MBT

High Synchronous Torque Motors

Project Planning Manual
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Edition 08

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See tab. 1-1 "Record of revisions" on page 4

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Table of Contents

Page

Page

Page

Page

Page

Page

1 Introduction

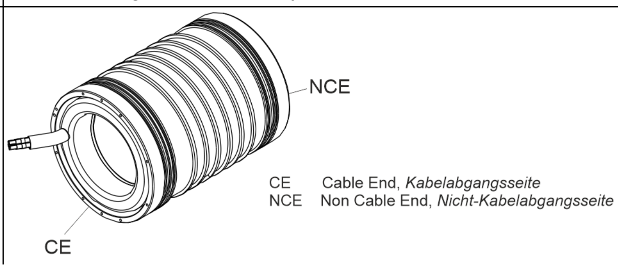
1.1 Fields of application

Typical fields of application of these motors are direct drives, e.g., in rotary tables, swivel axes of machining centers, printing units as well as grinding machines. But they also provide new solutions for innovative machine construction where robots, plastics machines, woodworking machines, lathes and special machines are concerned. These motors have the following essential advantages:

- Maximum torques of up to 13,800 Nm
- Full torque already at standstill
- Extreme overload capability
- Best synchronous operation
- Liquid cooling with thermal encapulation
- Easy assembly

For a comprehensive overview of all product groups of Bosch Rexroth Electric Drives and Controls, please refer to the online product catalog: http://www.boschrexroth.com/dcc/Vornavigation/VorNavi.cfm?Language=DE&VHist=g97568&PageID=g96068.

1.2 Basic features

Product	3~ PM motor
Type	MBT consist of MST and MRT
Ambient temperature during operation	0 … 40 °C
Protection class (EN 60034-5)	IP00
Cooling mode (EN 60034-6)	IC3W7, Water cooling
Installation altitude	0 ... 1000 m above MSL (without derating)
Thermal class (EN 60034-1)	155 (F)
Electrical connection	Connection cable with open cable ends Shielded cable (3x power + 1x PE, 2x KTY, 2x PTC) Wires with open end (3x power, PE. 2x KTY, 2x PTC)
Mechanical protection	MRT: Bandaged magnets MST: Winding moulded with synthetic resin
Motor ends	

1.3 Motor layout

MBT synchronous torque motors are liquid-cooled kit motors which have been optimized for high torques. They consist of a stator with three-phase winding and a rotor with permanent magnets.

Descriptions of the individual modules:

- **MBT**: The assembly kit motor consists of the components stator (MST) and rotor (MRT)
- **MST**: MBT motor stator
- **MRT**: MBT motor rotor

The stator consists of a laminated core with multipolar winding, a liquid cooling jacket and a connection cable. The option "cooling jacket in housing" for stators contains a cooling jacket with a closed cooling circuit, a mounting flange and an electrical connection via terminal box or device connector. The cooling jacket is open at the rear and the rotor is connected to the machine shaft and bearing.

Two characteristics are available for the motors

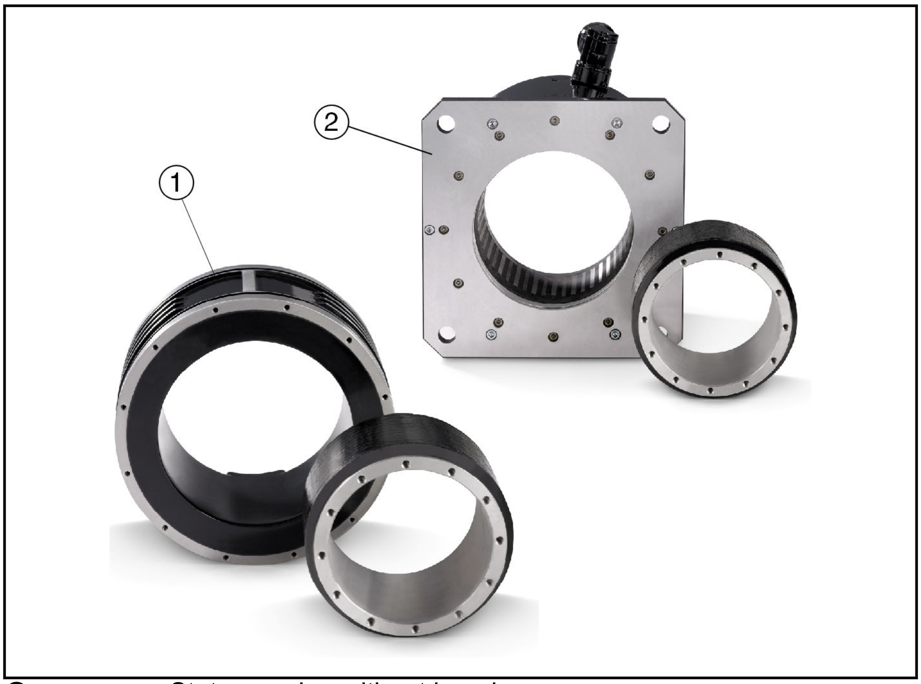
- **Characteristics = MRTxx0 / MSTxx0**

  MBTxx0 motors are charaterized by a high continuous force and a very high maximum force. The MBTxx0 motors represent classic high-torque motors.

- **Characteristics = MRTxx1 / MSTxx1**

  MBTxx1 motors are optimized regarding their synchronization characteristics. They have a force ripple that is about a factor of 3 lower than that of the MBTxx0. The magnetic circuit was changed to achieve this. This results in lower continuous and maximum forces for the same frame size. These motors can be especially used for grinding applications, for example.

☞ Using Bosch Rexroth drive controllers, a comparable synchronization quality can be achieved with both MBTxx0 and MBTxx1, e.g. by activating the so-called "cogging torque compensation”.



① Stator version without housing
② Stator version with housing

Fig. 1-1: MBT components stator and rotor

1.4 Motor power spectrum

Very high torque densities are achieved with watercooled synchronous kit torque motors of the MBT series. The available torque is from 5 Nm to 13,800 Nm for speeds of 4.000 min-1. The following figures give an overview about the power spectrum:

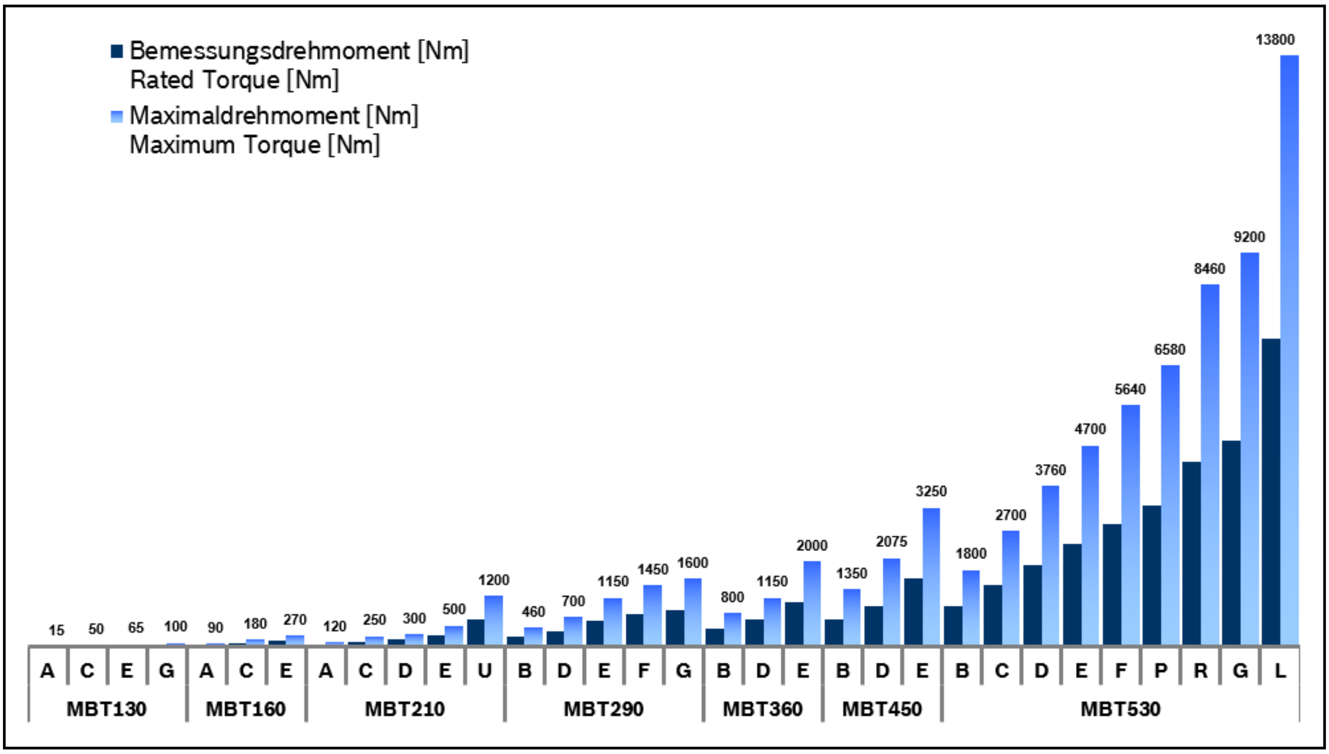


Fig. 1-2: MBTxx0 Power spectrum

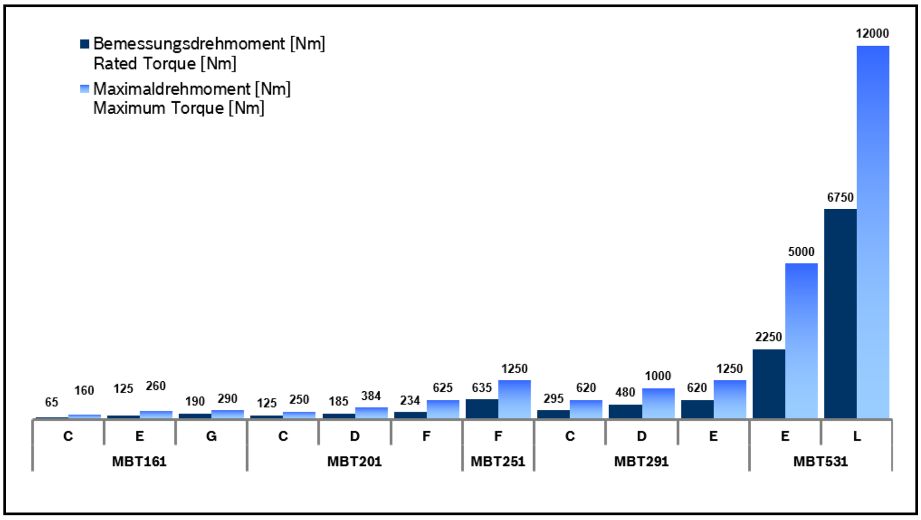


Fig. 1-3: MBTxx1 Power spectrum

1.5 About this documentation

1.5.1 Editions of this documentation

Edition	Release date	Notes
08	2021-07	Revision and amendment of new frame sizes and windings
07	2018-12	Revision and amendment, incorporation of MBTxx1 series
06	2011-11	Revision and amendment
...		
01	2001-01	First edition

Tab. 1-1: Record of revisions

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>
<tr><th>Chapter</th><th>Title</th><th colspan="2">Description</th></tr>
<tr><td>1</td><td>Introduction</td><td colspan="2">Introduction to the product and reading instructions</td></tr>
<tr><td>2</td><td>Important instructions for use</td><td colspan="2" rowspan="2">Important safety instructions</td></tr>
<tr><td>3</td><td>Safety</td></tr>
<tr><td>4</td><td>Technical data</td><td rowspan="4">Product description</td><td rowspan="6">for designers and project developers</td></tr>
<tr><td>5</td><td>Dimensional sheets</td></tr>
<tr><td>6</td><td>Type codes</td></tr>
<tr><td>7</td><td>Accessories</td></tr>
<tr><td>8</td><td>Connection technology</td><td rowspan="5">Practice</td></tr>
<tr><td>9</td><td>Application instructions</td></tr>
<tr><td>10</td><td>Handling and transport</td><td rowspan="3">for operating and maintenance personnel</td></tr>
<tr><td>11</td><td>Installation</td></tr>
<tr><td>12</td><td>Operation</td></tr>
</table>

Chapter	Title	Description
13	Service & support	Additional information
	Index	

Tab. 1-2: Chapter structure

1.5.3 Further documentation

For the project planning of drive systems with motors of the series, you will require further documentation, depending on the devices used. Rexroth provides the entire product documentation in the Bosch Rexroth media directory in PDF format.

http://www.boschrexroth.com/various/utilities/mediadirectory/index.jsp

1.5.4 Standards

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

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Burggrafenstraße 6

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Internet: http://www.din.de/beuth

Email: postmaster@beuth.de

1.5.5 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.

For references to manufacturers, please refer to chapter 9 "Application notes" on page 259.

1.5.6 Your feedback

Your experiences are an essential part of the improvement process of product and documentation.

Please send your feedback to:

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E-Mail: dokusupport@boschrexroth.de

2 Important instructions on use

2.1 Intended use

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.

☞ 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 Rexroth, the following condition precedent must be fulfilled so as to ensure that they are used as intended:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with their intended 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 and maintained in compliance with all regulations specified in the documentation.

Rexroth synchronous torque motors of the MBT series are designed to be used as rotary main drive motors in machines.

For application-specific use of the motors, device types with different drive power and different interfaces are available.

To control and monitor the motors, it may be necessary to connect additional sensors and actuators.

☞ 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.

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.

2.2 Non-intended 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 MBT motors if

- they are exposed to operating conditions that do not meet the specified ambient conditions. This includes, for example, operation under water, under extreme temperature fluctuations or extreme maximum temperatures.
- the intended application range is not explicitly approved. Therefore, please carefully follow the specifications outlined in the general safety instructions!

3 Safety instructions for electric drive and control systems

3.1 Definitions of terms

Axis processor The axis processor is a micro processor in which the control algorithms to operate the actor (e.g. a motor) are running.

Installation An installation consists of several devices or systems interconnected for a defined purpose and on a defined site which, however, are not intended to be placed on the market as a single functional unit.

Drive A drive (electric drive) consists of a drive controller with an electric motor.

Electric drive system An electric drive system comprises all components from mains supply to motor shaft; this includes, for example, electric motor(s), motor encoder(s), supply units and drive controllers, as well as auxiliary and additional components, such as mains filter, mains choke and the corresponding lines and cables.

User A user is a person installing, commissioning or using a product which has been placed on the market.

Application documentation Application documentation comprises the entire documentation used to inform the user of the product about the use and safety-relevant features for configuring, integrating, installing, mounting, commissioning, operating, maintaining, repairing and decommissioning the product. The following terms are also used for this kind of documentation: Operating Instructions, Commissioning Manual, Instruction Manual, Project Planning Manual, Application Description, etc.

B sample To a large extent, the B sample comes with the technical function. However, there are restrictions, e.g. insufficient testing. Therefore, errors or product variations are to be expected. The product may only be used after a prototype agreement was signed.

Electrical equipment Electrical equipment encompasses all devices used to generate, convert, transmit, distribute or apply electrical energy, such as electric motors, transformers, switching devices, cables, lines, power-consuming devices, circuit board assemblies, plug-in units, control cabinets, etc.

Device A device is a finished product with a defined function, intended for users and placed on the market as an individual piece of merchandise.

Manufacturer The manufacturer is an individual or legal entity bearing responsibility for the design and manufacture of a product which is placed on the market in the individual's or legal entity's name. The manufacturer can use finished products, finished parts or finished elements, or contract out work to subcontractors. However, the manufacturer must always have overall control and possess the required authority to take responsibility for the product.

Incompatibility Incompatible new functions or incompatible functional enhancements produce a device behavior which does not correspond to the previous version.

Island grid An island grid supplies a limited area and is not connected to the public grid system or other power networks. The power supply company has to control the balance between consumed and generated power in the island grid. An energy storage system can be used. The operator of an island grid can determine individual standards for the island grid. These standards can deviate from rules of public power supply companies.

Compatibility Compatibility of a new function or functional enhancement means that, for example, a parameter file from a previous version can be used in the new firmware.

Component A component is a combination of elements with a specified function, which are part of a piece of equipment, device or system. Components of the electric drive and control system are, for example, supply units, drive controllers, mains choke, mains filter, motors, cables, etc.

Machine A machine is the entirety of interconnected parts or units at least one of which is movable. Thus, a machine consists of the appropriate machine drive elements, as well as control and power circuits, which have been assembled for a specific application. A machine is, for example, intended for processing, treatment, movement or packaging of a material. The term "machine" also covers a combination of machines which are arranged and controlled in such a way that they function as a unified whole.

Mains operation/island grid mode Mains operation and island grid mode are differentiated. In mains operation, the grid system defines the grid properties. Supply units that supply a grid system have to synchronize their voltages and frequencies to the existing grid system. In island grid mode, however, the supply unit defines the properties of the island grid. The supply unit controls the voltage and frequency in the island grid and thus assumes a "grid generator function". The power output is determined by the loads and, where applicable, other supply units in the island grid.

Patch A patch corrects errors in the firmware.

Product Examples of a product: Device, component, part, system, software, firmware, among other things.

Project Planning Manual A Project Planning Manual is part of the application documentation used to support the sizing and planning of systems, machines or installations.

Qualified persons In terms of this application documentation, qualified persons are those individuals who are familiar with the installation, mounting, commissioning and operation of the components of the electric drive and control system, as well as with the hazards this implies, and who possess the qualifications their work requires. To comply with these qualifications, it is necessary, among other things,

- to be trained, instructed or authorized to switch electric circuits and devices safely on and off, to ground them and to mark them.
- to be trained or instructed to maintain and use adequate safety equipment.
- to attend a course of instruction in first aid.

Qualified personnel for handling functionally safe products Individuals configuring, commissioning and operating functionally safe products must have the knowledge specified under "Qualified persons". Additionally, these individuals must be familiar with technical safety concepts as well as prevailing standards and regulations in the field of functional safety.

Release, firmware/Runtime release A new release makes available compatible functional enhancements or corrects errors in the firmware, see "RS" in AXS-V-VS**RS**.

Control system A control system comprises several interconnected control components placed on the market as a single functional unit.

Technology Function The ctrlX DRIVE technology function refers to the PLC firmware function in which the use of customized PLC programs or technology apps is facilitated by the axis processor of the ctrlX DRIVE system.

Grid system A grid system is a large-scale, supraregional network of power plants (with respect to electric power). It is operated by a power supply company that is responsible for the mains and thus also specifies the rules for mains supply.

Version, firmware/Runtime version Compared to the previous version, a new version of a firmware contains important changes in the scope of functions. The scope of functions may also contain incompatible changes, see "VS" in AXS-V-**VS**RS.

3.2 General information

3.2.1 Using the Safety instructions and passing them on to others

Do not attempt to install and operate the components of the electric drive and control system without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation prior to working with these components. If you do not have the user documentation for the components, contact your responsible Bosch Rexroth sales partner. Ask for these documents to be sent immediately to the person or persons responsible for the safe operation of the components.

If the component is resold, rented and/or passed on to others in any other form, these safety instructions must be delivered with the component in the official language of the user's country.

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, injury, electric shock or even death.

3.2.2 Requirements for safe use

Read the following instructions before initial commissioning of the components of the electric drive and control system in order to eliminate the risk of injury and/or property damage. You must follow these safety instructions.

- Bosch Rexroth is not liable for damages resulting from failure to observe the safety instructions.
- Read the operating, maintenance and safety instructions in your language before commissioning. If you find that you cannot completely understand the application documentation in the available language, please ask your supplier to clarify.
- Proper and correct transport, storage, mounting and installation, as well as care in operation and maintenance, are prerequisites for optimal and safe operation of the component.
- Only qualified persons may work with components of the electric drive and control system or within its proximity.
- Only use accessories and spare parts approved by Bosch Rexroth.
- Follow the safety regulations and requirements of the country in which the components of the electric drive and control system are operated.
- Only use the components of the electric drive and control system in the manner that is defined as appropriate. See chapter "Appropriate Use".
- The ambient and operating conditions given in the available application documentation must be observed.
- Applications for functional safety are only allowed if clearly and explicitly specified in the application documentation "Integrated Safety Technology". If this is not the case, they are excluded. Functional safety is a safety concept in which measures of risk reduction for personal safety depend on electrical, electronic or programmable control systems.
- The information given in the application documentation with regard to the use of the delivered components contains only examples of applications and suggestions.

  The machine and installation manufacturers must

  - make sure that the delivered components are suited for their individual application and check the information given in this application documentation with regard to the use of the components,
  - make sure that their individual application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
- Commissioning of the delivered components is only allowed once it is sure that the machine or installation in which the components are installed complies with the national regulations, safety specifications and standards of the application.
- Operation is only allowed if the national EMC regulations for the application are met.
- The instructions for installation in accordance with EMC requirements can be found in the section on EMC in the respective application documentation.

  The machine or installation manufacturer is responsible for compliance with the limit values as prescribed in the national regulations.
- The technical data, connection and installation conditions of the components are specified in the respective application documentations and must be followed at all times.

National regulations which the user has to comply with

- European countries: In accordance with European EN standards
- United States of America (USA):
  - National Electrical Code (NEC)
  - National Electrical Manufacturers Association (NEMA), as well as local engineering regulations
  - Regulations of the National Fire Protection Association (NFPA)
- Canada: Canadian Standards Association (CSA)
- Other countries:
  - International Organization for Standardization (ISO)
  - International Electrotechnical Commission (IEC)

3.2.3 Hazards by improper use

- High electrical voltage and high working current! Danger to life or serious injury by electric shock!
- High electrical voltage by incorrect connection! Danger to life or injury by electric shock!
- Dangerous movements! Danger to life, serious injury or property damage by 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! Injury by crushing, shearing, cutting, hitting!
- Risk of injury by improper handling of batteries!
- Risk of injury by improper handling of pressurized lines!

3.3 Instructions with regard to specific dangers

3.3.1 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 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 electric components in accordance with the connection diagram.
- Even for brief measurements or tests, operation is only allowed if the equipment grounding conductor has been permanently connected to the points of the components provided for this purpose.
- Before accessing electrical parts with voltage potentials higher than 50 V, you must disconnect electric components from the mains or from the power supply unit. Secure the electric component from reconnection.
- With electric components, observe the following aspects:

  Always wait **30 minutes** after switching off power to allow live capacitors to discharge before accessing an electric component. Measure the electrical voltage of live parts before beginning to work to make sure that the equipment is safe to touch.
- Install the covers and guards provided for this purpose before switching on.
- Never touch any electrical connection points of the components while power is turned on.
- Do not remove or plug in connectors when the component has been powered.
- Under specific 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!

- Before switching on and before commissioning, ground or connect the components of the electric drive and control system to the equipment grounding conductor at the grounding points.

- Connect the equipment grounding conductor of the components of the electric drive and control system 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.

Cross section outer conductor	Minimum cross section equipment grounding conductor Leakage current ≥ 3.5 mA	
	1 equipment grounding conductor	2 equipment grounding conductors
1.5 mm² (16 AWG)	10 mm² (8 AWG)	2 × 1.5 mm² (16 AWG)
2.5 mm² (14 AWG)		2 × 2.5 mm² (14 AWG)
4 mm² (12 AWG)		2 × 4 mm² (12 AWG)
6 mm² (10 AWG)		2 × 6 mm² (10 AWG)
10 mm² (8 AWG)		-
16 mm² (6 AWG)	16 mm² (6 AWG)	-
25 mm² (4 AWG)		-
35 mm² (2 AWG)		-
50 mm² (1/0 AWG)	25 mm² (4 AWG)	-
70 mm² (2/0 AWG)	35 mm² (2 AWG)	-
...	...	...

Tab. 3-1: Minimum cross section of the equipment grounding connection

3.3.2 Protective extra-low voltage as protection against electric shock

Protective extra-low voltage is used to allow connecting devices with basic insulation to extra-low voltage circuits.

On 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").

3.3.3 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, serious injury or property 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 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 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 securing the vertical axes,
  - adding an external braking/arrester/clamping mechanism or
  - ensuring sufficient counterbalancing of the vertical axes.
- The standard equipment **motor holding brake** or an external holding brake controlled by the drive controller is **not sufficient to guarantee personal safety**!
- 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-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.

3.3.4 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.
- Entering these areas can pose an increased risk to the above-mentioned groups of persons. They should seek advice from their physician.
- 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.

3.3.5 Protection against contact with hot parts

Hot surfaces of components of the electric drive and control system. Risk of burns!

- 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.
- Before touching motors after having switched them off, let them cool down for a sufficient period of time. Cooling down can 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 chokes, supply units and drive controllers off, 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 installation must take measures to avoid injuries caused by burns in the final application. These measures can be, for example: Warnings at the machine or installation, guards (shieldings or barriers) or safety instructions in the application documentation.

3.3.6 Protection during handling and mounting

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

- Observe the relevant statutory regulations of accident prevention.
- Use suitable equipment for mounting and transport.
- 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!

3.3.7 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 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. Observe the national regulations of your country.

3.4 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 meant to draw the reader's attention to the safety instruction and identifies 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

In case of non-compliance with this safety instruction, death or serious injury **will** occur.

⚠ WARNING

In case of non-compliance with this safety instruction, death or serious injury **could** occur.

⚠ CAUTION

In case of non-compliance with this safety instruction, minor or moderate injury could occur.

NOTICE

In case of non-compliance with this safety instruction, property damage could occur.

4 Technical data

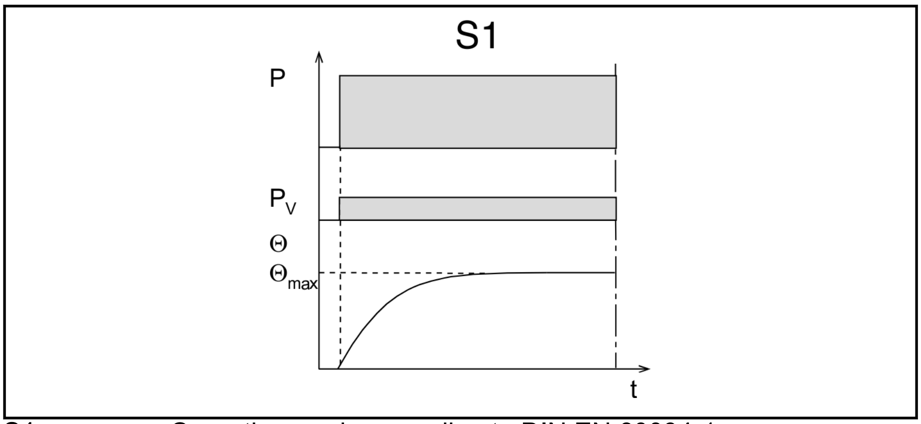
4.1 Definitions

4.1.1 Rates values

☞ 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. MST130C with MRT130C).

Bosch Rexroth motors are qualified and documented according to the test criteria and measuring methods of DIN EN 60034-1. The specified technical data refers to ambient temperatures of 0 ... 40 °C and installation altitudes of up to 1000 m above sea level. MBT motors are operated with liquid cooling and water as coolant. Some types are also equipped with natural cooling. The specified rating refers to an increase of the winding temperature in a steady state of 100 K.

For further notes regarding liquid cooling, especially about adjusting the coolant inlet temperature, please refer to chapter 9.7 "Motor cooling" on page 264.



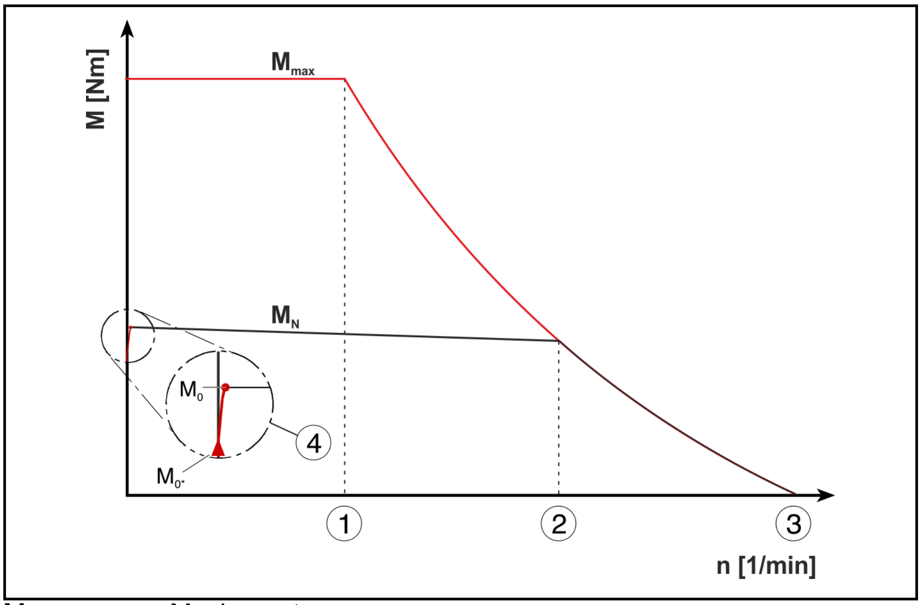
S1	Operation mode according to DIN EN 60034-1
P	Load
P_V	Electric losses
Θ	Temperature
$Θ_{max}$	Highest temperature (stator)
t	Time

Fig. 4-1: Operation mode according to DIN EN 60034-1

4.1.2 Operating behavior

The following sample characteristic curve explains the operating behavior of the motors, based on the motor data sheet information.

