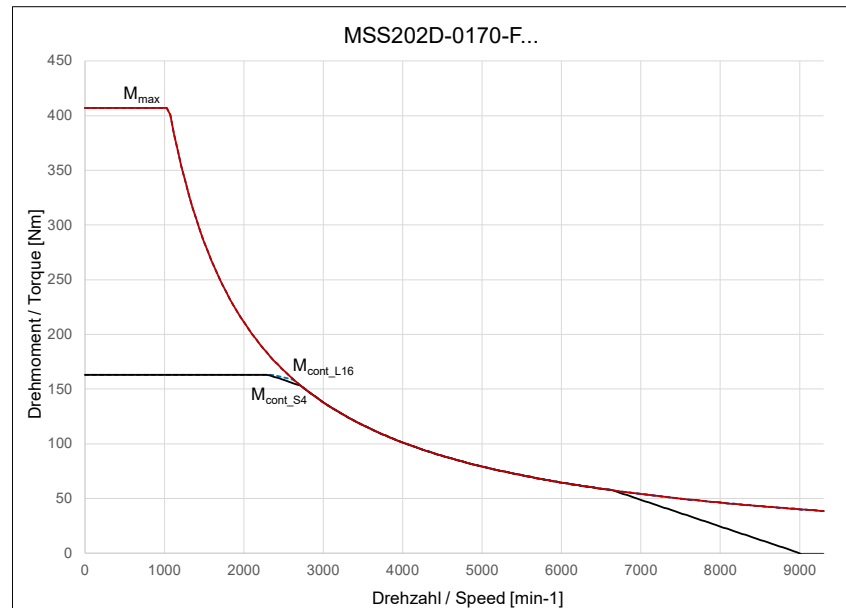


Fig. 31: Motor characteristic curve MSS202D-0170-F_

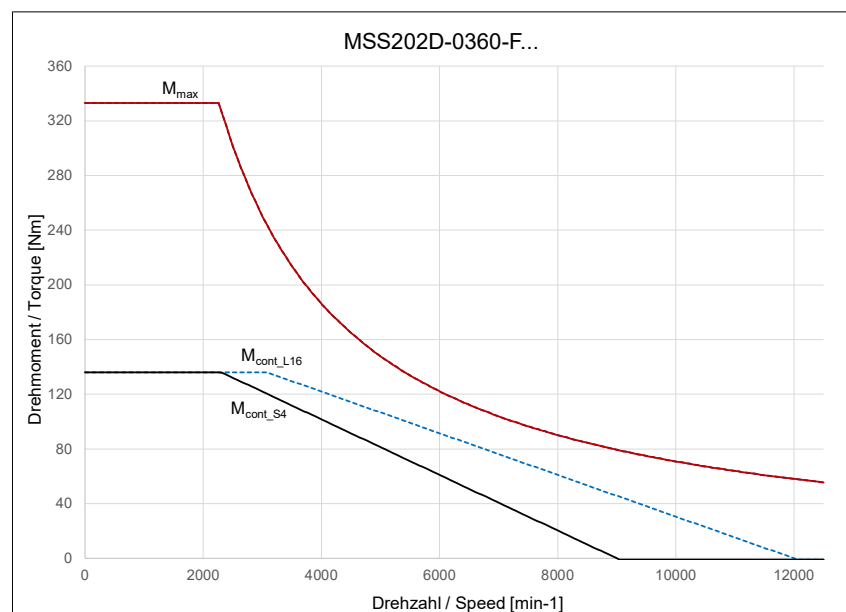


Fig. 32: Motor characteristic curve MSS202D-0360-F_

Frame lengths "F"

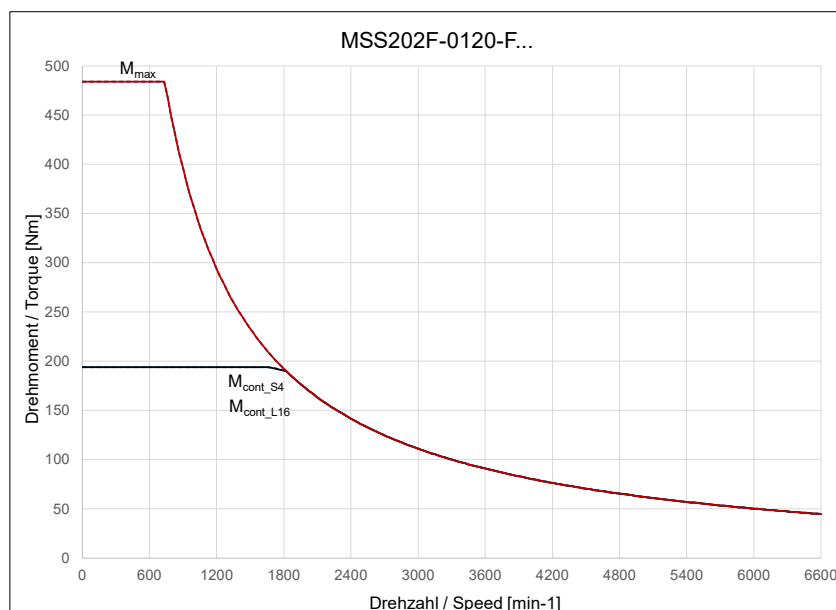


Fig. 33: Motor characteristic curve MSS202F-0120-F_

3.9 Frame size 242

3.9.1 Data sheet MSS242

Technical data MSS242

Designation	Symbol	Unit	MSS242B	MSS242D	MSS242F
			-0100-F	-0070-F	-0060-F
Standstill torque ¹⁾	M_0	Nm	220	335	380
Continuous current at standstill	I_0	A	60.0	47.7	60.0
Torque at maximum continuous output ²⁾	M_{opt}	Nm	211.4	329.2	373.4
Current at maximum continuous power	I_{opt}	A	57.7	46.9	59.0
Maximum continuous output ³⁾	P_{opt}	kW	24.8	26.2	26.2
Optimum speed ⁴⁾	n_{opt}	min-1	1120	760	670
Maximum torque ⁵⁾	M_{max}	Nm	575	860	970
Maximum current	I_{max}	A	180	180	180
Maximum speed (electrical) ⁶⁾	n_{max}	min-1	6,000	4200	3600
Power wire cross-section	A	mm ²	16.0	10.0	16.0
Torque constant at 20 °C ⁷⁾	$K_{M,0}$	Nm/A	3.68	7.17	6.25
Voltage constant at 20 °C ⁸⁾	$K_{EMK,1000}$	V/1000 min-1	310	454	570
Winding resistance at 20 °C	R_{12}	Ohm	0.26	0.57	0.42
Winding inductance	L_{12}	mH	9.1	21.1	15.6
Winding inductivity longitudinal	L_d	mH	4.5	8.2	3.0

Designation	Symbol	Unit	MSS242B	MSS242D	MSS242F
			-0100-F	-0070-F	-0060-F
Winding inductivity across	L _q	mH	8.8	14.3	13.3
Leakage capacitance of the component	C _{ab}	nF	8.22	7.80	14.39
Brake resistance	R _{Brems}	Ohm	8.84	11.0	3.12
Thermal time constant	T _{th}	min	1.6	1.6	1.6
Stator mass	m _{Stat}	kg	66.7	78	105.1
Number of pole pairs	p	-	5		
Details about liquid cooling					
Power dissipation	P _v	kW	2.3	3.3	3.8
Required coolant flow for P _v	Q _{min}	l/min	4	5	6
Pressure drop at Q _{min}	Δp	bar	1.2	1.2	1.2
Volume of coolant duct	V _{kuehl}	l	0.076	0.107	0.122
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

3.9.2 Data sheet MRS242

Table 35: Technical data MRS242B

Designation	Symbol	Unit	MRS242B-1N-0110	MRS242B-2N-0100
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.119	0.128
Rotor mass	m_{rot}	kg	22.5	25.6
Maximum speed (mechanical)	$n_{max,mech}$	min-1	11,000	11,000
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 36: Technical data MRS242D

Designation	Symbol	Unit	MRS242D-1N-0110	MRS242D-2N-0100
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.167	0.18
Rotor mass	m_{rot}	kg	31.7	35.9
Maximum speed (mechanical)	$n_{max,mech}$	min-1	11,000	11,000
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 37: Technical data MSS242F

Designation	Symbol	Unit	MRS242F-1N-0110	MRS242F-2N-0100
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.193	0.207
Rotor mass	m_{rot}	kg	36.5	41.4
Maximum speed (mechanical)	$n_{max,mech}$	min-1	11,000	11,000
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

3.9.3 Motor characteristic curves MSS242

Frame lengths "B"

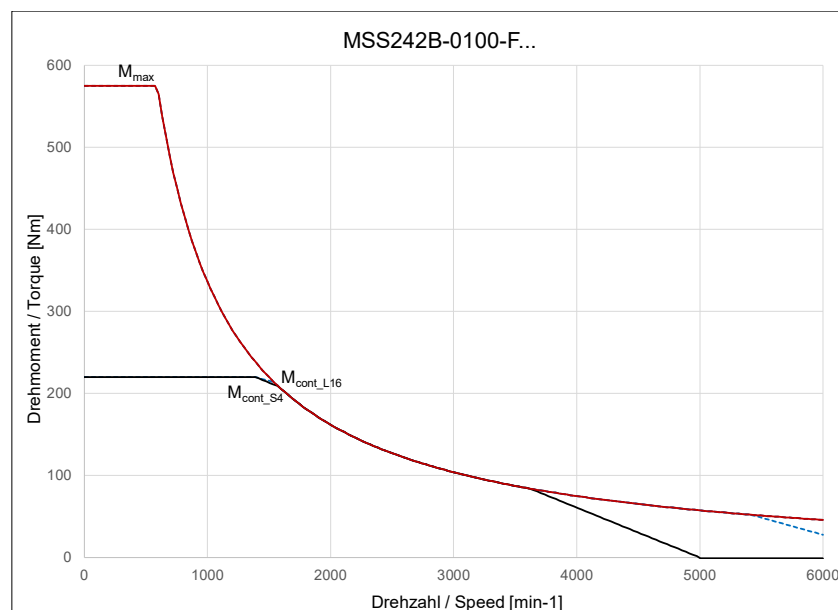


Fig. 34: Motor characteristic curve MSS242B-0100-F_

Frame lengths "D"

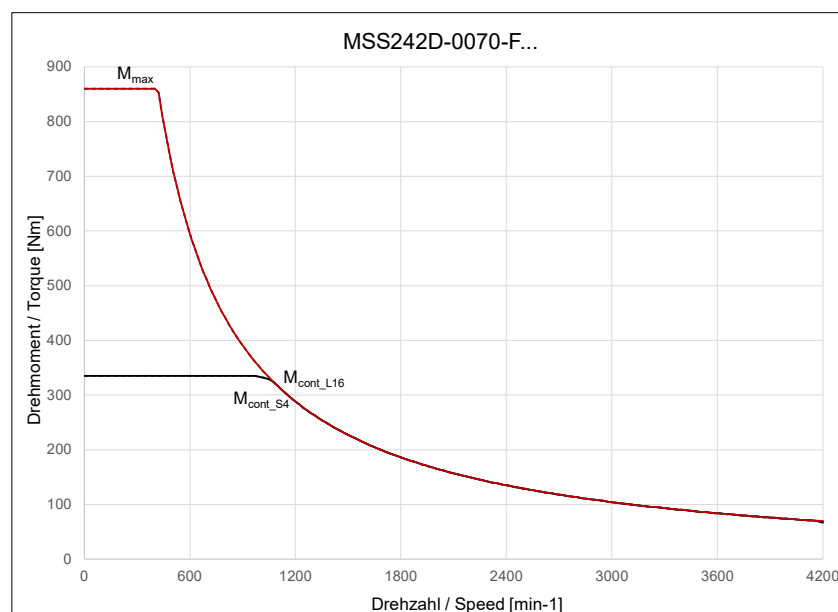


Fig. 35: Motor characteristic curve MSS242D-0070-F_

Frame lengths "F"

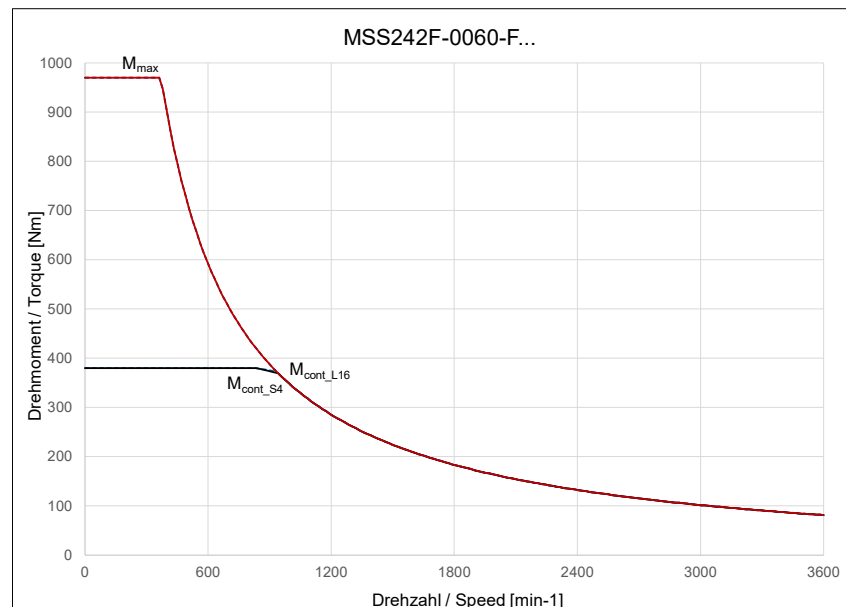


Fig. 36: Motor characteristic curve MSS242F-0060-F_

3.10 Frame size 272

3.10.1 Data sheet MSS272

Technical data MSS272

Designation	Symbol	Unit	MSS272B		MSS272D	MSS272F
			-0065-F	-0080-F	-0050-F	-0040-F
Standstill torque ¹⁾	M_0	Nm	400	400	505	650
Continuous current at standstill	I_0	A	71	82	62	71
Torque at maximum continuous output ²⁾	M_{opt}	Nm	394.1	390.5	498.7	640.2
Current at maximum continuous power	I_{opt}	A	70.0	80.1	61.2	69.9
Maximum continuous output ³⁾	P_{opt}	kW	29.3	36.8	28.2	29.5
Optimum speed ⁴⁾	n_{opt}	min-1	710	900	540	440
Maximum torque ⁵⁾	M_{max}	Nm	900	900	1200	1,500
Maximum current	I_{max}	A	200	250	180	200
Maximum speed (electrical) ⁶⁾	n_{max}	min-1	3000	3200	2,200	1800
Power wire cross-section	A	mm ²	16.0	25.0	16.0	16.0
Torque constant at 20 °C ⁷⁾	$K_{M,0}$	Nm/A	5.63	4.88	8.145	9.15
Voltage constant at 20 °C ⁸⁾	$K_{EMK,1000}$	V/1000 min-1	520	465	522	775
Winding resistance at 20 °C	R_{12}	Ohm	0.298	0.244	0.38	0.36
Winding inductance	L_{12}	mH	17	11.1	15.4	17.0
Winding inductivity longitudinal	L_d	mH	2	6.9	8.0	4.4

Designation	Symbol	Unit	MSS272B		MSS272D	MSS272F
			-0065-F	-0080-F	-0050-F	-0040-F
Winding inductivity across	L _q	mH	10.2	7.8	9.0	17
Leakage capacitance of the component	C _{ab}	nF	12.81	12.81	10.30	20.49
Brake resistance	R _{Brems}	Ohm	2.77	2.33	4.8	4.2
Thermal time constant	T _{th}	min	1.6	1.6	3.4	1.6
Stator mass	m _{Stat}	kg	90.4	90.4	112.3	134.2
Number of pole pairs	p	-	6			
Details about liquid cooling						
Power dissipation	P _v	kW	3.8	3.8	4.5	4.9
Required coolant flow for P _v	Q _{min}	l/min	6	6	7	7
Pressure drop at Q _{min}	Δp	bar	1.2	1.2	1.2	1.2
Volume of coolant duct	V _{kuehl}	l	0.075	0.075	0.091	0.108
1...8) Tolerance ± 5%						
Latest amendment: 2024-03-18						

3.10.2 Data sheet MRS272

Table 38: Technical data MRS272B

Designation	Symbol	Unit	MRS272B-1N-0135	MRS272B-2N-0125
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.268	0.287
Rotor mass	m_{rot}	kg	35.5	40.0
Maximum speed (mechanical)	$n_{max,mech}$	min-1	9500	9500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 39: Technical data MRS272D

Designation	Symbol	Unit	MRS272D-1N-0135	MRS272D-2N-0125
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.335	0.36
Rotor mass	m_{rot}	kg	44.5	50.2
Maximum speed (mechanical)	$n_{max,mech}$	min-1	9500	9500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 40: Technical data MRS272F

Designation	Symbol	Unit	MRS272F-1N-0135	MRS272F-2N-0125
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.403	0.433
Rotor mass	m_{rot}	kg	53.5	60.4
Maximum speed (mechanical)	$n_{max,mech}$	min-1	9500	9500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

3.10.3 Motor characteristic curves MSS272

Frame lengths "B"

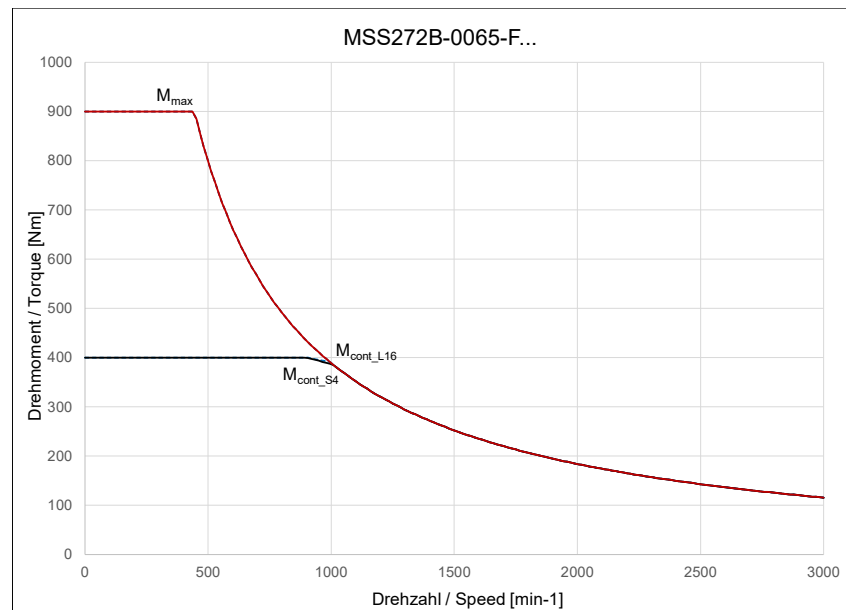


Fig. 37: Motor characteristic curve MSS272B-0065-F_

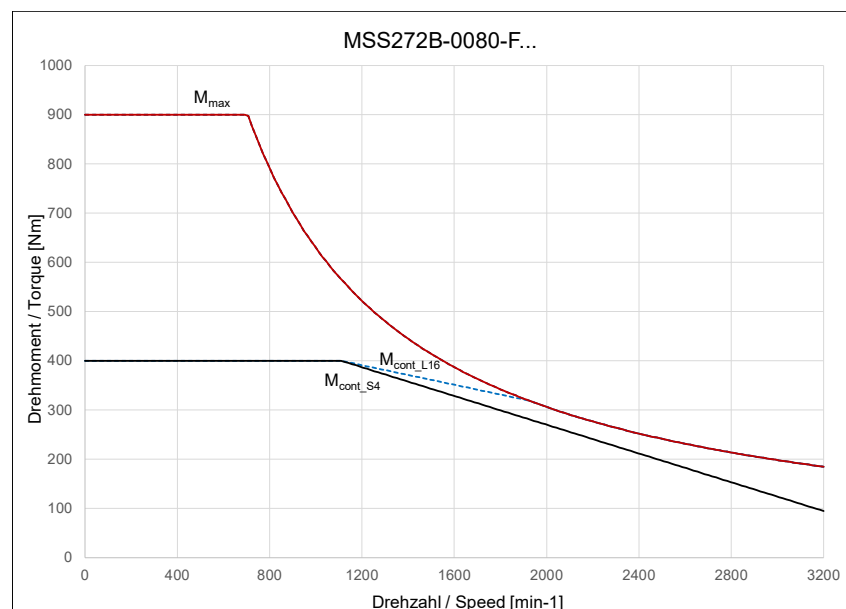


Fig. 38: Motor characteristic curve MSS272B-0080-F_

Frame lengths "D"

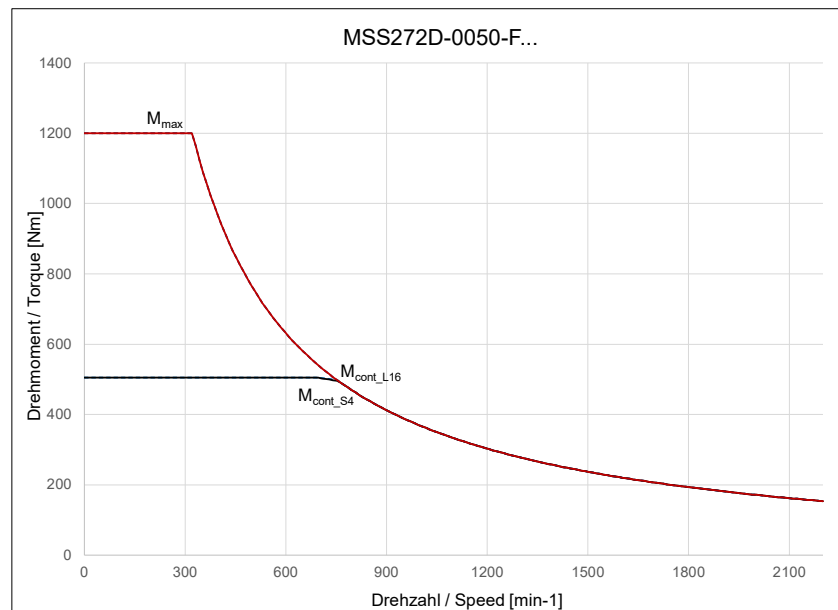


Fig. 39: Motor characteristic curve MSS272D-0050-F_

Frame lengths "F"

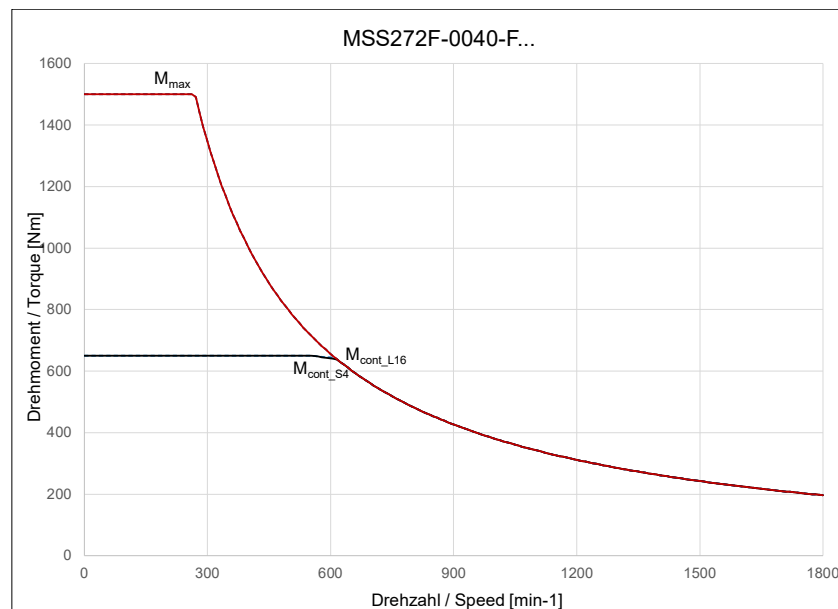


Fig. 40: Motor characteristic curve MSS272F-0040-F_

3.11 Frame size 312

3.11.1 Data sheet MSS312

Table 41: Technical data MSS312B/-D

Designation	Symbol	Unit	MSS312B	MSS312D	
			-0035-F	-0028-F	-0060-F
Standstill torque ¹⁾	M ₀	Nm	650	820	820
Continuous current at standstill	I ₀	A	62.5	59.5	93.2
Torque at maximum continuous output ²⁾	M _{opt}	Nm	643.3	814.9	790.6
Current at maximum continuous power	I _{opt}	A	61.9	59.1	89.9
Maximum continuous output ³⁾	P _{opt}	kW	25.6	25.6	56.3
Optimum speed ⁴⁾	n _{opt}	min-1	380	300	680
Maximum torque ⁵⁾	M _{max}	Nm	1550	1950	1950
Maximum current	I _{max}	A	170	160.0	250
Maximum speed (electrical) ⁶⁾	n _{max}	min-1	1,500	1200	2400
Power wire cross-section	A	mm ²	16.0	16.0	2 x 16.0
Torque constant at 20 °C ⁷⁾	K _{M,0}	Nm/A	10.48	12.62	8.80
Voltage constant at 20 °C ⁸⁾	K _{EMK,1000}	V/1000 min-1	686	926	432
Winding resistance at 20 °C	R ₁₂	Ohm	0.47	0.57	0.294
Winding inductance	L ₁₂	mH	16.4	19.5	10.1
Winding inductivity longitudinal	L _d	mH	7.8	8.2	3.2
Winding inductivity across	L _q	mH	10	10.4	7.8
Leakage capacitance of the component	C _{ab}	nF	19.89	24.86	24.86
Brake resistance	R _{Brems}	Ohm	7.75	8.9	6.95
Thermal time constant	T _{th}	min	3	1.6	1.6
Stator mass	m _{Stat}	kg	128.7	154.1	154.1
Number of pole pairs	p	-	7		
Details about liquid cooling					
Power dissipation	P _v	kW	4.1	5.0	5.2
Required coolant flow for P _v	Q _{min}	l/min	7.0	7.3	7.6
Pressure drop at Q _{min}	Δp	bar	0.5	0.51	0.53
Volume of coolant duct	V _{kuehl}	l	0.126	0.152	0.152
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

Table 42: Technical data MSS312F/-H

Designation	Symbol	Unit	MSS312F	MSS312H	
			-0028-F	-0025-F	-0085-F
Standstill torque ¹⁾	M ₀	Nm	975	1,125	1100
Continuous current at standstill	I ₀	A	62	62	197
Torque at maximum continuous output ²⁾	M _{opt}	Nm	967.7	1089.9	1060.4
Current at maximum continuous power	I _{opt}	A	61.5	60.1	189.9
Maximum continuous output ³⁾	P _{opt}	kW	30.4	33.1	106.6

Designation	Symbol	Unit	MSS312F	MSS312H	
			-0028-F	-0025-F	-0085-F
Optimum speed ⁴⁾	n _{opt}	min-1	300	290	960
Maximum torque ⁵⁾	M _{max}	Nm	2275	2750	2750
Maximum current	I _{max}	A	180	180	570
Maximum speed (electrical) ⁶⁾	n _{max}	min-1	1200	1100	3400
Power wire cross-section	A	mm ²	16.0	16.0	2 x 50.0
Torque constant at 20 °C ⁷⁾	K _{M,0}	Nm/A	15.72	20.5	5.6
Voltage constant at 20 °C ⁸⁾	K _{EMK,1000}	V/1000 min-1	930	1,250	375
Winding resistance at 20 °C	R ₁₂	Ohm	0.54	0.96	0.073
Winding inductance	L ₁₂	mH	19.2	32.2	2.53
Winding inductivity longitudinal	L _d	mH	15	20.8	1.8
Winding inductivity across	L _q	mH	18.8	26	2.25
Leakage capacitance of the component	C _{ab}	nF	29.83	36.46	36.46
Brake resistance	R _{Brems}	Ohm	15.7	15.2	4.43
Thermal time constant	T _{th}	min	1.6	1.6	1.6
Stator mass	m _{Stat}	kg	179.5	215.0	215.0
Number of pole pairs	p	-	7		
Details about liquid cooling					
Power dissipation	P _v	kW	5.3	5.6	6.0
Required coolant flow for P _v	Q _{min}	l/min	7.7	8.3	8.7
Pressure drop at Q _{min}	Δp	bar	0.5	0.5	0.5
Volume of coolant duct	V _{kuehl}	l	0.179	0.207	0.207
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

3.11.2 Data sheet MRS312

Table 43: Technical data MRS312B

Designation	Symbol	Unit	MRS312B-			
			1N-0170	2N-0112	2N-0130	2N-0160
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.617	0.795	0.762	0.664
Rotor mass	m_{rot}	kg	55.0	89.1	80.1	62.2
Maximum speed (mechanical)	$n_{max,mech}$	min-1	7,500	7,500	7,500	7,500
1) Tolerance +/- 10%						
Latest amendment: 2019-07-01						

Table 44: Technical data MRS312D

Designation	Symbol	Unit	MRS312D-			
			1N-0170	2N-0112	2N-0130	2N-0160
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.751	0.969	0.927	0.809
Rotor mass	m_{rot}	kg	67.4	108.6	97.6	75.7
Maximum speed (mechanical)	$n_{max,mech}$	min-1	7,500	7,500	7,500	7,500
1) Tolerance +/- 10%						
Latest amendment: 2019-07-01						

Table 45: Technical data MRS312F

Designation	Symbol	Unit	MRS312F-			
			1N-0170	2N-0112	2N-0130	2N-0160
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	0.885	1.142	1.093	0.953
Rotor mass	m_{rot}	kg	79.5	128.0	115.1	89.3
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min-1	7,500	7,500	7,500	7,500
1) Tolerance +/- 10%						
Latest amendment: 2019-07-01						

Table 46: Technical data MRS312H

Designation	Symbol	Unit	MRS312H-			
			1N-0170	2N-0112	2N-0130	2N-0160
Moment of inertia of rotor ¹⁾	J_{Rot}	kg * m ²	1.064	1.373	1.314	1.146
Rotor mass	m_{rot}	kg	95.6	153.9	138.3	107.3
Maximum speed (mechanical)	$n_{\text{max,mech}}$	min-1	7,500	7,500	7,500	7,500
1) Tolerance +/- 10%						
Latest amendment: 2019-07-01						

3.11.3 Characteristic curves of motor MSS312

Frame lengths "B"

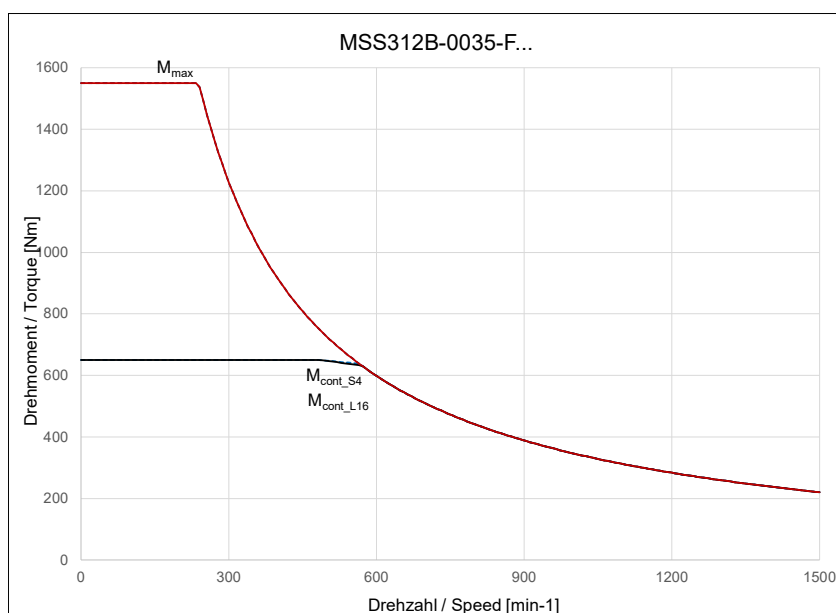


Fig. 41: Motor characteristic curve MSS312B-0035-F_

Frame lengths "D"

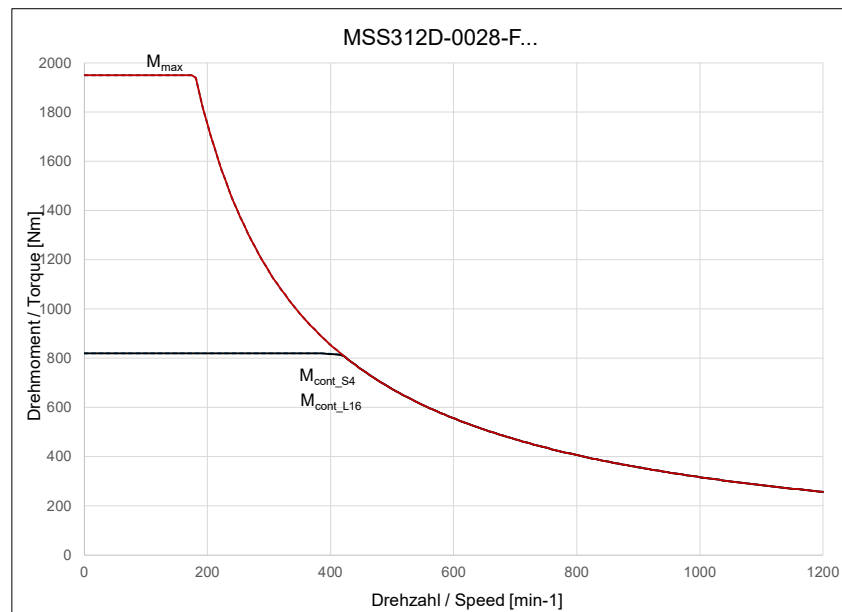


Fig. 42: Motor characteristic curve MSS312D-0028-F_

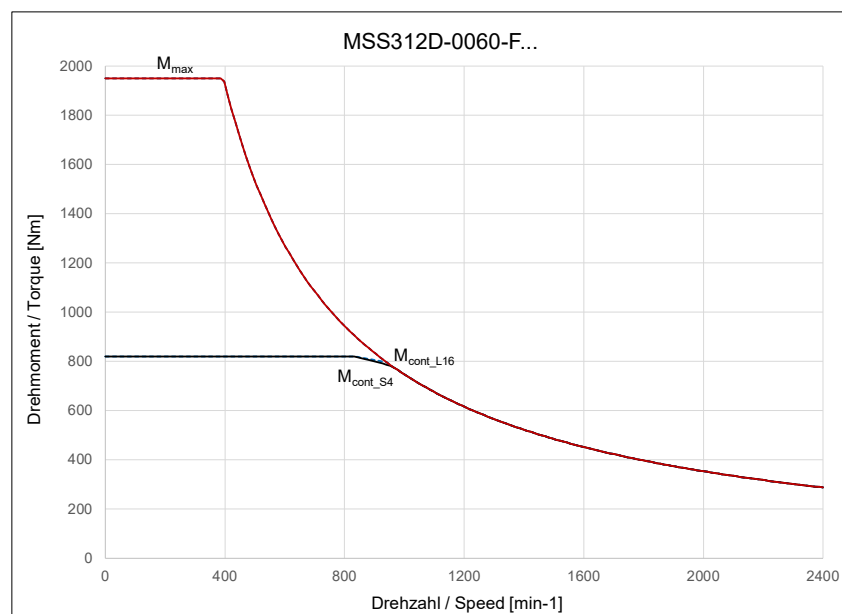


Fig. 43: Motor characteristic curve MSS312D-0060-F_

Frame lengths "F"

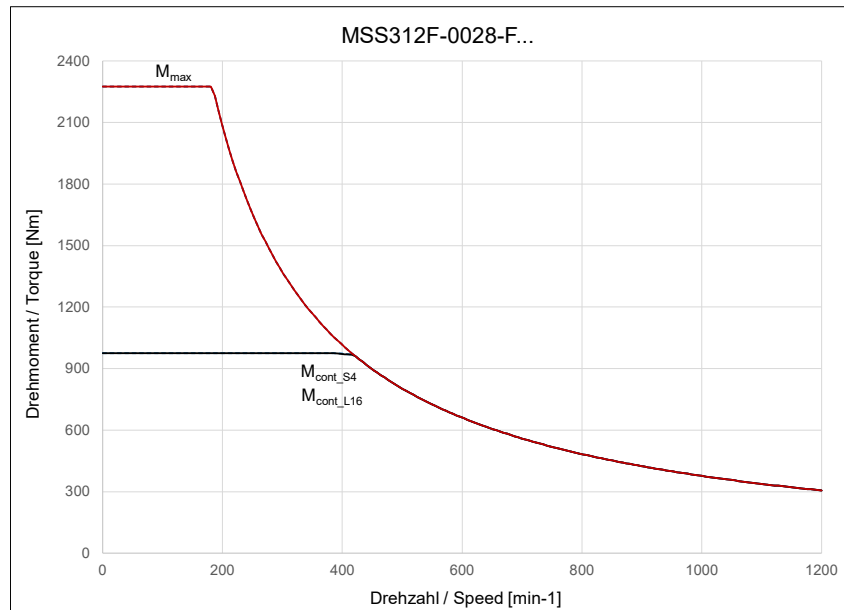


Fig. 44: Motor characteristic curve MSS312F-0028-F_

Frame lengths "H"

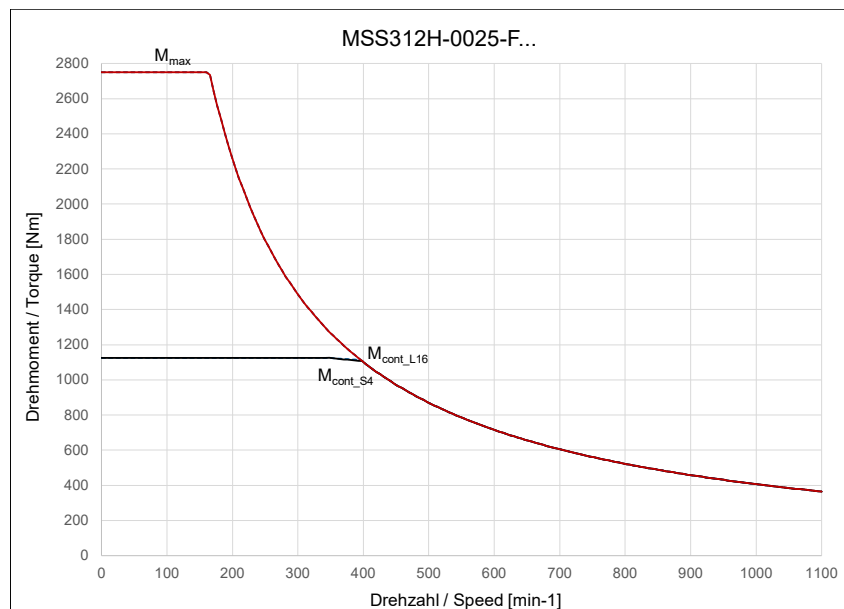


Fig. 45: Motor characteristic curve MSS312H-0025-F_

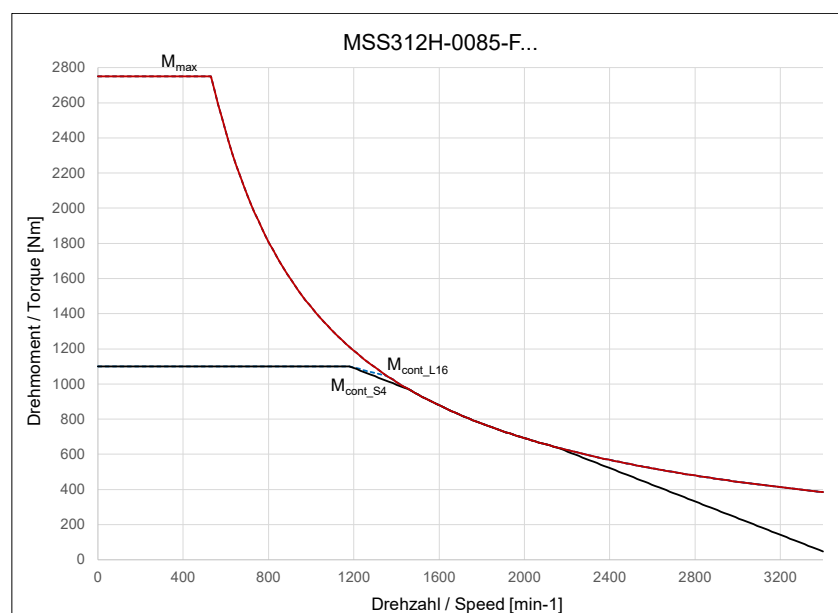


Fig. 46: Motor characteristic curve MSS312H-0085-F_

3.12 Frame size 382

3.12.1 Data sheet MSS382

Technical data MSS382

Designation	Symbol	Unit	MSS382B	MSS382D	MSS382F
			-0025-F	-0020-F	-0018-F
Standstill torque ¹⁾	M_0	Nm	1375	1775	2170
Continuous current at standstill	I_0	A	94	101	83.6
Torque at maximum continuous output ²⁾	M_{opt}	Nm	1343.7	1710.2	2143.8
Current at maximum continuous power	I_{opt}	A	83.1	97.3	82.6
Maximum continuous output ³⁾	P_{opt}	kW	39.4	39.4	44.9
Optimum speed ⁴⁾	n_{opt}	min-1	280	220	200
Maximum torque ⁵⁾	M_{max}	Nm	2875	3700	4500
Maximum current	I_{max}	A	230	250	250
Maximum speed (electrical) ⁶⁾	n_{max}	min-1	1,000	800	720
Power wire cross-section	A	mm ²	25.0	2 x 16.0	25.0
Torque constant at 20 °C ⁷⁾	$K_{M,0}$	Nm/A	14.62	17.57	26.15
Voltage constant at 20 °C ⁸⁾	$K_{EMK,1000}$	V/1000 min-1	884	1153	1842
Winding resistance at 20 °C	R_{12}	Ohm	0.33	0.42	0.76
Winding inductance	L_{12}	mH	12.1	15.6	27.2
Winding inductivity longitudinal	L_d	mH	6.1	5.0	13
Winding inductivity across	L_q	mH	19.8	8.0	17.5

Designation	Symbol	Unit	MSS382B	MSS382D	MSS382F
			-0025-F	-0020-F	-0018-F
Leakage capacitance of the component	C _{ab}	nF	33.95	44.8	53.35
Brake resistance	R _{Brems}	Ohm	5.5	5.66	8.4
Thermal time constant	T _{th}	min	1.6	1.6	1.6
Stator mass	m _{Stat}	kg	178.5	242.7	262
Number of pole pairs	p	-	9		
Details about liquid cooling					
Power dissipation	P _v	kW	6.4	9.4	10.0
Required coolant flow for P _v	Q _{min}	l/min	9.2	13.5	14.4
Pressure drop at Q _{min}	Δp	bar	1.0	1.0	1.0
Volume of coolant duct	V _{kuehl}	l	0.73	0.91	1.09
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

3.12.2 Data sheet MRS382

Table 47: Technical data MRS382B

Designation	Symbol	Unit	MRS382B-1N-0240	MRS382B-2N-0230
Moment of inertia of rotor ¹⁾	J _{Rot}	kg * m ²	1.525	1.682
Rotor mass	m _{rot}	kg	77.6	84.5
Maximum speed (mechanical)	n _{max,mech}	min-1	5,500	5,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 48: Technical data MRS382D

Designation	Symbol	Unit	MRS382D-1N-0240	MRS382D-2N-0230
Moment of inertia of rotor ¹⁾	J _{Rot}	kg * m ²	1.911	2.108
Rotor mass	m _{rot}	kg	97.2	105.8
Maximum speed (mechanical)	n _{max,mech}	min-1	5,500	5,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

Table 49: Technical data MRS382F

Designation	Symbol	Unit	MRS382F-1N-0240	MRS382F-2N-0230
Moment of inertia of rotor ¹⁾	J _{Rot}	kg * m ²	2.296	2.41
Rotor mass	m _{rot}	kg	116.8	127.2
Maximum speed (mechanical)	n _{max,mech}	min-1	5,500	5,500
1) Tolerance +/- 10%				
Latest amendment: 2019-07-01				

3.12.3 Motor characteristic curves MSS382

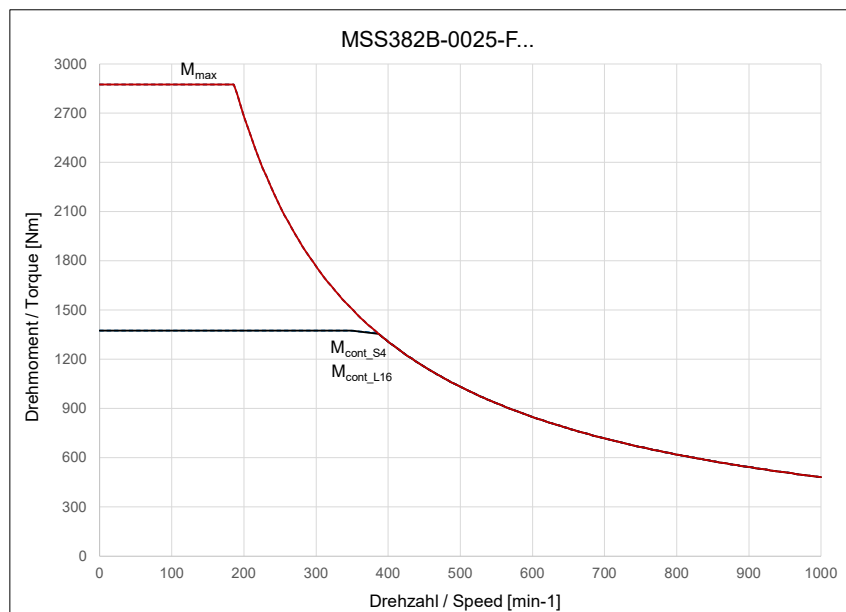


Fig. 47: Motor characteristic curve MSS382B-0025-F_

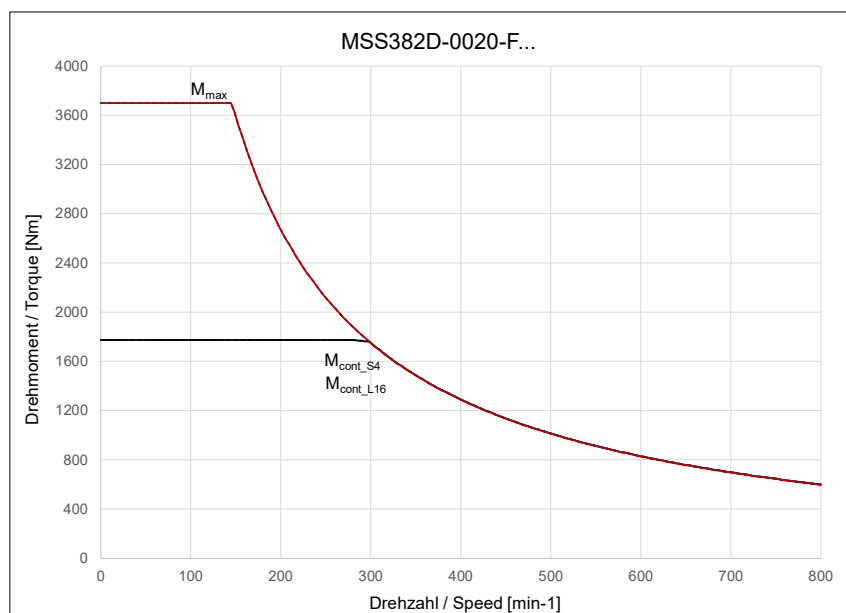


Fig. 48: Motor characteristic curve MSS382D-0020-F_

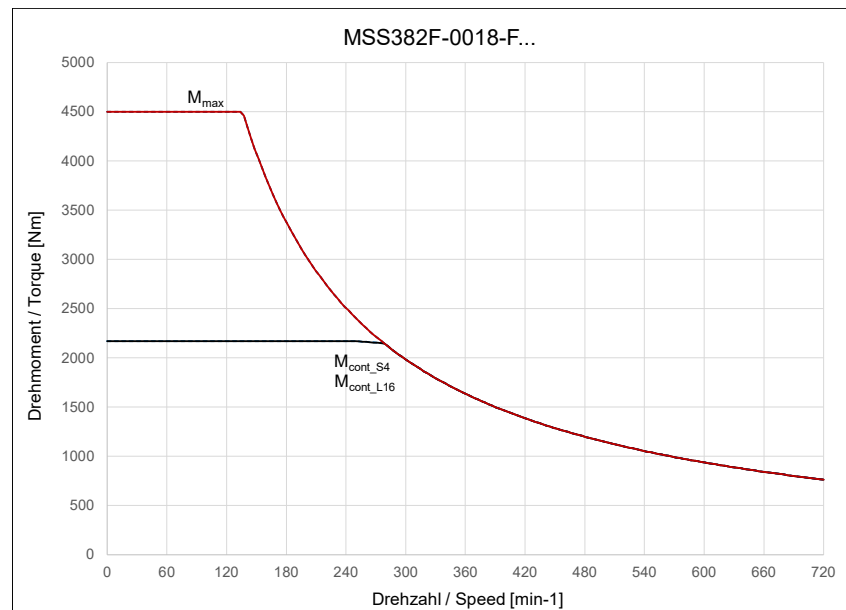


Fig. 49: Motor characteristic curve MSS382F-0018-F_

4 Dimensional sheets

4.1 General notes

In this chapter, the dimensional sheets are summarized according to their size. The order of the drawings for each frame size complies with the following scheme:

- Dimensional sheet of complete motor with coolant connection “axial” and rotor frame size “1N”
- Dimensional sheet of complete motor with coolant connection “axial” and rotor frame size “2N”
- Dimensional sheet of complete motor with coolant connection “axial” and rotor frame size “1N” (only for frame size 182 and 312)
- Dimensional sheet of complete motor with coolant connection “axial” and rotor frame size “2N” (only for frame size 182 and 312)
- Component drawing of the stator with coolant connection “axial”
- Component drawing of the stator with coolant connection “radial” (only for frame size 182)
- Component drawing of the rotor in frame size “1N”
- Component drawing of the rotor in frame size “2N”

The dimensions and tolerances shown in the drawings are subject to the following standards:

- Longitudinal dimensions: DIN ISO 2768, Part 1
- Angular dimensions: DIN 7168 medium
- Form and position tolerances: DIN ISO 1101



Comply with the trademark rights of third parties during assembly and use of single components delivered by Bosch Rexroth. For any infringement of the right, the customer is liable for the accruing damage.

4.2 Frame size 102

4.2.1 MBS102 with rotor frame size “1N”

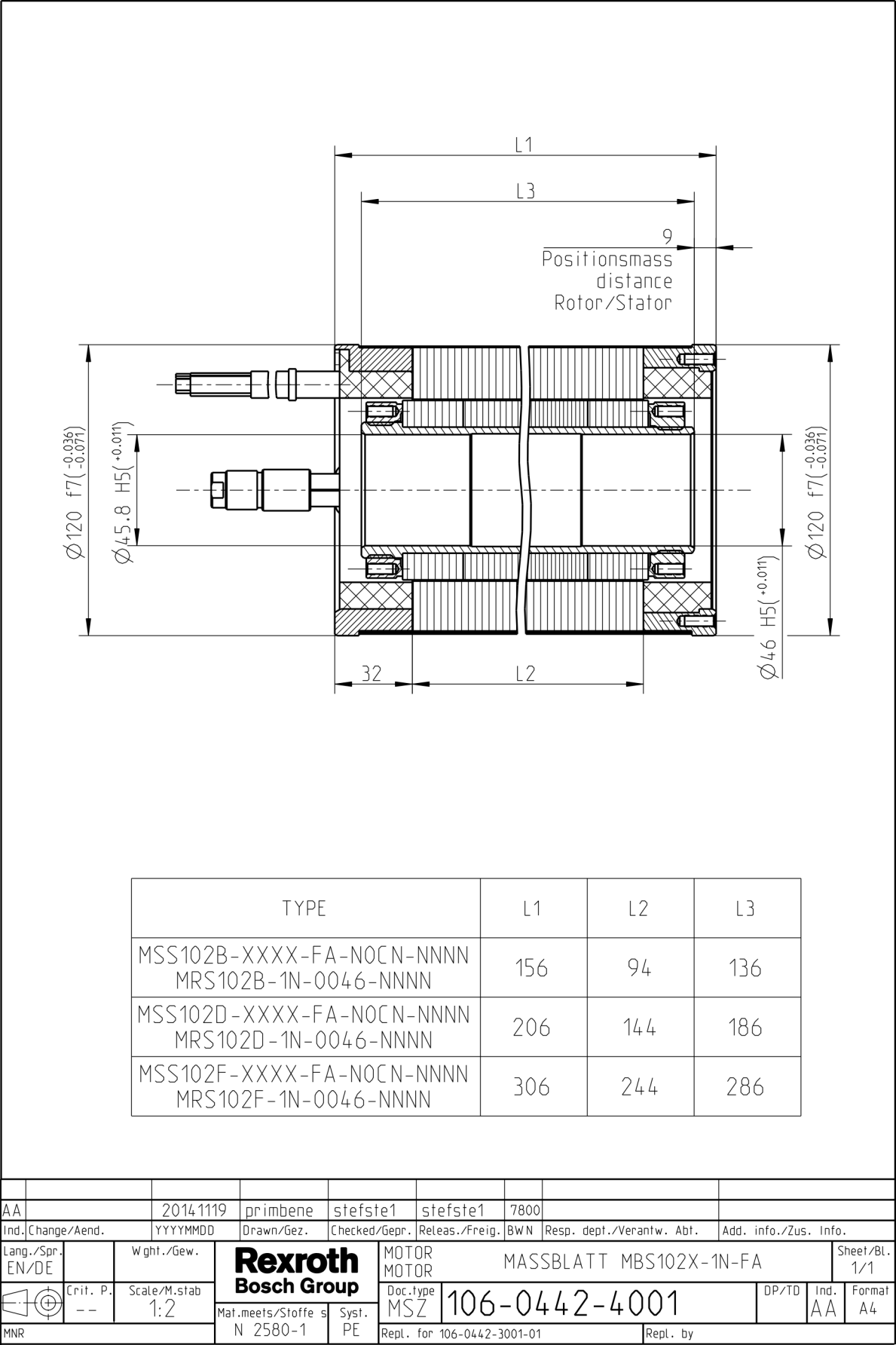
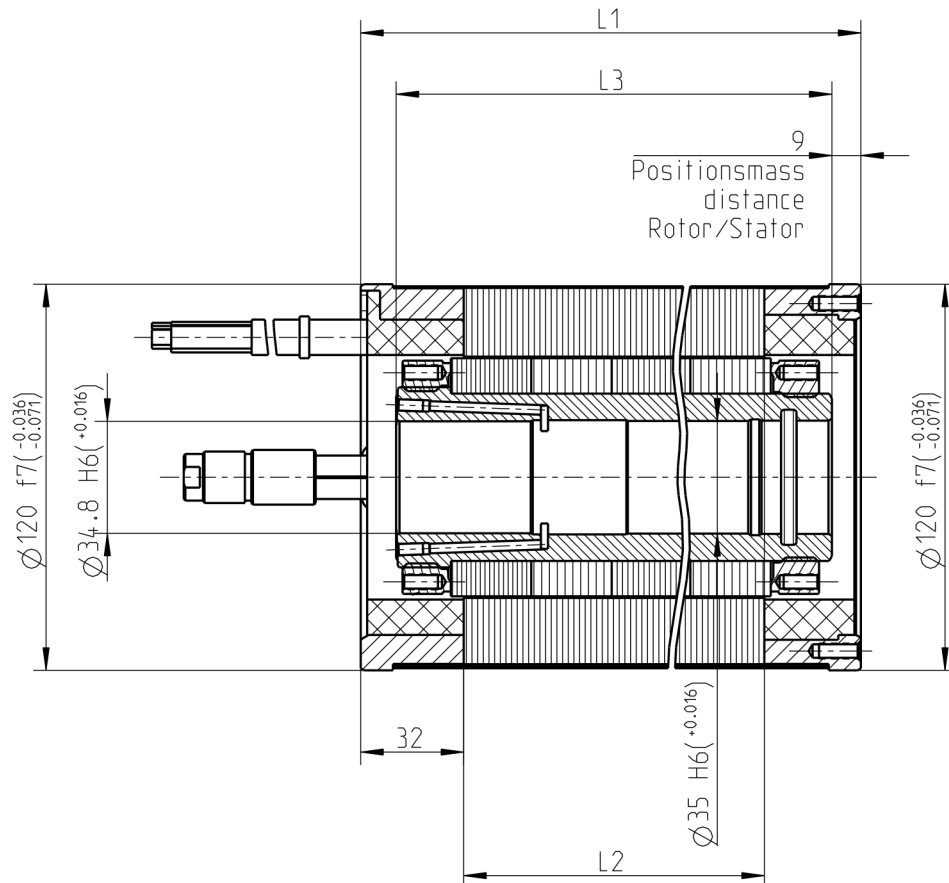


Fig. 50: MBS102 with coolant connection axial and rotor frame size “1N”
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4.2.2 MBS102 with rotor frame size “2N”



TYPE	L1	L2	L3
MSS102B-XXXX-FA-NOCN-NNNN MRS102B-2N-0035-NNNN	156	94	136
MSS102D-XXXX-FA-NOCN-NNNN MRS102D-2N-0035-NNNN	206	144	186
MSS102F-XXXX-FA-NOCN-NNNN MRS102F-2N-0035-NNNN	306	244	286

[illegible]

Fig. 51: MBS102 with coolant connection axial and rotor frame size “2N”

4.2.3 **MSS102 with coolant connection “FA”**

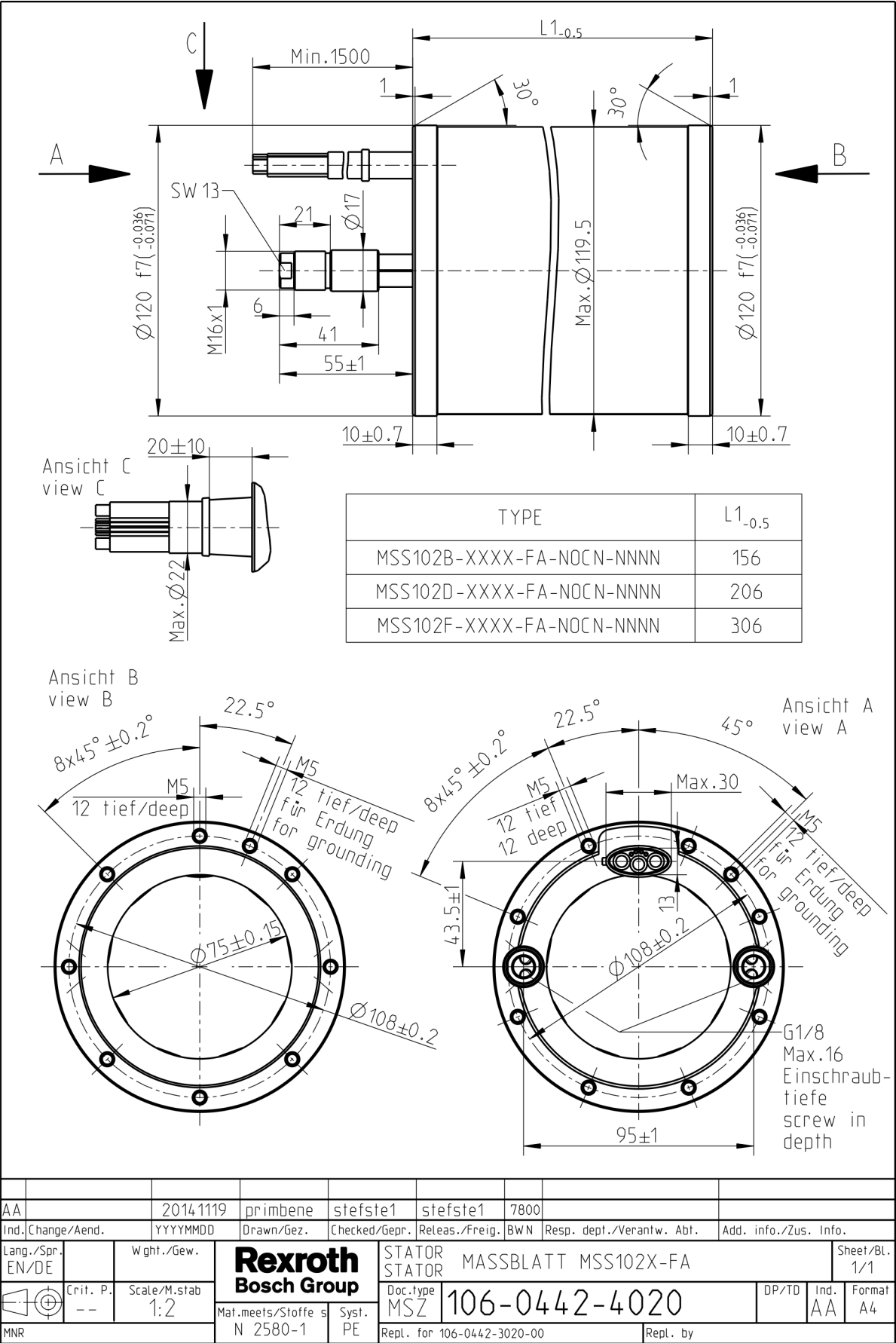


Fig. 52: MSS102 with coolant connection axial

4.2.4 MSS102 with coolant connection “FA”, mounted

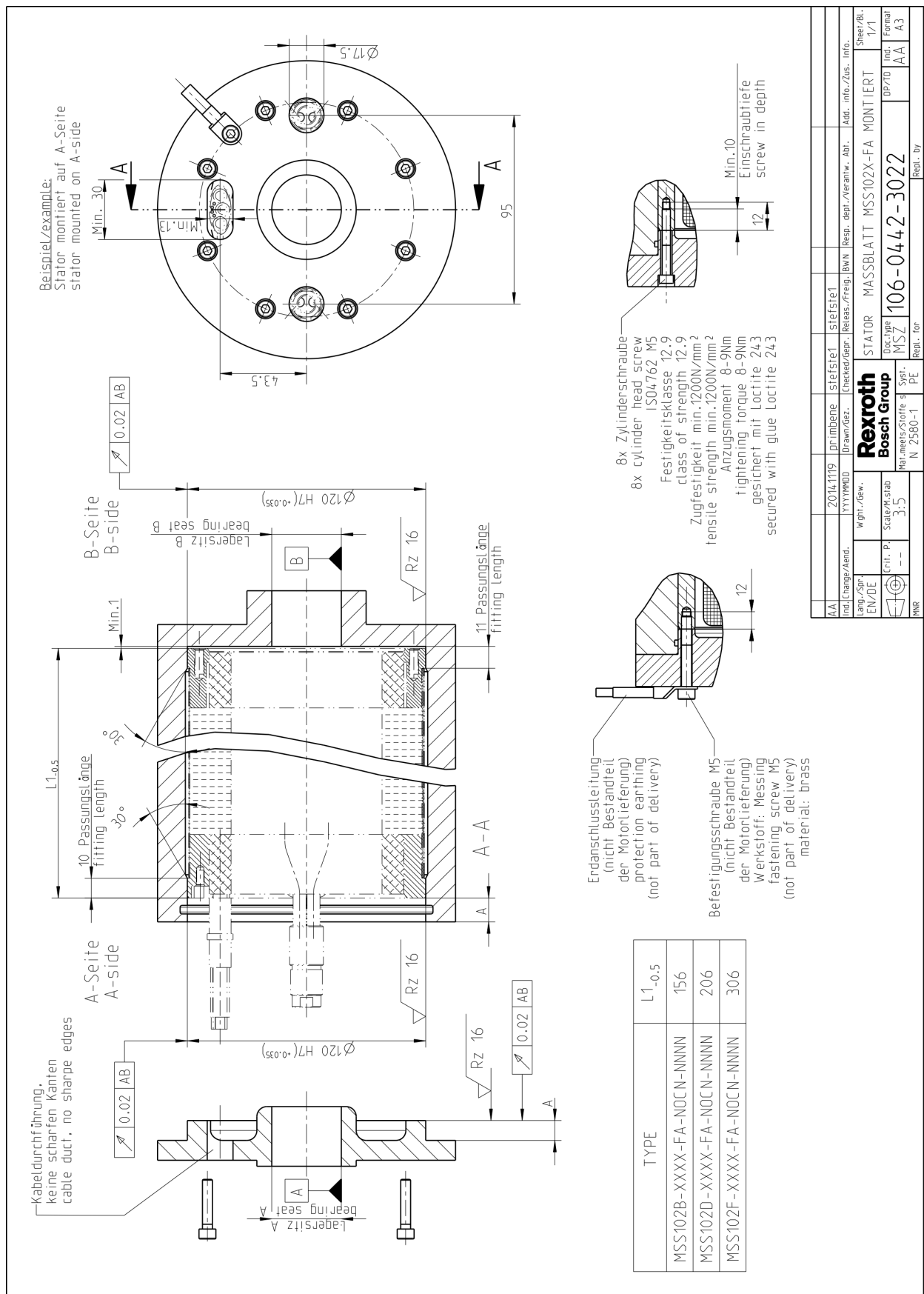


Fig. 53: MSS102 with coolant connection axial, mounted

4.2.5 MRS102 in frame size “1N” (smooth hole)

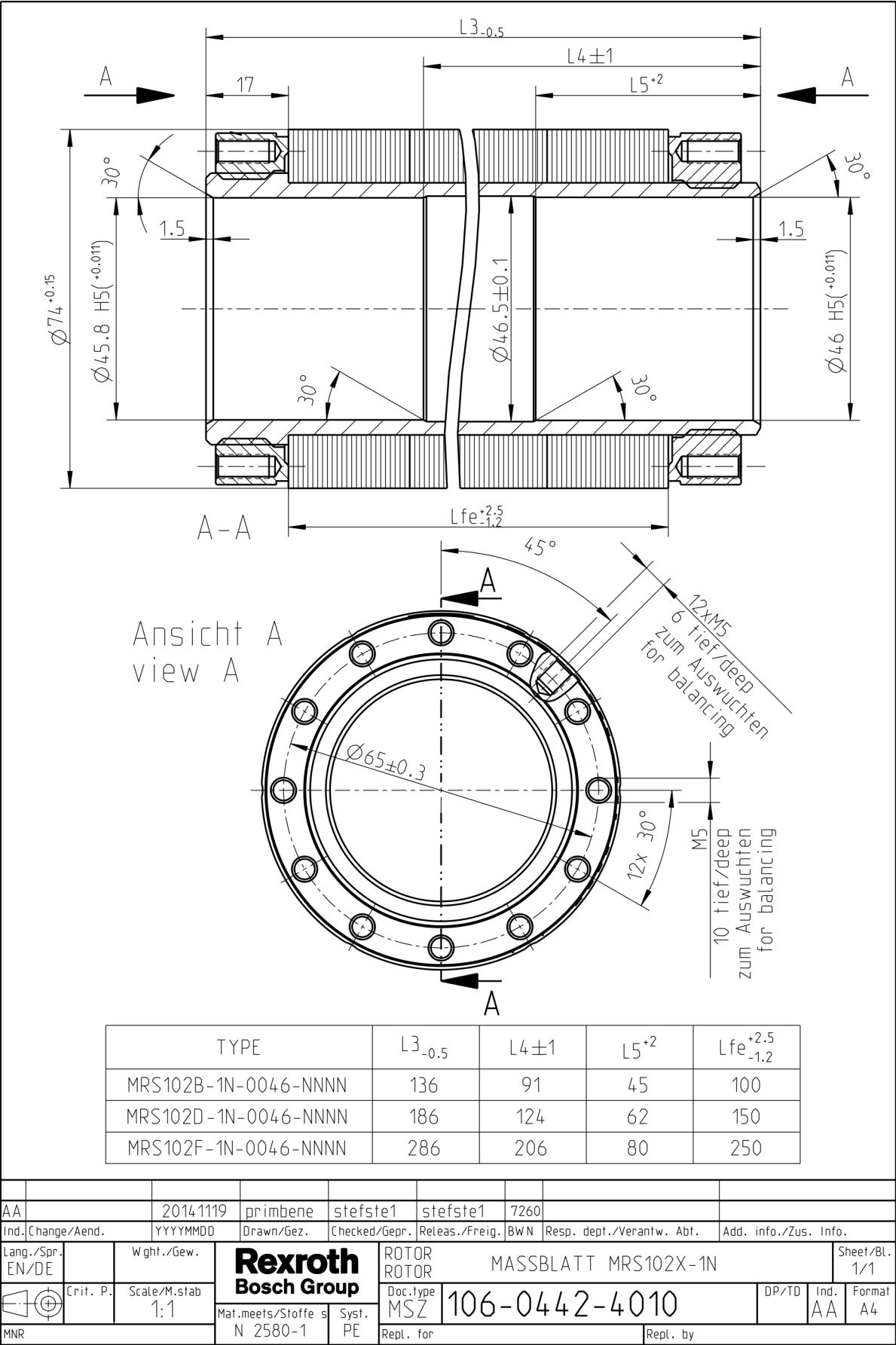


Fig. 54: MRS102 in frame size “1N”