☞ The achievable motor torque depends on the drive controller used (see Chapter 4.1.3 IndraSize). The reference value for the motor characteristic curves is a DC bus voltage of 540 V_{DC}.



M_{max}	Maximum torque
M_N	Rated torque
M_0	Torque for speeds n ~ 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: $M_0 = M_0/\sqrt{2}$
①	Maximum speed at maximum torque
②	Rated speed
③	Maximum speed
④	When using the motor in this operating range, observe the notes under chapter 9.8 "Motor temperature monitoring" on page 277

Fig. 4-2: Example characteristic curve MBT

The maximum torque M_{max} is available up to the velocity n_{Mmax}. When the velocity increases, the available DC bus voltage is reduced by the velocity-dependent back electromotive force of the motor. This leads to a reduction of the maximum torque with rising velocity.

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

$$n_{(UCxxx)} = \frac{U_{DCxxx}}{540V} \times n_N$$

U_{DCxxx} New DC bus voltage

Fig. 4-3: Conversion example

Conversion torque to DC bus voltage $750V_{DC}$

$$M_{\max 750V} = M_{\max} = cons\tan t \qquad M_{nenn750V}\ M_{nenn} = cons\tan t$$

$$n_{\max 750V} = \frac{750V}{540V} \times n_{\max} \qquad n_{nenn750V} = \frac{750V}{540V} \times n_{nenn}$$

Fig. 4-4: Example conversion to DC bus voltage 750 V

4.1.3 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

4.1.4 Characteristics

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.

☞ Behind the product-size-length-winding combination in the stator data sheet is the cooling type.

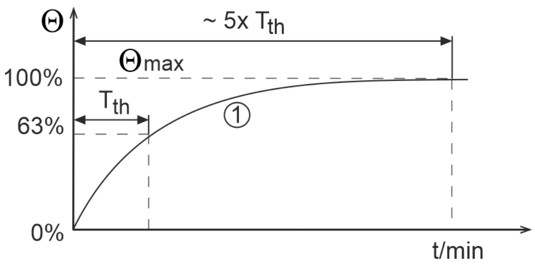
Example: MST130C-0200-**F**...

“F” stands for water cooling

“N” stands for self-cooling

General technical data for stators MST

Designation	Symbol	Unit	Toler-ance	Description
Standstill torque	M_0	Nm	± 5 %	Torque for speeds n ~ 0 Hz but n > 0.1 Hz.
Standstill current	I_0	A		For standstill torque M_0, required phase current of the motor at a speed n > 0.1 Hz.
Rated torque	M_N	Nm	± 5 %	Available torque that can be output at the rated speed in operation mode S1 (continuous operation).
Rated power	P_N	kW	± 5 %	Power output of the motor at rated speed and load with rated torque.
Rated current	I_N	A		Phase current of the motor at rated speed and load with rated torque.
Rated speed	n_N	min^{-1}	± 5 %	Useful speed defined by the manufacturer. Depending on the application, other speeds are possible (see speed-torque characteristic curve).
Maximum torque	M_{max}	Nm	± 5 %	Maximum torque available at maximum current I_{max}. The achievable maximum torque depends on the drive controller used.
Maximum current	I_{max}	A		Maximum current (root-mean-square) of the motor at M_{max}.
Maximum speed	n_{max}	min^{-1}	± 5 %	Maximum permissible speed of the motor. Normally restricted by mechanical factors such as centrifugal forces or bearing stress.
Power wire cross section	A	mm²		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. When selecting the power cable, refer to the specifications in chapter 8 ”Connection technique” and the documentation ”Rexroth Connection Cables" (DOK-CONNEC-CABLE*INDRV-AU□□-□□-P).
Torque constant	K_{M_N}	Nm/A	± 5 %	Ratio of generated torque M_N to motor phase current I_N at a winding overtemperature of 100 K.
Voltage constant	K_{EMK_1}	V/min^{-1}	± 5 %	Root-mean-square value of the induced motor voltage at a motor temperature of 20 °C and 1 revolution per minute.

Designation	Symbol	Unit	Toler-ance	Description
Thermal time constant	T_{th_nom}	min		Duration of the temperature rise to 63% of the final temperature of the winding at motor load with permissible S1 continuous torque. The thermal time constant is determined by the cooling type used.  ①: chronological profile of the winding temperature Θmax: max. winding temperature T_{th}: Thermal time constant
Winding resistance at 20 °C	R_{12}	Ohm		Measured winding resistance among two strands.
Winding inductance	L_{12}	mH		Measured inductance between two strands.
Leakage capacitance	C_{dis}	nF		Capacity of short-circuited power connections U, V, W against the motor housing.
Number of pole pairs	p	-		Quantity of pole pairs of the motor.
Stator mass	m_{stat}	kg		For stator mass depended from frame size and cooling mode refer to Chapter 4.15 .
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 coolant 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!
Permissible coolant temperature increase at 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 at 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.

General technical data for rotors MRT

Designation	Symbol	Unit	Toler-ance	Description
Moment of inertia of the rotor	J_{rot}	kgm^2	± 10%	Moment of inertia of the rotor without brake, bearing and motor encoder.
Rotor mass	m_{rot}	kg		Mass of the components without attached parts (brake, encoder, etc.).
Maximum speed of rotor	n_{max_mech}	min^{-1}		Mechanic maximum speed of the rotor.

4.2 General technical data

For the sake of clarity, the following table contains data which is applicable to all motor frame sizes. However, refer to the information on the individual aspects in the respective chapter.

Designation	Symbol	Unit	MSTxxx	MRTxxx
Ambient temperature in operation (see also chapter 9.1 "Installation altitude and ambient temperature" on page 259)	T_{amb}	°C	0 ... +40	
Allowed transport temperature (see also chapter 11.2.2 "Transport instructions" on page 304)	T_T	°C	-25 ... +70	
Allowed storage temperature (see also chapter 11.2.3 "Storage instructions" on page 306)	T_L	°C	-25 ... +55	
Permissible coolant inlet temperature (see alsoChapter 9.7.5)	T_{in}	°C	+5 ... +40	
Maximum allowed coolant input pressure	P_{max}	bar	6	
Thermal class acc. to DIN EN 60034-1	---	-	155	/
Warning temperature (winding)	T_{warn}	°C	145	/
Shutdown temperature (winding)	T_{abst}	°C	155	/
Degree of protection MST and MRT according to DIN EN 60034-5	-	-	IP00	
RoHS conformity			according to directive 2011/65/EU	
E-file number	-	-	E341734	

Tab. 4-1: General technical data

4.3 Frame size 130

4.3.1 Data sheet MST130

Designation	Symbol	Unit	MST130A		MST130C			
			0200-F	0250-N	0050-F	0075-N	0200-F	0300-N
Standstill torque	M_0	Nm	9	5	27	14.6	27	12.5
Standstill current	I_0	A	6.5	3.9	6.8	3.9	16.2	8
Rated torque	M_N	Nm	8.1	4.5	25.0	13.5	25.0	6.8
Rated power	P_N	kW	1.70	1.20	1.31	1.10	5.24	2.14
Rated current	I_N	A	6.4	3.5	6.1	3.5	15.2	5.3
Rated speed	n_N	min^{-1}	2,000	2,500	500	750	2000	3000
Maximum torque	M_{max}	Nm	15	13	50	40		
Maximum current	I_{max}	A	16.0	12.0	12.5	13.0	38.0	26.6
Max. speed (electrical)	n_{max}	min^{-1}	4,000		1,500		3850	
Power wire cross-section	A	mm^2	1.0				1.5	1.0
Torque constant at 20 °C	K_{M_N}	Nm/A	1.25	1.30	4.30	3.86	1.65	1.28
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	0.094	0.085	0.285	0.280	0.071	0.103
Thermal time constant	T_{th_nom}	min	4.1	15.0	2.5	15.0	2.0	47.0
Winding resistance at 20 °C	R_{12}	Ohm	5.5		10.3		1.68	
Winding inductance	L_{12}	mH	17.5		40	41.4	6.8	
Leakage capacitance of the component	C_{ab}	nF	2.0	2.2	2.7	6.6	2.7	
Number of pole pairs	p	-	10					
Details about liquid cooling								
Power dissipation	P_V	kW	0.50	0.11	1.40	0.17	1.00	0.17
Inlet temperature coolant	T_{in}	°C	10 ... 40	-	10 ... 40	-	10 ... 40	-
Permissible coolant temperature increase at P_V	ΔT_{max}	K	10	-	10	-	10	-
Required coolant flow at P_V	Q_{min}	l/min	0.7	-	2.0	-	1.4	-
Pressure drop at Q_{min}	Δp	bar	0.1	-	0.1	-	0.1	-
Volume of coolant duct	V_{cool}	l	0.04	-	0.09	-	0.09	-
Maximum permissible inlet pressure	p_{max}	bar	6.0	-	6.0	-	6.0	-
Latest amendment: 2019-07-04								

Tab. 4-2: MST130A/ -C - Technical data

<table>
<tr><th rowspan="2">Designation</th><th rowspan="2">Symbol</th><th rowspan="2">Unit</th><th colspan="2">MST130E-</th><th colspan="2">MST130G-</th></tr>
<tr><th>0020-F</th><th>0035-N</th><th>0035-N</th><th>0100-F</th></tr>
<tr><td>Standstill torque</td><td>M_0</td><td>Nm</td><td>45</td><td>24.3</td><td>34</td><td>64</td></tr>
<tr><td>Standstill current</td><td>I_0</td><td>A</td><td>6.7</td><td>3.8</td><td>5.3</td><td>17.7</td></tr>
<tr><td>Rated torque</td><td>M_N</td><td>Nm</td><td>42.0</td><td>22.5</td><td>31.5</td><td>60.0</td></tr>
<tr><td>Rated power</td><td>P_N</td><td>kW</td><td>2.00</td><td>1.90</td><td>1.20</td><td>6.30</td></tr>
<tr><td>Rated current</td><td>I_N</td><td>A</td><td>6.3</td><td>3.5</td><td>4.9</td><td>17.5</td></tr>
<tr><td>Rated speed</td><td>n_N</td><td>min^{-1}</td><td>450</td><td>800</td><td>350</td><td>1,000</td></tr>
<tr><td>Maximum torque</td><td>M_{max}</td><td>Nm</td><td colspan="2">65</td><td>80</td><td>100</td></tr>
<tr><td>Maximum current</td><td>I_{max}</td><td>A</td><td colspan="2">12.0</td><td>18.0</td><td>33.2</td></tr>
<tr><td>Max. speed (electrical)</td><td>n_{max}</td><td>min^{-1}</td><td colspan="3">950</td><td>2,700</td></tr>
<tr><td>Power wire cross-section</td><td>A</td><td>mm^2</td><td colspan="3">1.0</td><td>2.5</td></tr>
<tr><td>Torque constant at 20 °C</td><td>K_{M_N}</td><td>Nm/A</td><td>5.60</td><td>6.60</td><td>6.43</td><td>3.43</td></tr>
<tr><td>Voltage constant at 20 °C</td><td>K_{EMK_1}</td><td>V/min^{-1}</td><td>1.050</td><td>0.340</td><td>0.520</td><td>0.220</td></tr>
<tr><td>Thermal time constant</td><td>T_{th_nom}</td><td>min</td><td>2.0</td><td colspan="2">15.0</td><td>5.7</td></tr>
<tr><td>Winding resistance at 20 °C</td><td>R_{12}</td><td>Ohm</td><td>5.9</td><td>15.1</td><td>17.4</td><td>3.3</td></tr>
<tr><td>Winding inductance</td><td>L_{12}</td><td>mH</td><td colspan="2">65.4</td><td>99.0</td><td>14.5</td></tr>
<tr><td>Leakage capacitance of the component</td><td>C_{ab}</td><td>nF</td><td colspan="2">10.9</td><td colspan="2">+15.3</td></tr>
<tr><td>Number of pole pairs</td><td>p</td><td>-</td><td colspan="4">10</td></tr>
<tr><td>Details about liquid cooling</td><td></td><td></td><td colspan="4"></td></tr>
<tr><td>Power dissipation</td><td>P_V</td><td>kW</td><td>1.40</td><td>0.22</td><td>0.29</td><td>1.95</td></tr>
<tr><td>Coolant inlet temperature</td><td>T_{in}</td><td>°C</td><td>10 ... 40</td><td colspan="2">-</td><td>10 ... 40</td></tr>
<tr><td>Permissible coolant temperature increase for P_V</td><td>ΔT_{max}</td><td>K</td><td>10</td><td colspan="2">-</td><td>10</td></tr>
<tr><td>Required coolant flow at P_V</td><td>Q_{min}</td><td>l/min</td><td>2.0</td><td colspan="2">-</td><td>2.8</td></tr>
<tr><td>Pressure drop at Q_{min}</td><td>Δp</td><td>bar</td><td>0.1</td><td colspan="2">-</td><td>0.2</td></tr>
<tr><td>Volume of coolant duct</td><td>V_{cool}</td><td>l</td><td>0.16</td><td colspan="2">-</td><td>0.25</td></tr>
<tr><td>Maximum allowed inlet pressure</td><td>p_{max}</td><td>bar</td><td>6.0</td><td colspan="2">-</td><td>6.0</td></tr>
<tr><td colspan="7" align="right">Latest amendment: 2020-02-25</td></tr>
</table>

Tab. 4-3: MST130E/ -G - Technical data

4.3.2 Data sheet MRT130

Designation	Symbol	Unit	MRT130A	MRT130C	MRT130E	MRT130G
			_-0060			
Moment of inertia of the rotor	J_{rot}	kg * m²	0.00080	0.00180	0.00290	0.00390
Rotor mass	m_{rot}	kg	0.6	1.5	2.2	3.0
Maximum speed (mechanical)	$n_{max\ mech}$	min^{-1}	4,000			
						Latest amendment: 2013-09-27

Tab. 4-4: MRT130 - Technical data

4.3.3 Motor characteristic curves MST130

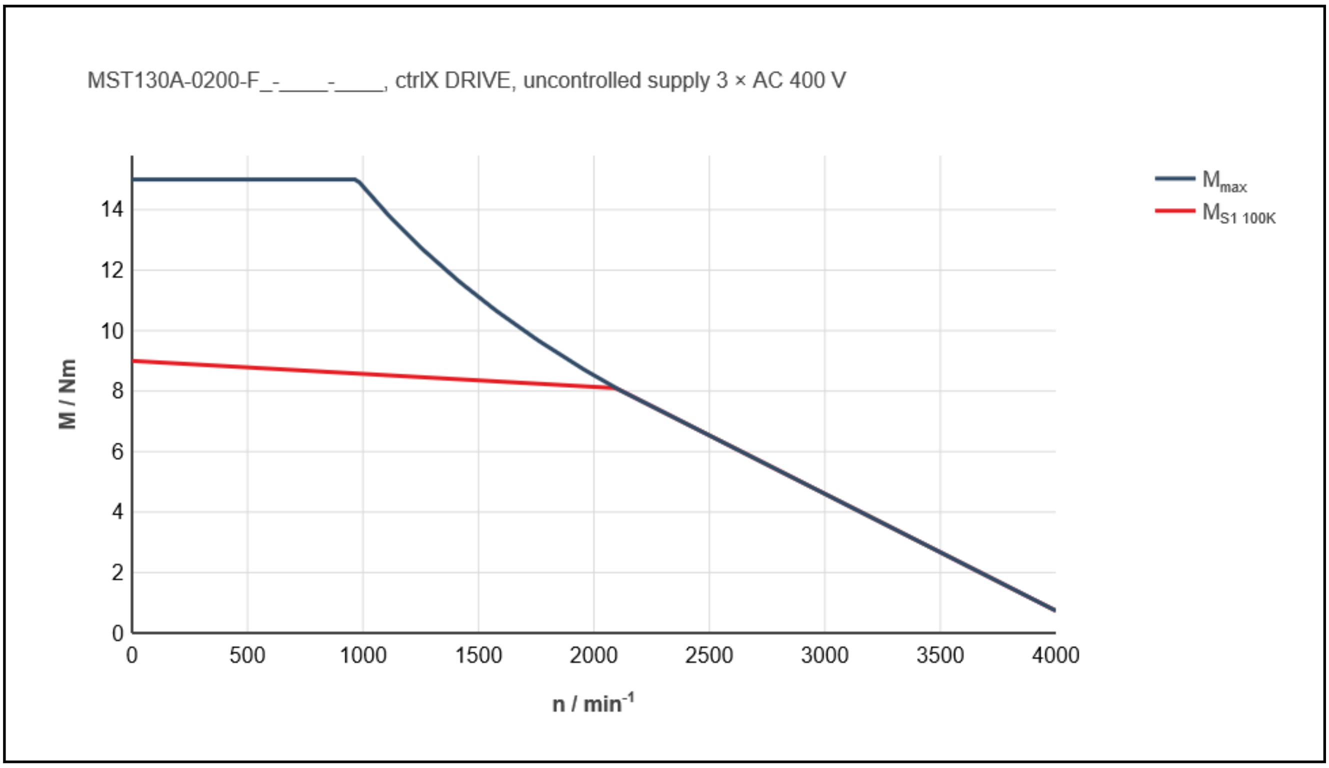


Fig. 4-5: Motor characteristic curve of MST130A-0200-F... at 540 V_{DC}

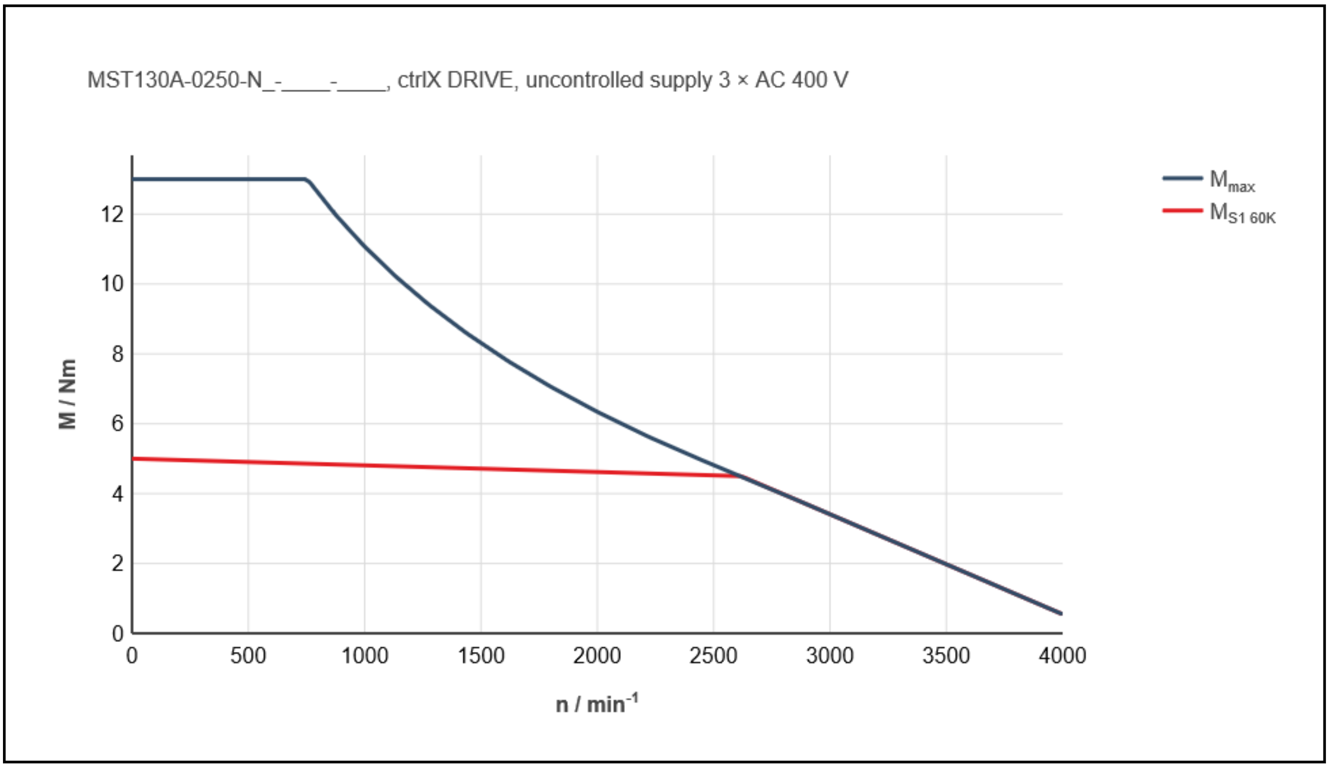


Fig. 4-6: Motor characteristic curve of MST130A-0250-N... at 540 V_{DC}

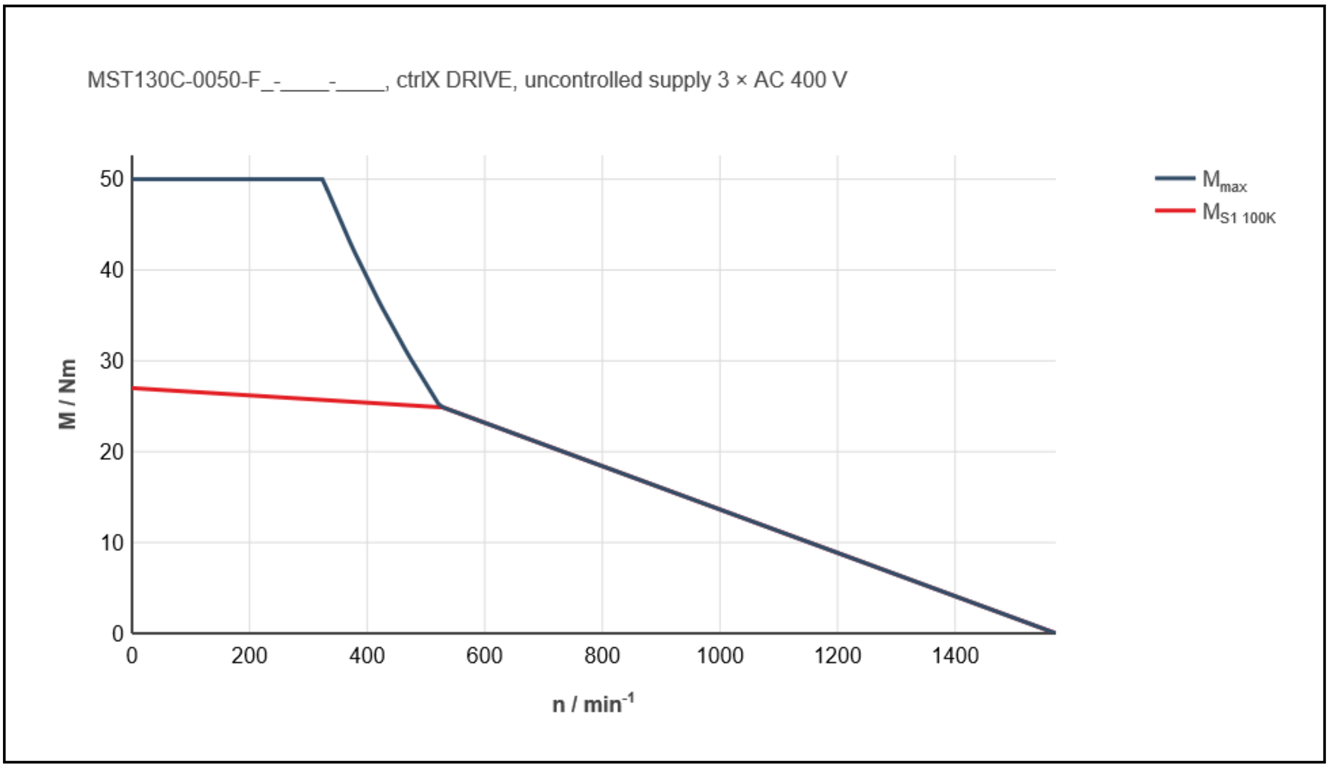


Fig. 4-7: Motor characteristic curve of MST130C-0050-F... at 540 V_{DC}

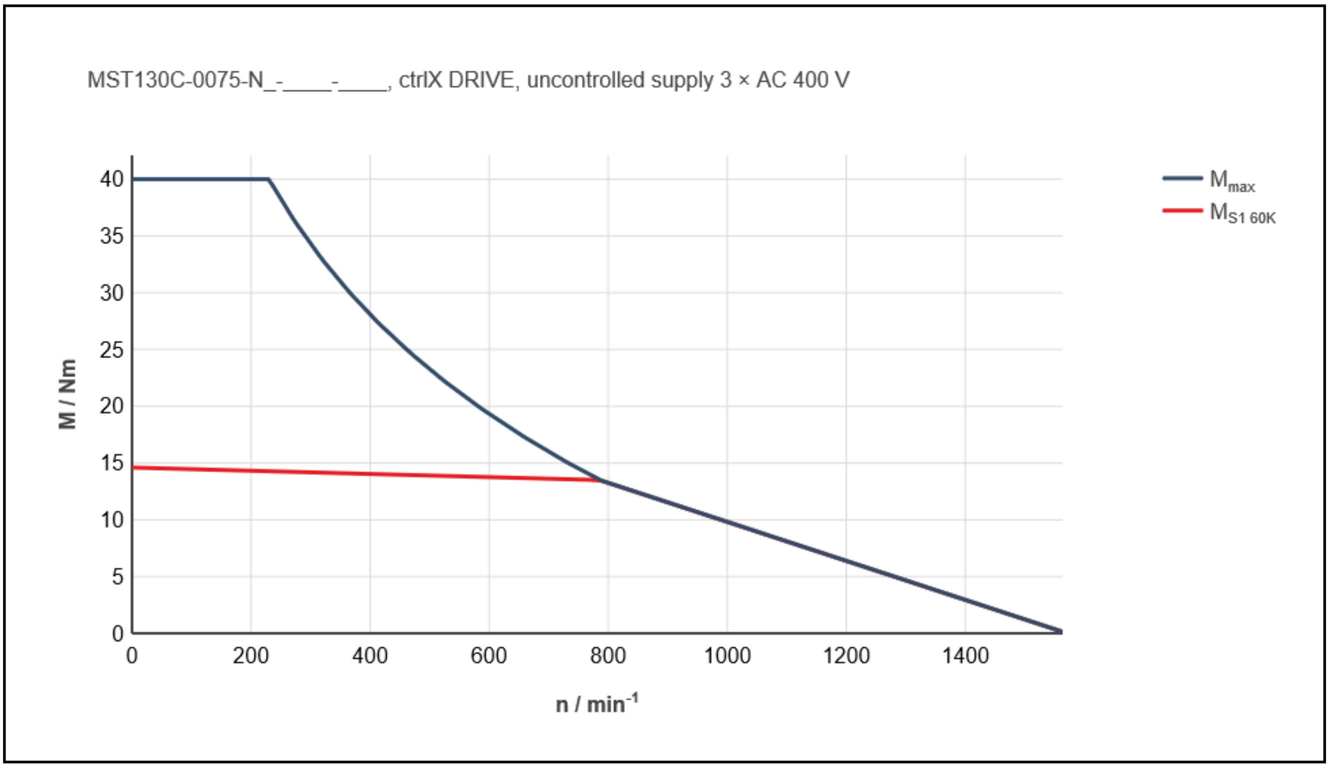


Fig. 4-8: Motor characteristic curve of MST130C-0075-N... at 540 V_{DC}

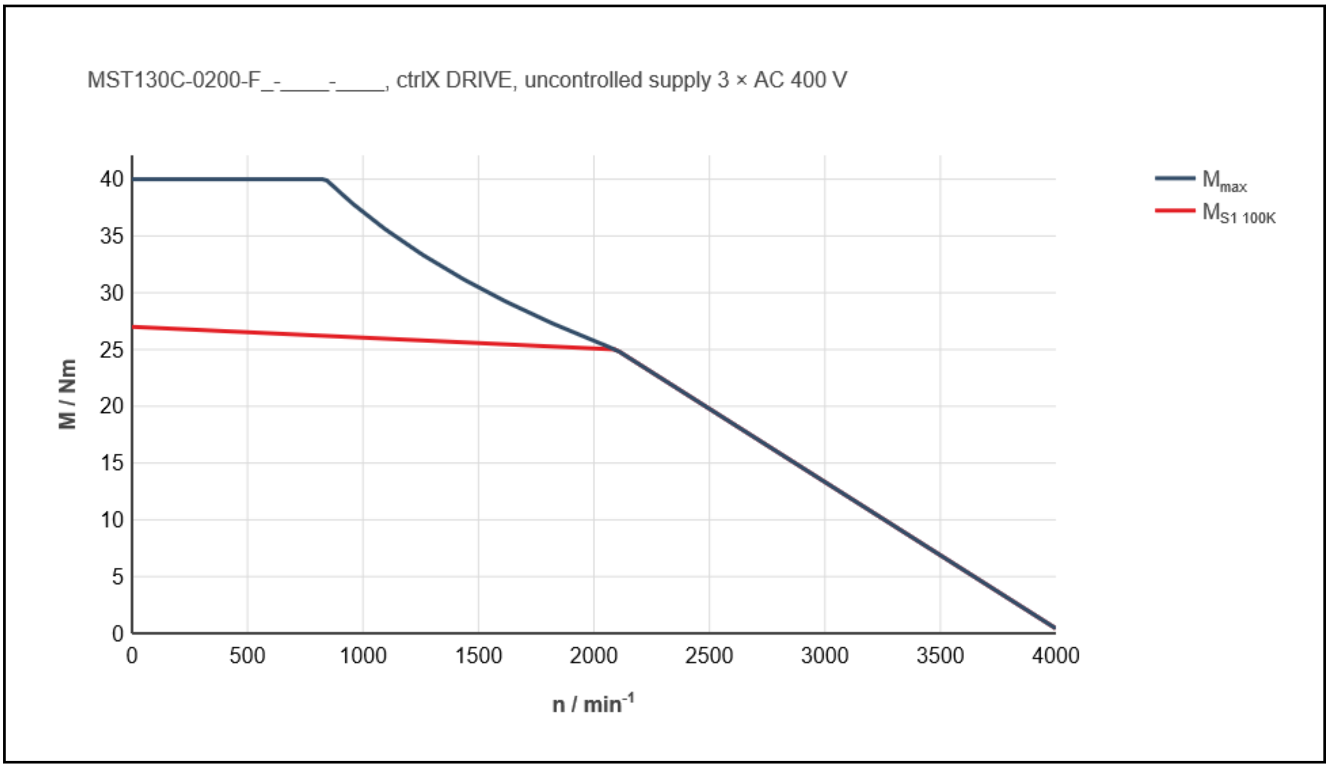


Fig. 4-9: Motor characteristic curve of MST130C-0200-F... at 540 V_{DC}

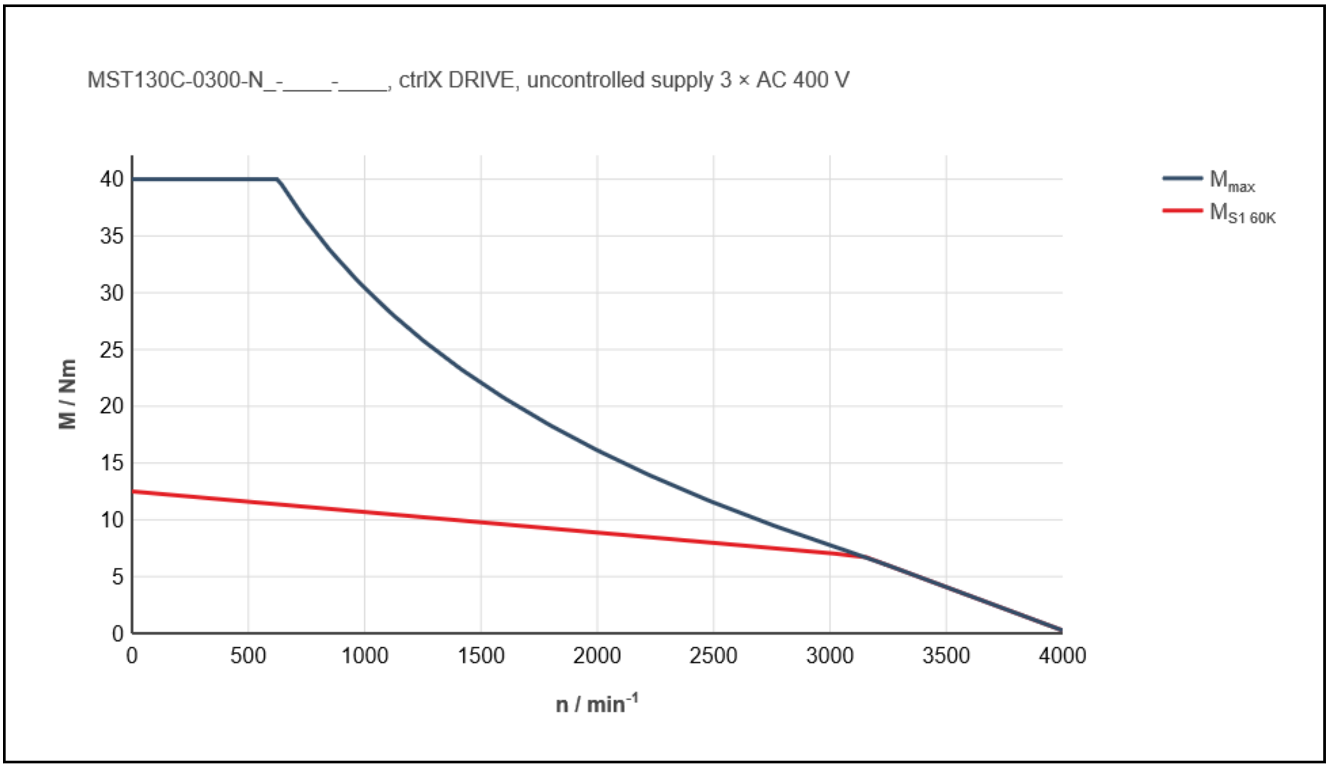


Fig. 4-10: Motor characteristic curve of MST130C-0300-N... at 540 V_{DC}

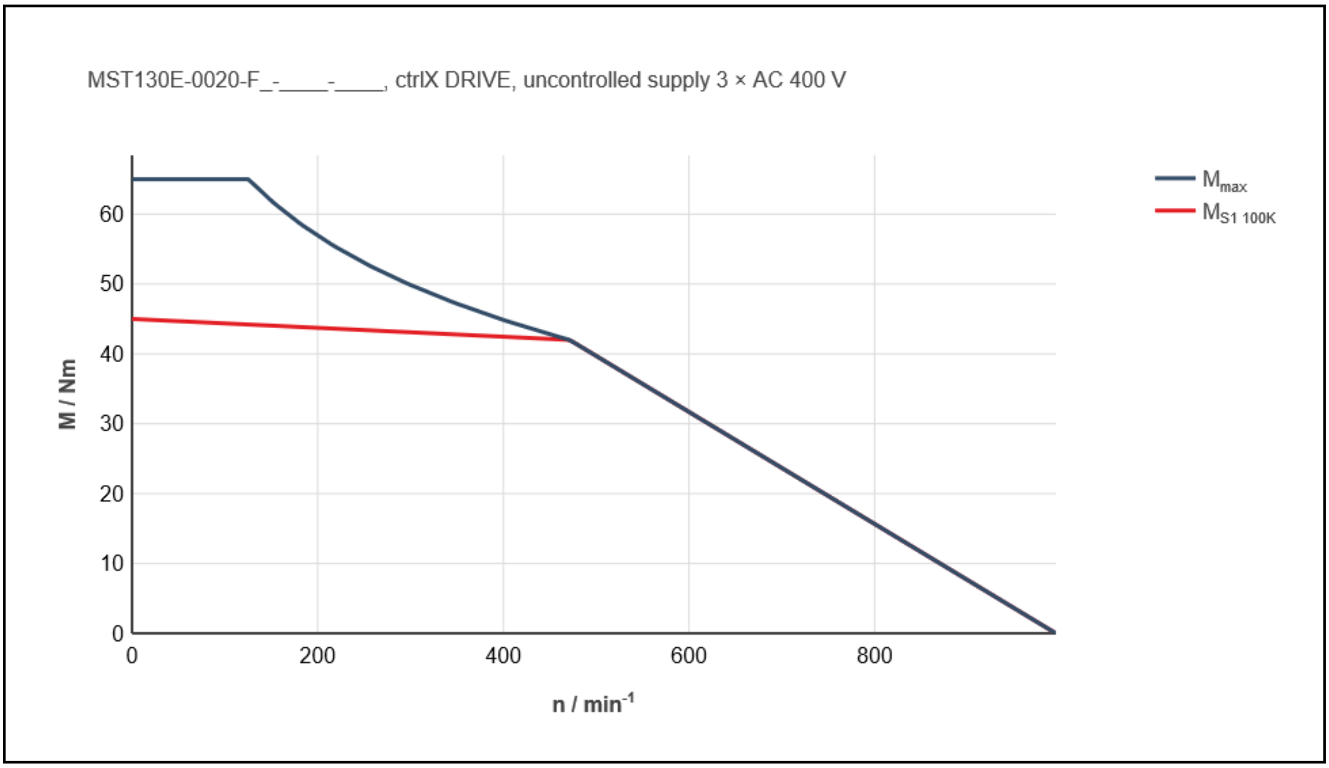


Fig. 4-11: Motor characteristic curve of MST130E-0020-F... at 540 V_{DC}

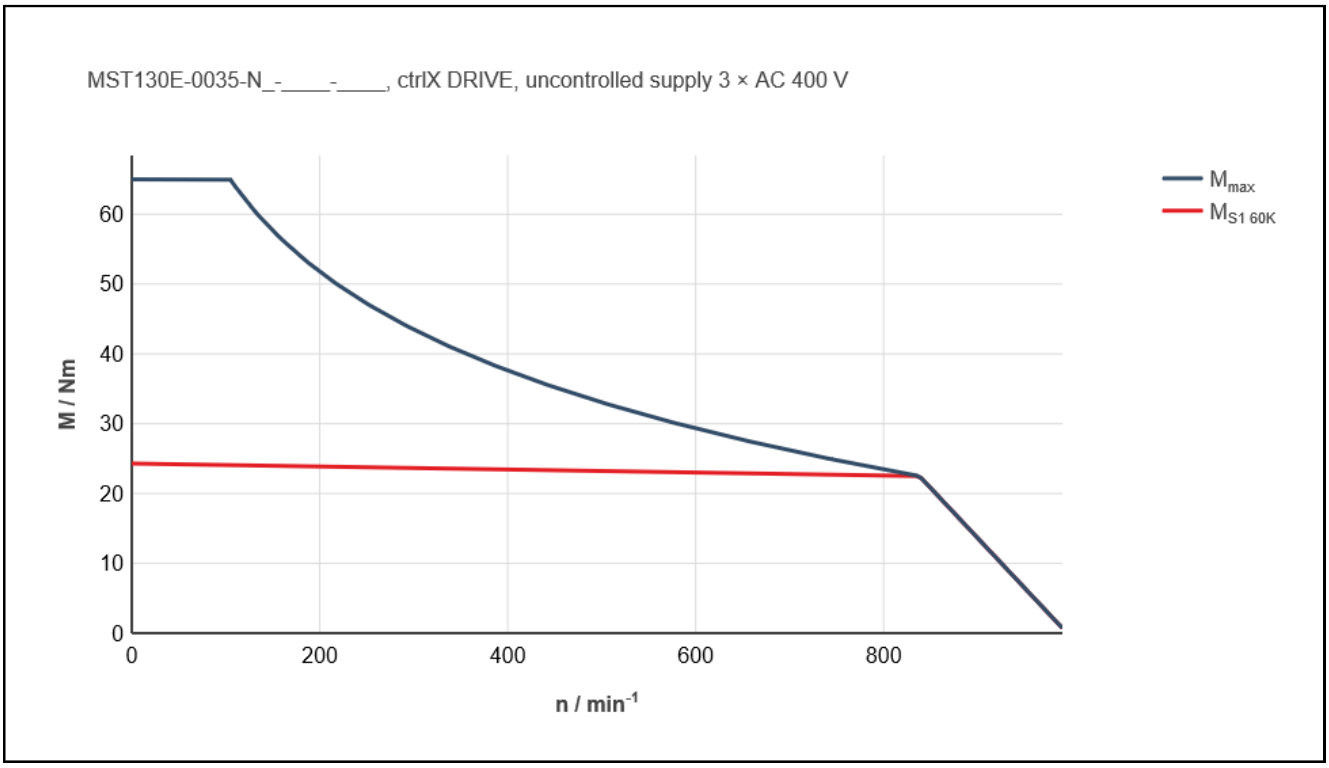


Fig. 4-12: Motor characteristic curve of MST130E-0035-N... at 540 V_{DC}

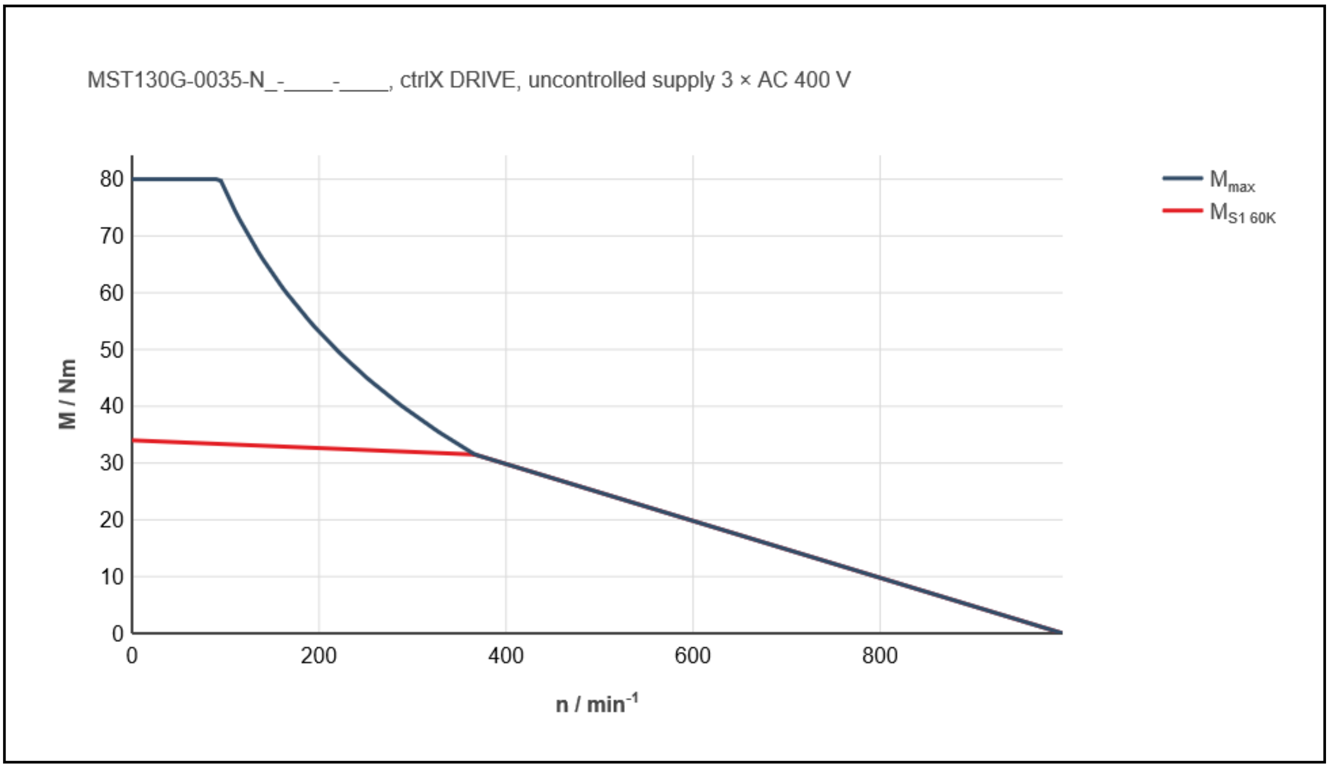


Fig. 4-13: Motor characteristic curve of MST130G-0035-N... at 540 V_{DC}

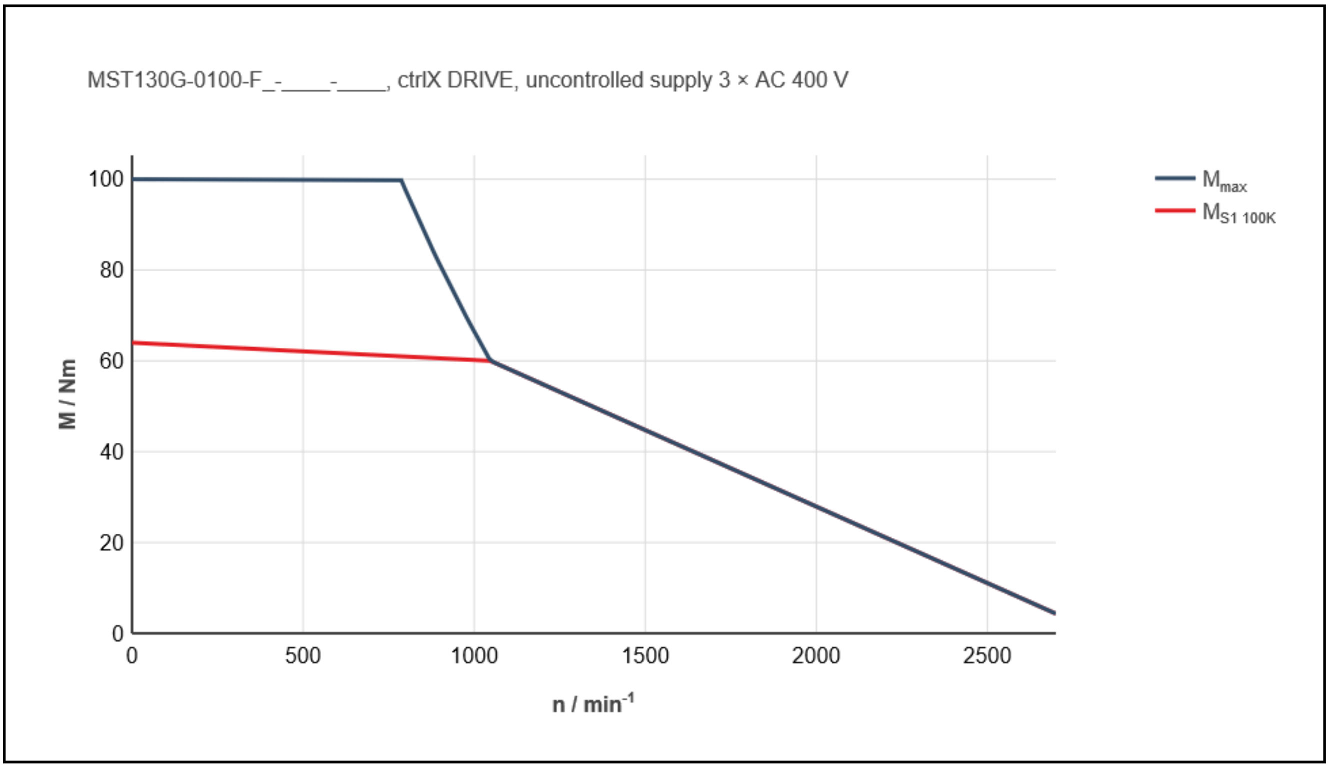


Fig. 4-14: Motor characteristic curve MST130G-0100-F... at 540 V_{DC}

4.4 Frame size 160

4.4.1 Data sheet MST160

Designation	Symbol	Unit	MST160A	MST160C	MST160E	
			0050-F	0050-F	0027-F	0050-F
Standstill torque	M_0	Nm	43	95	145	
Standstill current	I_0	A	8.2	16.4	11.4	21.4
Rated torque	M_N	Nm	40.0	80.0	125.0	120.0
Rated power	P_N	kW	2.10	5.40	3.30	6.90
Rated current	I_N	A	7.5	14.2	9.8	19.5
Rated speed	n_N	min^{-1}	500	650	250	550
Maximum torque	M_{max}	Nm	90	180	270	
Maximum current	I_{max}	A	20.0	40.0	22.4	60.0
Max. speed (electrical)	n_{max}	min^{-1}	1100		450	900
Power wire cross-section	A	mm^2	1.0			2.5
Torque constant at 20 °C	K_{M_N}	Nm/A	5.33	5.63	12.75	6.15
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	0.356	0.365	0.893	0.433
Thermal time constant	T_{th_nom}	min	2.0		7.0	
Winding resistance at 20 °C	R_{12}	Ohm	8.6	3.7	12.4	3.24
Winding inductance	L_{12}	mH	30.5	14.4	49.4	13.1
Leakage capacitance of the component	C_{ab}	nF	4.4	11.7	17.5	
Number of pole pairs	p	-	15			
Details about liquid cooling						
Power dissipation	P_V	kW	1.30	2.40	3.00	
Coolant inlet temperature	T_{in}	°C	10 ... 40			
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10			
Required coolant flow at P_V	Q_{min}	l/min	1.9	3.5	4.3	
Pressure drop at Q_{min}	Δp	bar	0.1			
Volume of coolant duct	V_{cool}	l	0.07	0.16	0.26	
Maximum permissible inlet pressure	p_{max}	bar	6.0			
Latest amendment: 2018-04-27						

Tab. 4-5: MST160 - Technical data

4.4.2 Data sheet MRT160

Designation	Symbol	Unit	MRT160A	MRT160C	MRT160E
				_-0080	
Rotor inertia	J_{rot}	kg * m²	0.00590	0.01080	0.01580
Rotor mass	m_{rot}	kg	2.4	4.3	6.2
Maximum speed (mechanical)	$n_{max\ mech}$	min^{-1}		3500	
					Latest amendment: 2010-08-09