4.2.6 MRS102 in frame size “1N”, mounted

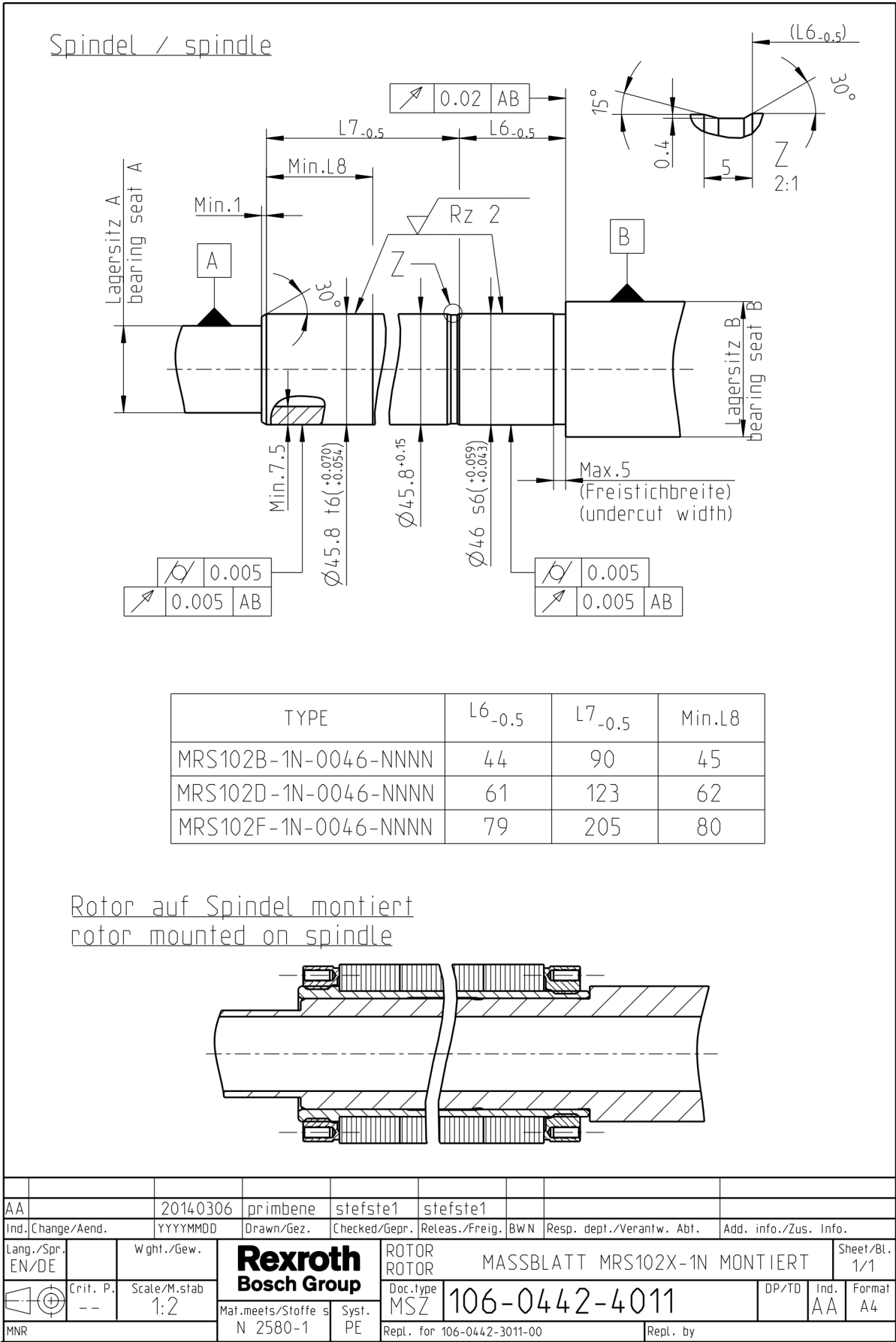


Fig. 55: MRS102 in frame size “1N”, mounted

4.2.7 MRS102 in frame size "2N" (step interference fit)

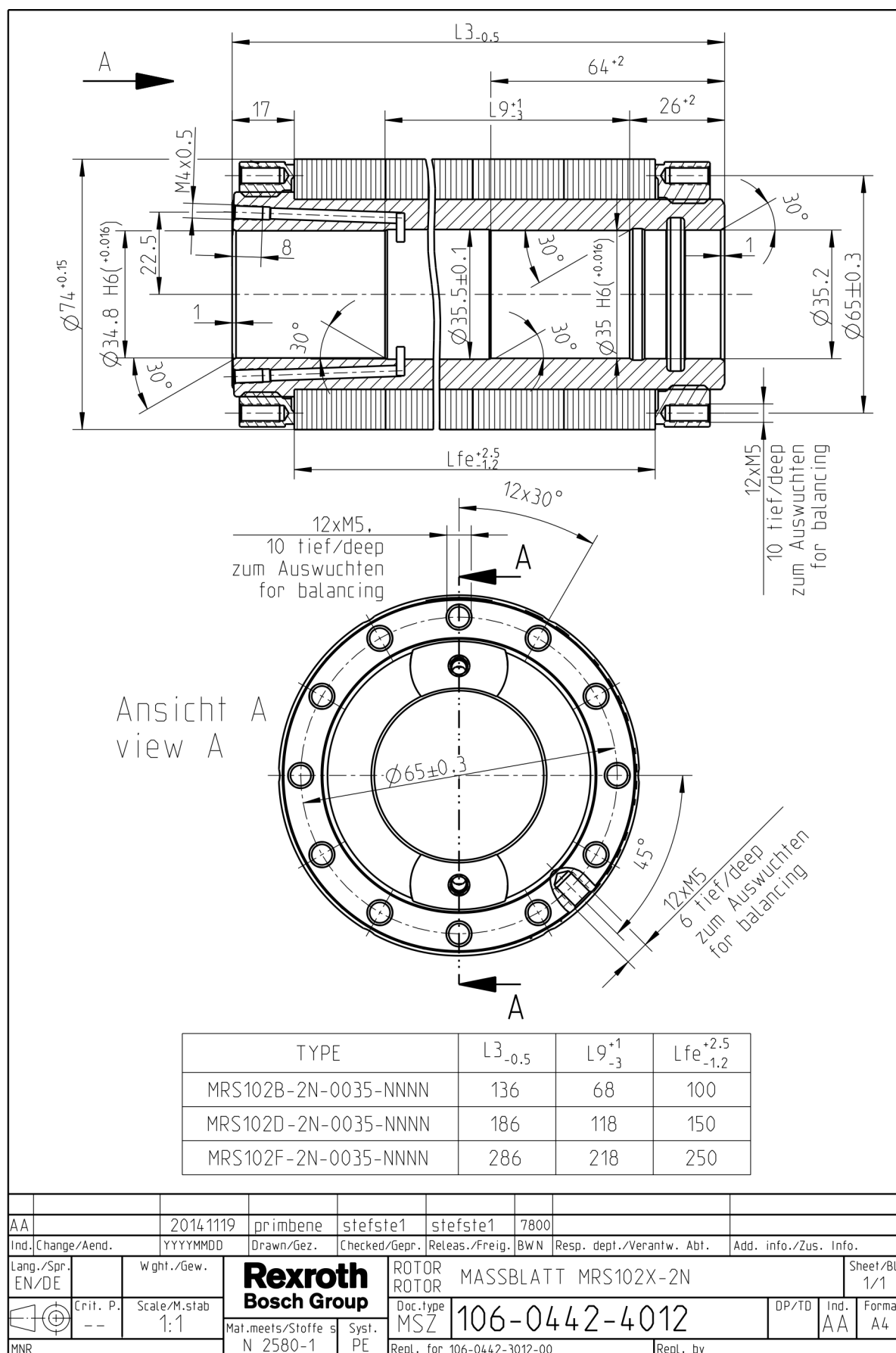


Fig. 56: MRS102 in frame size "2N"

4.2.8 MRS102 in frame size "2N", mounted

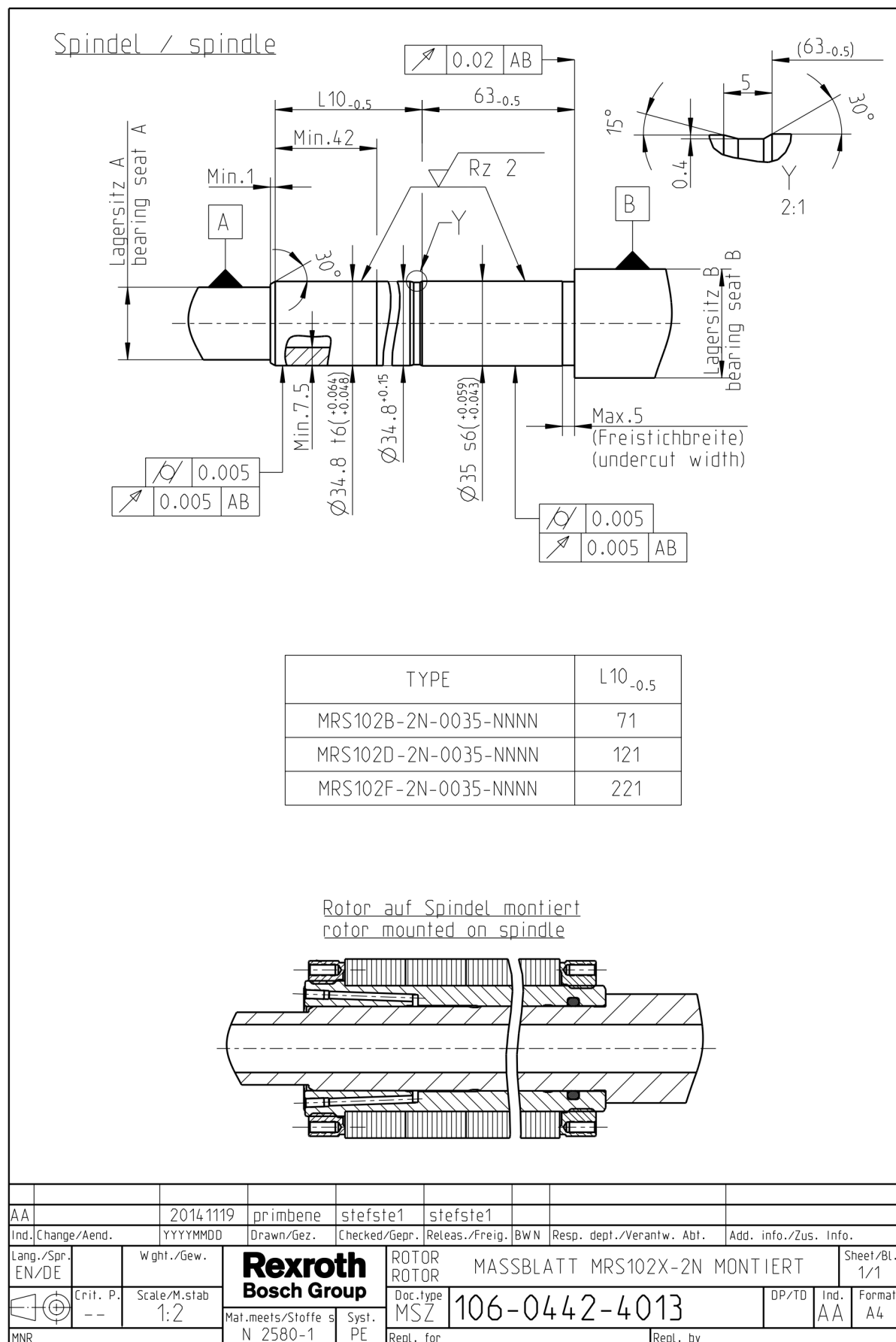
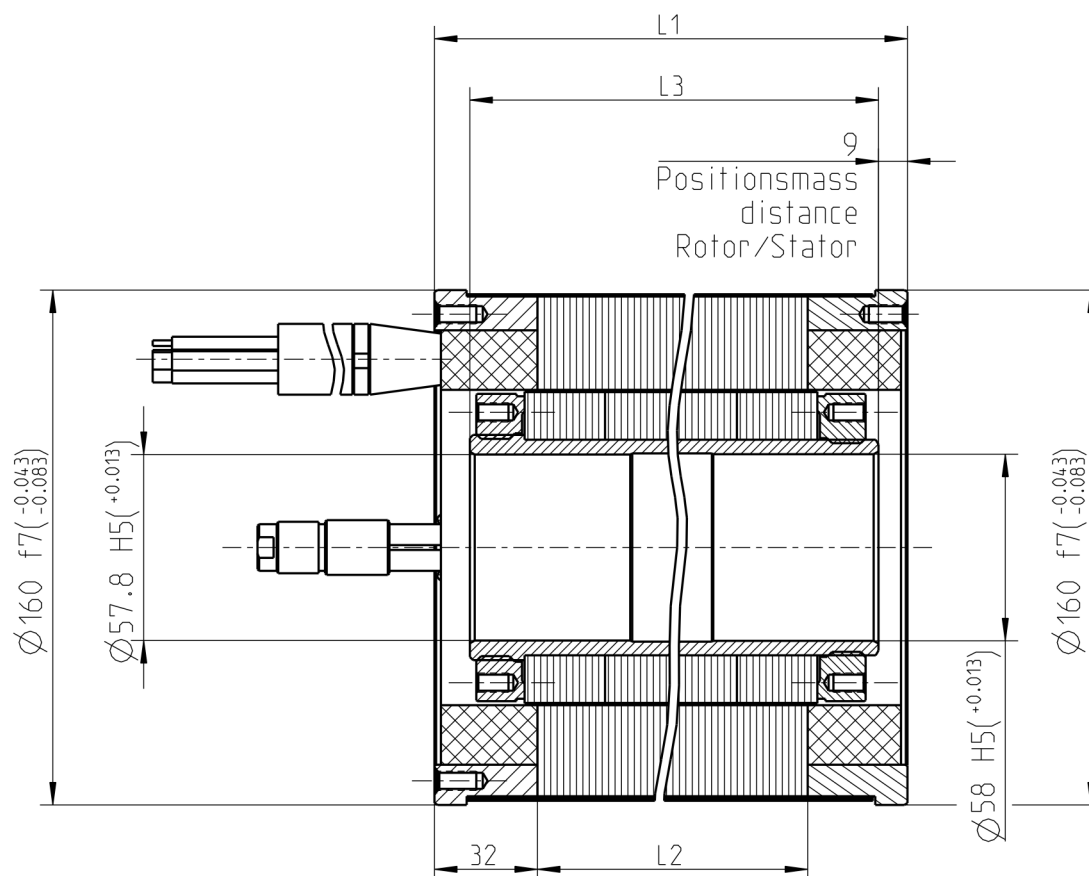


Fig. 57: MRS102 in frame size "2N", mounted

4.3 Frame size 142

4.3.1 MBS142 with rotor frame size "1N"



TYPE	L1	L2	L3
MSS142B-XXXX-FA-NOCN-NNNN MRS142B-1N-0058-NNNN	181	118	161
MSS142D-XXXX-FA-NOCN-NNNN MRS142D-1N-0058-NNNN	231	168	211
MSS142F-XXXX-FA-NOCN-NNNN MRS142F-1N-0058-NNNN	281	218	261

A		20141126	primbene	stefste1	stefste1	7260		
d./Change/Aend.		YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt. Add. info./Zus. Info.	
ng./Spr. N/DE		Wght./Gew.	Rexroth Bosch Group	MOTOR MOTOR	MASSBLATT MBS142X-1N-FA			Sheet/Bl. 1/1
	Crit. P. --	Scale/M.stab 1:2		Doc.type MSZ	106-0443-4001	DP/TD	Ind. AA	Forma A4
NR				Mat.meets/Stoffe s N 2580-1	Syst. PE	Repl. for 106-0443-3001-01		

Fig. 58: MBS142 with coolant connection and rotor frame size "1N"

4.3.2 MBS142 with rotor frame size "2N"

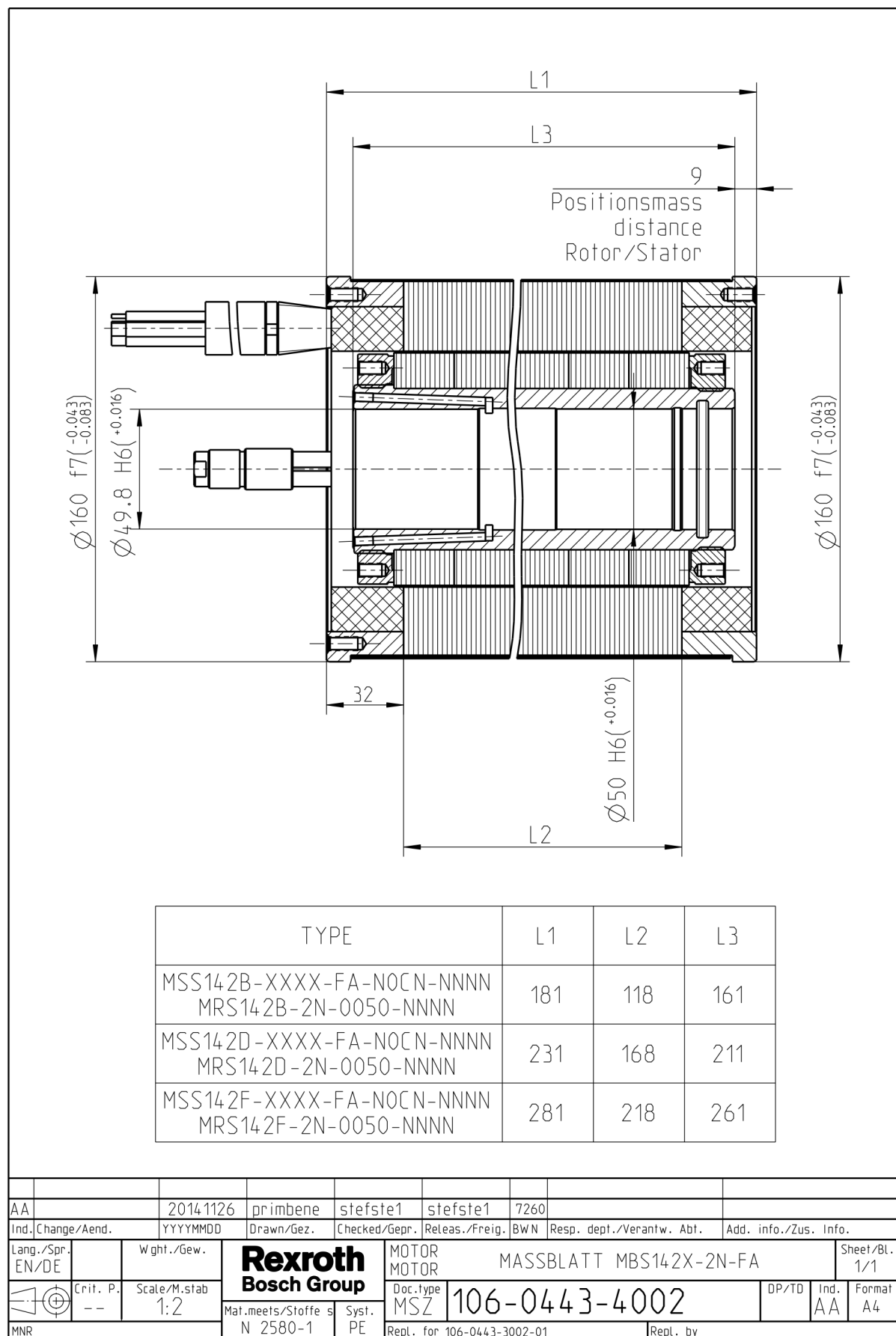


Fig. 59: MBS142 with coolant connection axial and rotor frame size "2N"

4.3.3 MSS142 with coolant connection "FA"

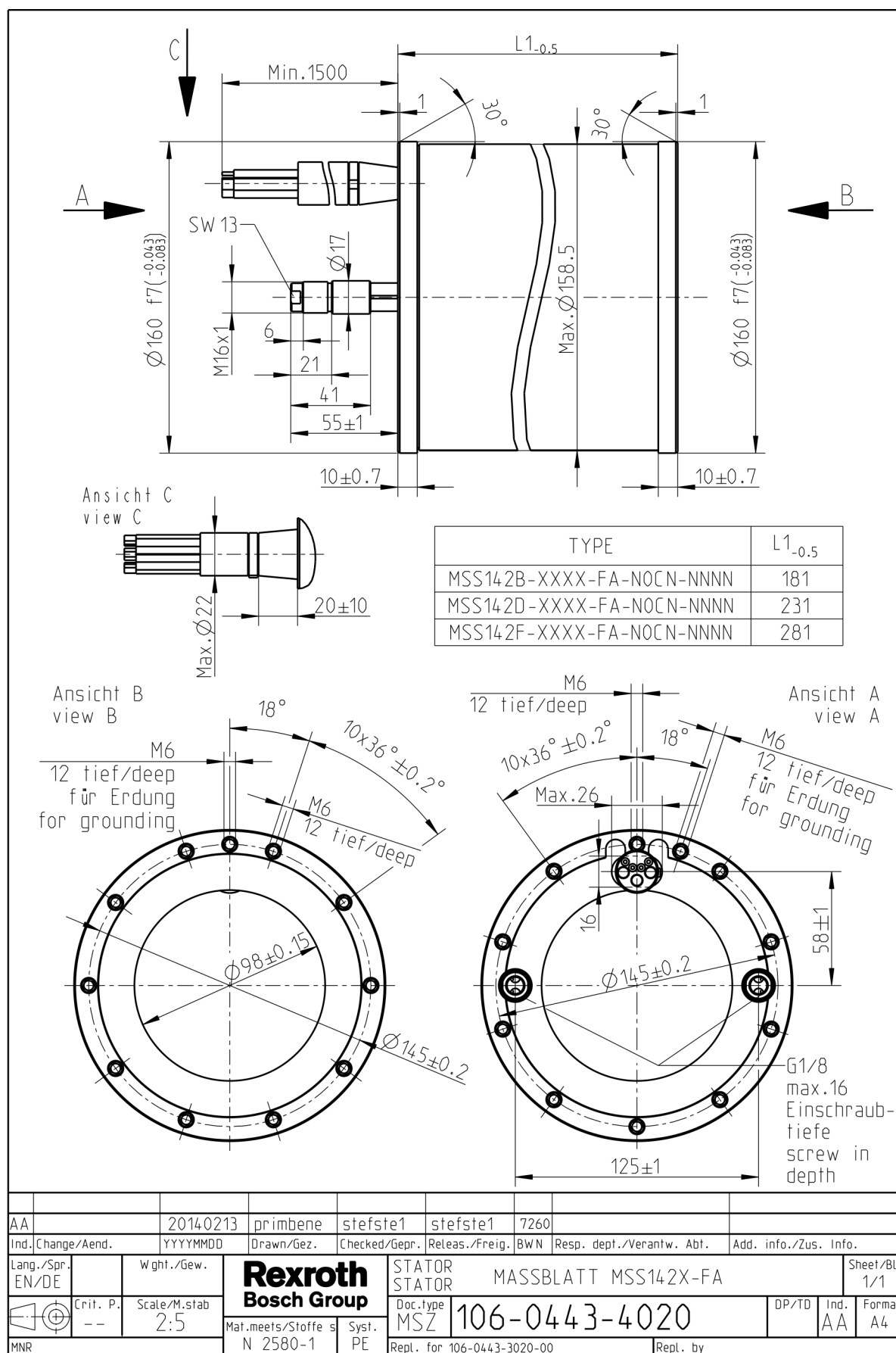


Fig. 60: MSS142 with coolant connection axial

4.3.4 MSS142 with coolant connection “FA”, mounted

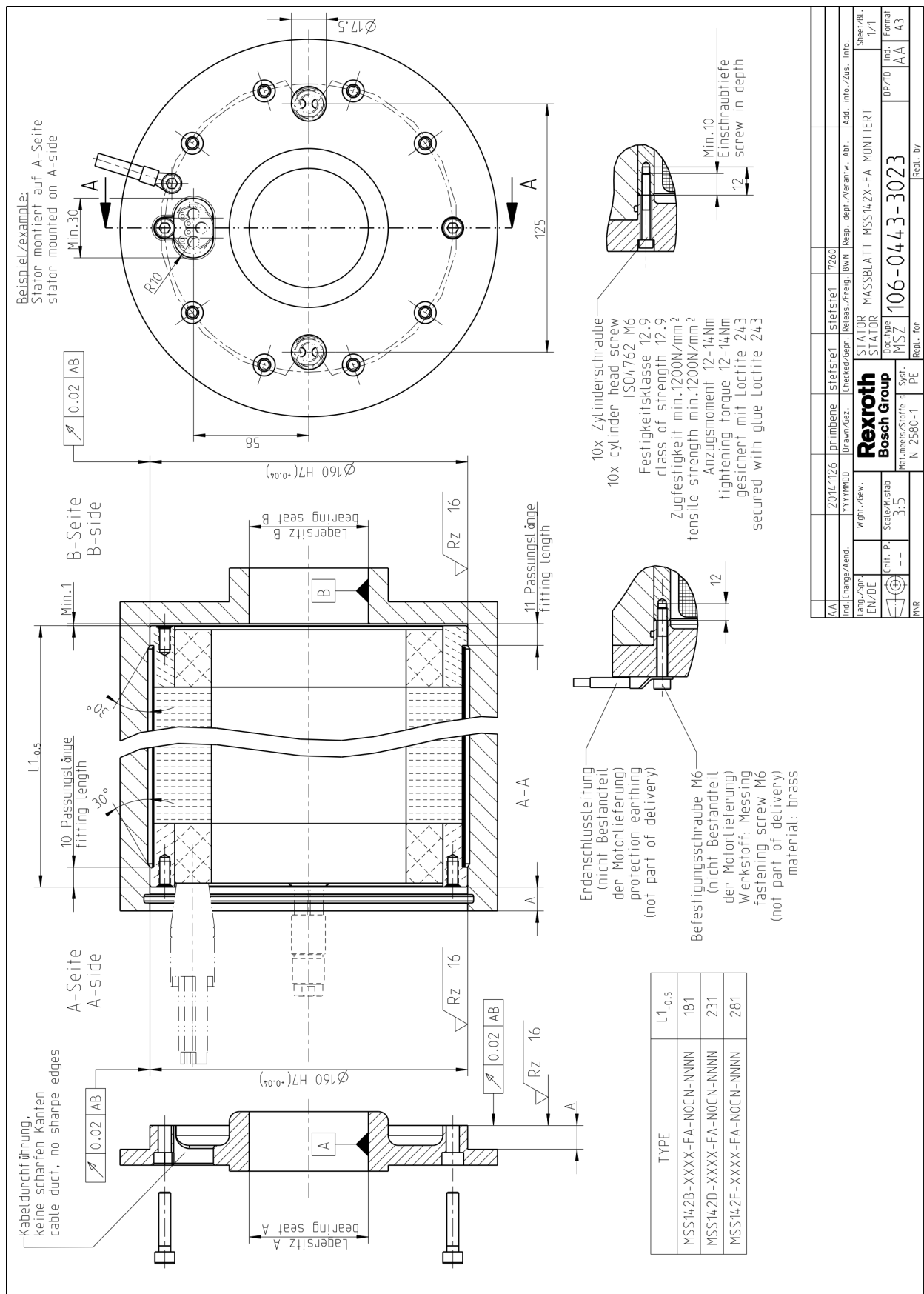


Fig. 61: MSS142 with coolant connection axial, mounted

4.3.5 MRS142 in frame size "1N" (smooth hole)

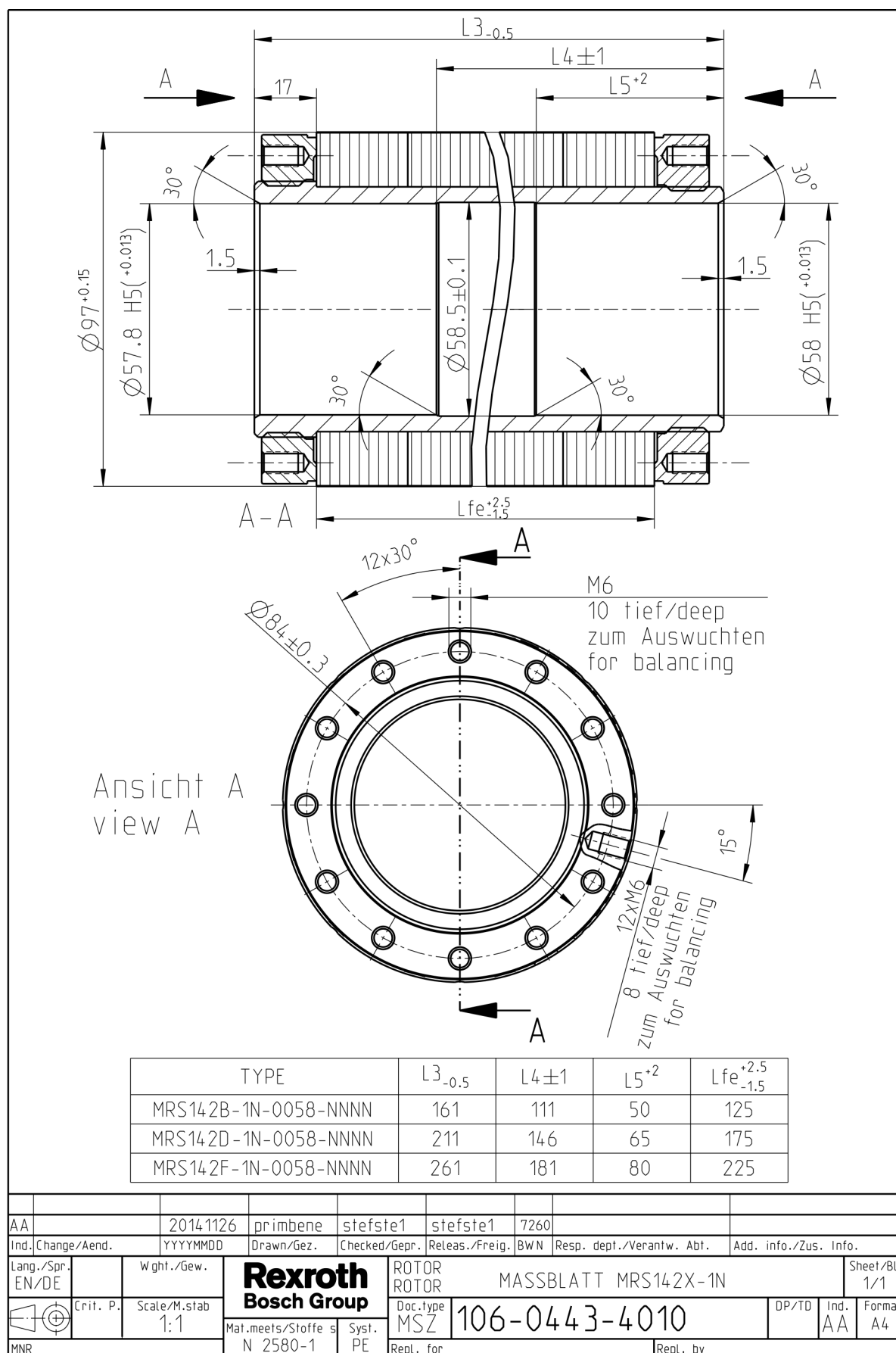


Fig. 62: MRS142 in frame size "1N"

4.3.6 MRS142 in frame size "1N", mounted

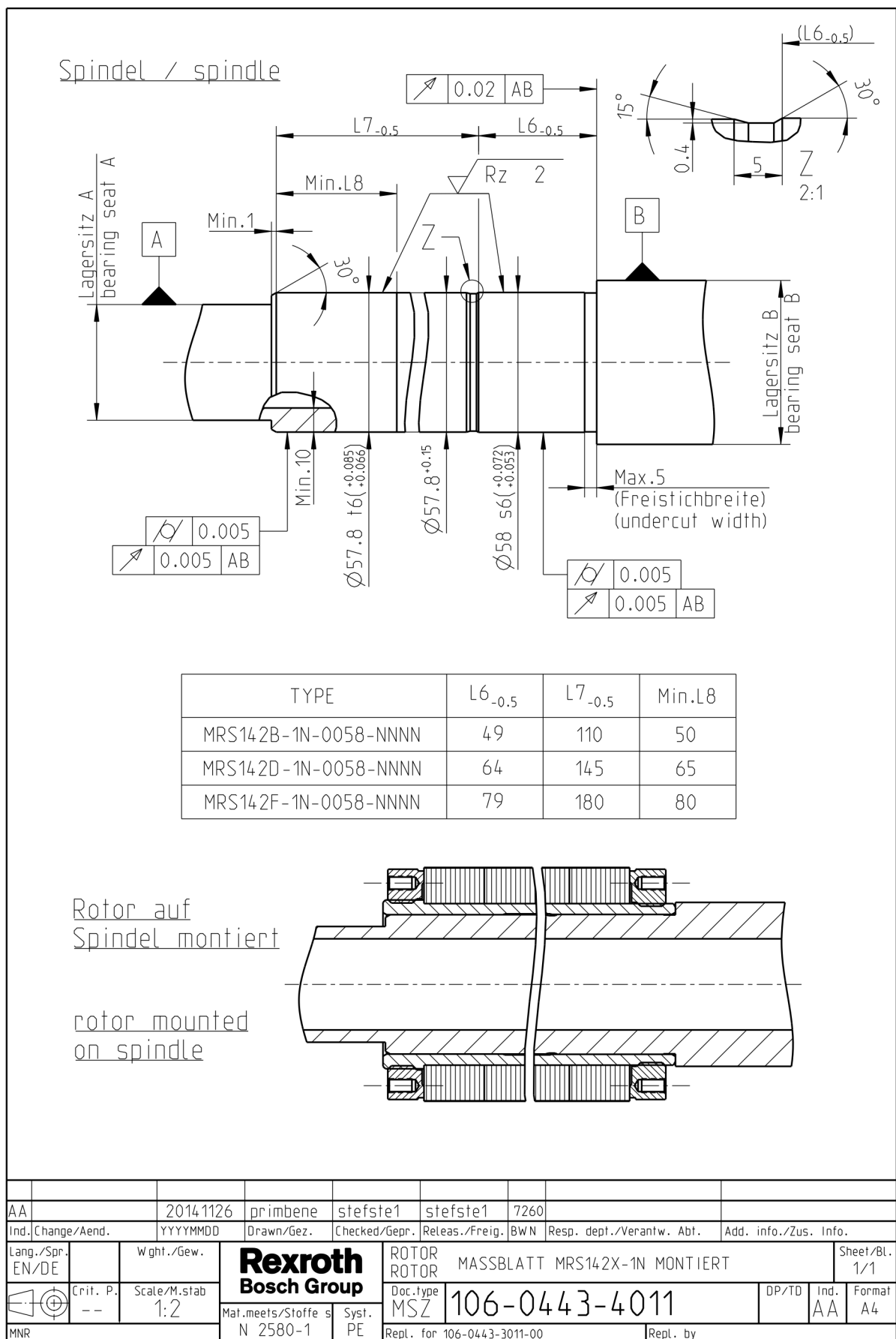


Fig. 63: MRS142 in frame size "1N", mounted

4.3.7 MRS142 in frame size "2N" (step interference fit)

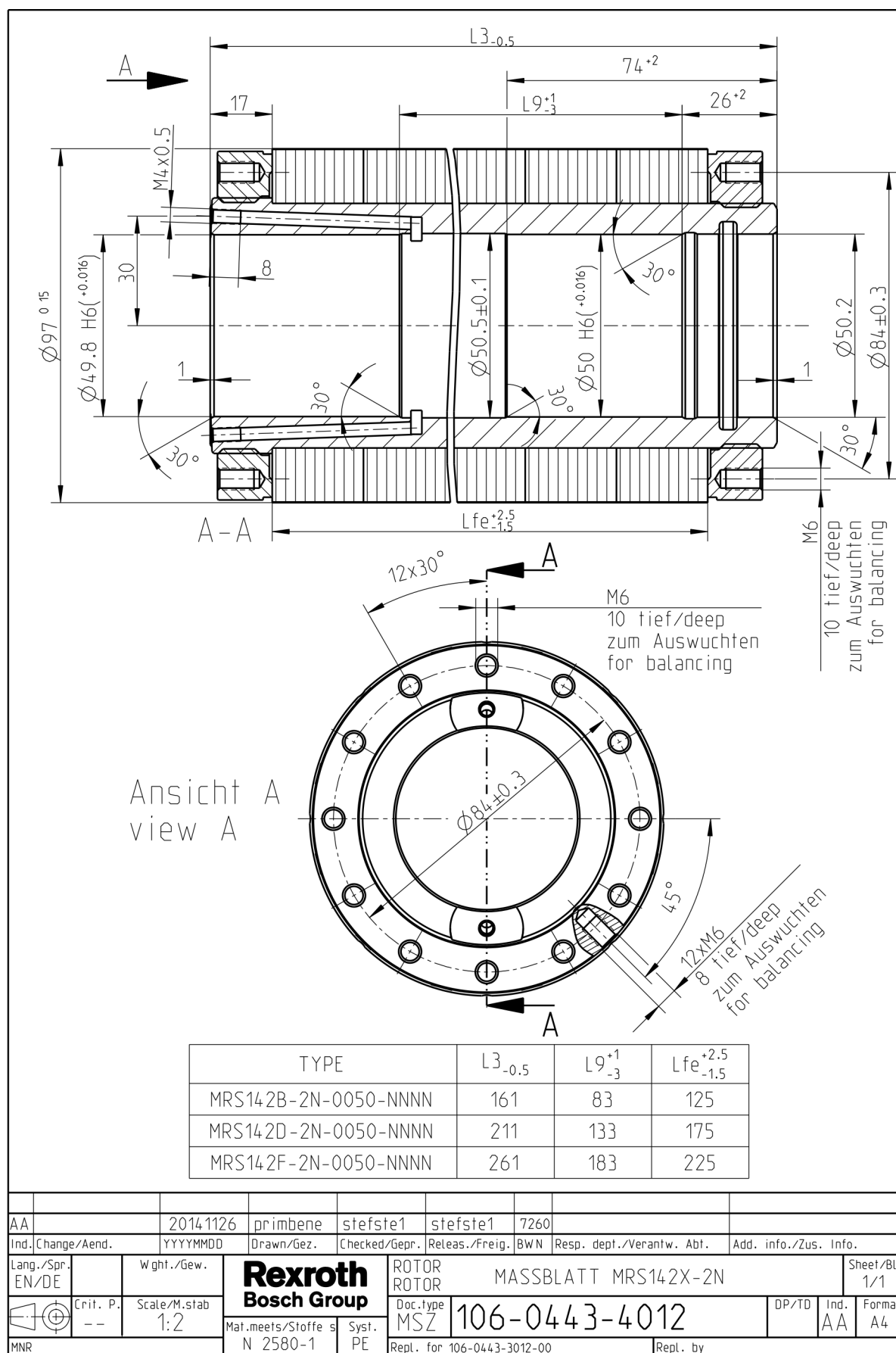


Fig. 64: MRS142 in frame size "2N"

4.3.8 MRS142 in frame size "2N", mounted

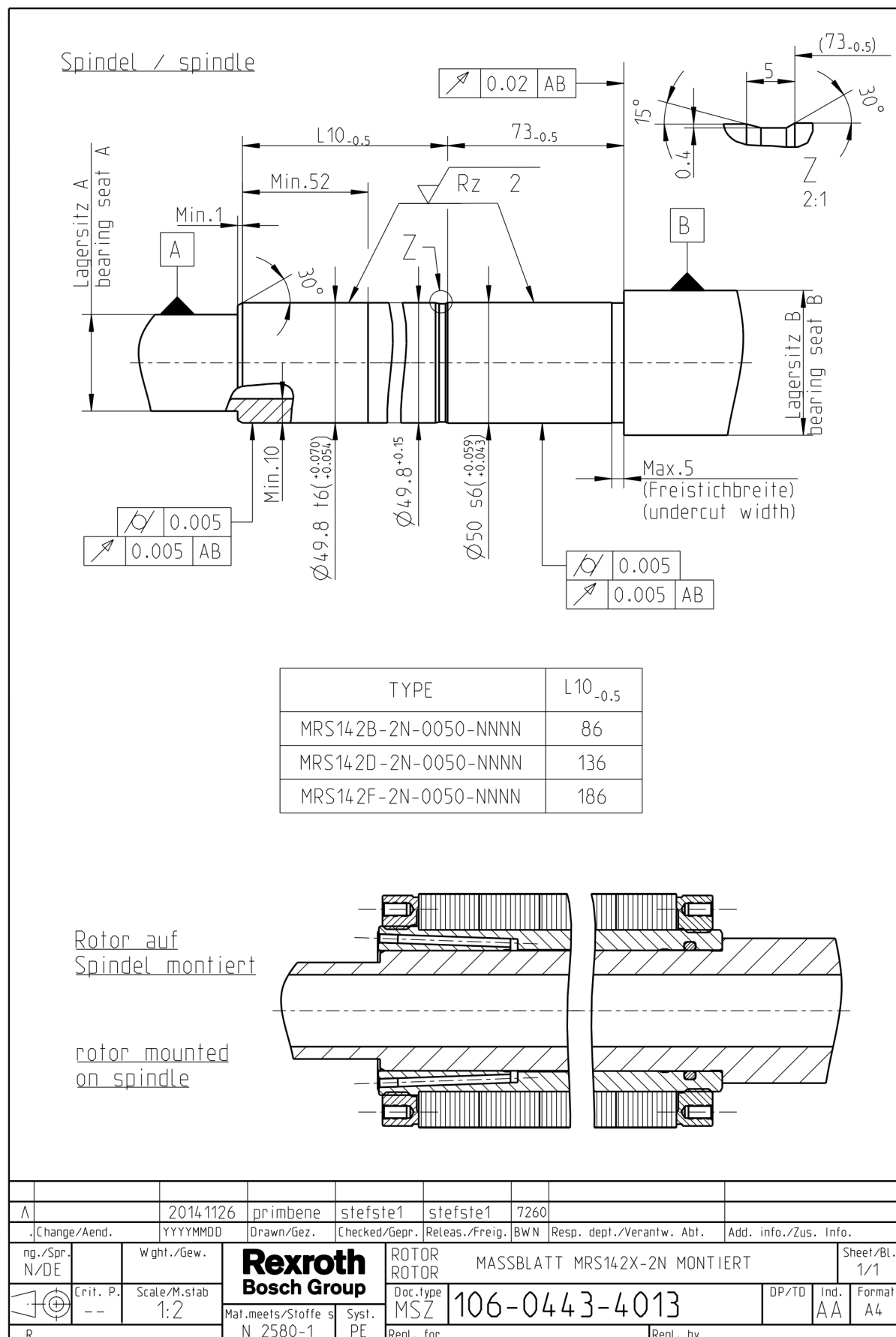
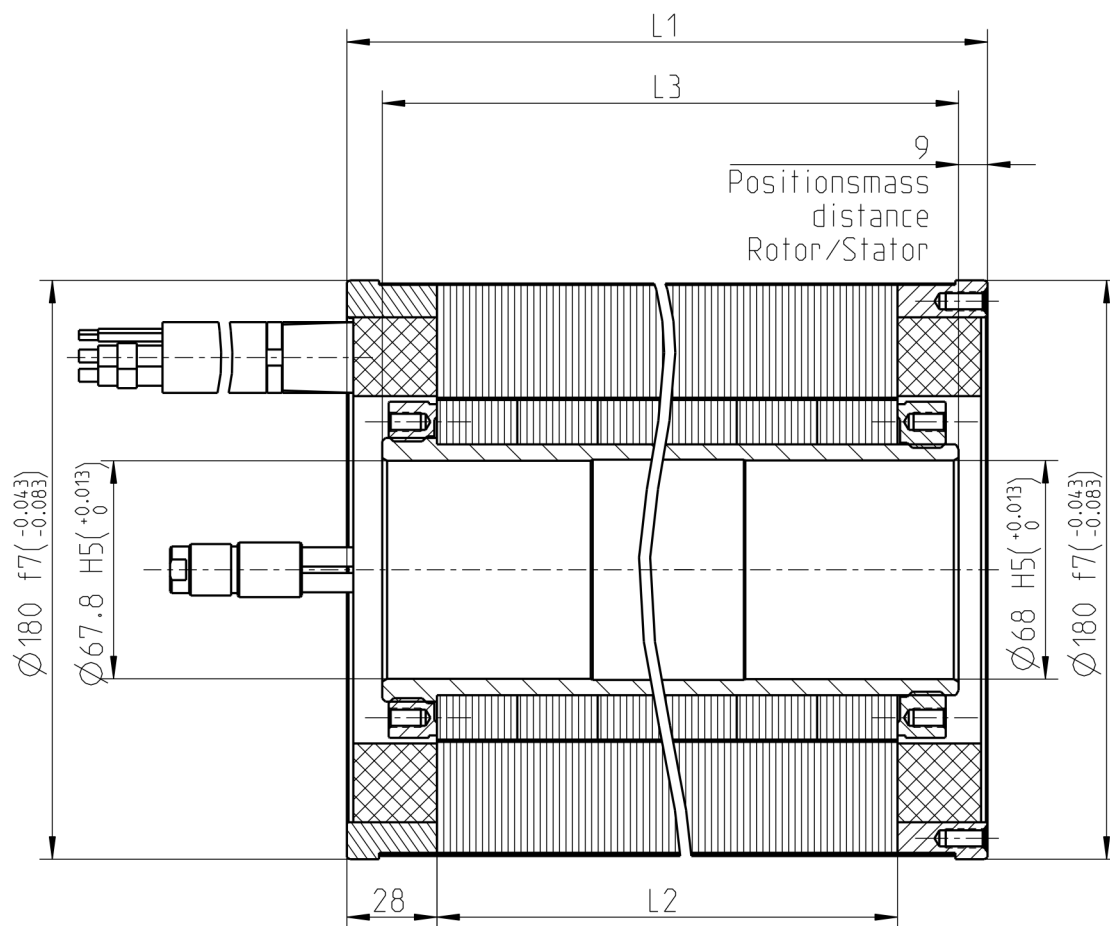


Fig. 65: MRS142 in frame size "2N", mounted

4.4 Frame size 162

4.4.1 MBS162 with rotor frame size "1N"



TYPE	L1	L2	L3
MSS162B-XXXX-FX-NOCN-NNNN MRS162B-1N-0068-NNNN	206	150	186
MSS162D-XXXX-FX-NOCN-NNNN MRS162D-1N-0068-NNNN	256	200	236
MSS162F-XXXX-FX-NOCN-NNNN MRS162F-1N-0068-NNNN	306	250	286
MSS162J-XXXX-FX-NOCN-NNNN MRS162J-1N-0068-NNNN	381	325	361

A	20141127	primbene	stefste1	stefste1	7800		
d./Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.
ng./Spr. N/DE		Wght./Gew.	Rexroth Bosch Group		MOTOR MOTOR		Sheet/Bl. 1/1
Crit. P.	Scale/M.stab 1:2	Mat.meets/Stoffe s N 2580-1	Syst. PE	Doc.type MSZ	106-0444-4001		DP/TD AA
R				Repl. for 106-0444-3001-05	Repl. by		Format A4

Fig. 66: Frame size 162 with rotor frame size "1N"
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4.4.2 MBS162 with rotor frame size "2N"

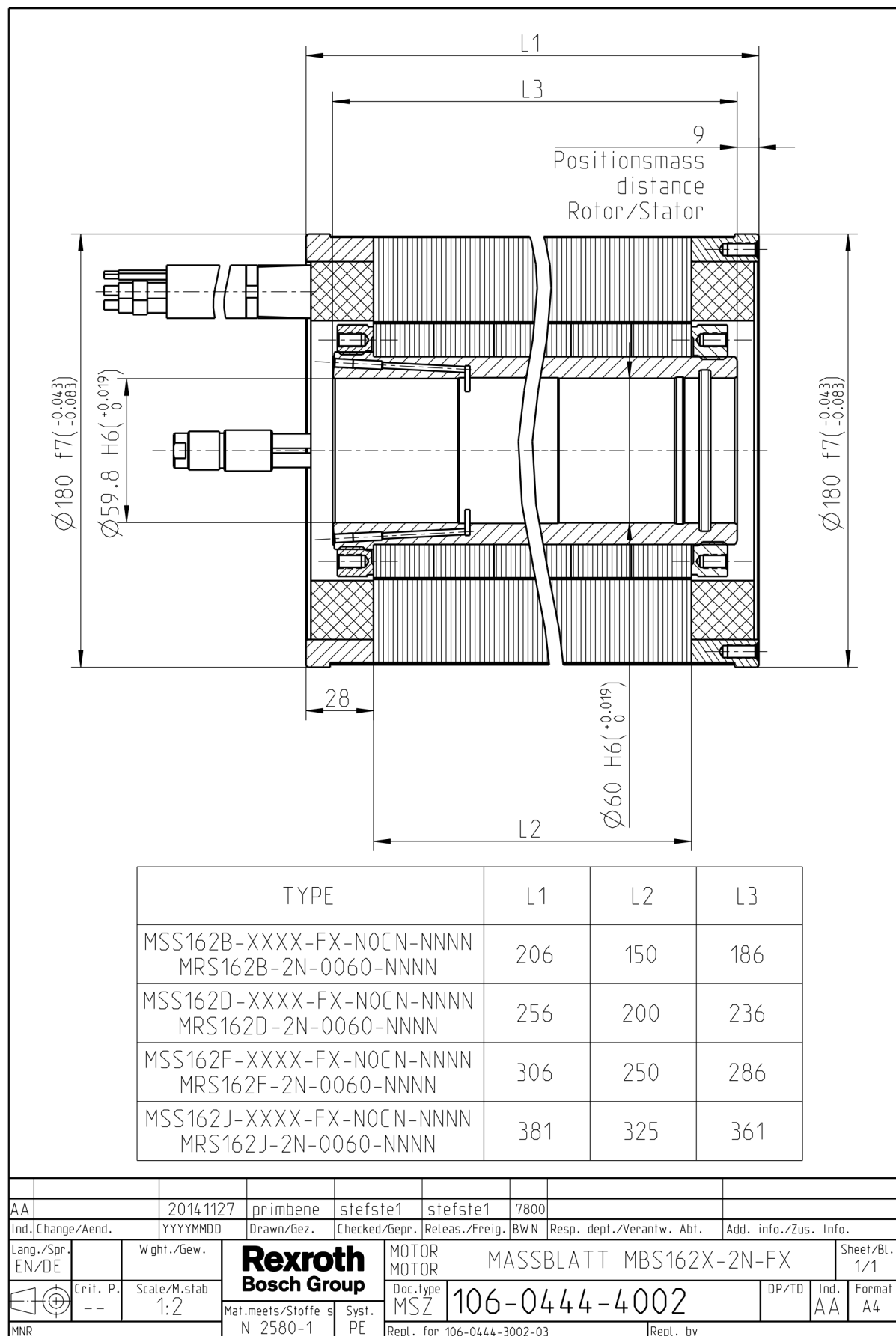


Fig. 67: Frame size 162 with rotor frame size "2N"

4.4.3 MSS162 with coolant connection “FA”

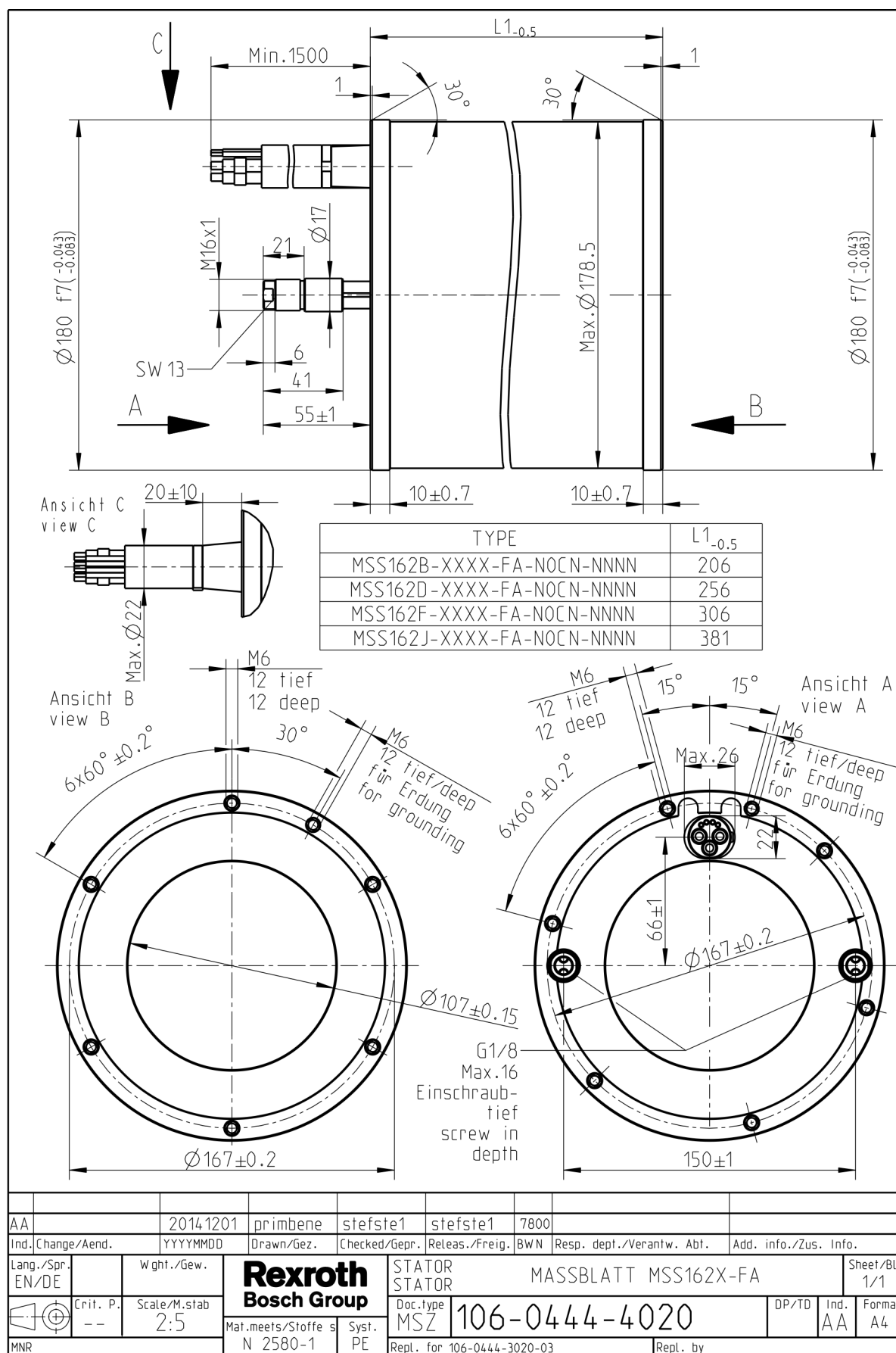


Fig. 68: MSS162 with coolant connection axial

4.4.4 MSS162 with coolant connection “FA”, mounted

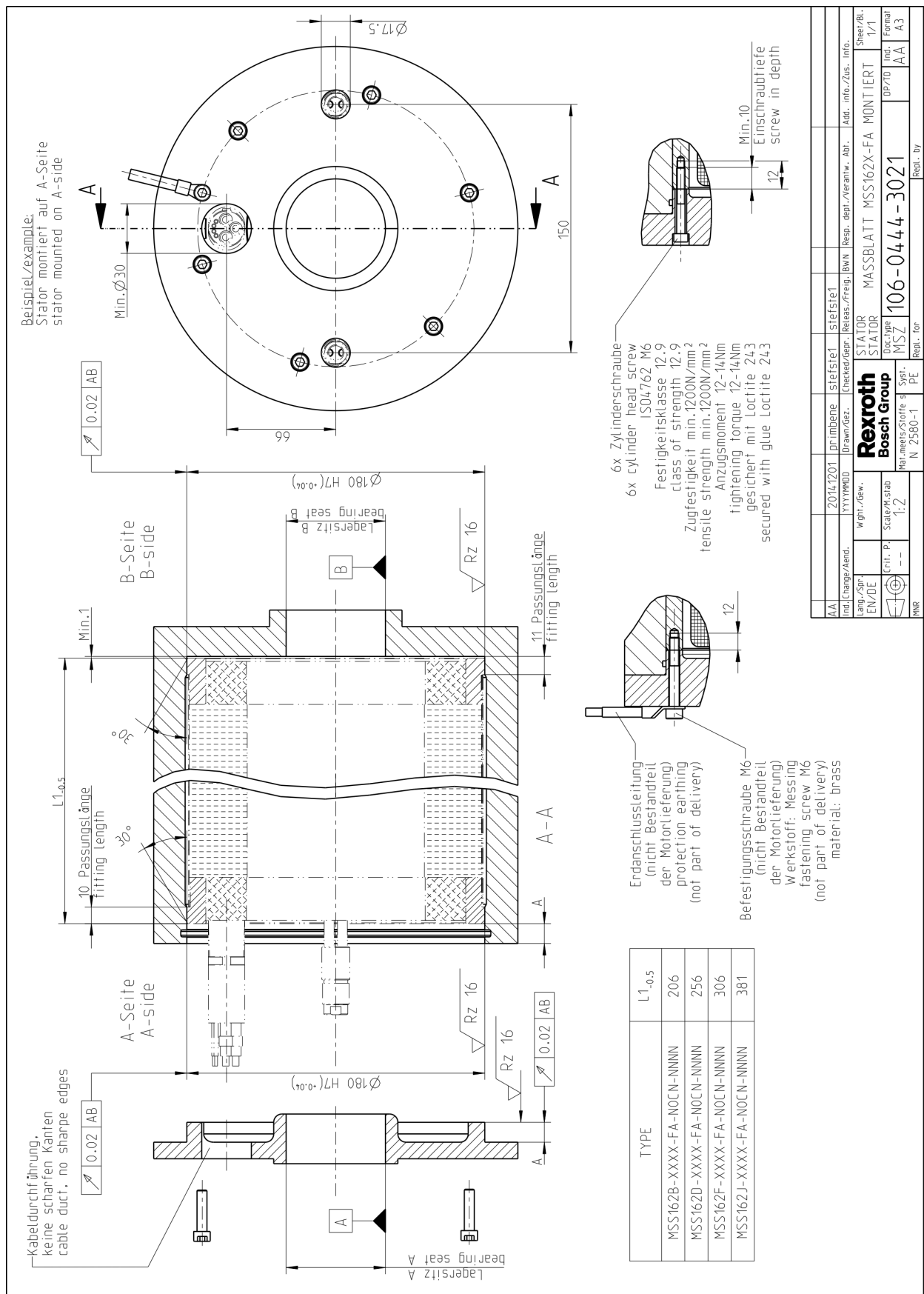


Fig. 69: MSS162 with coolant connection axial, mounted

4.4.5 MSS162 with coolant connection “FR”

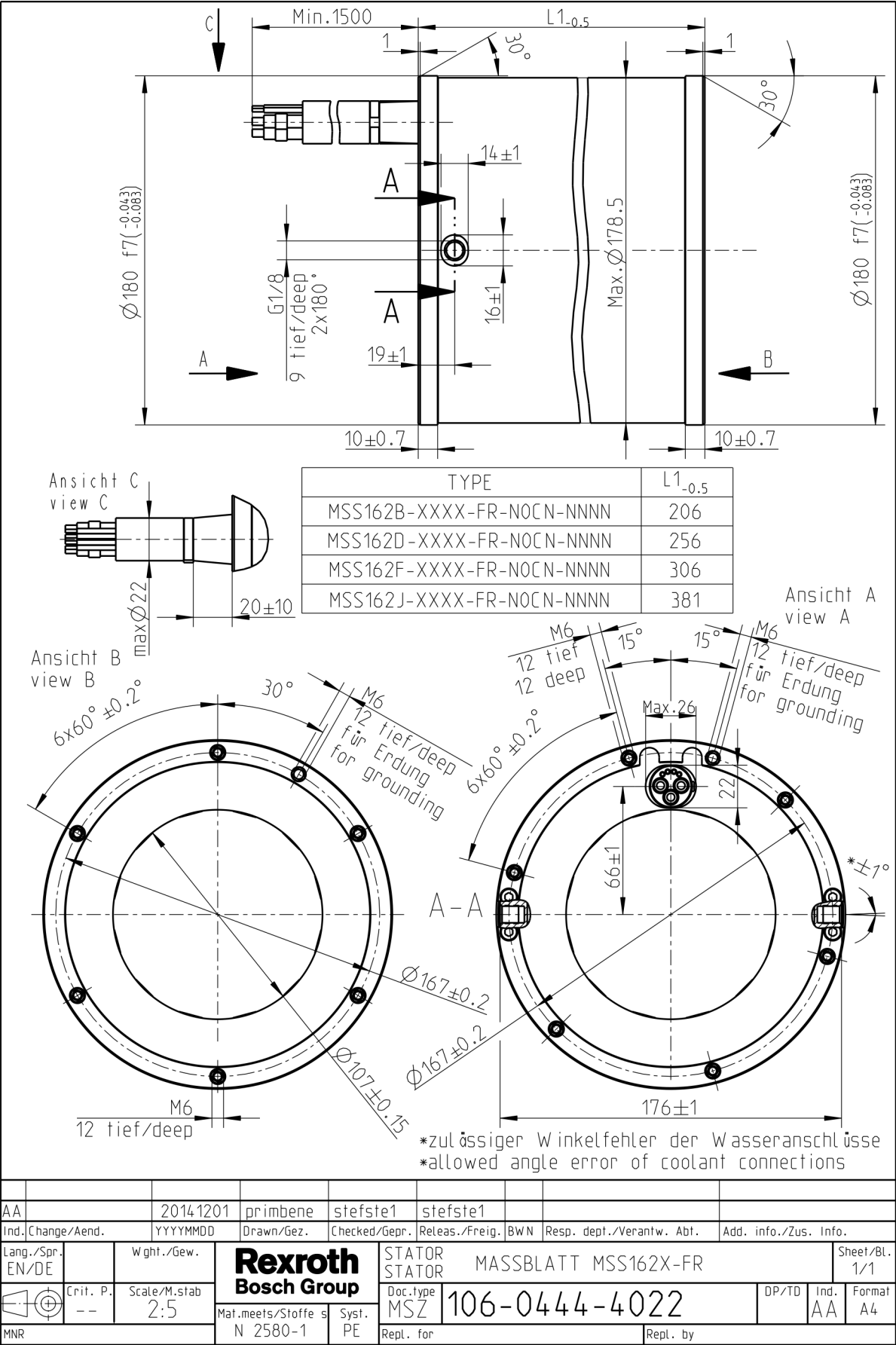


Fig. 70: MSS162 with coolant connection radial

4.4.6 MSS162 with coolant connection “FR”, mounted

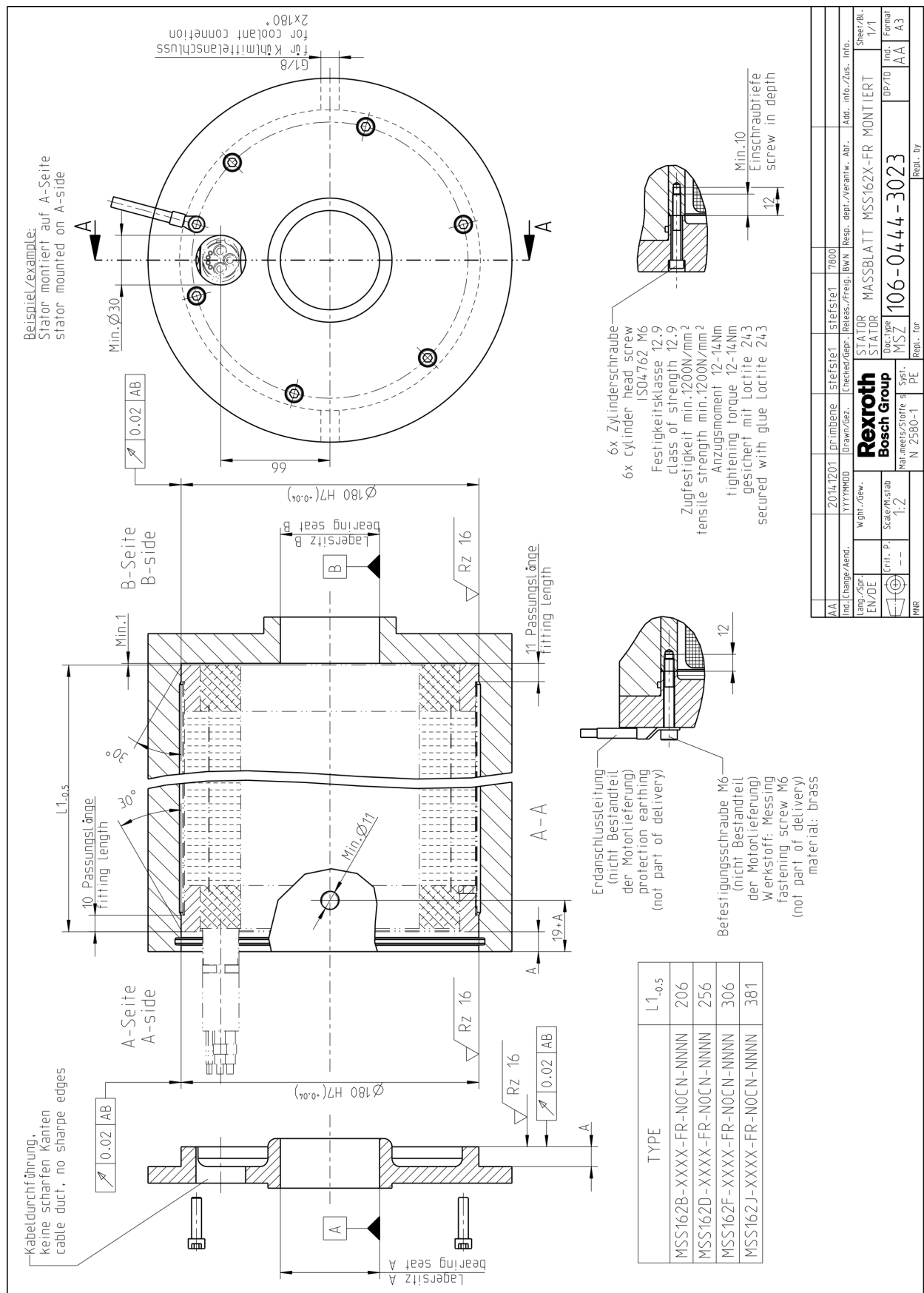
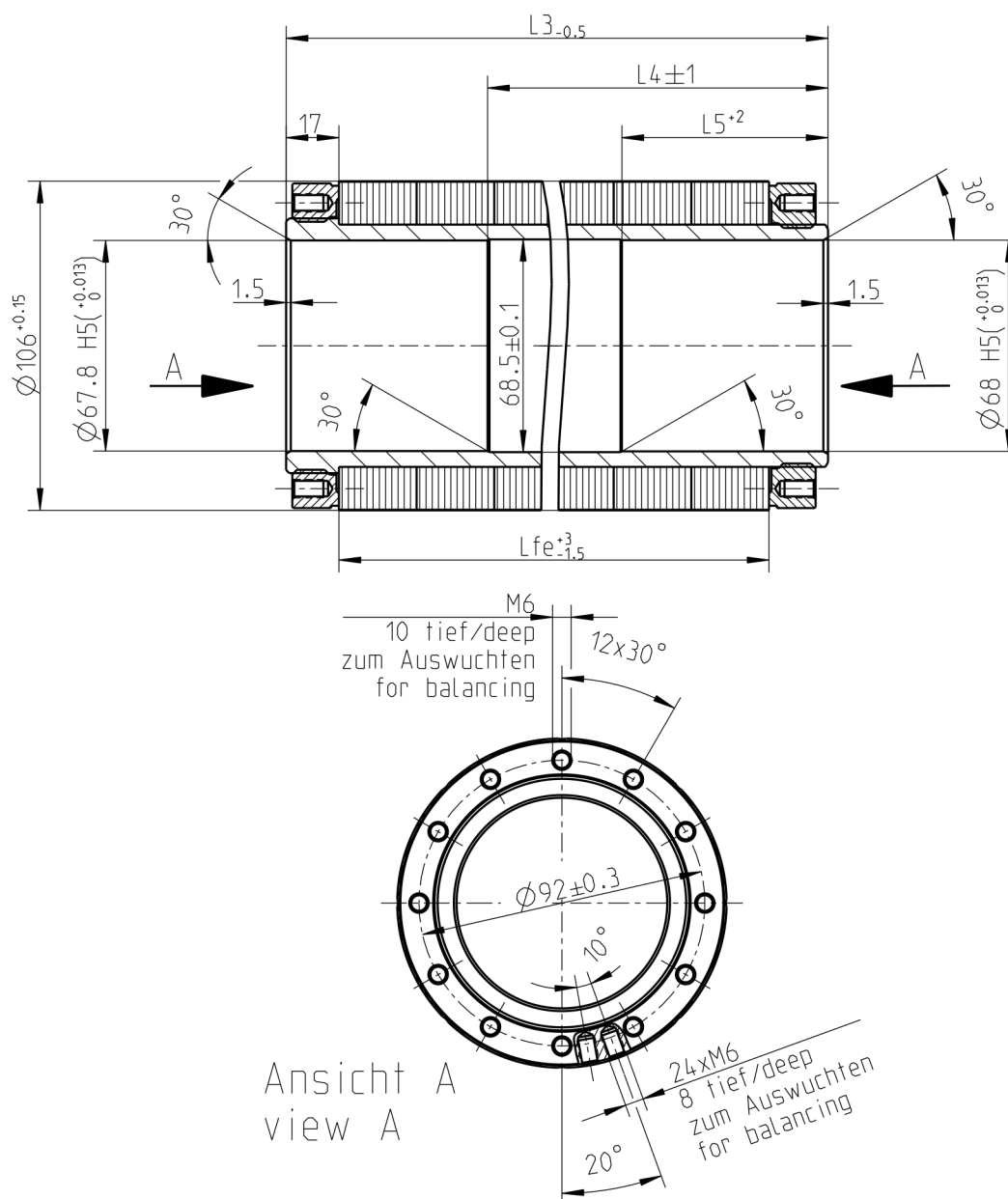


Fig. 71: MSS162 with coolant connection radial, mounted

4.4.7 MRS162 in frame size “1N” (smooth hole)



TYPE	L3 _{-0.5}	L4 $\pm$ 1	L5 ⁺²	LFe _{-1.5} ⁺³
MRS162B-1N-0068-NNNN	186	121	65	150
MRS162D-1N-0068-NNNN	236	156	80	200
MRS162F-1N-0068-NNNN	286	196	90	250
MRS162J-1N-0068-NNNN	361	251	110	325

[illegible]

Fig. 72: MRS162 in frame size “1N” (smooth hole)

4.4.8 MRS162 in frame size “1N”, mounted

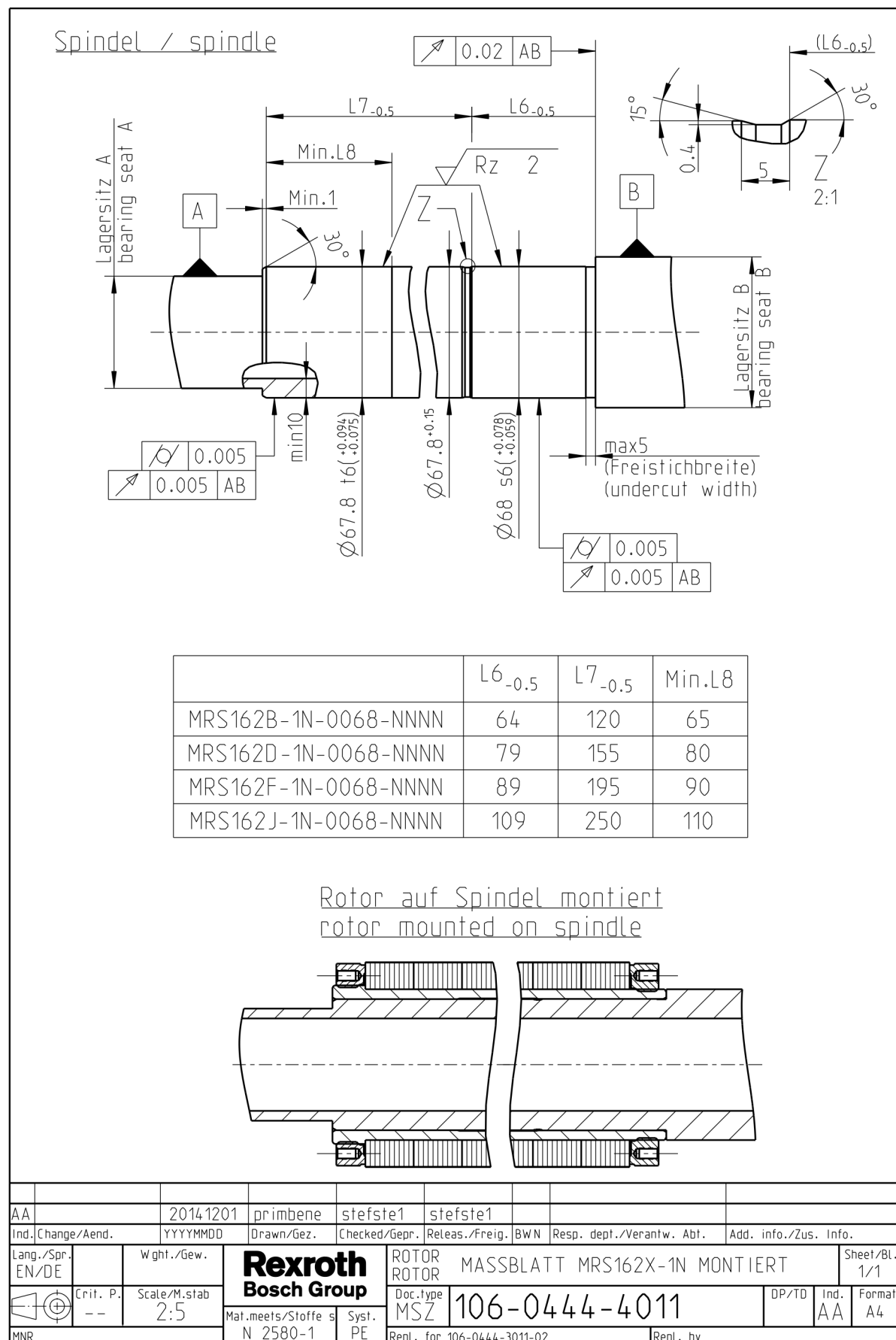
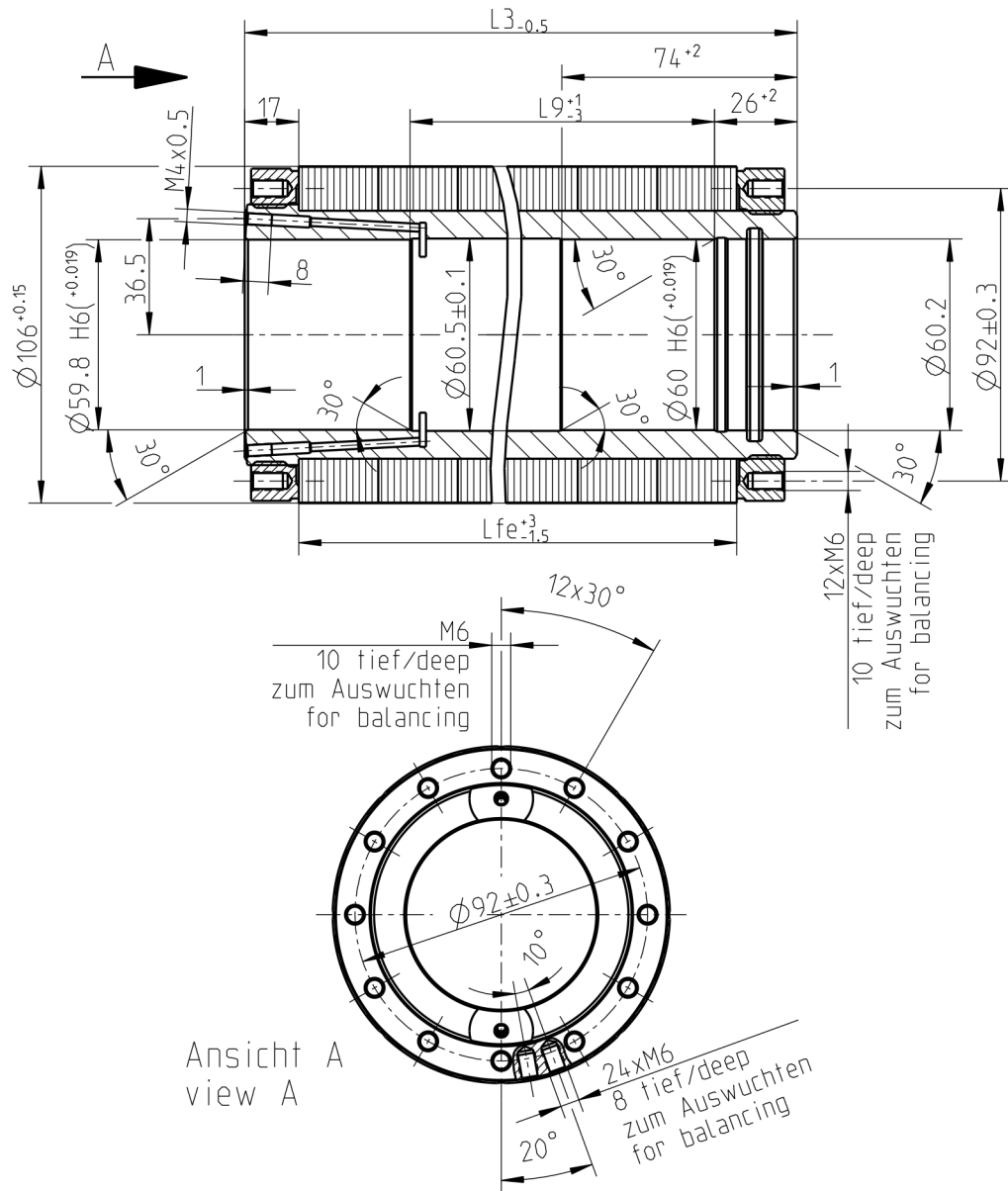