Tab. 4-6: MRT160 - Technical data

4.4.3 Motor characteristic curves MST160

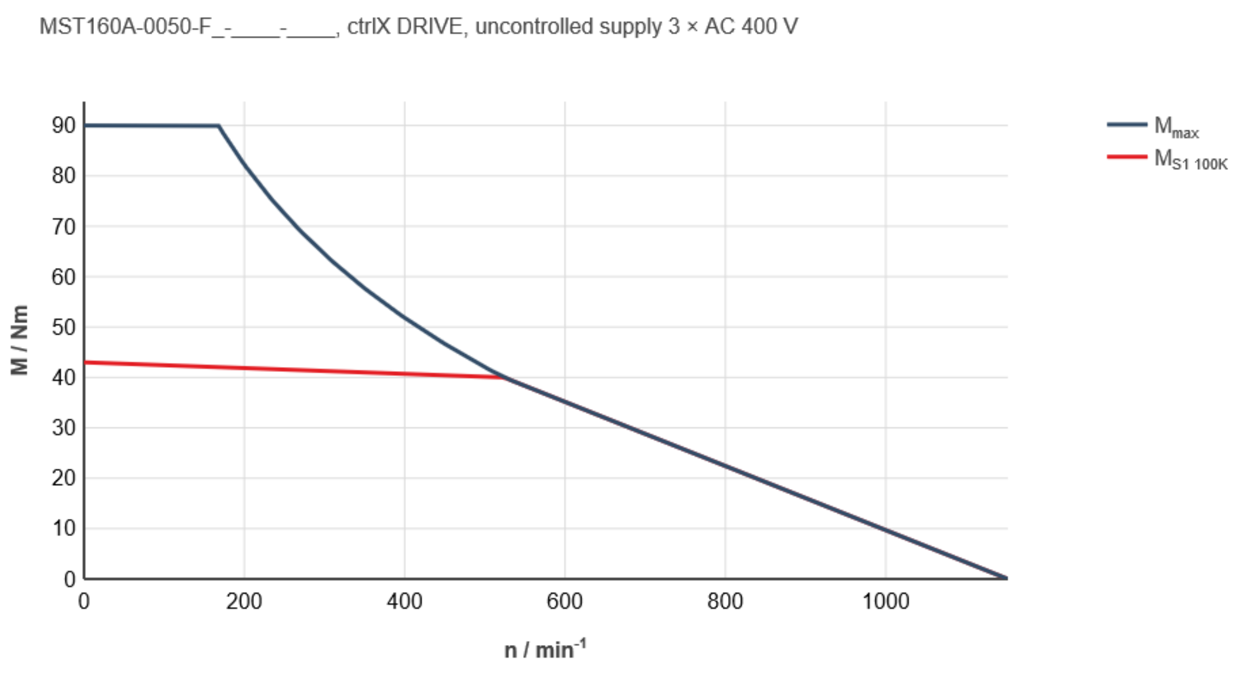


Fig. 4-15: Motor characteristic curve of MST160A-0050-F... at 540 V_{DC}

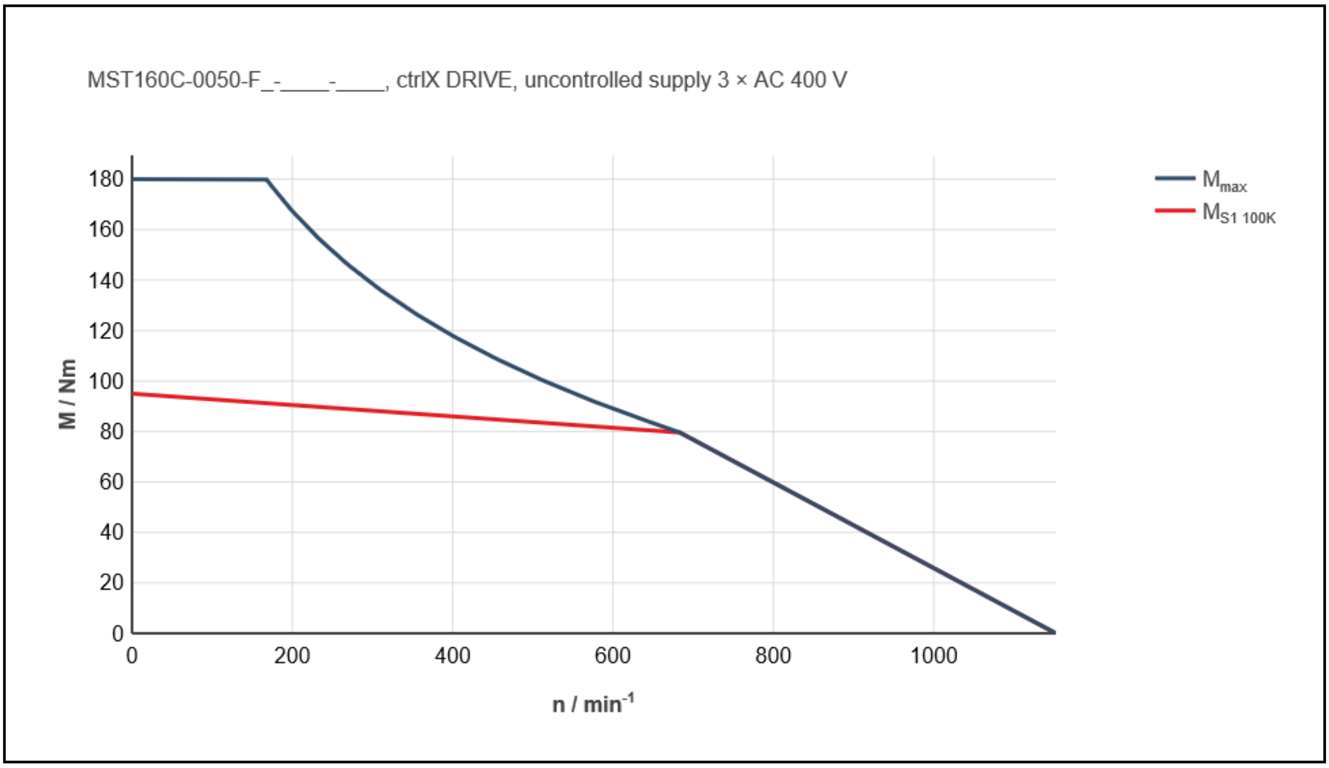


Fig. 4-16: Motor characteristic curve of MST160C-0050-F... at 540 V_{DC}

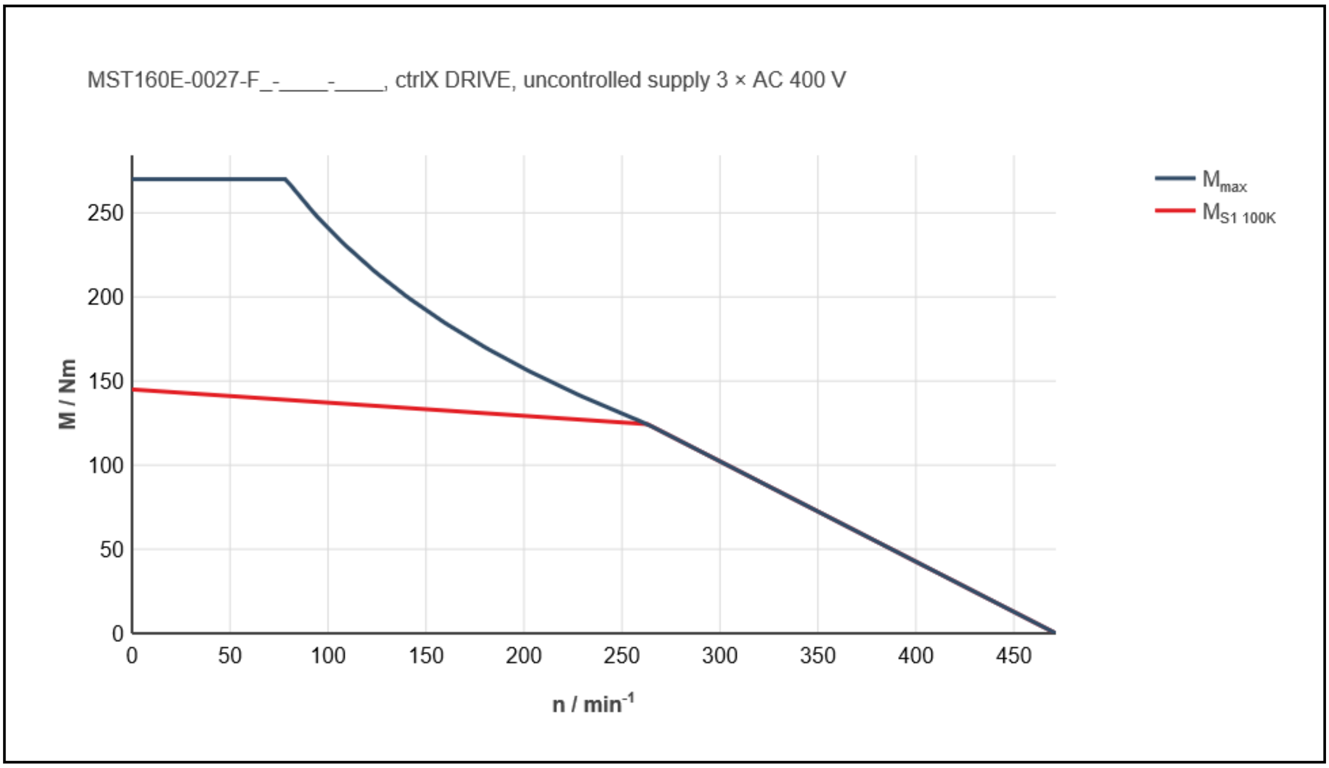


Fig. 4-17: Motor characteristic curve of MST160E-0027-F... at 540 V_{DC}

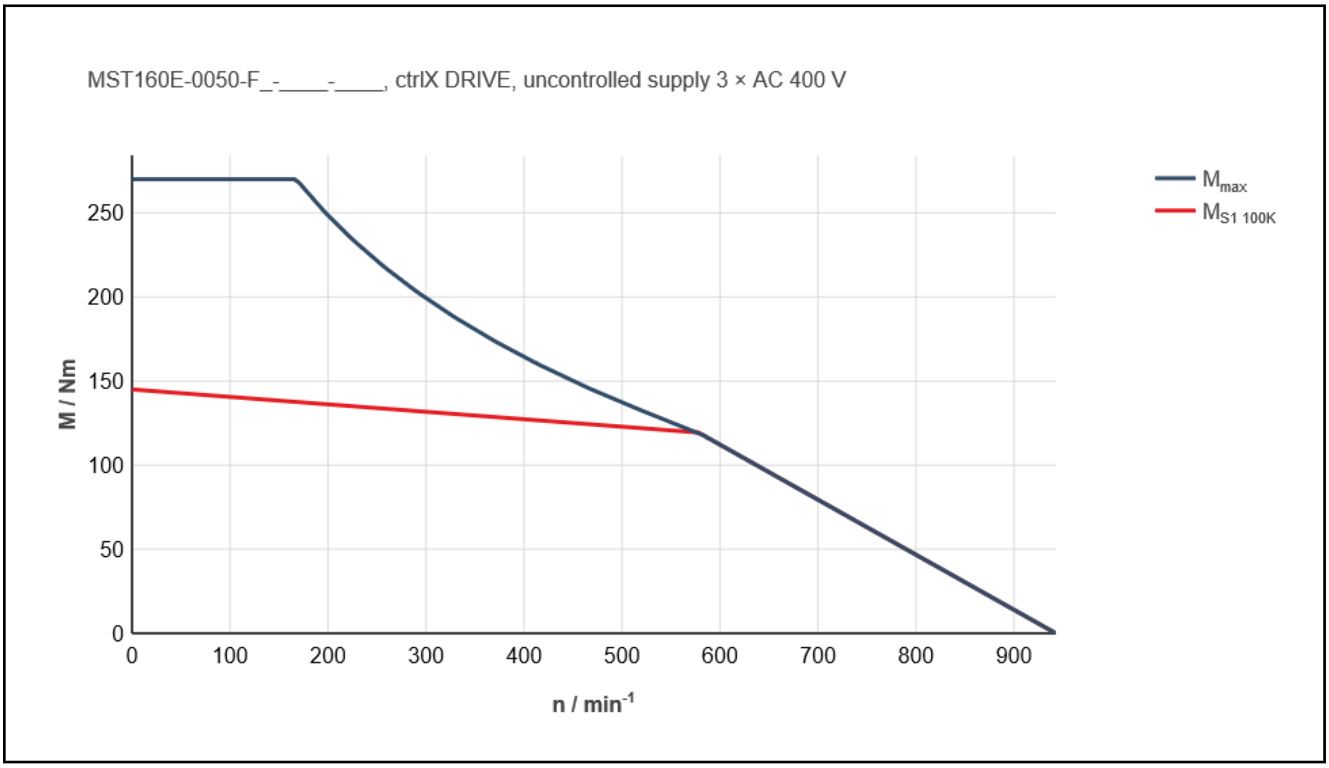


Fig. 4-18: Motor characteristic curve of MST160E-0050-F... at 540 V_{DC}

4.5 Frame size 161

4.5.1 Data sheet MST161

Designation	Symbol	Unit	MST161C	MST161E		MST161G
			0140-F	0050-F	0140-F	0100-F
Standstill torque	M_0	Nm	65	125	105	190
Standstill current	I_0	A	19.2	19.5	35.4	40
Rated torque	M_N	Nm	52.0	110.0	95.0	175.0
Rated power	P_N	kW	7.60	7.80	9.95	16.50
Rated current	I_N	A	17.4	16.7	32.0	35.0
Rated speed	n_N	min^{-1}	1400	675	1,000	900
Maximum torque	M_{max}	Nm	160	260		290
Maximum current	I_{max}	A	53.0	45.8	84.0	58.0
Max. speed (electrical)	n_{max}	min^{-1}	1900	1,050	2,000	1,600
Power wire cross-section	A	mm^2	2.5		6.0	
Torque constant at 20 °C	K_{M_N}	Nm/A	3.25	6.01	3.13	4.75
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	0.204	0.407	0.207	0.288
Thermal time constant	T_{th_nom}	min	2.0	3.0		4.0
Winding resistance at 20 °C	R_{12}	Ohm	2.0	3.0	0.82	1.17
Winding inductance	L_{12}	mH	10.6	18.2	4.8	7.5
Leakage capacitance of the component	C_{ab}	nF	5.6	8.3		12.5
Number of pole pairs	p	-	10			
Details about liquid cooling						
Power dissipation	P_V	kW	1.35	2.51		3.95
Coolant inlet temperature	T_{in}	°C	10 ... 40			10 … 40
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10			
Required coolant flow at P_V	Q_{min}	l/min	2.0	3.6		5.7
Pressure drop at Q_{min}	Δp	bar	0.1			0.2
Volume of coolant duct	V_{cool}	l	0.14	0.26		0.40
Maximum allowed inlet pressure	p_{max}	bar	6.0			
Latest amendment: 2020-09-07						

Tab. 4-7: MST161 - Technical data

4.5.2 Data sheet MRT161

Designation	Symbol	Unit	MRT161C	MRT161E	MRT161G
			_-0080		
Rotor inertia	J_{rot}	kg * m²	0.00750	0.01500	0.00270
Rotor mass	m_{rot}	kg	3.0	6.3	13.0
Maximum speed (mechanical)	$n_{max\ mech}$	min^{-1}	2200		
Latest amendment: 2020-02-25					

Tab. 4-8: MRT161 - Technical data

4.5.3 Motor characteristic curves MST161

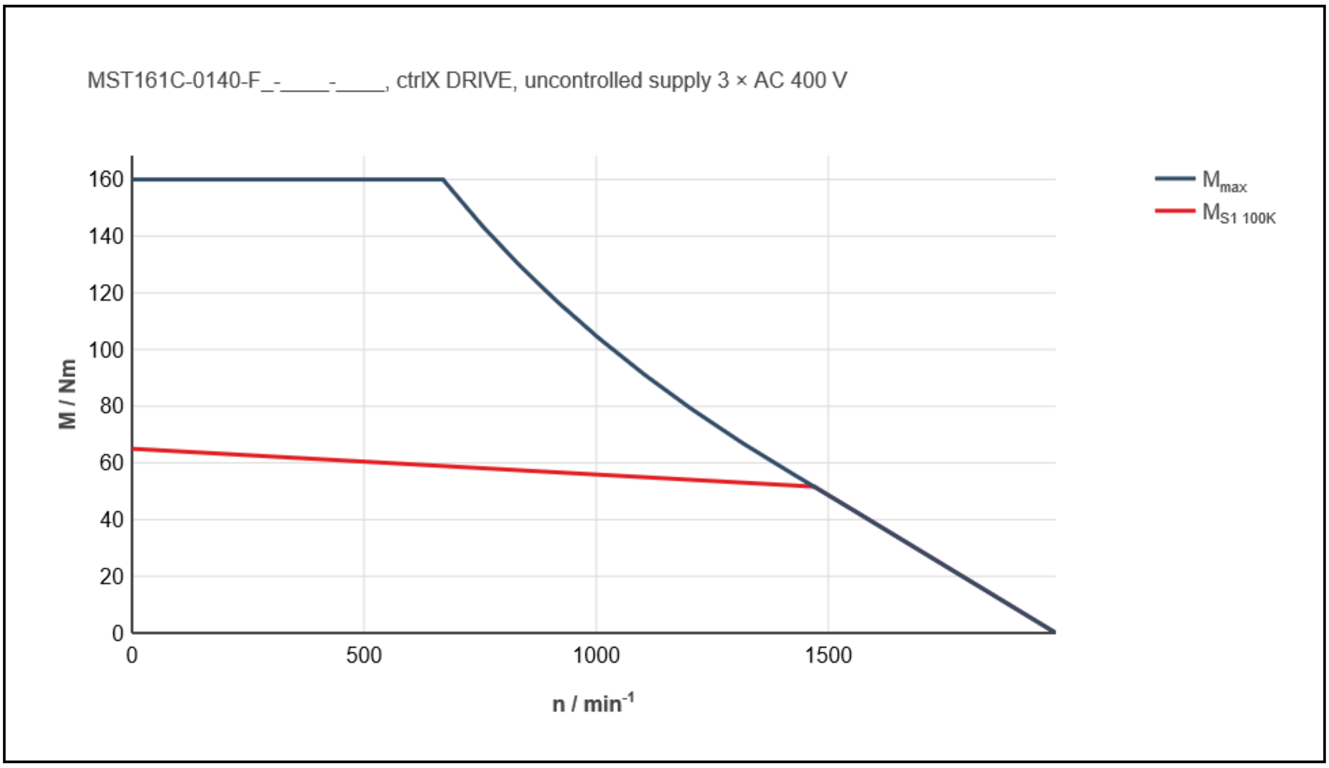


Fig. 4-19: Motor characteristic curve of MST161C-0140-F... at 540 V_{DC}

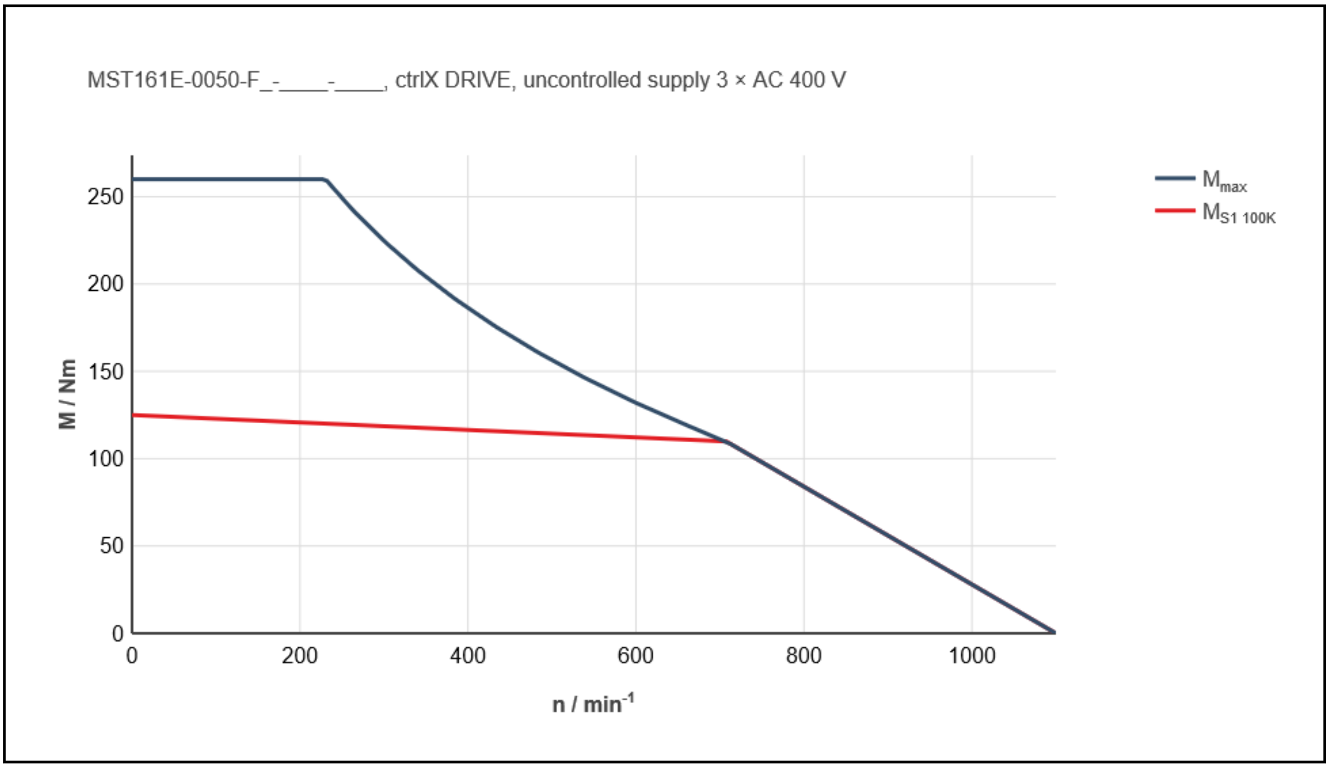


Fig. 4-20: Motor characteristic curve of MST161E-0050-F... at $540V_{DC}$

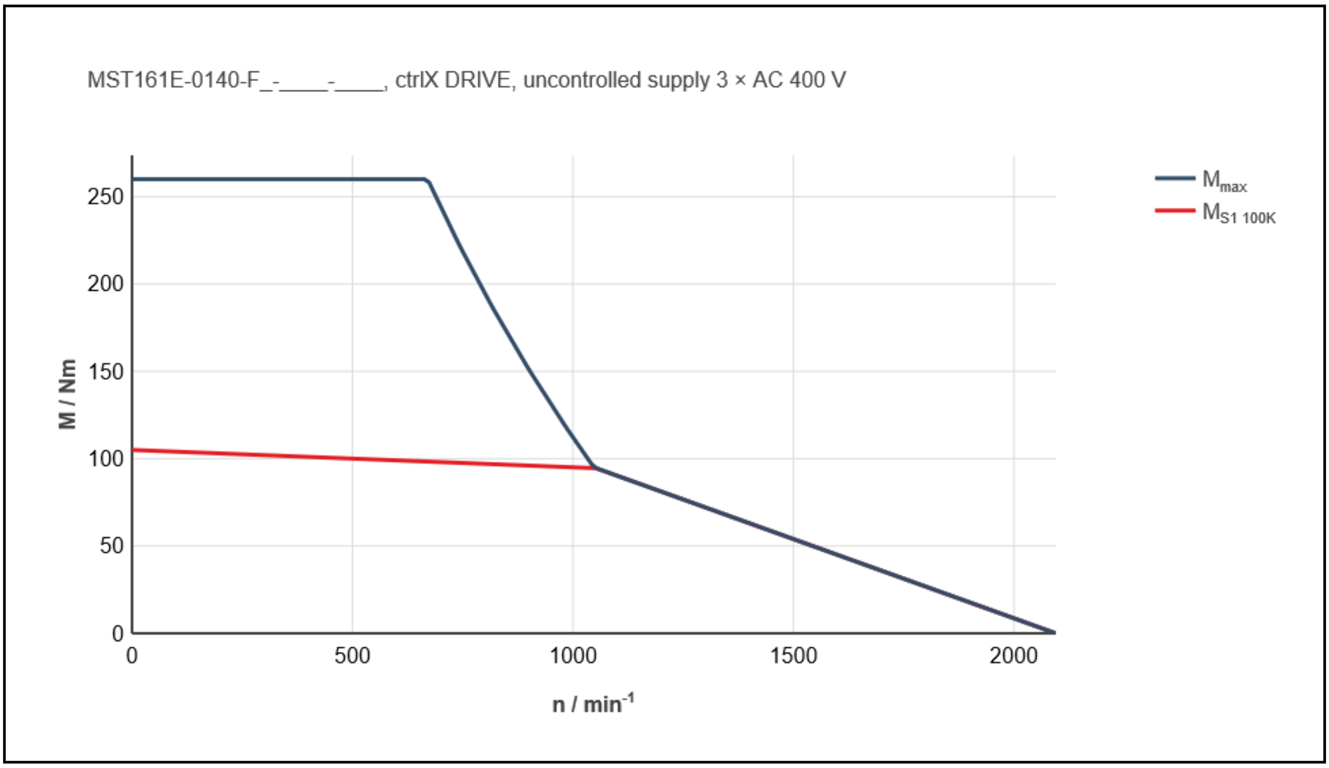


Fig. 4-21: Motor characteristic curve of MST161E-0140-F... at 540 V_{DC}

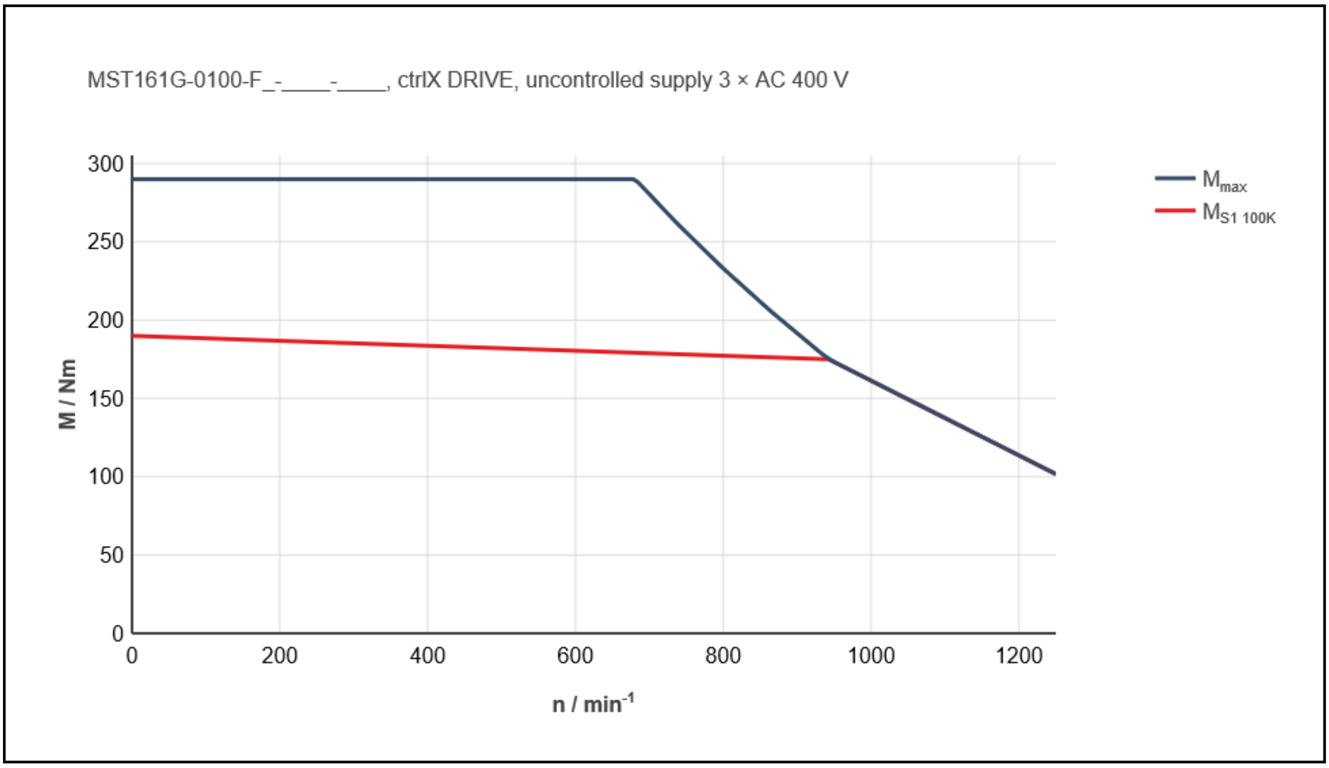


Fig. 4-22: Motor characteristic curve MST161G-0100-F... at 540 V_{DC}

4.6 Frame size 201

4.6.1 Data sheet MST201

Designation	Symbol	Unit	MST201C		MST201D		MST201F
			0010-F	0027-F	0010-F	0027-F	0075-F
Standstill torque	M_0	Nm	125	115	185	175	234
Standstill current	I_0	A	6.2	10.3	7.9	14.4	38.3
Rated torque	M_N	Nm	105.0		160.0	140.0	225.0
Rated power	P_N	kW	1.32	3.63	2.01	4.84	17.67
Rated current	I_N	A	5.2	9.4	6.9	13.0	36.8
Rated speed	n_N	min^{-1}	120	330	120	330	750
Maximum torque	M_{max}	Nm	250		384	350	625
Maximum current	I_{max}	A	12.4	25.7	17.9	31.0	123.9
Max. speed (electrical)	n_{max}	min^{-1}	300	540	255	520	1,050
Power wire cross-section	A	mm^2	1.0	1.5	1.0		6.0
Torque constant at 20 °C	K_{M_N}	Nm/A	20.19	11.17	24.60	10.77	6.11
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	1.020	0.567	1.070	0.780	0.373
Thermal time constant	T_{th_nom}	min	2.5				
Winding resistance at 20 °C	R_{12}	Ohm	22.6	7.1	18.3	4.9	0.90
Winding inductance	L_{12}	mH	193.0	57.0	168.8	39.7	8.0
Leakage capacitance of the component	C_{ab}	nF	5.2		8.1	7.8	13.1
Number of pole pairs	p	-	10				
Details about liquid cooling							
Power dissipation	P_V	kW	1.50		2.30	2.23	3.70
Coolant inlet temperature	T_{in}	°C	10 ... 40				
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10				
Required coolant flow at P_V	Q_{min}	l/min	3.2				5.3
Pressure drop at Q_{min}	Δp	bar	0.1				0.3
Volume of coolant duct	V_{cool}	l	0.07		0.11		0.19
Maximum allowed inlet pressure	p_{max}	bar	6.0				
Latest amendment: 2019-06-06							

Tab. 4-9: MST201 - Technical data

4.6.2 Data sheet MRT201

Designation	Symbol	Unit	MRT201C	MRT201D	MRT201F
			_-0110		
Rotor inertia	J_{rot}	kg * m²	0.02300	0.03400	0.05500
Rotor mass	m_{rot}	kg	4.5	6.8	10.8
Maximum speed (mechanical)	$n_{max\ mech}$	min^{-1}	1,500		
Latest amendment: 2019-05-23					