Fig. 73: MRS162 in frame size “1N”, mounted

4.4.9 MRS162 in frame size “2N”, (step interference fit)

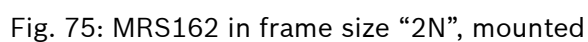


TYPE	$L3_{-0.5}$	$L9_{-3}^{+1}$	$Lfe_{-1.5}^{+3}$
MRS162B-2N-0060-NNNN	186	108	150
MRS162D-2N-0060-NNNN	236	158	200
MRS162F-2N-0060-NNNN	286	208	250
MRS162J-2N-0060-NNNN	361	283	325

AA		20141127	primbene	stefste1	stefste1	7800					
Ind.	Change./Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.			
Lang./Spr.		Wght./Gew.	Rexroth Bosch Group		ROTOR		MASSBLATT MRS162X-2N				Sheet/Bl.
EN/DE					ROTOR						1/1
	Crit. P.	Scale/M.stab	Mat.meets/Stoffe s	Syst.	Doc.type		DP/TD	Ind.	Format		
--	--	1:2			MSZ						
MNR			N 2580-1	PE	106-0444-4012						
					Repl. for 106-0444-3012-03				Repl. by		

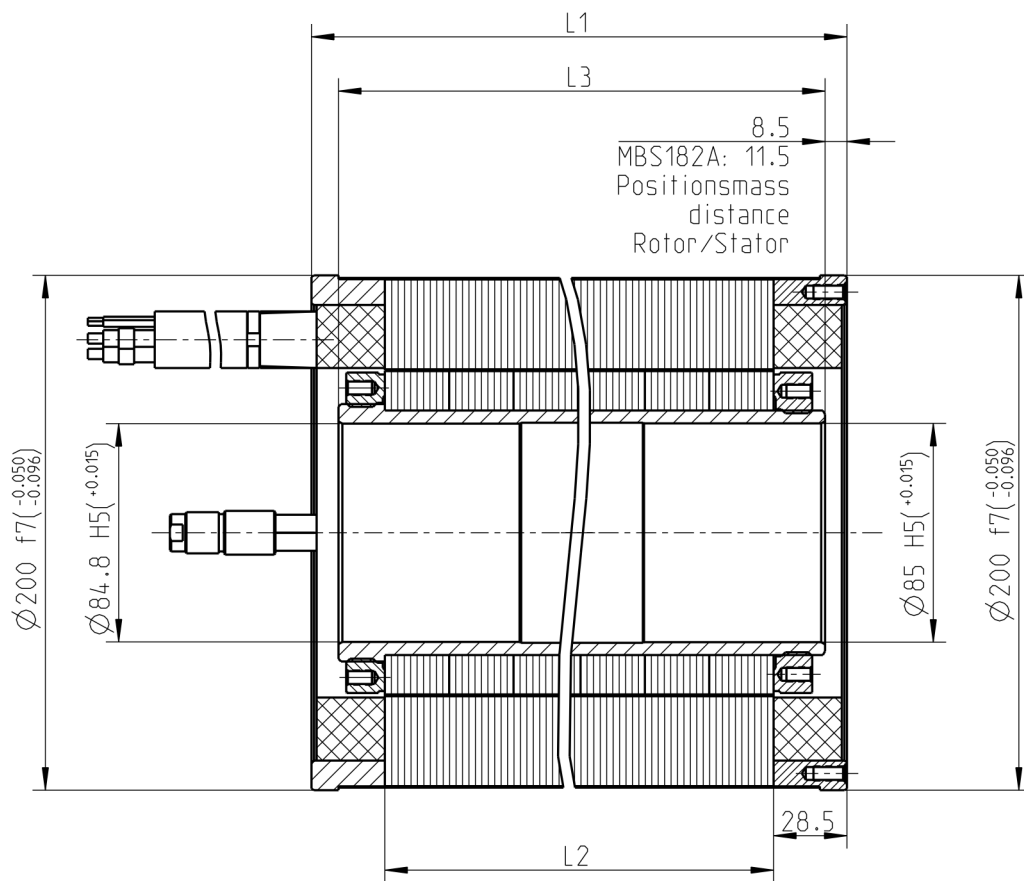
Fig. 74: MRS162 in frame size “2N”, (step interference fit)

Spindel / spindle



4.5 Frame size 182

4.5.1 MBS182 with rotor frame size “1N”



TYPE	L1	L2	L3
MSS182A-XXXX-FX-NOC N-NNNN MRS182A-1N-0085-NNNN	82	25	60
MSS182B-XXXX-FX-NOC N-NNNN MRS182B-1N-0085-NNNN	232	175	213
MSS182D-XXXX-FX-NOC N-NNNN MRS182D-1N-0085-NNNN	282	225	263
MSS182F-XXXX-FX-NOC N-NNNN MRS182F-1N-0085-NNNN	382	321	363

AA		20141205	primbene	stefste1	stefste1	7800							
Ind. Change./Aend.		YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.		Add. info./Zus. Info.				
Lang./Spr. EN/DE		Wght./Gew.		Rexroth Bosch Group		MOTOR		MASSBLATT MBS182X-1N-FX		Sheet/Bl 1/1			
		Crit. P. --				Scale/M.stab 2:5							
		Mat.meets/Stoffe s N 2580-1		Syst. PE		Doc.type MSZ		106-0445-4001		DP/TD AA		Forma A4	
MNR						Repl. for 106-0445-3001-04		Repl. by					

Fig. 76: MBS182 with rotor frame size "1N"

4.5.2 MBS182 with rotor frame size "2N"

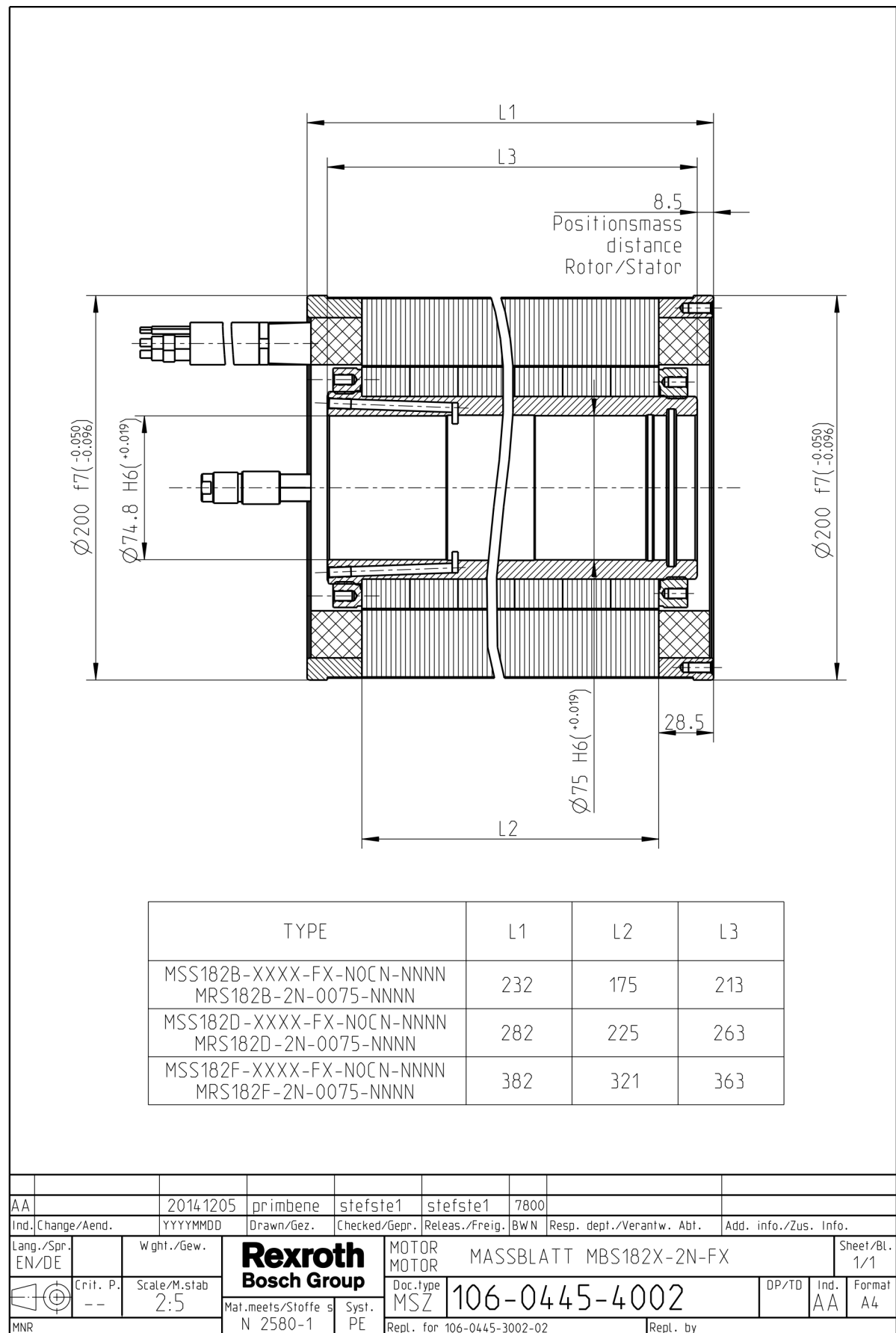


Fig. 77: MBS182 with rotor frame size "2N"

4.5.3 MSS182 with coolant connection “FA”

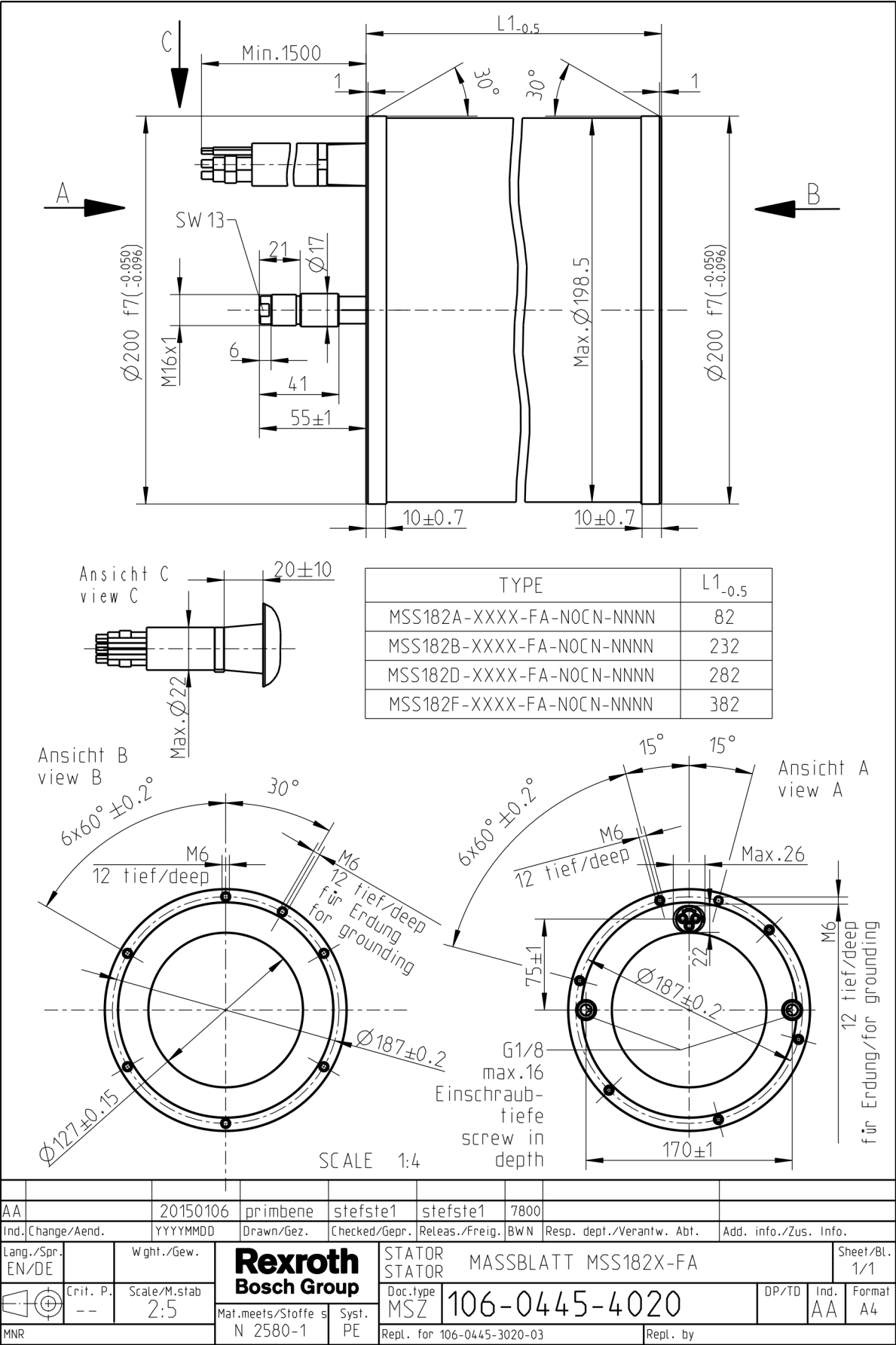


Fig. 78: MSS182 with coolant connection axial

4.5.4 MSS182 with coolant connection “FA”, mounted

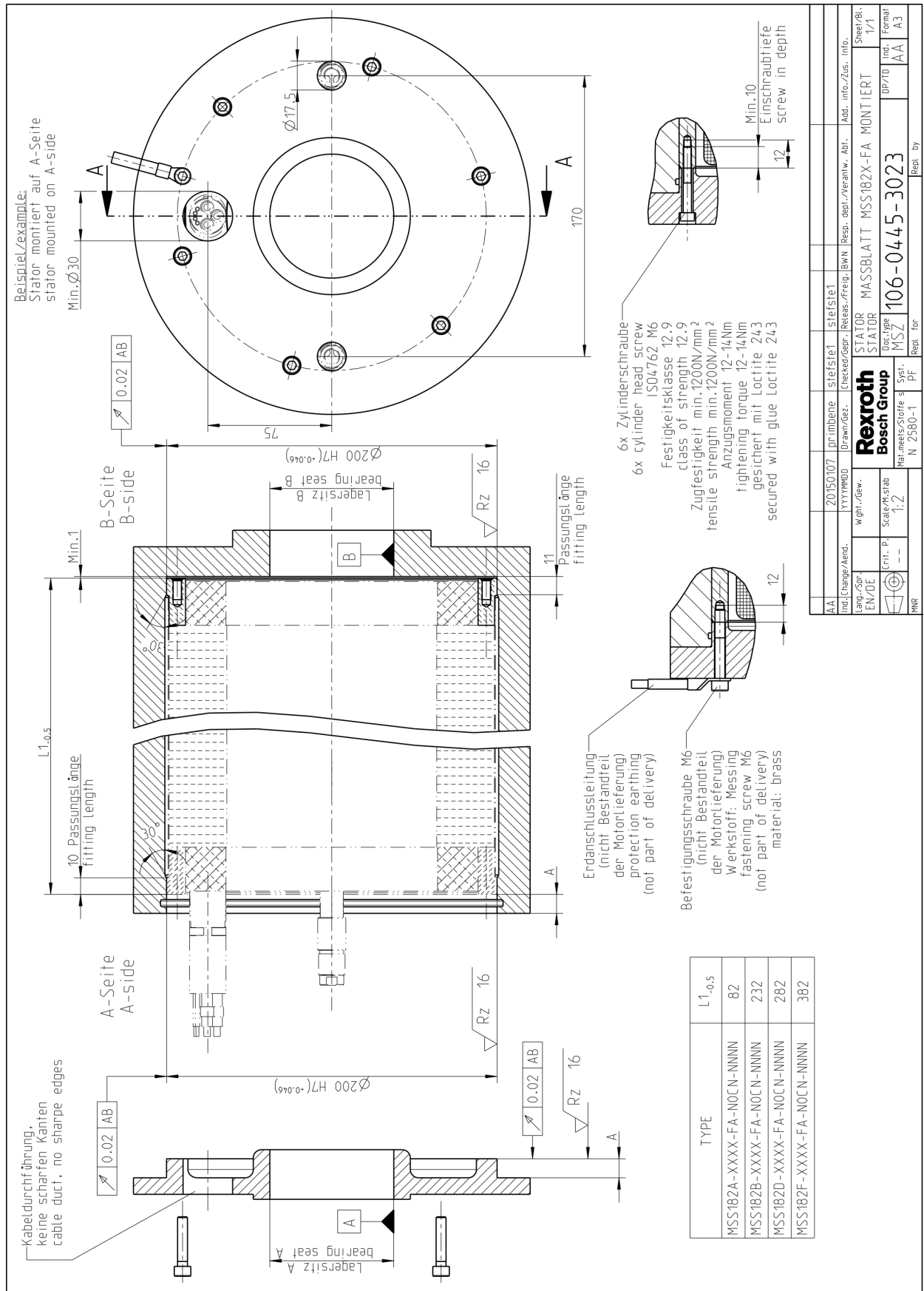


Fig. 79: MSS182 with coolant connection axial, mounted

4.5.5 MSS182 with coolant connection “FR”

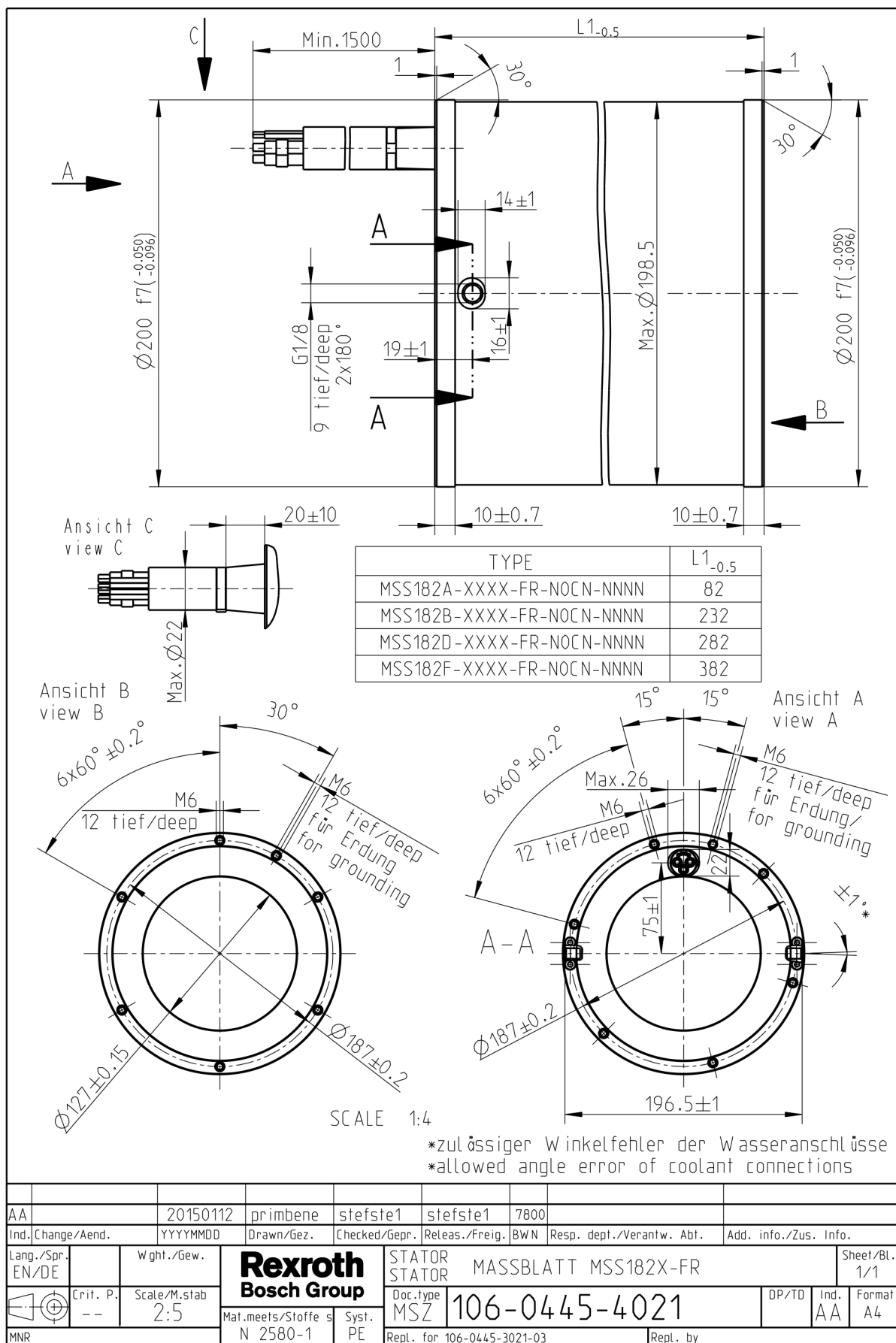


Fig. 80: MSS182A with coolant connection radial

4.5.6 MSS182 with coolant connection “FR”, mounted

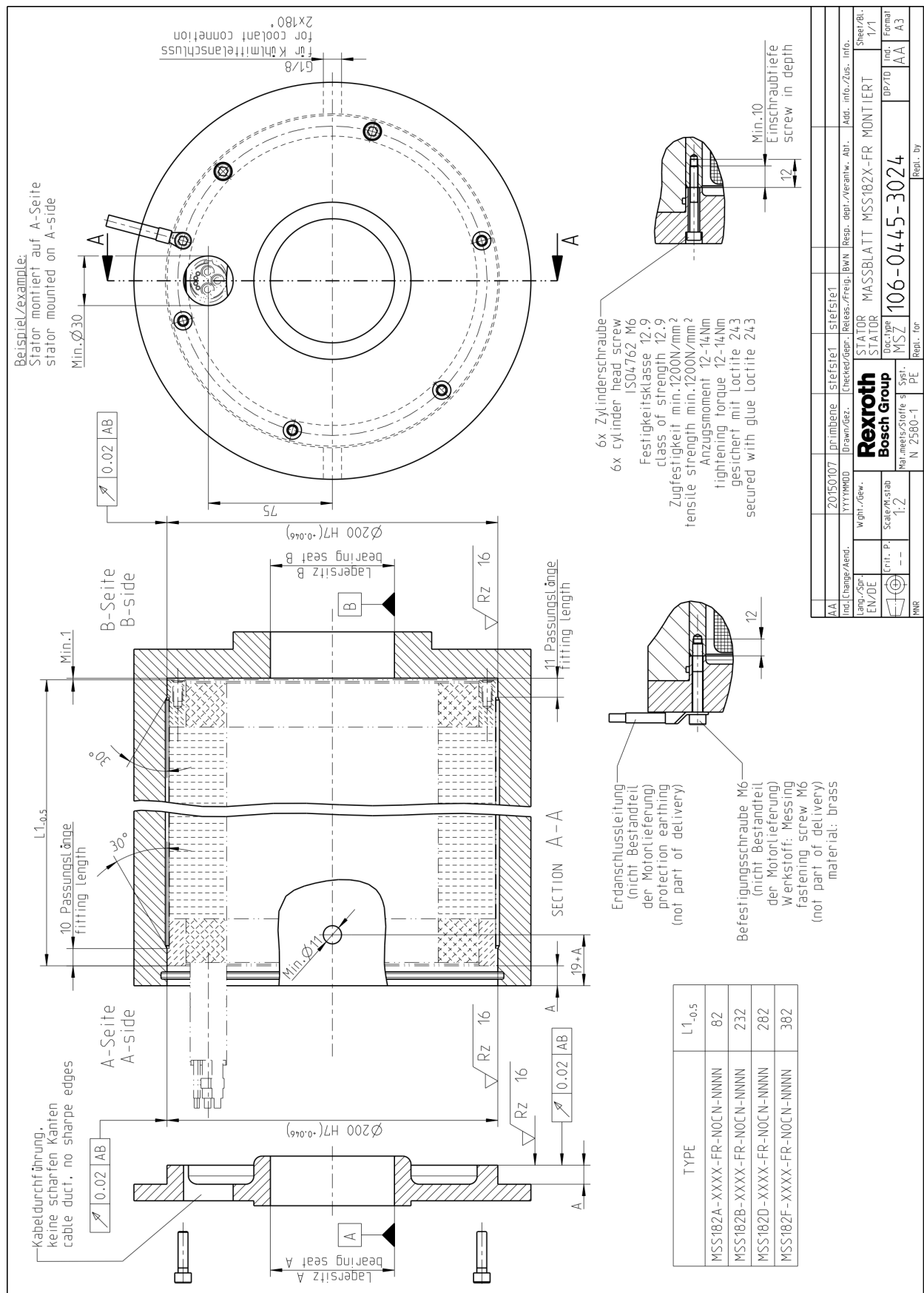


Fig. 81: MSS182 with coolant connection radial, mounted

4.5.7 MRS182 in frame size "1N" (smooth hole)

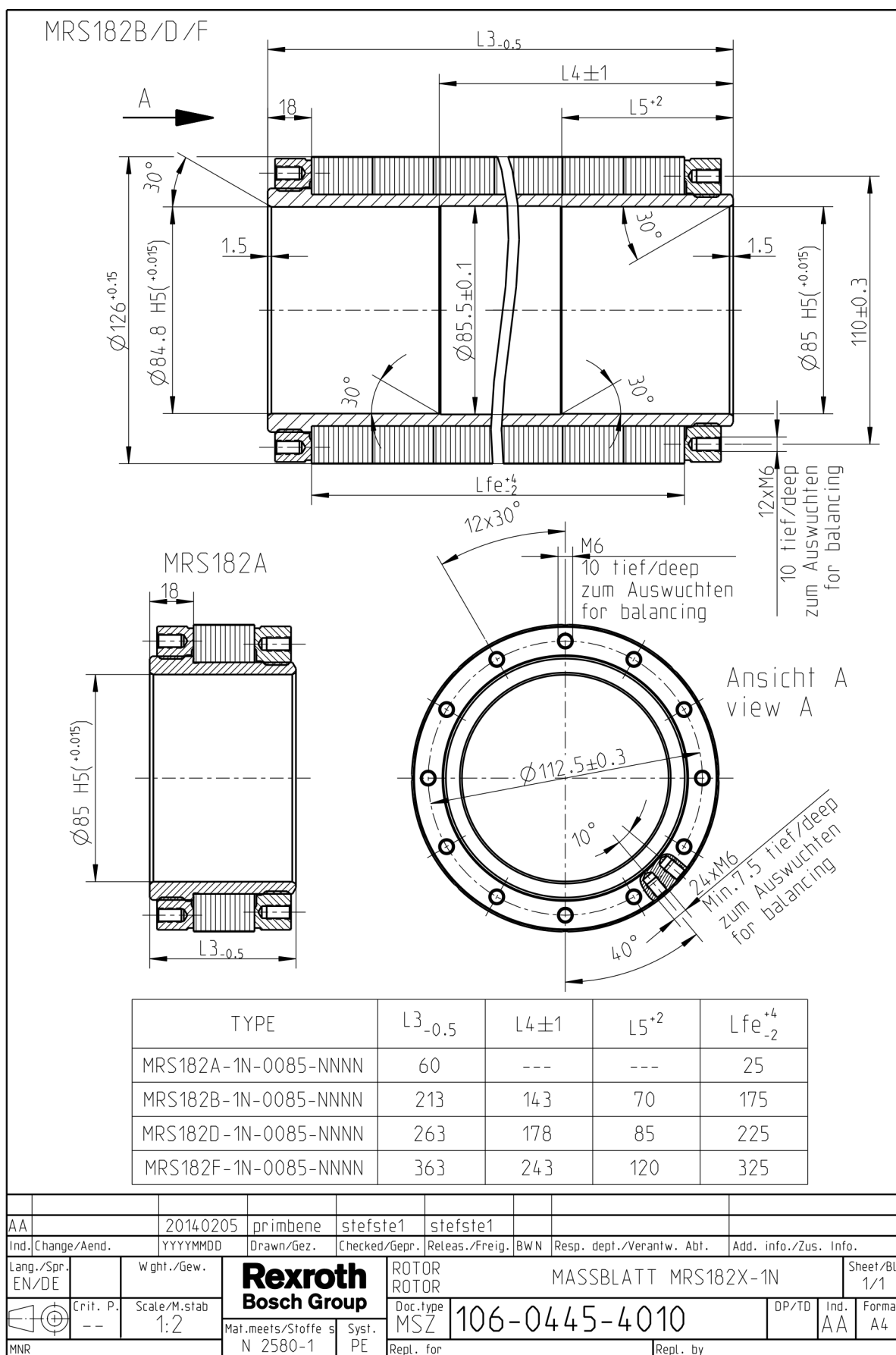


Fig. 82: MRS182 in frame size "1N"

4.5.8 MRS182 in frame size "1N", mounted

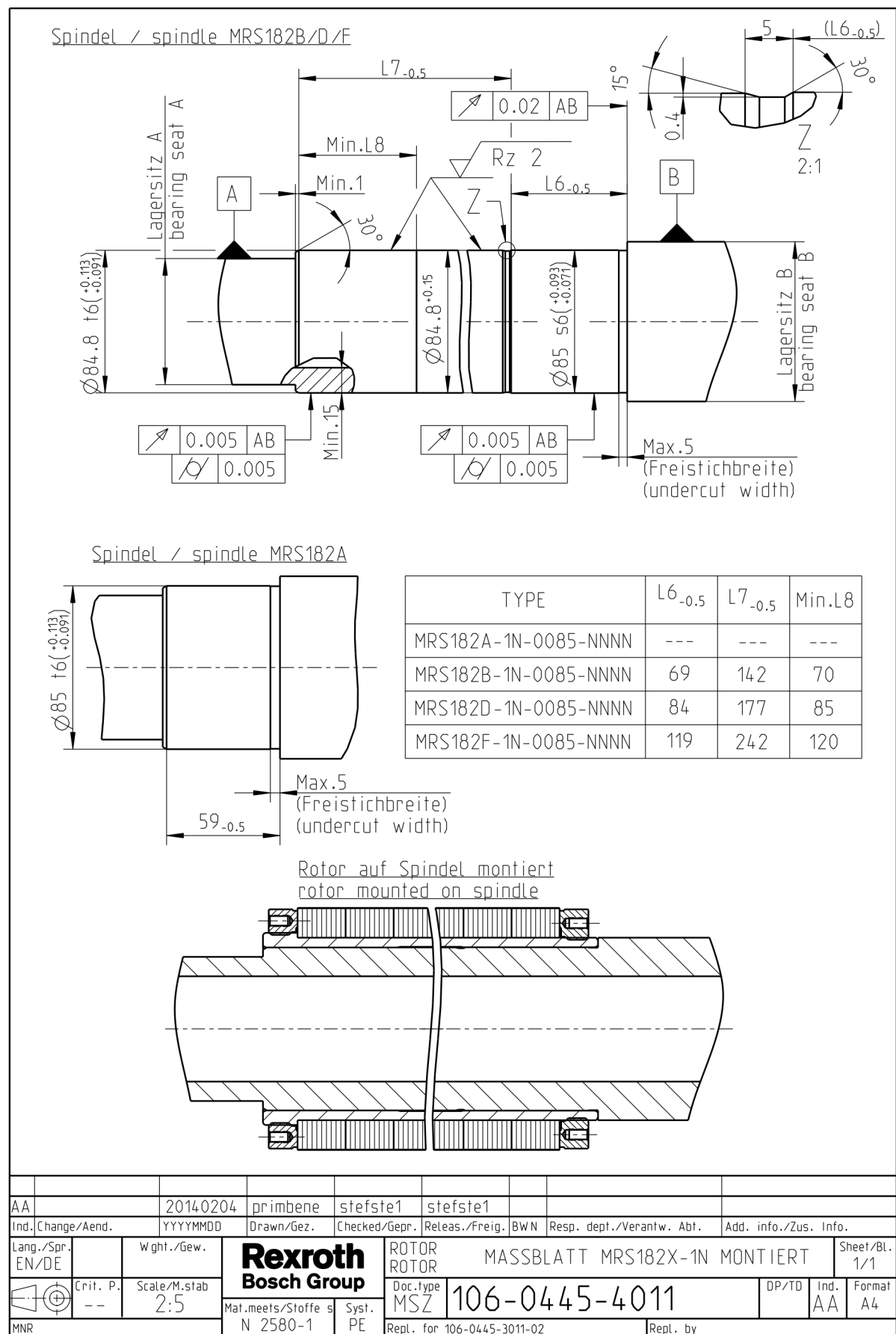


Fig. 83: MRS182 in frame size "1N", mounted

4.5.9 MRS182 in frame size “2N” (step interference fit)

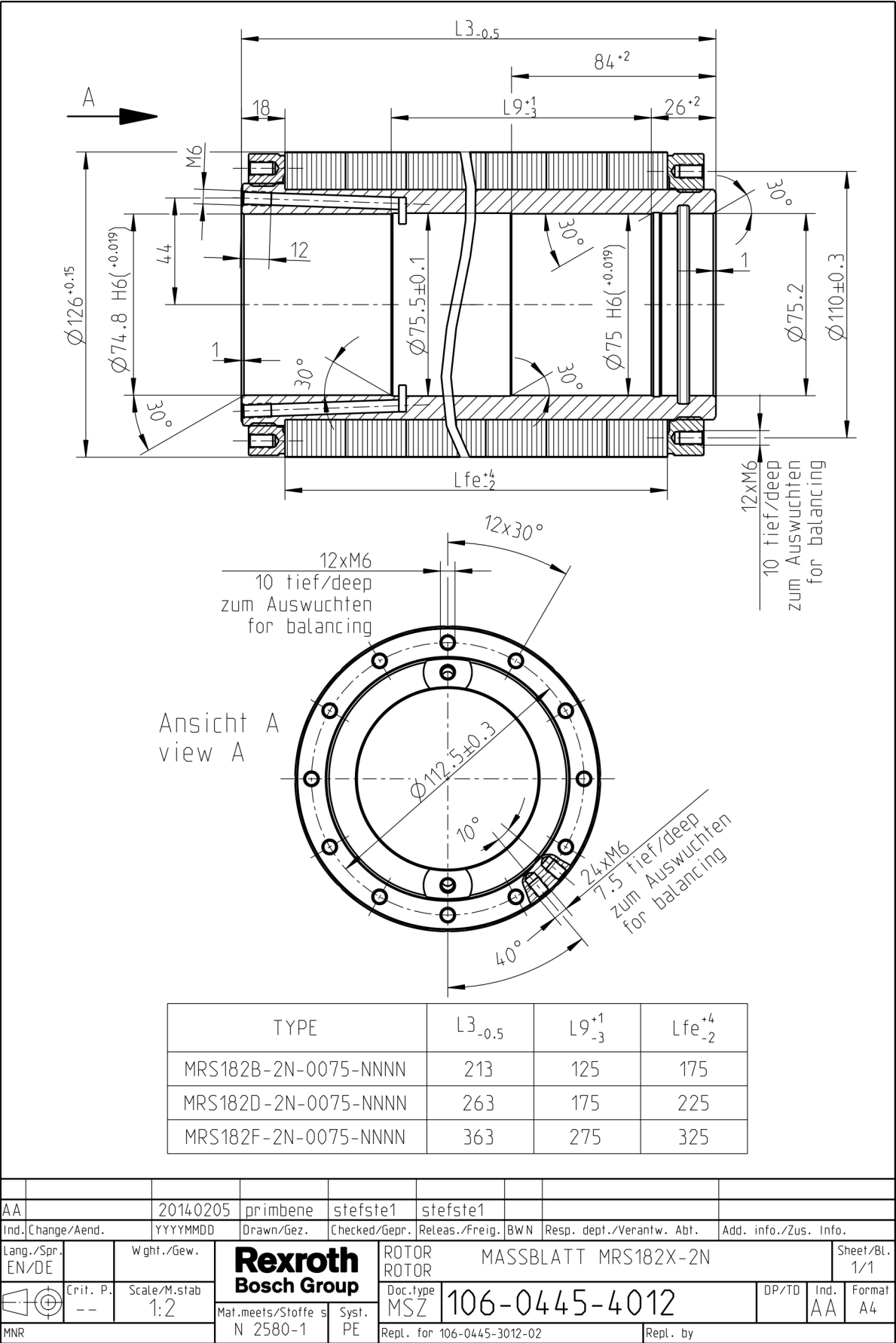


Fig. 84: MRS182 in frame size “2N”

Spindel / spindle

TYPE	L10 _{-0.5}
MRS182B-2N-0075-NNNN	128
MRS182D-2N-0075-NNNN	178
MRS182F-2N-0075-NNNN	278

Rotor auf Spindel montiert
rotor mounted on spindle

AA	20150123	primbene	stefste1	stefste1				
Ind. Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.	
Lang./Spr. EN/DE		Wght./Gew.	Rexroth Bosch Group			ROTOR ROTOR MASSBLATT MRS182X-2N MONTIERT		Sheet/Bl. 1/1
	Crit. P. --	Scale/M.stab 2:5	Mat.meets/Stoffe s N 2580-1	Syst. PE	Doc.type MSZ	106-0445-4013	DP/TD	Ind. AA
					Repl. for	Repl. by	Format A4	

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4.6 Frame size 202

4.6.1 MBS202 with rotor frame size “1N”

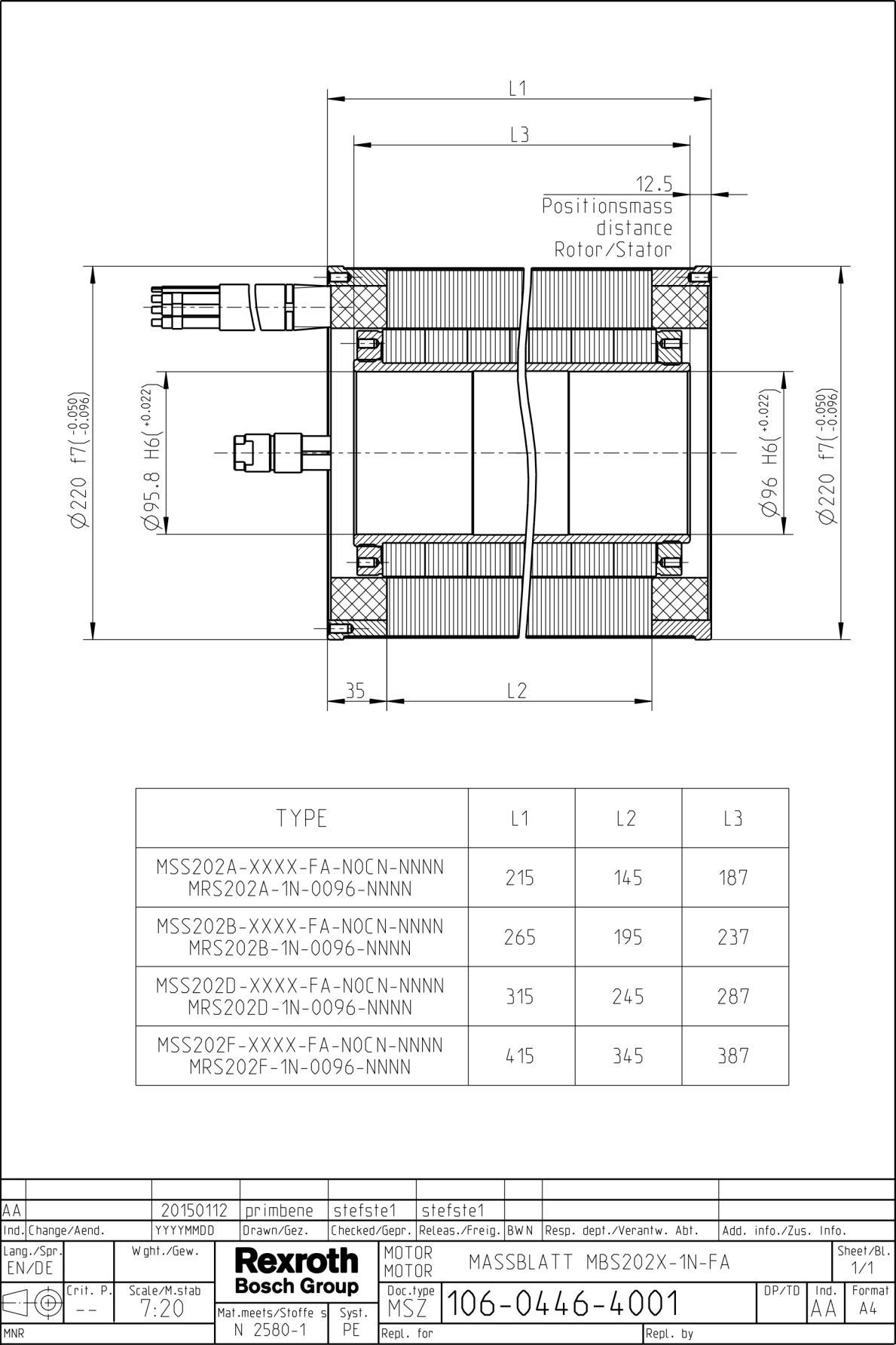
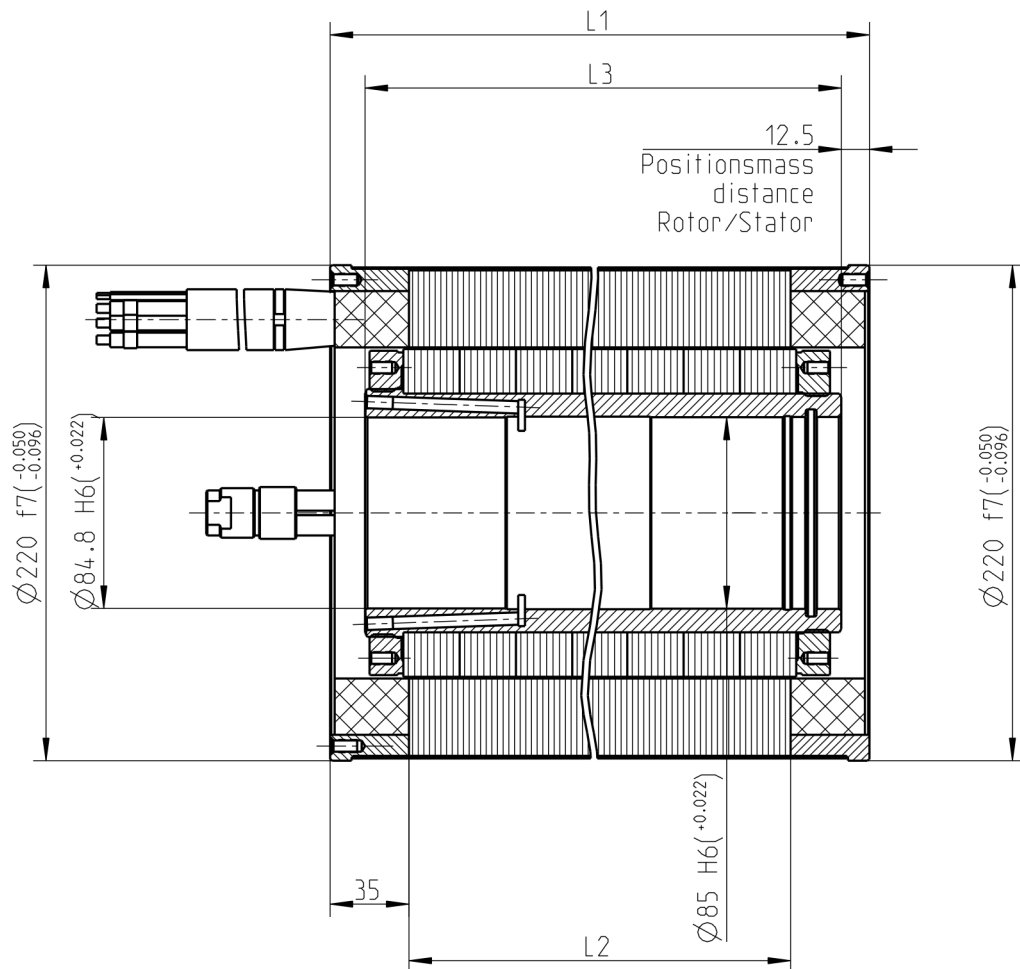


Fig. 86: MBS202 with rotor frame size “1N”
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4.6.2 MBS202 with rotor frame size "2N"



TYPE	L1	L2	L3
MSS202A-XXXX-FA-NOCN-NNNN MRS202A-2N-0085-NNNN	215	145	187
MSS202B-XXXX-FA-NOCN-NNNN MRS202B-2N-0085-NNNN	265	195	237
MSS202D-XXXX-FA-NOCN-NNNN MRS202D-2N-0085-NNNN	315	245	287
MSS202F-XXXX-FA-NOCN-NNNN MRS202F-2N-0085-NNNN	415	345	387

AA	20150120	primbene	stefste1	stefste1				
Ind. Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.	
Lang./Spr. EN/DE	Wght./Gew.	Rexroth Bosch Group			MOTOR MOTOR MASSBLATT MBS202X-2N-FA			Sheet/Bt. 1/1
	Crit. P. --	Scale/M.stab 7:20	Mat.meets/Stoffe s N 2580-1	Syst. PE	Doc.type MSZ	106-0446-4002	DP/TD AA	Format A4
MNR					Repl. for	Repl. by		

Fig. 87: MBS202 with rotor frame size "2N"

4.6.3 MSS202 with coolant connection “FA”

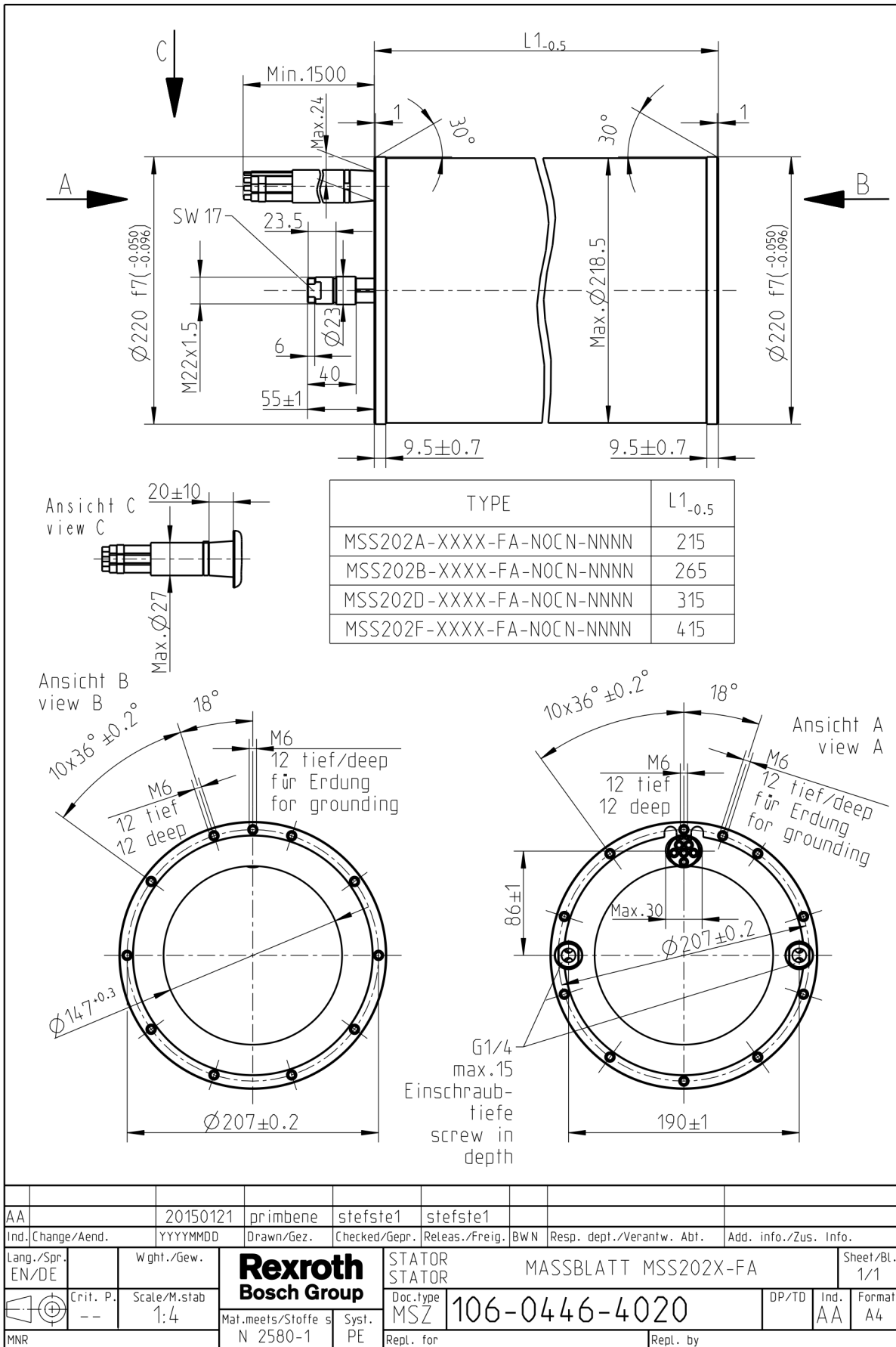


Fig. 88: MSS202 with coolant connection “axial”

4.6.4 MSS202 with coolant connection “FA”, mounted

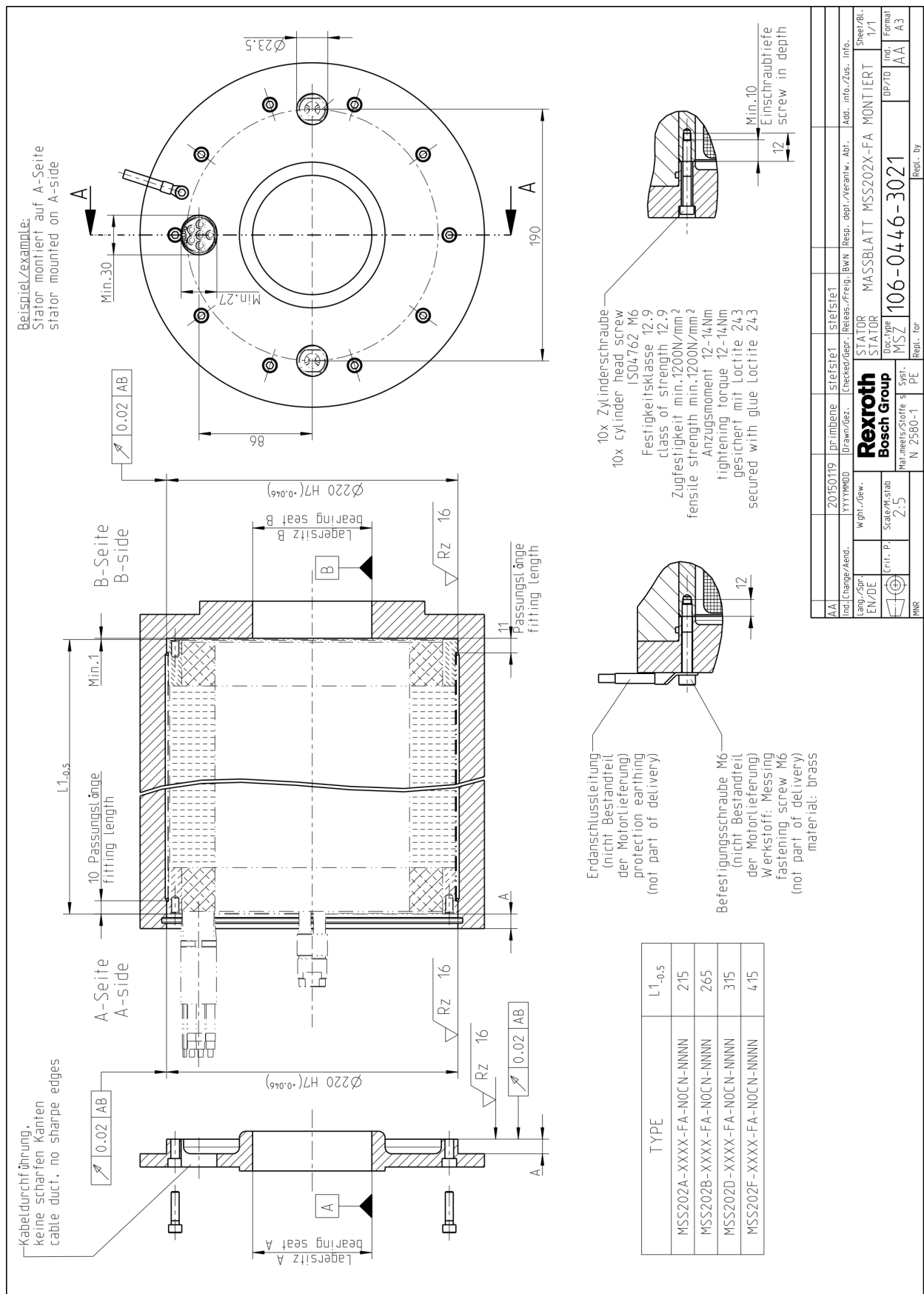


Fig. 89: MSS202 with coolant connection “axial”, mounted

4.6.5 MRS202 in frame size “1N” (smooth hole)

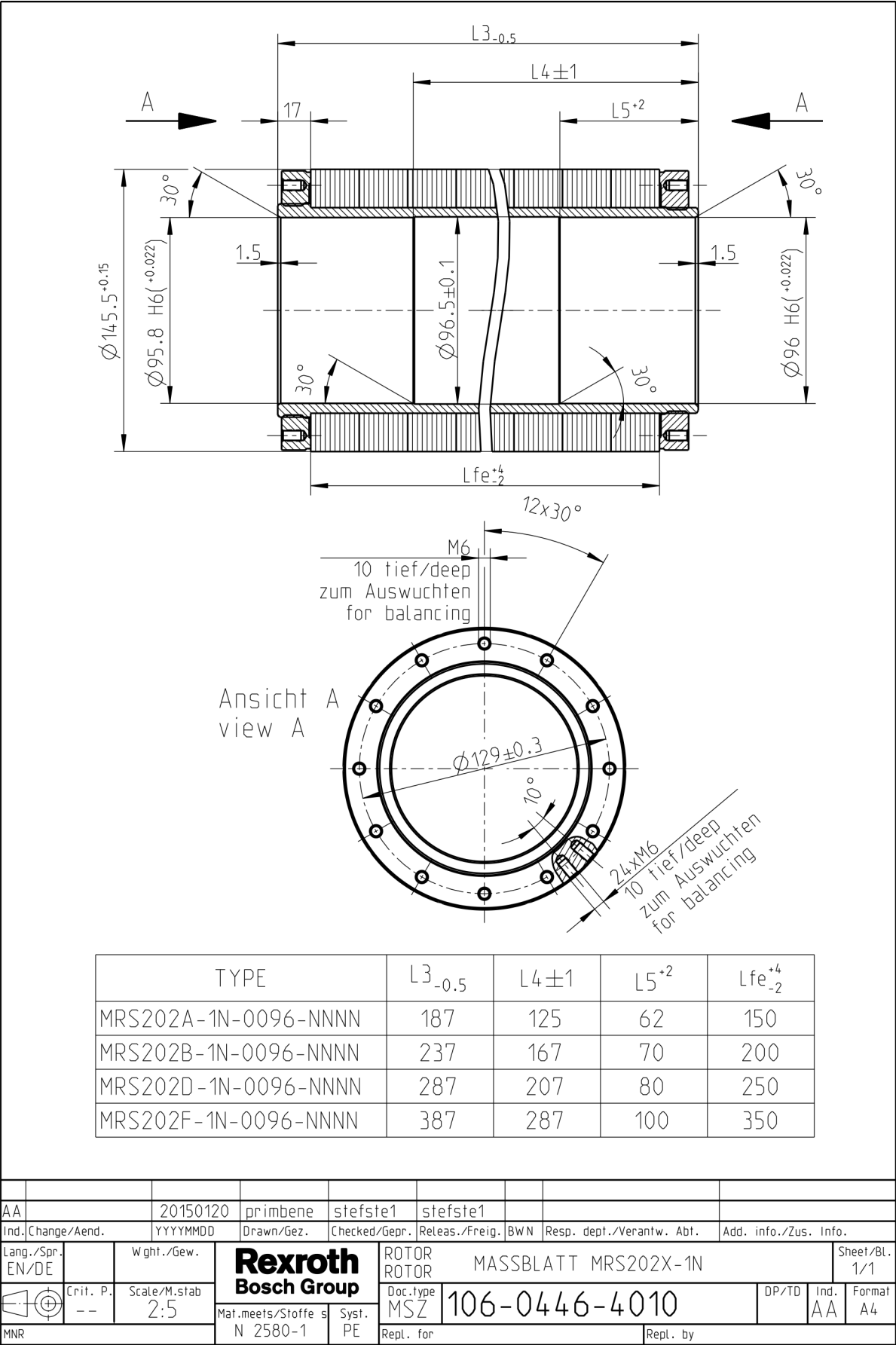


Fig. 90: MRS202 in frame size “1N”

4.6.6 MRS202 in frame size "1N", mounted

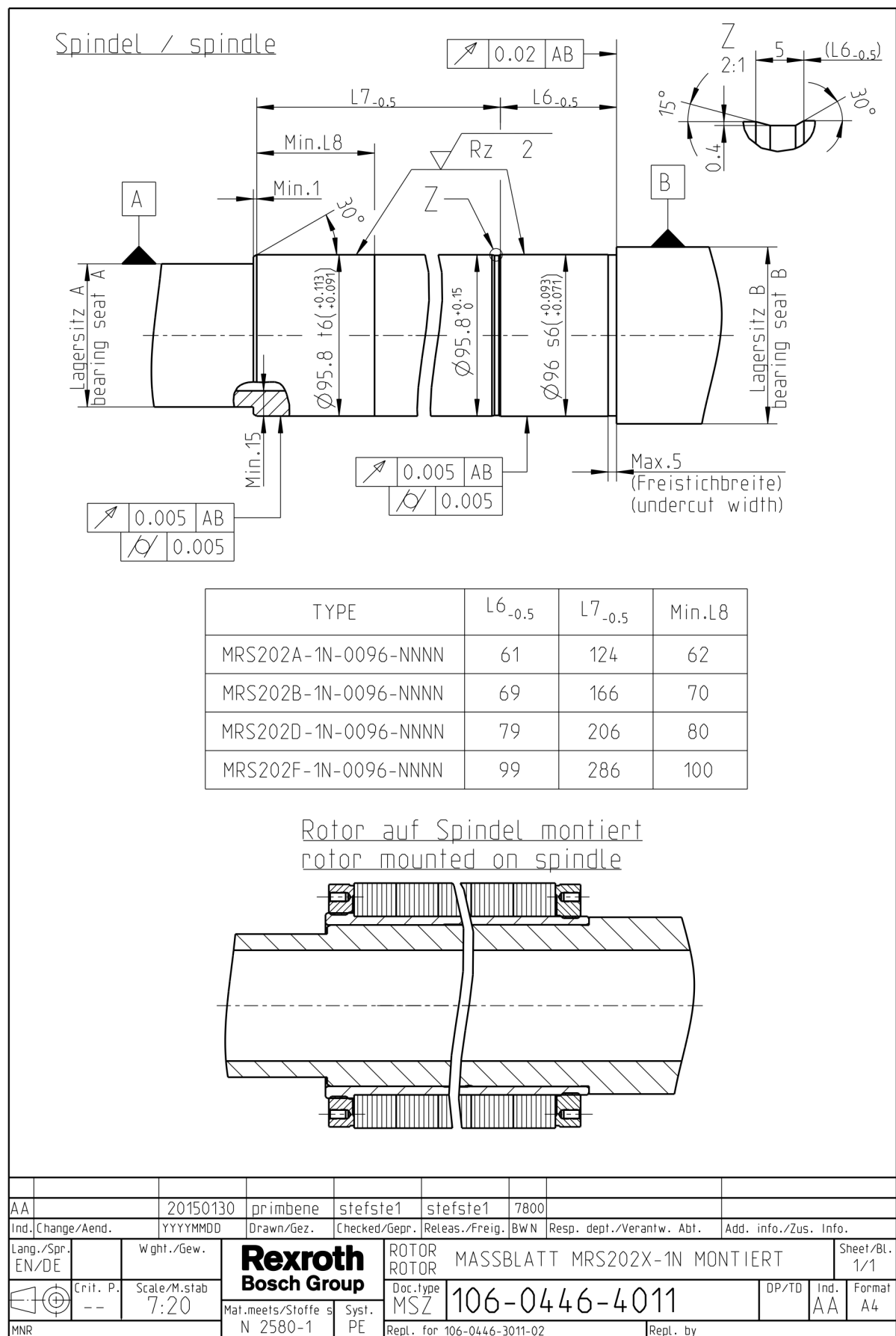
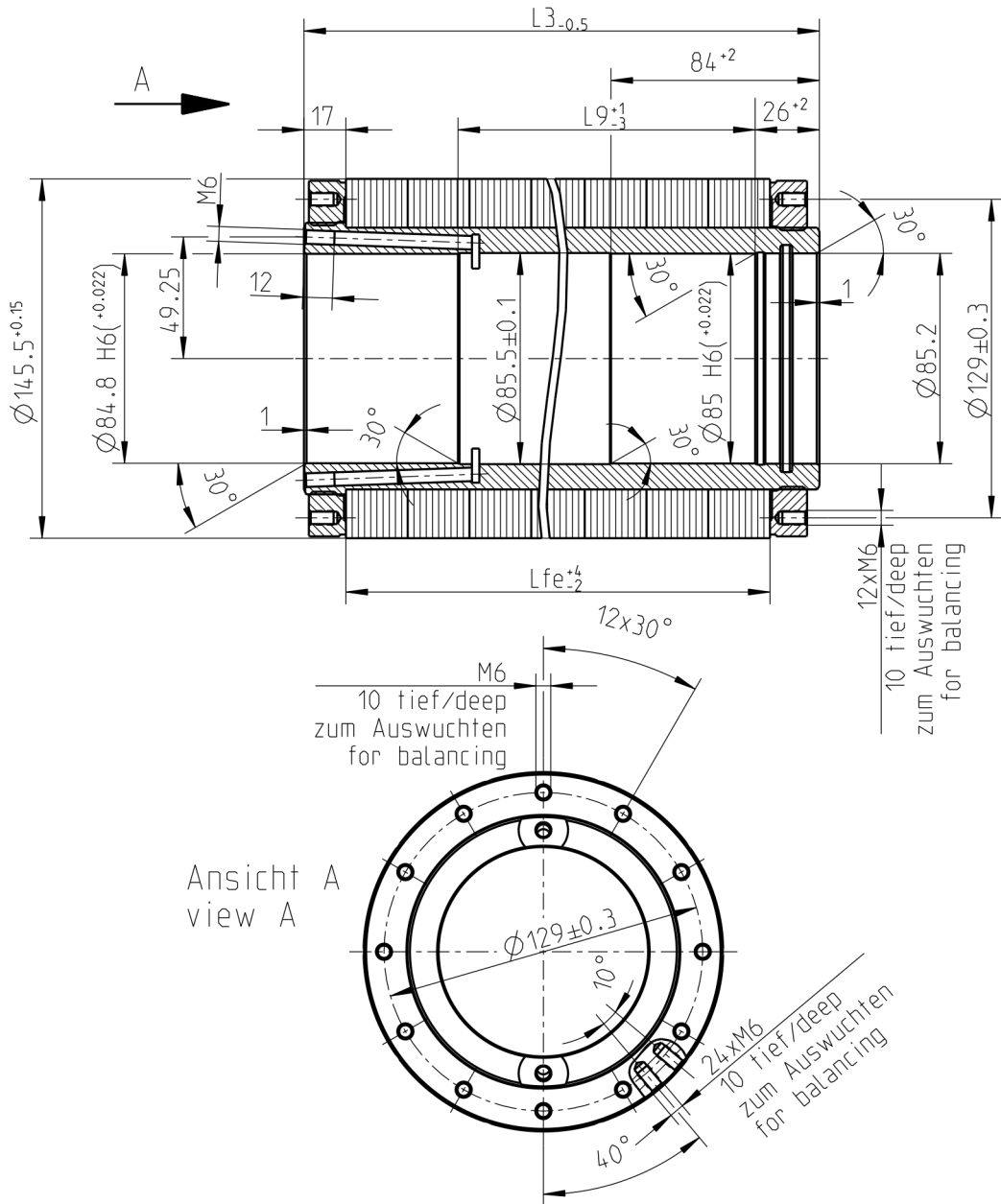


Fig. 91: MRS202 in frame size "1N", mounted

4.6.7 MRS202 in frame size “2N” (step interference fit)



TYPE	$L3_{-0.5}$	$L9_{-3}^{+1}$	Lfe_{-2}^{+4}
MRS202A-2N-0085-NNNN	187	99	150
MRS202B-2N-0085-NNNN	237	149	200
MRS202D-2N-0085-NNNN	287	199	250
MRS202F-2N-0085-NNNN	387	299	350

AA		20150112	primbene	stefste1	stefste1	7800				
Ind.	Change./Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.		
Lang./Spr.		W ght./Gew.	Rexroth Bosch Group	ROTOR ROTOR MASSBLATT MRS202X-2N					Sheet./Bl.	
EN/DE									1/1	
	Crit. P.	Scale/M.stab		Doc.type	106-0446-4012			DP/TD	Ind.	Format
--	2:5			MSZ						AA
MNR		Mat.meets/Stoffe s	Syst.	Repl. for 106-0446-3012-02			Repl. by			
		N 2580-1	PE							

Fig. 92: MRS202 in frame size “2N”

4.6.8 MRS202 in frame size “2N”, mounted

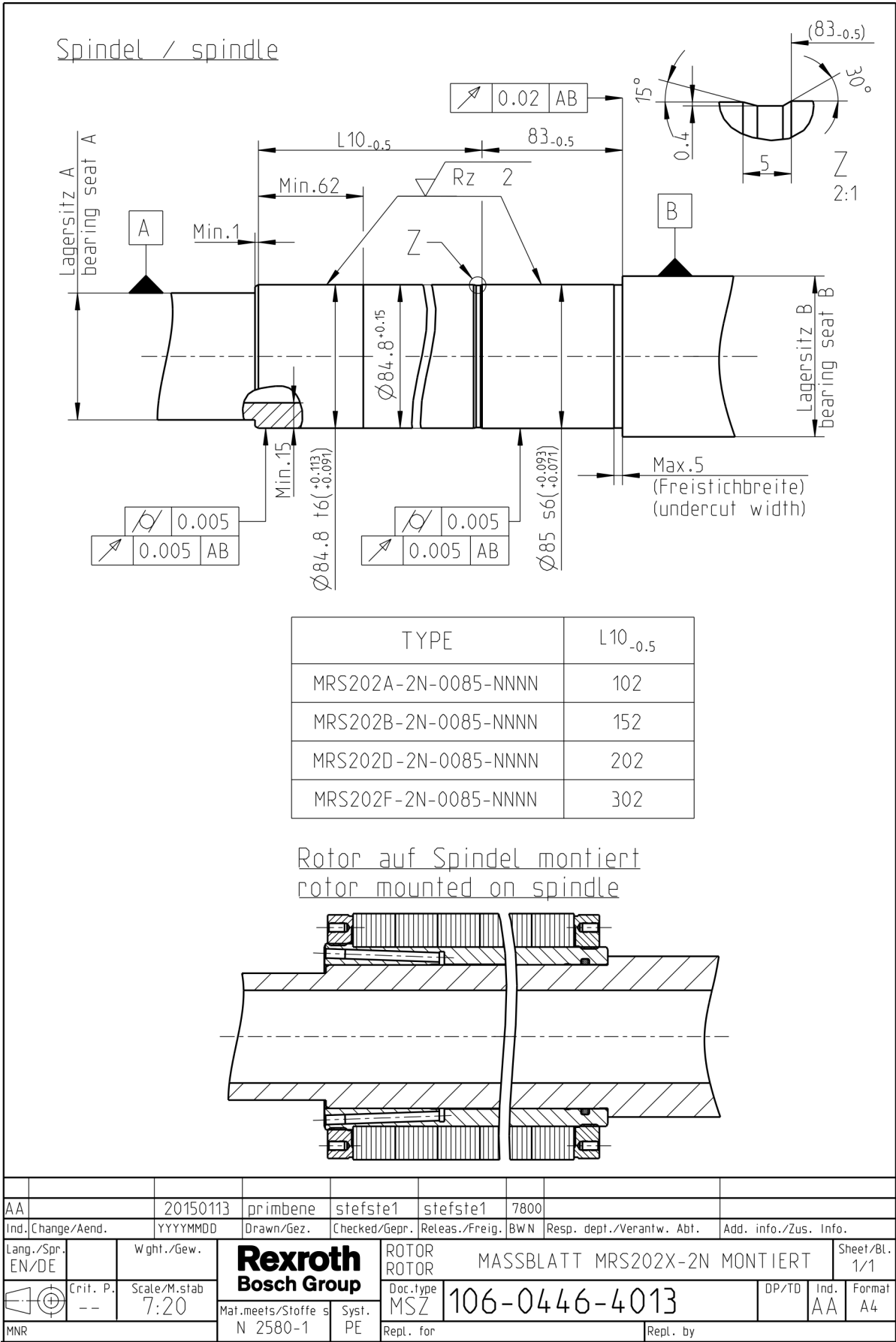
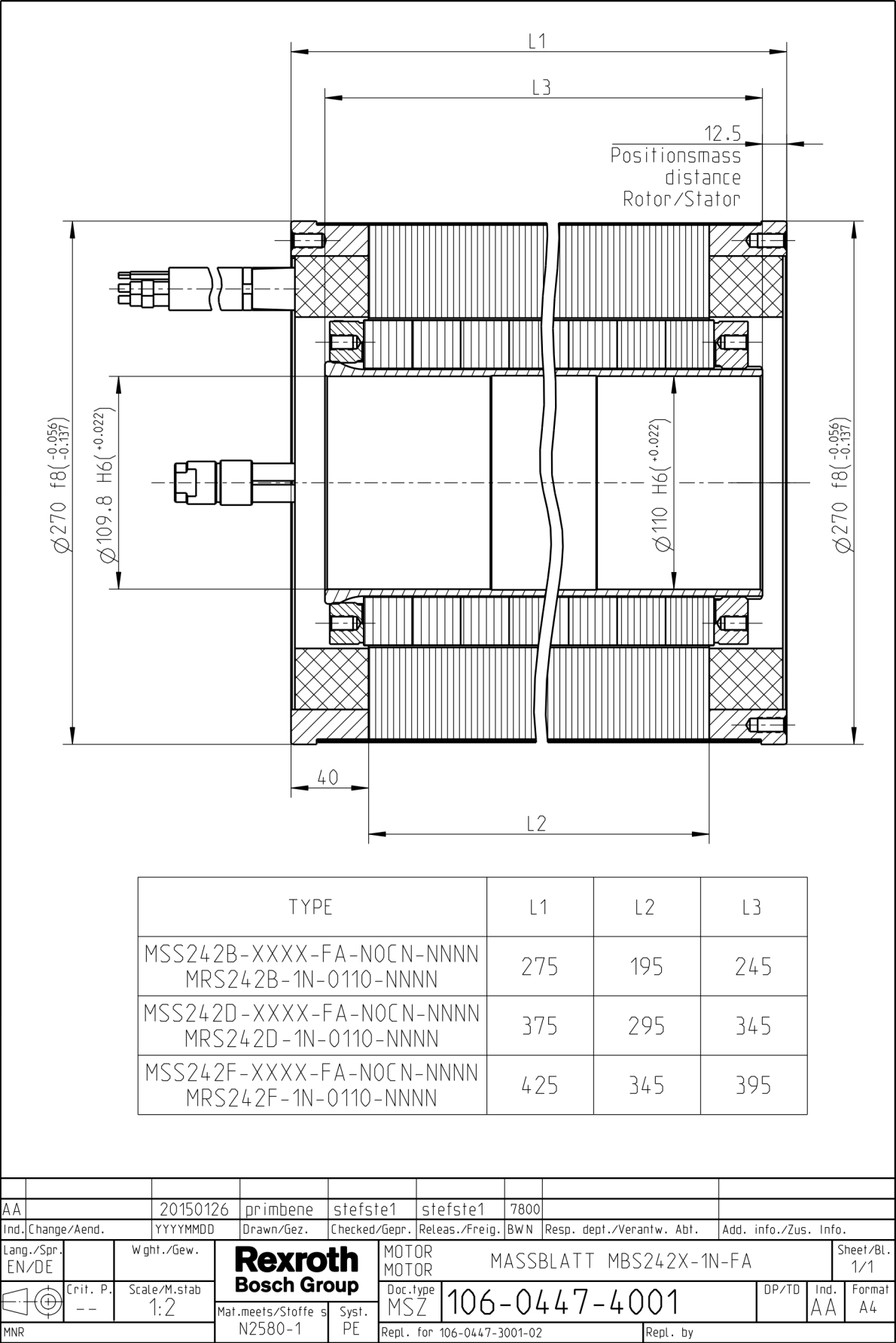


Fig. 93: MRS202 in frame size “2N”, mounted

4.7 Frame size 242

4.7.1 MBS242 with rotor frame size “1N”



4.7.2 MBS242 with rotor frame size "2N"

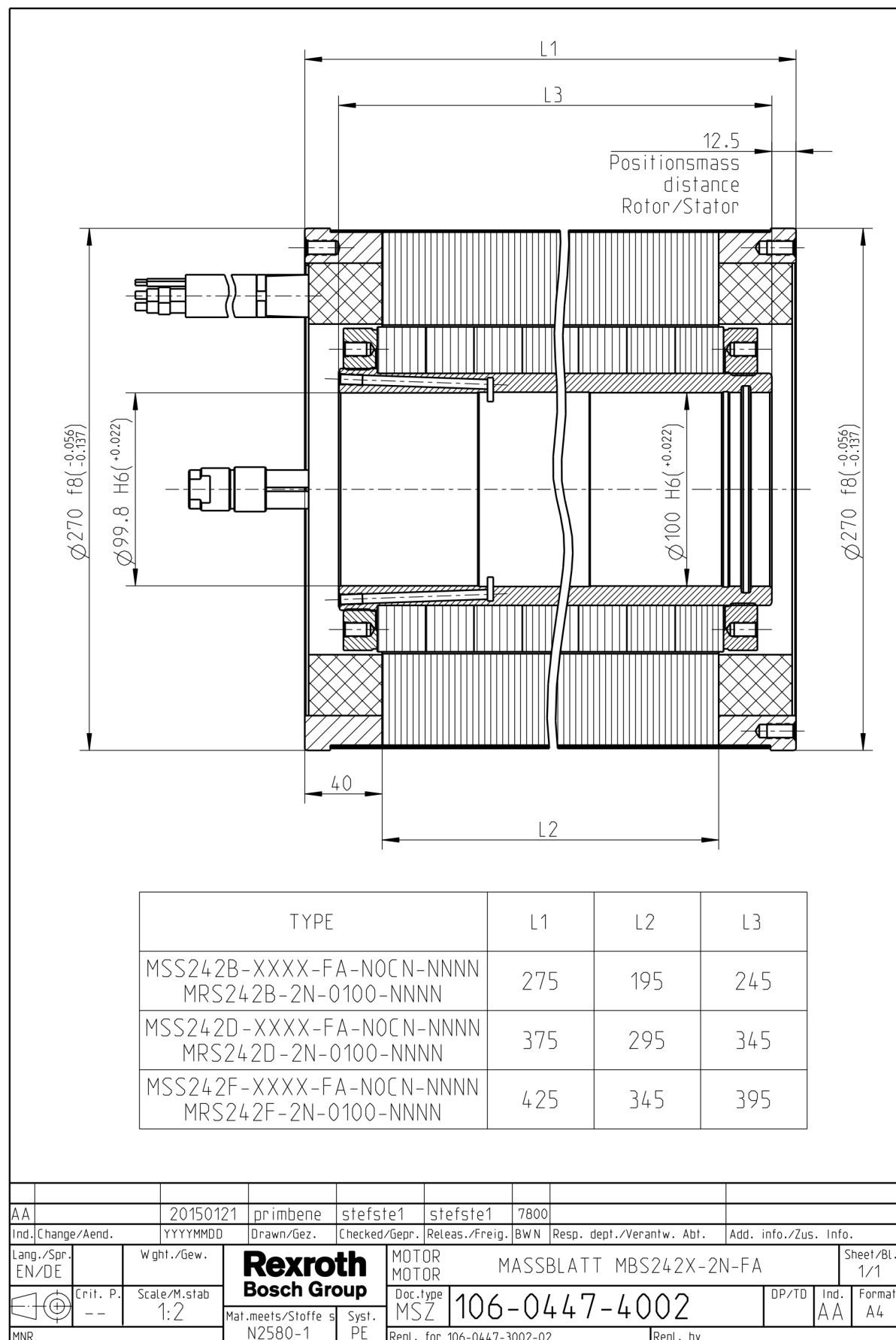


Fig. 95: MBS242 with rotor frame size "2N"

4.7.3 MSS242 with coolant connection “FA”

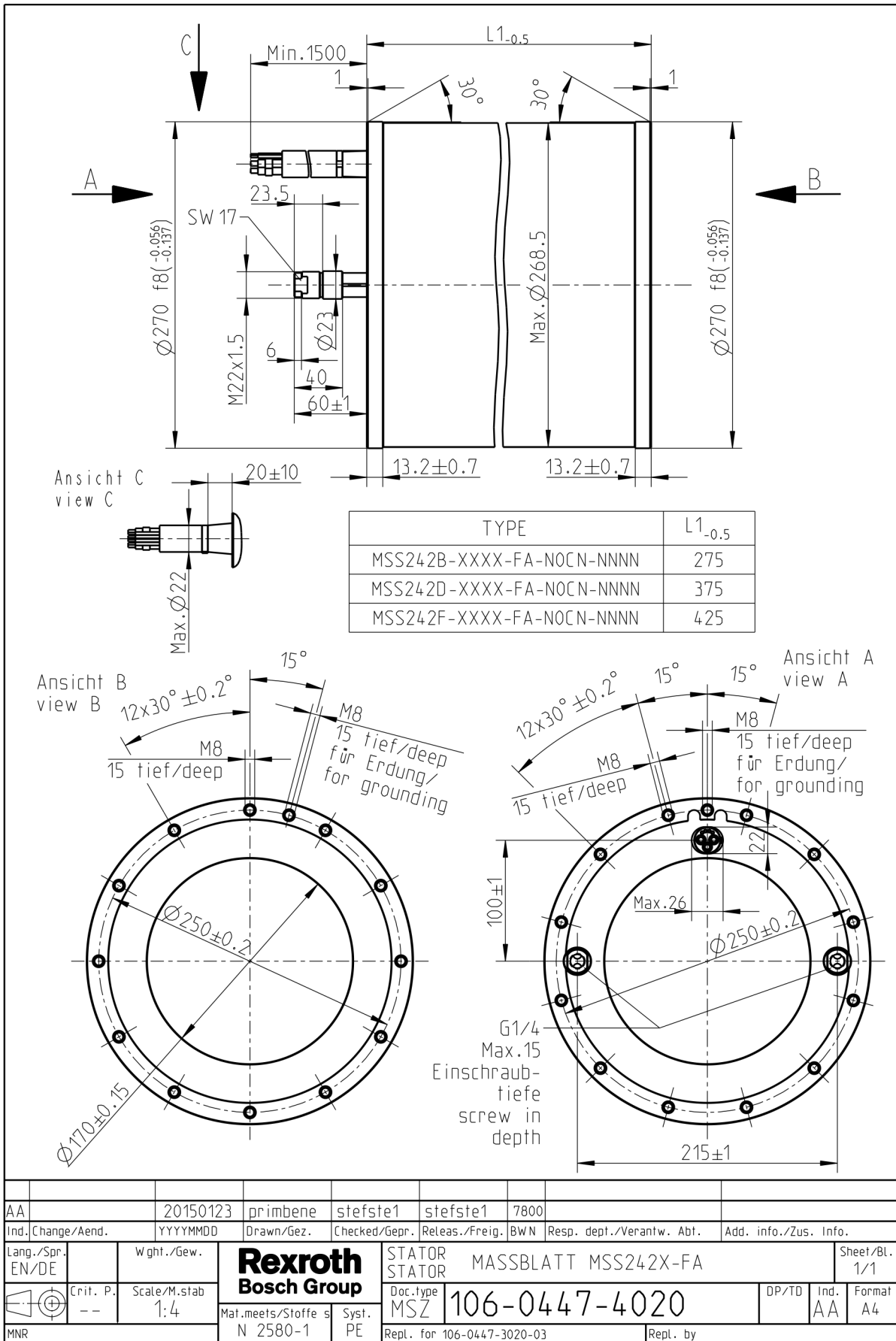


Fig. 96: MSS242 with coolant connection “axial”

4.7.4 MSS242 with coolant connection “FA”, mounted

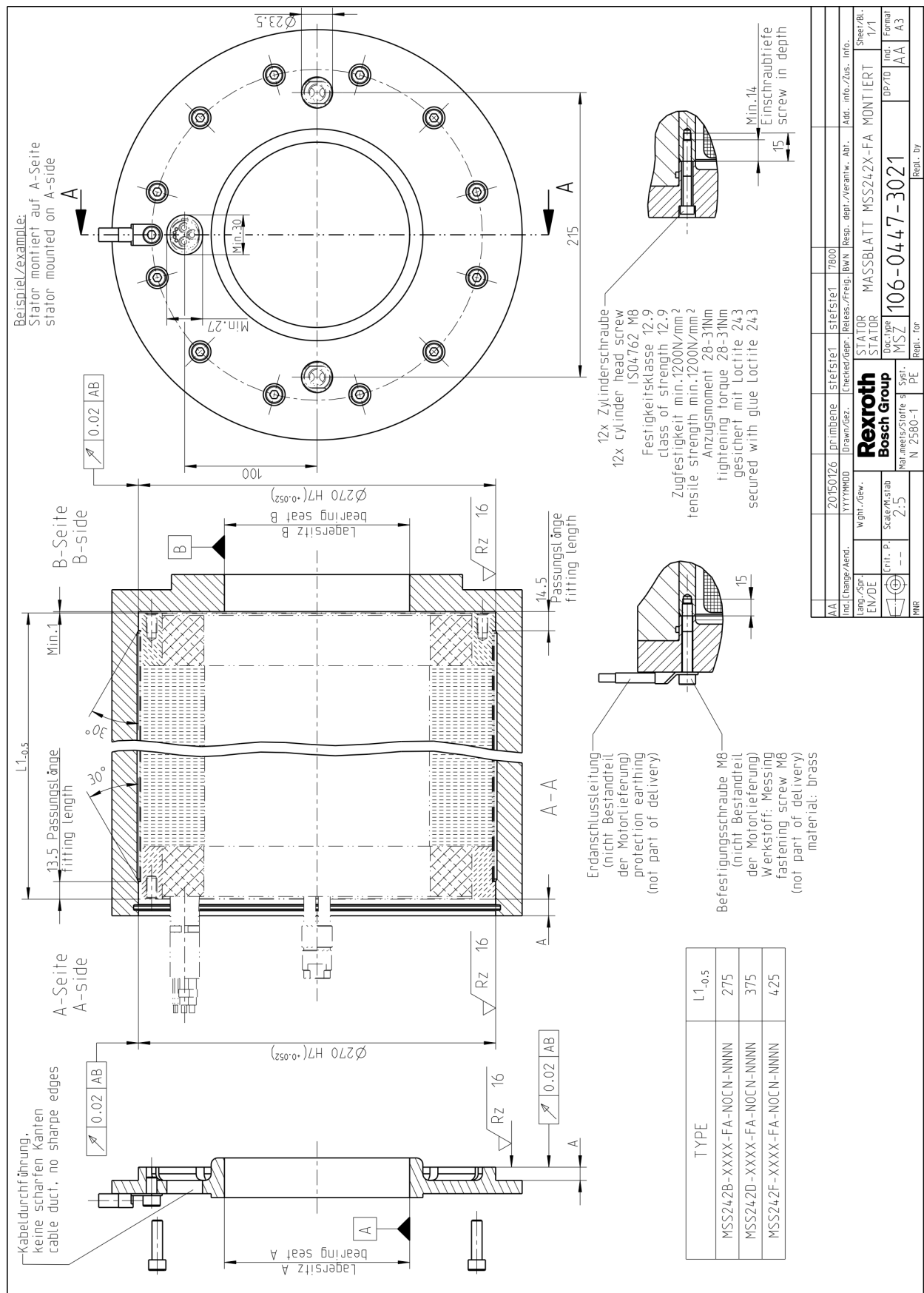


Fig. 97: MSS242 with coolant connection “axial”, mounted

4.7.5 MRS242 in frame size “1N” (smooth hole)

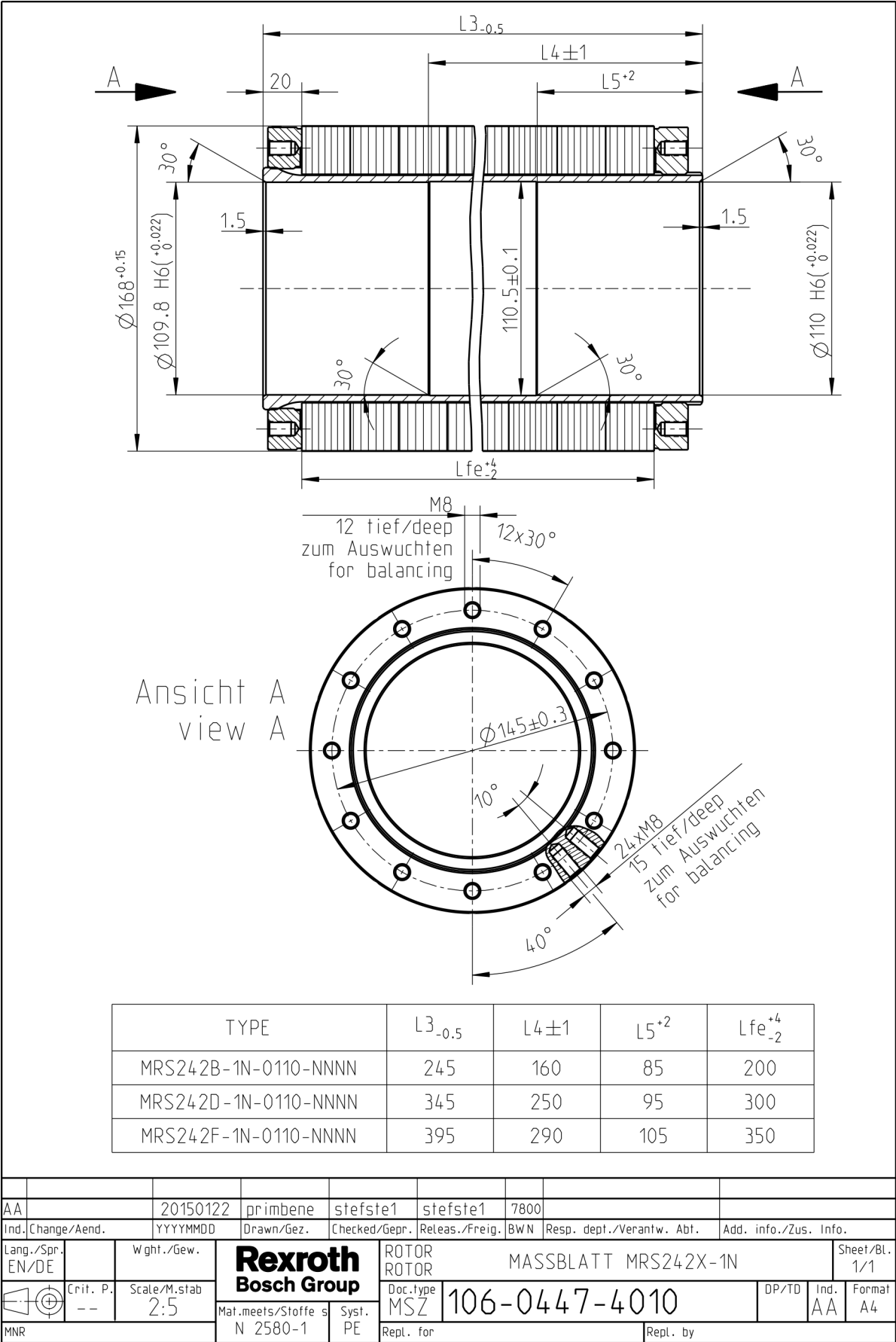


Fig. 98: MRS242 in frame size “1N”

4.7.6 MRS242 in frame size "1N", mounted

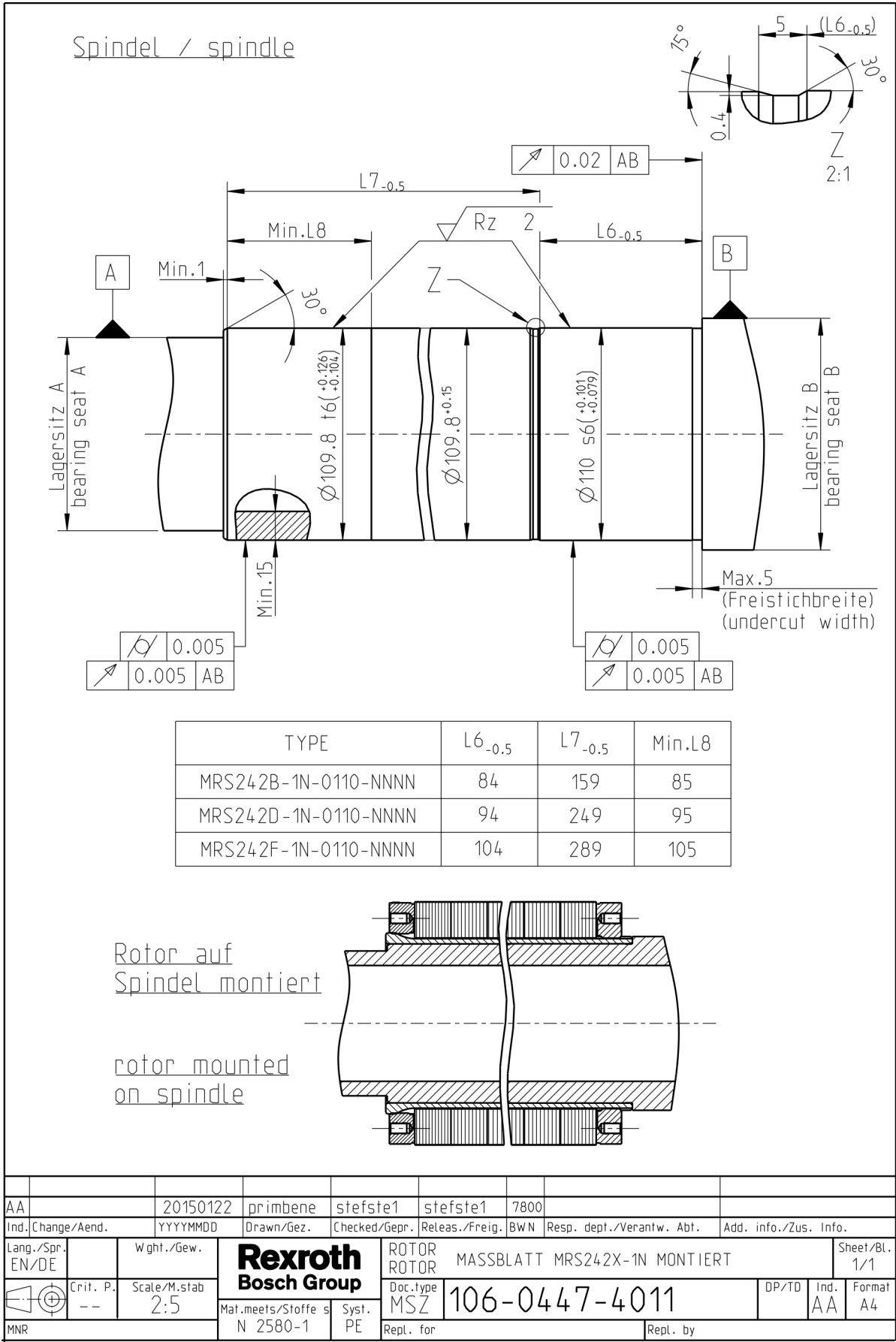


Fig. 99: MRS242 in frame size "1N", mounted

4.7.7 MRS242 in frame size “2N” (step interference fit)

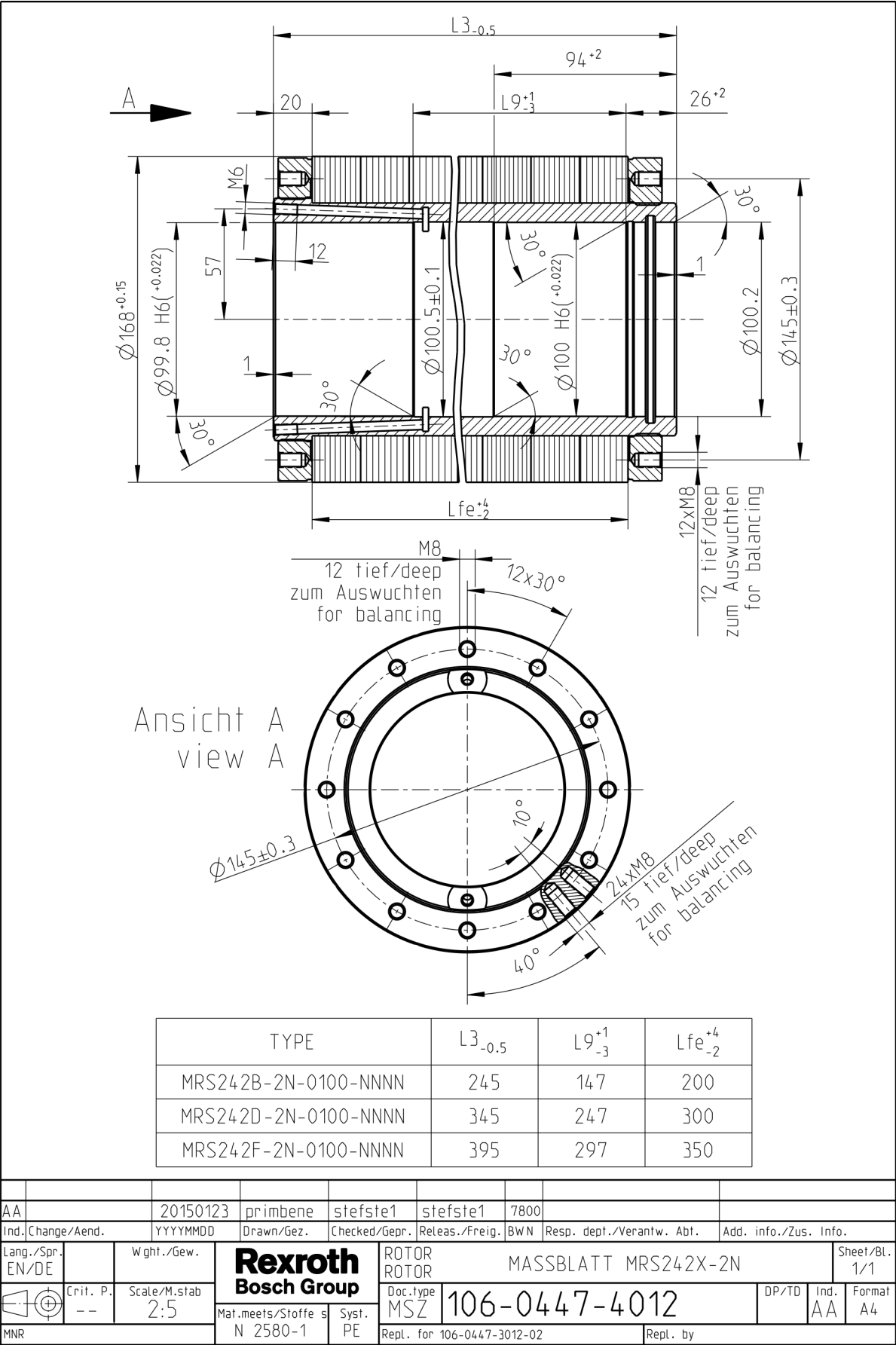


Fig. 100: MRS242 in frame size “2N”

4.7.8 MRS242 in frame size “2N”, mounted

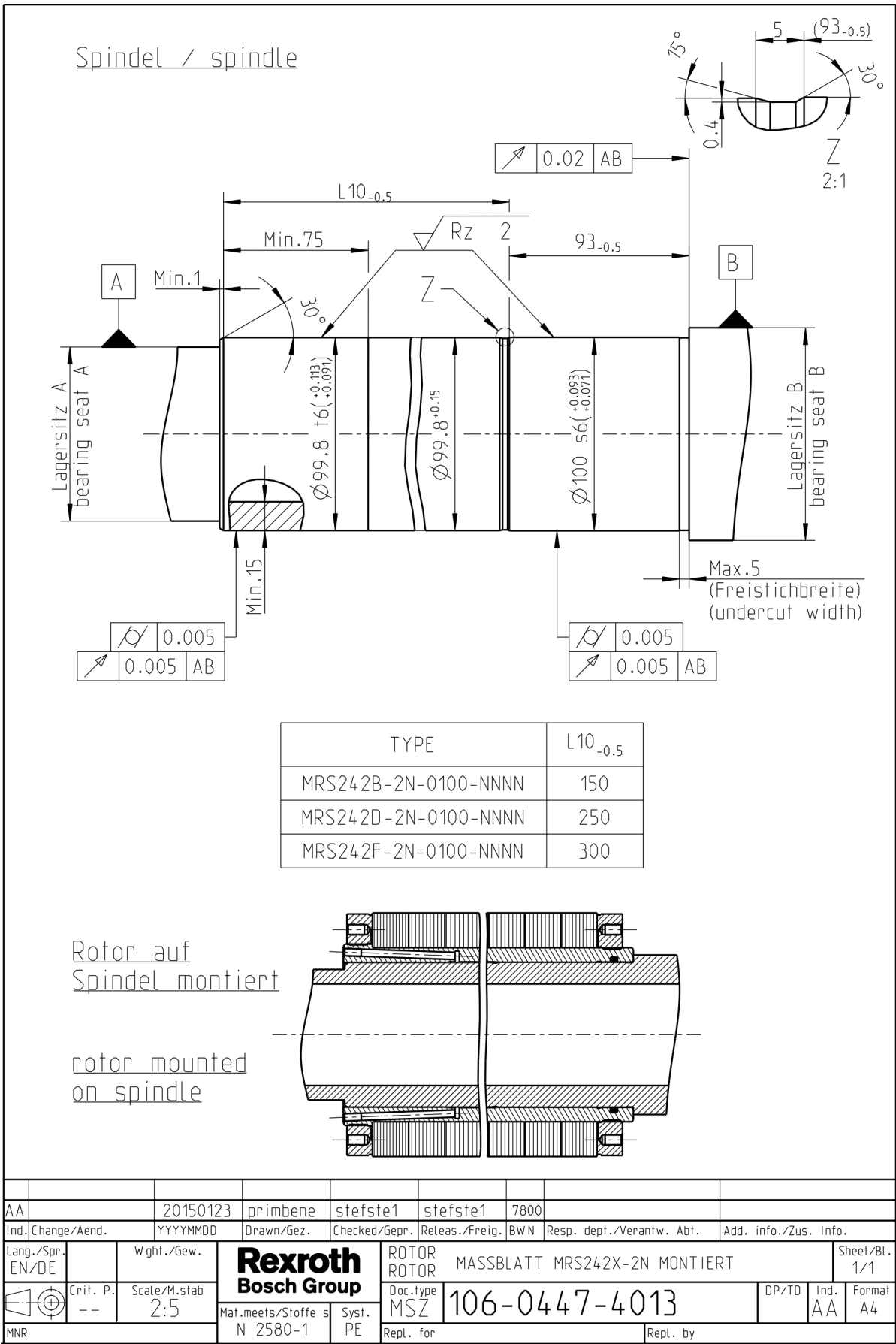


Fig. 101: MRS242 in frame size “2N”, mounted

4.8 Frame size 272

4.8.1 MBS272 with rotor frame size “1N”

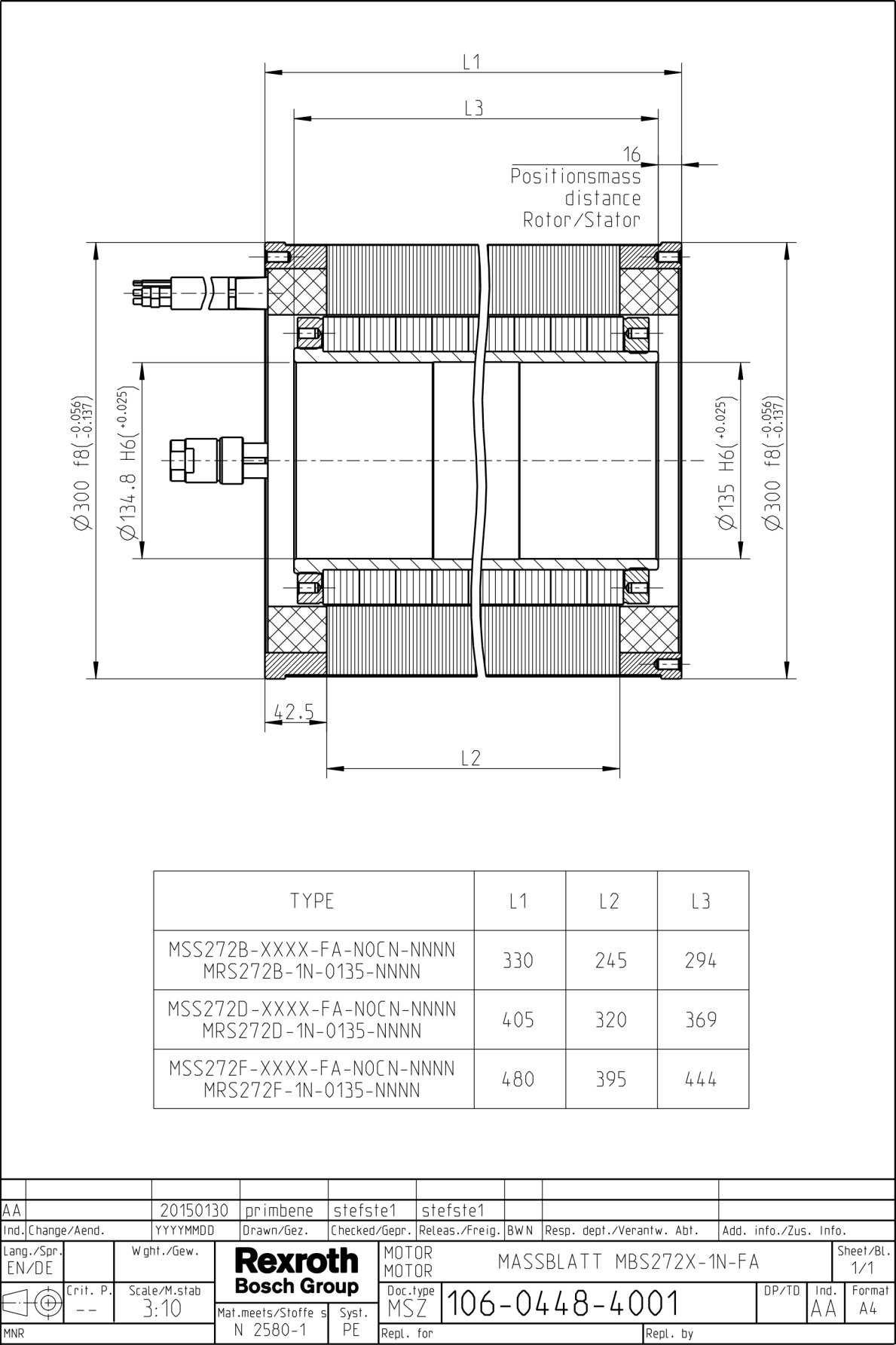
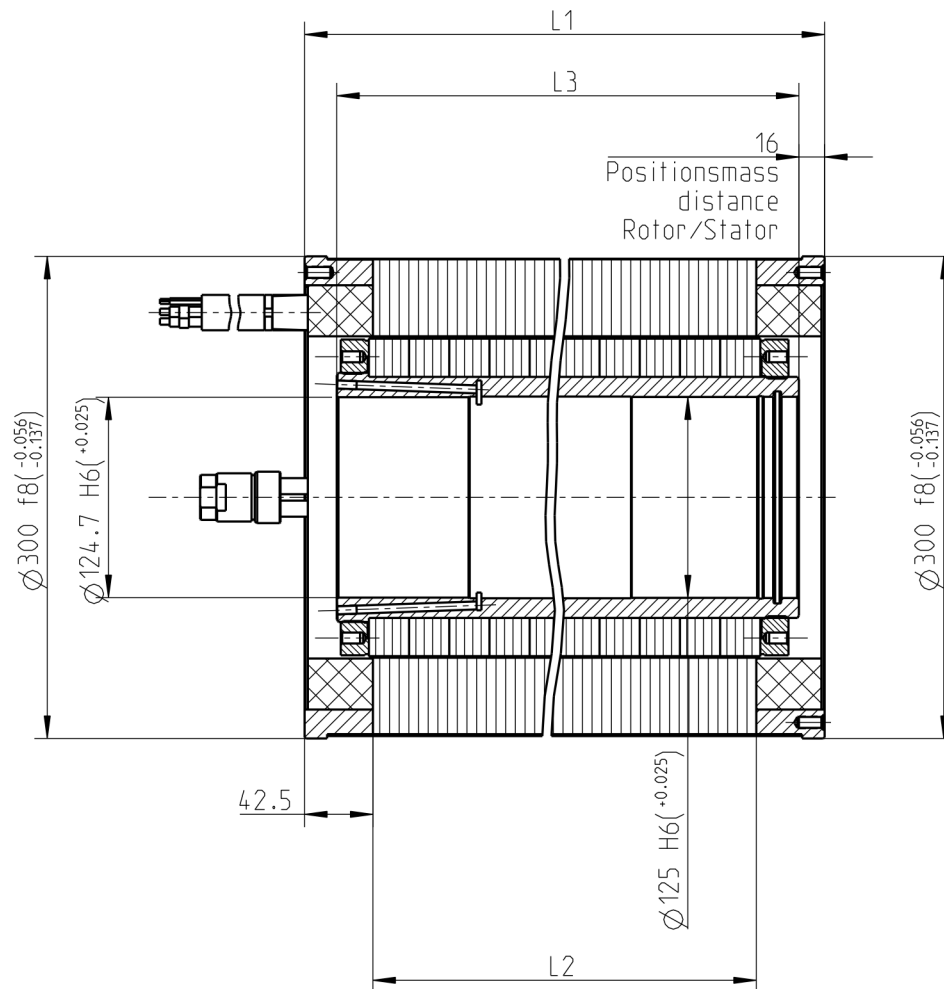


Fig. 102: MBS272 with coolant connection “axial” and rotor frame size “1N”

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4.8.2 MBS272 with rotor frame size "2N"



TYPE	L1	L2	L3
MSS272B-XXXX-FA-NOCN-NNNN MRS272B-2N-0125-NNNN	330	245	294
MSS272D-XXXX-FA-NOCN-NNNN MRS272D-2N-0125-NNNN	405	320	369
MSS272F-XXXX-FA-NOCN-NNNN MRS272F-2N-0125-NNNN	480	395	444

AA		20150128	primbene	stefste1	stefste1				
Ind. Change/Aend.		YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.	
Lang./Spr. EN/DE		Wght./Gew.	Rexroth Bosch Group			MOTOR MOTOR MASSBLATT MBS272X-2N-FA			Sheet/Bt. 1/1
	Crit. P. --	Scale/M.stab 1:4				Doc.type MSZ	106-0448-4002	DP/TD AA	Formal A4
MNR			Mat.meets/Stoffe s N 2580-1	Syst. PE	Repl. for		Repl. by		

Fig. 103: MBS272 with coolant connection "axial" and rotor frame size "2N"

4.8.3 MSS272 with coolant connection “FA”

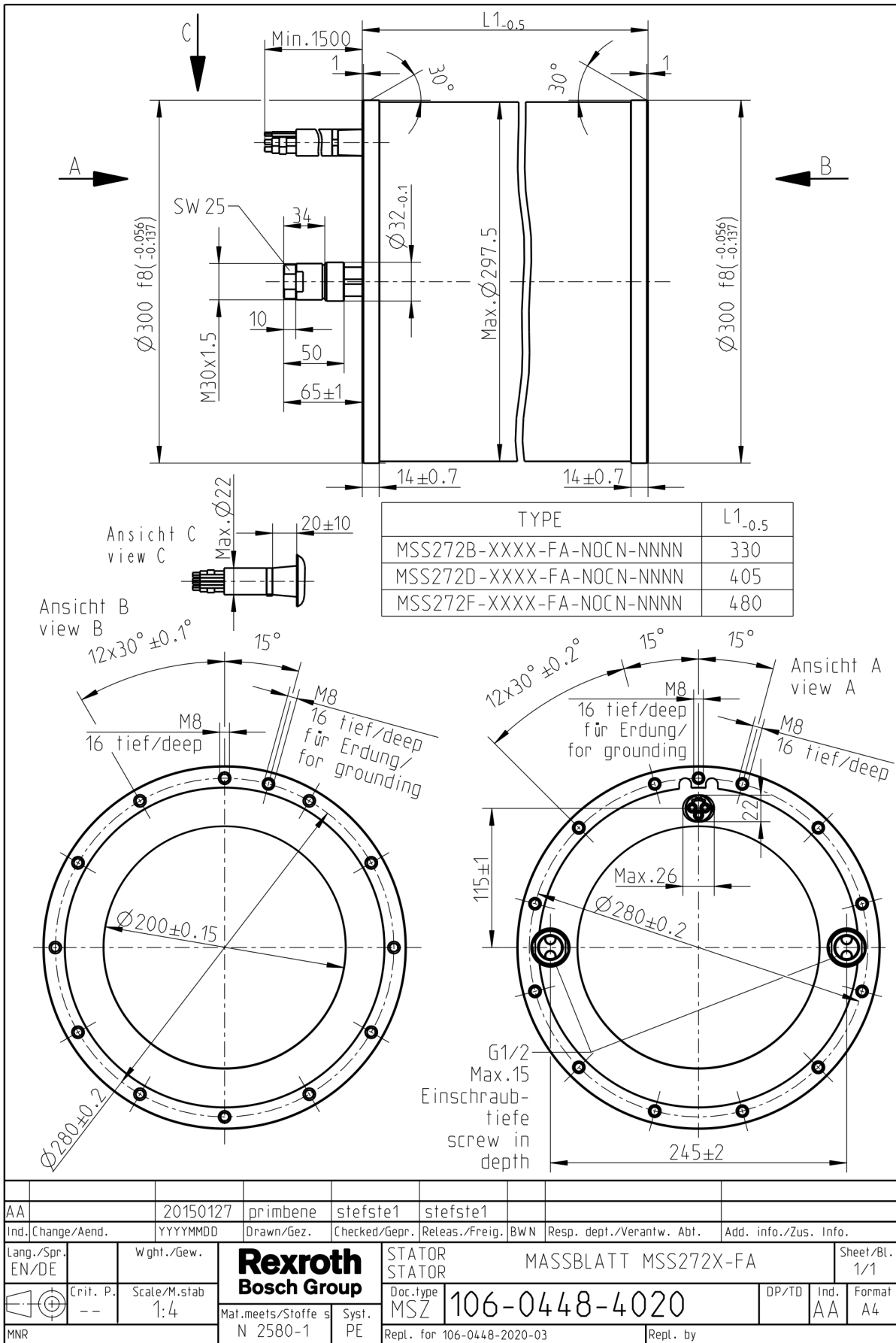


Fig. 104: MSS272 with coolant connection “axial”

4.8.4 MSS272 with coolant connection “FA”, mounted

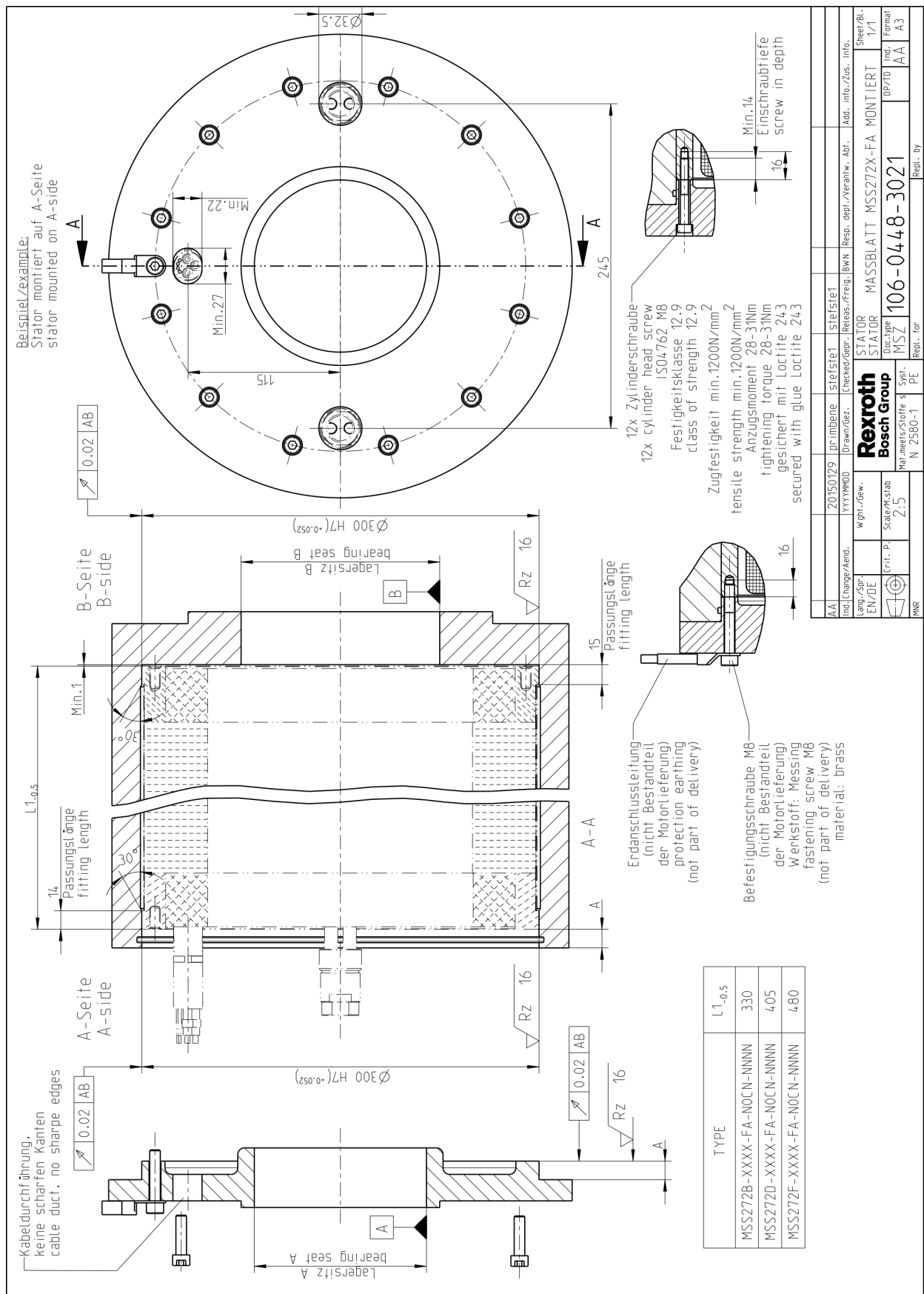


Fig. 105: MSS272 with coolant connection “axial”, mounted

4.8.5 MRS272 in frame size “1N” (smooth hole)

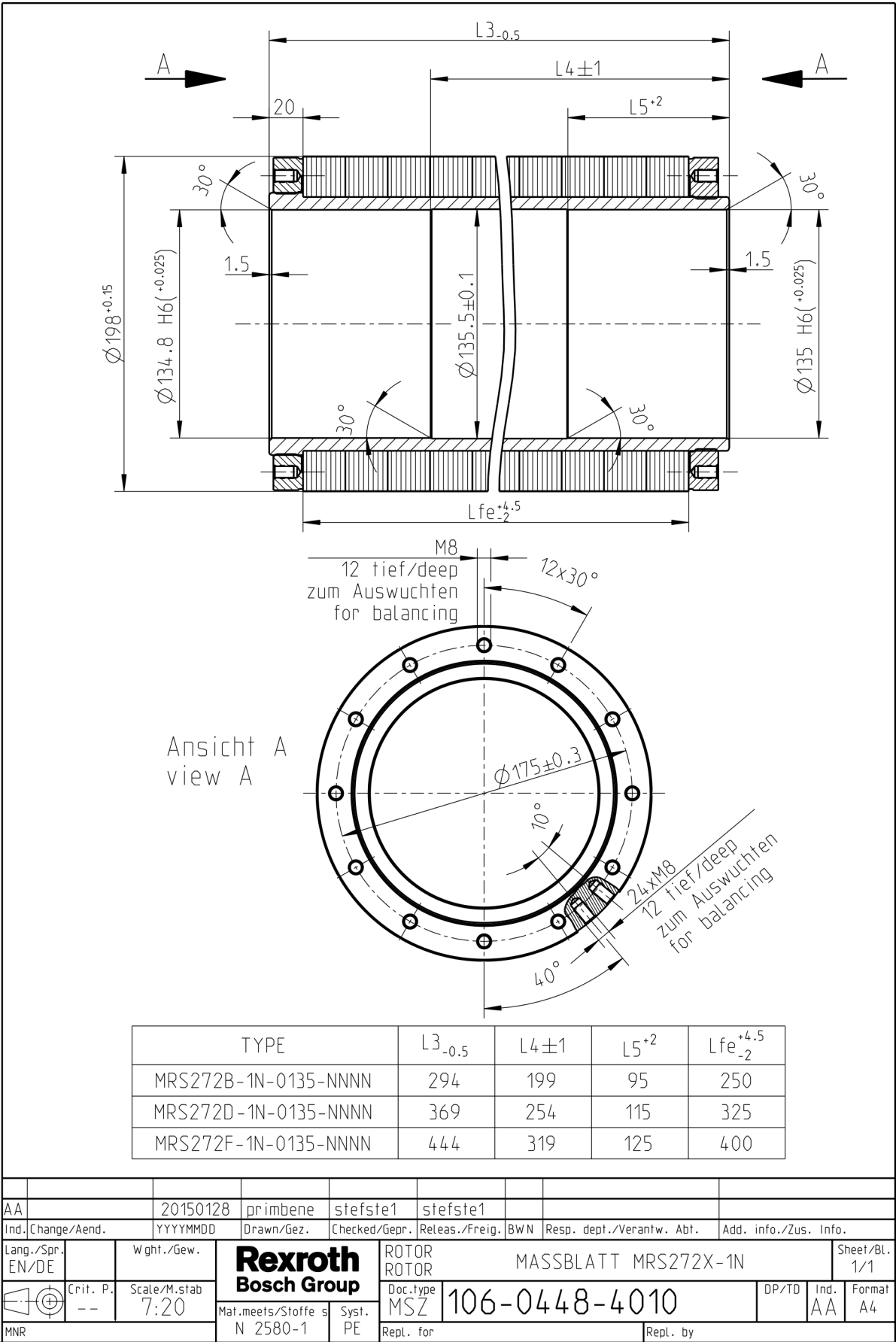
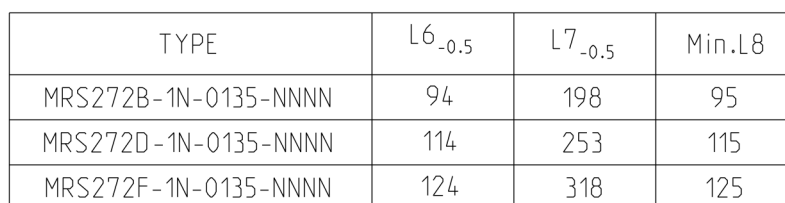
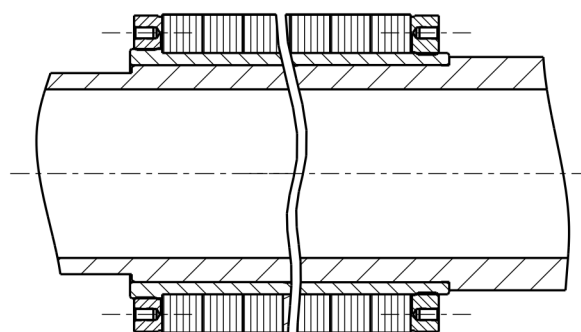


Fig. 106: MRS272 in frame size “1N”

Spindel / spindle

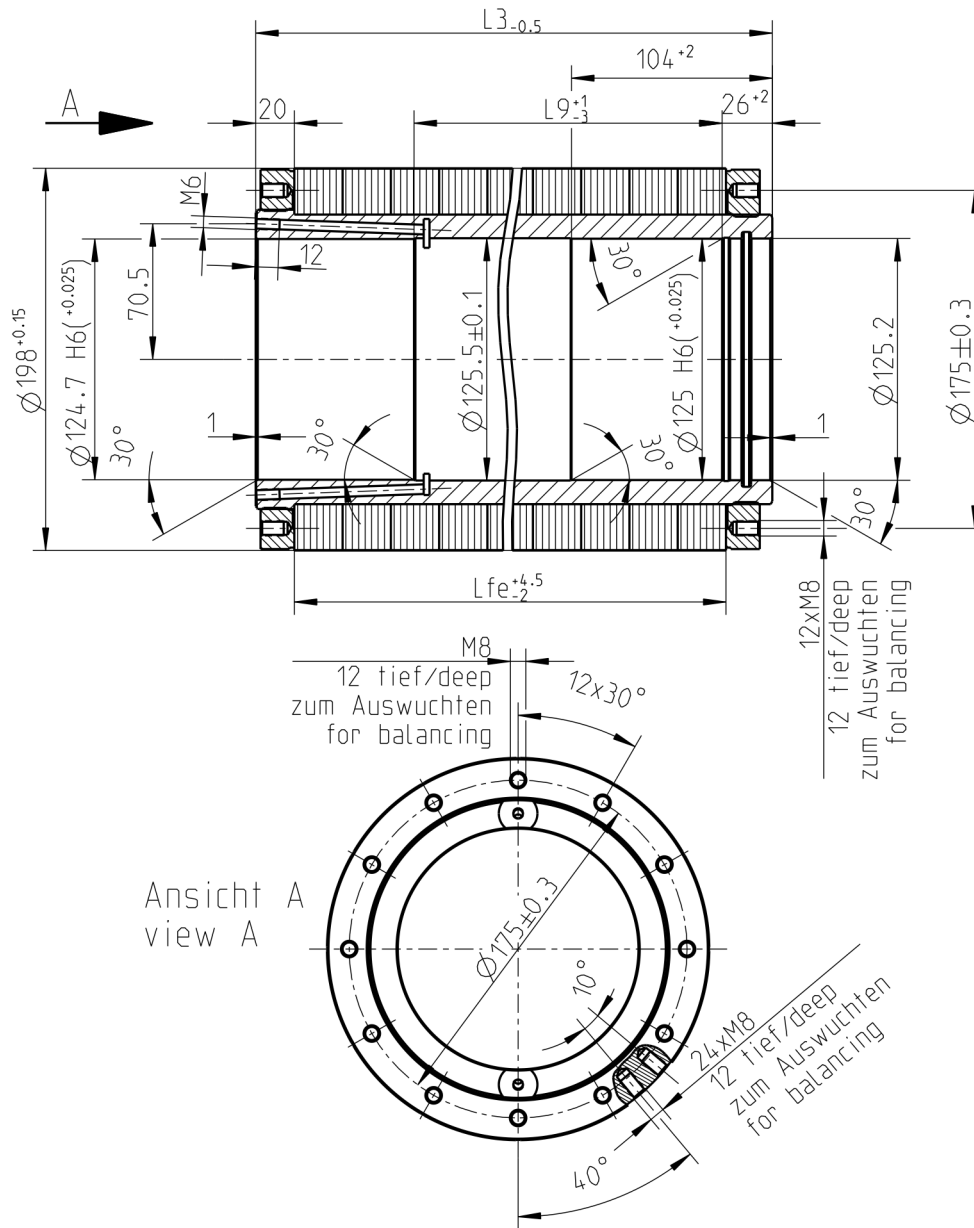


Rotor auf Spindel montiert
rotor mounted on spindle

[illegible]

Bosch Rexroth AG

4.8.7 MRS272 in frame size “2N” (step interference fit)



TYPE	$L_{-0.5}^3$	L_{-3}^{9+1}	$L_{-2}^{4.5+}$
MRS272B-2N-0125-NNNN	294	186	250
MRS272D-2N-0125-NNNN	369	261	325
MRS272F-2N-0125-NNNN	444	336	400

AA		20150130	primbene	stefste1	stefste1								
Ind.	Change./Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.					
Lang./Spr.		W ght./Gew.	Rexroth Bosch Group	ROTOR ROTOR MASSBLATT MRS272X-2N							Sheet./Bl.		
EN/DE											1/1		
	Crit. P.	Scale/M.stab		Doc. type MSZ							DP/TD	Ind.	Format
		3:10		106-0448-4012							AA	A4	
MNR			Mat.meets/Stoffe s	Syst.	Repl. for 106-0448-3012-02				Repl. by				
			N 2580-1	PE									

Fig. 108: MRS272 in frame size "2N"

Spindel / spindle



4.9 Frame size 312

4.9.1 MBS312 with rotor frame size “1N”

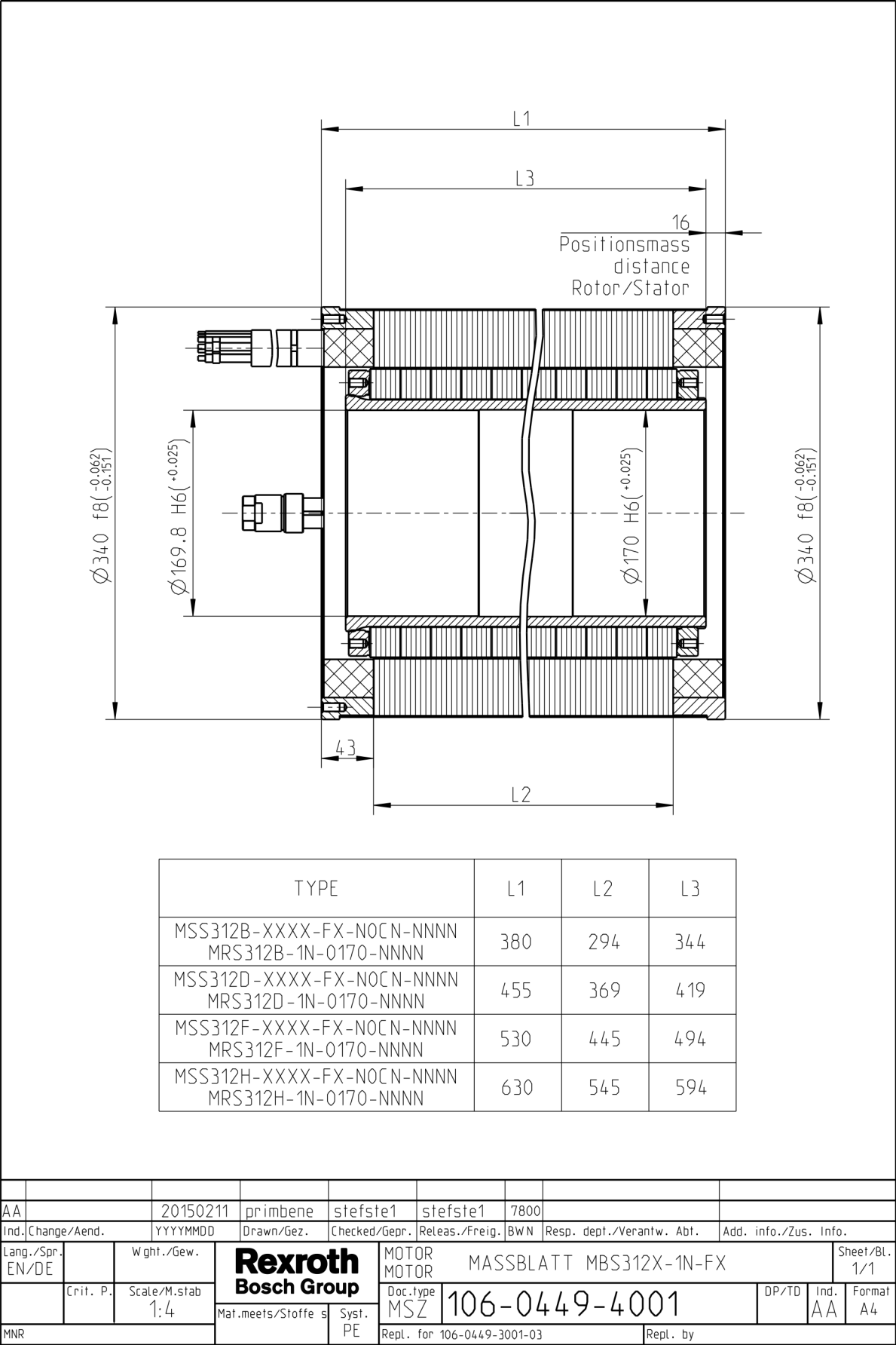


Fig. 110: MBS312 with rotor frame size “1N”

4.9.2 MBS312 with rotor frame size "2N"

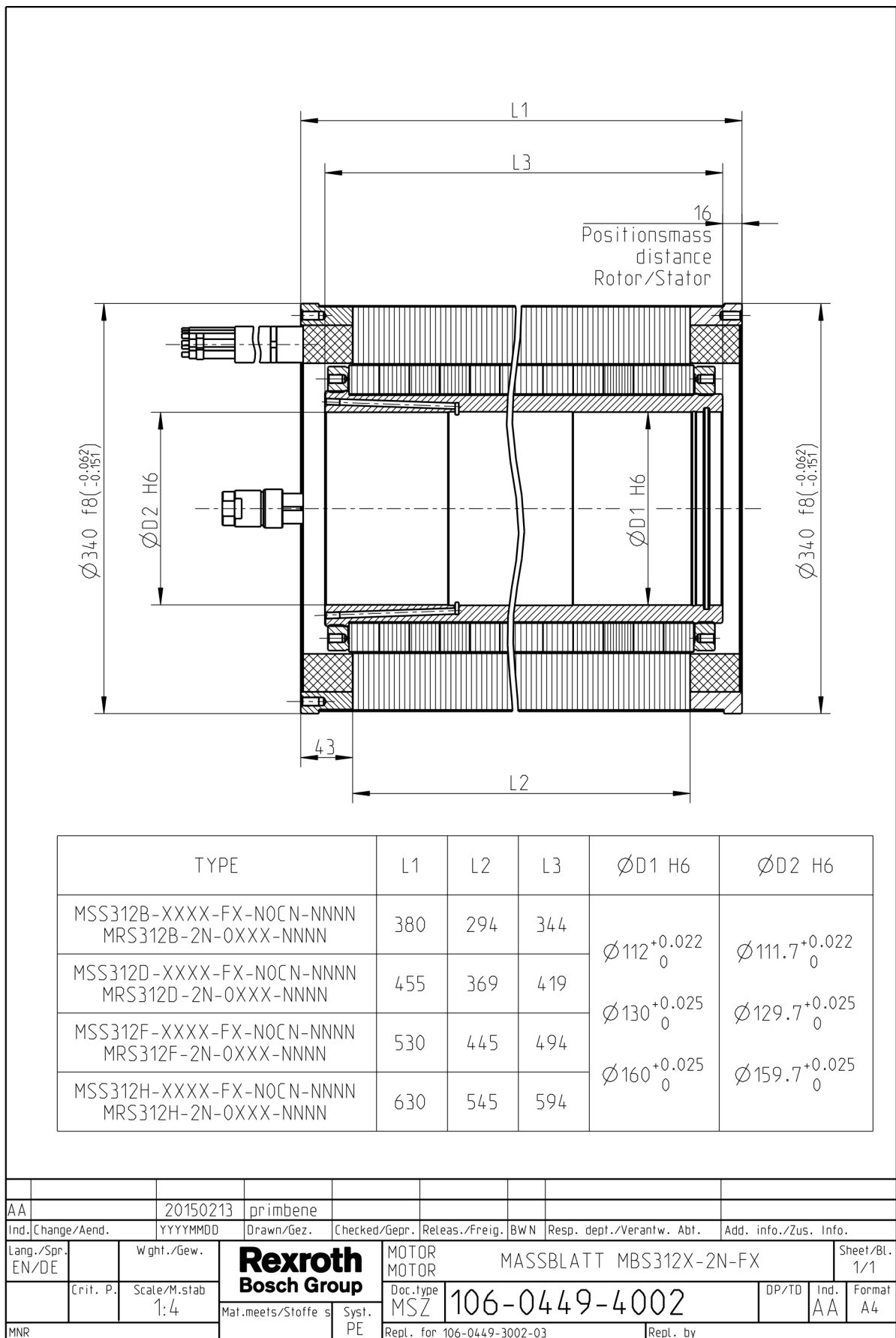


Fig. 111: MBS312 with rotor frame size "2N"

4.9.3 MSS312 with coolant connection “FA”

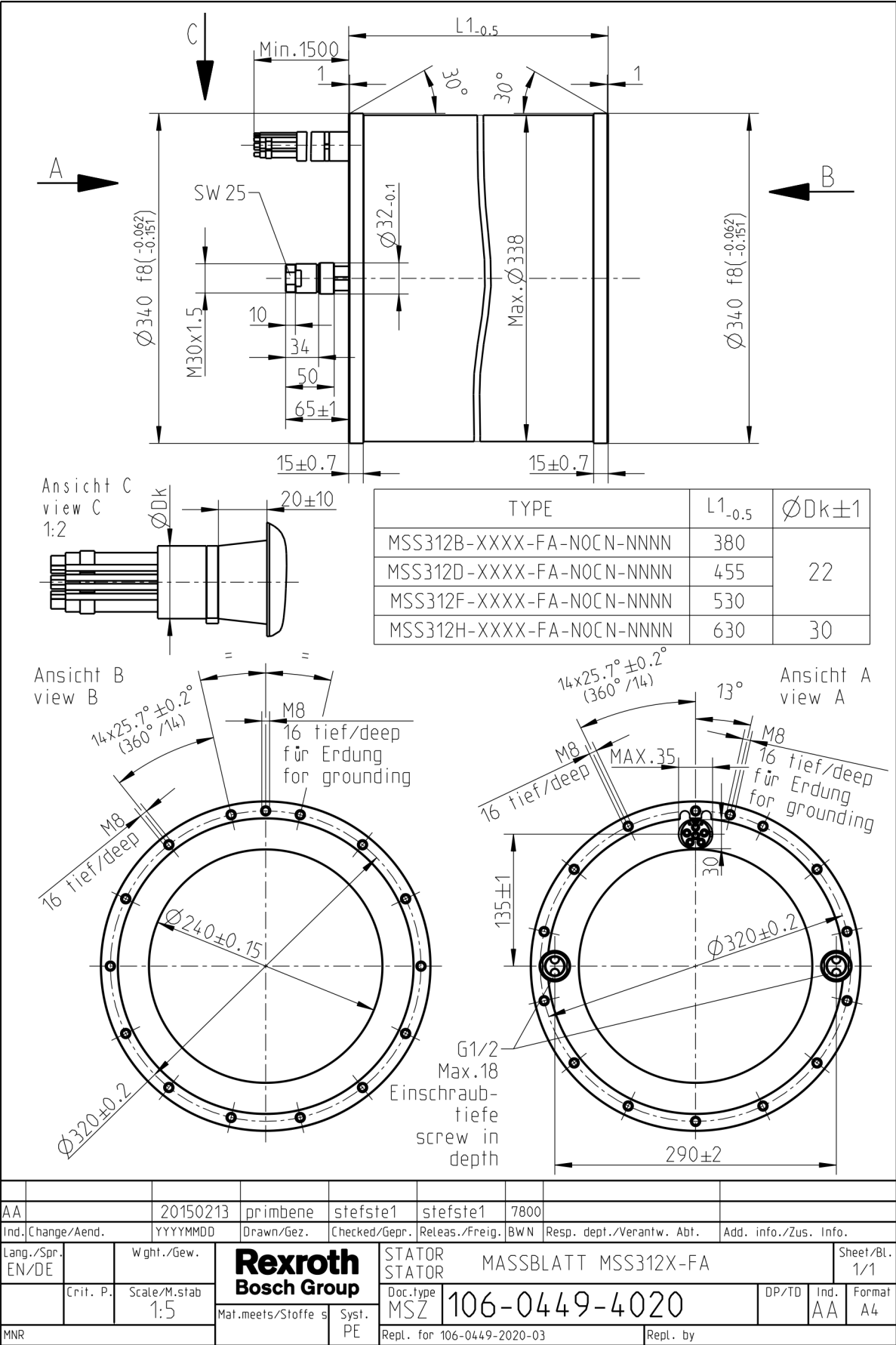


Fig. 112: MSS312 with coolant connection “axial”

4.9.4 MSS312 with coolant connection “FA”, mounted

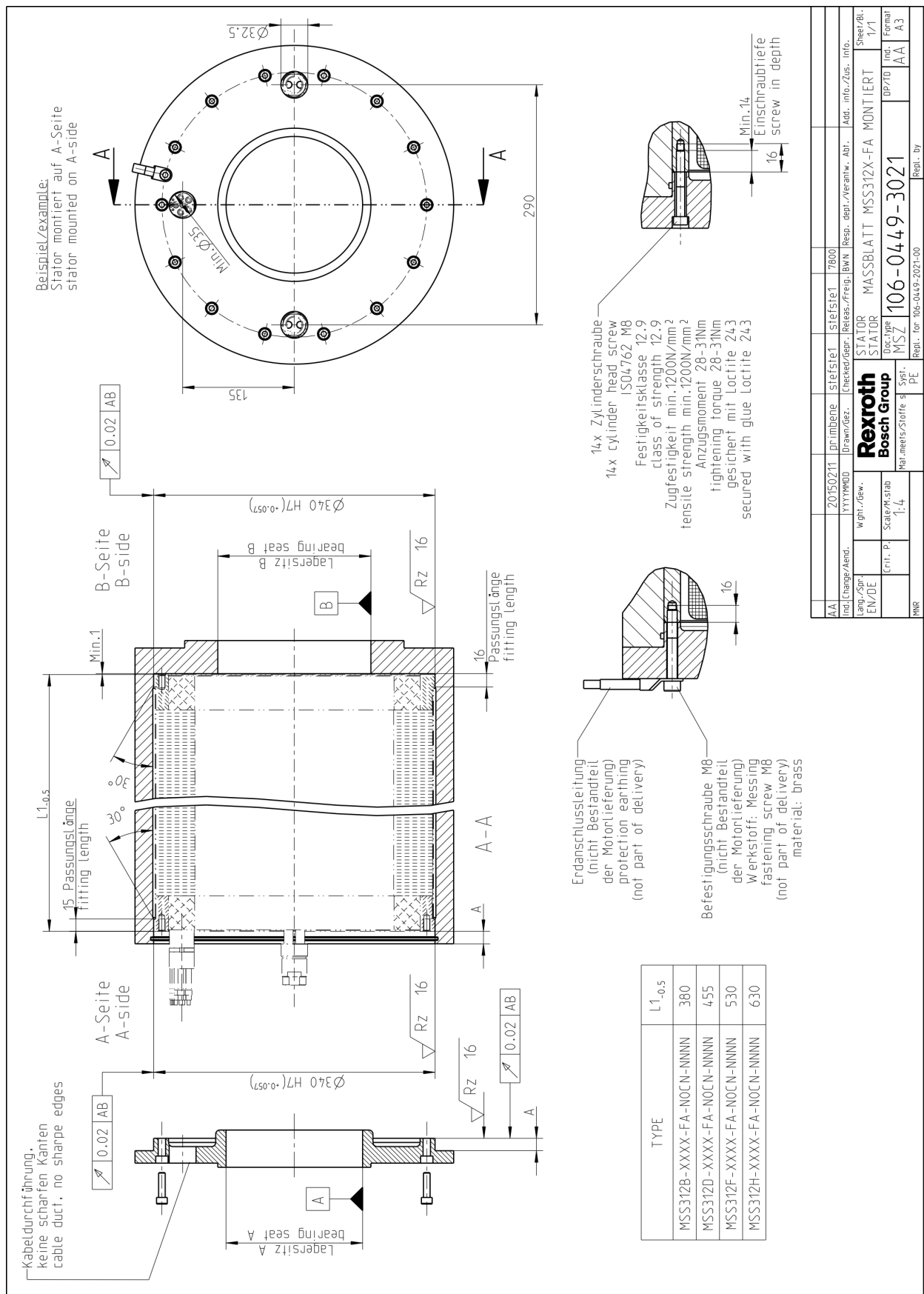


Fig. 113: MSS312 with coolant connection “axial”, mounted

4.9.5 MSS312 with coolant connection "FR"

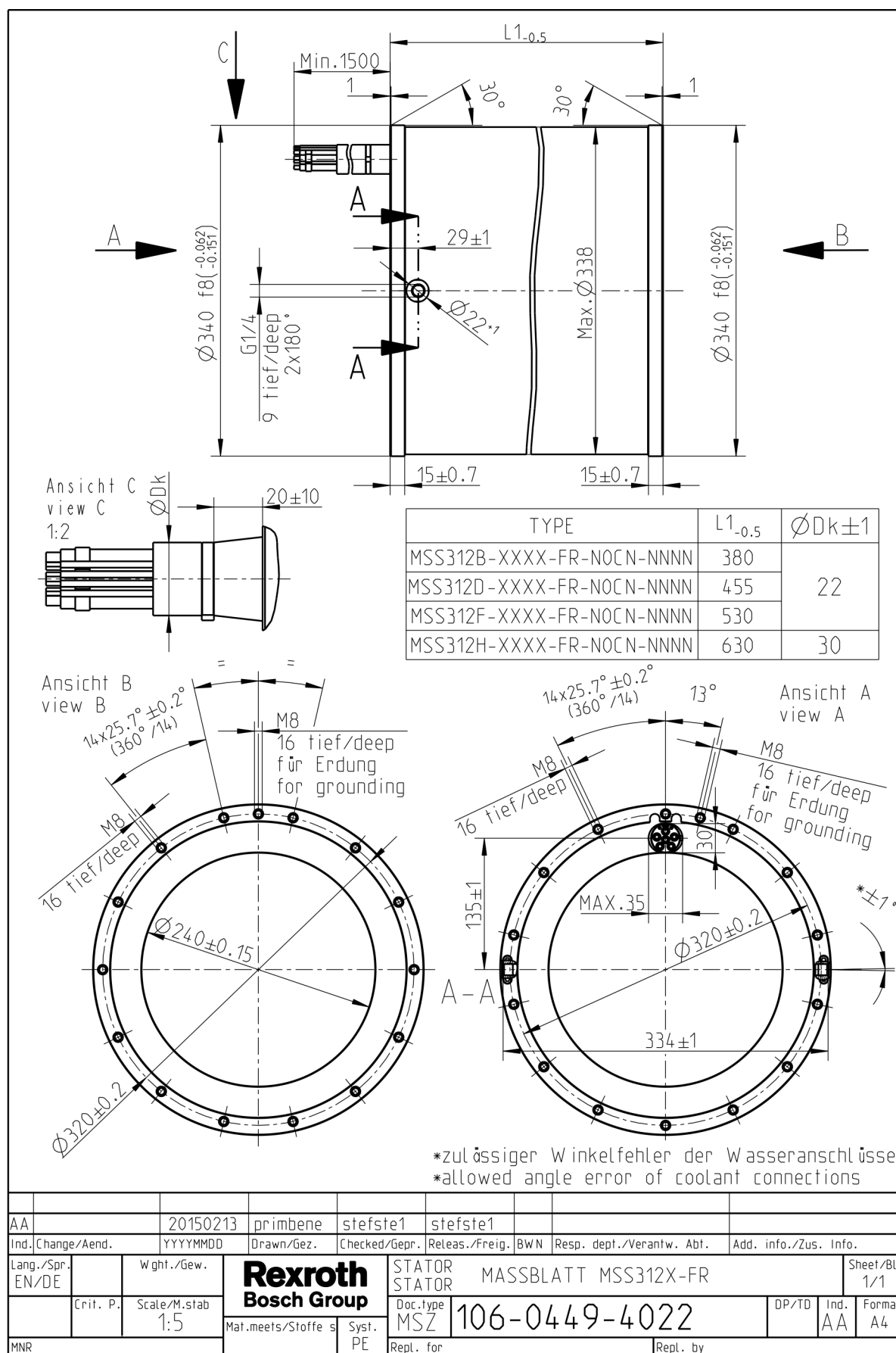


Fig. 114: MSS312 with coolant connection "radial"