Tab. 4-10: MRT201 - Technical data

4.6.3 Motor characteristic curves MST201

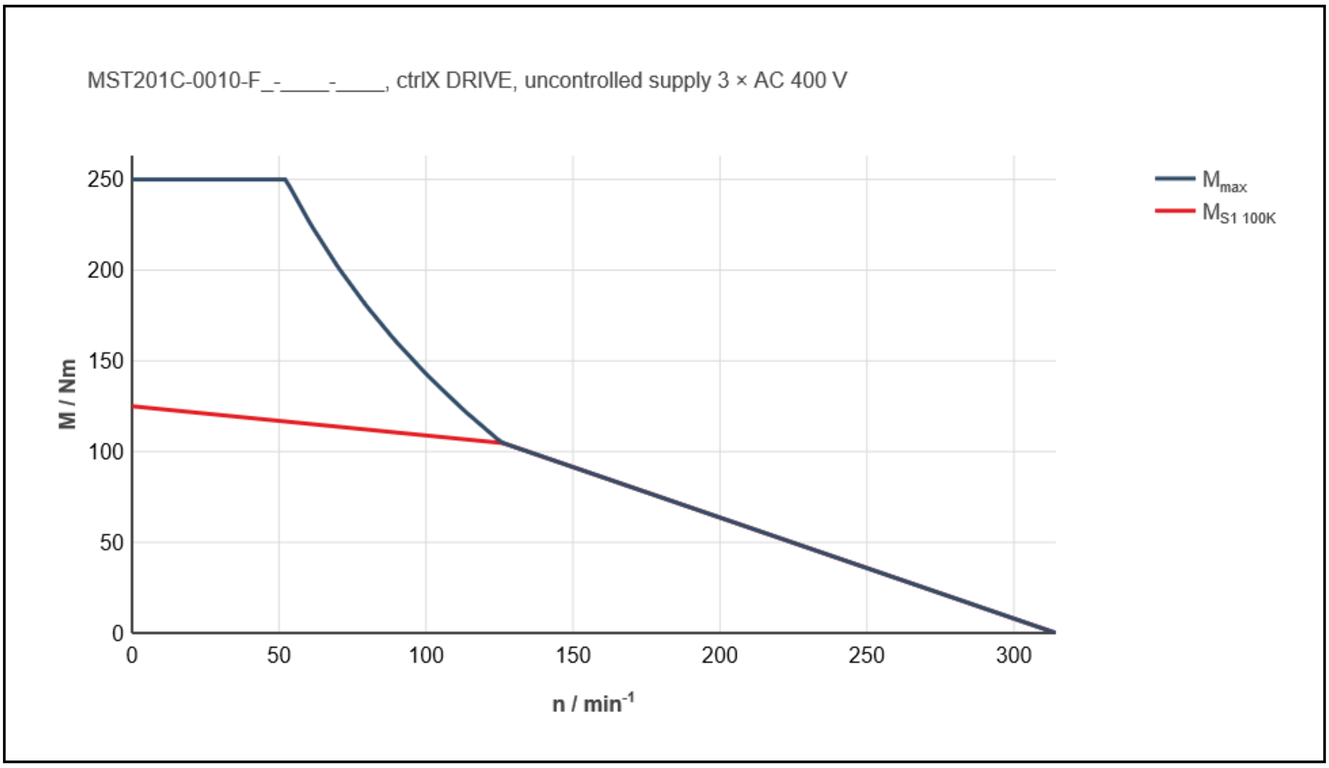


Fig. 4-23: Motor characteristic curve of MST201C-0010-F... at 540 V_{DC}

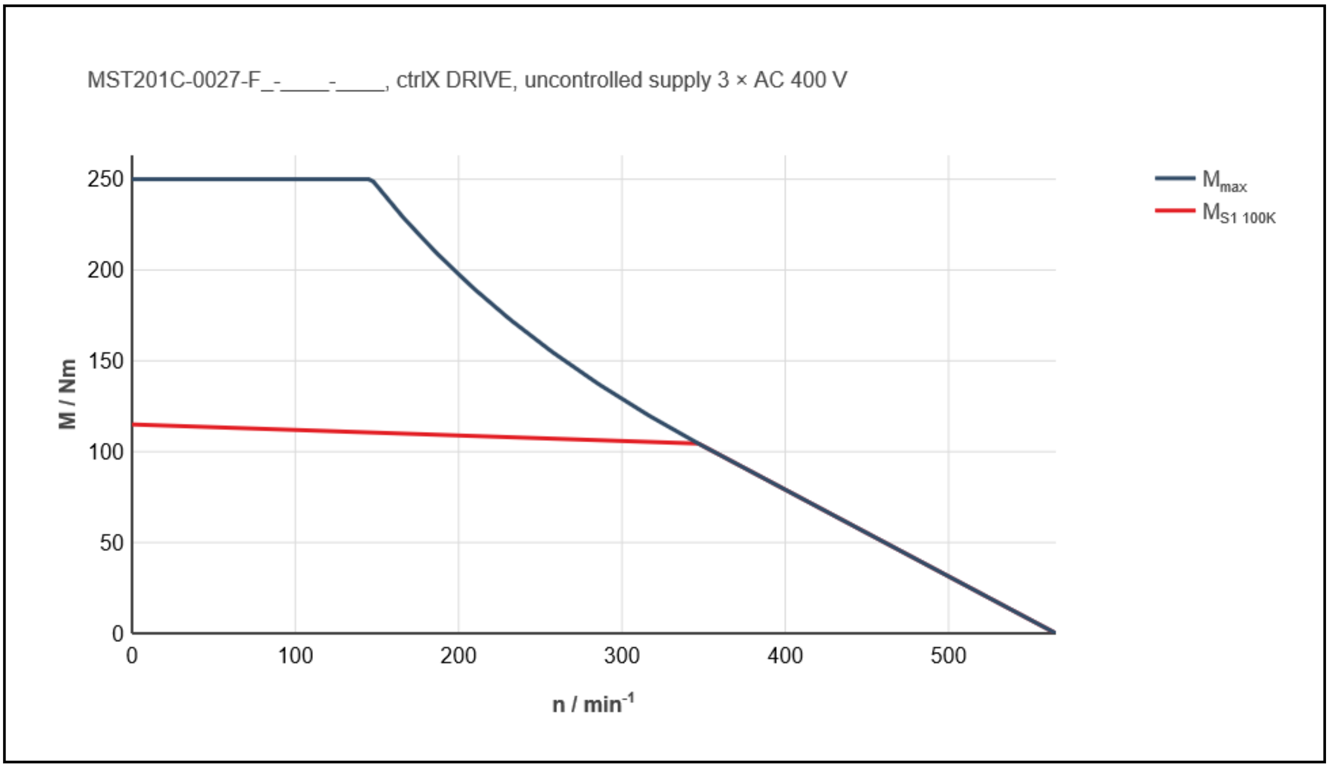


Fig. 4-24: Motor characteristic curve of MST201C-0027-F... at 540 V_{DC}

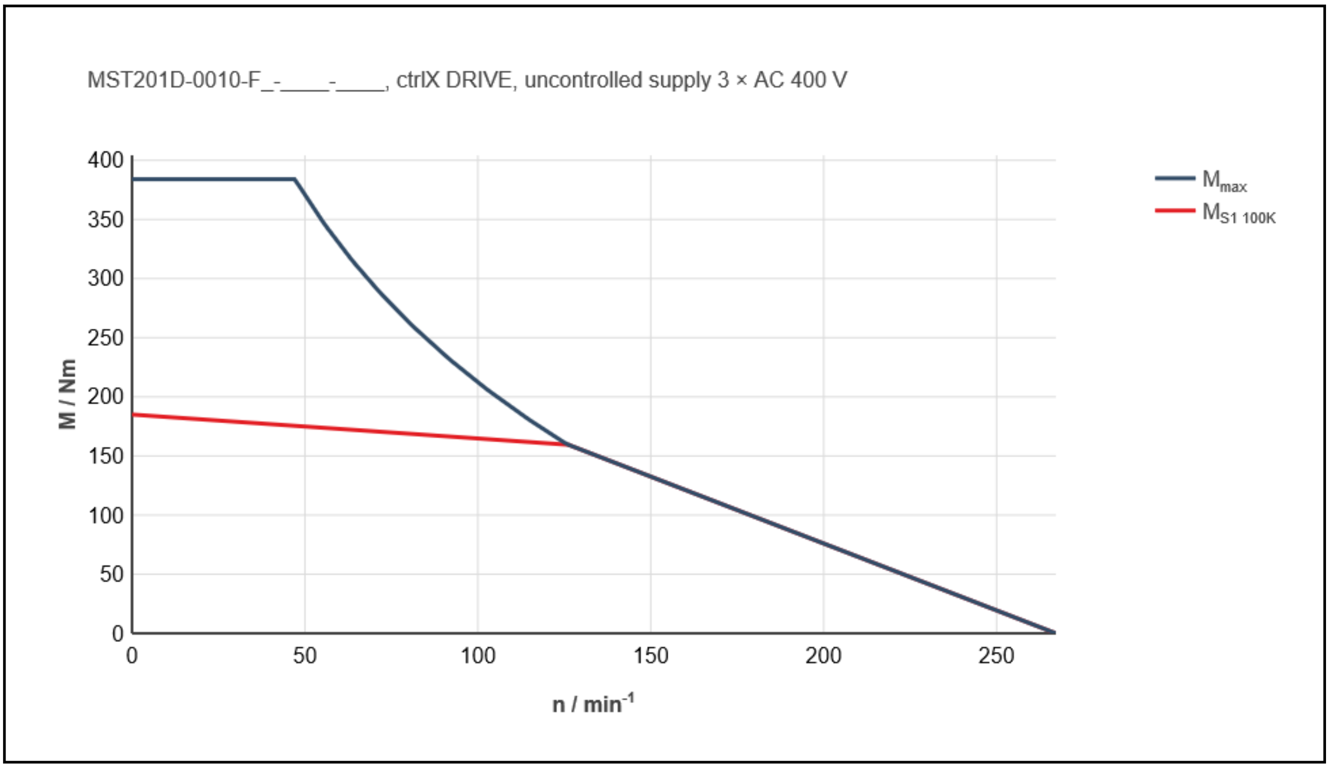


Fig. 4-25: Motor characteristic curve of MST201D-0010-F... at 540 V_{DC}

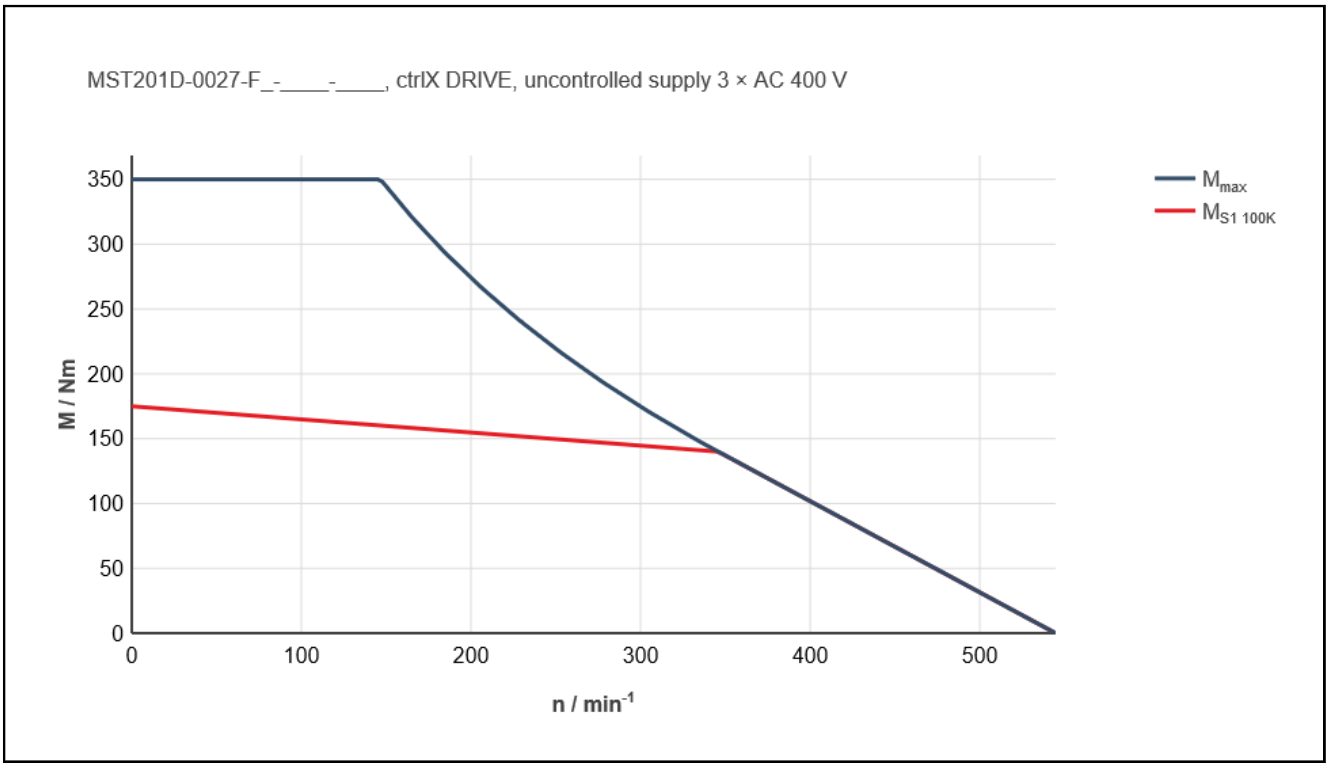


Fig. 4-26: Motor characteristic curve of MST201D-0027-F... at 540 V_{DC}

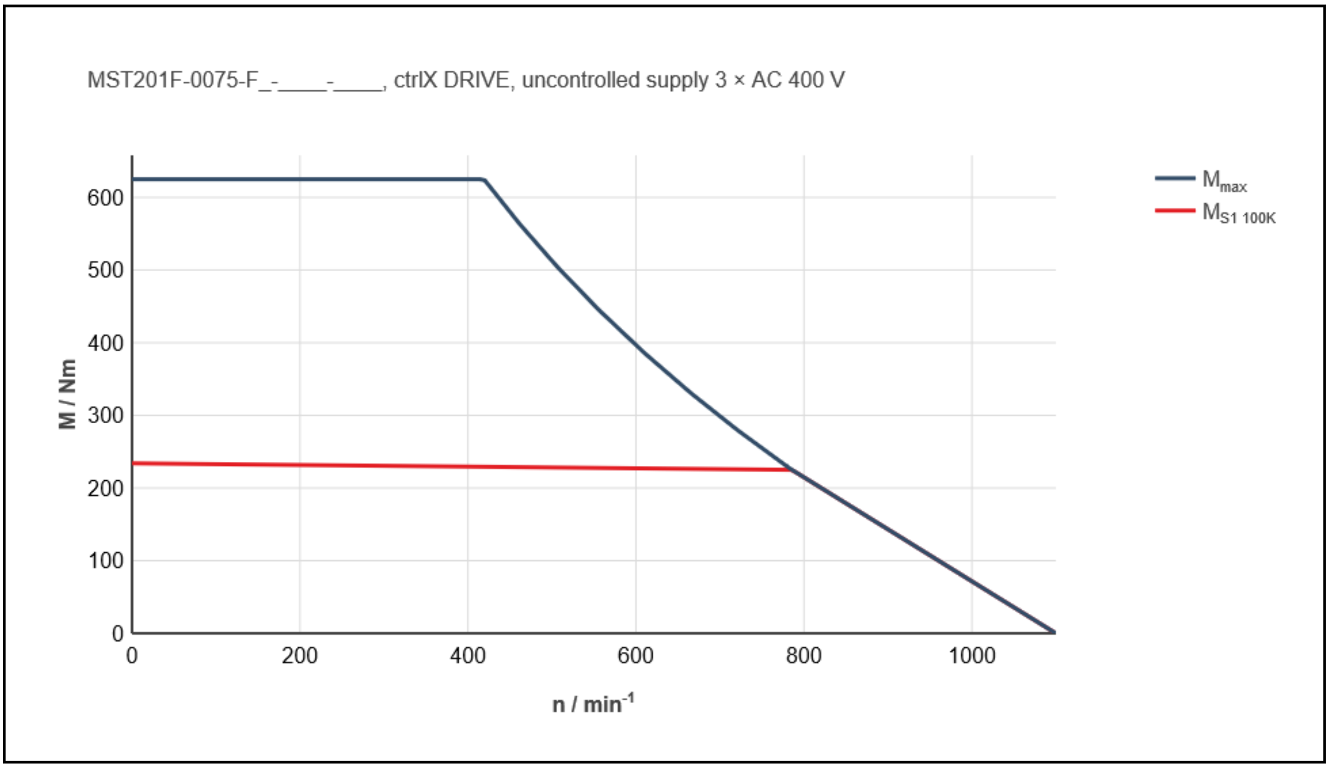


Fig. 4-27: Motor characteristic curve MST201F-0075-F... at 540 V_{DC}

4.7 Frame size 210

4.7.1 Data sheet MST210

Designation	Symbol	Unit	MST210					
			A	C		D	E	U
			0027-F	0027-F	0050-F	0070-F	0027-F	0030-F
Standstill torque	M_0	Nm	55	132		165	264	630
Standstill current	I_0	A	7.7	14.3	27.5	35.2	26.4	51.4
Rated torque	M_N	Nm	50.0	120.0		150.0	240.0	530.0
Rated power	P_N	kW	2.10	4.10	9.40	11.00	8.30	17.80
Rated current	I_N	A	7.0	13.0	25.0	32.0	24.0	45.7
Rated speed	n_N	min^{-1}	400	330	750	700	330	320
Maximum torque	M_{max}	Nm	120	250		300	500	1200
Maximum current	I_{max}	A	25.0	50.0	100.0	72.0	90.0	165.0
Max. speed (electrical)	n_{max}	min^{-1}	720	950	1350	1100	600	580
Power wire cross-section	A	mm^2	1.0		4.0	6.0	4.0	10.0
Torque constant at 20 °C	K_{M_N}	Nm/A	7.71	9.20	4.80	4.70	10.00	11.62
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	0.510	0.620	0.310		0.700	0.780
Thermal time constant	T_{th_nom}	min	2.4	3.0				3.9
Winding resistance at 20 °C	R_{12}	Ohm	10.9	5.2	1.3	1.0	2.26	1.56
Winding inductance	L_{12}	mH	53.0	30.1	7.5	6.0	14.1	9.33
Leakage capacitance of the component	C_{ab}	nF	4.8	9.5		13.3	19.0	24.6
Number of pole pairs	p	-	20					
Details about liquid cooling								
Power dissipation	P_V	kW	1.20	2.60	2.80	3.40	4.00	9.30
Coolant inlet temperature	T_{in}	°C	10 ... 40					
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10					12
Required coolant flow for P_V	Q_{min}	l/min	6.0					11.1
Pressure drop at Q_{min}	Δp	bar	0.1					1.8
Volume of coolant duct	V_{cool}	l	0.18			0.21	0.37	0.81
Maximum permissible inlet pressure	p_{max}	bar	6.0					
Latest amendment: 2020-01-07								

Tab. 4-11: MST210 - Technical data

4.7.2 Data sheet MRT210

Designation	Symbol	Unit	MRT210A	MRT210C	MRT210D	MRT210E	MRT210U
			_-0120				
Rotor inertia	J_{rot}	kg * m²	0.01200	0.02300	0.02700	0.04200	0.09200
Rotor mass	m_{rot}	kg	3.0	4.8	5.8	7.8	16.0
Maximum speed (mechanical)	$n_{max\ mech}$	min^{-1}	2,500				1,500
Latest amendment: 2018-04-05							