4.9.6 MSS312 with coolant connection “FR”, mounted

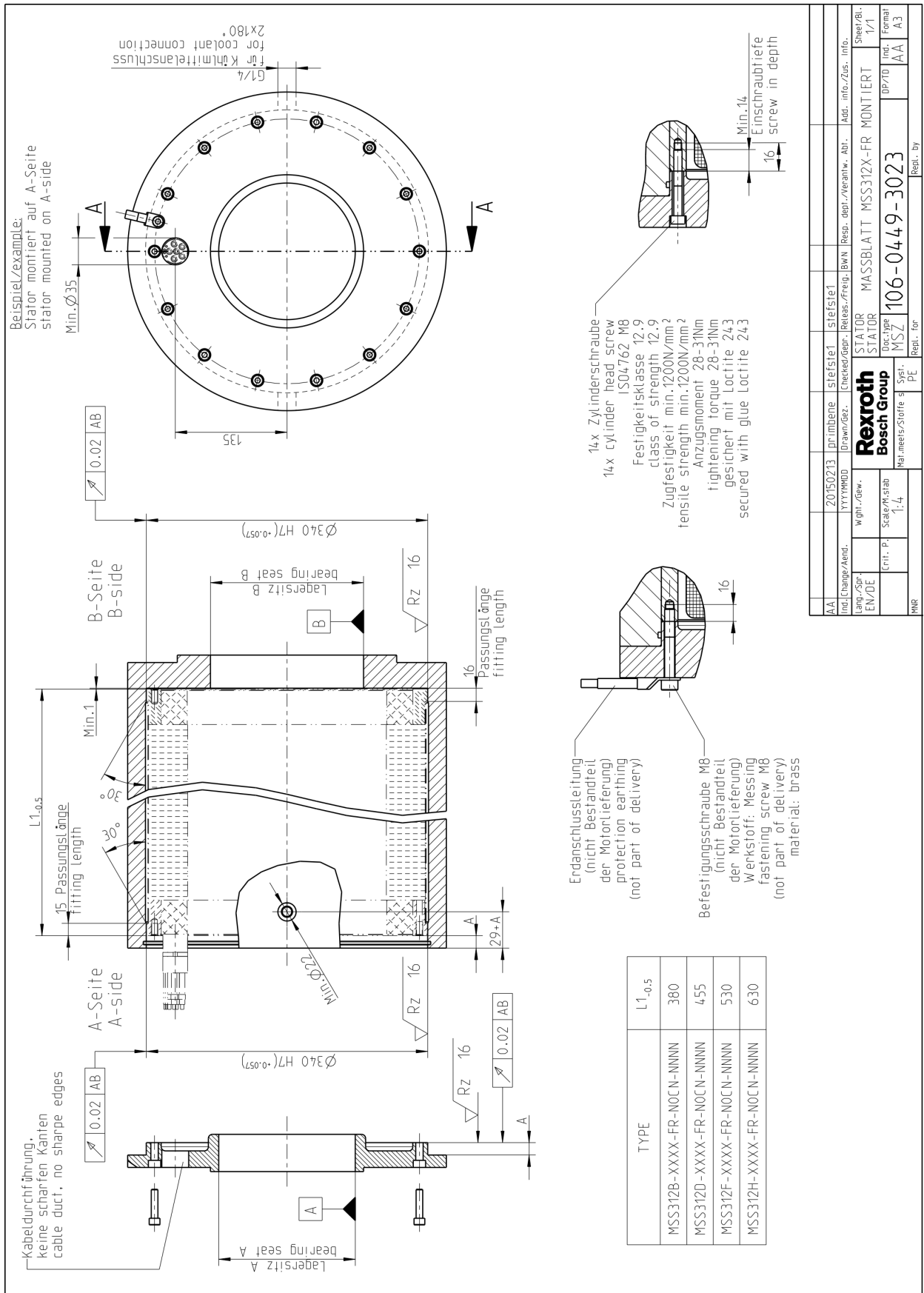


Fig. 115: MSS312 with coolant connection “radial”, mounted

4.9.7 MRS312 in frame size "1N" (smooth hole)

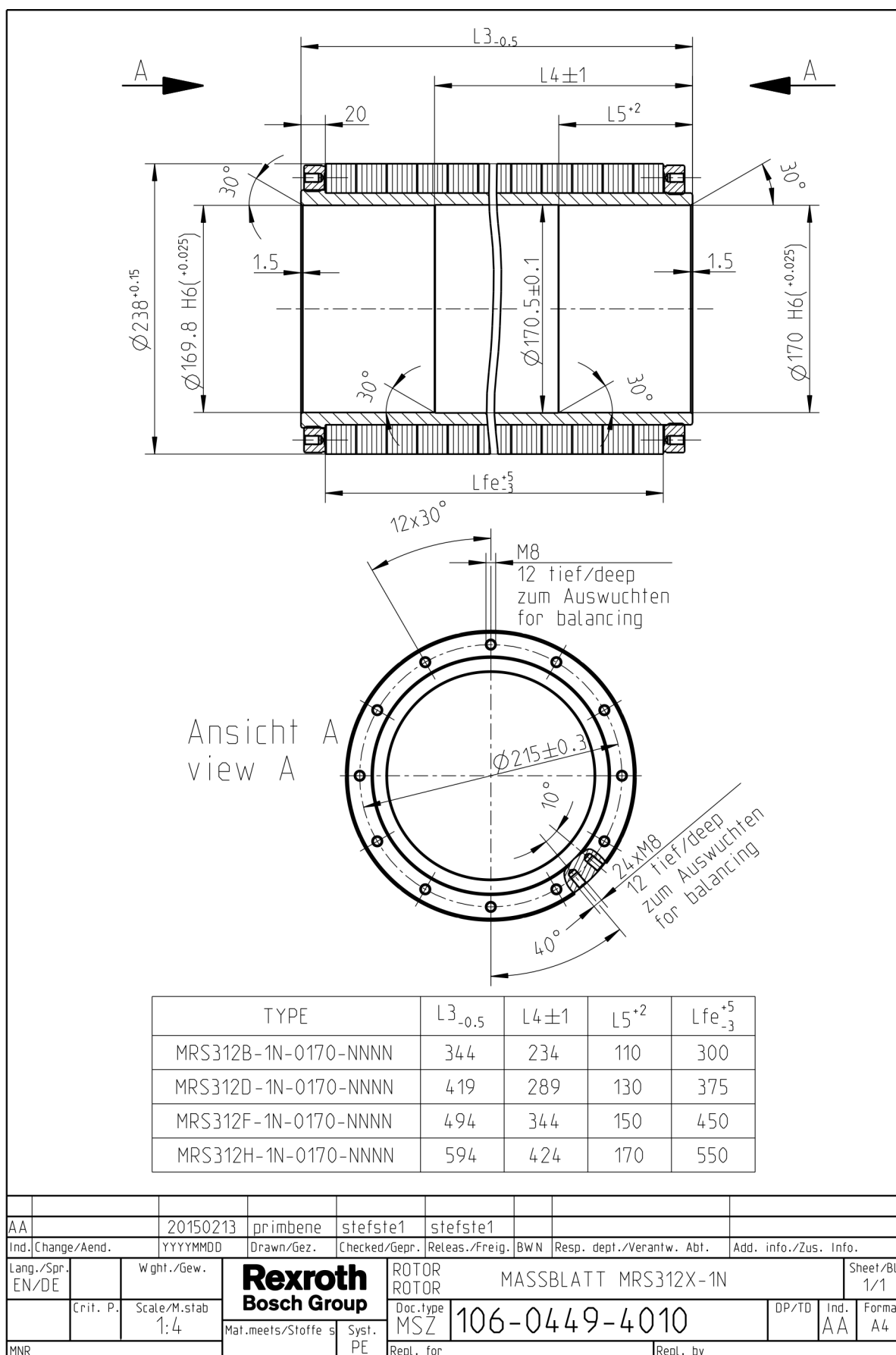


Fig. 116: MRS312 in frame size "1N"

4.9.8 MRS312 in frame size "1N", mounted

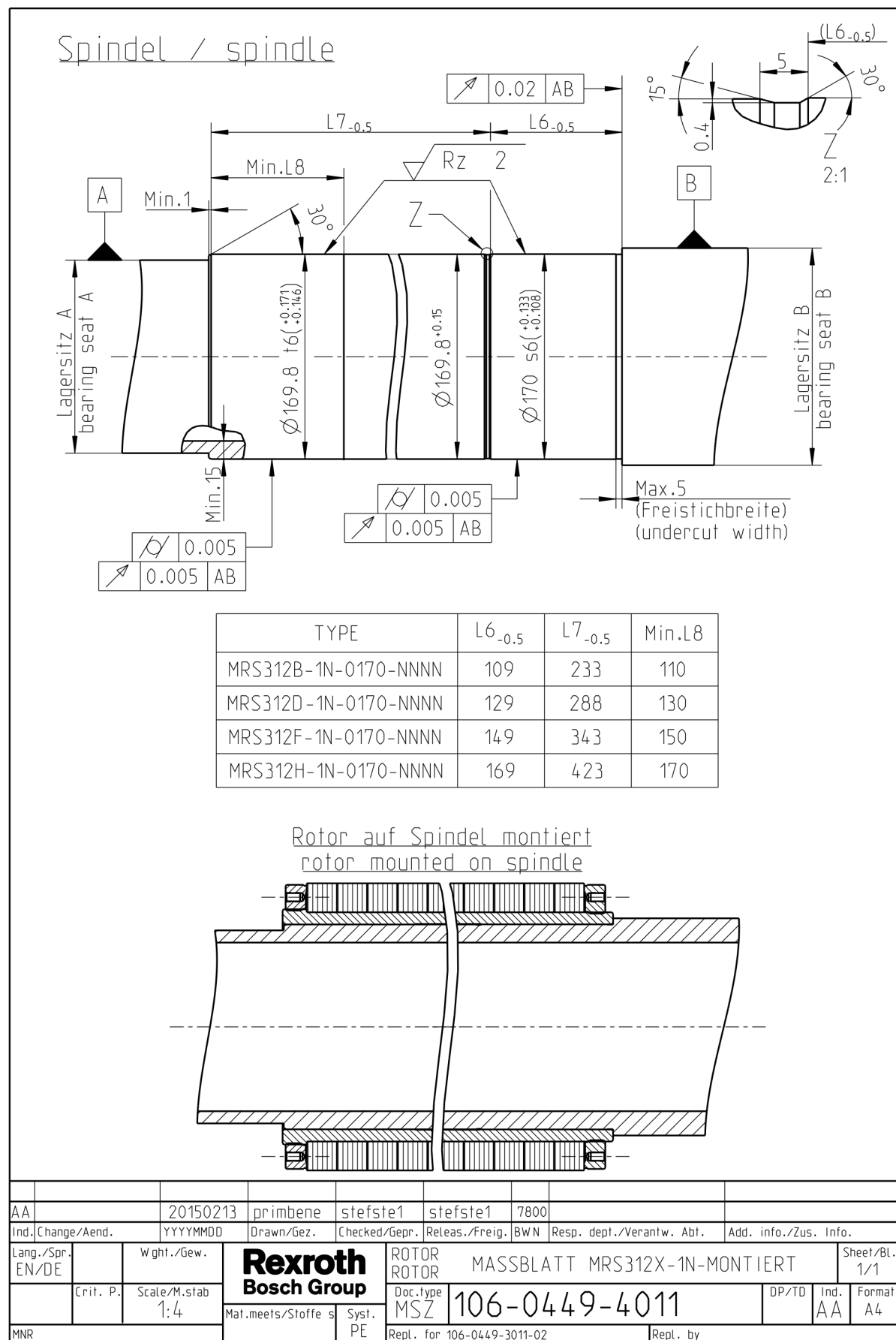


Fig. 117: MRS312 in frame size "1N", mounted

4.9.9 MRS312 in frame size “2N” (step interference fit)

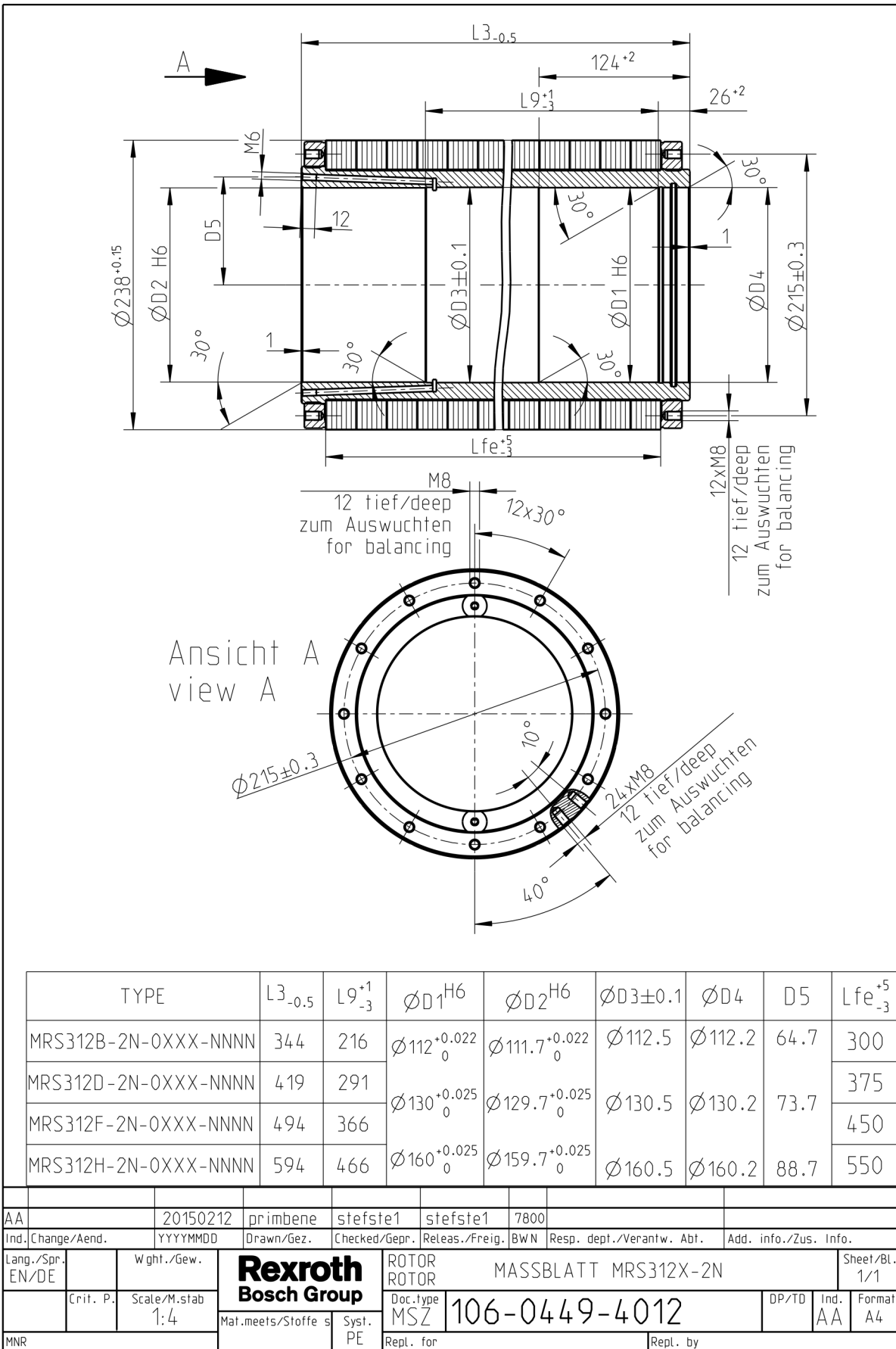


Fig. 118: MRS312 in frame size “2N”

4.9.10 MRS312 in frame size "2N", mounted

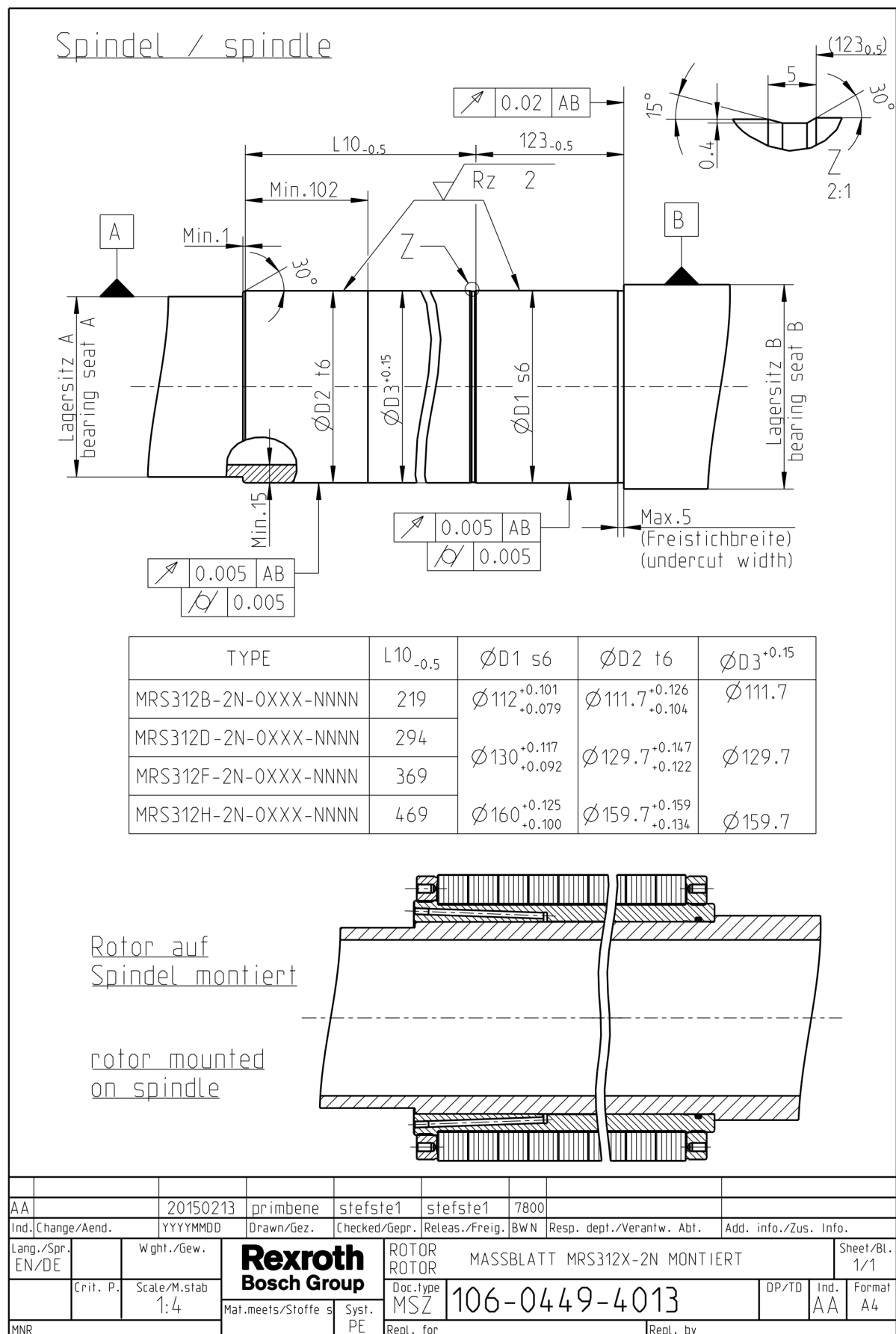


Fig. 119: MRS312 in frame size "2N", mounted

4.10 Frame size 382

4.10.1 MBS382 with rotor frame size “1N”

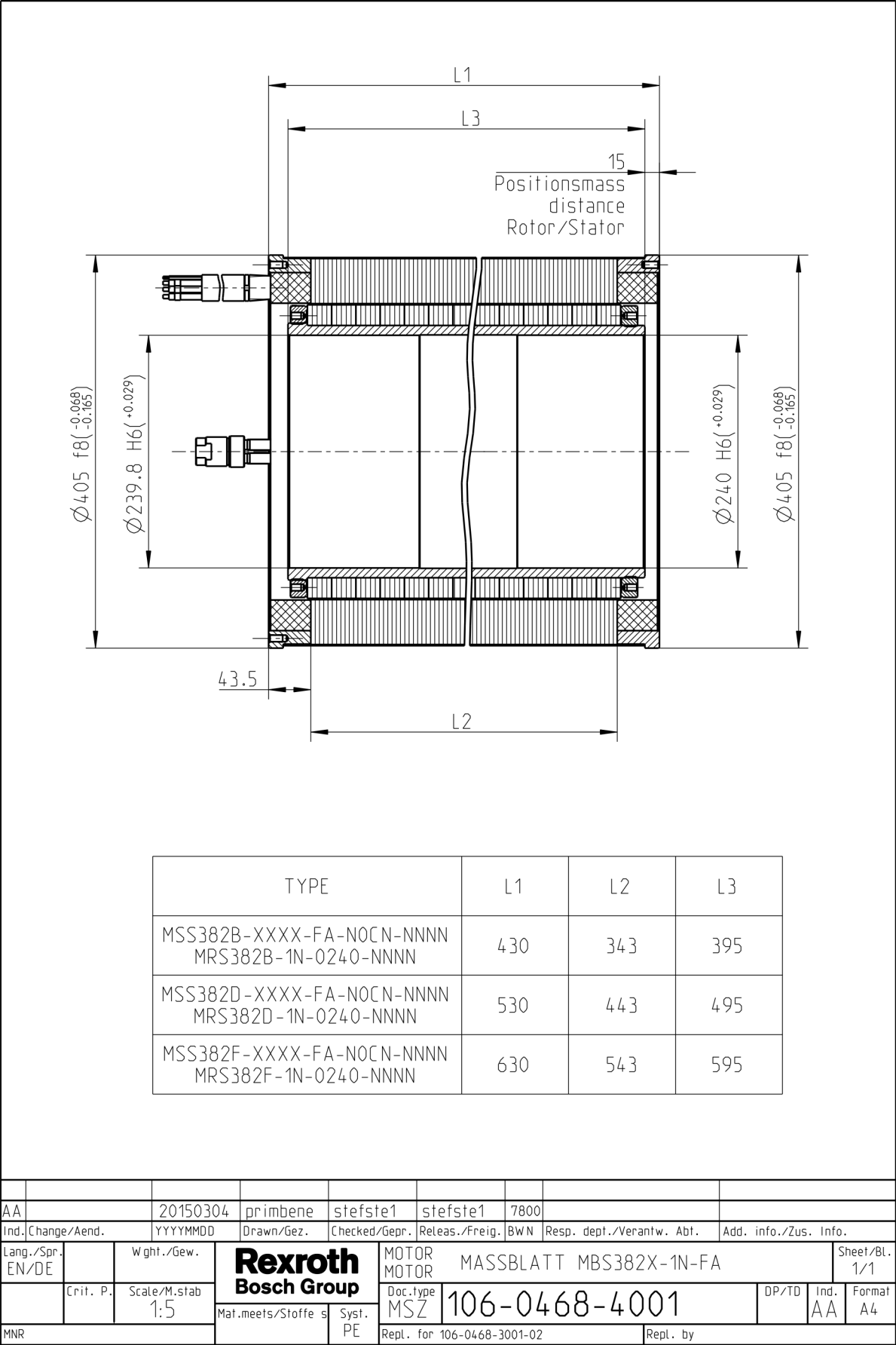


Fig. 120: MBS382 with rotor frame size “1N”

4.10.2 MBS382 with rotor frame size "2N"

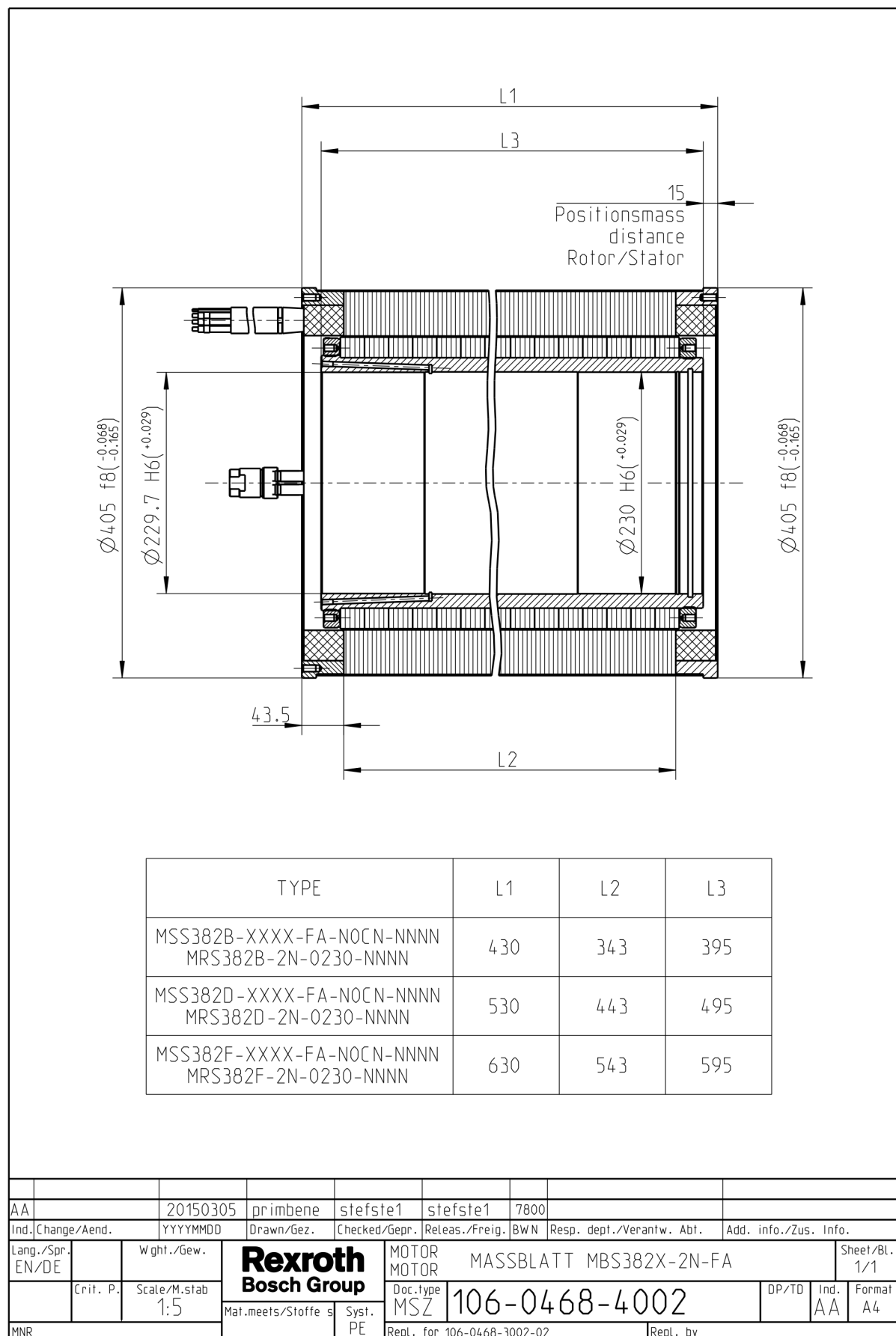


Fig. 121: MBS382 with rotor frame size "2N"

4.10.3 MSS382 with coolant connection “FA”

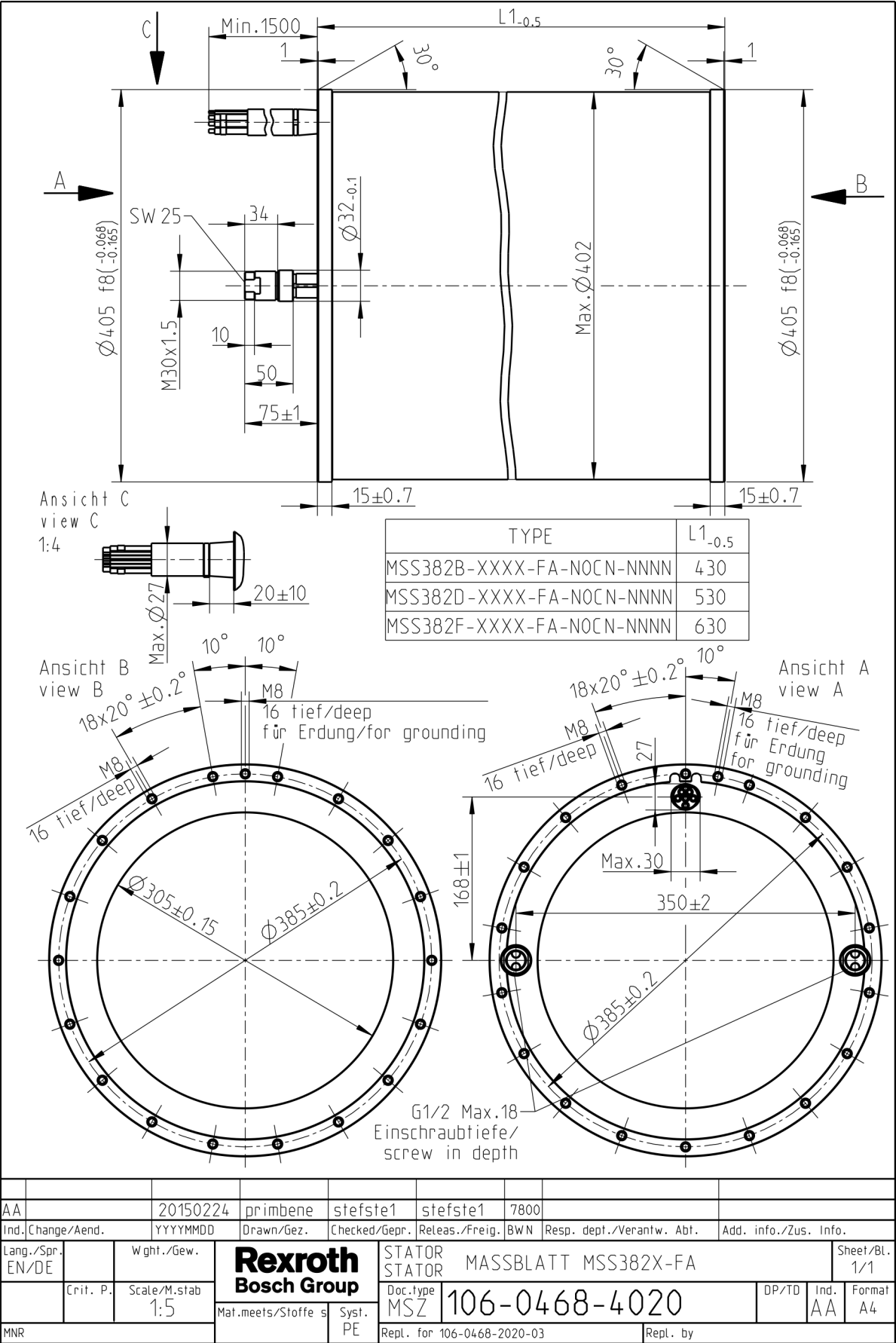


Fig. 122: MSS382 with coolant connection “FA”

4.10.4 MSS382 with coolant connection “FA”, mounted

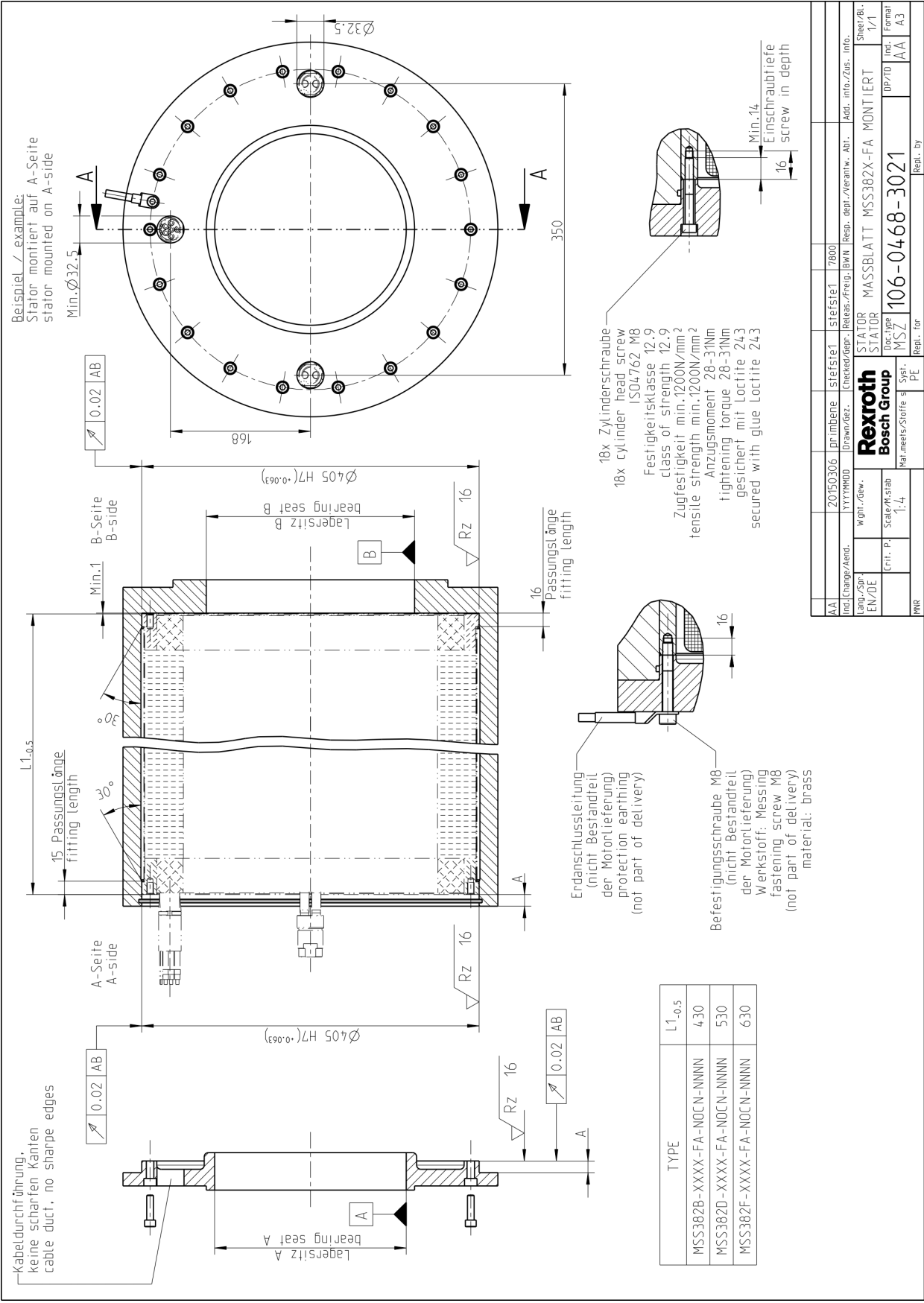


Fig. 123: MSS382 with coolant connection “FA”, mounted

4.10.5 MRS382 in frame size “1N” (smooth hole)



TYPE	L3 _{-0.5}	L4±1	L5 ⁺²	Lfe ₋₃ ⁵
MRS382B-1N-0240-NNNN	395	260	130	350
MRS382D-1N-0240-NNNN	495	330	160	450
MRS382F-1N-0240-NNNN	595	390	200	550

AA		20150304	primbene	stefste1	stefste1	7800						
Ind./Change/Aend.		YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.		Add. info./Zus. Info.			
Lang./Spr. EN/DE		Wght./Gew.				ROTOR		MASSBLATT MRS382X-1N		Sheet/Bt. 1/1		
						ROTOR						
	Crit. P.	Scale/M.stab 1:5	Mat.meets/Stoffe s		Syst. PE	Doc.type MSZ		106-0468-4010		DP/TD	Ind. AA	Format A4
MNR							Repl. for				Repl. by	

Fig. 124: MRS382 in frame size "1N"

4.10.6 MRS382 in frame size "1N", mounted

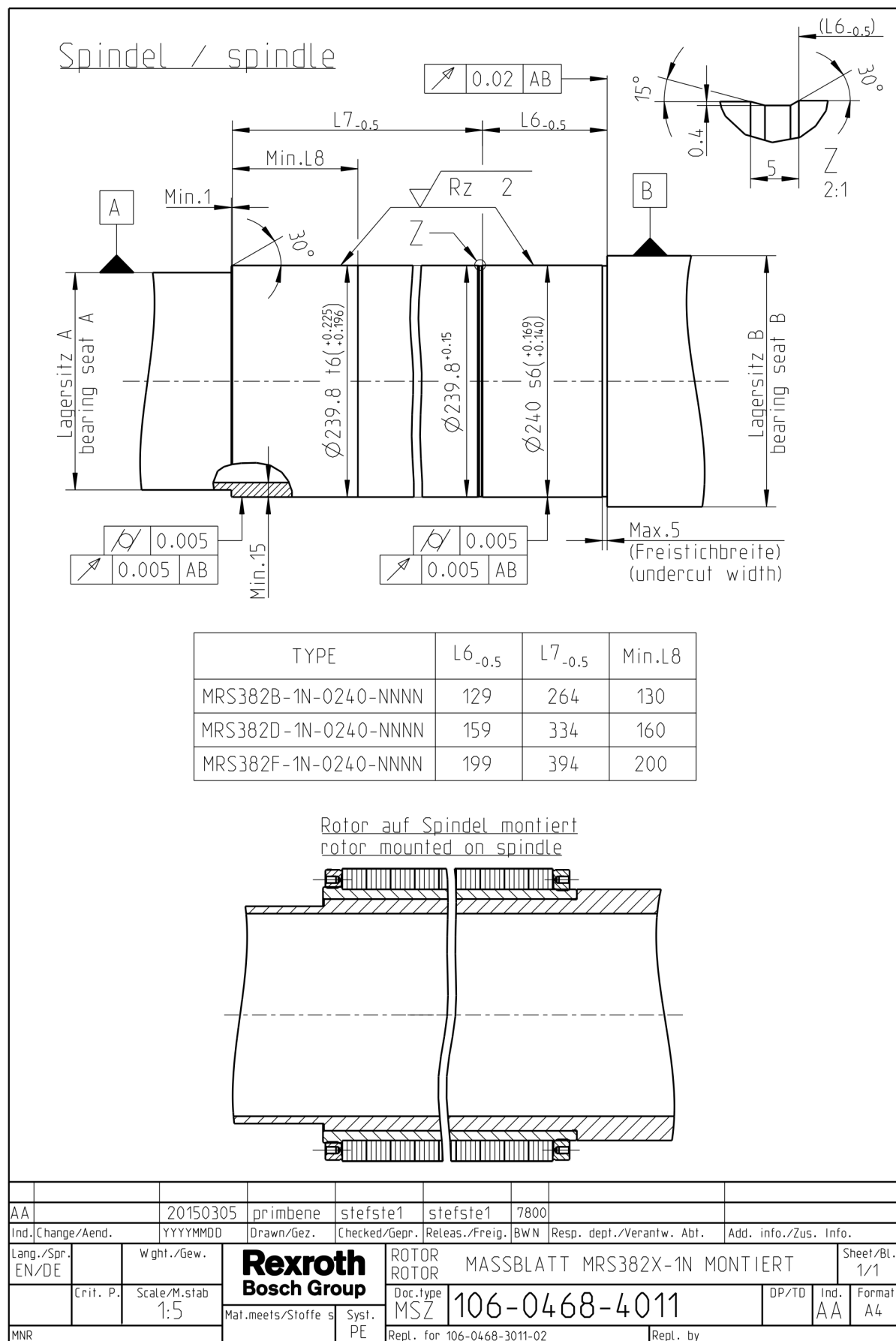


Fig. 125: MRS382 in frame size "1N", mounted

4.10.7 MRS382 in frame size “2N” (step interference fit)

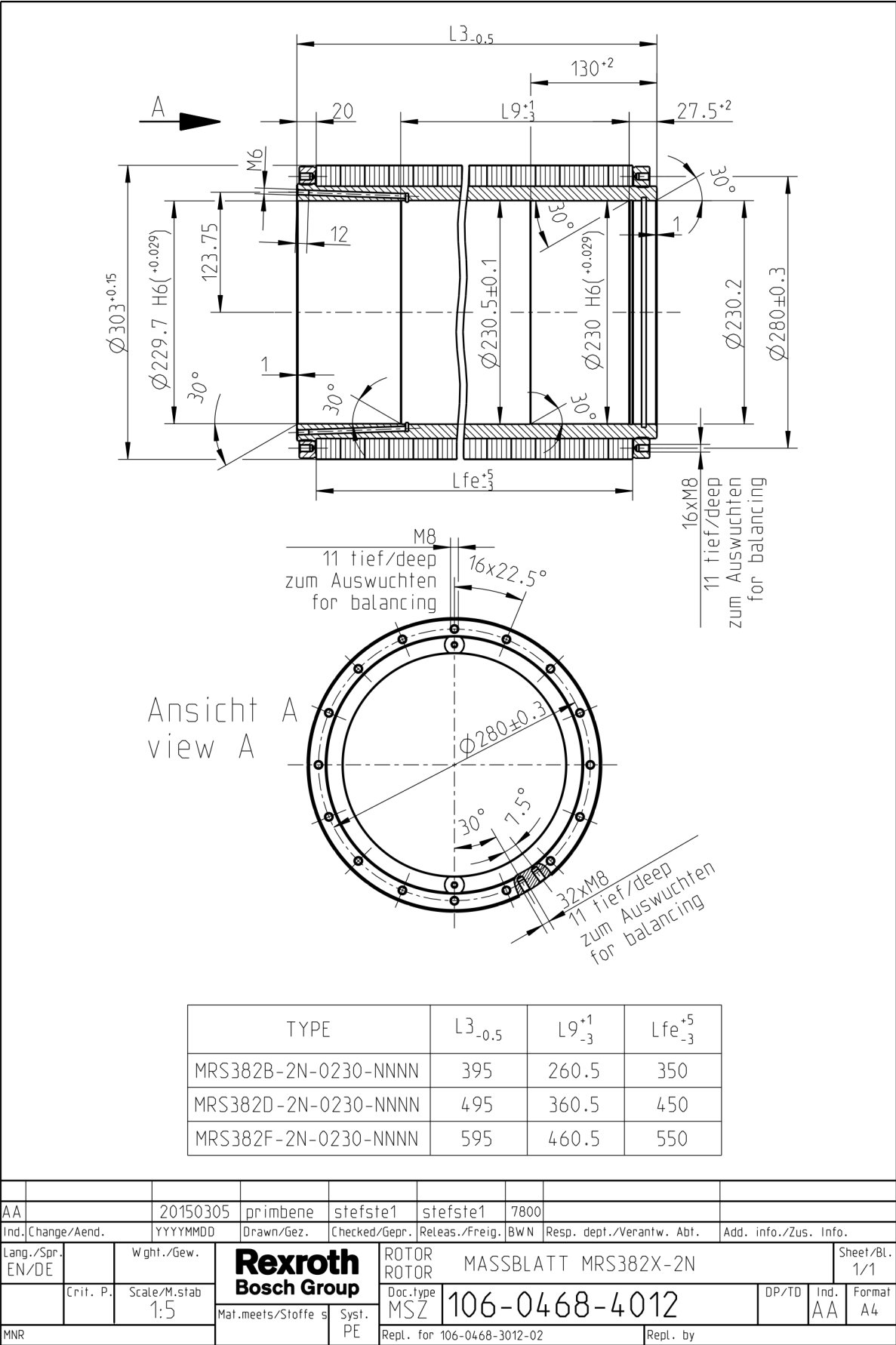


Fig. 126: MRS382 in frame size “2N”

4.10.8 MRS382 in frame size "2N", mounted

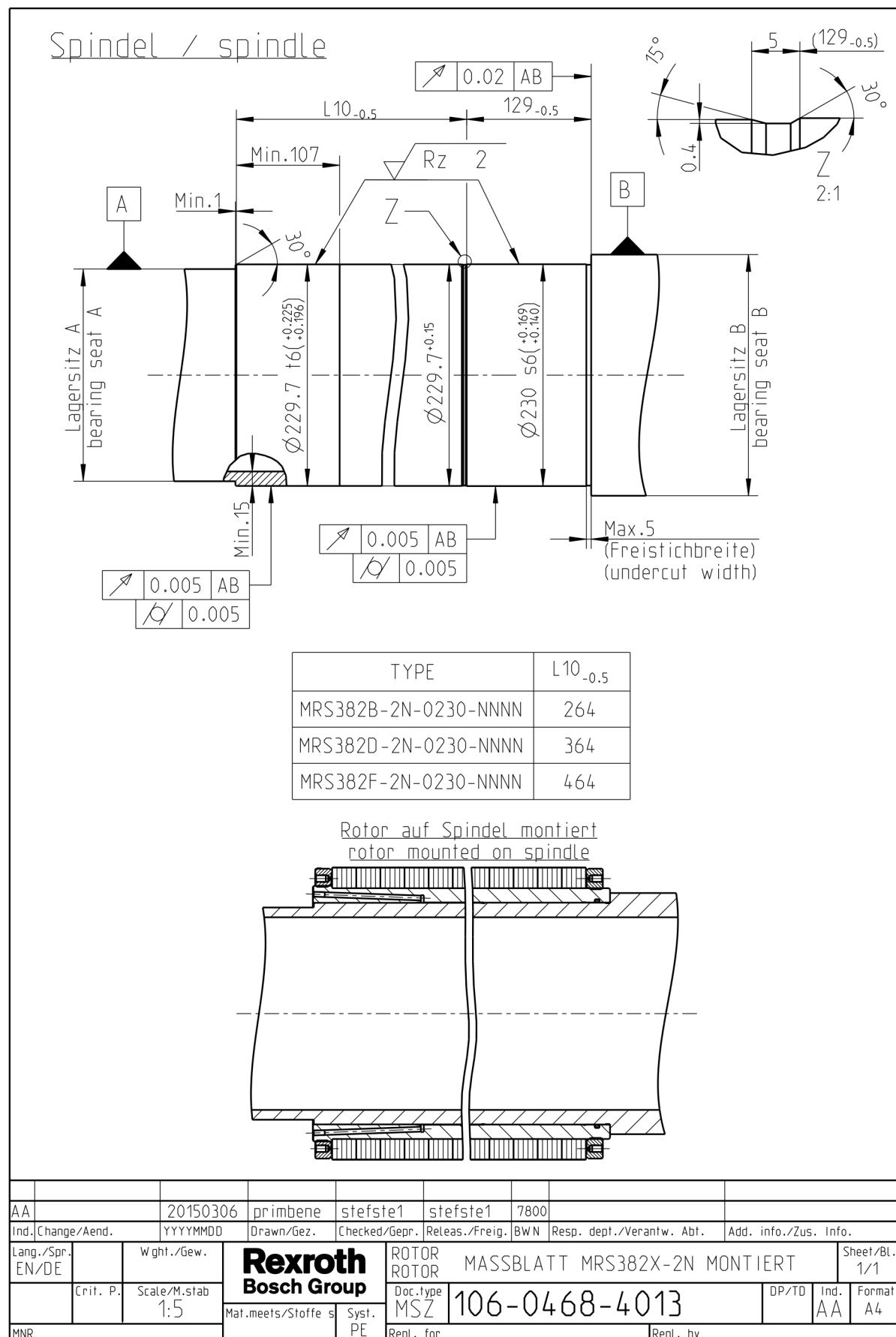


Fig. 127: MRS382 in frame size "2N", mounted

5 Identification

5.1 Identification of motor components

5.1.1 Type codes

The type code describes the available motor variants. It is the basis for selecting and ordering products from Bosch Rexroth. This applies to new products as well as to spare parts and repairs.

MBSxx2 motors is the general product name for the high-speed kit motors of Rexroth and identifies the technical further development of MBS motors.

MBS motors are kit motors. Rotor and stator have an additional unequivocal defined short term.

The designation of rotor (MRS) and stator (MSS) is applied from MBS motors. The motor generation is defined at the 6th position of the type code with the number 2 (e.g. MSSxx2 / MRSxx2).

The following figures give an example of a motor type code for rotor and stator, by which an exact specification of the single parts (e.g. for orders) is possible.

The following description gives an overview over the separate columns of the type code ("abbrev. column") and its meaning.

5.1.2 Type plate

Rotor and stator are delivered with two type plates with peel-off foils for varnish protection.

Attach the type plate of rotor and stator to an easily visible position at the machine. This way, you can read the motor data at any time without having to work in areas that are difficult to access and where the motor may be attached.



Each Bosch Rexroth product can be unequivocally identified by the designation and the serial number. Before contacting Bosch Rexroth, always specify the full type designations and serial numbers of the products involved.

Attach type plate

1. ➔ Find an easily accessible position at the machine.
2. ➔ Clean the adhesive area and make sure the surface is free from grease.
3. ➔ Remove the peel-off foil from the rear side of the type plate and attach the type plate with the peel-off foil to the cleaned adhesive area.
4. ➔ If the machine or the type plate is not recoated after it has been attached to the machine, the peel-off foil can be removed. Otherwise, remove the peel-off foil only after painting has been completed to ensure readability.

5.2 Identification Stator MSS

5.2.1 Type codes

General

The type code describes the available motor variants. The type code is the basis for selecting and ordering products from Bosch Rexroth. This applies to new products as well as to spare parts and repairs.

MBSxx2 High speed motors of Rexroth consist of the components "stator" and "rotor". The type code is divided into "Type code stator MSS..." and "Type code rotor MRS...".

The following description gives an overview of the separate columns of the type code ("abbrev. column") and its meaning. The sections below describe the type codes for specific frame sizes.

MSS Type codes

Product

Example: **MSS**□□□□-□□□□-□□-□□□□-□□□□

MSS is the stator of a synchronous kit spindle motor of the MBS series.

Frame size

Example: **MSS202**□-□□□□-□□-□□□□-□□□□

The frame size is derived from the mechanical motor dimensions and represents different power ranges.

Frame length

Example: **MSS202B**-□□□□-□□-□□□□-□□□□

Within a series, increasing stator frame length is graded by means of code letters. The longer the frame length, the higher the torque. Frame lengths are, for example A, B, C, ...

Winding

Example: **MSS202B-0150**-□□-□□□□-□□□□

The winding codes "0120", "0170", a.s.o. serve to differentiate the winding variants and refer to the rated speed.

Example: Winding "0150" stands for a rated velocity $n_N = 1500 \text{ min}^{-1}$. The reference value is a DC bus voltage of 540 V_{DC}.

Cooling mode

Example: **MSS202B-0150-F**□-□□□□-□□□□

MBSxx2 motors are generally equipped with a stator cooling jacket for operation with liquid cooling.

Table 50: MSS - Cooling mode

Option	Design	Detail
F	Water cooling	Default cooling type.

Coolant connection

Example: **MSS202B-0150-FA**-□□□□-□□□□

Denotes the position of the coolant connection on the stator

Table 51: MSS - Coolant connection

Option	Design	Detail
A	Axial	Standard coolant connection
R	radial	Only available for MSS182 and MSS312

Encoder

Example: **MSS202B-0150-FA-NO**□□-□□□□

MBS motors are delivered without a motor encoder For information on how to select the motor encoder, please refer to ➔ [Chapter 8.11 Third-party components on page 210](#).

Electrical connection

Example: MSS202B-0150-FA-N0CN-□□□□

Table 52: MSS - Electrical connection

Option	Description
CN	Connection harness is axially lead out of the stator front face.

Other design

Example: MSS202B-0150-FA-N0CN-NNNN

Table 53: MSS - Other design

Option	Description
NNNN	Standard version

Notes

More important information about the handling of the type code can be found here. The information can comprise descriptions of footnotes or information on delivery options, for example.

5.2.2 Type plate MSS stator

An individual type plate with the exact type designation and technical data are enclosed for each stator. Attach the type plate to an easily visible position at the machine. In this way, you can read the motor data at any time without having to work in areas that are difficult to access and where the motor may be attached.

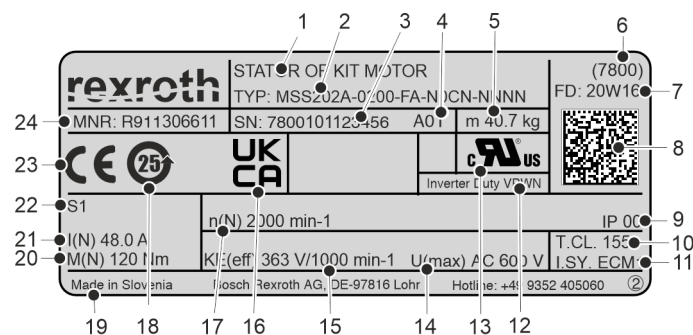


Fig. 128: Example of a MSS type plate

- 1 Type of machine
- 2 Type designation
- 3 Serial number
- 4 Revision state
- 5 Mass in kg
- 6 Manufacturing plant
- 7 Date of manufacture
- 8 Rexroth barcode
- 9 Degree of protection by housing
- 10 Thermal temperature class
- 11 Insulation system
- 12 Inverter Duty VPWM
- 13 UL label
- 14 Maximum input voltage
- 15 R.m.s. voltage constant
- 16 UK Conformity Assessed (UKCA)
- 17 Rated velocity in mode S1

- 18 China-RoHs 2 label
- 19 Designation of origin
- 20 Rated torque in mode S1
- 21 Rated current in operation mode S1
- 22 Operation mode S1
- 23 CE mark of conformity
- 24 Material number

5.3 Identification rotor MRS

5.3.1 Rotor MRS Type codes

Product

Example: **MRS**□□□□-□□-□□□□-□□□□

MRS is the rotor of a synchronous kit spindle motor of the MBS series.

Frame size

Example: MRS **202** □-□□-□□□□-□□□□

The frame size is derived from the mechanical motor dimensions and represents different power ranges.

Frame length

Example: MRS202 **B** -□□-□□□□-□□□□

Within a series, increasing motor frame length is graded by means of code letters. Frame lengths are, for example A, B, C, ...

Design

Example: MRS202B- **1N** -□□□□-□□□□

The frame size denotes the condition of the rotor hole.

Table 54: MRS - Frame size

Option	Description
1N	Smooth hole
2N	Step interference fit

You can find further notes about the frame size under [Chapter 8.9 Rotor design and installation principle of rotor/spindle shaft](#) on page 205.

Inside rotor diameter

Example: MRS202B-1N- **0096** -□□□□

Stands for the inside diameter of the rotor in millimeters (mm).

Other design

Example: MRS202B-1N-0096-**NNNN**

Reserved for optional designs.

Table 55: MRS - Other design

Option	Description
NNNN	Standard version

Notes

More important information about the handling of the type code can be found here. The information can comprise descriptions of footnotes or information on delivery options, for example.

5.3.2 Type plate MRS rotor

An individual type plate with the exact type designation and technical data are enclosed for each rotor. Attach the type plate to an easily visible position at the machine. In this way, you can read the motor data at any time without having to work in areas that are difficult to access and where the motor may be attached.

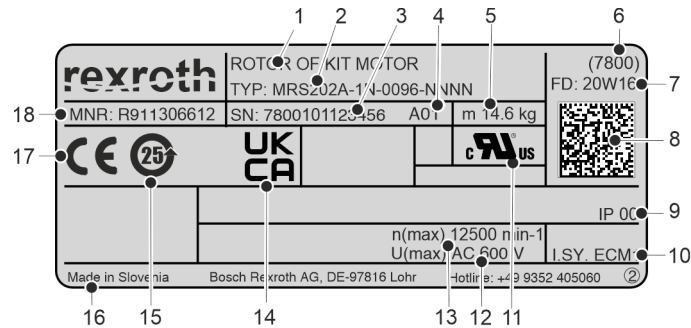


Fig. 129: Example of a MRS type plate

- 1 Type of machine
- 2 Type designation
- 3 Serial number
- 4 Revision state
- 5 Mass in kg
- 6 Manufacturing plant
- 7 Date of manufacture
- 8 Rexroth barcode
- 9 Degree of protection by housing
- 10 Insulation system
- 11 UL label
- 12 Maximum input voltage
- 13 Highest allowed velocity (mechanical)
- 14 UK Conformity Assessed (UKCA)
- 15 China-RoHs 2 label
- 16 Designation of origin
- 17 CE mark of conformity
- 18 Material number

5.4 Type code MBS102

5.4.1 MSS102 type code

Abbreviation Column		1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0				
Example:		M	S	S	1	0	2	B	-	0	8	0	0	-	F	A	-	N	0	C	N	-	N	N	N	N																			
1.	Product																																												
1.1	MSS																																												
2.	Frame size																																												
2.1	102																																												
3.	Frame lengths																																												
3.1	Frame lengths																																												
4.	Winding																																												
4.1	MSS102B																																												
4.2	MSS102D																																												
4.3	MSS102F																																												
5.	Cooling mode																																												
5.1	Liquid cooling																																												
6.	Coolant connection																																												
6.1	Axial																																												
7.	Encoder																																												
7.1	Without motor encoder																																												
8.	Electrical connection																																												
8.1	Cable lead out axially																																												
9.	Other design																																												
9.1	None																																												

Fig. 130: MSS102 type code

5.4.2 MRS102 type code

Abbreviation	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	2	1	2	3	4	5	6	7	8	9	0	3	0	1	2	3	4	5	6	7	8	9	0	4			
Column																																															
Example:	M	R	S	1	0	2	B	-	1	N	-	0	0	4	6	-	N	N	N	N																											

1. Product

1.1 MRS = MRS

2. Frame size

2.1 102 = 102

3. Frame lengths

3.1 Frame lengths = B, D, F

4. Design ①

4.1 Plain bore hole = 1N

4.2 Step interference fit = 2N

5. Rotor internal diameter

5.1 35 mm = 0035

5.2 46 mm = 0046

6. Other design

6.1 None = NNNN

Remark:

① Design "1N" is only available with rotor internal diameter "046"
Design "2N" is only available with rotor internal diameter "035"

Fig. 131: MRS102 type code

5.5 Type code MBS142

5.5.1 MSS142 type code

Abbreviation Column		1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0		
Example:		M	S	S	1	4	2	B	-	0	7	0	0	-	F	A	-	N	0	C	N	-	N	N	N	N																	

1.
1.1

Product
MSS = MSS

2.
2.1

Frame size
142 = 142

3.
3.1

Frame lengths
Frame lengths = B, D, F

4.
4.1
4.2
4.3

Winding
MSS142B = 0700
MSS142D = 0700
MSS142F = 0700

5.
5.1

Cooling mode
Liquid cooling = F

6.
6.1

Coolant connection
Axial. = A

7.
7.1

Encoder
Without motor encoder = N0

8.
8.1

Electrical connection
Cable lead out axially. = CN

9.
9.1

Other design
None = NNNN

Fig. 132: MSS142 type code

5.5.2 MRS142 type code

Abbreviation	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	2	1	2	3	4	5	6	7	8	9	0	3	1	2	3	4	5	6	7	8	9	0	4		
Column																																													
Example:	M	R	S	1	4	2	B	-	1	N	-	0	0	5	8	-	N	N	N	N																									

1. Product

1.1 MRS = MRS

2. Frame size

2.1 142 = 142

3. Frame lengths

3.1 Frame lengths = B, D, F

4. Design ①

4.1 Plain bore hole = 1N

4.2 Step interference fit = 2N

5. Rotor internal diameter

5.1 50 mm = 0050

5.2 58 mm = 0058

6. Other design

6.1 None = NNNN

Remark:

① Design "1N" is only available with "0058"
Design "2N" is only available with "0050"

Fig. 133: MRS142 type code

5.6 Type codeMBS162

5.6.1 MSS162 type code

[illegible]

Product

$$\overline{\text{MSS}} \dots\dots\dots = \text{MSS}$$

Frame size

$$162 \dots\dots\dots = 162$$

Frame lengths

Frame lengths = B, D, F, J

Winding designation

MSS162B..... = 0200, 0400

MSS162D = 0400

MSS162F = 0310

MSS162J = 0200, 0500

Cooling mode

Liquid cooling = F

Coolant connection

Axial. = A

Radial = R

Encoder

Without encoder = N0

Electrical connection

Cable lead out axially = CN

Other design

None..... = NNNN

ZN-40011-162_NOR_N_DE_2009-03-06

Identification

Fig. 134: MSS162 type code

5.6.2 MRS162 type code

Abbreviation	Column	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	2	1	2	3	4	5	6	7	8	9	0	3	0	1	2	3	4	5	6	7	8	9	0	4		
Example:		M	R	S	1	6	2	B	-	1	N	-	0	0	6	8	-	N	N	N	N																										

1. Product

1.1 MRS = MRS

2. Frame size

2.1 162 = 162

3. Frame lengths

3.1 Frame lengths. = B, D, F, J

4. Design ①

4.1 Plain bore hole = 1N

4.2 Step interference fit = 2N

5. Rotor internal diameter

5.1 60 mm = 0060

5.2 68 mm = 0068

6. Other design

6.1 None = NNNN

Remark:

① Design "1N" is only available with rotor internal diameter "0068"
Design "2N" is only available with rotor internal diameter "0060"

Fig. 135: MRS162 type code

5.7 Type code MBS182

5.7.1 MSS182 type code

Abbreviation Column	1									2									3									4												
	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0
Example:	M	S	S	1	8	2	A	-	0	1	0	0	-	F	A	-	N	0	C	N	-	N	N	N	N															

Product

MSS = MSS

Frame size

182 = 182

Frame lengths

Frame lengths = A, B, D, F

Winding

MSS182A = 0100, 0250

MSS182B = 0280

MSS182D = 0260

MSS182F = 0200

Cooling mode

Liquid cooling = F

Coolant connection

Axial = A

Radial = R

Encoder

Without encoder = N0

Electrical connection

Cable lead out axially = CN

Other design

None = NNNN

ZN-40030-182_NOR_N_DE_2008-04-16

Identification

Fig. 136: MSS182 type code

5.7.2 MRS182 type code

Abbreviation																																									
Column	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	
Example:	M	R	S	1	8	2	A	-	1	N	-	0	0	8	5	-	N	N	N	N																					

1. Product

1.1 MRS = MRS
2. Frame size

2.1 182 = 182
3. Frame lengths ①

3.1 Frame lengths = A, B, D, F
4. Design ②

4.1 Plain bore hole = 1N

4.2 Step interference fit = 2N
5. Rotor internal diameter

5.1 75 mm = 0075

5.2 85 mm = 0085
6. Other design

6.1 None = NNNN

Remark:

① Frame length "A" is only available in design "1N"

② Design "1N" is only available with rotor internal diameter "0085"

Design "2N" is only available with rotor internal diameter "0075"

Fig. 137: MRS182 type code

5.8 Type code MBS202

5.8.1 MSS202 type code

Abbreviation Column	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40	
Example:	M	S	S	2	0	2	B	-	0	1	5	0	-	F	A	-	N	0	C	N	-	N	N	N	N																

</

ZN-40011-202_NOR_N_DE_2009-07-28

Identification

Fig. 138: MSS202 type code

5.8.2 MRS202 type code

Abbreviation Column	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
Example:	M	R	S	2	0	2	A	-	1	N	-	0	0	9	6	-	N	N	N	N																				
Product																																								
MRS																																								
MRS																																								
Frame size																																								
202																																								
Frame lengths																																								
Frame lengths																																								
Design ①																																								
Plain bore hole																																								
Step interference fit.																																								
Rotor internal diameter																																								
85 mm																																								
96 mm																																								
Other design																																								
None																																								
None																																								

Remark:
① Design "1N" is only available with rotor internal diameter "0096"
Design "2N" is only available with rotor internal diameter "0085"

Fig. 139: MRS202 type code

ZN-40029-202_NOR_N_DE_2012-11-30

5.9 Type code MBS242

5.9.1 MSS242 type code

[illegible]

Fig. 140: MSS242 type code

5.9.2 MRS242 type code

Abbreviation	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	2	1	2	3	4	5	6	7	8	9	0	3	1	2	3	4	5	6	7	8	9	0	4		
Example:	M	R	S	2	4	2	B	-	1	N	-	0	1	1	0	-	N	N	N	N																									

1. Product

1.1 MRS = MRS

2. Frame size

2.1 242 = 242

3. Frame lengths

3.1 Frame lengths = B, D, F

4. Design ^①

4.1 Plain bore hole = 1N

4.2 Step interference fit = 2N

5. Rotor internal diameter

5.1 100 mm = 0100

5.2 110 mm = 0110

6. Other design

6.1 None = NNNN

Remark:

① Design "1N" is only available with rotor internal diameter "0110"
Design "2N" is only available with rotor internal diameter "0100"

Fig. 141: MRS242 type code

5.10 Type code MBS272

5.10.1 MSS272 type code

Abbreviation Column		1										2										3										4										
		1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	
Example:		M	S	S	2	7	2	B	-	0	0	6	5	-	F	A	-	N	0	C	N	-	N	N	N	N																

1. Product

1.1 MSS = MSS

2. Frame size

2.1 272 = 272

3. Frame lengths

3.1 Frame lengths = B, D, F

4. Winding

4.1 MSS272B = 0065, 0080

4.2 MSS272D = 0050

4.3 MSS272F = 0040

5. Cooling mode

5.1 Liquid cooling = F

6. Coolant connection

6.1 Axial = A

7. Encoder

7.1 Without motor encoder..... = N0

8. Electrical connection

8.1 Cable lead out axially = CN

9. Other design

9.1 None..... = NNNN

Fig. 142: MSS272 type code

5.10.2 MRS272 type code

[illegible]
$$MRS_{12} = MRS_{21}$$
$$272 \dots\dots\dots = 272$$

Frame lengths = B, D, F

Plain bore hole = 1N

Step interference fit = 2N

125 mm = 0125

135 mm = 0135

None = NNNN

① Design "1N" is only available with rotor internal diameter "0135"
Design "2N" is only available with rotor internal diameter "0125"

Design "2N" is only available with rotor internal diameter "0125"

ZN-40029-272 NOR_N_DE_2012-11-30

Fig. 143: MRS272 type code

5.11 Type code MBS312

5.11.1 MSS312 type code

Abbreviation Column		1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0		
Example:		M	S	S	3	1	2	B	-	0	0	3	5	-	F	A	-	N	0	C	N	-	N	N	N	N																	

1. **Product**

1.1 MSS = MSS

2. **Frame size**

2.1 312 = 312

3. **Frame lengths**

3.1 Frame lengths = B, D, F, H

4. **Winding**

4.1 MSS312B = 0035

4.2 MSS312D = 0028, 0060

4.3 MSS312F = 0028

4.4 MSS312H = 0025, 0085

5. **Cooling mode**

5.1 Liquid cooling = F

6. **Coolant connection**

6.1 Axial = A

6.2 Radial = R

7. **Encoder**

7.1 Without motor encoder. = N0

8. **Electrical connection**

8.1 Cable lead out axially = CN

9. **Other design**

9.1 None = NNNN

Fig. 144: MSS312 type code

5.11.2 MRS312 type code

[illegible]

Product

$$MRS_{12} = MRS_{21}$$

Frame size

$$312 \dots\dots\dots = 312$$

Frame lengths

Frame lengths = B, D, F, H

Design¹

Plain bore hole = 1N

Step interference fit = 2N

Rotor internal diameter

112 mm = 0112

130 mm = 0130

160 mm = 0160

170 mm = 0170

Other design

None = NNNN

Remark:

- ① Design "1N" is only available with rotor internal diameter "0170"
Design "2N" is only available with rotor internal diameters "0112", "0130" or "0160"

ZN-40046-312 NOR_N_DE_2012-12-17

Fig. 145: MRS312 type code

5.12 Type code MBS382

5.12.1 MSS382 type code

Abbreviation column		1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0		
Example:		M	S	S	3	8	2	F	-	0	0	1	8	-	F	A	-	N	0	C	N	-	N	N	N	N																	
1.	Product																																										
1.1	MSS = MSS																																										
2.	Motor frame size																																										
2.1	382 = 382																																										
3.	Motor frame lengths																																										
3.1	Frame lengths. = B, D, F																																										
4.	Winding designation																																										
4.1	MSS382B = 0025																																										
4.2	MSS382D = 0020																																										
4.3	MSS382F = 0018																																										
5.	Cooling mode																																										
5.1	Liquid cooling = F																																										
6.	Coolant connection																																										
6.1	Axial = A																																										
7.	Motor encoder																																										
7.1	Without motor encoder. = N0																																										
8.	Electrical connection																																										
8.1	Cable lead out axially = CN																																										
9.	Other design																																										
9.1	None = NNNN																																										

Fig. 146: MSS382 type code

5.12.2 MRS382 type code

Abbreviation Column	1									2									3									4																
	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0	1	2	3	4	5	6	7	8	9	0				
Example:	M	R	S	3	8	2	F	-	1	N	-	0	2	4	0	-	N	N	N	N																								

1. **Product**
 - 1.1 MRS = MRS
2. **Motor frame size**
 - 2.1 382 = 382
3. **Motor frame lengths**
 - 3.1 Frame lengths..... = B, D, F
4. **Design ①**
 - 4.1 Plain bore hole = 1N
 - 4.2 Step interference fit = 2N
5. **Rotor internal diameter**
 - 5.1 230 mm = 0230
 - 5.2 240 mm = 00240
6. **Other design**
 - 6.1 None..... = NNNN

Remark:

Design "1N" is only available with rotor internal diameter "00240"

① Design "2N" is only available with rotor internal diameter "00230"

Fig. 147: MRS382 type code

6 Accessories

6.1 O-ring for stator

If the o-ring for the step interference fit on the rotor was damaged during transport or during assembly, it is possible to re-order it by observing the exact rotor type at Bosch Rexroth:

Table 56: O-ring for rotor design ..-2N-..

Rotor MRS...	O-ring
102x-2N-0035-xxxx	35x4 75FKM
142x-2N-0050-xxxx	50x4 75FKM
162x-2N-0060-xxxx	60x4 75FKM
182x-2N-0075-xxxx	75x4 75FKM
202x-2N-0085-xxxx	85x4 75FKM
242x-2N-0100-xxxx	100x4 75FKM
272x-2N-0125-xxxx	125x4 75FKM
312x-2N-0112-xxxx	112x4 75FKM
312x-2N-0130-xxxx	130x4 75FKM
312x-2N-0160-xxxx	160x4 75FKM
382x-2N-0230-xxxx	230x4 75FKM

7 Connection technique

7.1 Power connection

7.1.1 General notes

⚠ CAUTION

Direct connection to the 50/60Hz - external supply network (three-wire or single-phase network) results in motor destruction!

MBSxx2 motors can only be operated with suitable drive controllers with variable output voltage and frequency (converter mode) as specified by Rexroth.

Bosch Rexroth provides a wide range of ready-made cables for connecting MBSxx2-motors. These cables are optimally adapted to the products and a great variety of requirements.

Significant advantages of Rexroth's ready-made cables are:

- Ready for connection without any additional finishing
- Designed for continuous alternating bending stress
- Resistant against mineral oil, grease and bio-oil, silicone and halogen-free, low-adhesion
- Use of cables approved according to UL and CSA
- Flammability fulfills requirements of VDE0472-804
- Compliance with the EMC directives and protection class up to IP67

NOTICE

Note that self assembled cables or cable systems of other manufactures possibly do not meet these requirements. Rexroth shall not be held responsible for resulting malfunction states or damage.

Connection

The power connection of a kit spindle motor can be done as

- **Clamping connection** (terminal box) or as
- **Plug-in connection** (device connector).

From this junction, the power supply can be realized using a power cable to the controller. Respective ready-made power cables are available from Rexroth.

The stator is provided with an approx. 1.5m long connection strand (single wires within a protective conduit). The connection strand consists of three power wires or three power adapter pairs and two wire pairs for the cold conductors in the winding head.

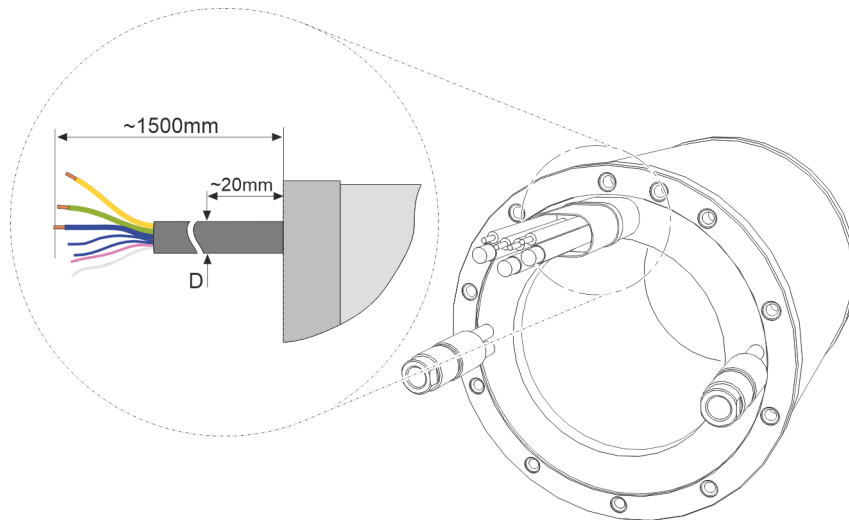


Fig. 148: Connection strand at MSS stator

D Diameter of the connection strand at a distance of approx. 20 mm from the partly oval outlet at the stator

Wire designation in connection strand

At cross-sections exceeding 10 mm², the power wires in the connection strand of the motor are marked with U-V-W. Smaller power wire cross-sections can be color-coded:

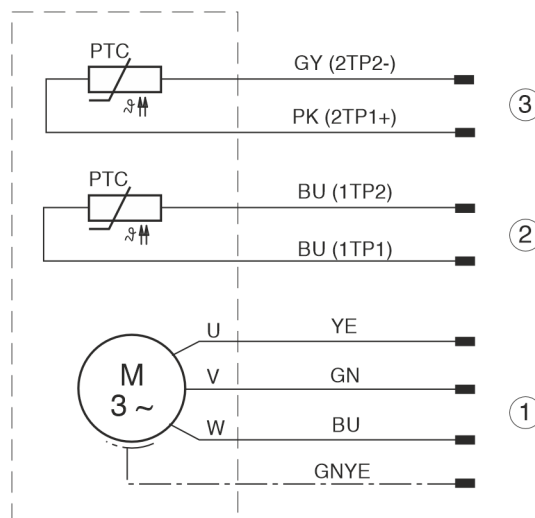


Fig. 149: Wire designation in power strand

- ① Power connection
- ② Temperature sensor SNM.150.DK...(connect on controller for motor protection)
- ③ Temperature sensor KTY84-130 (for external temperature analysis)

7.2 Ground connection

The grounding connection of the stator must be realized after installation into the machine by means of a separate cable. For this purpose, the stator is equipped with threaded bores for grounding connection at both face ends. Fasten the ground cable with a ring terminal at one of these threaded holes. For grounding connection, observe all applicable standards.

For details on the exact position and the connection thread of the threaded hole, refer to the dimensional drawing of the respective motor (see [Chapter 4 Dimensional sheets on page 75](#)). The power wire cross-section specified in the data sheet of the motor is also applies for the grounding cable and must be complied with (see [Chapter 3 Technical data on page 31](#)).

7.3 Connection wires in connection strand

The cross-sections of the power wires in the connection strand depend on the rated current of the motor. For information on wire cross-section, refer to the following table.



The connection strand is a motor-internal connection. For this reason, the insulation of the connection strand is designed for higher temperatures than the power cables (connection between stator and controller). For this reason, the minimum cross-sections for power wires specified in the motor data sheet may deviate from the power wire cross-sections in the connection strand specified below.

Table 57: Connection strand - wire cross sections and diameters

Type	Cross section power wires	Diameter (D) connection strand
	mm ²	mm
MSS102B-0800	AWG12	13.0
MSS102D-0800	AWG12	13.0
MSS102F-0300	AWG14	13.0
MSS102F-0800	10.0	22.0
MSS142B-0700	AWG8	22.0
MSS142D-0700	16.0	
MSS142F-0700	16.0	
MSS162B-0200	AWG12	13.0
MSS162B-0400	AWG8	22.0
MSS162D-0400	16.0	22.0
MSS162F-0310	16.0	22.0
MSS162J-0200	16.0	22.0
MSS162J-0500	25.0	30.0
MSS182A-0100	AWG14	13.0
MSS182A-0250	AWG14	13.0
MSS182B-0280	16.0	22.0
MSS182D-0260	16.0	22.0
MSS182F-0200	16.0	22.0
MSS182F-0550	2 x 10.0	2x 22.0
MSS202A-0200	AWG8	22.0
MSS202B-0150	AWG8	22.0
MSS202B-0210	25.0	30.0
MSS202D-0170	16.0	22.0
MSS202D-0360	25.0	30.0
MSS202F-0120	16.0	22.0

Type	Cross section power wires	Diameter (D) connection strand
	mm ²	mm
MSS242B-0100	16.0	22.0
MSS242D-0070		
MSS242F-0060		
MSS272B-0065	16.0	22.0
MSS272B-0080	25.0	30.0
MSS272D-0050	16.0	22.0
MSS272F-0040	16.0	22.0
MSS312B-0035	16.0	22.0
MSS312D-0028	25.0	30.0
MSS312D-0060	25.0	30.0
MSS312F-0028	16.0	22.0
MSS312H-0025	16.0	22.0
MSS312H-0085	2 x 25.0	2x 30.0
MSS382B-0025	2 x 16.0	2x 22.0
MSS382D-0020		
MSS382F-0018		
Latest amendment: 2024-03-11		

Table 58: Connection strand - cross sections sensor cables and bending radius

Cross section of sensor cables [mm ²]	Minimal bending radius statically [mm]
2 x 0.25 (KTY84-130)	4 x D
2 x 0.5 (SNM150)	

Connection strand installation

The connection strand connected to the stator ends with open wire ends and must not be subject to dynamic bending loads.

When connecting the cables at the spindle housing, it must be ensured that

- the specified admissible bending radius of the cable strand is observed (see [Tab. 58](#)),
- the edges of the through holes at the spindle housing are rounded or protected by a plastic sleeve.

7.4 Power connection via terminal box

For clamping connection, the connection strand of the stator is connected to the power cable in a terminal box. The terminal box is attached to the spindle housing. Inside, a three or six-pole terminal board for power connection and a terminal strip with at least four clamping points for cold conductor connection must be installed.

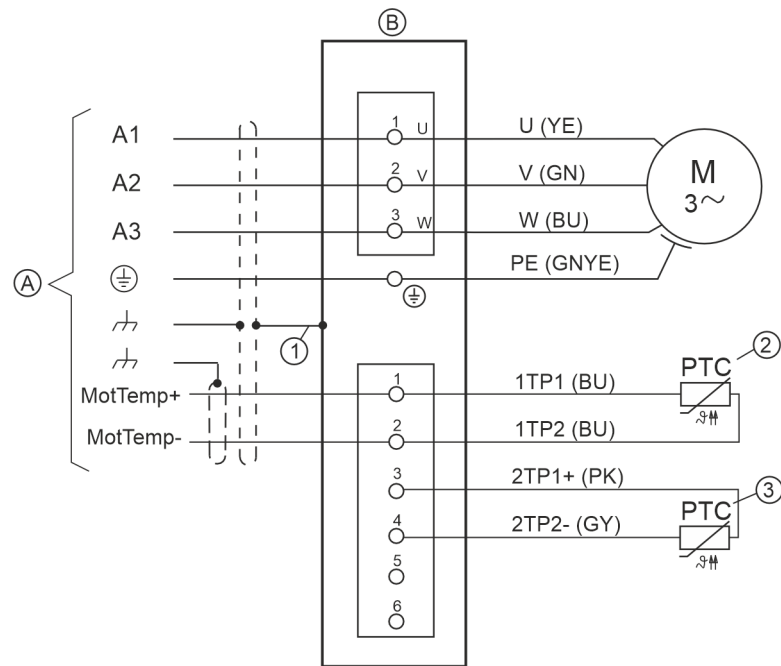


Fig. 150: Connection diagram for power connection with terminal box

- (A) Rexroth drive controller
 (B) Terminal box
 ① Total shield connection via cable clamp of strain relief in the PG fitting.
 ② Connect the temperature sensor SNM150 to the controller for motor protection.
 ③ The temperature sensor KTY84-130 can only be used for external temperature measurement.

To ensure proper realization of the clamping connection, the standards listed in the following table must be complied with.

Table 59: Standards for terminal connection

Designation	Standard	Reference for terminal connection
Terminal board	DIN 46 294	Max. Nominal voltage AC 660 V
Terminal strip	DIN VDE 0110	Max. Nominal voltage AC 380 V
Connection bolt	DIN 46 200	Definition of the bolt diameter; Tightening torques
Crimped cable lug	DIN 46 237	Power wires in cable strand
Wire end ferrules	DIN 46 228 part 3	Hot conductor wires in cable strand
Degree of protection	DIN EN 60034-5	Minimum degree of protection IP54
Connection designation	EN 60 445	

The components for connection by means of terminal box are not provided by Rexroth. Possible suppliers are

Table 60: Suppliers of terminal boxes

Components	Supplier
Terminal box	KIENLE & SPIESS Stanz- und Druckgießwerk GmbH 74343 Sachsenheim, Germany Tel.: +49 (0) 7147 29 - 0 Internet: ➔ www.kienle-spiess.de

Components	Supplier
Clipboard	MORGAN-REKOFA GmbH 53424 Remagen, Germany Tel.: +49 (0) 2642 9040-0 Internet: ➔ www.morganamt.com
Terminal strip	WIELAND ELECTRIC GmbH 96052 Bamberg, Germany Tel.: +49 (0) 951 93 24-0 Internet: ➔ www.wieland-electric.com

To be observed for selection of components:

- That the components have to be suitable for currents and voltage of the chosen drive system. In particular for high DC bus voltages up to 750 V_{DC}.
- Required cross-sections and connection threads of PG fitting
- Tightness of the housing. Minimum protection class IP65 is recommended.

A complete terminal box consists, for example, of the following assemblies:

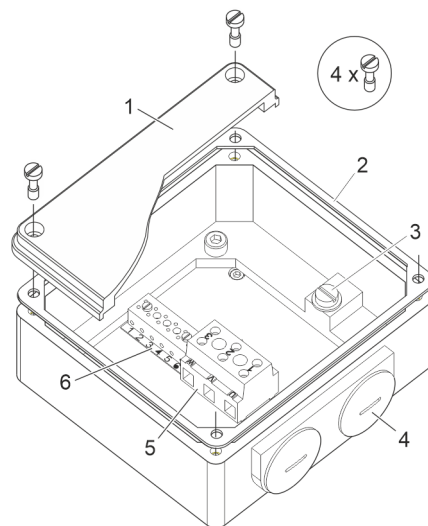


Fig. 151: Terminal box

- ① Cover
- ② Seal
- ③ PE connection
- ④ Cable entry
- ⑤ U-V-W power connection
- ⑥ Terminal strip

Overview of double cabling

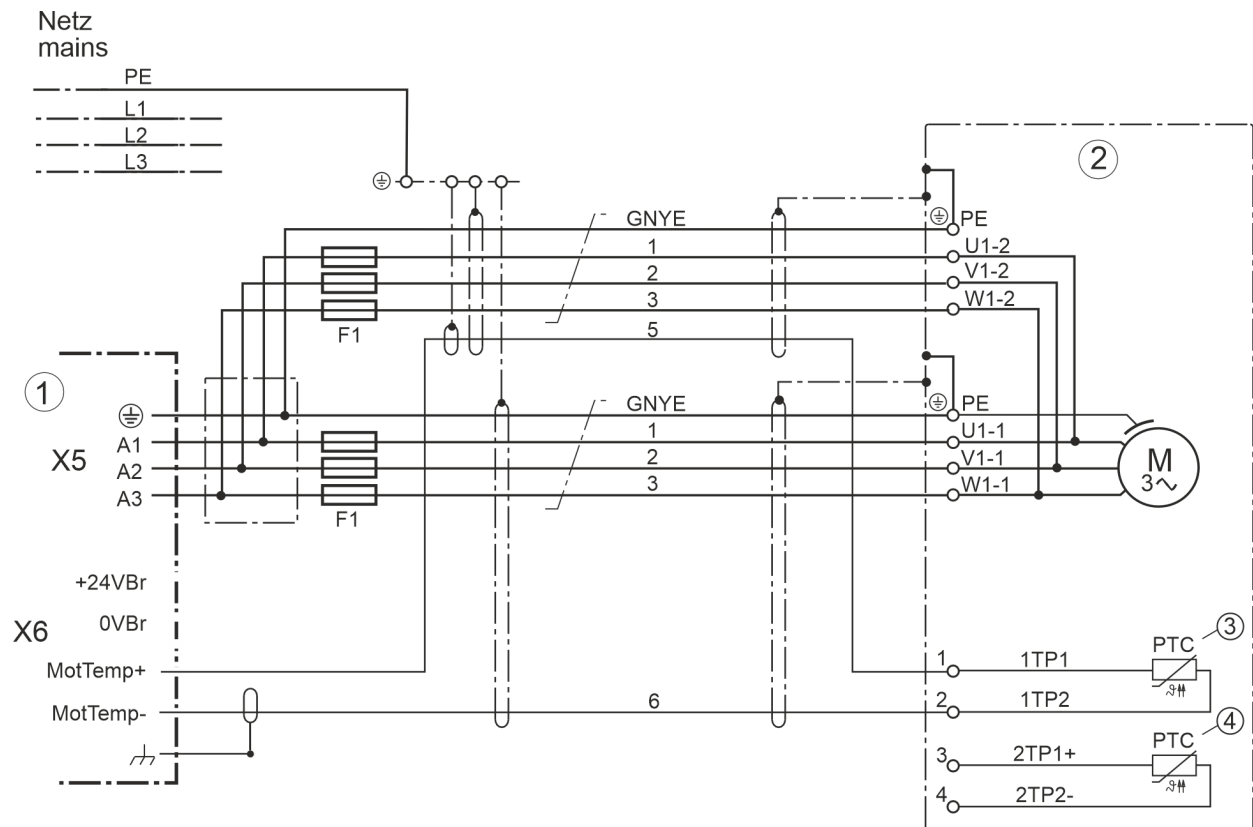


Fig. 152: Double cabling connection diagram

- ① Bosch Rexroth controller
- ② Motor terminal box
- ③ Temperature sensor SNM.150.DK (have to be connected to controller for thermal motor protection)
- ④ Temperature sensor KTY84-130 (for external temperature monitoring)



The terminal box can only be used for double cabling for power connection.

- Fuses F1 (NH...) protecting the wires against overload in case of a cable break must be dimensioned according to the current carrying capacity of the particular line cross-section.
- The fuses should be installed in the control cabinet such that they are as close as possible to the power output of the controller.
- The shield of the motor power cable must be connected to the control cabinet on the motor side of the fuses such that it is conducting over a large area.
- Power cables are not available to establish the double cabling. For installation of the fuses, the standard power cables of Rexroth must be opened and cut respectively on site.

7.5 Power connection with device connector

7.5.1 General

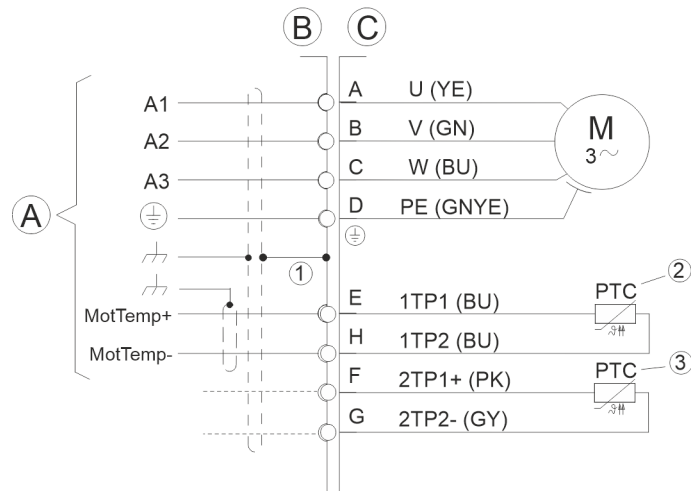


Fig. 153: Connection diagram for power connection with device connector

- Ⓐ Rexroth drive controller
- Ⓑ Device connector
- Ⓒ Device coupling
- ① Total shield connection via cable clamp of strain relief in the PG fitting.
- ② Connect the temperature sensor SNM150 to the controller for motor protection.
- ③ The temperature sensor KTY84 can only be used for external temperature measurement

Select a coupling with suitable connector socket and the required connection cross-section according to the motor data sheet.



Order designation, for example

RLS1200/Cxx with RLS1201/Cxx

RLS1300/Cxx with RLS1301/Cxx

– ../..xx = Connection cross section (e.g. 6 mm² = 06)

RLS120x is suited for connection cross sections from 1.5 mm² up to 10 mm².
RLS130x from 1.5 mm² up to 25 mm².

Coupling and connector required for connecting the stators are designed with a bayonet lock and are not included in the scope of delivery.

Please note:

- If a power cable dimensioned by Rexroth is used, the connection wires of the temperature sensor (KTY84) must not be connected to the controller. For temperature measurement and analysis, they are to be connected to an external unit.
- Special tools are required for preparing plug-in connections with crimp contacts.

7.5.2 Device connector

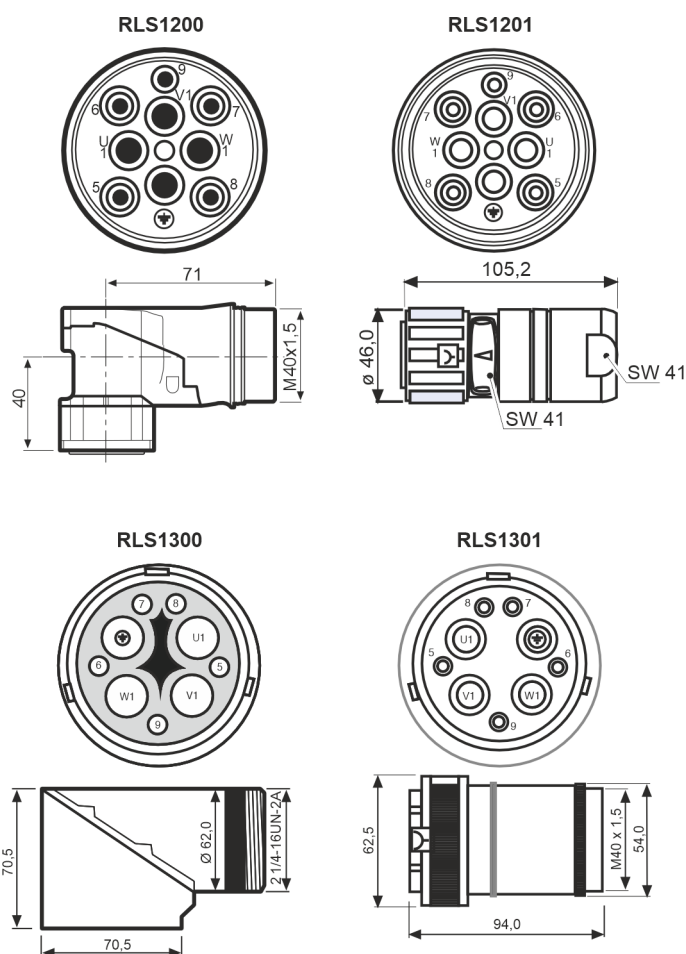


Fig. 154: Plug-in power connection

Handling

1. Insert the plug into the coupling while ensuring correct coding.
2. Manually tighten the bayonet lock until it audibly engages.
The marks at the flange socket and the plug have to be positioned opposite to each other once the lock engaged.

7.6 Sensors

7.6.1 Temperature sensors

In their standard configuration, MSSxx2 stators are equipped with integrated SNM.150.DK.* temperature sensors for motor protection. All stators are fitted with an additional temperature sensor KTY84-130 for external temperature measurement.

To ensure safe motor protection against thermal overload, the temperature sensor SNM.150.DK has to be connected to the drive controller. Comply with the respective connection diagram for the selected connection type (device connector or terminal box) when connecting the temperature sensors.



- To ensure safe motor protection against thermal overload, temperature sensor SNM.150.DK has to be connected to the drive controller.
- Ensure correct polarity when connecting the temperature sensor KTY84-130 for external temperature measurement (see [Chapter 7 Connection technique on page 177](#)).
- KTY84-130 is an ESD sensitive device! For this reason, the stranded wires of the sensor are protected by a protective foil at the connection cable. Before connecting the sensor, take measures regarding ESD protection. (ESD = electrostatic discharge).

Also note the information on motor temperature monitoring in [Chapter 8.8 Motor temperature monitoring on page 203](#).

7.6.2 Encoder

Encoder and encoder connection components are not included in the scope of delivery of the motor. Select the components according to the machine requirements.

Setting the encoder polarity depends on the direction of rotation of the rotor and have to be parameterized upon controller startup. Refer to the instructions in the functional description of the controller and the definitions in [Chapter 12.5 Determining the polarity of the encoder system on page 263](#).

You will find more information about encoder manufacturers in [Chapter 8.11.1](#).

Please note:

The connection cable for connecting the motor encoder and the controller to an encoder-compatible plug. When using components of different manufacturers, ensure continuous compatibility of the connection technique.

7.7 Motor cooling

7.7.1 Coolant connection

The coolant connections at the stator can be realized "axially" or "radially".

The assignment of inlets and outlets does not influence the performance data of the motor. For standardization and easier handling, an arrangement once established should be retained.

For details on the dimension, shape and position of the coolant connections, refer to the dimensional drawing of the respective motor.

Install systems in the cooling circuit for monitoring flow, pressure and temperature.



You need other installation materials like couplings, tubes and fastening clips (not in the scope of delivery) to supply motors with a coolant.

The machine manufacturer is responsible for ensuring that the coolant connection is tight and for verifying and accepting the tightness after the motor has been installed.

Additional, regular inspections to ensure proper condition of the coolant connection should be logged in the maintenance schedule of the machine.

"Axial" coolant connection

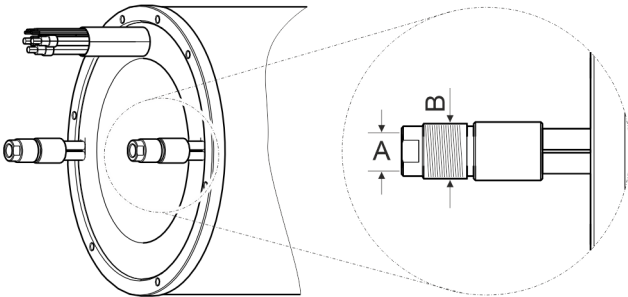


Fig. 155: "Axial" coolant connection
A Thread diameter for coolant connection
B Thread for coolant connection at the machine

Table 61: Overview of axial coolant connection threads

Stator MSS....	Thread A	Thread B
102 / 142	G 1/8	M16 x 1
162 / 182	G 1/8	M16 x 1
202 / 242	G 1/4	M22 x 1.5
272 / 312 / 382	G 1/2	M30 x 1.5

"Radial" coolant connection

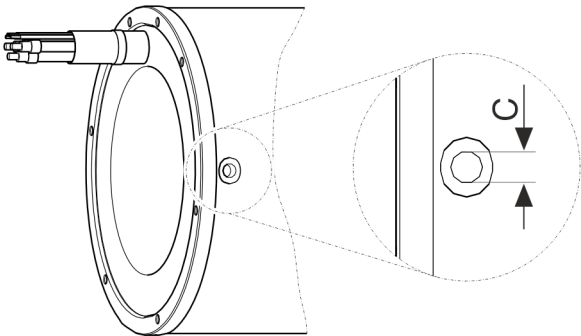


Fig. 156: "Radial" coolant connection
C Thread diameter for coolant connection

Table 62: Overview of radial coolant connection threads

Stator MSS....	Thread C
162 / 182	G 1/8
312	G 1/4

Realization and sealing of coolant connection

To seal the coolant connection thread, Bosch Rexroth therefore recommends to use screw connections which already contain an O-ring for sealing the screw connection in axial direction.

Not suited are sealings made of hamp, teflon-tape or with conical thread, as this mode of sealing can permanently damage the connection thread or lead to excessively overload due to unprofessional execution.

There are the following possibilities to connect liquid cooling, for example:

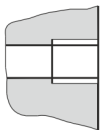
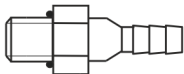
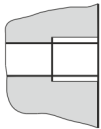
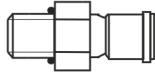
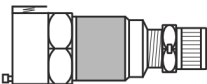
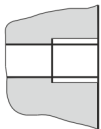
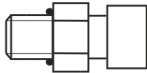
Connection mode	Draft			
Tube clip	Motor 	Tube clip with thread 	Tube 	Hose clamp 
Fast coupling connector	Motor 	Coupling with thread 	Coupling with clamp connection 	Tube 
Clamp connection	Motor 	Clamp connection with thread 	Tube 	

Fig. 157: Connection examples of liquid cooling

7.7.2 Operating pressure

The maximum coolant inlet pressure of **6 bar** applies to all MBSxx2 motors, in relation to the pressure effectively existing directly at the coolant connection of the motor.

Please observe that additional screw connections or junctions in the cooling circuit can reduce the flow and supply pressure of the cooling medium.

Select well-spaced dimensioned connection screws and tube diameters.

8 Application and construction instructions

8.1 Environmental conditions during operation

Environmental conditions during operation

Environmental conditions during operation are defined according to EN IEC 60721-3-3:2019 in different classes. They are based on worldwide long-term experiences and take all influencing variables into account, e.g., air temperature and air humidity.

Table 63: Allowed classes of environmental conditions during operation according to EN IEC 60721-3-3:2019

Classification type	Allowed class
Classification of climatic environmental conditions	3K22
Classification of biological environmental conditions	3B1
Classification of mechanically active materials	3S6
Classification of mechanical environmental conditions	3M12

Based on EN IEC 60721-3-3:2019 , some limit values are partially defined in the following, which our products are allowed to be exposed to during operation. Unless otherwise specified, the values given are the values of the particular class. Observe the detailed description of the classifications to take all of the factors which are specified in the particular class into account.

However, Bosch Rexroth reserves the right to adjust these values at any time based on future experiences or changed environmental factors.

Table 64: Allowed operation conditions

Environmental factor	Unit	Value
Temperature	°C	0 ... +40 ¹⁾ +5 ... +40 ²⁾
Relative air humidity	%	5 ... 95 ¹⁾
Absolute air humidity	g/m ³	1 ... 29 ¹⁾
Installation altitude	m	up to 1,000 m above sea level
¹⁾ Deviating from EN IEC 60721-3-3:2019		
²⁾ for water cooling		

8.2 Degree of protection

The degree of protection is indicated by IP (International Protection) and two digits. The first code number describes the degree of protection against contact and penetration of foreign substances; the second code number describes the degree of protection against ingress of water.

Protection class **IP00** according to DIN EN 60034-5 is valid for stator and rotor. The applicability of the motor under specific conditions has to be checked thoroughly.

Refer to the following list (the list is not exhaustive).

Problem areas

- Use of the motor in a damp environment, in a foggy atmosphere.
- Use of coolants, aggressive materials or other liquids.
- Cleaning procedures with high pressures, steam or jets of water.

Possible effects

- Chemical or electro-chemical interactions with subsequent corrosion or disintegration of motor parts.
- Damage to the winding insulation and irreparable damage to the motor.

Possible countermeasures

- Provide suitable covers or seals to protect the motor.
- Use only such coolants lubricants and other media which do not have any aggressive or disintegrating effect on the motor parts.
- Do not clean under high pressures, steam or jets of water.



The machine manufacturer is responsible for conducting the tests and for providing suitable measures.

8.3 Acceptances and approvals

8.3.1 CE Mark



For MBT motors, declarations of conformity are available, confirming the design and the compliance with valid EN standards and directives. If required, the declarations of conformity can be requested from the responsible sales office.

The CE mark is attached to the motor type label of the motors.

8.3.2 UR/cUR listing



MBS motors were presented to “Underwriters Laboratories Inc.®” and have been approved by this UL authority. The E-file number issued is **E341734**. The appropriate identification of the motors is specified on the motor type plate.

8.3.3 UKCA label



The motors fulfill the requirements acc. to UKCA. The appropriate identification of the motors is specified on the motor type plate.

8.3.4 China RoHS 2

Mounting of the MBS series according to the specifications of standard SJ/T11364 and they have an EFUP (Environmentally friendly use period) of 25 years.

8.4 Compatibility test

All Rexroth controls and drives are developed and tested according to the state of the art.

However, since it is not possible to keep track of the continuous development of all substances with which our controls and drives may come into contact (e.g. lubricants on machine tools), reactions with the materials we use cannot be ruled out in every case.



Before using our products, carry out a compatibility test with the substances used on site (e.g. coolants and lubricants, cleaning agents, etc.) and our housing or device materials.

8.5 Magnetic fields

During operation of electric motors, electromagnetic fields are generated at live components and connection lines of these motors. The secondary parts equipped with permanent magnets of synchronous linear motors and rotors of synchronous kit motors are magnetically not shielded and permanently generate a static magnetic field (DC field) even if not activated. This is indicated by a warning label attached to each package with open permanent magnet components.

If all regulations and safety measures are complied with, synchronous kit motors with open permanent magnet components do not cause any inadmissible hazards. As of a distance of approx. 100 mm to the surface of open permanent magnet parts, there is practically no effective magnetic attraction of ferromagnetic parts. However, for people with implants, a minimum safety distance of 1 meter (1000 mm) is recommended.

Depending on the operating location, transport ways and storage of the machine and its components, local regulations and laws apply and have to be complied with during construction, transport and operation of the machine.

⚠ WARNING

Electromagnetic / magnetic fields! Health hazard for persons with heart pacemakers, metal implants or hearing aids! Material damage.

- Hazards due to magnetic and electromagnetic fields at live components or permanent magnets of electric motors.
- Persons with active implantable medical devices (AIMD) or passive metallic implants must keep clear from these motor components.
The above-specified persons are prohibited from accessing areas where such drive components are installed and operated or access is subject to prior medical consultation.
- Keep magnetic data carriers, credit cards, check cards and identity cards and all ferromagnetic metal parts away from magnetic fields. Do not wear jewelry, particularly made of ferromagnetic material, during work at magnetic components.

Safety measures for operating personnel

In the European Community (EU), directive 2004/40/EC specifies minimum requirements for protection of the safety and health of employees from hazards due to electromagnetic and magnetic fields. Regulations and guides for machine manufacturers and machine operators are included in the following documents:

- Standard EN 50499 (DE: DIN EN 50 499, DIN VDE 0808-499)
- Standard EN 50527 (DE: DIN VDE 0848-3)
- In Germany: Accident prevention regulations BGV/GUV-V B11

This list does not claim to be exhaustive. Machine manufacturers and machine operators are required to define the regulations applicable on site and the occupational health and safety measures to be applied for working in the area of exposure. The decisive factors are not the electromagnetic properties of individual machine components but the effective overall exposition in electrical, magnetic and electromagnetic fields in the actual working area.

Construction information

During construction of the machine, suitable covers and safety equipment for safe operation must be applied.



- During construction of the machine, observe applicable standards and regulations on marking of and access to exposure areas.
- Prevent any access of operating personnel in the motion range of motors during operation.
- Prevent any contamination, chips and dirt in the motion range of motors.

8.6 Thermal utilization for higher speeds

Due to the high speeds that are usually run with spindle motors, there are special aspects with regard to the operating behavior of the MBSxx2 motors. In the higher speed range, continuous operation (S1) of the motor is restricted in the rotor and stator by hysteresis and eddy current losses and in the stator by the additional current heat losses of the field weakening current.

Rotor heating

Hysteresis and eddy current losses in the rotor laminations and eddy current losses in the magnets increase with increasing speed or stator frequency. These losses can lead to impermissible temperatures in the rotor, especially in the magnets. Two variables have a significant influence on the actual heating and must be taken into account during project planning:

- Heat capacity of the rotor depending from its installation mode (see [↗ Chapter Operating behavior](#))
- the PWM switching frequency of the inverter (see [↗ Chapter Operating behavior](#))

If the Rexroth IndraSize sizing tool is used correctly, both sizes are taken into account.

Field weakening operation

In field weakening mode, an increasing field current is impressed in the stator as the speed increases. This does not make a relevant contribution to torque formation, but does generate additional current heat losses in the stator winding. These losses result in heating of the winding. Unacceptable heating must be prevented. This is ensured by using the thermal model in the Rexroth drive control units. This must also be taken into account during project planning.

8.7 Motor cooling

8.7.1 General

The motor power loss P_V is converted into heat and then dissipated via the liquid cooling system. MBS motors may therefore only be operated if the coolant supply is guaranteed. The machine manufacturer has to realize the cooling system in so that all requirements regarding flow, pressure, cleanliness, temperature gradient, etc. are complied with in every operating state.

⚠ CAUTION	Impairment or failure of motor, machine or cooling system! – Be sure to take the motor data into account when designing cooling systems. – Observe the manufacturer's instructions when designing and operating cooling systems. – Do not use any cooling lubricants or cutting materials from machining processes. – Avoid contamination of the cooling medium as well as modifications of chemical composition and pH.
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8.7.2 Coolant

General

All details and technical data are based on water as coolant. If other coolants are used, this data is no longer valid and must be recalculated.

It is not recommended to use cooling with running tap water. Calcareous tap water can cause deposits and damage the motor and the cooling system.

For corrosion protection and for chemical stabilization, an additive which is suitable for mixed installations with the materials AlSi5Mg (cooling jacket) and FPM (O-ring) has to be added to the cooling water.

The motors can be damaged irreparably by use of aggressive coolants, additives and cooling lubricant or by contaminations of the coolant.

- Use systems with a closed circuit and a fine filter $\leq 100 \mu\text{m}$.
- Avoid contamination of the cooling medium as well as modifications of chemical composition and pH.
- Refer to the environmental protection and waste disposal instructions at the place of installation when selecting the coolant.

Rexroth does not make any general statements and does not contact any research regarding the suitability of system-specific coolants or operating conditions.



The performance test for the used coolants and the design of the liquid coolant system are generally the responsibility of the machine manufacturer.

Quality of cooling water

Cooling water quality for motors with internal cooling circuit made of aluminum die-casting / steel.	
pH value (bei 20 °C)	6 ... 9
Total hardness	1.2 ... 1.8 mmol/l
Chloride concentration	< 40 ppm
Sulfate concentration	< 50 ppm
Nitrate concentration	< 50 ppm
Amount solutes	< 350 ppm
Particle size of dirt	$\leq 100 \mu\text{m}$
Conductivity	< 500 $\mu\text{S/cm}$

Aqueous solution

Aqueous solutions ensure reliable corrosion protection without significant changes to the physical properties of the water. The recommended additives do not contain any substances hazardous to water.

Emulsion with corrosion protection

Corrosion protection oils for coolant circuits contain emulsifiers which ensure a fine distribution of the oil in the water. The oily components of the emulsion protect the metal surfaces of the coolant ducts against corrosion and cavitation. Here, an oil content of 0.5 to 2 volume percent has proved successful.

If the corrosion protection oil is intended to lubricate the coolant pump in addition to providing corrosion protection, the required oil content is approx. 5 volume percent.

Comply with instructions of the pump manufacturer!

Cleaning the coolant circuit

Inspect and clean (purge) the cooling system at regular intervals as specified in the machine and cooling system manufacturer's maintenance schedule.

Note that the utilization of unsuitable cleaning agents may cause irreversible damage to the motor cooling system. This type of damage does not lie within the responsibility of Bosch Rexroth.

▲ CAUTION

Risk of damage to the motor cooling system by improper cleaning agents! Loss of warranty!

- The only liquids or materials allowed for cleaning and motor cooling are liquids which do not corrode the motor cooling system and do not react aggressively to the materials used in Bosch Rexroth motors.
- Refer to the instructions of the manufacturers of the cleaning agent and the cooling system.

8.7.3 Coolant additives

The following table shows several manufacturers of cooling additives. Products of other manufacturers can be also be used.

Table 65: Coolant additives

Nalco Deutschland GmbH	➔ https://www.ecolab.com/nalco-water
FUCHS PETROLUB AG	➔ https://www.fuchs.com
Clariant Produkte (Deutschland) GmbH	➔ https://www.clariant.com
hebro chemie GmbH	➔ https://www.hebro-chemie.de/
TYFOROP Chemie GmbH	➔ https://tyfo.de/
Schweizer-Chemie GmbH	➔ https://www.schweitzer-chemie.de/



Bosch Rexroth does not make any general statement and does not conduct any surveys regarding the suitability of device-specific cooling media, additives or operating conditions and does not assume any warranty for third-party products.

The performance test for the used cooling media and the design of the liquid cooling system is the responsibility of the machine manufacturer. The selected coolant additives have to comply with the materials within the cooling system.

Comply with the environmental protection and waste disposal instructions at the place of installation when selecting the coolant additives.

The proper chemical treatment of the closed water systems is precondition to prevent corrosion, to maintain thermal transmission, and to minimize the growth of bacteria in all parts of the system.

Coolant additives of NALCO Deutschland GmbH (example):

Coolant water Nalco CCL100 is a ready-to-use, preserved cooling water for use in closed cooling water systems. Nalco CCL100 contains corrosion inhibitor protecting ferrous metal, copper, copper alloys and aluminum. It is free from nitrite and minimizes the micro-biological growth.

Coolant additive NALCO TRAC100 is a liquid corrosion and film inhibitor for the use in closed cooling systems. Nalco TRAC100 is a complete inhibitor protecting ferrous metal, copper alloys and aluminum against corrosion. It is free from nitrite and minimizes the micro-biological growth.

Coolant additive NALCO 7330 is a non-oxidizing broad band biocide and suitable for application in closed cooling circuit systems.

Coolant additive Nalco 73199 is an organic corrosion inhibitor supporting a fast own protection layer and covering protection layer for non-ferrous metals.

8.7.4 Materials used

The coolant used for MBS motors comes into contact with the following materials:

Table 66: Materials coming into contact with the coolant

Frame size MSS ...	Coolant ducts	Screw connections
102 ... 382	Copper (Cu)	Brass (CuZn39Pb2)

For dimensioning and operation of the cooling system, the machine manufacturer has to ensure that the components of the motor do not get into contact with materials with chemical or electro-chemical impact leading to corrosion or disintegration.

8.7.5 Coolant inlet temperature

The motors are designed in compliance with DIN EN 60034-1 for operation at coolant temperatures of +10 ... +40 °C. This temperature range must be complied with. Higher coolant temperatures cause a higher reduction of the available torque. Due to high temperature gradients, lower coolant temperatures can result in the destruction of the motor.



Install systems in the cooling circuit for monitoring flow, pressure and temperature.

Setting the inlet temperature

When setting the coolant inlet temperature, comply with the temperature range specified and the existing ambient temperature. The lower limit of the recommended coolant inlet temperature can be limited in relation to the existing ambient temperature. To avoid condensation, the lowest value that is allowed to be set is therefore only a temperature of max. 5 °C below the existing ambient temperature.

Example 1:

Specified temperature range: +10 ... +40 °C

Ambient temperature: +20 °C

Coolant inlet temperature to be set: +15 ... +40 °C

Example 2:

Specified temperature range: +10 ... +40 °C

Ambient temperature: +30 °C

Coolant inlet temperature to be set: +25 ... +40 °C



The coolant inlet temperature must be set in a temperature range of +10 ... +40 °C and should only be max. 5 °C below the existing ambient temperature to avoid condensation.

8.7.6 Dimensioning the cooling circuit

General

For dimensioning of the cooling circuit, the power loss P_V consumed by the water in the coolant system of the motor has to be taken into account. The heat energy taken up by the water depends on the flow rate Q in l/min and the temperature difference ΔT of inlet and outlet. Above the motor, a pressure drop Δp between the water connections occurs.

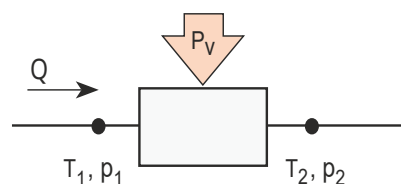


Fig. 158: Liquid-cooled component

Q Flow rate

T_1 Coolant inlet temperature

T_2 Coolant outlet temperature

p_1 Inlet pressure

p_2 Outlet pressure

Coolant temperature rise

$$\Delta T = T_2 - T_1$$

Fig. 159: Coolant temperature rise in K

ΔT Coolant temperature rise in K

T_2 Coolant outlet temperature in K

T_1 Coolant inlet temperature in K

Pressure drop

$$\Delta p = p_1 - p_2$$

Fig. 160: Pressure drop via flow through component

Δp Pressure drop

p_1 Inlet pressure

p_2 Outlet pressure

Flow rate

Coolant flow for compliance with the specified motor torque

The required coolant flow for compliance with the specified motor torque is specified in chapter "Technical data".

For this value, a temperature increase of 10 K in the coolant is applied.

The required coolant flow at deviating temperature increase and/or non-water coolants is determined according to Fig. 161 and Tab. 67:

$$Q = \frac{P_V \cdot 60000}{c \cdot \rho \cdot \Delta T}$$

Fig. 161: Coolant flow required for removing power loss.

Q Rated coolant flow in l/min

P_V Amount of power to be dissipated in W

c Specific heat capacity of the coolant in J / kg · K

ρ Density of the coolant in kg/m³

ΔT Coolant temperature rise in K

Table 67: Substance values of different coolants at 20°C

Coolants	Specific heat capacity c in J / kg · K	Density ρ in kg/m ³
Water	4183	998.3
Thermal oil (example)	1,000	887
Air	1007	1.188

Reduction of the motor torque with non-water coolants and identical flow rate

To determine the reduction in motor torque with a non-water coolant at an **identical** flow rate, use the following formula:

$$k_{\text{cred}} = \sqrt{\frac{c_x \cdot \rho_x}{c_w \cdot \rho_w}} \cdot 100\%$$

Fig. 162: Reduced motor torque with non-water coolant at identical flow rate

k_{cred} Motor torque reduction factor referred to water in percent

c_w Specific heat capacity of water in J / kg · K

ρ_w Density of water in kg/m³

c_x Specific heat capacity of the applied coolant in J / kg · K

ρ_x Density of the used coolant in kg/m³

Pressure drop

The flow resistance at the pipe walls, deflections and changes in cross section leads to a pressure drop in the flow through component (see Fig. 160).

The pressure drop Δp is increased with an increase in flow rate (see Fig. 163).



The overall pressure drop of the cooling system is determined by various partial pressure drops (motor, feeders, connectors, etc.). This has to be taken into account by using manufacturer-specific data when the cooling circuit is sized.

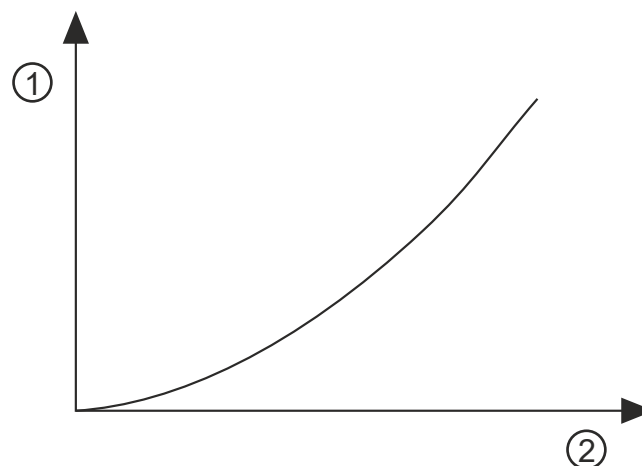


Fig. 163: Pressure drop depending on the flow rate; general representation

① Pressure drop Δp

② Flow rate Q

Cooling system principle

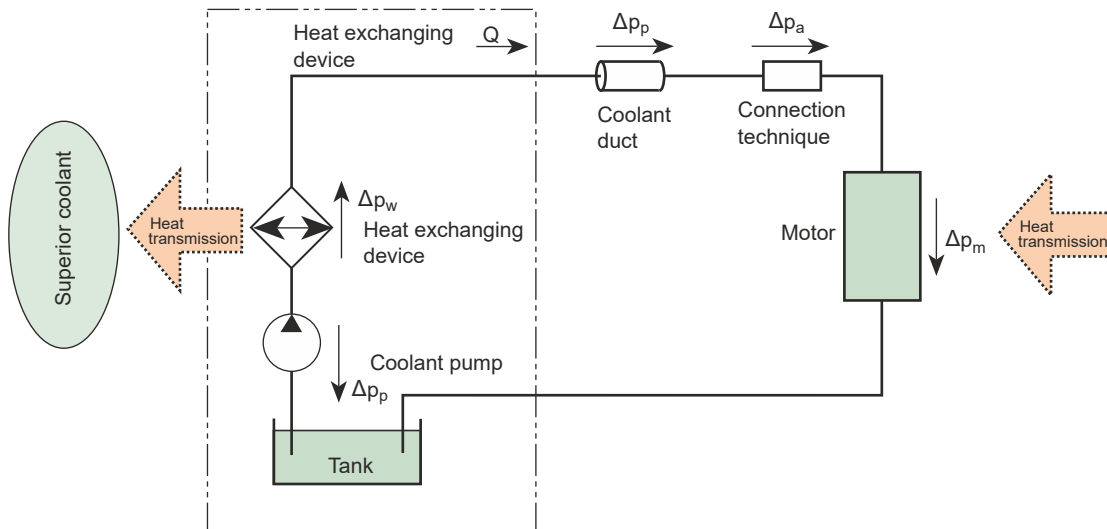


Fig. 164: General arrangement of a liquid cooled motor with heat removal facility

8.7.7 Liquid cooling system

General

Machines and systems can require liquid cooling for one or more drive components. If several liquid-cooled drive components exist, they are connected to the heat dissipation device via a distribution unit.

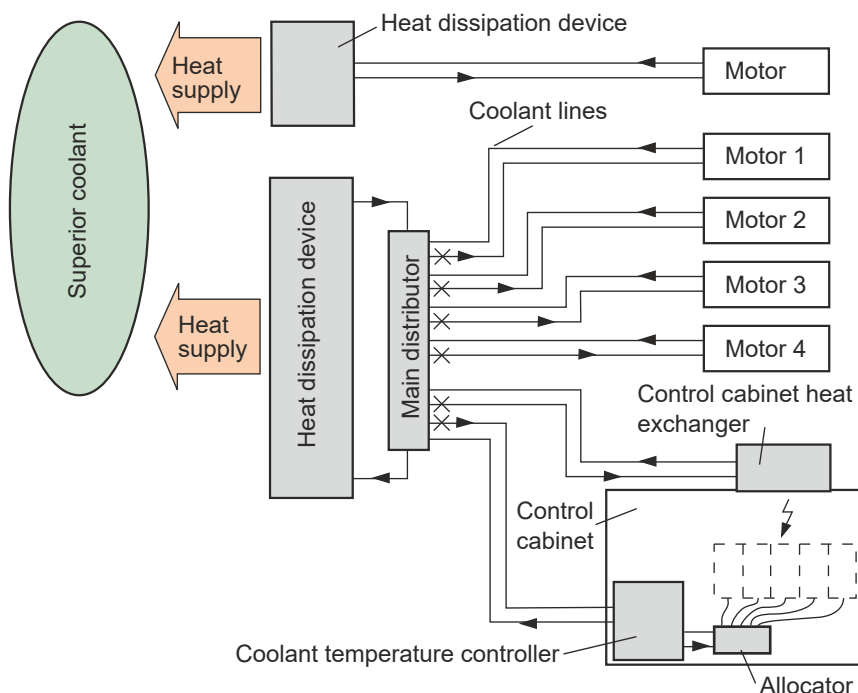


Fig. 165: General arrangement of cooling systems with one and more drive components

Heat dissipation device

The heat dissipation device dissipates the total heat that was fed into the liquid into a superordinate coolant. It provides a temperature-controlled coolant and thus maintains a required temperature level at the components that are to be cooled.

There are three different types of heat dissipation device. They are identified by the type of the heat exchanger between the different media:

- Air-to-liquid cooling unit
- Liquid-to-liquid cooling unit
- Cooling unit

A heat dissipation device includes a heat exchanger, a coolant pump and a coolant container (see Fig. 166).

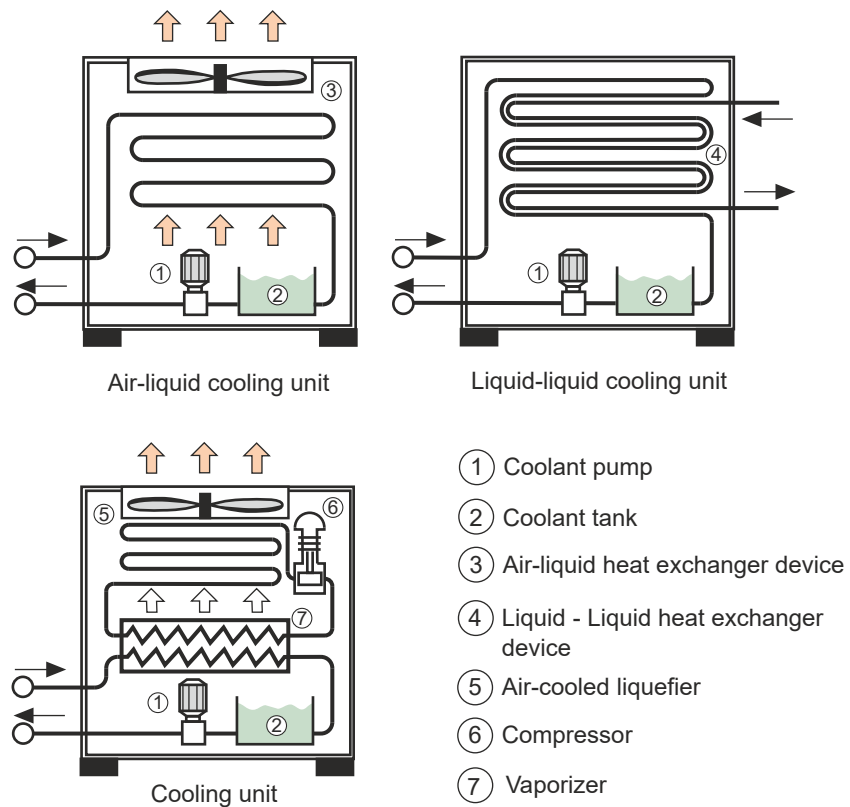


Fig. 166: Heat dissipation devices

Table 68: Overview of the heat dissipation device according to utilization criteria

	Air-to-liquid Cooling unit	Liquid-to-liquid cooling unit	Cooling unit
Coolant temperature control accuracy	Low (± 5 K)	Low (± 5 K)	Good (± 1 K)
Superordinate coolant circuit required	No	Yes	No
Heating of ambient air	Yes	No	Yes
Power loss recovery	No	Yes	No
Size of the cooling unit	Small	Small	Large
Depending on ambient temperature	Yes	No	No
Environment-damaging coolant	No	No	Yes

	Air-to-liquid Cooling unit	Liquid-to-liquid cooling unit	Cooling unit
Notes on operational criteria	Particularly suitable for stand-alone machines that do not have a superordinate coolant circuit and which do not have to fulfill high requirements on the stability of the coolant temperature.	This cooling type is particularly suitable for systems with existing central feedback cooler. It does not fulfill high requirements on the stability of the coolant temperature.	Particularly suitable for high requirements on the thermal stability e.g. for high-precision applications.

Coolant lines

The coolant lines are a major part of the cooling system. They have a great influence on the operational safety and pressure drop of the system. The lines can be made up as hoses or pipes.

The continuous bending strain of the coolant lines always have to be taken into account when they are sized and selected.

Further optional components

- Distributions
- Coolant temperature controller
- Flow indicator
A message is output when the flow drops below a minimum flow quantity.
- Level monitor
Mainly minimum-maximum level monitors to check the coolant level in the coolant container.
- Overflow valve
- Safety valve
Opens a connection between the coolant inlet and tank when a certain pressure is reached
- Coolant filter (100 µm)
- Coolant heating
To provide coolant at a correct temperature, in particular for coolant temperature control
- Choke and shut-off valves

Circuit types

The two possible ways of connecting hydraulic components (series/parallel connection) show significant differences with respect to:

- Pressure drop of the entire cooling system
- Capacity of the coolant pump
- Temperature level and controllability of the individual components that are to be cooled

Parallel connection

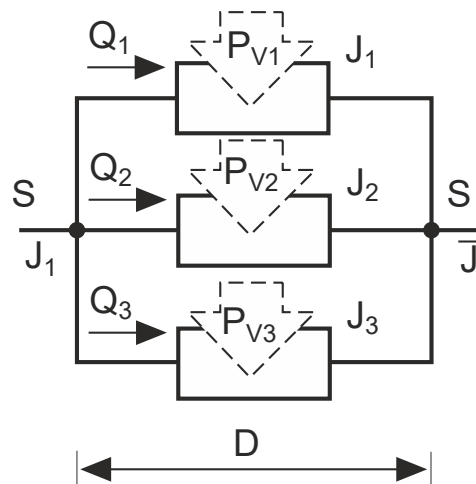


Fig. 167: Parallel connection of liquid-cooled drive components

The parallel connection is characterized by nodes in the hydraulic system. The sum of the coolant streams flowing into a node is equal to the sum of the coolant streams flowing out of this node. Between two nodes, the pressure difference (pressure drop) is the same for all intermediate cooling system branches.

$$Q = Q_1 + Q_2 \dots + Q_n$$

$$\Delta p = \Delta p_1 = \Delta p_2 = \Delta p_n$$

Fig. 168: Pressure drop and flow rate in the parallel connection of hydraulic components

Δp Pressure drop

Q Flow rate

When several drive components are cooled, parallel connection is advantageous for the following reasons:

- The individual components that are to be cooled can be cooled using the individual required flow rate. This means a high thermal operational reliability.
- Same temperature level at the coolant entry of all components (uniform machine heating)
- Same pressure difference between coolant entry and outlet of all components (no high overall pressure required)

Series connection

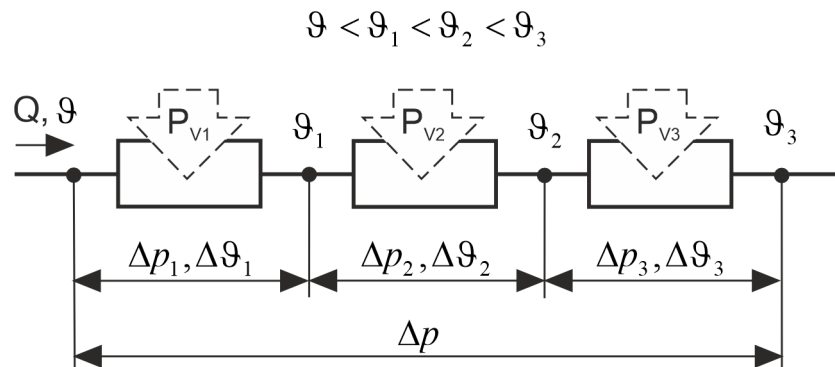


Fig. 169: Series connection of liquid-cooled drive components

In series connection, the same coolant stream flows through all components that are to be cooled. Each component has a pressure drop between coolant inlet and coolant outlet. The individual pressure drops add up to the overall pressure drop of the drive components.

Series connection does not permit any individual selection of the flow quantity required for the individual components to be made. It is only recommended if the individual components that are to be cooled need approximately the same flow rate and only cause a small pressure drop or if they are installed very far away from the heat dissipation device.

$$Q = Q_1 = Q_2 = Q_n$$

$$\Delta p = \Delta p_1 + \Delta p_2 \dots + \Delta p_n$$

Fig. 170: Pressure drop and flow rate in series connection of hydraulic components

Δp Pressure drop

Q Flow rate

The following disadvantages of series connection must always be taken into account:

- The required system pressure corresponds to the sum of all pressure drops of the individual components. This means a reduced hydraulic operational safety due to a high system pressure.
- The temperature level of the coolant increases from one component to the next. Each heat dissipation in the coolant rises its temperature (unsymmetrical machine heating)
- Some components may not be cooled as required since the flow quantity cannot be selected individually.

Combination of series and parallel connection

Combining series and parallel connections of the drive components that are to be cooled permits the benefits of both connection types to be used.

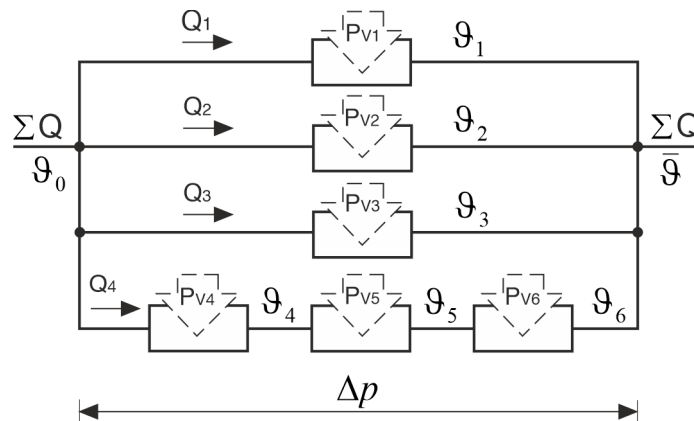


Fig. 171: Combination of series and parallel connection

8.8 Motor temperature monitoring

▲ CAUTION

Failure in the machine or damage by improper use of the sensors!

- The PTC sensors are no safety devices and are not intended for integration into safety systems to protect persons or machines.
- The PTC sensors are neither designed nor intended for measuring the temperatures of the housing, rotor or motor bearing. Additional temperature control requirements have to be realized by the machine manufacturer.
- To ensure safe motor protection against thermal overload, the temperature sensor SNM.150.DK has to be connected to the drive controller.
- The used temperature sensors are equipped with double or reinforced insulation according to DIN EN 50178, so separation exists according to DIN EN 61800-5-1.
- Due to the high speeds, additional losses are generated in the rotor leading to an additional increase in rotor temperature. To prevent inadmissible temperature increase, continuous operation may need to be reduced at high speeds. Please observe the information in [Chapter. Operating behavior](#).

Stators of synchronous torque motors type MBSxx2 are provided with integrated temperature sensors for motor protection by default. Each motor phase contains one of three ceramic PTCs connected in series so that reliable thermal monitoring of the motor is possible in every operation phase. This temperature sensor (motor protection temperature sensor) has switching properties (see [Fig. 172](#)) and enables evaluation at all Bosch Rexroth drive controllers.

Furthermore all stators feature an additional temperature sensor for temperature measurement. This sensor (temperature measurement sensor) has a nearly linear characteristic curve (see [Fig. 173](#)).

Motor protection temperature sensor

Table 69: Reference values temperature sensor SNM.150.DK

Type	PTC SNM.150.DK.***
Rated response temperature ϑ_{NAT}	150 °C

Type	PTC SNM.150.DK.***
Resistance at 25 °C	≈ 100 ... 250 ohm

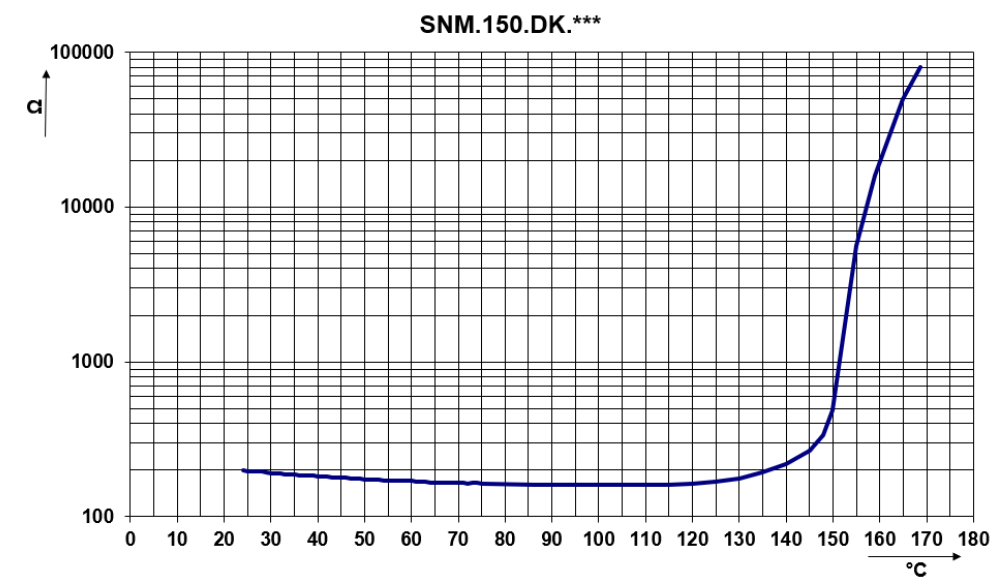


Fig. 172: Motor protection sensor characteristics (PTC)

Temperature sensor KTY84-130

Table 70: Reference values temperature sensor KTY84-130

KTY84-130	Value
Resistance at 25 °C	min. 577 ... max. 629 Ohm
Resistance at 100 °C	min. 970 ... max. 1000 Ohm
Continuous current at 100 °C	2 mA

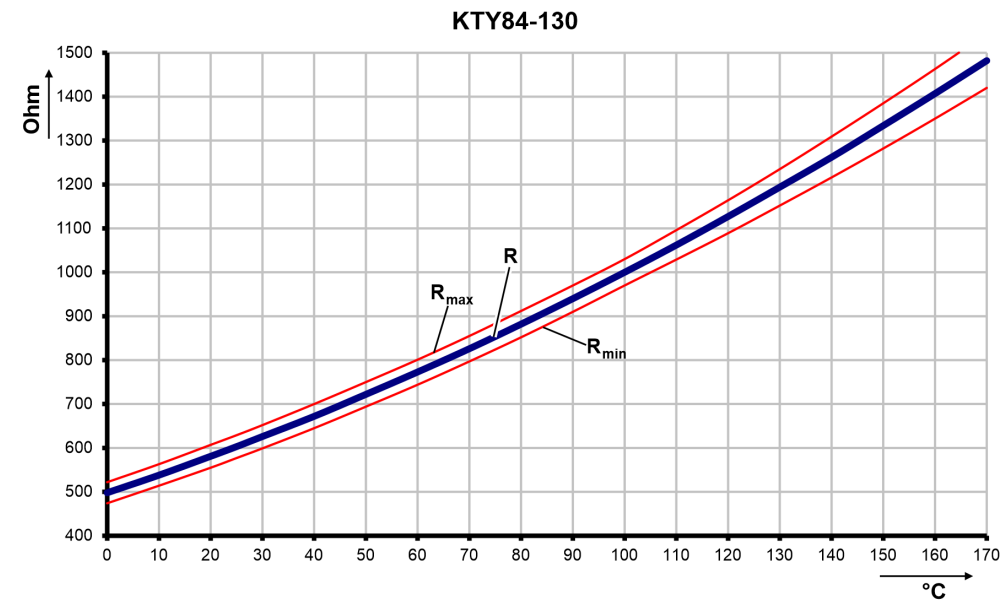


Fig. 173: Characteristic temperature sensor KTY84-130



- KTY84-130 is an ESD sensitive device! For this reason, the stranded wires of the sensor are protected by a protective foil at the connection cable. Before connecting the sensor, take measures regarding ESD protection. (ESD = electrostatic discharge).
- The used temperature sensors are equipped with double or reinforced insulation according to DIN EN 50178, so separation exists according to DIN EN 61800-5-1.

You will find additional information about temperature sensors in [Chapter 7.6.1](#).

8.9 Rotor design and installation principle of rotor/spindle shaft

8.9.1 General information

Rotor and spindle shaft are connected by shrink-fitting (thermal fitting). Due to the rotor design, the following distinction has to be made for assembly:

- **Rotor with smooth bore** (type code designation **1N**)
- **Rotor with step interference fit** (type code designation **2N**)

The following descriptions provide a rough overview of the steps required for assembly and connection of the rotor with the spindle shaft. For detailed information on assembly of the motors, refer to [Chapter 11 Assembly on page 231](#).



Due to shrink-fitting, there is a favorable thermal connection between rotor and shaft. In case of high speeds, additional losses may occur in the rotor leading to an additional increase in temperature. To prevent inadmissible temperatures, heat energy dissipation via the shaft must be ensured.

8.9.2 Rotor with smooth bore

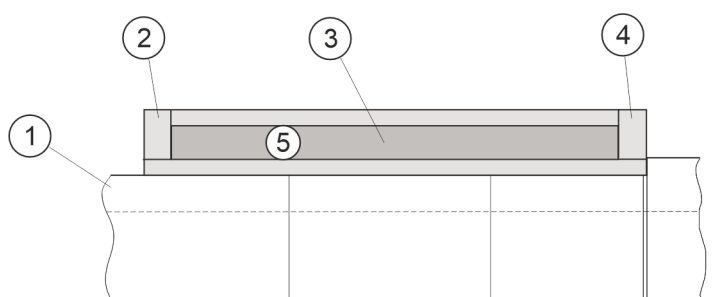


Fig. 174: 1N rotor design - smooth shaft

- ① Spindle
- ② Balancing ring
- ③ Permanent magnets
- ④ Balancing ring
- ⑤ Rotor mounted

The rotor consists of a steel sleeve with internal permanent magnets. Depending on the rotor type, the spindle has several fitting surfaces with graded diameter tolerances. The friction-fit connection of rotor and spindle is realized at the fitting surfaces and ensures alignment of the assembled rotor to the spindle.

As this rotor design does not require any hydraulic oil ports like rotors with step interference fit, it offers the advantages of

- compact construction and
- Enables the realization of larger internal rotor diameters without additional space requirements.

The rotor is installed on the spindle by means of shrink-fitting.

The spindle design in the area of the rotor bore is to be realized according to the dimensional drawings of the respective motor in [Chapter Dimensional sheets](#)

This design does not enable disassembly of the rotor from the spindle without destroying it.



For dimensioning of the motor spindle, it must be observed that the 1N rotor design (smooth bore) cannot be disassembled from the spindle after shrink-fitting without destroying it.

Assembly

Due to the required pressure fittings, the rotor sleeve has to be heated to 135 °C to 145 °C before assembly.

⚠ CAUTION

Damage to magnets in rotor due to temperatures over 145 °C!

The temperature increase at the rotor sleeve must be controlled. Rotor sleeve temperatures exceeding 145 °C are not admissible.

Due to material expansion, the dimensions of the rotor bores are increased.

At the same time, the spindle has to be cooled to –20 °C.

In this condition, rotor and spindle can be connected without any pressure.

Disassembly



Disassembly of rotor design 1N with "smooth shaft" is not possible!

Balancing

After assembly, the rotor is balanced according to the required vibration severity grade (DIN EN 60034-14). To balance the mass of the rotor, grub screws are screwed in radially around the circumference of the balancing ring and secured with liquid screwlocker.

8.9.3 Rotor with step interference fit

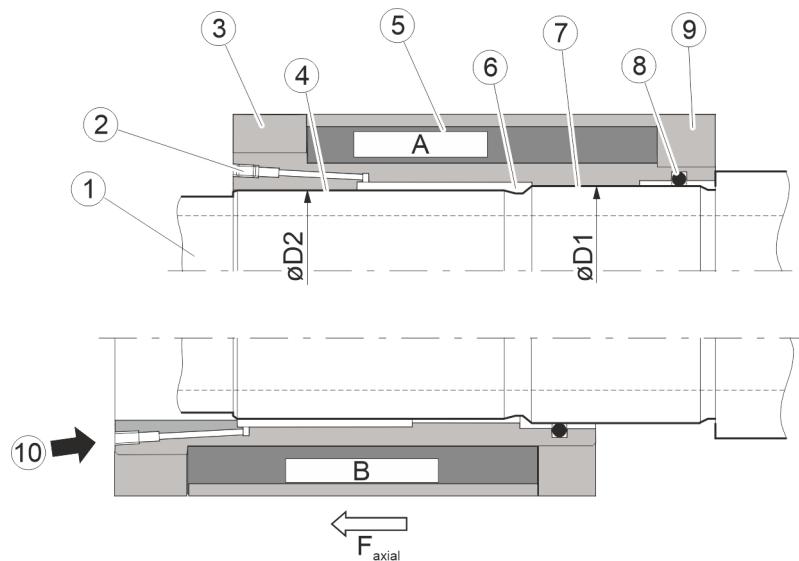


Fig. 175: Rotor installation and step interference fit function

- A Rotor mounted
- B Rotor dismounted
- ① Spindle
- ② Pressure oil connection (sealed)
- ③ Balancing ring
- ④ Step interference fit
- ⑤ Permanent magnets
- ⑦ Oil chamber
- ⑧ Step interference fit
- ⑨ O-ring
- ⑩ Balancing ring
- ⑪ Pressure oil for disassembly

The rotor consists of a steel sleeve with internal permanent magnets. The spindle has two fitting surfaces with graded diameters ($\text{ØD1} > \text{ØD2}$). The friction-fit connection of rotor and spindle is realized by what is referred to as step interference fit. The graded fitting surfaces align the assembled rotor to the spindle and are required for disassembly of the rotor without damaging it.

The spindle design in the area of the step interference fit is to be realized according to the dimensional drawings of the respective motor in [Chapter Dimensional sheets](#).

The rotor is installed on the spindle by means of shrink-fitting and disassembled by means of hydraulic oil.

Assembly

Due to the required pressure fittings, the rotor sleeve has to be heated to 135 °C to 145 °C before assembly. Due to material expansion, the dimensions of at the D1 and D2 diameters are increased..

▲ CAUTION

Damage to magnets in rotor due to temperatures over 145 °C!

The temperature increase at the rotor sleeve must be controlled. Rotor sleeve temperatures exceeding 145 °C are not admissible.

At the same time, the spindle has to be cooled to -20 °C.

Rotor and spindle can then be connected without any pressure.