Tab. 4-12: MRT210 - Technical data

4.7.3 Motor characteristic curves MST210

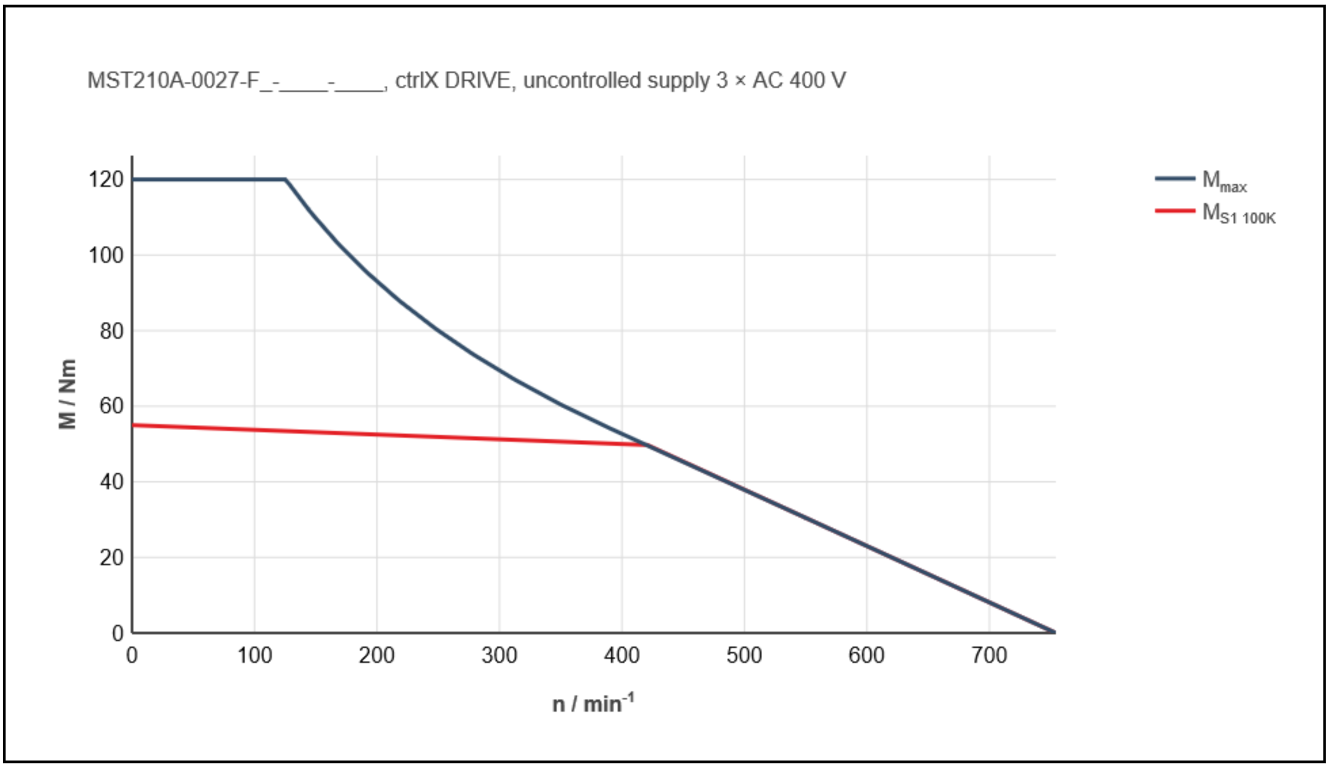


Fig. 4-28: Motor characteristic curve of MST210A-0027-F... at 540 V_{DC}

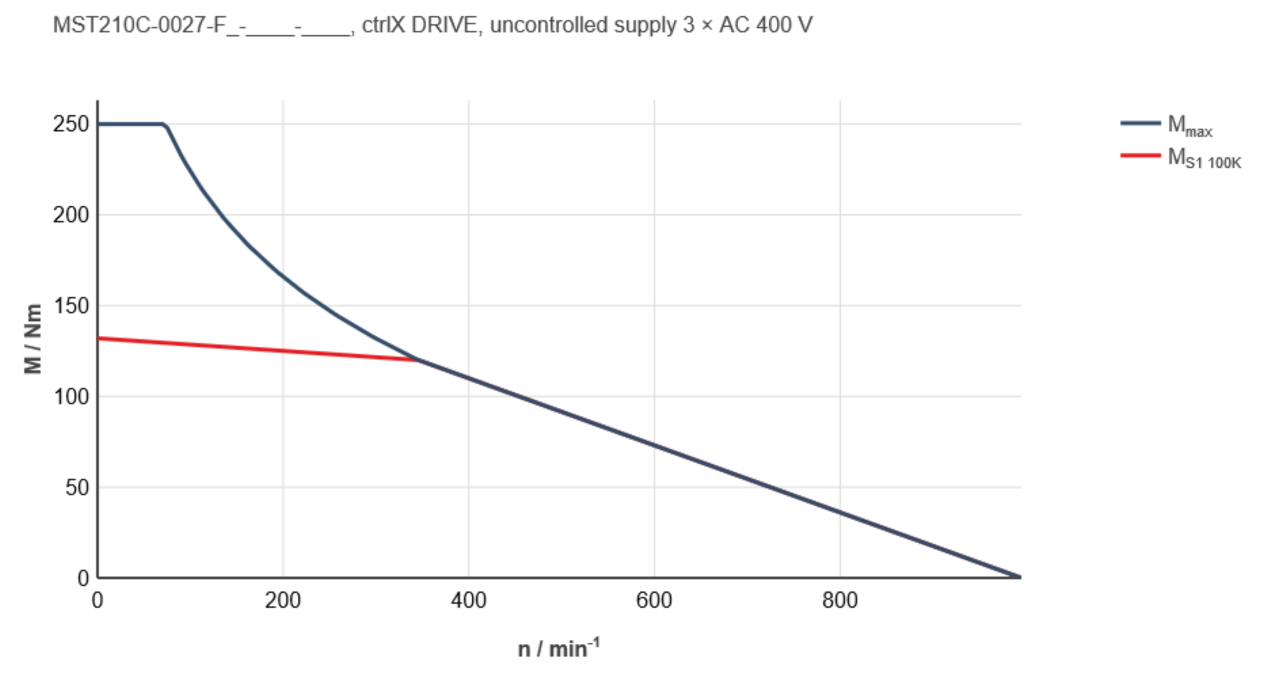


Fig. 4-29: Motor characteristic curve of MST210C-0027-F... at 540 V_{DC}

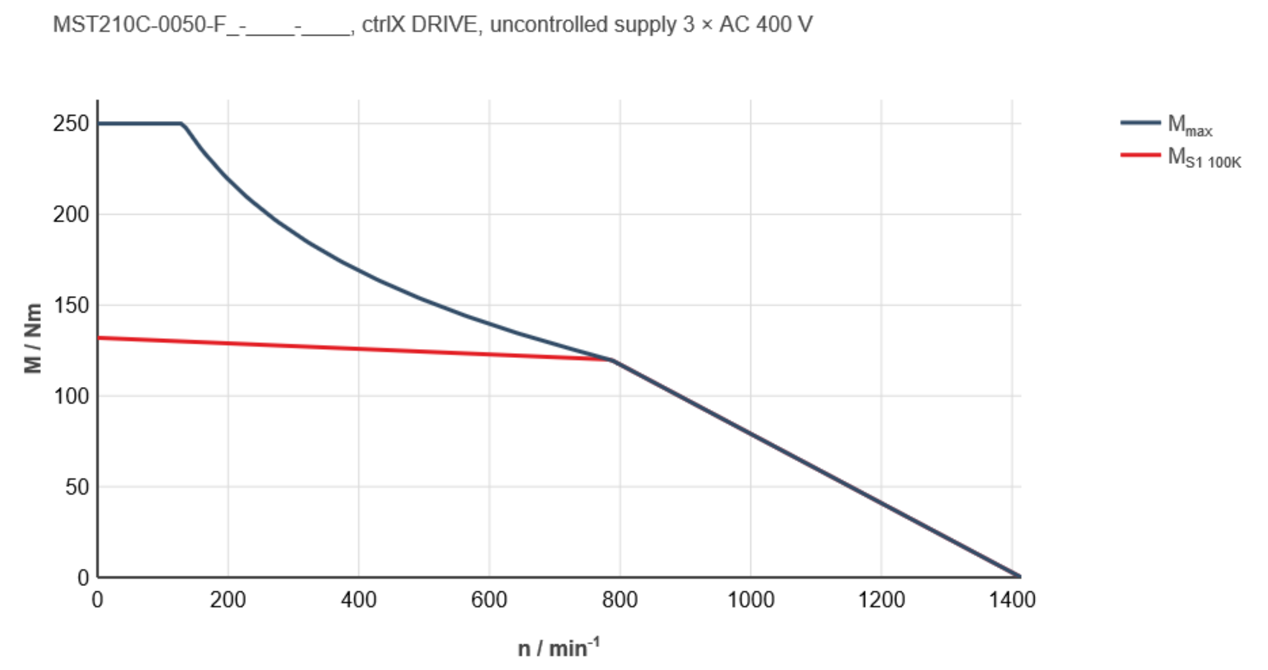


Fig. 4-30: Motor characteristic curve of MST210C-0050-F... at 540 V_{DC}

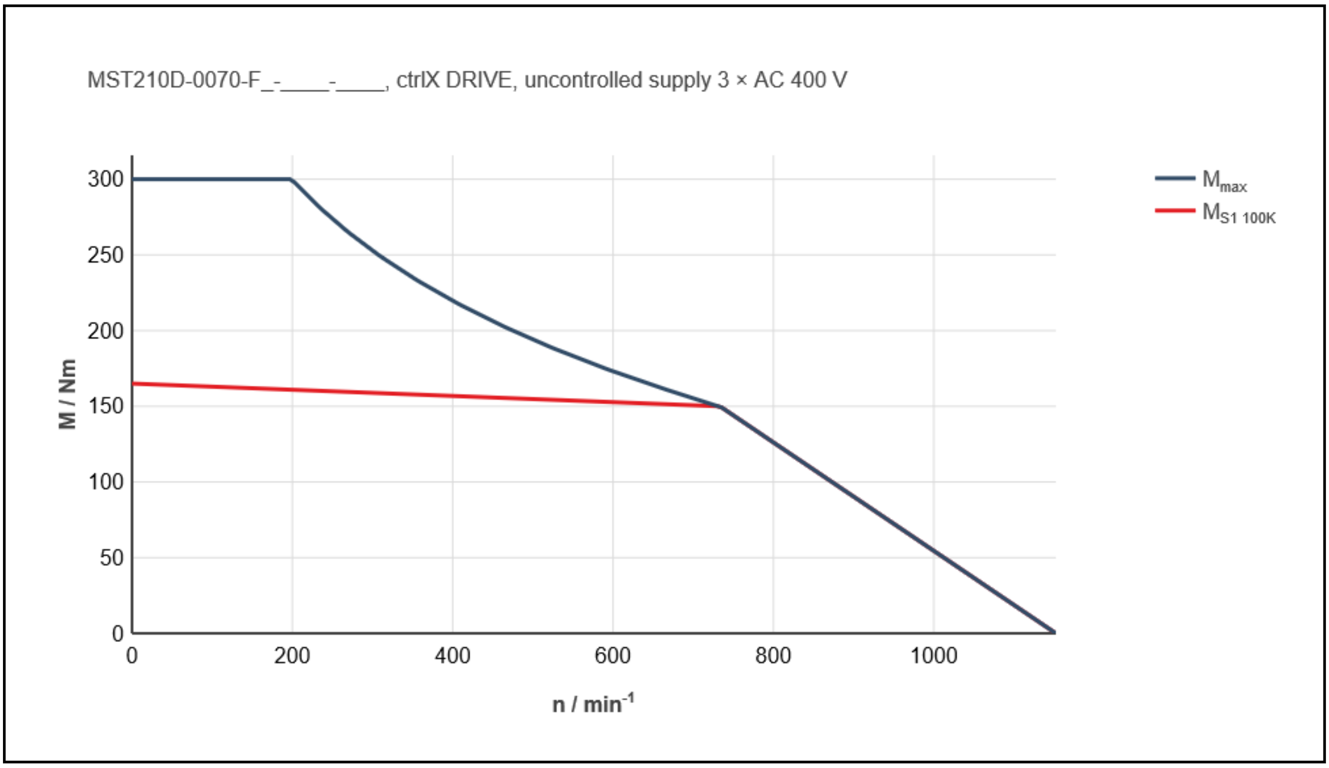


Fig. 4-31: Motor characteristic curve of MST210D-0070-F... at 540 V_{DC}

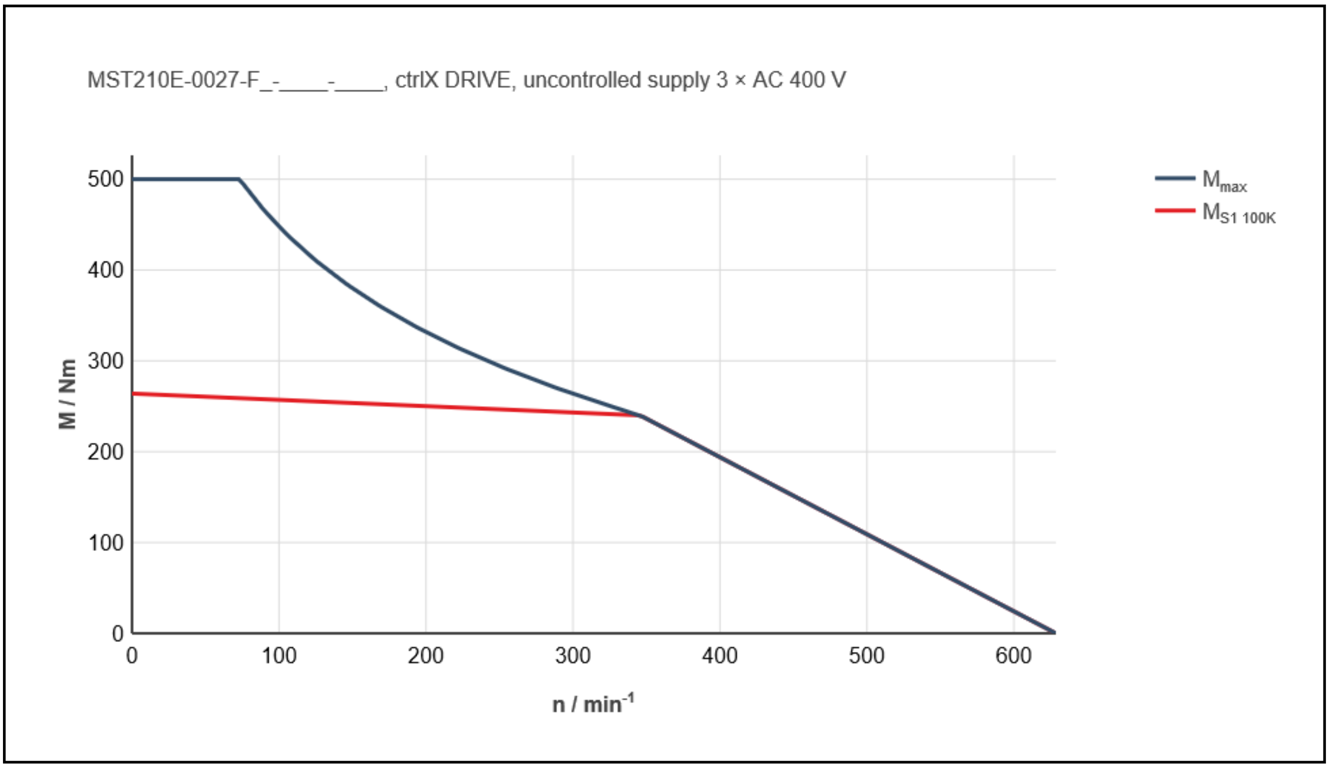


Fig. 4-32: Motor characteristic curve of MST210E-0027-F... at 540 V_{DC}

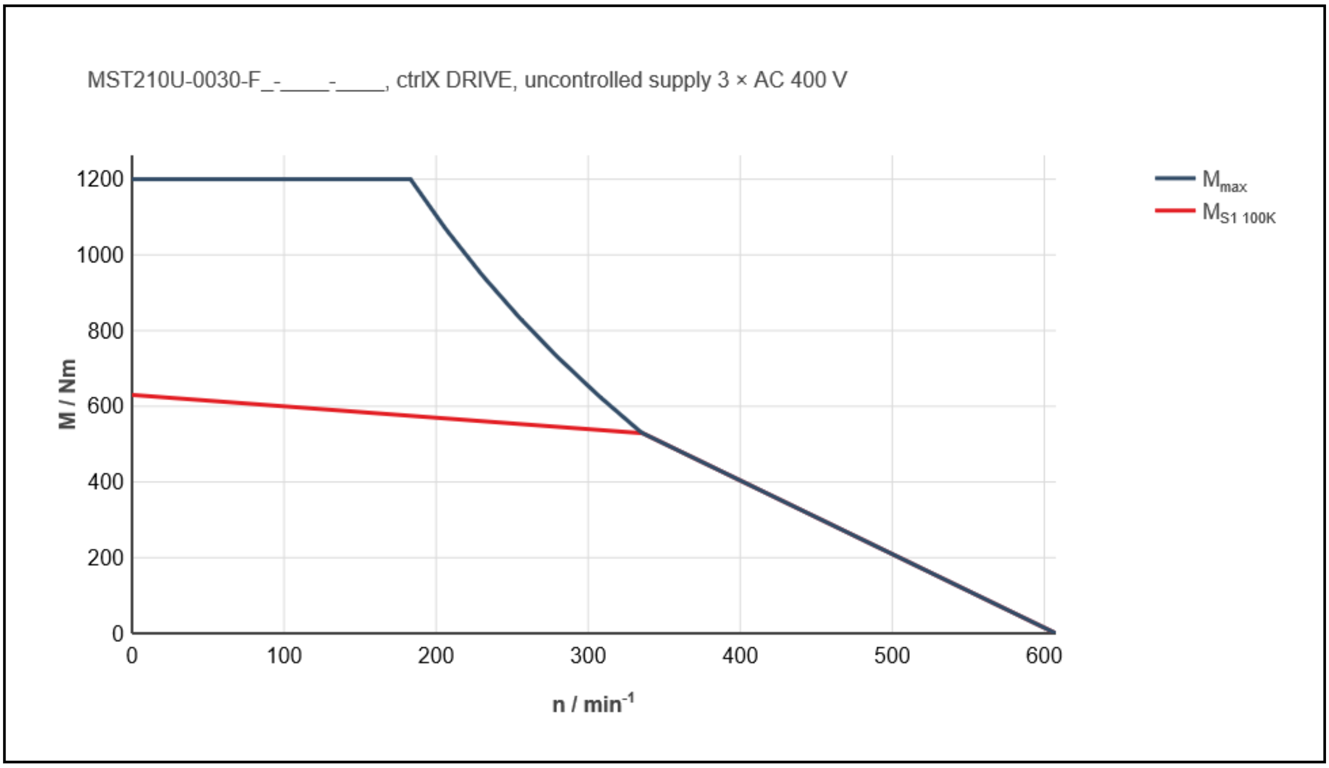


Fig. 4-33: Motor characteristic curve of MST210U-0030-F... at 540 V_{DC}

4.8 Frame size 251

4.8.1 Data sheet MST251

Designation	Symbol	Unit	MST251F-0040-F
Standstill torque	M_0	Nm	635
Standstill current	I_0	A	66.9
Rated torque	M_N	Nm	546.0
Rated power	P_N	kW	22.90
Rated current	I_N	A	59.0
Rated speed	n_N	min^{-1}	400
Maximum torque	M_{max}	Nm	1250
Maximum current	I_{max}	A	177.0
Max. speed (electrical)	n_{max}	min^{-1}	700
Power wire cross-section	A	mm^2	16.0
Torque constant at 20 °C	K_{M_N}	Nm/A	9.26
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	0.670
Thermal time constant	T_{th_nom}	min	4.0
Winding resistance at 20 °C	R_{12}	Ohm	0.63
Winding inductivity	L_{12}	mH	8.9
Leakage capacitance of the component	C_{ab}	nF	24.4
Number of pole pairs	p	-	15
Details about liquid cooling			
Power dissipation	P_V	kW	6.62
Coolant inlet temperature	T_{in}	°C	10 ... 40
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10
Required coolant flow at P_V	Q_{min}	l/min	9.5
Pressure drop at Q_{min}	Δp	bar	1.0
Volume of coolant duct	V_{cool}	l	0.48
Maximum allowed inlet pressure	p_{max}	bar	6.0
			Latest amendment: 2020-01-07

Tab. 4-13: MST251 - Technical data

4.8.2 Data sheet MRT251

Designation	Symbol	Unit	MRT251F-__-0145
Moment of inertia of the rotor	J_{rot}	kg * m²	0.08500
Rotor mass	m_{rot}	kg	16.0
Maximum speed (mechanical)	$n_{max\ mech}$	min^{-1}	1,500
			Latest amendment: 2007-10-09

Tab. 4-14: MRT251 - Technical data

4.8.3 Motor characteristic curve MST251

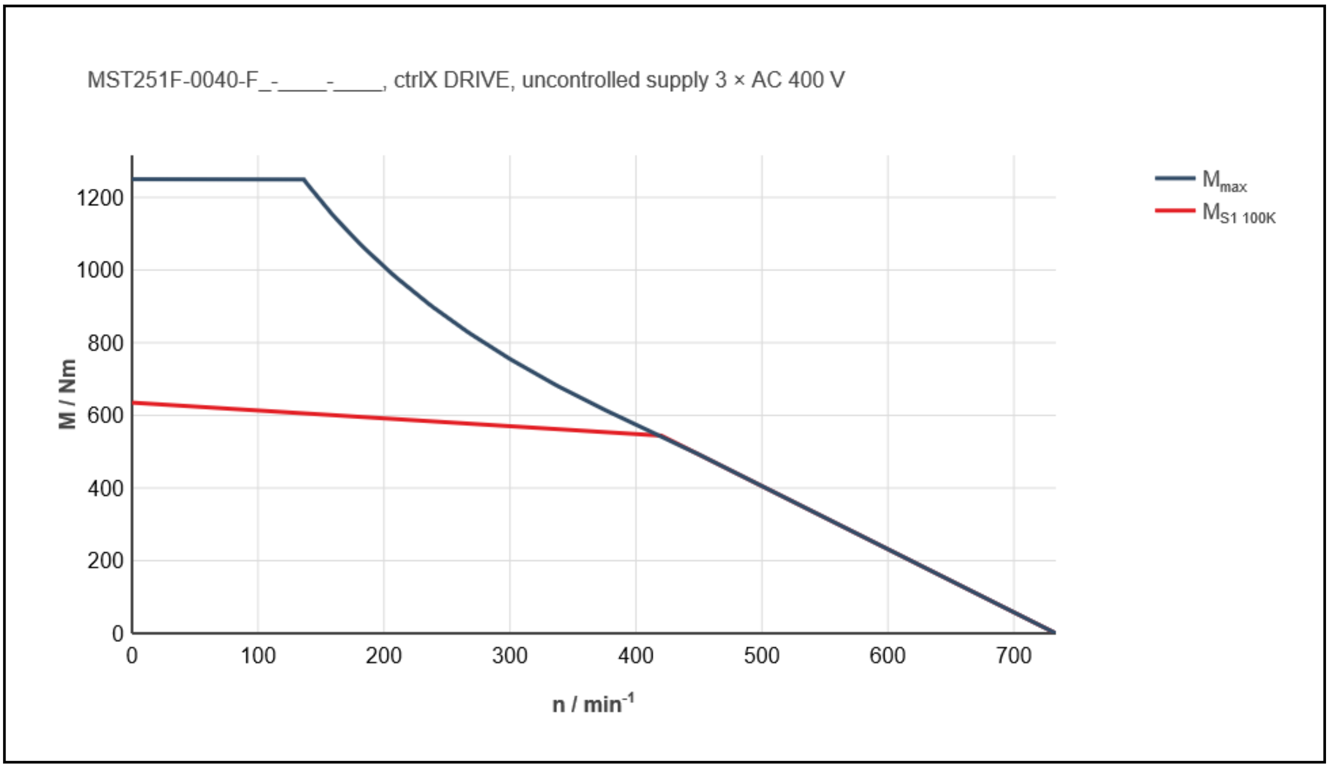


Fig. 4-34: Motor characteristic curve of MST251F-0040-F... at 540 V_{DC}

4.9 Frame size 290

4.9.1 Data sheet MST290

Designation	Symbol	Unit	MST290B	MST290D		
			0018-F	0002-F	0004-F	0018-F
Standstill torque	M_0	Nm	245	365		
Standstill current	I_0	A	16.5	6.6	11.6	27.1
Rated torque	M_N	Nm	220.0	350.0		
Rated power	P_N	kW	4.10	0.90	1.65	6.60
Rated current	I_N	A	14.8	6.3	10.4	26.0
Rated speed	n_N	min^{-1}	180	25	45	180
Maximum torque	M_{max}	Nm	460	700		
Maximum current	I_{max}	A	60.0	25.0	30.0	100.0
Max. speed (electrical)	n_{max}	min^{-1}	340	120	150	400
Power wire cross-section	A	mm^2	1.5	1.0		4.0
Torque constant at 20 °C	K_{M_N}	Nm/A	14.90	55.50	33.70	13.50
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	1.640	4.670	2.190	0.962
Thermal time constant	T_{th_nom}	min	3.3			
Winding resistance at 20 °C	R_{12}	Ohm	6.6	21.0	13.9	2.24
Winding inductance	L_{12}	mH	34.8	118.7	75.1	12.9
Leakage capacitance of the component	C_{ab}	nF	8.4	15.6	12.6	14.7
Number of pole pairs	p	-	30			
Details about liquid cooling						
Power dissipation	P_V	kW	3.00	4.20		
Coolant inlet temperature	T_{in}	°C	10 ... 40			
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10			
Required coolant flow at P_V	Q_{min}	l/min	5.0	7.0		
Pressure drop at Q_{min}	Δp	bar	0.1			
Volume of coolant duct	V_{cool}	l	0.20	0.31		
Maximum permissible inlet pressure	p_{max}	bar	6.0			
Latest amendment: 2019-05-06						

Tab. 4-15: MST290B/ -D - Technical data

Designation	Symbol	Unit	MST290E		MST290F	MST290G
			0004-F	0018-F	0020-F	0020-F
Standstill torque	M_0	Nm	610		755	855
Standstill current	I_0	A	13.3	42.1	41.1	46.1
Rated torque	M_N	Nm	575.0	563.0	715.0	810.0
Rated power	P_N	kW	2.40	14.15	19.80	22.10
Rated current	I_N	A	12.5	34.3	39.9	43.7
Rated speed	n_N	min^{-1}	40	240	265	260
Maximum torque	M_{max}	Nm	1150		1450	1,600
Maximum current	I_{max}	A	50.0	125.0	120.0	118.0
Max. speed (electrical)	n_{max}	min^{-1}	145	415	425	
Power wire cross-section	A	mm^2	1.0	6.0	10.0	
Torque constant at 20 °C	K_{M_N}	Nm/A	46.00	16.40	17.92	18.54
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	3.620	1.037	1.204	1.196
Thermal time constant	T_{th_nom}	min	3.3		5.2	5.1
Winding resistance at 20 °C	R_{12}	Ohm	8.2	1.5	1.74	1.58
Winding inductance	L_{12}	mH	49.5	8.9	10.9	9.9
Leakage capacitance of the component	C_{ab}	nF	21.0	20.0	24.9	28.3
Number of pole pairs	p	-	30			
Details about liquid cooling						
Power dissipation	P_V	kW	5.50		6.60	7.70
Coolant inlet temperature	T_{in}	°C	10 ... 40			10 ... +40
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10			
Required coolant flow at P_V	Q_{min}	l/min	9.0		9.6	10.0
Pressure drop at Q_{min}	Δp	bar	0.1			
Volume of coolant duct	V_{cool}	l	0.55		0.68	0.82
Maximum allowed inlet pressure	p_{max}	bar	6.0			
						Latest amendment: 2020-04-01

Tab. 4-16: MST290E/ -F/ -G - Technical data

4.9.2 Data sheet MRT290

Designation	Symbol	Unit	MRT290B	MRT290D	MRT290E	MRT290F	MRT290G
			_-0200				
Rotor inertia	J_{rot}	kg * m²	0.08000	0.11000	0.17000	0.20000	0.23500
Rotor mass	m_{rot}	kg	6.2	9.0	11.6	13.6	15.7
Maximum speed (mechanical)	$n_{max\ mech}$	min^{-1}	2,000				
Latest amendment: 2018-07-11							

Tab. 4-17: MRT290 - Technical data

4.9.3 Motor characteristic curves MST290

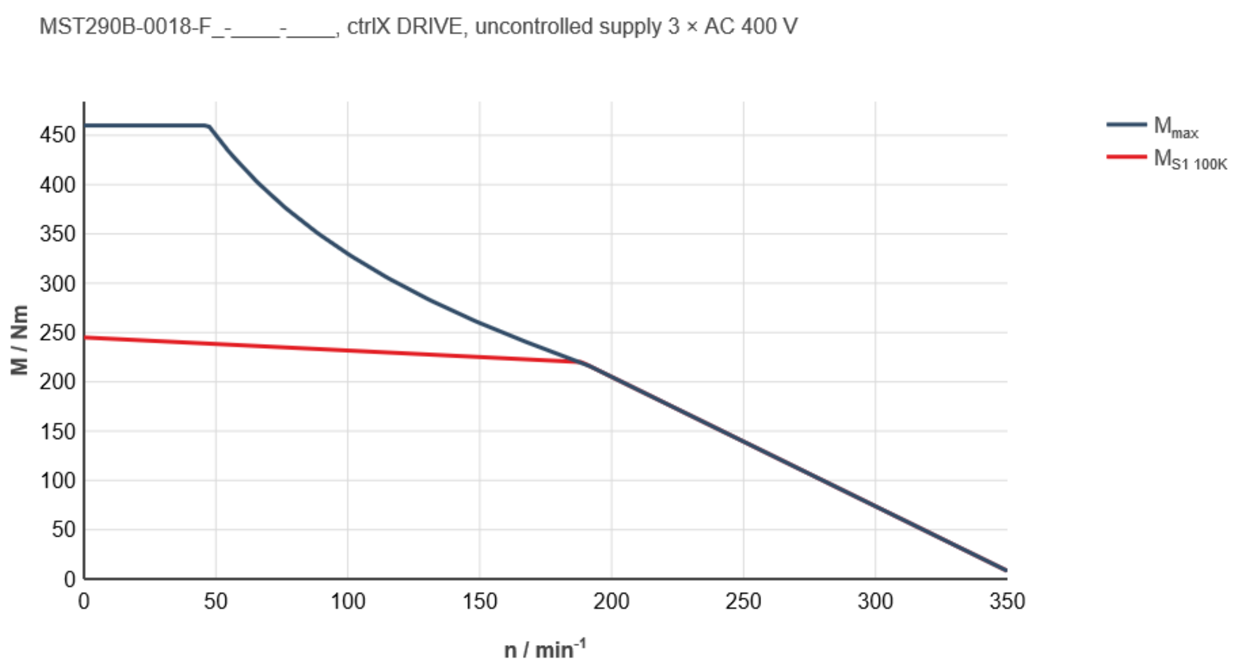


Fig. 4-35: Motor characteristic curve of MST290B-0018-F... at 540 V_{DC}

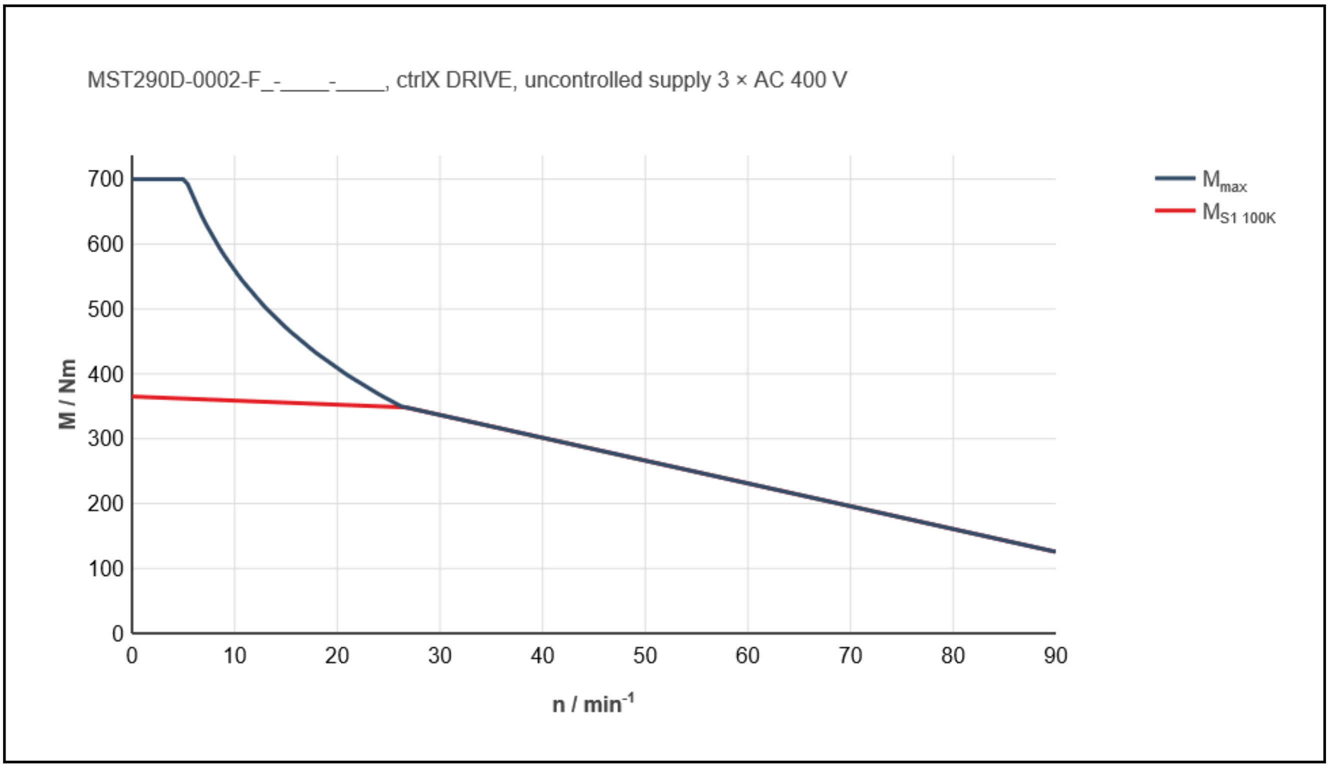


Fig. 4-36: Motor characteristic curve of MST290D-0002-F... at 540 V_{DC}

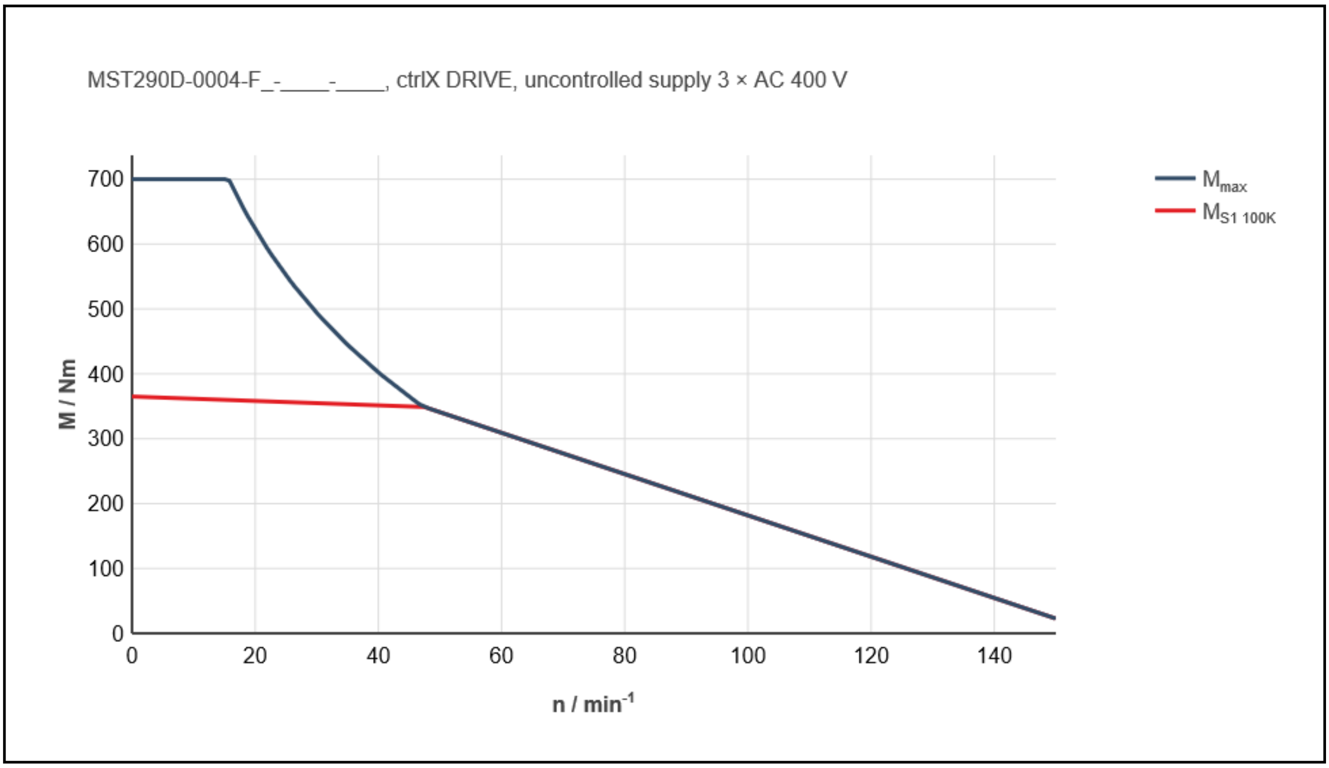


Fig. 4-37: Motor characteristic curves MST290D-0004-F... at 540 V_{DC}

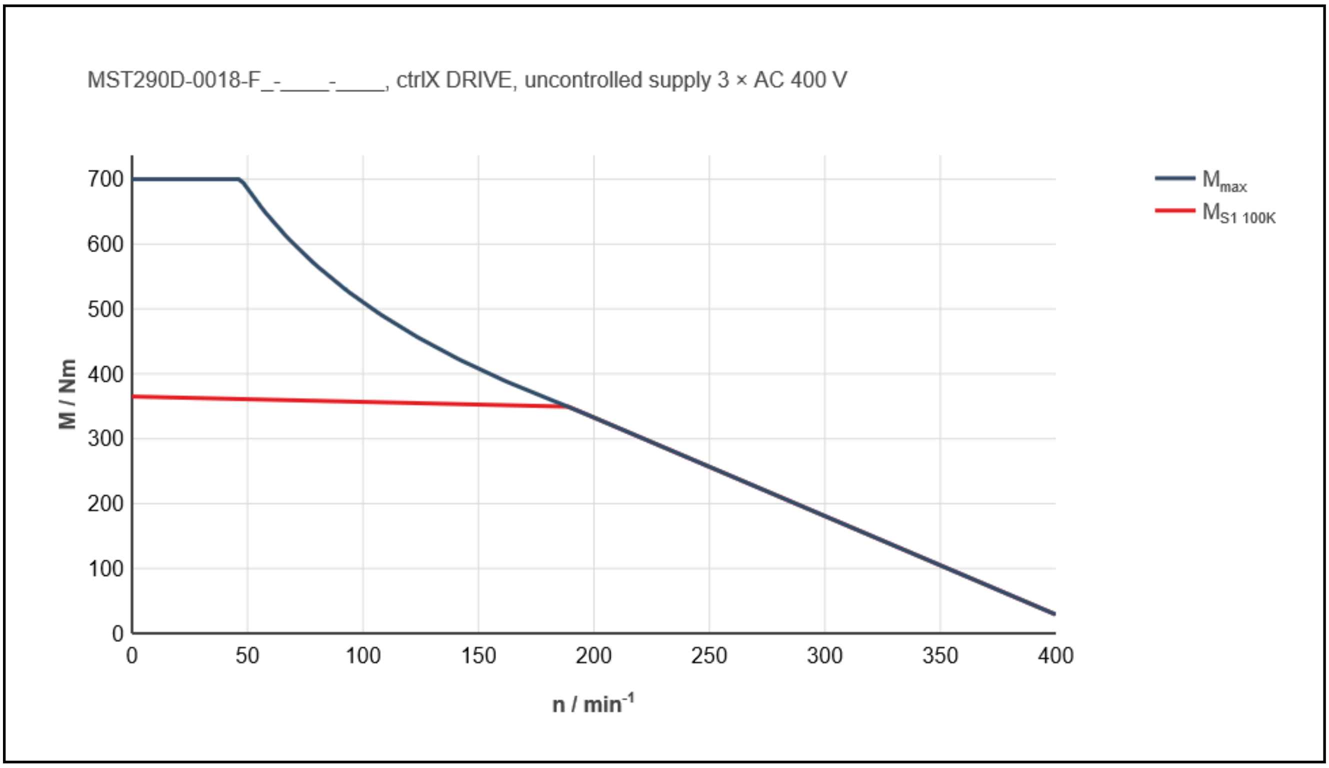


Fig. 4-38: Motor characteristic curve of MST290D-0018-F... at 540 V_{DC}

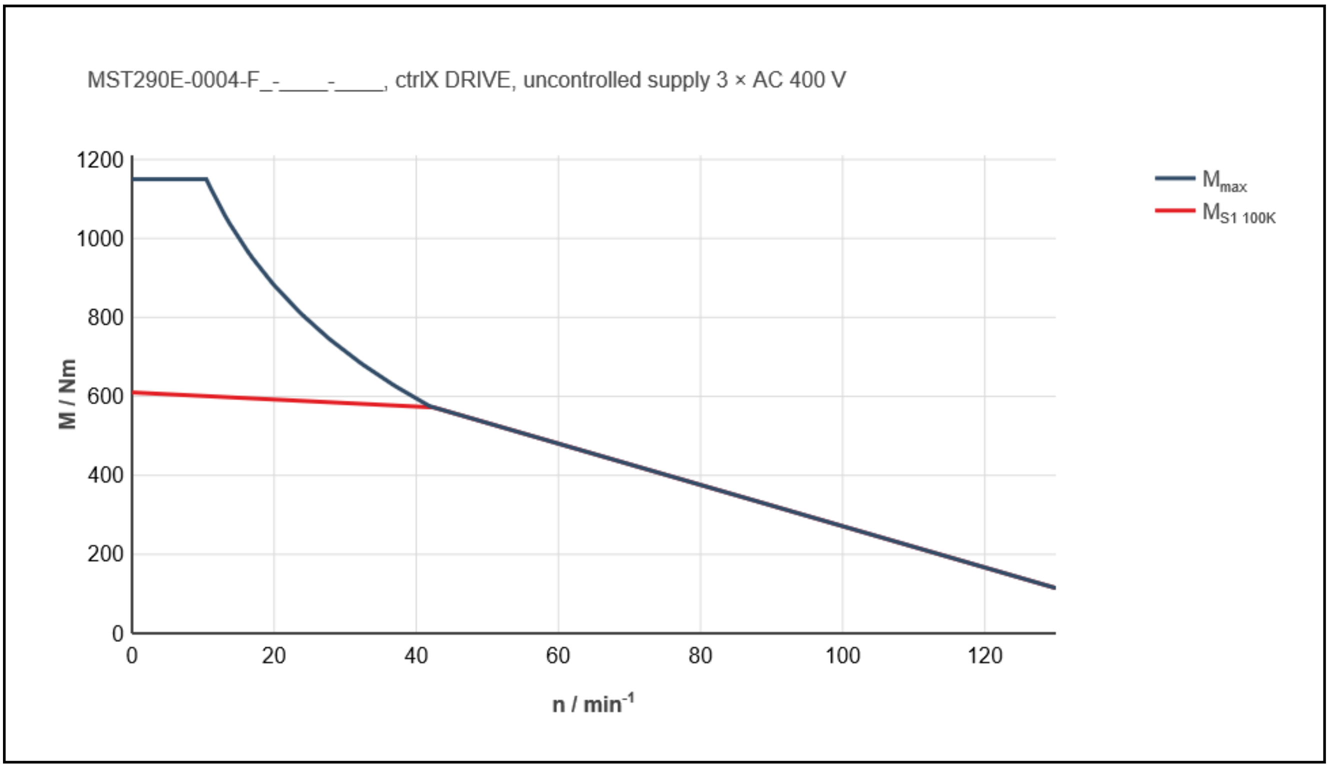


Fig. 4-39: Motor characteristic curve of MST290E-0004-F... at 540 V_{DC}

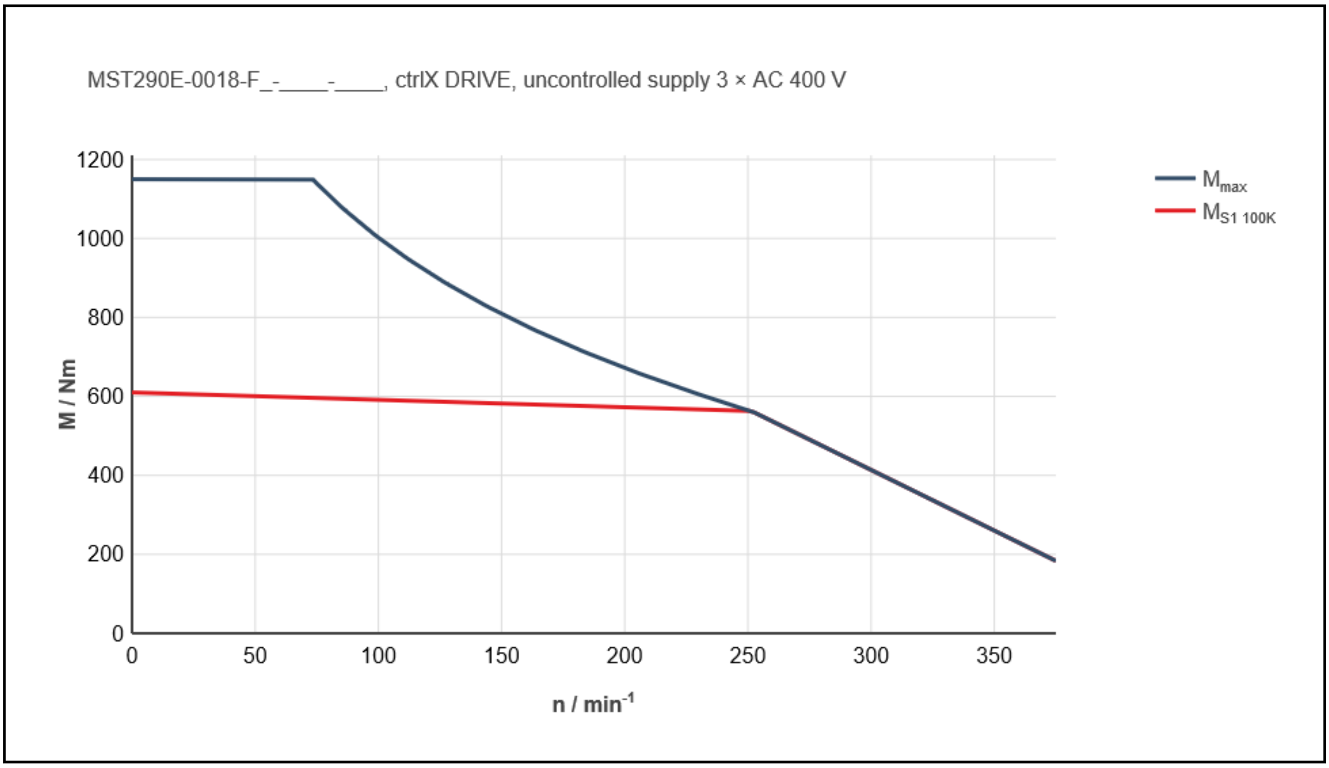


Fig. 4-40: Motor characteristic curve of MST290E-0018-F... at 540 V_{DC}

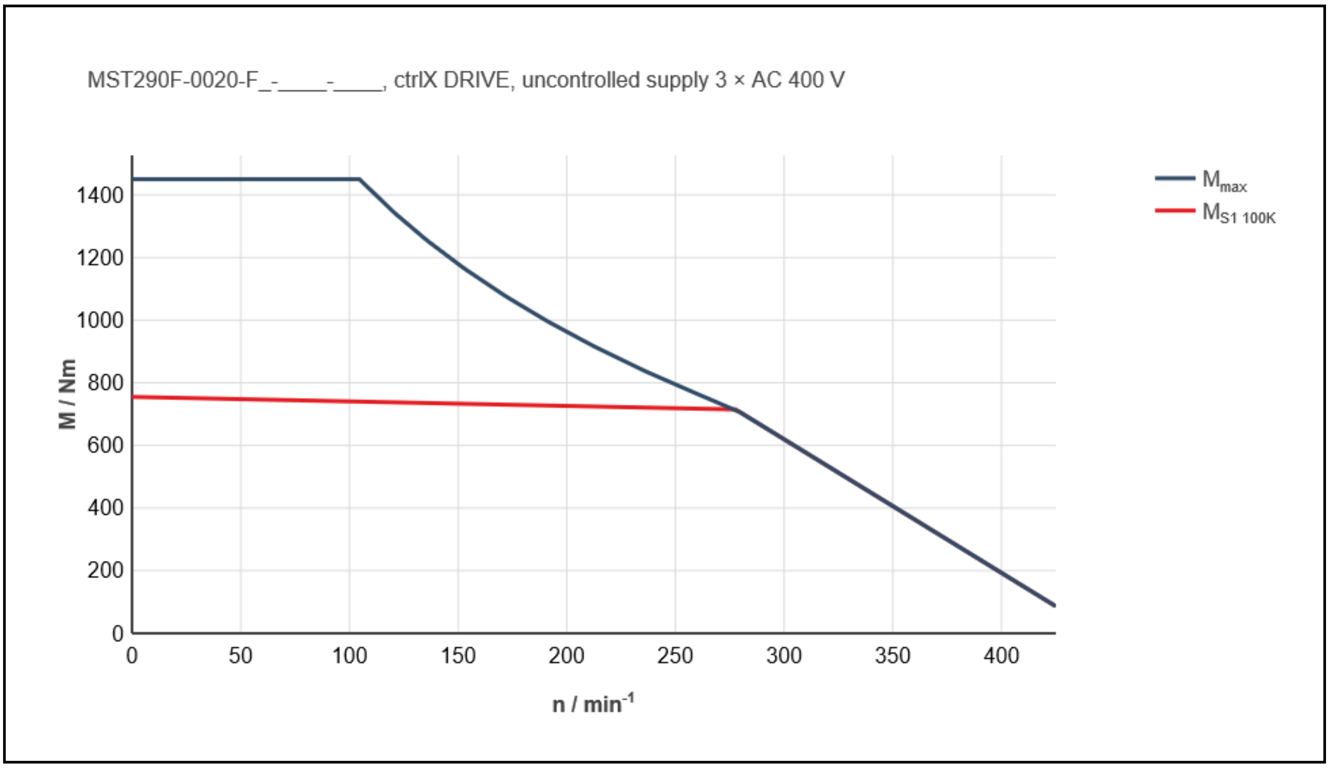


Fig. 4-41: Motor characteristic curve of MST290F-0020-F... at 540 V_{DC}

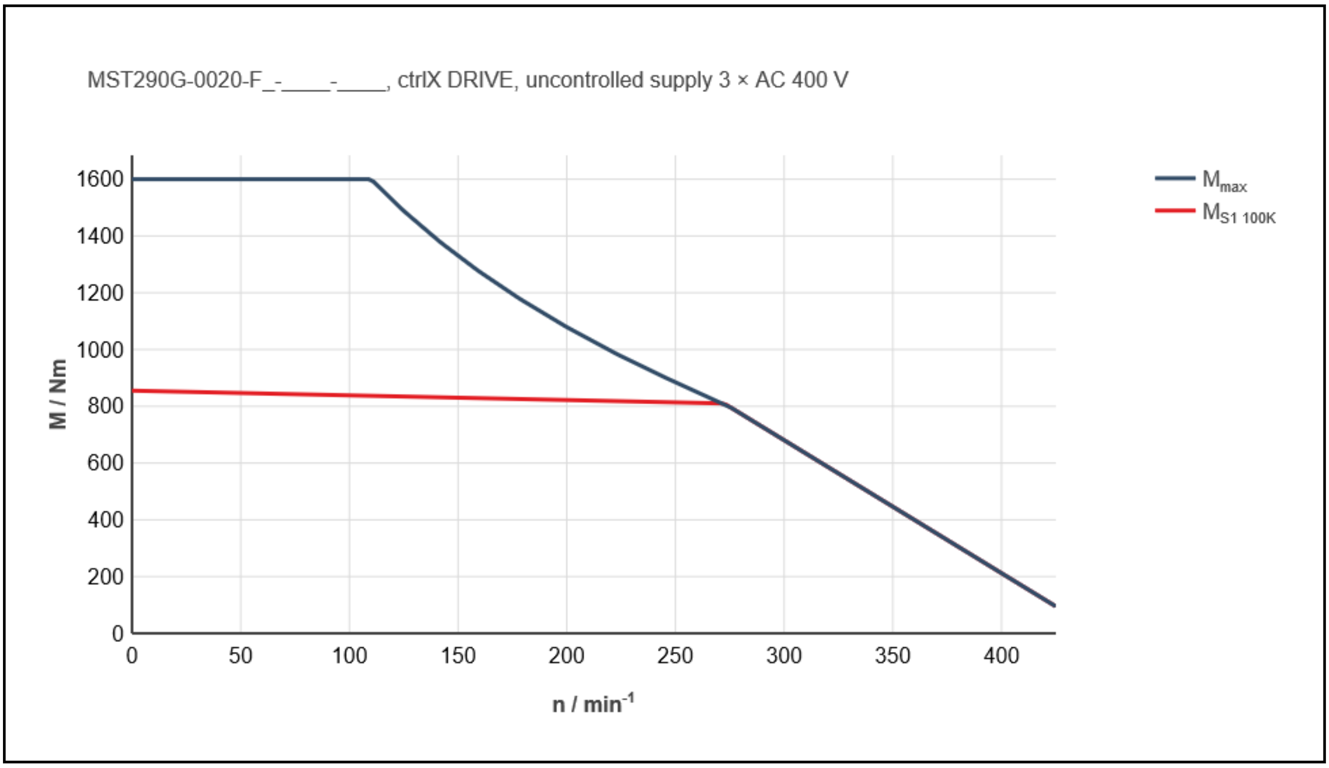


Fig. 4-42: Motor characteristic curve of MST290G-0020-F... at 540 V_{DC}

4.10 Frame size 291

4.10.1 Data sheet MST291

Designation	Symbol	Unit	MST291C	MST291D	MST291E
			0018-F	0010-F	0010-F
Standstill torque	M_0	Nm	295	480	620
Standstill current	I_0	A	18.0	19.2	21.8
Rated torque	M_N	Nm	280.0	440.0	570.0
Rated power	P_N	kW	6.74	6.45	8.36
Rated current	I_N	A	16.9	16.0	20.0
Rated speed	n_N	min^{-1}	230	140	
Maximum torque	M_{max}	Nm	620	1000	1250
Maximum current	I_{max}	A	42.2	44.0	50.0
Max. speed (electrical)	n_{max}	min^{-1}	400	250	245
Power wire cross-section	A	mm^2	2.5		
Torque constant at 20 °C	K_{M_N}	Nm/A	16.57	27.50	28.75
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	1.100	1.632	1.920
Thermal time constant	T_{th_nom}	min	5.0		
Winding resistance at 20 °C	R_{12}	Ohm	3.9	5.6	4.4
Winding inductivity	L_{12}	mH	34.3	51.0	56.0
Leakage capacitance of the component	C_{ab}	nF	8.2	12.4	16.5
Number of pole pairs	p	-	15		
Details about liquid cooling					
Power dissipation	P_V	kW	3.49	3.60	3.70
Coolant inlet temperature	T_{in}	°C	10 ... 40		
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10		
Required coolant flow at P_V	Q_{min}	l/min	5.0		
Pressure drop at Q_{min}	Δp	bar	0.4	0.6	0.8
Volume of coolant duct	V_{cool}	l	0.13	0.23	0.32
Maximum allowed inlet pressure	p_{max}	bar	6.0		
Latest amendment: 2019-05-29					

Tab. 4-18: MST291 - Technical data

4.10.2 Data sheet MRT291

Designation	Symbol	Unit	MRT291C	MRT291D	MRT291E
			_-0200		
Rotor inertia	J_{rot}	kg * m²	0.07800	0.11600	0.15400
Rotor mass	m_{rot}	kg	6.5	11.0	14.3
Maximum speed (mechanical)	$n_{max\ mech}$	min^{-1}	400		
Latest amendment: 2014-03-31					

Tab. 4-19: MRT291 - Technical data

4.10.3 Motor characteristic curves MST291

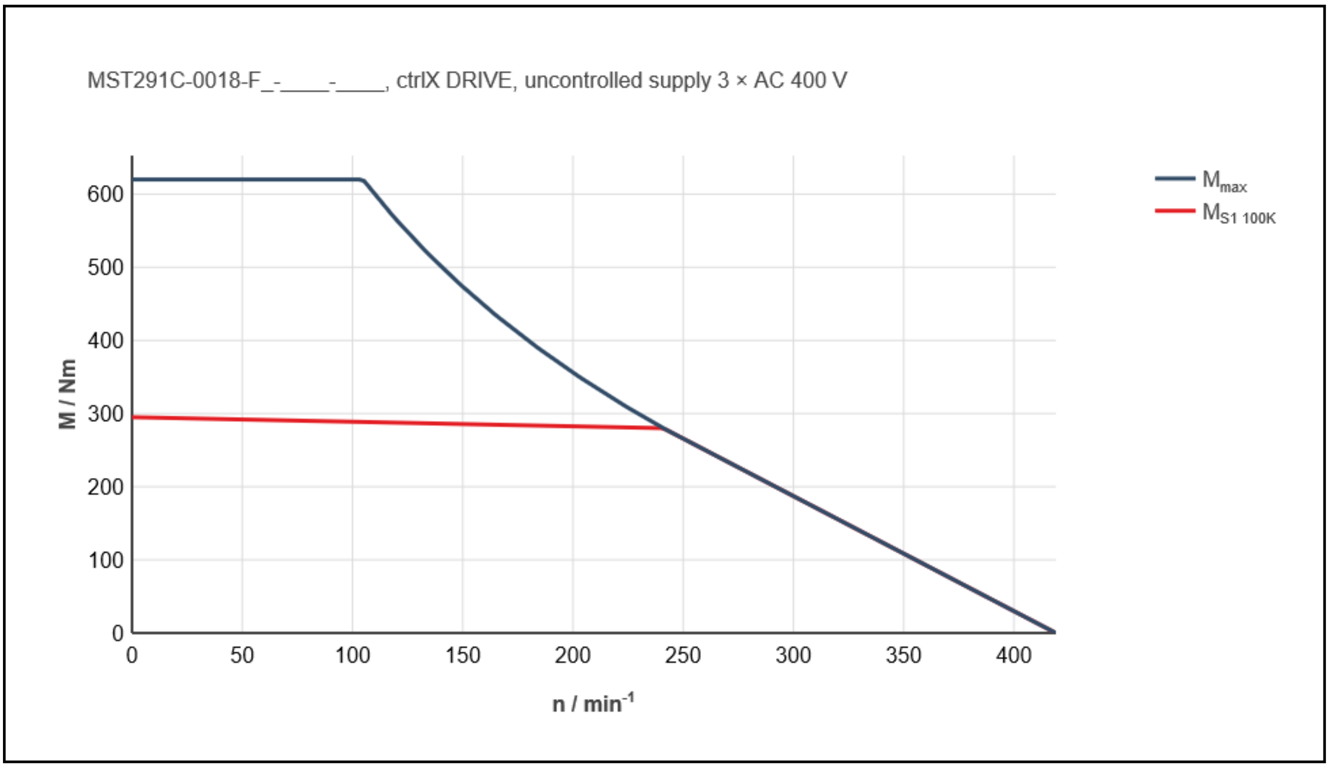


Fig. 4-43: Motor characteristic curve of MST291C-0018-F... at 540 V_{DC}

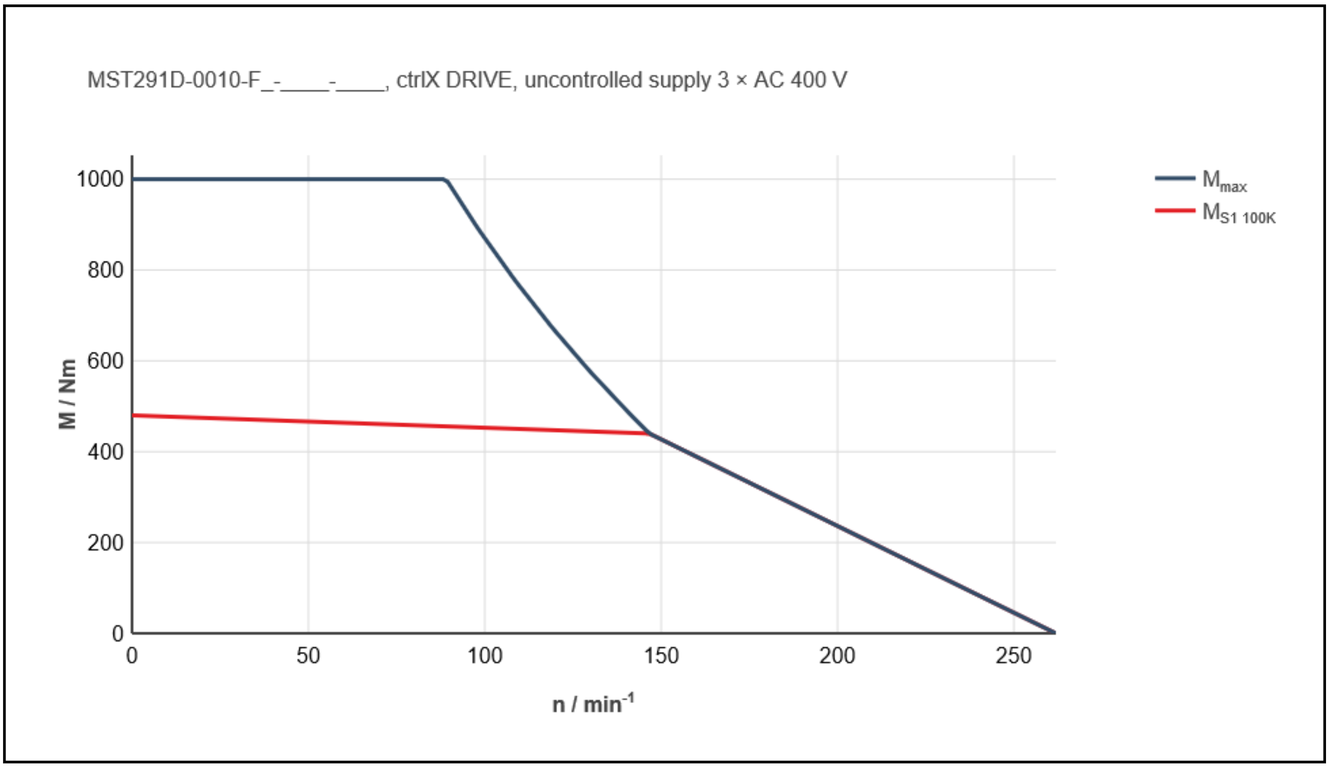


Fig. 4-44: Motor characteristic curve of MST291D-0010-F... at 540 V_{DC}

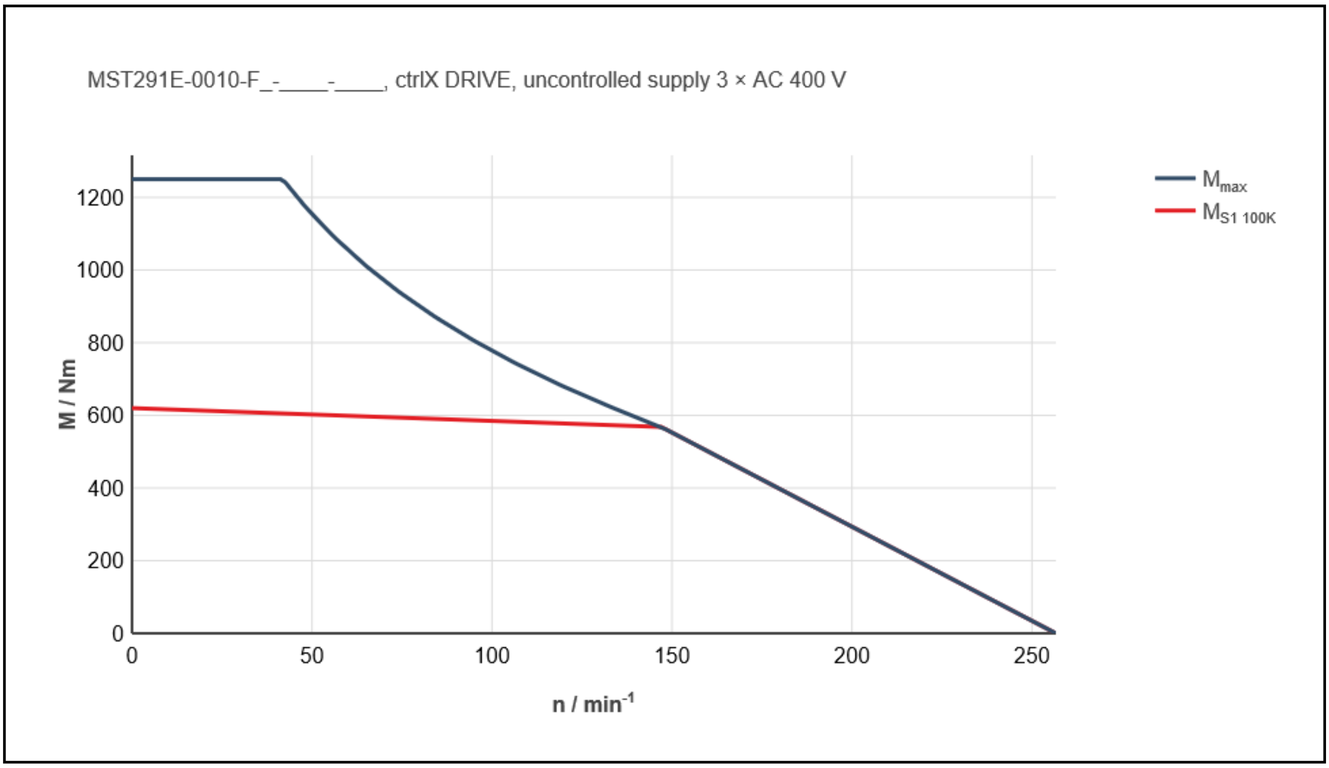


Fig. 4-45: Motor characteristic curve of MST291E-0010-F... at 540 V_{DC}

4.11 Frame size 360

4.11.1 Data sheet MST360

Designation	Symbol	Unit	MST360B-		MST360D-		
			0006-F	0018-F	0009-F	0012-F	0018-F
Standstill torque	M_0	Nm	440		640		
Standstill current	I_0	A	9.3	22.6	15.5	19.2	34.6
Rated torque	M_N	Nm	375.0		525.0		
Rated power	P_N	kW	2.90	7.10	4.70	6.30	12.90
Rated current	I_N	A	8.8	20.0	12.7	15.7	28.3
Rated speed	n_N	min^{-1}	75	180	85	115	235
Maximum torque	M_{max}	Nm	800	900	1150		
Maximum current	I_{max}	A	21.5	70.0	32.6	39.8	72.0
Max. speed (electrical)	n_{max}	min^{-1}	150	330	155	190	350
Power wire cross-section	A	mm^2	1.0	2.5	1.0	2.5	4.0
Torque constant at 20 °C	K_{M_N}	Nm/A	47.31	18.80	41.29	33.33	18.50
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	3.148	1.220	2.515	2.043	1.300
Thermal time constant	T_{th_nom}	min	5.0				
Winding resistance at 20 °C	R_{12}	Ohm	14.8	2.43	8.16	5.4	1.6
Winding inductance	L_{12}	mH	105.9	19.2	71.5	46.2	14.4
Leakage capacitance of the component	C_{ab}	nF	9.0		13.5		
Number of pole pairs	p	-	25				
Details about liquid cooling							
Power dissipation	P_V	kW	2.70		3.60		
Coolant inlet temperature	T_{in}	°C	10 ... 40				
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10				
Required coolant flow at P_V	Q_{min}	l/min	4.0		6.0		
Pressure drop at Q_{min}	Δp	bar	0.1				
Volume of coolant duct	V_{cool}	l	0.27		0.39		
Maximum permissible inlet pressure	p_{max}	bar	6.0				
Latest amendment: 2020-11-13							

Tab. 4-20: MST360B/ -D - Technical data

Designation	Symbol	Unit	MST360E	
			0008-F	0018-F
Standstill torque	M_0	Nm	1,050	
Standstill current	I_0	A	25.2	50.4
Rated torque	M_N	Nm	875.0	
Rated power	P_N	kW	7.30	16.50
Rated current	I_N	A	21.0	42.0
Rated speed	n_N	min^{-1}	80	180
Maximum torque	M_{max}	Nm	2,000	1900
Maximum current	I_{max}	A	53.0	141.0
Max. speed (electrical)	n_{max}	min^{-1}	140	300
Power wire cross-section	A	mm^2	2.5	10.0
Torque constant at 20 °C	K_{M_N}	Nm/A	41.67	20.80
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	2.560	1.890
Thermal time constant	T_{th_nom}	min	5.0	
Winding resistance at 20 °C	R_{12}	Ohm	4.67	1.2
Winding inductance	L_{12}	mH	39.9	10.6
Leakage capacitance of the component	C_{ab}	nF	20.0	
Number of pole pairs	p	-	25	
Details about liquid cooling				
Power dissipation	P_V	kW	4.00	
Coolant inlet temperature	T_{in}	°C	10 ... 40	
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10	
Required coolant flow at P_V	Q_{min}	l/min	6.0	
Pressure drop at Q_{min}	Δp	bar	0.1	
Volume of coolant duct	V_{cool}	l	0.69	
Maximum permissible inlet pressure	p_{max}	bar	6.0	
Latest amendment: 2019-12-11				