Disassembly

For disassembly, hydraulic oil is pressed into the step interference fit. The resulting axial force enables sliding of the rotor from the spindle if a separating oil film is applied between the fitting surfaces. The step interference fit becomes loose first at diameter D1. At this side, oil leakage is prevented by the O-ring.

Balancing

After assembly, the rotor is balanced according to the required vibration severity grade (DIN EN 60034-14). To balance the mass of the rotor, grub screws are screwed in radially around the circumference of the balancing ring and secured with liquid screwlocker.

8.9.4 Stator installation - Principle

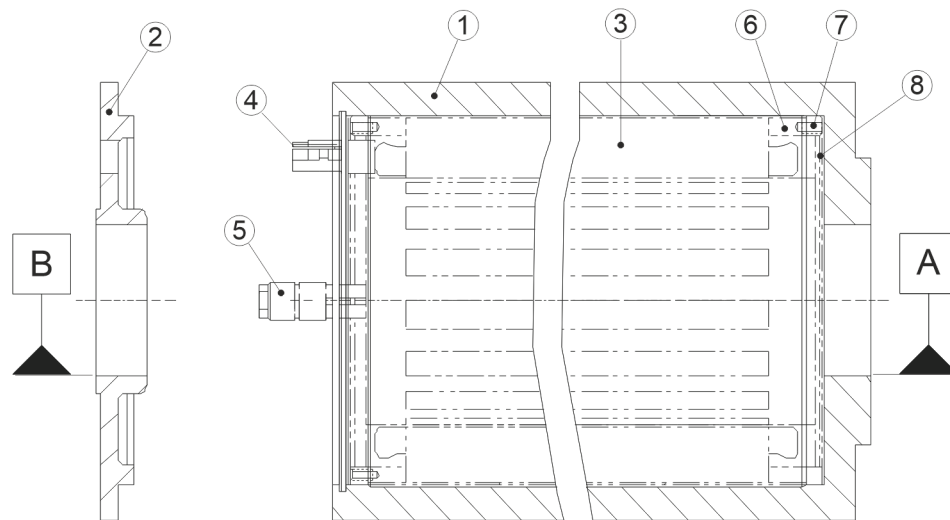


Fig. 176: Stator installation principle

- ① Spindle housing
- ② Bearing shield
- ③ Stator plate package
- ④ Power strand
- ⑤ Coolant connection
- ⑥ Stator flange
- ⑦ Stator mounting thread (only tighten one side of the stator!)
- ⑧ Clearance for expansion in length (take into account on opposite side of stator mounting)

Stator

The stator consists of a plate package with winding heads at the face end, two stator flanges and an integrated cooling system.

The installation bore in the spindle housing is to be realized according to the dimensional drawings of the respective motor in [Chapter Dimensional sheets](#)

Stator attachment

Inside the motor spindle, the stator is attached at the respective side by axial connection and secured against twisting. For this purpose, threads are provided at both end faces inside the stator flange for axial connection.



Mounting is realized either at side A or B of the stator, however, never at both ends!

At the respectively opposite stator end, a clearance of 1 mm must be ensured between the stator and spindle housing to enable expansion in length of the stator. The expansion in length occurs due to the increase in temperature during operation of the motor spindle.

The stator is designed for low weight and low volume. For this reason, its final bending rigidity cannot be ensured before it is installed in the spindle housing.

Cooling

The motors are equipped with a cooling system already integrated in the stator. The coolant lines are connected to the A side of the stator by means of two connectors.

Corrosion protection

The spindle housing must be protected against corrosion by means of a suitable corrosion agent.

Electrical connection

The power connection is established to the A side of the stator. In addition, the winding head includes two cold conductors for monitoring and measurement of the winding temperature by means of the controller.

The line connection and cold conductor connection are guided both as one cable strand in the same duct.

The grounding connection must be realized in compliance with [↗ Chapter Connection technique](#))

When connecting the cables at the spindle housing, it must be ensured that

- the admissible bending radius of the cable strand is observed (see [↗ 7.3](#) and
- that the edges of the through holes at the spindle housing are rounded.

8.10 Energy feedback absorption

If all motors in a drive package are set to braking at the same time (e.g. malfunction at all drives), it must be ensured that the total generated energy feedback (motor inertia including inertia of the load) can be converted to heat or fed back.

⚠ CAUTION

Property damage due to brake resistance overload and excessive braking time/distance!

When selecting the supply unit, ensure that the sum of the peak feedback of all drives does not exceed the brake resistance peak of the supply unit.

If the supply cannot be fed back or in case of a potential defect in the control voltage of the supply, the active brake resistance must enable full absorption of the fed-back energy of an emergency stop.

Calculation

Particularly for motors of the MBSxx2 series with high maximum speeds, the brake energy feedback must be observed and compared with the energy feedback absorption of the applied supply or the converter!

If necessary and if possible, an additional braking resistor must be used!

For information on calculation of the energy feedback as well as the applicable supply and converter data, please refer to the project planning manual

- Rexroth IndraDrive Drive System
[↗ DOK-INDRV*-SYSTEM*****-PRxx](#)



8.11 Third-party components

8.11.1 Motor encoder

General information

A motor encoder is required for measuring the position and the velocity. Particularly high requirements are imposed on the motor encoder and its mechanical connection.



The motor encoder does not belong to the scope of delivery of a motor. Suitable motor encoders have to be selected by the machine manufacturer based on the requirements of your application or machinery.

In case of questions on technical compatibility of the motor encoder with Rexroth controllers, please contact the Rexroth customer support.

If the position of the rotor to the stator has to be determined immediately after power-up or a malfunction (pole position recognition), an absolute encoder system is recommended.

The achievable accuracy of the motors is essentially determined by the mechanical rigidity of the overall system.

Selection

For selection of the motor encoder to achieve the required accuracy, the following points have to be taken into consideration:

- Speed range of the motor
- Speed range of the encoder
- Encoder resolution/accuracy
- Compatibility with controller

Measuring principle

Absolute encoder

The advantages of absolute encoder systems are based on a high availability and operational reliability of the entire system. Additional advantages include:

- Monitoring and diagnostic functions of the electronic drive system are possible without any additional wiring
- The maximum available motor force is available immediately after power-up
- No referencing required
- Easy commissioning
- Commutation settings are only required for initial commissioning



The use of an absolute encoder system enables that commutation of the motor only needs to be carried out once upon initial commissioning.

Incremental encoder

If an incremental encoder system is used, the pole position has to be determined every time the drive is switched on. This is done by means of a drive-internal process every time the motor is switched on. Subsequently, the motor power can develop.



The drive-internal procedure for commutation has to be carried out every time the drive is switched on.

Source of supply motor encoder

Suppliers for encoder systems include:

Table 71: Motor encoder suppliers

Components	Supplier
Angle measuring instruments ER....	DR. JOHANNES HEIDENHAIN GmbH Dr.-Johannes-Heidenhain-Strasse 5 83301 Traunreut, Germany Tel.: +49 (0) 86 69 31 – 0 Fax: +49 (0) 86 69 50 61 Internet: ➔ https://www.heidenhain.de
Angle measuring systems RESR	RENISHAW GmbH Karl-Benz Strasse 12 72124 Pliezhausen, Germany Tel.: +49 (0) 71 27 / 98 10 Fax: +49 (0) 71 27 / 88 23 7 Internet: ➔ https://www.renishaw.de
Gear wheel encoder GEL....	Lenord, Bauer &Co.GmbH Dohlenstraße 32 46145 Oberhausen, Germany Tel.: +49 (0) 208 / 9963 – 0 Fax: +49 (0) 208 / 6762 – 92 Internet: ➔ https://www.lenord.de

8.11.2 Bearing

Selection



Motor bearings do not belong to the scope of delivery. Suitable bearings have to be selected by the machine manufacturer based on the requirements of your application or machinery.

For selection of bearings regarding the service life, comply with the following:

- Speed range of the motor
- Radial and axial load on the bearing during operation.

For detailed information on bearing selection, please refer to the respective publications of the encoder manufacturers.

Suppliers for bearings include:

Table 72: Motor bearing suppliers

Components	Supplier
Bearings YRT...	INA-SCHAEFFLER KG Industriestrasse 1-3 91074 Herzogenaurach, Germany Tel.: +49 (0) 91 32 / 82 - 0 Fax: +49 (0) 91 32 / 82 - 49 50 Internet: ➔ www.ina.de
Bearings	SKF GmbH Gunnar-Wester-Straße 12 97421 Schweinfurt, Germany Tel.: +49 (0)-9721-56-0 Fax: +49 (0)-9721-56-6000 Internet: ➔ www.skf.com

Components	Supplier
Bearings	NSK Deutschland GmbH Hauptverwaltung Harkortstraße 15 40880 Ratingen, Germany Tel: +49 (0)-21-02-4810 Fax: +49 (0)-21-02-4812290 Internet: ➔ www.nsk.com
Bearings	NTN Wälzlager GmbH Max-Planck-Straße 23 40699 Erkrath, Germany Tel.: +49 (0)-211-2508-0 Fax: +49 (0)-211-2508-400 Internet: ➔ www.ntn-snr.com

9 Motor dimensioning

9.1 General procedure

Torque drive dimensioning is determined by the application-dependent characteristics of speed and torque. The sequence of dimensioning of torque drives is illustrated by the following figure.

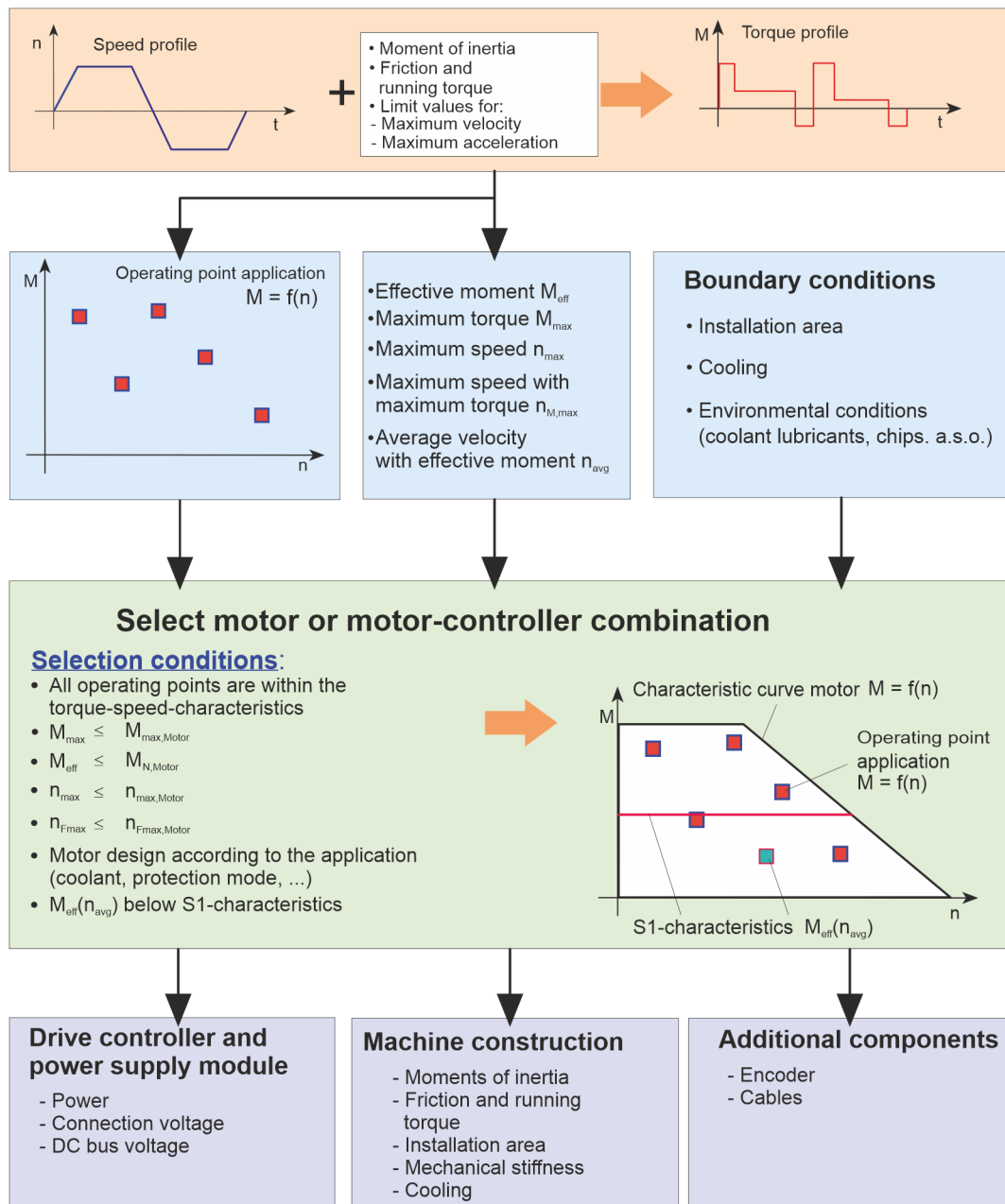


Fig. 177: Sequence of torque drive dimensioning

9.2 Basic formulae

9.2.1 General movement equations

The variables required for sizing and selecting the motor are calculated using the equations shown in the following.



The torques and speeds of the process are used to select drives when configuring rotary direct drives.

$$n(t) = \frac{\varphi(t)}{dt \times 60}$$

$$a(t) = \frac{n(t)}{dt \times 60}$$

$$M(t) = J_{rot} \times a(t) + M_F$$

$$M_{eff} = \sqrt{\frac{1}{T} \times \int_0^T M(t)^2 dt}$$

$$n_{avg} = \frac{1}{T} \times \int_0^T n(t) dt$$

Fig. 178: General equations of motion

$n(t)$ Speed profile in time characteristic

$a(t)$ Acceleration profile vs. time in m/s^2

$M(t)$ Torque profile in time characteristic in N

J_{rot} Rotor inertia torque in $kg \cdot m^2$

$F_0(t)$ Base force in N

M_F Friction torque in N

M_{eff} Effective force in N

n_{avg} Mean speed in min^{-1}

t Time in s

T Total time in s

In most cases the mathematical description of the required positions vs. the time is known (NC-program, electronic cam disk). The load cycle or the load profile can be calculated using the load cycle/the load profile. Standard software (such as MS Excel or MathCad) can be used for calculating the required variables, even with complex motion profiles.



The following chapter provides a more detailed correlation for trapezoidal or triangular speed curves.

9.2.2 Torques

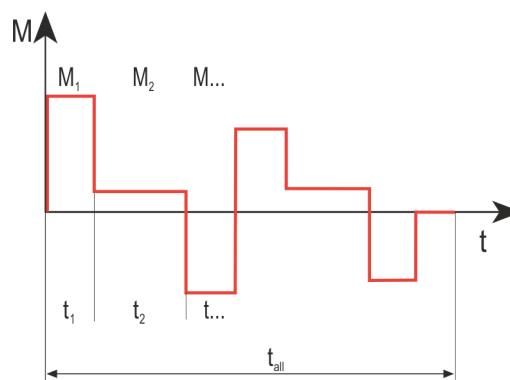


Fig. 179: Determining torques

$$M_{acc} = J_{rot} \times a$$

$$M_{max} = M_{acc} + M_F$$

$$M_{eff} = \sqrt{\frac{M_1^2 \times t_1 + M_2^2 \times t_2 + \dots}{t_{all}}}$$

Fig. 180: Determining torques

M_{acc} Acceleration torque in N
 M_F Friction and running torque
 M_{max} Maximum torque in N
 M_{eff} Effective force in N
 a Acceleration in m/s^2
 J_{rot} Moment of inertia of rotor
 t_{all} Total duty cycle time in s



For dimensioning of rotary drives, take the rotor inertia into consideration (in particular in case of low load inertia). The rotor inertia can only be established after the motor has been selected. Thus, first make assumptions for these variables and verify these values after the motor has been selected.

9.2.3 Mean speed

The mean speed is required to determine the mechanic continuous power of the drive. The following calculation can be used for a user-friendly determination of trapezoidal or triangular speed profiles:

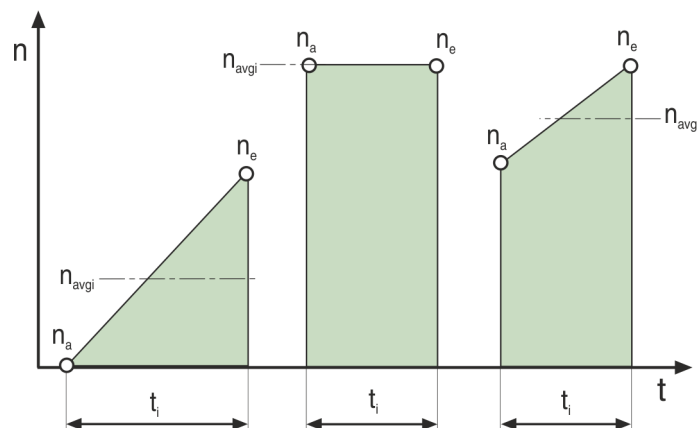


Fig. 181: Triangular or trapezoidal velocity profile

$$n_{avg} = \frac{|n_a| - |n_e|}{2}$$

$$n_{avg} = \frac{\sum n_{avg\ i} \cdot t_i}{t_{all}}$$

Fig. 182: Determining the mean speed of triangular or trapezoidal speed profiles

$n_{avg\ i}$ Mean speed for speed segment with duration t_i in min^{-1}

n_a Initial speed of the speed segment in min^{-1}

n_e Final speed of speed segment in min^{-1}

n_{avg} Mean speed via total duration in min^{-1}

t_i Duration of speed segment in s

t_{all} Total duty cycle time, including breaks and/or standstill time, in s

9.2.4 Trapezoidal speed

General

This mode of operation is characteristic for the most applications. After the acceleration phase, constant speed is used for operation until the deceleration phase.

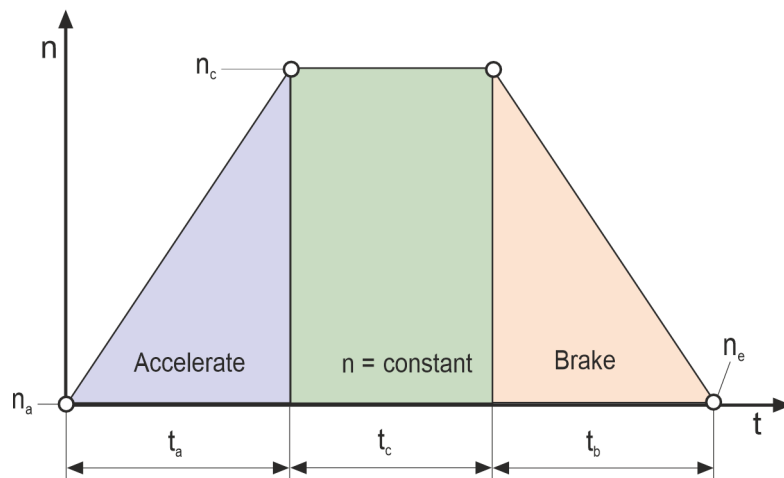


Fig. 183: Trapezoidal speed profile

Accelerate, initial speed = 0 min^{-1}



- Speed $n \neq \text{constant}$
- Initial velocity $n_a = 0 \text{ min}^{-1}$
- Acceleration $a = \text{constant and positive}$

$$a = \frac{n_c}{t_a} = \frac{2 \times \varphi}{t_a^2} = \frac{n_c^2}{2 \times \varphi}$$

$$n_c = a \times t_a = \sqrt{2 \times a \times \varphi} = \frac{2 \times \varphi}{t_a}$$

$$t_a = \frac{n_c}{a} = \frac{2 \times \varphi}{n_c} = \sqrt{\frac{2 \times \varphi}{a}}$$

$$\varphi = \frac{n_c}{2} \times t_a = \frac{n_c^2}{2 \times a} = \frac{a \times t_a^2}{2}$$

Fig. 184: Uniformly accelerated motion, initial speed = 0 (for trapezoidal speed profile)

- a Acceleration in m/s²
- n_c Final speed in min⁻¹
- t_a Acceleration time in s
- φ Phase during acceleration in ° (' '')

Accelerate, initial speed ≠ 0 min⁻¹



- Speed n ≠ constant
- Initial velocity n_a ≠ 0 min⁻¹
- Acceleration a = constant and positive

$$a = \frac{n_c - n_a}{t_a} = \frac{2 \times \varphi}{t_a^2} - \frac{2 \times n_a}{t_a} = \frac{n_c^2 - n_a^2}{2 \times \varphi}$$

$$n_c = n_a + a \times t_a = \sqrt{2 \times a \times \varphi + n_a^2} = \frac{2 \times \varphi}{t_a} + n_a$$

$$t_a = \frac{n_c - n_a}{a} = \frac{2 \times \varphi}{n_c + n_a} = \sqrt{\frac{2 \times a \times \varphi + n_a^2 - n_a^2}{a}}$$

$$\varphi = \frac{n_c + n_a}{2} \times t_a = \frac{n_c^2 - n_a^2}{2 \times a} = n_a \times t_a + \frac{a \times t_a^2}{2}$$

Fig. 185: Uniformly accelerated motion, initial speed ≠ 0 (for trapezoidal speed profile)

- a Acceleration in m/s²
- n_c Final speed in min⁻¹
- n_a Initial speed in min⁻¹
- t_a Acceleration time in s
- φ Phase during acceleration in ° (' '')

Constant speed



- Speed n = constant
- Acceleration a = 0

$$n_c = \frac{\varphi_c}{t_c}$$

$$t_c = \frac{\varphi_c}{n_c}$$

$$\varphi_c = n_c \times t_c$$

Fig. 186: Constant speed (for trapezoidal speed profile)

n_c Constant speed in min^{-1}

t_c Time during constant speed in s

φ_c Phase during constant speed in $^\circ (' '')$

Decelerate, final speed = 0 min^{-1}



- Speed $n \neq$ constant
- Final speed $n_e = 0 \text{ min}^{-1}$
- Acceleration $a =$ constant and negative

$$a = \frac{n_c}{t_b} = \frac{2 \times \varphi}{t_b^2} = \frac{n_c^2}{2 \times \varphi}$$

$$n_c = a \times t_b = \sqrt{2 \times a \times \varphi} = \frac{2 \times \varphi}{t_b}$$

$$t_b = \frac{n_c}{a} = \frac{2 \times \varphi}{n_c} = \sqrt{\frac{2 \times \varphi}{a}}$$

$$\varphi = \frac{n_c}{2} \times t_b = \frac{n_c^2}{2 \times a} = \frac{a \times t_b^2}{2}$$

Fig. 187: Constantly decelerated motion, final speed = 0 (for trapezoidal speed profile)

a Acceleration in m/s^2

v_c Final speed in min^{-1}

t_b Braking time in s

φ Phase during deceleration in $^\circ (' '')$

Decelerate, final speed $\neq 0 \text{ min}^{-1}$



- Speed $n \neq$ constant
- Final speed $n_e \neq 0 \text{ min}^{-1}$
- Acceleration $a =$ constant and negative

$$a = \frac{n_c - n_e}{t_b} = \frac{2 \times n_c}{t_b} - \frac{2 \times \varphi}{t_b^2} = \frac{n_c^2 - n_e^2}{2 \times \varphi}$$

$$n_e = n_c - a \times t_b = \sqrt{n_c^2 - 2 \times a \times \varphi} = \frac{2 \times \varphi}{t_b} - n_c$$

$$t_a = \frac{n_c - n_e}{a} = \frac{2 \times \varphi}{n_c + n_e} = \frac{n_c - \sqrt{n_c^2 - 2 \times a \times \varphi}}{a}$$

$$\varphi = \frac{n_c + n_e}{2} \times t_b = \frac{n_c^2 - n_e^2}{2 \times a} = n_c \times t_b + \frac{a \times t_b^2}{2}$$

Fig. 188: Constantly decelerated motion, final speed $\neq 0 \text{ min}^{-1}$ (for trapezoidal speed profile)

a Acceleration in m/s^2

n_c Initial speed in min^{-1}

n_e Final speed in min^{-1}

t_a Braking time in s

φ Phase during deceleration in $^\circ (' '')$

9.2.5 Triangular speed

This speed profile does not have a phase of constant speed in contrast to the trapezoidal profile. The acceleration phase is immediately followed by the deceleration phase.

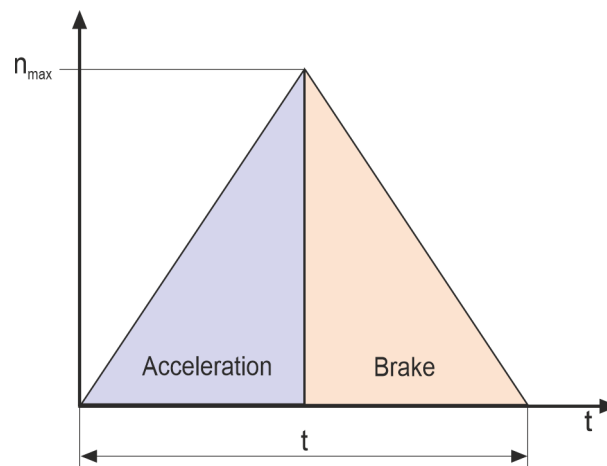


Fig. 189: Triangular speed profile

$$n_{\max} = \frac{a \times t}{2} = \sqrt{a \times \varphi_{\text{all}}} = \frac{2 \times \varphi_{\text{all}}}{t}$$

$$a = \frac{2 \times n_{\max}}{t} = \frac{4 \times \varphi_{\text{all}}}{t^2} = \frac{n_{\max}^2}{\varphi}$$

$$\varphi_{\text{all}} = \frac{n_{\max} \times t}{2} = \frac{n_{\max}^2}{4 \times a} = \frac{a \times t^2}{4}$$

$$t = \frac{2 \times n_{\max}}{a} = \frac{4 \times \varphi_{\text{all}}}{n_{\max}} = \sqrt{\frac{4 \times \varphi_{\text{all}}}{a}}$$

Fig. 190: Calculation of triangular speed profile

$n_{\max}$ Maximum reachable speed in min^{-1}

a Acceleration in m/s^2

φ_{all} Total travel path

t Positioning time in s

9.3 Duty cycle and torque

9.3.1 General

The relative duty cycle ED specifies the duty cycle percentage of the load with respect to a total duty cycle time, including idle time. The thermal load capacity of the motor limits the duty cycle. Loading the motor with a continuous rated torque is possible during the entire duty cycle time. To avoid thermal overload at motors with higher torques, reduce the duty cycle at $M > M_N$ (see [Fig. 9.3.1](#)).

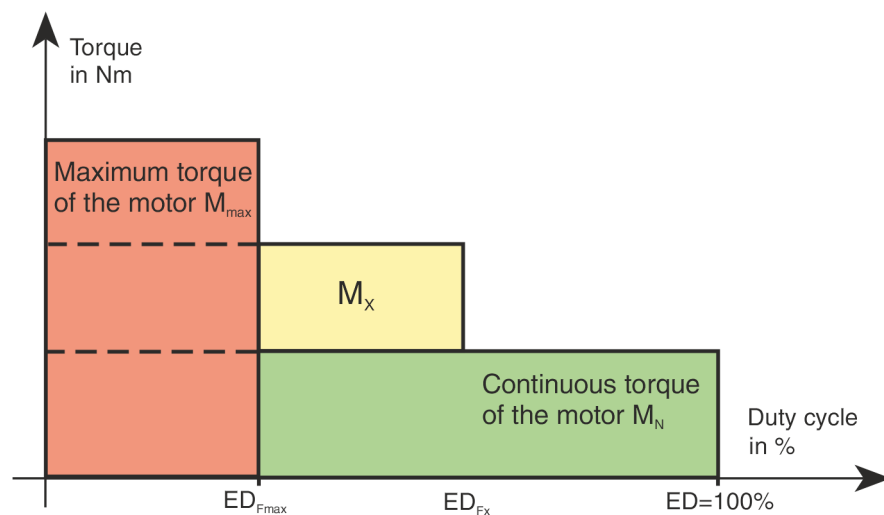


Fig. 191: Correlation between duty cycle and torque.

9.3.2 Determining the duty cycle

The approximate determination of the relative duty cycle ED_{ideal} is performed via the correlation:

$$ED_{ideal} = \left(\frac{M_N^2}{M_{max}^2} \right) \cdot 100$$

Fig. 192: Approximate determination of duty cycle ED

ED_{ideal} Cyclic duration factor in %
M_N Continuous rated torque in Nm
M_{max} Maximum torque in Nm

Prerequisites: Linear correlation between torque and current.

For MBSxx2 motors acc. to Fig. 192, only an approximate duty cycle calculation is possible since there is a non-linear correlation between torque and current.

To roughly determine potential duty cycles in case of short-time duty forces with M_{KB} ≤ 1.5 M_N, this calculation is valid.



For an exact determination of the relative duty cycle of the MBSxx2 motors, use Fig. 192 or Fig. 194.

The non-linearity of the characteristic curve torque via current of synchronous torque motors leads to an increased rise of power loss at higher torque forces. This increased power loss leads – in particular at a high percentage of acceleration and deceleration processes – to a possible duty cycle that is reduced with respect to Fig. 192.

$$ED_{real} = \frac{P_{vN}}{P_{AVG\ a}} \cdot 100$$

Fig. 193: Determining the duty cycle ED

ED_{real} Possible relative duty cycle in %
P_{vN} Maximum heat dissipation of the motor in W (for continuous power loss see → Chapter) Technical data)
P_{AVG a} Average motor power loss in application over a duty cycle time including idle time in W

Prerequisites: Duty cycle time ≤ Thermal time constant of motor

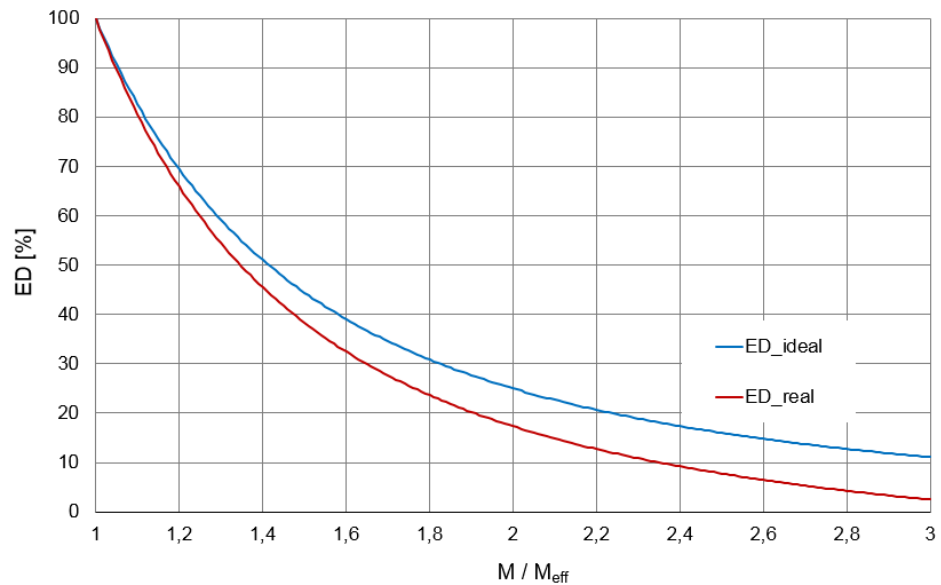


Fig. 194: Duty cycle via force

9.4 Determining the drive power

9.4.1 General



To size the power supply module or the mains connected load, you must determine the rated (continuous) and maximum power of the rotary drive.

Take the corresponding simultaneity factor into account when determine the total power of several drives that are connected to a single power supply module.

9.4.2 Continuous power

The continuous power corresponds to the sum of the mechanical and electrical motor power.

$$\text{Total rated output: } P_c = P_{cm} + P_{ce}$$

$$\text{Mechanical rated output: } P_{cm} = F_{eff} \times v_{avg}$$

$$\text{Rated electrical output: } P_{ce} = \left(\frac{F_{eff}}{F_{dn}} \right)^2 \times P_{vn} \text{ with } F_{eff} \leq F_{dn}$$

Fig. 195: Continuous power of the linear motor

P_c Continuous power in W

P_{cm} Mechanical continuous power in W

P_{ce} Electrical continuous power loss of motor in W

F_{eff} Effective force in N (from application)

v_{avg} Average velocity in m/s

F_{dn} Nominal force of the motor in N (see [Chapter](#) Technical data)

P_{vn} Nominal power loss of the motor in W (see [Chapter](#) Technical data)



When reducing the continuous torque, the electirc continuous poweris also reduced (seeFig.). 195).

9.4.3 Maximum output

The maximum output is also the sum of the mechanical and electrical maximum output. It must be made available to the drive during acceleration and deceleration phase or for very high machining forces, for example.

$$\text{Total maximum power: } P_{\max} = P_{\max m} + P_{\max e}$$

$$\text{Mechanical maximum power: } P_{\max m} = F_{\max} \times v_{F \max}$$

Fig. 196: Maximum power of the linear motor

$P_{\max}$ Total maximum power in W

$P_{\max m}$ Mechanical maximum power in W

$P_{\max e}$ Electrical maximum power in W (see the following diagram)

$F_{\max}$ Maximum feed force in N

$v_{F \max}$ Maximum velocity with $F_{\max}$ in N



When reducing the maximum torque compared to the maximum torque of the motor, the electric maximum power is also reduced $P_{\max e}$. To determine the reduced electrical maximum output $P_{\max e}$, use Fig. 197.

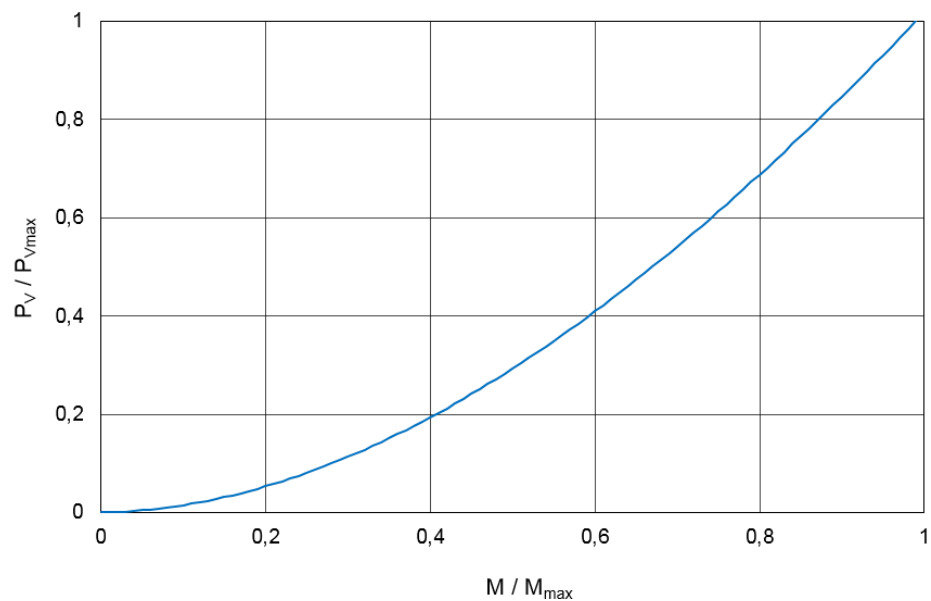


Fig. 197: Diagram used for determining the reduced electrical power loss

M Maximum torque of application in N

$M_{\max}$ Maximum torque of the motor in N

P_V Power loss of motor application in W

$P_{V\max}$ Maximum power loss of the motor in W

9.4.4 Cooling capacity

The necessary cooling capacity corresponds the electric continuous power loss of the motor. In case of increasing speed, the additional losses such as iron losses (hysteresis and eddy current losses) in sheet-metal and solenoids.

$$P_{co} = P_{ce} = \left(\frac{M_{eff}}{M_N} \right)^2 \times P_V$$

$$P_{ce} = P_{Cu} = \frac{3}{2} \times R_{12} \times (1 + \Delta\vartheta \times \alpha_{Cu})^2$$

Fig. 198: Required cooling capacity of the motor

P_{co} Required cooling capacity in W

P_{ce} Electrical dissipation (copper loss) of motor in W

M_{eff} Effective force in N

M_N Rated torque of motor in N (see [Chapter Technical data](#))

P_V Power loss of motor in kW (see [Chapter Technical data](#))

P_{Cu} Copper loss

R_{12} Winding resistance at 20 °C (see [Chapter Technical data](#))

$\Delta\vartheta$ Temperature difference between inlet and outlet at the cooling connections of the motor

α_{Cu} Temperature coefficient 0.0039 1/K

The required flow rate to dissipate the cooling capacity of [Chapter 9.4.4 Cooling capacity on page 223](#) for the cooling medium water is calculated from:

$$Q = \frac{P_{co} \times 60}{C_{H2O} \times \Delta\vartheta} = \frac{P_{co} \times 60}{4186,8 \frac{J}{kg \times K} \times \Delta\vartheta}$$

Fig. 199: Required flow rate

Q Flow rate due to cooling jacket of motor in l/min

P_{co} Required cooling capacity in W

$\Delta\vartheta$ Temperature difference between inlet and outlet at the cooling connections of the motor

10 Handling, transport and storage

10.1 Delivery condition

10.1.1 General

On delivery, MBSxx2 motors are packed in a cardboard box with polystyrene half-shells or in wooden crates depending on the respective frame size.

The goods are delivered on pallets or in a lattice box. Packing units on pallets are secured with straps.

The rotor and stator are packed separately and are thus protected against mechanical damage caused by bumping against each other during transport.

If several kit spindle motors or components are ordered at the same time, they will be combined into one package if possible.

An envelope with the delivery note is attached on the wooden box or carton.

There are more labels on the package:

- 1 label with notes about safe handling
- 1 label with instructions about safe transport
- Bar code label (amount depends on the contents) with details about:
 - Customer
 - Delivery number

- Commission
- Commissioned forwarder

Any further accompanying papers, if not required, are not applicable.

⚠ WARNING

Injuries due to uncontrolled movement of the tightening straps when cutting them!

- Keep sufficient distance
- Carefully remove the retaining straps

⚠ CAUTION

Risk of injury and/or property damage when handling rotors of MBSxx2 motors!

- Strictly observe and adhere to all warnings and safety instructions!
- Mark the working area as hazardous magnetic environment.
- Due to the strong magnetic field, do not unpack the rotors before they are required for assembly.

When selecting the transport and lifting devices, the different weights and sizes of the individual designs must be taken into account. For information on the weight of the rotor and stator, refer to ➔ [Chapter 3 Technical data on page 31](#).

Special care is also required for models transported by hand and transport and storage instructions must always be observed.

10.1.2 Motor component marking

Bar code

A bar code label is attached to each packaging of rotors and stators. The bar code label is provided for identifying the contents of the packages during processing of the order.

Type plate

Stators MSS and rotors MRS are delivered with 2 type plates.

Attach one of the type plates each at a well visible point at the machine. This allows you to read the motor data at any time without having to work in hard-to-reach places.



Before contacting Bosch Rexroth, always specify the full type designations and serial numbers of the products involved.

Stator identification

The stator is marked at its front face with the electrical connections. The data of this marking are identical with the data of the associated stator nameplate and consist of

- Type identification
- Serial number
- Manufacturing month and year

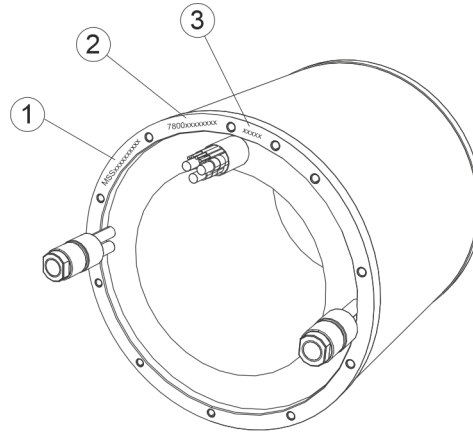


Fig. 200: Stator designation

- ① Type identification
- ② Serial number
- ③ Manufacturing month and year

Rotor identification

As with the stator, the rotor is also marked on one of the two end faces. The following marking is done:

- Type identification
- Serial number
- Manufacturing month and year

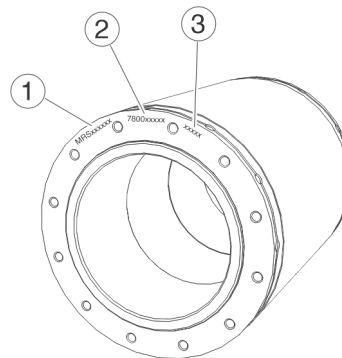


Fig. 201: Rotor designation

- ① Type identification
- ② Serial number
- ③ Manufacturing month and year

10.1.3 Factory testing

All MBSxx2 motors are subjected to the following tests at the factory:

- High voltage test according to DIN EN 60034-1.
- Insulation resistance according to DIN EN 60204-1/1.92, section 20.3.
- Geometric measurement of all mounting sizes.

10.1.4 Customer testing

Since all MBSxx2 motors are subjected to a standardized test procedure, high-voltage tests by the customer are not necessary. Motors and components could be damaged if they are subjected to repeated high-voltage tests. If a new test is nevertheless to be carried out, it is essential that you consult Rexroth.

⚠ CAUTION

Destruction of motor components due to improperly executed high-voltage test! Loss of warranty!

- Avoid repeated inspections.
- Observe the guidelines of DIN EN 60034-1.

10.1.5 Scope of delivery

The total scope of delivery can be seen from the delivery note or the accompanying document. The content, however, can be delivered in several packages. Each package can be identified by a forwarding label.

For stator and rotor, 2 type plates are provided. Additionally, a shipping note with information on handling is provided.



Compare the ordered and delivered types after receipt of the goods. Reclaim deviations immediately.

10.2 Transport and storage

10.2.1 General notes

Also refer to the notes regarding storage and transport on the package and accompanying papers.

⚠ WARNING

The rotor is magnetic! Risk of injury and danger of crushing body parts by magnetic forces!

- ⇒ Remove or secure any movable metal objects.
- ⇒ Carefully handle all magnetic components.

⚠ CAUTION

Damage or injuries and loss of the warranty due to improper handling! Heavy weight!

- ⇒ **Strictly comply with all safety and warning notes (see also → Chapter 2 Safety instructions on page 17).**
- ⇒ Protect the products against moisture and corrosion.
- ⇒ Avoid mechanical loads, strokes, throwing, tilting or dropping of the products.
- ⇒ Use only suitable lifting gear.
- ⇒ To transport the stators with housings, use the mounted eye bolt.
- ⇒ Do not lift the motor at its connectors, cables or connection fittings.
- ⇒ Use suitable protective equipment and protective clothing during transport.
- ⇒ **Transport** the motors horizontally in a dry, vibration-free, dust-free and corrosion-protected condition.
- ⇒ **Store** the motors horizontally in a dry, vibration-free, dust-free and corrosion-protected condition.

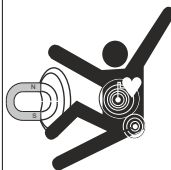
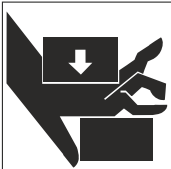
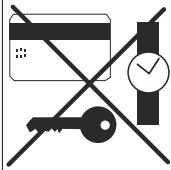
	⚠ WARNING Health hazard to people with heart pacemakers, metal implants and hearing aids when in proximity to these parts! Strong magnetic fields due to permanent motor magnets! - Anyone with pacemakers, metal implants or hearing aids are not permitted to approach or to handle these motor parts. - If you have such conditions, consult with a physician prior to handling these parts.	⚠ WARNUNG Gesundheitsgefahr für Personen mit Herzschrittmachern, metallischen Implantaten oder Splittern und Hörgeräten in unmittelbarer Umgebung dieser Teile! Starkes Magnetfeld durch Permanentmagnete der Motorteile! - Personen mit Herzschrittmachern, metallischen Implantaten oder Hörgeräten dürfen sich nicht diesen Motorteilen nähern oder damit umgehen. - Besteht die Notwendigkeit für solche Personen, sich diesen Teilen zu nähern, so ist das zuvor von einem Arzt zu entscheiden.
	⚠ CAUTION Hazardous to fingers and hands due to high attractive forces of permanent motor magnets! Strong magnetic fields due to permanent motor magnets! Handle only with protective gloves! Handle with extreme care.	⚠ VORSICHT Quetschgefahr von Finger und Hand durch starke Anziehungskräfte der Magnete! Starkes Magnetfeld durch Permanentmagnete der Motorteile! Nur mit Schutzhandschuhen anfassen. Vorsichtig handhaben.
	⚠ CAUTION Hazardous to sensitive parts! Keep watches, credit cards, identification cards with magnetic strips, magnetic tape and ferromagnetic material (such as iron, nickel, and cobalt) away from magnetic parts.	⚠ VORSICHT Zerstörungsgefahr empfindlicher Teile! Uhren, Kreditkarten, Scheckkarten und Ausweise mit Magnetstreifen sowie alle ferromagnetischen Metallteile wie Eisen, Nickel und Cobalt von den Permanentmagneten der Motorteile fernhalten.

Fig. 202: Warning label on and in the packaging.

The self-adhesive warning label (dimensions approx. 110 mm x 150 mm) can be ordered from Rexroth (MNR R911278745) for the user's own purposes.

10.2.2 Transport instructions

Environmental conditions during transport

Transport our products only in their original package. Also refer to the specific ambient factors to protect the products from transport damage.

Based on EN IEC 60721-3-2:2018, the tables below specify classifications and limit values which are allowed for our products while they are transported by land, sea or air. Refer to the detailed description of the classifications to take all of the factors which are specified in the particular class into account.

Table 73: Allowed classes of environmental conditions during transport according to EN IEC 60721-3-2:2018

Classification type	Class
climatic environmental conditions	2K11
environmental conditions	2B1
classification of chemically active materials	2C1
classification of mechanically active materials	2S5
climatic environmental conditions	2M4

For a better overview, some essential environmental influencing variables of the previously mentioned classifications are listed. Unless otherwise specified, the values given are the values of the particular class. However, Bosch Rexroth reserves the right to adjust these values at any time based on future experiences or changed environmental factors.

Table 74: Permissible ambient conditions deviating from EN IEC 60721-3-2:2018

Environmental factor	Unit	Value
Temperature	°C	-25 ... +70 ¹⁾
Relative air humidity	%	5 ... 75 ¹⁾
Absolute air humidity	g/m ³	1 ... 29 ¹⁾
1) Deviating from EN IEC 60721-3-2:2018		



Before transport, discharge the liquid coolant from liquid-cooled motors to avoid frost damage.

Lifting eyebolts

To lift the motor out of the transport crate or to install it in the machine, use the transport or lifting eyebolts at the motor.

The lifting eyebolts at least meet the requirements of DIN 580. Before each transport, ensure that the lifting eyebolts have been screwed down fully to the contact surface and that your selected lifting equipment and lifting method does not overstress the lifting eyebolts.



Please comply with DIN 580 on the transport of motors using the attached lifting eyebolts. Non-observance of the information in this standard can cause overstress to the lifting eyebolts and result in personal injury and/or product damage.

Achtung! Caution!	
Handhabungs- und Lager- vorschriften unbedingt beachten! <i>Note the handling and storage instructions!</i>	
Rotor Handhabung <i>Handling</i>	
Stator Rotor Lagerung <i>Storage</i>	
Stator Handhabung <i>Handling</i>	

Fig. 203: Transport MBSxx2

Please note:

- Use only suitable lifting gear.
- Use lifting eye bolts during transport in opposite holes only.

- Place the rotor and stator on a clean and level surface. If possible, both assemblies should be stored in vertical position and secured against falling over. If horizontal storage cannot be avoided for some frame sizes of rotors or stators, the components have to be secured against rolling. The surface on which the rotor is stored must not be magnetic.
- Damage to the fitting at the stator flanges has to be prevented to ensure that installation is not impeded.

Instructions on transport by air

If motor components with permanent magnets are shipped by air, the DGR (Dangerous Goods Regulations) of the IATA (International Air Transport Association) for hazardous materials of class 9 which also include magnetized substances and objects has to be complied with. This involves, for example:

- Secondary parts of synchronous linear motors
- Rotors of synchronous kit motors
- Rotors of synchronous housing motors (if these are dispatched as motor component, i.e. separate from the stator or motor housing, in service cases)

For details on the maximum allowed magnetic field strengths as well as information on measurement methods for these magnetic field strengths, please refer to the current IATA DGR.

10.2.3 Storage instructions

Environmental conditions during storage

NOTICE	Damage or destruction of motor components due to improperly handling during storage and transport!
	– Observe the permitted environmental conditions for storage. – Covers fitted to the motor at the factory must remain on the motor during transport and storage.

Generally, Bosch Rexroth recommends storing all components until they are actually installed in the machine as follows:

- at a dry and dustfree location
- at room temperature
- free from vibrations and oscillations
- protected against light or direct sunlight

Based on EN IEC 60721-3-1:2018, the tables below specify classifications and limit values which are allowed for our products while they are stored. Refer to the detailed description of the classifications to take all of the factors which are specified in the particular classification into account.

Table 75: Allowed classes of environmental conditions during storage according to EN IEC 60721-3-1:2018

Classification type	Class
Classification of climatic environmental conditions	1K21
Classification of biological environmental conditions	1B1
Classification of chemically active materials	1C1
Classification of mechanically active materials	1S10
Classification of mechanical environmental conditions	1M11

For a better overview, some essential environmental influencing variables of the previously mentioned classifications are listed. Unless otherwise specified, the values given are the values of the particular class. However, Bosch Rexroth reserves the right to adjust these values at any time based on future experiences or changed environmental factors.

Table 76: Permissible ambient conditions deviating from EN IEC 60721-3-1:2018

Environmental factor	Unit	Value
Air temperature	°C	-25 ... +55 ¹⁾
Relative air humidity	%	5 ... 75 ¹⁾
Absolute air humidity	g/m ³	1 ... 29 ¹⁾
Direct solar radiation	-	Not permitted
1) Deviating from EN IEC 60721-3-1:2018		

NOTICE

Damage due to moisture and humidity!

- Protect the products from dampness and corrosion.
- Store them only in rainproof and dry rooms.
- Before storage, discharge the liquid coolant from liquid-cooled motors to avoid damage.

Storage times

The maximum storage duration is 2 years.

Storage durations of more than 6 months require conservation measures by the customer. Untreated metallic surfaces (e.g. shaft or flange) must be treated with a preserving agent to protect against corrosion.

Additional measures have to taken upon commissioning to ensure smooth functioning – irrespective of the storage time which may be longer than the warranty period of our products. However, this does not entail any additional warranty claims.

Table 77: Measures to be taken before commissioning motors or motor components in long-term storage

Storage time / months				Measures prior to commissioning
> 1	> 6	> 12	> 24	
●	●	●	●	Visual inspection of all parts to be damage-free
●	●	●	●	Resurface the holding brake ¹⁾
	●	●	●	Check conservation measures. Renew corrosion protection if necessary. Remove the preserving agent before commissioning
		●	●	Check the electric contacts to verify that they are free from corrosion
		●	●	Let the motor run in without load for one hour at ~20% of the specified nominal speed ²⁾
		●	●	Measure insulation resistance. Dry the winding at a value of < 1kOhm per volt rated voltage.
			●	Function test and product revision if necessary by Bosch Rexroth Service
1) Only motors with holding brake are affected				
2) Only motors with roller bearings are affected				

11 Assembly

11.1 Basic precondition

Thorough execution of the described work steps ensures:

- correct and safe mounting and dismounting of the components,
- correct function of the motor.



If there are bearings to the left and to the right of the motor, e.g. also encoders, all bearings have to be insulated on one side, e.g. insulation of the stator.

Assembly procedure

For an overview of the individual assembly steps, please refer to the following chart.

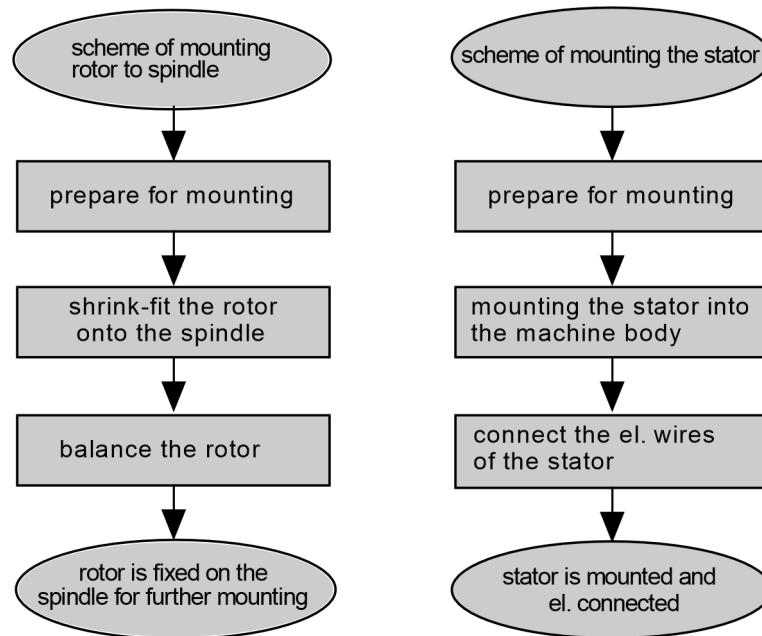


Fig. 204: Chart for rotor and stator assembly

11.1.1 Safety instructions

Strictly observe the listed safety instructions in the following mounting procedure → [Chapter 2 Safety instructions on page 17](#). They support the prevention of accidents and damage at material due to incorrect handling.

▲ WARNING

Injuries caused by live parts! Lifting of heavy loads! Risk of damage!

- Carry out all work steps with particular care. This minimizes the risk of accidents and damage.
- Use suitable lifting equipment and protective equipment and wear protective clothing during transport.
- Do not lift or move the motor at the cable strand.
- Install the motors only when they are de-energized and not connected electrically.

The volume and order of the steps described can be affected by special features of the machine construction and deviate from the schematic procedure. The following description only serves for orientation. The machine manufacturer's mounting instructions are the only binding guidelines.

General information

Take the strong magnetic field around the rotor into account. Do not unpack the rotors from the original packaging before they are required for assembly.

Keep the rotor away from ferromagnetic bodies (e.g. tools, workbench made from metal, ...)

Workwear

Wear appropriate protective workwear when mounting such as

- Safety glasses
- Safety gloves

Work space, handling and transport

Sufficiently mark your work space with notes according to Fig. 202 and observe the handling and transport instructions under ➔ Chapter 10 Handling, transport and storage on page 224.

Accident prevention

The accident prevention "Electrical plant and apparatus" (VBG 4) has to be complied with:

Prior to working on shock-hazardous parts of electrical systems, ensure that these parts are de-energized and remain de-energized during the duration of the work. The electrical systems and equipment have to be checked before initial startup by an electrician to ensure that they are in proper condition.

The user is responsible for proper grounding of the complete system. To prevent accidents due to touching of live parts, protective measures against direct and indirect touch are necessary. For notes, refer to DIN VDE 0100, Part 410.

Emergency tools

For removal of magnetically attached objects, have ready emergency tools like wedges (angle 10°-15°) and a hammer made of non-magnetic material.

Oil pump

For disassembly of a rotor with "Step interference fit" design from the spindle, only **manually operated** oil pumps may be used. Manually operated oil pumps ensure that the oil pressure does not drop to 0 bar in case of leakage in the step interference fit, connection thread or in the pump line system. For safety reasons, the oil pump must also be equipped with overpressure protection to prevent oil pressures over 1500 bar.

Securing the threaded pins

To prevent loosening of the threaded pins in the rotor during operation and any related hazards for personnel and property, the pins have to be secured. Please refer to the following instructions.

11.1.2 Screw lock

All screwed connections must be secured against potential impacts and vibrations during operation of the machine. A suitable and field-tested screw lock for all metal thread connections is, e.g., Loctite 243.

Loctite 243 is a liquid screw lock (medium-hard) and is applied to the parts to be mounted immediately prior to assembly. For detailed information on correct handling and processing, please refer to the manufacturer's data sheets under ➔ www.loctite.de. The manufacturer's homepage also provides information on hardening accelerators or other screw locks.

11.1.3 Accessories for assembly and disassembly

Tools and equipment	Mount rotor to spindle	Dismount rotor from spindle	Mount stator	Elec. test of motor spindle	Remove stator
Crane (size sufficient for weight of part)	x	x	x		x
Lifting device (sufficient size for weight of part)	x	x	x		x
Work fixture for attaching rotor ¹⁾	x				
Warming cupboard (+150°C minimum)	x				
Refrigerator (-20°C)	x				
Balancing equipment	x				
Test assembly to check concentricity	x				
Clamping device for fixing spindle-rotor ¹⁾	(x)				
Compressed air device	(x)				
Oil pump (max. 1500bar) with accessories ¹⁾	(x)	x			
Arresting device ¹⁾		x			
Drilling device			x		
Water pump to check tightness (up to 6 bar)			x		
Ohmmeter				x	
High-voltage testing equipment				x	
Inductance measuring equipment				x	
Torque wrench up to 35Nm			x		
Conventional tools and cleaning equipment	x	x	x		x
Aids					
LOCTITE 243			x		
LOCTITE 620	x				
LOCTITE quick clean 7061	x		x		
LOCTITE activator 7649	x		x		
Mineral oil: viscosity 300 mm ² /s at 20°C	(x)				
Mineral oil: viscosity 900 mm ² /s at 20°C		x			
Oil, conventional type, for lubrication	x				
Grease, conventional type	x		x		
Vaseline			x		
Coolant			x		
¹⁾ See the following explanations (x) Only applies to mounting errors					

Fig. 205: Accessories for assembly / disassembly

Explanations

Rotor fixture:

The fixture must be heat-resistant up to +150 °C and offer sufficient load-bearing capacity for the weight of the rotor and the spindle. Additionally, it has to consist of antiferromagnetic material and provide level and horizontal support for the rotor and spindle. An example for possible realization is provided below.

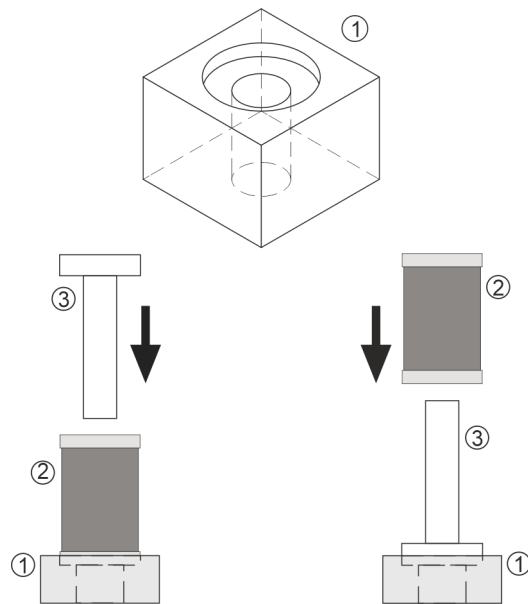


Fig. 206: Fixture principle

- ① Fixture
- ② Rotor
- ③ Spindle

Manually operated oil pump and accessories:

Oil pressure: 1500 bar with overpressure protection; connection thread of high-pressure hose: M4x0.5 or M6 (depending on rotor type)

Oil pumps and accessories are generally available from the manufacturers of roller bearings.

Spindle rotor clamping device:

If deformation of the spindle is recognized after shrink-fitting of the rotor with step interference fit, a clamping device and other equipment is required for correction. This clamping device must ensure secure retention of the rotor on the spindle and prevent axial motion of the rotor. For a respective example, refer to [Fig. 214](#)

Fixture:

For disassembly of the rotor with step interference fit from the spindle, the rotor may become loose unexpectedly from the spindle. For this reason, a fixture has to be attached to the spindle. For a respective example, refer to [Fig. 214](#). In this process, assembly dimension A must be observed.

11.2 Rotor with smooth bore assembly at the spindle

11.2.1 Components/scope of delivery of rotor with smooth bore

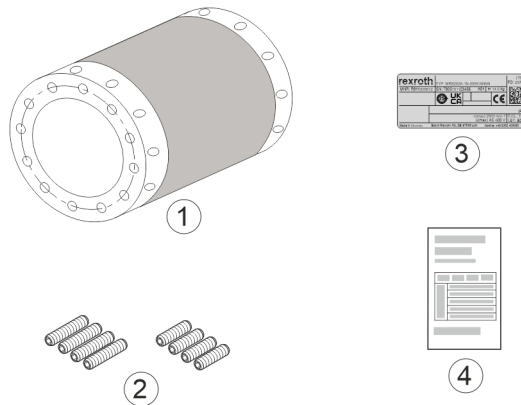


Fig. 207: Scope of delivery of rotor design 1N

- ① MRSxx2 rotor in design 1N
- ② Threaded pins for rotor balancing (number and type acc. to rotor type)
- ③ 2x type plate
- ④ Accompanying document

11.2.2 Before assembly

Assembly should be carried out in a dry and dust-free environment. For this purpose, the following preparation have to be made:

- Check the delivery for completeness.
- Visually check the rotor for visible damage.
- Attach the type plate visibly to the spindle housing.
- Thoroughly clean the internal rotor diameter and the pressure fittings at the spindle from dirt, dust, metal chipping, etc.
- Oil the pressure fittings at the spindle.

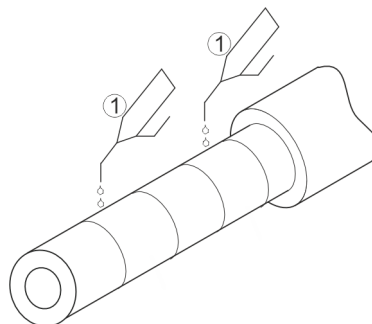


Fig. 208: Preparing the spindle for assembly

- ① Oil



Prepare the rotor fixture for vertical rotor support to assemble the spindle.

11.2.3 Shrink-fitting of the rotor on the spindle

Procedure:

1. ➤ Heat the rotor in a heating chamber under controlled conditions to at least +135 °C, however, no more than 145 °C.

NOTICE

- If the rotor is not heated sufficiently to at least +135 °C, there is a risk that the spindle gets stuck during shrink-fitting before reaching its end position.
- If the rotor is heated to more than +145 °C, the solenoids are damaged and the rotor can no longer be used.

⚠ CAUTION

Hot surfaces with temperatures over 50 °C may cause burns!

- The rotor is hot! Contact leads to severe injury from burning!
- Wear heat-resistant clothing and gloves!

2. ➤ Cool the spindle to –20 °C.

NOTICE

If the spindle is not cooled sufficiently to at least –20 °C, there is a risk that the spindle gets stuck during shrink-fitting before reaching its end position.

⚠ CAUTION

Components at very low temperatures down to –20 °C may cause injury!

- Spindle is cold!
- Wear suitable protective clothing and safety gloves!

3. ➤ Place the rotor in the prepared fixture.

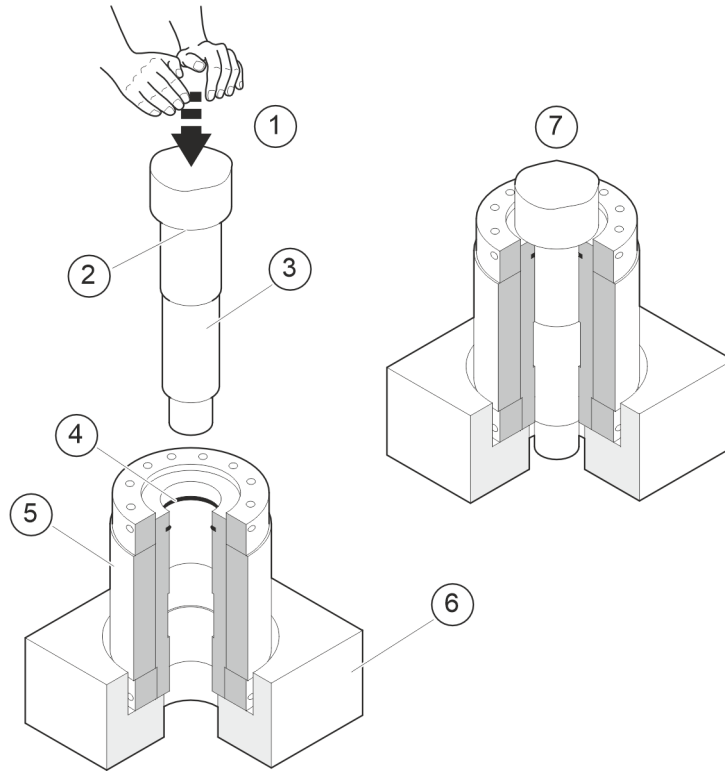


Fig. 209: Mount spindle

- ① $F_{\max} = 500 \text{ N}$
- ② Fixture
- ③ Spindle
- ④ O-ring
- ⑤ Rotor
- ⑥ Fixture
- ⑦ Spindle in final position

4. ➤ Lift the spindle and slide it quickly into the rotor.

Usually, the spindle slides into its intended end position (end stop at spindle) without any additional force. If the actual weight of the spindle is not sufficient to completely slide it into its end position, push it into the rotor with an external force of no more than 500 N (body weight of the installing technician).

5. ➤ Let the rotor and spindle cool down to room temperature.

6. ➤ Check proper shrink-fitting connection of the rotor on the spindle:

- Visual inspection whether the spindle is inserted into the rotor up to its end stop
- Check spindle rotation:
Make sure that the rotation of the spindle is not compromised by the shrink-fitting process. If the rotation is compromised, minor deformation occurred at the spindle. The deformation is caused by stress that may occur during cooling of the components.

11.3 Rotor with step interference fit assembly at the spindle

11.3.1 Components/scope of delivery of rotor with step interference fit

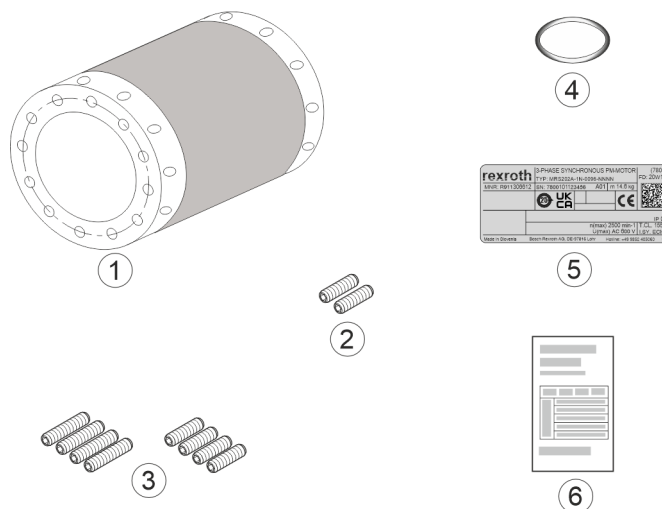


Fig. 210: Scope of delivery of rotor design 2N

- ① MRSxx2 rotor in design 2N
- ② 2 threaded pins for sealing of hydraulic oil ports.
- ③ Threaded pins for rotor balancing (number and type acc. to rotor type)
- ④ O-ring (Viton)
- ⑤ 2x type plate
- ⑥ Accompanying document

11.3.2 Before assembly

Assembly should be carried out in a dry and dust-free environment. For this purpose, the following preparation have to be made:

1. Check the delivery for completeness.
2. Visually check the rotor for visible damage.
3. Attach the type plate visibly to the spindle housing.
4. Make sure that there are no burrs at chamfers and edges at the pressure fittings of the spindle. Deburr as necessary.
5. Thoroughly clean the internal rotor diameter, the oil port and the pressure fittings at the spindle from dirt, dust, metal chipping, etc.
6. Grease the O-ring and insert it in the groove in the rotor. Do not twist the O-ring. Pay attention to cleanliness.

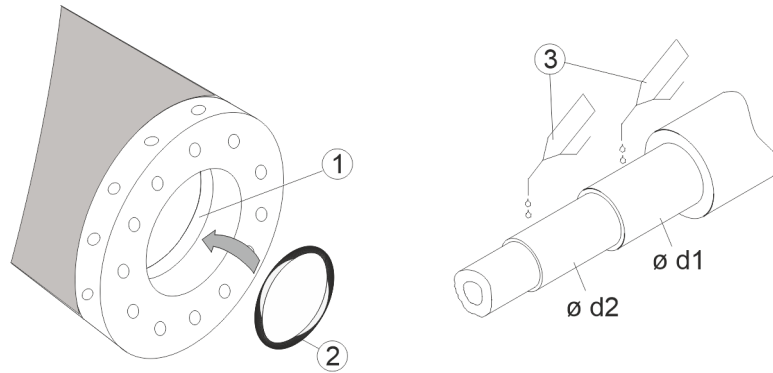


Fig. 211: MRS assembly in design 2N

- ① Groove
- ② Greased O-ring
- ③ Oil

- 7. ➔ Oil the pressure fittings at the spindle.
- 8. ➔ Prepare the rotor fixture for vertical rotor support to assemble the spindle.

11.3.3 Shrink-fitting of the rotor on the spindle

Procedure:

- 1. ➔ Heat the rotor in a heating chamber to at least +135 °C, however, no more than 145 °C.

NOTICE

- If the rotor is not heated sufficiently to at least +135 °C, there is a risk that the spindle gets stuck during shrink-fitting before reaching its end position.
- If the rotor is heated to more than +145 °C, the solenoids are damaged and the rotor can no longer be used.

⚠ CAUTION

Hot surfaces with temperatures over 50 °C may cause burns!

- The rotor is hot! Contact leads to severe injury from burning!
- Wear heat-resistant clothing and gloves!

- 2. ➔ Cool the spindle to –20 °C.

NOTICE

If the spindle is not cooled sufficiently to at least –20 °C, there is a risk that the spindle gets stuck during shrink-fitting before reaching its end position.

⚠ CAUTION

Components at very low temperatures down to –20 °C may cause injury!

- Spindle is cold!
- Wear suitable protective clothing and safety gloves!

- 3. ➔ Place the rotor in the prepared fixture. The O-ring must be on top.

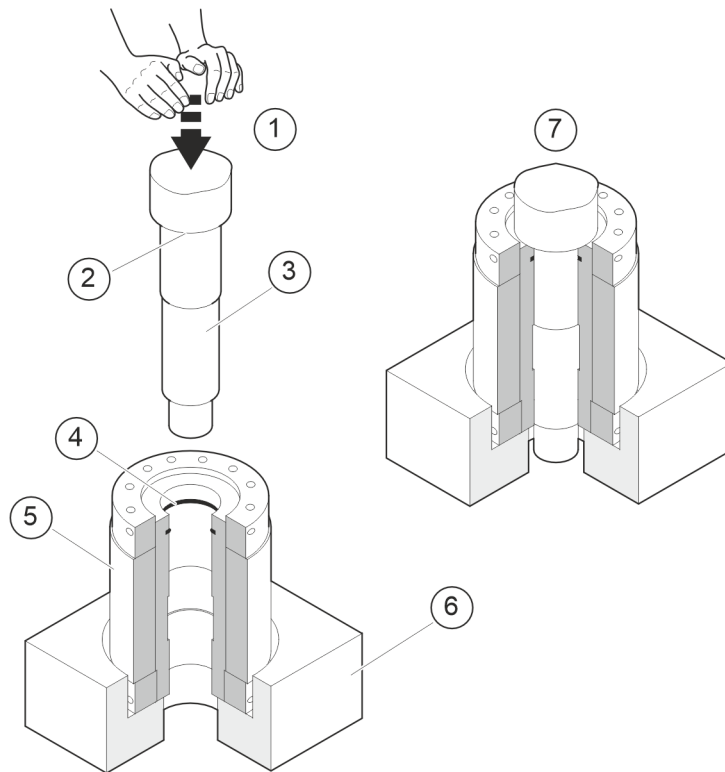


Fig. 212: Mount spindle

- ① $F_{\max} = 500 \text{ N}$
- ② Fixture
- ③ Spindle
- ④ O-ring
- ⑤ Rotor
- ⑥ Fixture
- ⑦ Spindle in final position

4. Lift the spindle and slide it quickly into the rotor.

Usually, the spindle slides into its intended end position (end stop at spindle) without any additional force. If the actual weight of the spindle is not sufficient to completely slide it into its end position, push it into the rotor with an external force of no more than 500 N (body weight of the installing technician).

5. Let the rotor and spindle cool down to room temperature.

6. Check proper shrink-fitting connection of the rotor on the spindle:

- Visual inspection whether the spindle is inserted into the rotor up to its end stop
- Check spindle rotation:
Make sure that the rotation of the spindle is not compromised by the shrink-fitting process. If the rotation is compromised, minor deformation occurred at the spindle. The deformation is caused by stress that may occur during cooling in the step interference fit.

ⓘ If the spindle is not in its end position and the required rotational accuracy cannot be achieved, the measures described in this chapter "Measures in case of assembly faults" have to be taken.

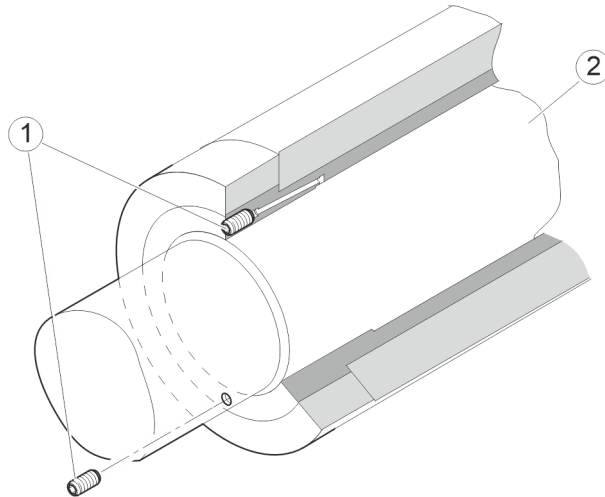


Fig. 213: Sealing of hydraulic oil ports

- ① Threaded pins with liquid screw lock.
- ② Spindle

7. ➤ Close the hydraulic oil ports in the rotor with the provided threaded pins. To do so, fully screw in the threaded pin and secure it with screw locking adhesive, e.g. with LOCTITE 620. The threaded pins are to be secured by adhesion in such a way that the ports are fully sealed against the oil pressure.

11.4 Measures in case of assembly faults

NOTICE

The following measures only apply for rotors with step interference fit. Assembly faults at rotors with smooth shaft cannot be corrected!

Error cause

During shrink-fitting, the spindle gets stuck in the rotor before its end position.

Procedure:

- 1.** ➤ Let the rotor and spindle cool down.
- 2.** ➤ Seal one of the two hydraulic oil ports at the rotor with a threaded pin. To do so, fully screw in the threaded pin and secure it with screw locking adhesive, e.g. with LOCTITE 620.
- 3.** ➤ Remove the rotor by means of hydraulic oil from the spindle (as described under "Disassembling the rotor from the spindle").
- 4.** ➤ Check pressure fitting tolerances.
- 5.** ➤ As necessary, grind off the spindle burr at internal rotor diameter and pressure fittings $\varnothing d1$ and $\varnothing d2$.
⚠ There must not be any burrs at the spindle and rotor!
- 6.** ➤ Shrink-fit the rotor to the spindle again.

Error cause

After shrink-fitting on the rotor, the spindle is deformed

During fitting, tensions may occur in the step interference fit. These can lead to micrometer deformation of the spindle. By pressing in of hydraulic oil into the step interference fit, these tensions are partly loosened and the deformation of the spindle partly reversed.

Procedure:

1. ➤ Let the rotor and spindle cool down.
2. ➤ Seal one of the two hydraulic oil ports at the rotor with a threaded pin. To do so, fully screw in the threaded pin and secure it with screw locking adhesive, e.g. with LOCTITE 620.
3. ➤ Secure the rotor and spindle with a suitable assembly tool in such a way that the rotor is securely held in its position on the spindle.
⚠ The rotor must not slide in axial direction on the spindle while the pressure oil is pressed in.

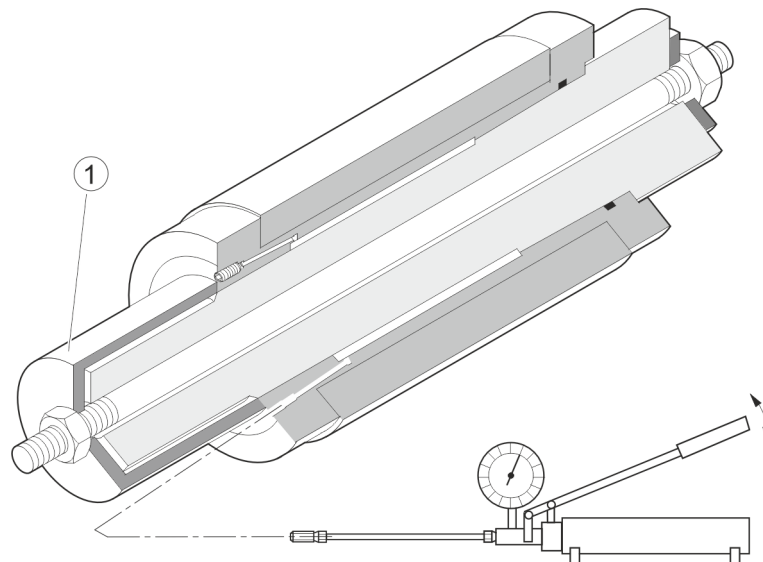


Fig. 214: "Floating" of the rotor

- ① Assembly tool
4. ➤ Connect an oil pump.
Use oil with a viscosity of 300 mm²/s at +20 °C! This way, it can be ensured that the oil is drained fully after "floating".
5. ➤ Pump oil into the step interference fit.
⚠ Oil is leaking!
Have ready a collection tray.
 - Slowly increase the oil pressure until the oil is leaking at the face of the pressing groove.
 - A separating oil film forms between the rotor and spindle. This "floating" of the rotor on the spindle enables loosening of tensions that occurred during shrink-fitting.
6. ➤ Depressurize the oil pump, feed lines and interference fit.
7. ➤ Open both hydraulic oil ports.

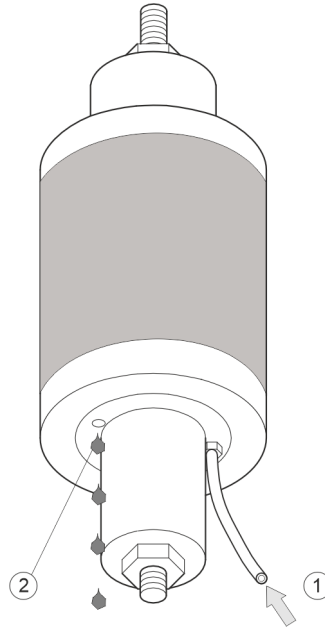


Fig. 215: Press out the oil with compressed air

- ① Compressed air
- ② Oil leakage

8. ➔ Bring the spindle with the clamping device in a vertical position and press the oil out of the step interference fit with compressed air.
9. ➔ Completely drain the oil from the step interference fit.

NOTICE

Wait 24 hours before fully loading the step interference fit!

10. ➔ Seal both hydraulic oil ports with the provided threaded pins and secure them with screw locking adhesive, e.g. with LOCTITE 620.

11.5 Balancing the rotor

To achieve the desired vibration severity grade of the spindle, the rotor and the spindle have to be balanced. Balancing rings with threaded bores can be found at the face end of the rotor. For balancing, threaded pins have to be screwed in as necessary. The provided threaded pins are listed in ➔ Tab. 78.

The required vibration severity grade depends on the machining accuracy of the motor spindle and is defined by the engineer of the motor spindle.

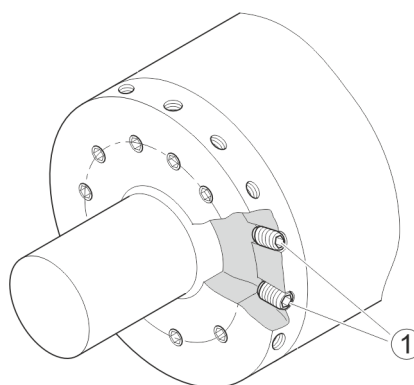


Fig. 216: Balancing by screwing in of threaded pins



① Secure screws with liquid screw lock (with Loctite 620 for example)

- For spindle balancing, no material may be removed from the balancing rings!
- Depending on necessary balancing, the depth for screwing in the threaded pins can be adjusted. However, they must not protrude over the balancing rings! Full tightening is not necessary!
- The threaded pins must be secured with liquid screw locking adhesive (e.g. LOCTITE 620) to prevent undesired loosening.

Table 78: Provided threaded pins

Threaded pins DIN 913	Quantity / MRSxx2									Mass g/pc
	102	142	162	182	202	242	272	312	382	
M5x6	8									0.53
M5x8	8									0.71
M6x6		8	8	8	8					0.76
M6x8		8	8	8	8					1.11
M8x8						8	8	8	10	1.89
M8x10						8	8	8	10	2.52

11.6 Disassembling the rotor with step interference fit from the spindle

In the following cases, it may become necessary to disassemble the rotor from the spindle:

- Bearing damage at the spindle
- Rotor damage
- Assembly fault



Before disassembly, the angular position of the rotor must be marked on the spindle.

Procedure

1. ➤ Open one hydraulic oil port.

The second port must remain sealed. As necessary, it has to be sealed with one of the provided threaded pins. To do so, fully screw in the threaded pin and secure it with screw locking adhesive, e.g. with LOCTITE 620.

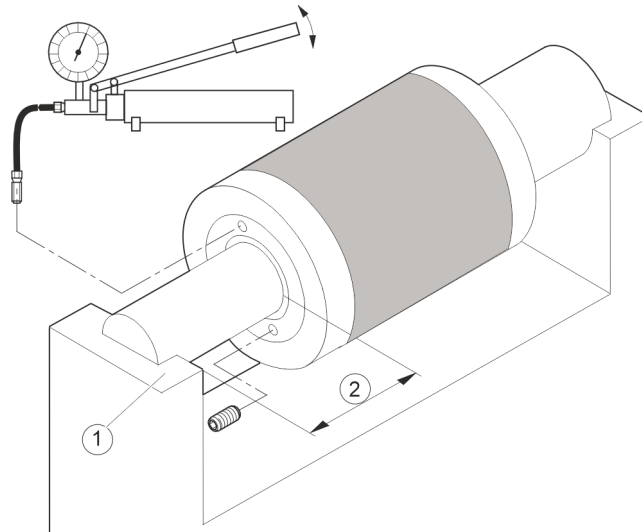


Fig. 217: Example of a fixture for disassembly

① Fixture

② Assembly dimension A

2. ➤ Attach the fixture. Observe assembly dimension A for the fixture.

Table 79: Assembly dimension A for various rotor types

Rotor	Dimension A (mm)
MRS 102	tbd
MRS 142	tbd
MRS 162	min. 80
MRS 182	min. 90
MRS 202	min. 90
MRS 242	min. 100
MRS 272	min. 110
MRS 312	min. 130
MRS 382	min. 140

3. ➤ Connect a manually operated oil pump.

4. ➤ Use oil with a viscosity of 900 mm²/s at +20 °C!**▲ WARNING****Injury due to sudden rotor motion!**

- The rotor may suddenly slide off the spindle while oil is pumped into the step interference fit.
- While oil is pumped in, a fixture has to be attached to the spindle.

5. ➤ Pump oil into the step interference fit.

⚠ Oil is leaking!

Keep ready a collection tray.

6. ➤ Slowly increase the oil pressure until the axial force in the step interference fit leads to sliding off of the rotor from the spindle.

7. ➤ In case of oil leakage at the front face of the step interference fit without loosening of the rotor from the spindle, slightly hammer (plastic hammer) against the rotor towards the fixture.

11.7 Stator installation into spindle housing

11.7.1 Components/scope of delivery of stator

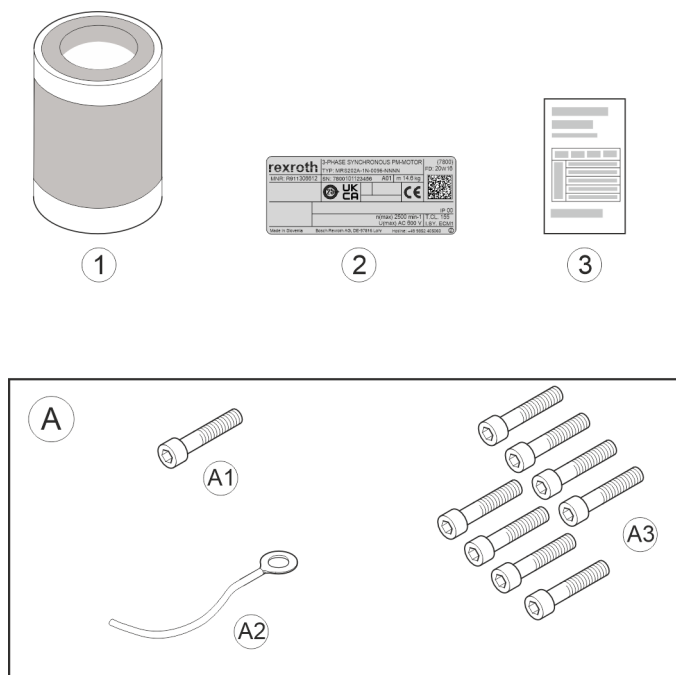


Fig. 218: Scope of delivery of the stator and additional materials

- ① Stator MSS....
- ② 2x type plate
- ③ Accompanying certificate at delivery
- A Provided materials
- A1 Brass screw
- A2 Grounding cable (GNY) with cable lug
- A3 Cylinder head screws DIN 912-12.9

11.7.2 Before assembly

Installation should be carried out in a dry and dust-free environment. For this purpose, the following preparation have to be made:

- Check the delivery for completeness.
- Provide additional materials. The precise dimensions of materials are specified in the construction drawings.
- Visually check the stator for visible damage.
- Attach the type plate visibly to the spindle housing.
- Check the bores for connections in customer-side spindle housing for burrs and deburr as necessary.



There must not be any burrs at the internal edges of the bores to prevent any damage to the stator during installation.

11.7.3 Installation procedure

For stator attachment inside the spindle housing, threaded bores are provided on both end faces of the stator.

NOTICE

Mounting is realized either at side A or B of the stator, however, never at both ends as a clearance between the stator and the housing has to be taken into account for stator expansion in length during operation.

Please note: The general approach for stator attachment inside the housing is always the same. However, there may be minor deviations from the described approach depending on the design of the spindle housing. In the following, the procedure for stator attachment at the housing is described.

Procedure:

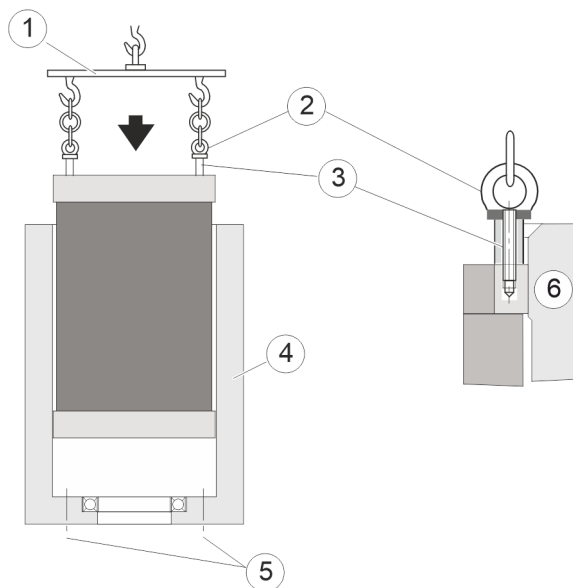


Fig. 219: Stator installation into spindle housing

- ① Lifting gear
- ② Ring nut
- ③ Threaded bar with distance sleeve
- ④ Spindle housing
- ⑤ Holes for stator fastening
- ⑥ Spindle mounted

1. ➤ Centrally slide the stator into the spindle housing. For lifting of the stator, parallel chain or rope hoists are to be used.



- For disassembly, do not use the cable loom to pull or push the unit!
- Always observe any applicable regulations on transport and handling!

2. ➤ Push the stator in its end position. In case of difficult assembly, use suitable tools.

3. Tighten the stator at the face to the housing.
 - Secure screws with screw lock, e.g. LOCTITE 243.
 - Evenly tighten the screws with a torque wrench.

Table 80: Mounting screws for stator

Stator	Fastening tread	Quantity	Strength class	Tightening torque (for friction coefficient $\mu=0.1$)
MSS102	M5 x 12	8	12.9	6 - 7 Nm
MSS142	M6 x 12	10		12 - 14 Nm
MSS162	M6 x 12	6		12 - 14 Nm
MSS182	M6 x 12	6		12 - 14 Nm
MSS202	M6 x 12	10		12 - 14 Nm
MSS242	M8 x 15	12		32 - 35 Nm
MSS272	M8 x 16	14		32 - 35 Nm
MSS312	M8 x 20	14		32 - 35 Nm
MSS382	M8 x 20	18		32 - 35 Nm

11.7.4 Stator connection

For information on electrical connection and coolant connection at the stator, refer to [Chapter 7 Connection technique on page 177](#).

11.8 Stator disassembly from spindle housing

Removal of the stator is necessary, for example, when,

- a winding is blown out,
- Defective cold conductor

⚠ DANGER

Risk of shock at live parts!

⇒ Before disassembly of the stator, always de-energize the electrical system and secure it against reactivation!

Procedure:

1. Loosening of electrical connections:
 - Power connection
 - Temperature sensor connection
 - Grounding cable
2. Untighten the coolant connections.
3. Loosen and untighten the stator mounting screws.
4. Slowly remove the bearing shield with a suitable tool.
5. Screw the transport lugs in suitable bores.

NOTICE

- During disassembly, do not pull or push at the cable strand to prevent damage at the stator.
- Always observe any applicable regulations on transport and handling.

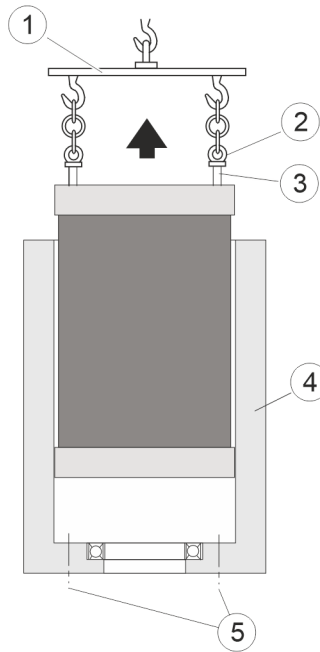


Fig. 220: Disassembly of the stator from the spindle housing

- ① Lifting gear
- ② Ring nut
- ③ Threaded bar with distance sleeve
- ④ Spindle housing
- ⑤ Fastening screws of stator
- 6. ➤ Slowly pull out the stator with a suitable lifting tool (observe stator weight!).

11.9 Motor spindle assembly

After rotor assembly on the spindle and installation of the stator inside the spindle housing, the components for completion of the motor spindle can be assembled.



The pre-assembled rotor package must be centrally inserted into the stator package.

Use an assembly fixture (for example, refer to Fig. 221), for central insertion of the rotor into the stator.

⚠ CAUTION

Property damage and/or injury during transport! Risk of crushing!

⇒ Observe all applicable safety instructions for handling of transport and load suspension equipment.

⇒ Carefully guide the spindle with the rotor to the stator.

Procedure:

- 1. ➤ Make sure that both assemblies are free from dirt.
- 2. ➤ Centrally guide the rotor package with suitable lifting gear over the stator package.

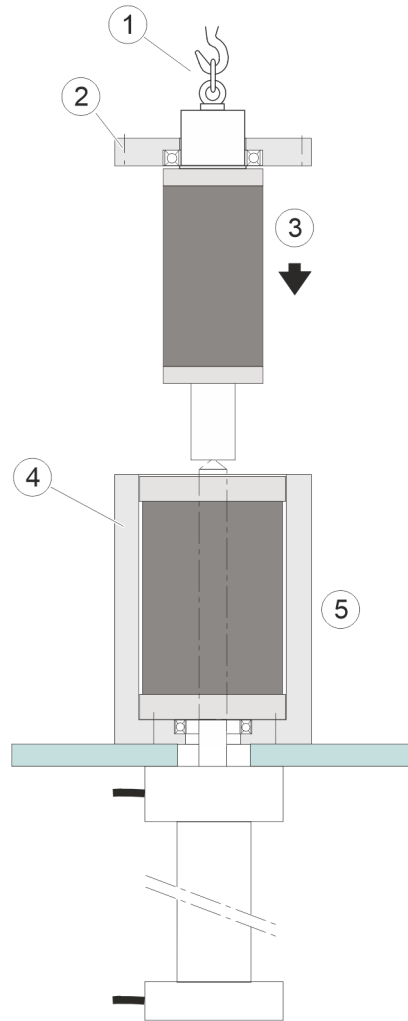


Fig. 221: Motor spindle assembly

- ① Lifting gear
- ② Bearing shield
- ③ Rotor package
- ④ Spindle housing
- ⑤ Stator package

3. → Slowly lower the rotor package over the stator package and slide it in centrally.

NOTICE

Prevent contact with and damage at the interior surfaces of the rotor and stator during insertion.

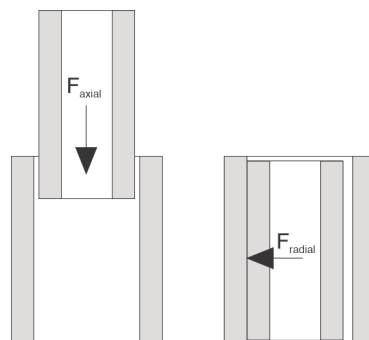


Fig. 222: Attractive forces during mounting

4. ➤ Observe the occurring radial and axial forces when inserting the rotor.

Table 81: Magnetic attractive forces

Type MRS...	F _{axial} [N]	F _{radial} [N]
102B	295	190
102D	445	
102F	740	
142B	635	265
142D	890	
142F	1,140	
162B	960	310
162D	1215	
162F	1528	
162J	1975	
182A	215	360
182B	1,500	
182D	1,890	
182F	2730	
202A	1,660	420
202B	2210	
202D	2760	
202F	3860	
242B	3050	480
242D	4,580	
242F	5490	
272B	5290	570
272D	6880	
272F	8470	
312B	9180	690
312D	11,480	
312F	13,780	

Type MRS...	F _{axial} [N]	F _{radial} [N]
312H	16,850	
382B	12,270	870
382D	22,280	
382F	27,280	
Latest amendment: 2024-03-11		

5. ➔ Attach the bearing shield at the spindle housing.

⚠ WARNING

Injury / damage due to strong magnetic fields! Risk of crushing! Carefully guide the rotor package to the stator. Due to permanent magnets on the rotor and the resulting magnetic forces, the rotor is pulled off the stator (see ➔ Tab.). 81).

11.10 Motor spindle disassembly

For disassembly of the motor spindle, proceed in reverse order of assembly. For this reason, use a suitable fitting for disassembly and removal of the rotor from the stator that enables pulling or pushing the rotor out of the stator without any contact (for example, refer to Fig.). 223).

Procedure:

1. ➔ Loosen and remove the mounting screws between end shield and spindle housing.

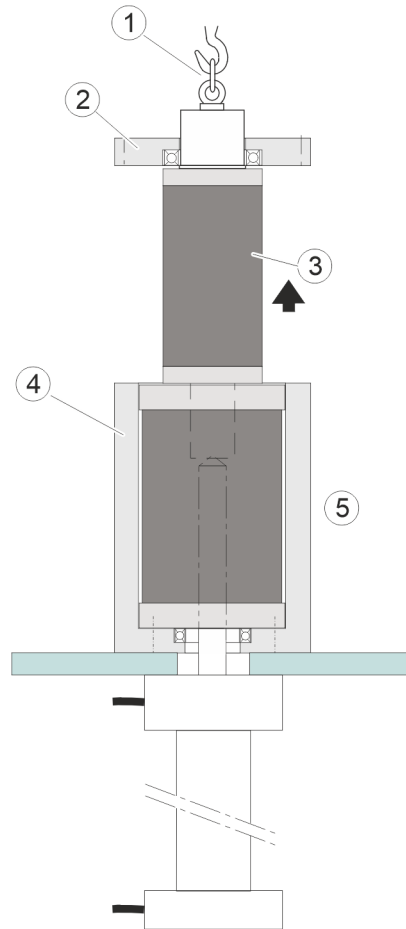


Fig. 223: Motor spindle disassembly

- ① Lifting gear
- ② Bearing shield
- ③ Rotor package
- ④ Spindle housing
- ⑤ Stator package

2. ➞ Centrally pull or push the rotor package out of the stator package with a suitable tool.

⚠ Prevent contact with and damage at the interior surfaces of the rotor and stator during pulling it out.

11.11 Coolant connection

Establish the connection of the coolant supply for the motor according to ➞ [Chapter 7.7 Motor cooling on page 186](#) and the machine manufacturer's connection diagrams.

Prior to machine commissioning, the whole cooling system must be subjected to a leakage test and be ventilated. Also comply with the manufacturer's instructions.



- The supply lines are not allowed to exert any force on the motor-sided screwed connections.
- The connection diagrams of the product documentation serve to create system circuit diagrams. Only the machine manufacturer's system wiring diagrams are relevant for the connection of the drive components in the machine. This also applies to the incorporation of systems for pressure reduction, flow and temperature monitoring.
- Start-up of the coolant system is not a part of motor commissioning. Refer to the instructions of the manufacturers of the machine and the cooling system.

11.12 Electrical connection

Connect the motor electrically according to the connection diagrams and the instructions in ➔ [Chapter 7 Connection technique on page 177](#). Refer to the references to supplementary documentation.



- When using self-manufactured cables, ensure EMC-compliant design and installation.
- Where applicable, ensure that connectors and lines are fastened for strain relief purposes.
- The connection diagrams of the product documentation serve to create system circuit diagrams. Only the machine manufacturer's system wiring diagrams are relevant for the connection of the drive components in the machine.

12 Commissioning, operation and maintenance

12.1 Notes about commissioning

The following points must be particularly observed for commissioning of MBSxx2 synchronous kit motors:

Parameters

MBSxx2 motors are kit motors whose single components are directly installed into the machine by the manufacturer – completed by an encoder system. As a result, kit motors do not feature any data memory to provide motor parameters, standard controller settings, etc. All parameters must be manually entered or loaded to the drive during commissioning. The IndraDrive commissioning program provides all Rexroth motor parameters.

Encoder polarity

When viewing on page A (opposite of the cable outlet), the encoder has to indicate a positive set value during clockwise rotation of the rotor. Before commutation adjustment, this relation must be established.

Commutation adjustment

At MBS motors, the position of the rotor to the stator has to be determined immediately after power-up or a malfunction. This is referred to as pole position detection or commutation adjustment. This means that the commutation adjustment is the establishment of a position reference to the electrical or magnetic model of the motor. The commutation adjustment method depends on the encoder type used.

Applicable documents

In addition to the motor documentation contained herein, commissioning of the motors may require further documentation.

Bosch Rexroth provides the complete product documentation in PDF format within the media directory. Please also observe the information provided under [↪ Chapter 1.5.4 Further documentation on page 16](#).

12.2 Commissioning

12.2.1 General

In addition to the motor documentation contained herein, commissioning of the motors requires further documentation. They are listed in [↪ Chapter 12.2.4](#)

The following requirements have to be met to ensure successful commissioning:

- Compliance with safety-related guidelines and instructions
- Check of electrical and mechanical components for reliable functioning
- Availability and provision of required tools
- Adherence to the commissioning procedure described below

12.2.2 Checking all electrical and mechanical components

Check all electrical and mechanical components prior to commissioning and pay particular attention to the following issues:

- Ensure safety for man and machine
- Correctly install the motor
- Correct power connection of the motor
- Connect the encoder system correctly
- Ensure proper function of existing safety limit switches, door switches, etc.
- Ensure correct function of the emergency stop circuit and emergency stop.
- Ensure proper and complete machine construction (mechanical installation)
- Ensure a correct connection and function of the motor cooling system
- Ensure correct connection and function of drive controller and control unit

12.2.3 Tools

Parameters

MBSxx2 are kit motors whose single components are directly installed into the machine by the manufacturer – completed by an encoder system. As a result, kit motors do not feature any data memory to provide motor parameters, standard controller settings, etc. All parameters must be manually entered or loaded to the drive during commissioning.

Rexroth provides various commissioning tools such as IndraWorks or ctrlX WORKS for commissioning.

Commissioning software

Commissioning can be carried out using a standard PC and special commissioning software. The commissioning software provided by Rexroth for this purpose enables, among other things, menu-guided, application- and motor-specific parameterization and optimization of the drives.

Commissioning via controller

Commissioning via the control unit requires access to all drive parameters and functionalities.

Multimeter

Troubleshooting and component checks can be facilitated by a multimeter allowing the measurement of voltage, current and resistance values.

12.2.4 Applicable documents**Project Planning Manual**

Title ctrlX DRIVE	Document type	Documentation type ¹⁾	Material number
ctrlXDRIVE Drive systems	Project Planning Manual	DOK-XDRV**-X*****-PRxx-EN-P	➔ R911386579
IndraDrive Drive systems with HMV01/02 HMS01/02, HMD01, HCS02/03	Project Planning Manual	DOK-INDRV*-SYSTEM*****-PRxx-EN-P	➔ R911309636

1) In the documentation types, xx is a placeholder for the current issue status of the documentation (example: PR02 means the second issue of a reference document)

Firmware/Runtime IndraDriveX

Table 82: Documentation - Firmware

Title ctrlX DRIVE	Document type	Documentation type ¹⁾	Material number
AXS-V-05 Functions	Application Manual	DOK-XDRV**-AXS-05VRS**-APxx-EN-P	➔ R911422255
AXS-V-05 (CoE) Functions	Application Manual	DOK-XDRV**-AXS-05VRS*C-APxx-EN-P	➔ R911422257
Diagnostic messages of runtime AXS-V-05RS	Reference	DOK-XDRV**-GEN5-DIAG**-RExx-EN-P	R911422251
Parameter/Objects of Runtime AXS-V-05RS	Reference	DOK-XDRV**-GEN5-PARA*C-RExx-EN-P	R911422253
AXS-V-04 Functions	Application Manual	DOK-XDRV**-AXS-04VRS**-APxx-EN-P	➔ R911421281
AXS-V-04 (CoE) Functions	Application Manual	DOK-XDRV**-AXS-04VRS*C-APxx-EN-P	➔ R911421283
Diagnostic messages of runtime AXS-V-04RS	Reference	DOK-XDRV**-GEN4-DIAG**-RExx-EN-P	➔ R911421277
Parameter/Objects of Runtime AXS-V-04RS	Reference	DOK-XDRV**-GEN4-PARA*C-RExx-EN-P	➔ R911421279
AXS-V-03 Functions	Application Manual	DOK-XDRV**-AXS-03VRS**-APxx-EN-P	➔ R911398021
AXS-V-03 (CoE) Functions	Application Manual	DOK-XDRV**-AXS-03VRS*C-APxx-EN-P	➔ R911398021
Diagnostic messages of runtime AXS-V-03RS	Reference	DOK-XDRV**-GEN3-DIAG**-RExx-EN-P	➔ R911409763
Parameter of Runtime AXS-V-03RS	Reference	DOK-XDRV**-GEN3-PARA**-RExx-EN-P	➔ R911409808
Parameter/Objects of Runtime AXS-V-03RS	Reference	DOK-XDRV**-GEN3-PARA*C-RExx-EN-P	➔ R911419643
AXS-V-02 Functions	Application Manual	DOK-XDRV**-AXS-02VRS**-APxx-EN-P	➔ R911398021

Title	Document type	Documentation type ¹⁾	Material number
ctrlX DRIVE			
Diagnostic messages of runtime AXS-V-02RS	Reference	DOK-XDRV**-GEN2-DIAG**- RExx-EN-P	➔ R911383776
Parameter of Runtime AXS-V-02RS	Reference	DOK-XDRV**-GEN2-PARA**- RExx-EN-P	➔ R911383778
1) In the documentation types, xx is a placeholder for the current issue status of the documentation (example: RE02 means the second issue of a reference document)			

Firmware

Table 83: Documentation - Overview

Title	Document type	Documentation type ¹⁾	Material number
Rexroth IndraDrive ...		DOK-INDRV*-...	R911...
Firmware for drive controllers MPH-08, MPB-08, MPD-08, MPC-08	Functional description	MP*-08VRS**-APxx-EN-P	➔ R911332643
Firmware for drive controllers MPH-07, MPB-07, MPD-07, MPC-07	Functional description	MP*-07VRS**-FKxx-EN-P	➔ R911328670
Firmware for drive controllers MPH-06, MPB-06, MPD-06, MPC-06	Functional description	MP*-06VRS**-FKxx-EN-P	R911326766
Firmware for drive controllers MPH-05, MPB-05, MPD-05	Functional description	MP*-05VRS**-FKxx-EN-P	➔ R911320182
Firmware for drive controllers MPH-04, MPB-04, MPD-04	Functional description	MP*-04VRS**-FKxx-EN-P	➔ R911315485
Firmware for drive controllers MPH-03, MPB-03, MPD-03	Functional description	MP*-03VRS**-FKxx-EN-P	➔ R911308329
Firmware for drive controllers MPH-02, MPB-02, MPD-02	Functional description	MP*-02VRS**-FKxx-EN-P	➔ R911299223
Drive controllers MPx-02 up to MPx-08	Parameter description	GEN**-VRS**-PAxx-EN-P	➔ R911297317
MPx-02 up to MPx-08 and HMV	Notes on troubleshooting	GEN**-VRS**-WAxx-EN-P	➔ R911297319
Integrated Safety Technology	Functional description and application manual	SI*-**VRS**-FKxx-EN-P	➔ R911297838
Integrated Safety Technology acc. to IEC61508	Functional description	SI2**-VRS**-FKxx-EN-P	➔ R911327664
Rexroth IndraMotion MLD	Application Manual	MLD**-VRS**-AWxx-EN-P	➔ R911306084
Rexroth IndraMotion MLD Library	Library description	MLD-SYSLIB*-FKxx-EN-P	➔ R911308317
1) In the documentation types, xx is a placeholder for the current issue status of the documentation (example: FK02 means the first issue of the functional description)			

Table 84: Documentation - Firmware

Title	Document type	Documentation type ¹⁾ DOK-INDRV*-...	Material number R911...
IndraDrive MPx-21 Functions	Application Manual	MP*-21VRS**-APxx-EN-P	➔ R911385758
IndraDrive MPx-20 Functions	Application Manual	MP*-20VRS**-APxx-EN-P	➔ R911345608
IndraDrive MPx-20 Version Notes	Release Notes	MP*-20VRS**-RNxx-EN-P	➔ R911345606
IndraDrive Power Supply Basic PSB-21 Functions	Application Manual	PSB-21VRS**-APxx-EN-P	➔ R911385754
IndraDrive Power Supply Basic PSB-21 Version Notes	Release Notes	PSB-21VRS**-RNxx-EN-P	R911385752
IndraDrive Power Supply Basic PSB-20 Functions	Application Manual	PSB-20VRS**-APxx-EN-P	➔ R911345610
Rexroth IndraDrive Power Supply Basic PSB-19 Functions	Application Manual	PSB-19VRS**-APxx-EN-P	➔ R911345602
Rexroth IndraDrive MPx-18 Functions	Application Manual	MP*-18VRS**-APxx-EN-P	➔ R911338673
Rexroth IndraDrive MPx-18 Version Notes	Release Notes	MP*-18VRS**-RNxx-EN-P	➔ R911338658
Rexroth IndraDrive MPx-17 Functions	Application Manual	MP*-17VRS**-APxx-EN-P	➔ R911331236
Rexroth IndraDrive MPx-17 Version Notes	Release Notes	MP*-17VRS**-RNxx-EN-P	➔ R911331588
Rexroth IndraDrive MPx-16 Functions	Application Manual	MP*-16VRS**-APxx-EN-P	➔ R911326767
Rexroth IndraDrive MPx-16 Version Notes	Release Notes	MP*-16VRS**-RNxx-EN-P	➔ R911329272
IndraDrive MPx-16 up to MPx-21 and PSB Parameter	Reference	GEN1-PARA**-RExx-EN-P	➔ R911328651

Title	Document type	Documentation type ¹⁾ DOK-INDRV*-...	Material number R911...
IndraDrive MPx-16 up to MPx-21 and PSB Diagnostics	Reference	GEN1-DIAG**-RExx-EN-P	➔ R911326738
Rexroth IndraDrive Integrated Safety Technology "Safe Torque Off" (from MPx-16)	Application Manual	SI3-**VRS**-APxx-EN-P	➔ R911332634
IndraDrive Integrated Safety Technology "Safe Motion" (as of MPx-18)	Application Manual	SI3*SMO-VRS-APxx-EN-P	➔ R911338920
Rexroth IndraDrive Rexroth IndraMotion MLD Libraries from MPx-17	Reference	MLD-SYSLIB2-RExx-EN-P	➔ R911332627
IndraDrive Rexroth IndraMotion MLD Libraries from MPx-18	Reference	MLD-SYSLIB3-RExx-EN-P	➔ R911338916
Rexroth IndraDrive Rexroth IndraMotion MLD from MPx-17	Application Manual	MLD2-**VRS*-APxx-EN-P	➔ R911334351
IndraDrive IndraMotion MLD from MPx-18	Application Manual	MLD3-**VRS*-APxx-EN-P	➔ R911338914
1) In the documentation types, xx is a placeholder for the current issue status of the documentation (example: RE02 means the second issue of a reference document)			

12.3 General commissioning procedure

The following flow chart illustrates the general commissioning procedure for synchronous kit motors. The individual items are explained in more detail in the chapters following thereafter.

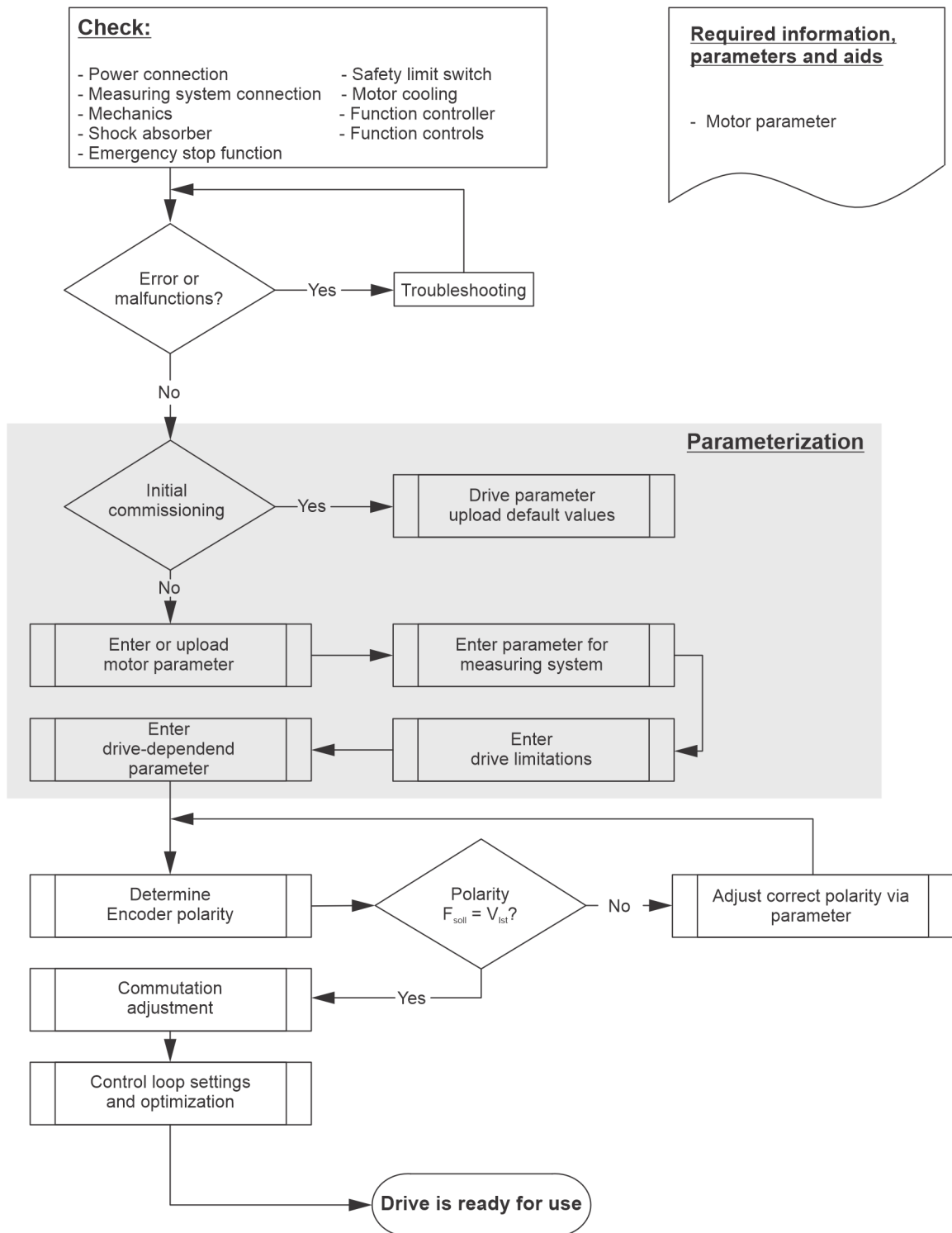


Fig. 224: General commissioning procedure for synchronous kit motors

12.4 Parameterization

12.4.1 General

The input or modification of certain parameters and the execution of commands during commissioning takes place within menu-guided dialogs and can optionally also be carried out via the control terminal.

12.4.2 Entering motor parameters



Motor parameters are specified by Rexroth and cannot be changed by the user. If these parameters are not available, commissioning is not possible! In this case, please contact your Rexroth Sales and Service Facility.

▲ WARNING

Activation of the motor immediately after motor parameter input may result in injury and mechanical damage! The motor is not yet ready for operation after the motor parameters have been entered!

- Do not switch on the motor immediately after entering the motor parameters
- Enter the parameters for the encoder system
- Check and adjust the encoder polarity
- Configure the commutation settings

The motor parameters should be entered as follows:



Load all motor parameters via commissioning software.

If the commissioning software is not available, manually type the parameters via the controller. A list of the corresponding motor parameters is available from your sales partner.

Table 85: MBSxx2 Motor parameters

Parameter		Description
CanBus	Sercos	
0x2220:05	P-0-0004.0.0	Velocity controller: Filter time constant
0x2010:03	P-0-0018.0.0	Basic data motor: Pole pair number / Pole pair width
0x210C:01	P-0-0045.0.0	Motor control function: Configuration 1
0x2010:02	P-0-0051.0.0	Basic data motor: Torque/force constant
0x2024:01	P-0-0512.0.0	Motor temperature sensor: Type
0x211C:01	P-0-0533.0.0	Motor - voltage control: Proportional gain
0x211C:02	P-0-0534.0.0	Motor - voltage control: Integral action time
0x211C:03	P-0-0535.0.0	Motor - voltage control: Voltage reference value 2
0x211C:04	P-0-0536.0.0	Motor - voltage control: Voltage reference value 1
0x2008:08	P-0-4005.0.0	Synchronous motor data: DC current limit value
0x2010:01	P-0-4014.0.0	Basic data motor: Type
0x2008:03	P-0-4016.0.0	Synchronous motor data: Longitudinal inductance
0x2008:04	P-0-4017.0.0	Synchronous motor data: Cross inductance
0x202A:02	P-0-4034.0.0	Motor thermal model 1 config.: Time constant, motor winding
0x202A:03	P-0-4035.0.0	Motor thermal model 1 config.: Time constant, motor housing
0x2010:05	P-0-4036.0.0	Basic data motor: Rated speed
0x202A:04	P-0-4037.0.0	Motor thermal model 1 config.: Short-term overload factor
0x2010:07	P-0-4048.0.0	Basic data motor: Motor winding resistance
0x2220:01	S-0-0100.0.0	Velocity controller: Proportional gain
0x2220:03	S-0-0101.0.0	Velocity controller: Integral action time
0x2102:05	S-0-0106.0.0	Motor - current control: Proportional gain 1
0x2102:06	S-0-0107.0.0	Motor - current control: Integral action time 1
0x2010:08	S-0-0109.0.0	Basic data motor: Peak current
0x6075:00	S-0-0111.0.0	Basic data motor: Standstill current motor

Parameter		Description
CanBus	Sercos	
0x6080:00	S-0-0113.0.0	Basic data motor: Max. Motor velocity
0x2022:01	S-0-0201.0.0	Motor temperature monitoring Warning threshold
0x2022:02	S-0-0204.0.0	Motor temperature monitoring Switch-off threshold

12.4.3 Parameterization encoder system

The parameterization of the encoder system must comply with the encoder system used. For corresponding details refer to the specific firmware description (see [Chapter 12.2.4](#)).

12.4.4 Entering drive limitations and application-related parameters

Drive limitations

The drive limitations that can be set, include:

- Current limitation
- Torque limitation
- Velocity limitation
- Travel range limitations

Application-related parameters

Application-related drive parameters include, for example, parameterization of the drive fault reaction.



For detailed descriptions refer to the specific functional description (see [Chapter 12.2.4](#)).

12.5 Determining the polarity of the encoder system

In order to avoid direct feedback in the velocity control loop, the effective direction of the motor torque and the count direction of the encoder system must be identical.

NOTICE

When adjusting the polarity of the encoder, ensure that the count direction of the encoder and the direction of rotation of the motor are the same.

In deviating cases adjust the encoder polarity via the parameters listed in the firmware description (see [Chapter 12.2.4](#)).

⚠ WARNING

Different effective directions of motor torque and count direction of the encoder system cause uncontrolled movements of the motor upon switch-on!

- Secure against uncontrolled movement
- Setting the effective direction of the motor torque to the counter direction of the encoder system

Position, velocity and force data may not be inverted when the encoder system count direction is set. Ensure that the following parameters are set before the encoder polarity is checked:

Table 86: Polarity parameters

Parameter		Description	Value
CanBus	Sercos		
0x290A:03	S-0-0085.0.0	Axis polarity: Torque / force	0000000000000000
0x290A:02	S-0-0043.0.0	Axis polarity: Velocity	0000000000000000
0x290A:01	S-0-0055.0.0	Axis polarity: Position	0000000000000000

The correct setting of the encoder polarity is set via the separate parameters of the firmware used. Observe the following table:

Table 87: Setting direction of rotation of encoder

Parameter		Description	Value Bit 3
CanBus	Sercos		
0x241A:02	S-0-0602.2.2	Phys. encoder configuration OPT_2: Properties	000000000000>0<000
Bit 3 at encoder		Designsee Fig.) 225	
		A	B
rotating clockwise (positive)		1	0
rotating counterclockwise (positive)		0	1

Direction of rotation of the motor

The direction of rotation of the motor or the rotor of MBSxx2 motors can be determined by means of the cable output side at the stator.

The following example starts from the assumption that the encoder manufacturer has provided a positive count direction with a view to the encoder shaft and the encoder shaft rotating in clockwise direction.

For the actual definition of the count direction of your encoder, please refer to the encoder manufacturer's encoder data sheet.

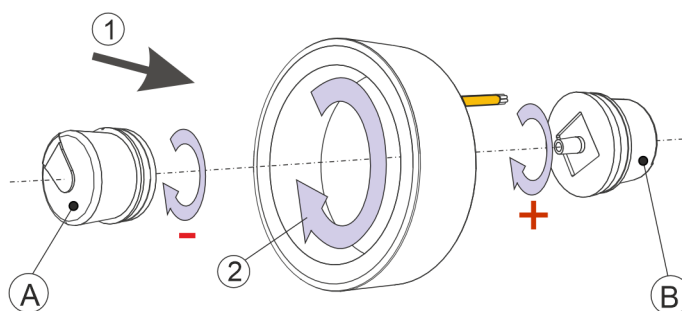


Fig. 225: Direction of rotation of the rotor, as viewed from the cable output side at the stator (MSS)

- ① Viewing direction (towards cable output)
- ② Direction of rotation of the rotor with phase sequence U-V-W
- + Positive count direction of the encoder = assumption (observe the count direction defined in the encoder data sheet)
- Negative count direction of the encoder = assumption (observe the count direction defined in the encoder data sheet)
- A Encoder attachment side "A"
- B Encoder attachment side "B"

Parametrization encoder attachment side "A"

If the encoder rotates clockwise (looking at the encoder shaft from the front, the encoder counts as positive when turning clockwise), the direction of encoder rotation must be changed by the corresponding parameters (see [Tab. 87](#)).

If the encoder rotates counterclockwise (looking at the encoder shaft from the front, the encoder counts negatively when turning clockwise), the encoder direction of rotation does NOT have to be turned.

Parametrization encoder attachment side "B"

If the encoder turns clockwise (looking at the encoder shaft from the front, the encoder counts as positive when turning clockwise), the encoder direction of rotation does NOT have to be turned.

If the encoder rotates counterclockwise (looking at the encoder shaft from the front, the encoder counts negatively when turning clockwise), the direction of encoder rotation must be changed using the corresponding parameters (see [↗ Tab. 87](#)).

12.6 Commutation adjustment

⚠ DANGER

Errors while activating motors and moving elements! Commutation adjustment always has to be performed in the following cases:

- Upon initial commissioning
- Change of the mechanical attachment of the encoder system
- Replacement of the encoder system
- Change the mechanical attachment of stator and/or rotor

⚠ WARNING

Errors in commutation adjustment can result in malfunctions and/or uncontrolled movements of the motor!

- Effective direction of motor torque = count direction of encoder system
- Complying with the described setting procedures
- Correct motor and encoder parameterization
- Appropriate parameterization of current and velocity control loops
- Correct connection of motor power cable
- Protection against uncontrolled movements

The torque of the synchronous torque motor can only develop to a maximum and constant degree, if the commutation phase is set correctly.

This procedure ensures that the angle between the current vector of the stator and the flux vector of the rotor is always 90°. The motor supplies the maximum torque in this state.

Motor connection

The individual phases of the motor power connection have to be assigned correctly. See also [↗ Chapter 7 Connection technique on page 177](#).

Adjustment procedure

Different commutation adjustment procedures have been implemented in the firmware. The following figure shows an overview of the connection between the encoder system used and the procedure to be applied.

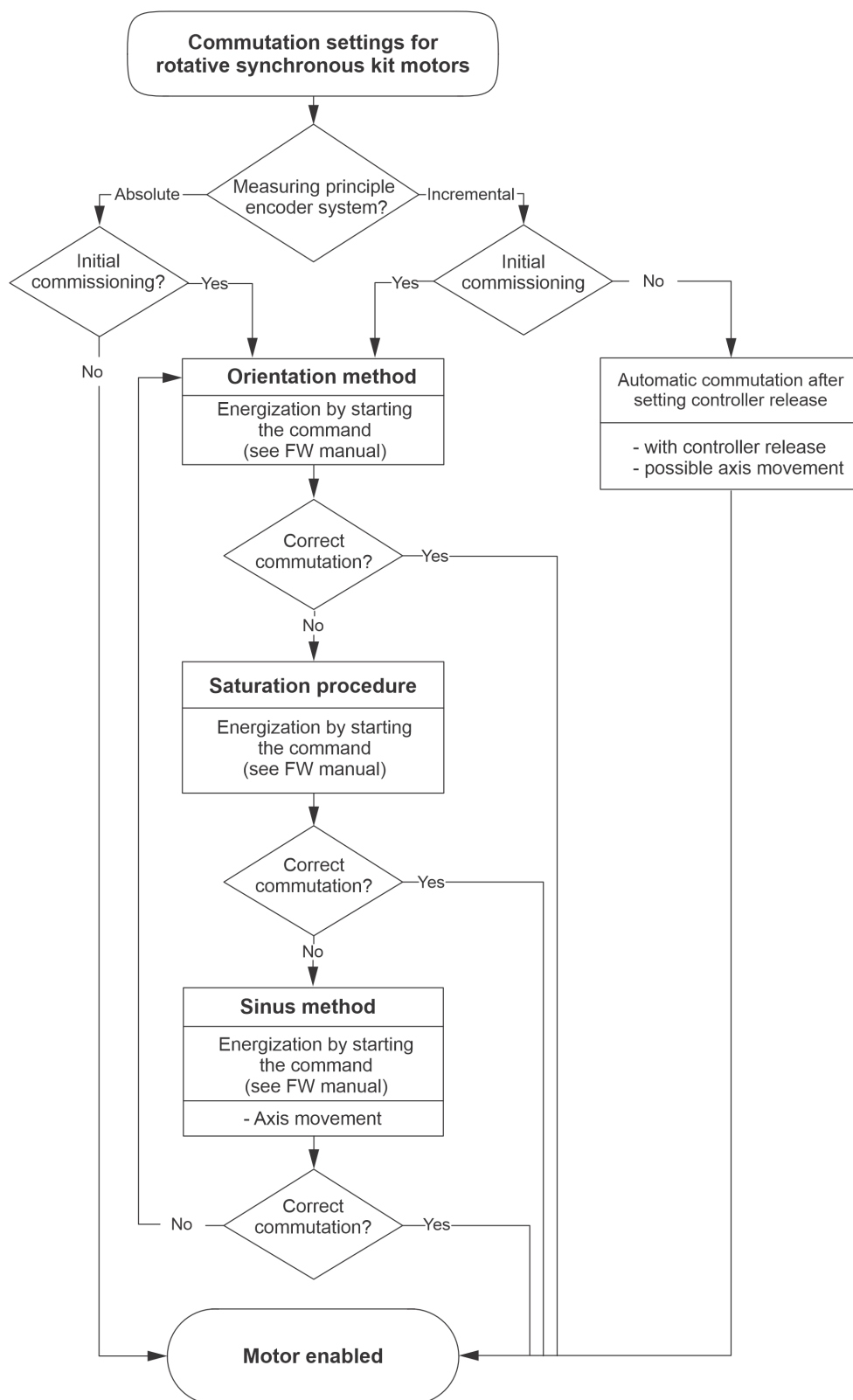


Fig. 226: Commutation adjustment



A detailed description of the different methods is given in the firmware description for Rexroth controllers (see [Chapter 12.2.4 Applicable documents on page 257](#)).

12.7 Setting and optimizing the control loop

12.7.1 General procedure

The control loop settings in a digital drive controller have an essential importance for the properties of the servo axis. The control loop structure consists of a cascaded position, velocity and current controller. Which controller is active is defined by the operation mode.



Defining the control loop settings requires the corresponding expertise.

Refer to the functional description of the drive controller for more detailed information.

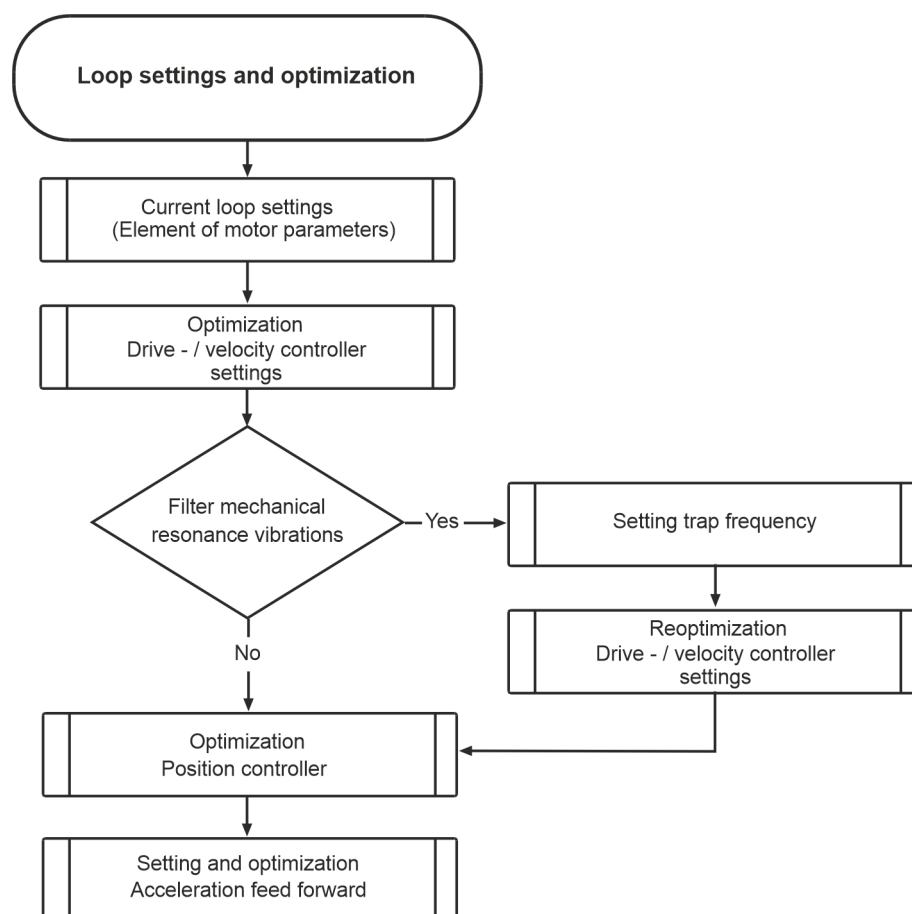


Fig. 227: Setting and optimizing the control loop of synchronous torque motors

Filtering mechanical resonance vibrations

Digital drives from Rexroth are able to provide a narrow-band suppression of vibrations that are produced due to the power train between motor and mechanical axis system. This results in increased drive dynamics with good stability.

The mechanical system is excited to vibrate mechanically due to the position and/or velocity return within the closed control loop. This behavior, known as "Two-mass vibrational system", is mainly in the frequency range from 400 to 800 Hz. It depends on the rigidity of the mechanical system and the spatial expansion of the system.

In most cases, this "Two-mass vibrational system" has a clear resonant frequency that can be selectively suppressed by a rejection filter installed in the drive.

When the mechanical resonant frequency is suppressed, the dynamic properties of the velocity control loop and of the position control loop may, under certain circumstances, be improved as compared with closed-loop operation without rejection filter.

This leads to an increased profile accuracy and shorter cycle times for positioning processes at a sufficient distance to the stability limit.

Rejection frequency and bandwidth of the filter can be selected. The rejection frequency is the frequency with the highest attenuation. The bandwidth defines the frequency range in which the attenuation is less than -3 dB. A higher bandwidth leads to less attenuation of the rejection frequency!

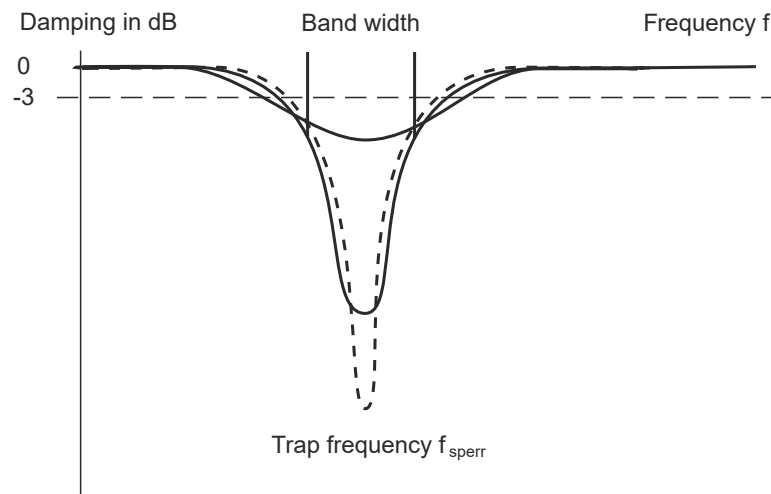


Fig. 228: Amplitude response of the rejection filter in relation to the bandwidth, qualitative

12.8 Shutdown

In the case of malfunctions, maintenance measures or to deactivate the motors, proceed as follows:

- Comply with the instructions in the machine documentation.
- Use the machine-side control commands to decelerate the drive to a controlled standstill.
- Switch off the power and control voltage of the controller.
- Switch off the main switch of the machine and deactivate external systems according to the instructions of the manufacturer.
- Secure the machine against accidental movements and against unauthorized operation.
- Wait until the discharge time of the electrical systems has elapsed and then disconnect all electrical connections. Secure electric cables and contacts against contact with other electrical parts.
- Document all executed measures in the commissioning report and the machine maintenance plan.

12.9 Disassembly

12.9.1 General notes about disassembly

⚠ DANGER	Fatal injury due to errors during the activation of motors or work on moving elements! – Work on machines is only allowed if they are secured and while they are not running. – Before starting disassembly, secure the machine against unforeseeable movements and against unauthorized operation. – Before dismounting the motor and the supply lines, secure them against dropping or moving and disconnect the mechanical connections only thereafter.
⚠ WARNING	High electric voltage! Danger to life, risk of injury by electric shock! – Life parts are dangerous. – Do not open any covers or flange sockets during operation. – Do not connect or disconnect plug-connectors and connection clamps.
NOTICE	The machine manufacturer must observe the special features of the construction and create a special disassembly instruction for the motor components. Only this disassembly instruction of the machine manufacturer is binding.

Basic procedure for disassembly:

1. ➤ Observe the disassembly instruction of the machine manufacturer.
2. ➤ Use the machine-side control command to decelerate the drive to a controlled standstill.
3. ➤ Switch off the power and control voltage of the controller.
4. ➤ Switch off the main switch of the machine and deactivate external systems according to the instructions of the manufacturer.
5. ➤ Secure the machine against accidental movements and against unauthorized operation.
6. ➤ Wait until the discharge time of the electrical systems has elapsed and then disconnect all electrical connections. Secure electric cables and contacts against contact with other electrical parts.
7. ➤ Remove dirt, chips and other any kind of residues from the motor.
8. ➤ Before disassembling the motor and the supply lines, secure them against dropping or movements. Subsequently, disconnect the mechanical connections.
9. ➤ Right after disassembly, store or transport the motor components in its origin package.
10. ➤ If necessary, record all measures in the commissioning log or machine maintenance plan.

12.10 Maintenance

12.10.1 General

Synchronous motors of the MBSxx2 series are maintenance-free as long as they are operated under the specified operating conditions and during their service life. Operation under unfavorable conditions can, however, lead to restrictions in availability.



Increase availability with regular preventive maintenance measures. Comply with the machine manufacturer's instructions in the machine maintenance plan and the maintenance measures described below.

Record all maintenance measures in the machine maintenance plan.

12.10.2 Measures

⚠ DANGER	Risk of injury due to moving elements! Risk of injury due to hot surfaces! ⇒ Do not carry out any maintenance measures while the machine is running. ⇒ While carrying out maintenance work, secure the machine such that it cannot restart or be used by unauthorized persons. ⇒ Do not work on hot surfaces.
-----------------	---

Bosch Rexroth recommends the following maintenance measures, based on the maintenance plan of the machine manufacturer:

Table 88: Maintenance measures

Measure	Interval
Check the cooling system for proper functioning.	According to the specifications in the machine maintenance plan, but at least every 1000 operating hours.
Check the mechanical and electrical connections.	According to the specifications in the machine maintenance plan, but at least every 1000 operating hours.
Check the machine for smooth running, vibrations and bearing noise.	According to the specifications in the machine maintenance plan, but at least every 1000 operating hours.
Remove dust, chips and other dirt from the motor housing, cooling fins and the connections.	Depending on the degree of soiling, but after one operating year at the latest.

12.10.3 Coolant supply

It can be necessary to disassemble the coolant supply for maintenance measures or troubleshooting.

- This work may only be carried out by skilled personnel.
- Do not carry out any maintenance measures while the machine is running. Comply with the safety instructions.
- Protect open supply lines and connections against ingress of dirt.

12.10.4 Electrical check of motor components

Electrical defects at stators can be indicated in advance by measuring the electrical characteristics. The following variables are relevant:

- Resistance between motor connecting wires 1-2, 2-3 and 1-3
- Inductance between motor connecting wires 1-2, 2-3 and 1-3
- Insulation resistance between motor connecting wires and guides

Resistance and inductance

The measured values of resistance and inductance can be compared to the values specified in [Chapter Technical data](#). The individual values of resistance and inductance measured between the connections 1-2, 2-3 and 1-3 should be identical within a certain tolerance. If one or several values deviate considerably, an inter-phase short circuit, an interturn fault or a short circuit occurred.



In case of considerable deviations in resistance, please contact the Bosch Rexroth customer service.

Insulation resistance

The insulation resistance – measured between the motor connection wires and ground – should be at least 1 MΩ (MegaOhm).



If the resistance too low, please contact the Bosch Rexroth customer service.

12.11 Troubleshooting

12.11.1 General

⚠ DANGER

Risk of injury due to moving elements! Risk of injury due to hot surfaces!

- ⇒ Do not carry out any maintenance measures while the machine is running.
- ⇒ Switch off the controller and the machine and wait until the discharging time of the electrical systems has elapsed before starting troubleshooting.
- ⇒ While carrying out maintenance work, secure the machine such that it cannot restart or be used by unauthorized persons.
- ⇒ Do not work on hot surfaces.

⚠ WARNING

The rotor is magnetic! Risk of injury and danger of crushing body parts by magnetic forces!

- ⇒ Remove or secure any movable metal objects.
- ⇒ Carefully handle all magnetic components.
- ⇒ Wear protecting clothes and use installation aids.

Possible causes for failures of motors can be restricted to the following areas:

- Motor cooling circuit and temperature curve
- Internal temperature sensor
- Mechanical damage of the motor
- Mechanical connection to machine

Encoder and temperature sensor are controlled by the controller or the control unit; corresponding diagnostic messages are displayed. Observe the instructions in the corresponding documentation.

The sections below describe examples of some fault states. Fault states along with possible causes. This list is not exhaustive.

12.11.2 Excessive temperature of motor housing

State

The housing temperature of the motor rises to unusually high values.

⚠ CAUTION

Damage to motor or machine by restarting after excessive motor temperature!

- Liquid-cooled motors may not be restarted or supplied with cold coolant immediately after a failure of the cooling system and an increased motor temperature. Risk of damage!
- Wait until the motor temperature has dropped under +40 °C before the restart

Possible causes

- Failure or malfunction in the cooling system.
- The original machining cycle has been changed.
- The original motor parameters have been changed.
- Motor bearings are worn or defective.

Measures for

- Check the cooling system. Clean or rinse the cooling circuit as required. Contact the machine manufacturer in the case of a cooling system failure.
- Check the sizing of the drive for changed requirements. Stop operation in case of overload. Risk of damage!
- Restore the original parameters. Check the sizing of the drive if requirements have been changed.
- Contact the machine manufacturer.

12.11.3 High motor temperature values, but housing temperature is normal

State

The diagnostic system of the machine shows unusually high winding temperature values via display or operator software. However, the temperature of the motor housing is normal.

Possible causes

- Wiring error or cable break in sensor cable.
- Diagnostic system defective.
- Failure of the winding temperature sensor (PTC).

Measures for

- Check the wiring and connection of the temperature sensor according to the interconnection diagram.
- Check the diagnostic system at the controller or the control unit.
- Check the resistance value of the temperature sensor using a multimeter.
 - Shut down the system and wait until the discharging time has elapsed.
 - Disconnect the connection of the temperature sensor at the controller. Set the measuring device to resistance measurement mode and connect the wire pair to the measuring device (this also checks the sensor line). Check values according to the characteristic curves in “Chapter Motor temperature monitoring”.

12.11.4 Motor or machine generate vibrations

State

Audible or tactile vibrations occur on the motor or on the machine.

Possible causes

- Driven machine elements are insufficiently coupled or damaged.
- Motor bearings are worn or defective. Available bearing lifetime or grease lifetime has elapsed.
- Motor mount has loosened.
- Drive system is instable from a control point of view.

Countermeasures

- Contact the machine manufacturer.
- Contact the machine manufacturer.
- Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
- Check the parameterization of the drive system (motor and encoder data). Comply with the instructions in the controller documentations.

12.11.5 Specified position is not reached

State

The positioning command of the control unit is executed either not precisely or not at all. No malfunction displayed by the controller or the control unit.

Possible causes

- Wiring of encoder cable is incorrect or defective. Pin assignment (encoder signals) in cable or plug may be interchanged.
- Insufficient shielding of encoder cable against interference signals.
- Incorrect parameterization of encoder data in controller.
- Motor-machine element connection has loosened.
- Encoder defective.

Countermeasures

- Check wiring according to interconnection diagram of machine and check cables for damage.
- Check shielding; if necessary, increase effective contact surfaces of shielding.
- Correct the parameterization. Observe the commissioning log.
- Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
- The encoder has to be replaced. Contact the machine manufacturer.

The temperatures at the shaft or bearing are high.

In the case of high temperatures at the shaft or at the bearing, different causes can be causally (therefore refer to [Chapter 8.6 Thermal utilization for higher speeds on page 191](#)). Check the following relations and measures:

- Compare the driven operating point with the continuous characteristic curves of the motors within [Chapter 3 Technical data on page 31](#).
- Increase the PWM switching frequency.

- Reduce the operating time in the case of high speed or extend the operating times in the case of low speed.
- Avoid unnecessary idle times in the case of high speed.

12.12 Operation with third-party controllers

Rate of rise of voltage

The electrical insulation system of the motor is subject to a higher dielectric load in converter mode than when it is operated with a merely sinusoidal source voltage. The voltage load of the winding insulation in converter mode is mainly defined by the following factors:

- Crest value of voltage
- Rise time of pulses at the motor terminals
- Switching frequency of final converter stage
- Length of power cable to the motor

Main components are the switching times of the final converter stage and the length of the power cable to the motor. The rates of rise of the voltage occurring at the motor may not exceed the pulse voltage limits specified in **DIN VDE 0530-25 (VDE 0530-25): 2009-08 (picture 14, limit curve A)**, measured at the motor terminals of two strands in relation to the rise time.

These limits are complied with by the final stages of Rexroth converters.



13 Environmental protection and disposal

Disposal of the motor components can be done according to the applicable legal process in normal recycling process.

Recycling

Most of the products can be recycled due to their high content of metal. In order to recycle the metal in the best possible way, the products must be disassembled into individual assemblies. Metals contained in electric and electronic assemblies can also be recycled by means of special separation processes.

Basic components

Basically, our motors consist of the following components:

- Steel, stainless steel, aluminum, copper, brass
- Plastic parts, insulation and composite material
- Electronic components
- Permanent magnets

Plastic parts of the products may contain flame retardants. These plastic parts are labeled according to EN ISO 1043-1:2011 + A1:2016. They have to be recycled separately or disposed of according to the applicable legal provisions.

Magnets

▲ WARNING

Danger due to permanent magnets!

- Health hazard for persons with heart pacemakers, metallic implants and hearing aids in direct environment of permanent magnets.
- Crushing hazard of fingers and hand due to heavy attractive forces of the magnets.
- Risk of destruction of sensitive parts like watches, credit cards, ...



Remark

The permanent magnets must be demagnetized before disposal to avoid injuries or damage. The demagnetization is reached via thermal treatment. The duration of the treatment depends on the size (guide value: 300 °C, 30 min).

Packaging

Our packaging materials do not contain any problematic materials and can therefore be easily disposed. Packaging materials are: wood, cardboard and polystyrene.



Batteries and accumulators

The symbol indicating "separate collection" for all batteries and accumulators is the crossed-out wheeled bin. End users in the EU are legally bound to return used batteries and accumulators. Outside the scope of the EU Directive 2006/66/EC, the applicable regulations must be followed. Batteries and accumulators can contain hazardous substances which can harm the environment or people's health when improperly stored or disposed of. The batteries or accumulators must be returned to the country-specific collection systems for proper disposal.

Disposal by the manufacturer

Our products can be returned to us for disposal. However, this requires that the products are free from oil, grease or other dirt. The motor components must be returned in a suitable packaging (origin package if possible). In the case of a transport by air freight, please observe the dangerous goods regulations (IATA) for the secondary part.

Send the products to the following address, carriage free:

Bosch Rexroth AG
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr a.Main, Germany

14 Service and support

Our worldwide service network provides an optimized and efficient support. Our experts provide you with advice and assistance. You can contact us **24/7**.

Service Germany

Our technology-oriented Competence Center in Lohr, Germany, is responsible for all your service-related queries for electric drive and controls.

Contact the **Service Hotline** and **Service Helpdesk** under:

Phone: **+49 9352 40 5060**

Fax: **+49 9352 18 4941**

Email: ➔ service.svc@boschrexroth.de

Internet: ➔ <http://www.boschrexroth.com>

Additional information on service, repair (e.g. delivery addresses) and training can be found on our internet sites.

Service worldwide

Outside Germany, please contact your local service office first. For hotline numbers, refer to the sales office addresses on the internet.

Preparing information

To be able to help you more quickly and efficiently, please have the following information ready:

- Detailed description of malfunction and circumstances
- Type plate specifications of the affected products, in particular type codes and serial numbers
- Your contact data (phone and fax number as well as your e-mail address)

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