Tab. 4-21: MST360E - Technical data

4.11.2 Data sheet MRT360

Designation	Symbol	Unit	MRT360B	MRT360D	MRT360E
			_-0260		
Rotor inertia	J_{rot}	kg * m²	0.19000	0.27000	0.44000
Rotor mass	m_{rot}	kg	9.8	13.5	20.9
Maximum speed (mechanical)	$n_{max\ mech}$	min^{-1}	1,700		
Latest amendment: 2016-11-09					

Tab. 4-22: MRT360 - Technical data

4.11.3 Motor characteristic curves MST360

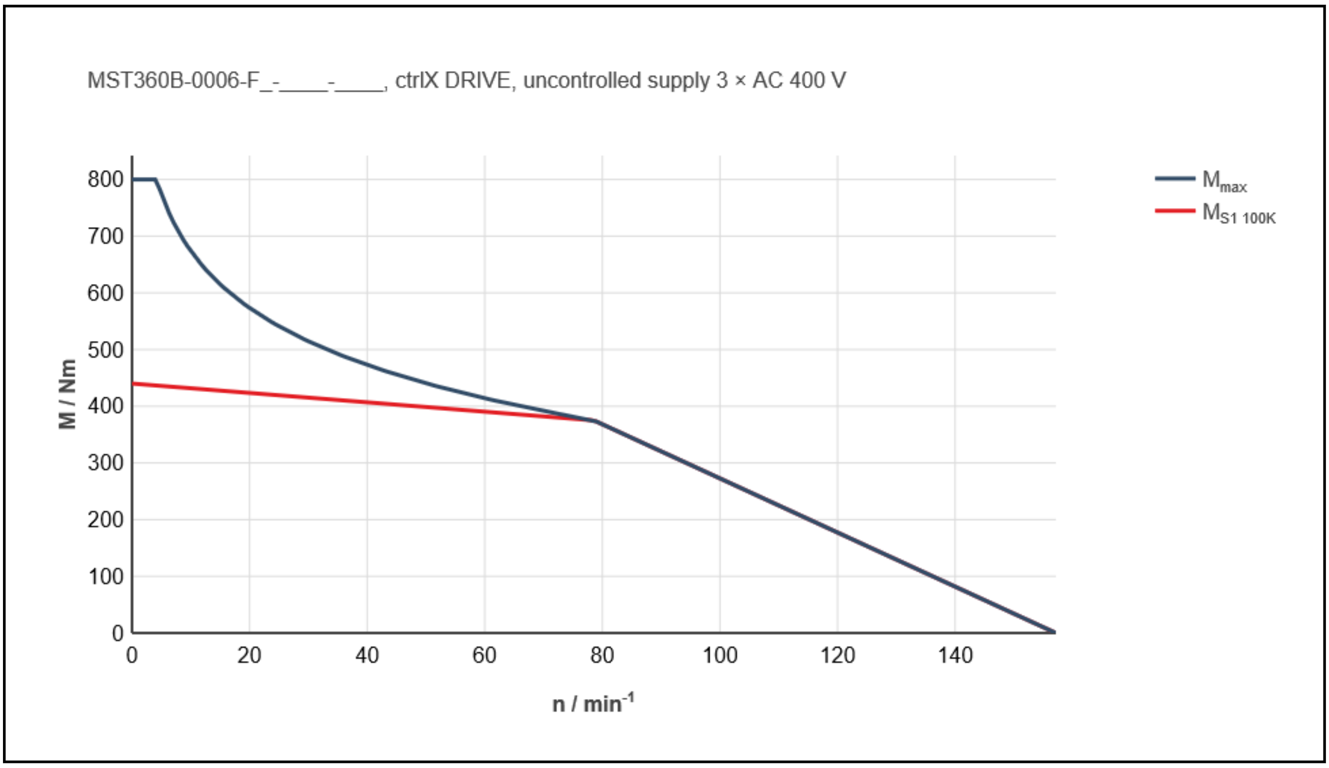


Fig. 4-46: Motor characteristic curve of MST360B-0006-F... at 540 V_{DC}

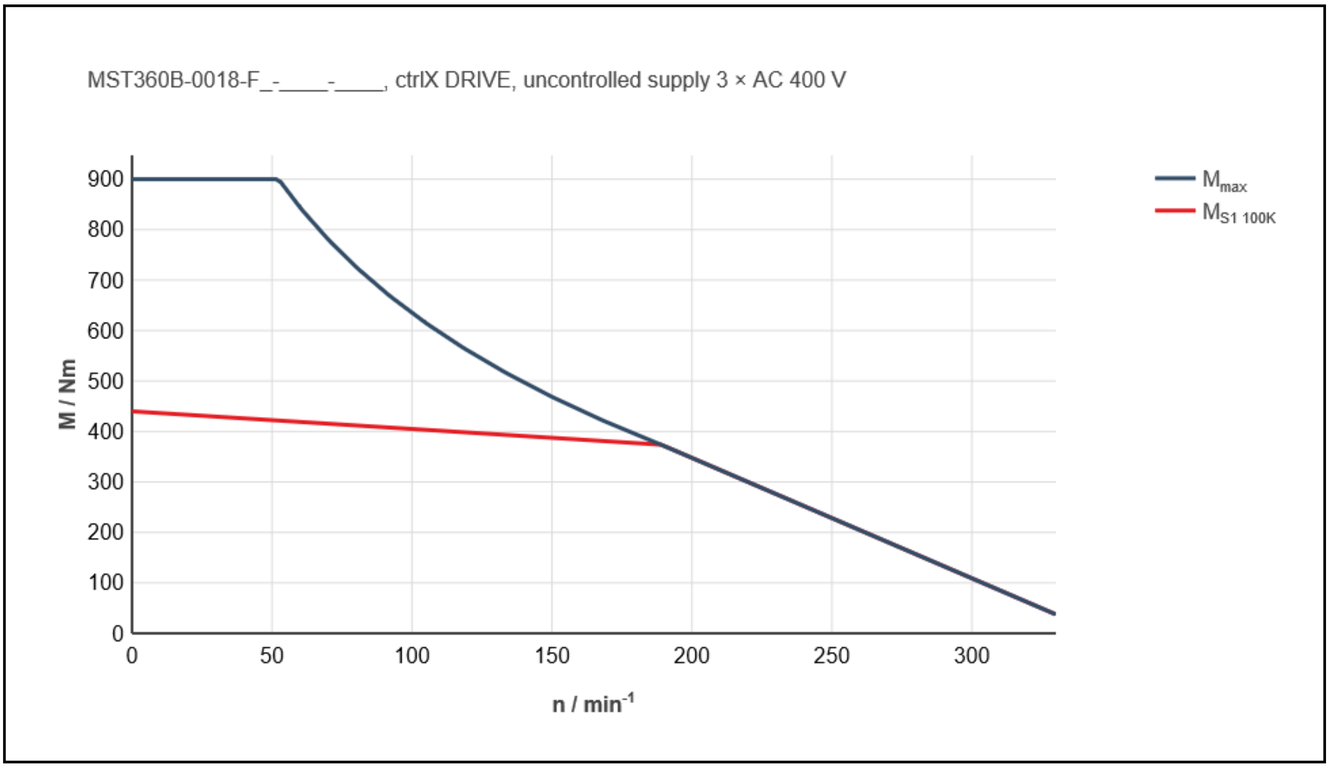


Fig. 4-47: Motor characteristic curve of MST360B-0018-F... at 540 V_{DC}

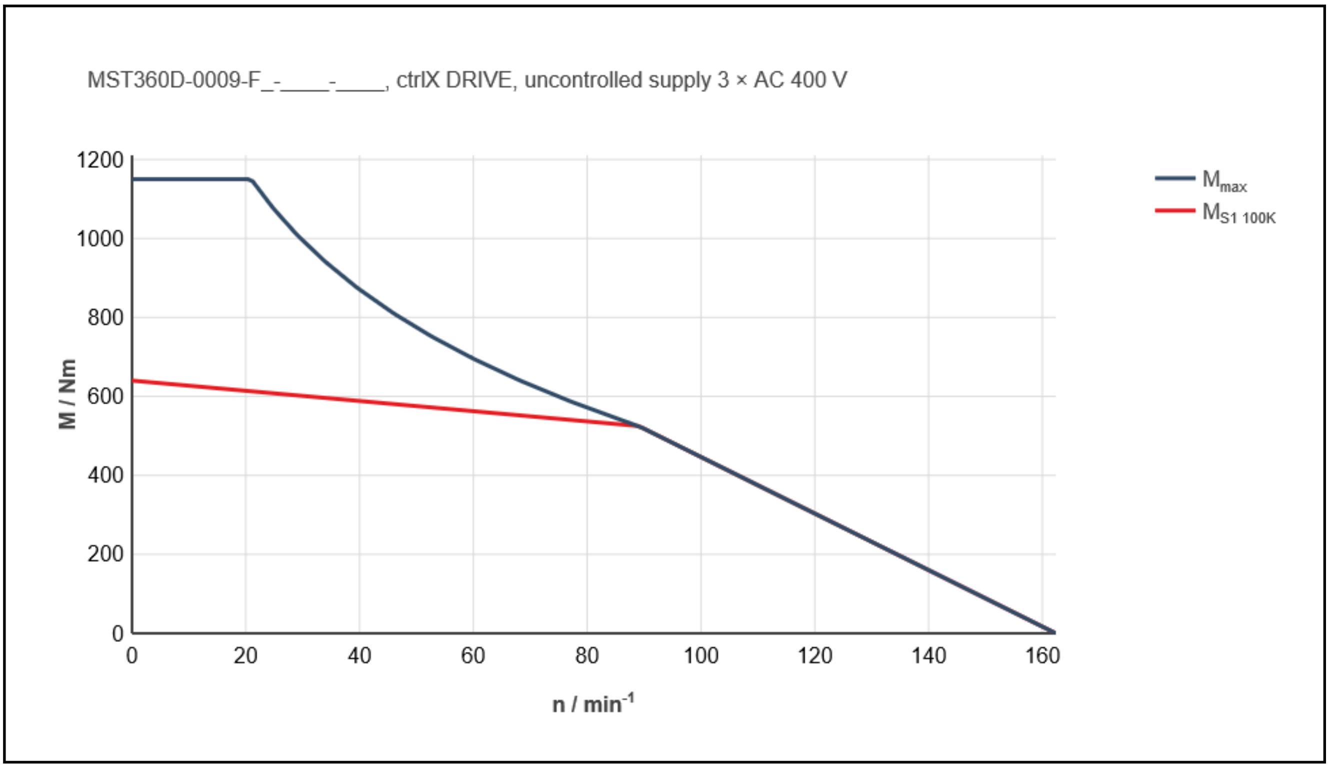


Fig. 4-48: Motor characteristic curve of MST360D-0009-F... at 540 V_{DC}

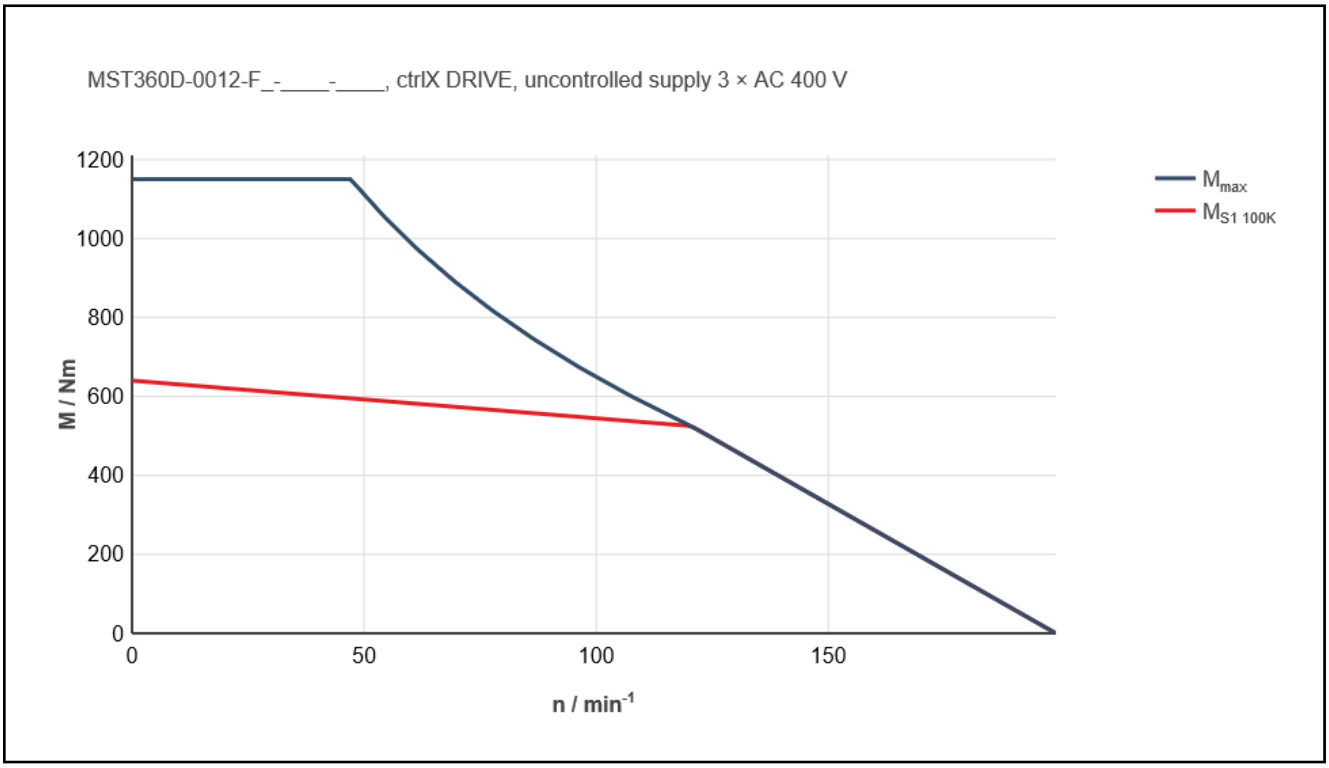


Fig. 4-49: Motor characteristic curve of MST360D-0012-F... at 540 V_{DC}

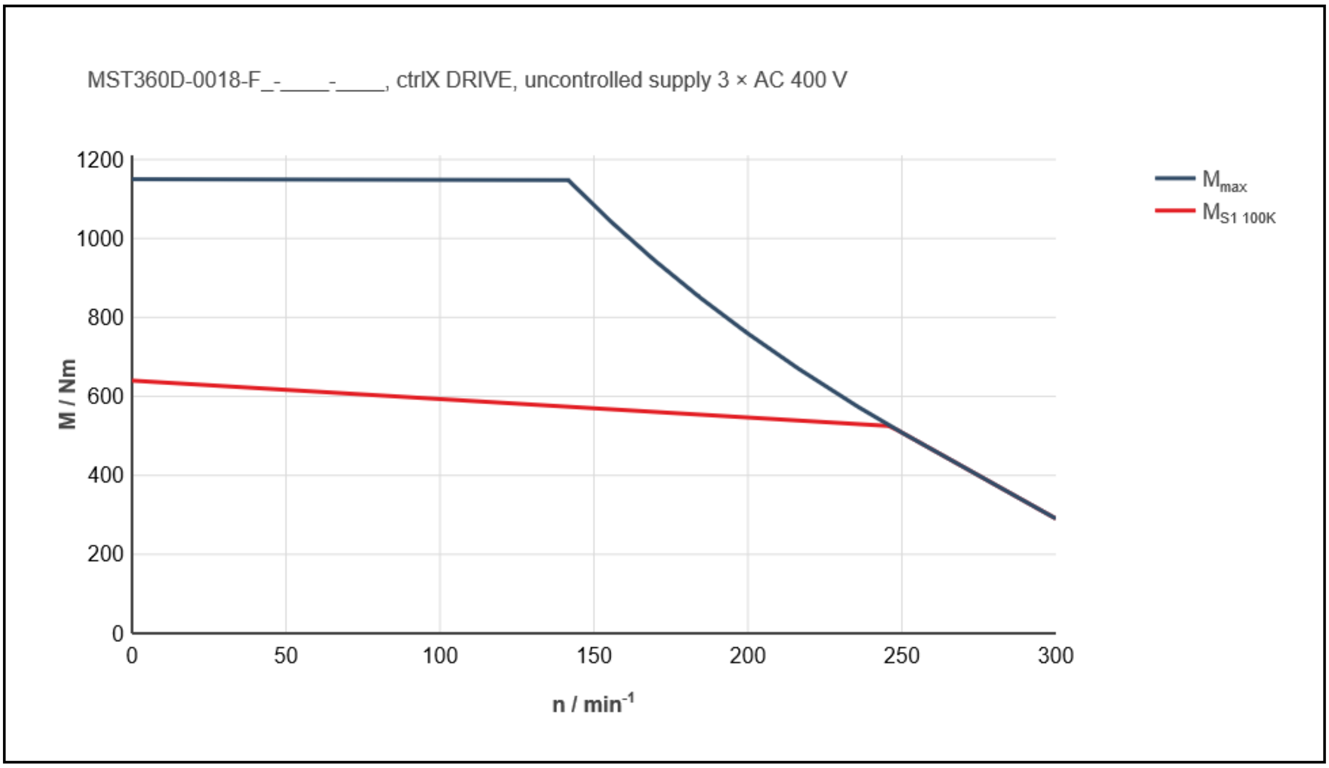


Fig. 4-50: Motor characteristic curve of MST360D-0018-F... at 540 V_{DC}

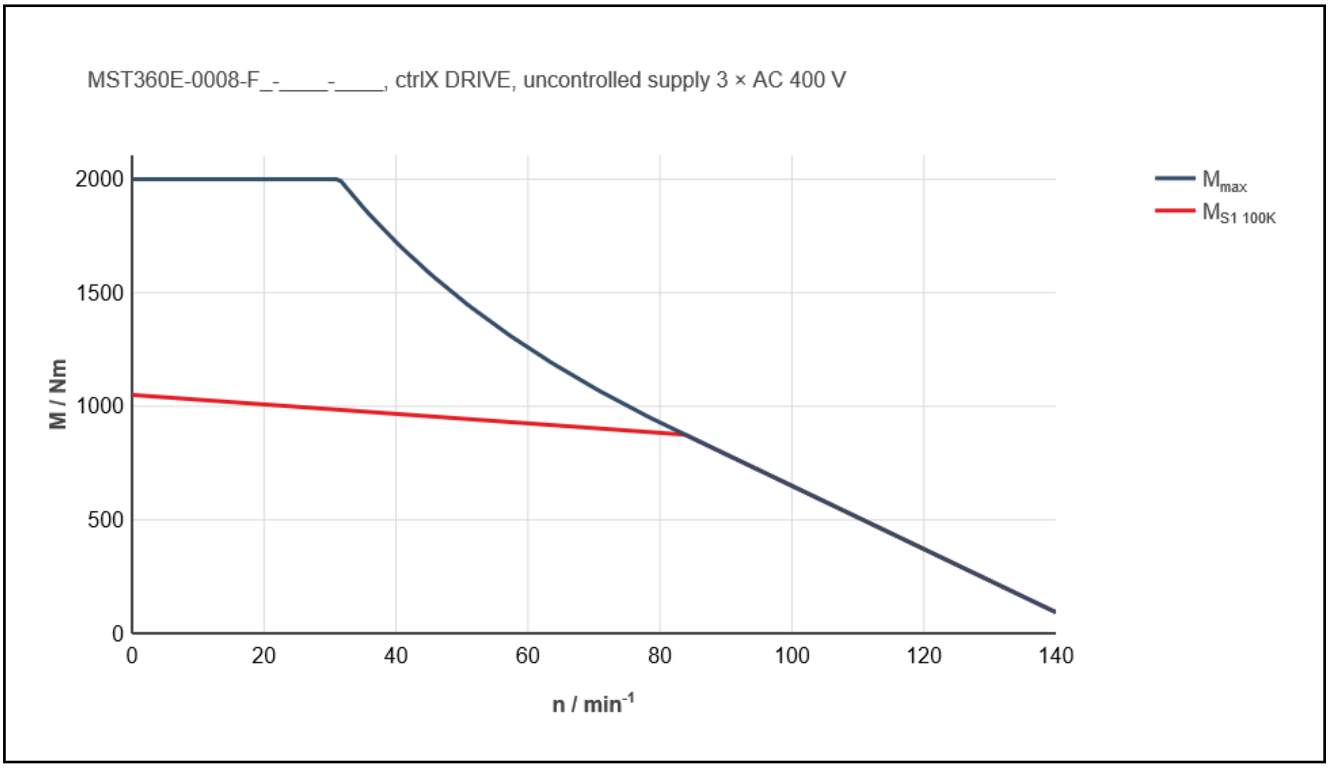


Fig. 4-51: Motor characteristic curve of MST360E-0008-F... at 540 V_{DC}

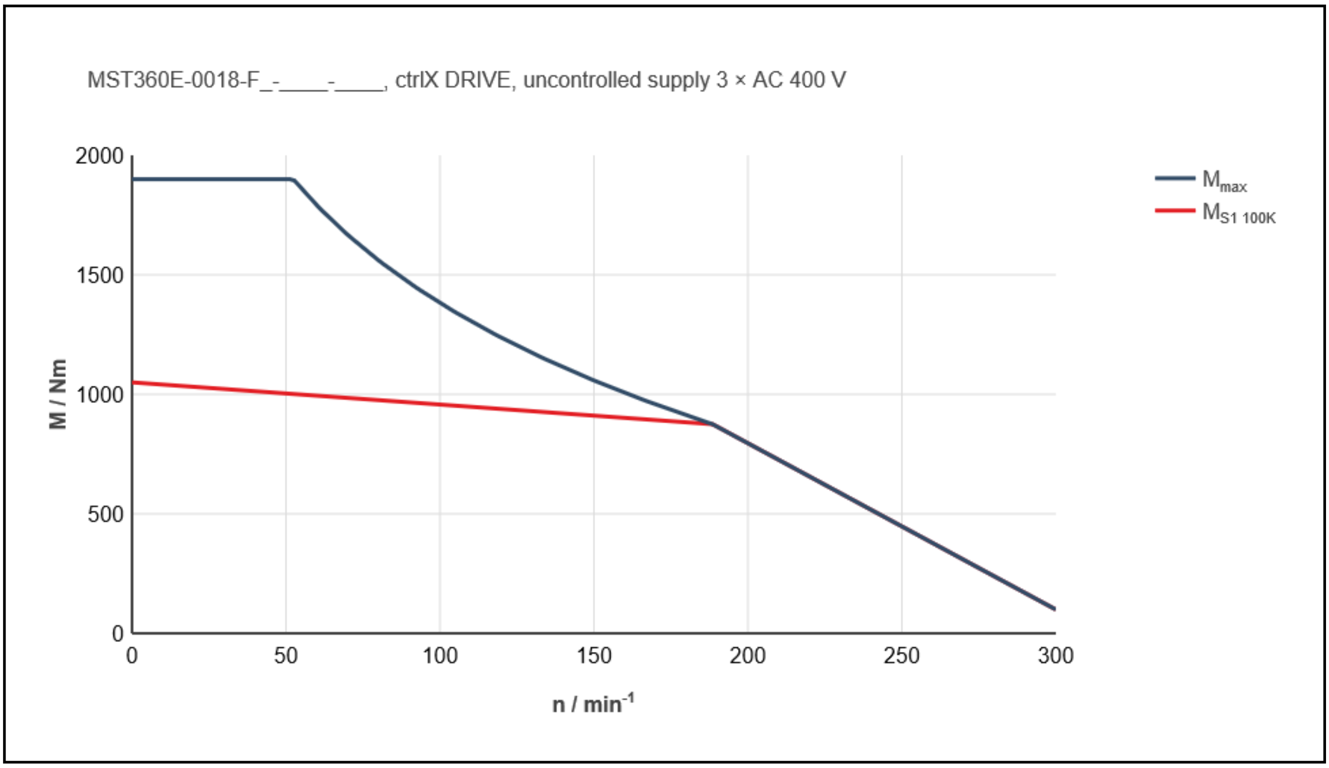


Fig. 4-52: Motor characteristic curve of MST360E-0018-F... at 540 V_{DC}

4.12 Frame size 450

4.12.1 Data sheet MST450

Designation	Symbol	Unit	MST450B	MST450D	
			0012-F	0006-F	0012-F
Standstill torque	M_0	Nm	640	965	
Standstill current	I_0	A	24.4	21.7	36.7
Rated torque	M_N	Nm	540.0	810.0	
Rated power	P_N	kW	10.50	8.10	16.10
Rated current	I_N	A	20.4	18.1	31.0
Rated speed	n_N	min^{-1}	185	95	190
Maximum torque	M_{max}	Nm	1350	2075	
Maximum current	I_{max}	A	65.0	60.0	100.0
Max. speed (electrical)	n_{max}	min^{-1}	350		
Power wire cross-section	A	mm^2	2.5		6.0
Torque constant at 20 °C	K_{M_N}	Nm/A	26.23	44.47	26.29
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	1.455	2.500	1.455
Thermal time constant	T_{th_nom}	min	6.0		
Winding resistance at 20 °C	R_{12}	Ohm	2.4	3.9	1.4
Winding inductance	L_{12}	mH	17.8	31.0	11.2
Leakage capacitance of the component	C_{ab}	nF	9.6	14.5	
Number of pole pairs	p	-	30		
Details about liquid cooling					
Power dissipation	P_V	kW	3.00	4.00	
Coolant inlet temperature	T_{in}	°C	10 ... 40		
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10		
Required coolant flow at P_V	Q_{min}	l/min	4.3	5.7	
Pressure drop at Q_{min}	Δp	bar	0.1		
Volume of coolant duct	V_{cool}	l	0.33	0.48	
Maximum allowed inlet pressure	p_{max}	bar	6.0		
Latest amendment: 2020-11-27					

Tab. 4-23: MST450B/ -D - Technical data

Designation	Symbol	Unit	MST450E			
			0006-F	0011-N	0012-F	0018-N
Standstill torque	M_0	Nm	1,600	625	1,600	625
Standstill current	I_0	A	33.1	14.3	48.6	19.8
Rated torque	M_N	Nm	1400.0	560.0	1400.0	540.0
Rated power	P_N	kW	12.70	6.50	21.20	10.20
Rated current	I_N	A	27.8	12.8	40.7	17.7
Rated speed	n_N	min^{-1}	90	110	150	180
Maximum torque	M_{max}	Nm	3250			
Maximum current	I_{max}	A	85.0	88.0	125.0	
Max. speed (electrical)	n_{max}	min^{-1}	350	135	350	195
Power wire cross-section	A	mm^2	6.0	1.0	10.0	2.5
Torque constant at 20 °C	K_{M_N}	Nm/A	48.34	43.80	35.92	30.40
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	2.759	3.860	1.818	1.930
Thermal time constant	T_{th_nom}	min	6.0	170.0	6.0	170.0
Winding resistance at 20 °C	R_{12}	Ohm	2.6		1.16	
Winding inductance	L_{12}	mH	21.9	22.1	10.0	
Leakage capacitance of the component	C_{ab}	nF	21.3	24.1	21.3	24.1
Number of pole pairs	p	-	30			
Details about liquid cooling						
Power dissipation	P_V	kW	6.20	1.14	6.20	1.14
Coolant inlet temperature	T_{in}	°C	10 ... 40			
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10		10	
Required coolant flow at P_V	Q_{min}	l/min	8.9	---	8.9	---
Pressure drop at Q_{min}	Δp	bar	0.1		0.1	
Volume of coolant duct	V_{cool}	l	0.86		0.86	
Maximum allowed inlet pressure	p_{max}	bar	6.0		6.0	
Latest amendment: 2020-11-16						

Tab. 4-24: MST450E - Technical data

4.12.2 Data sheet MRT450

Designation	Symbol	Unit	MRT450B	MRT450D	MRT450E
			_-0350		
Rotor inertia	J_{rot}	kg * m²	0.45000	0.64000	1.01000
Rotor mass	m_{rot}	kg	13.0	17.9	27.7
Maximum speed (mechanical)	$n_{max\ mech}$	min^{-1}	1400		
Latest amendment: 2016-11-09					

Tab. 4-25: MRT450 - Technical data

4.12.3 Motor characteristic curves MST450

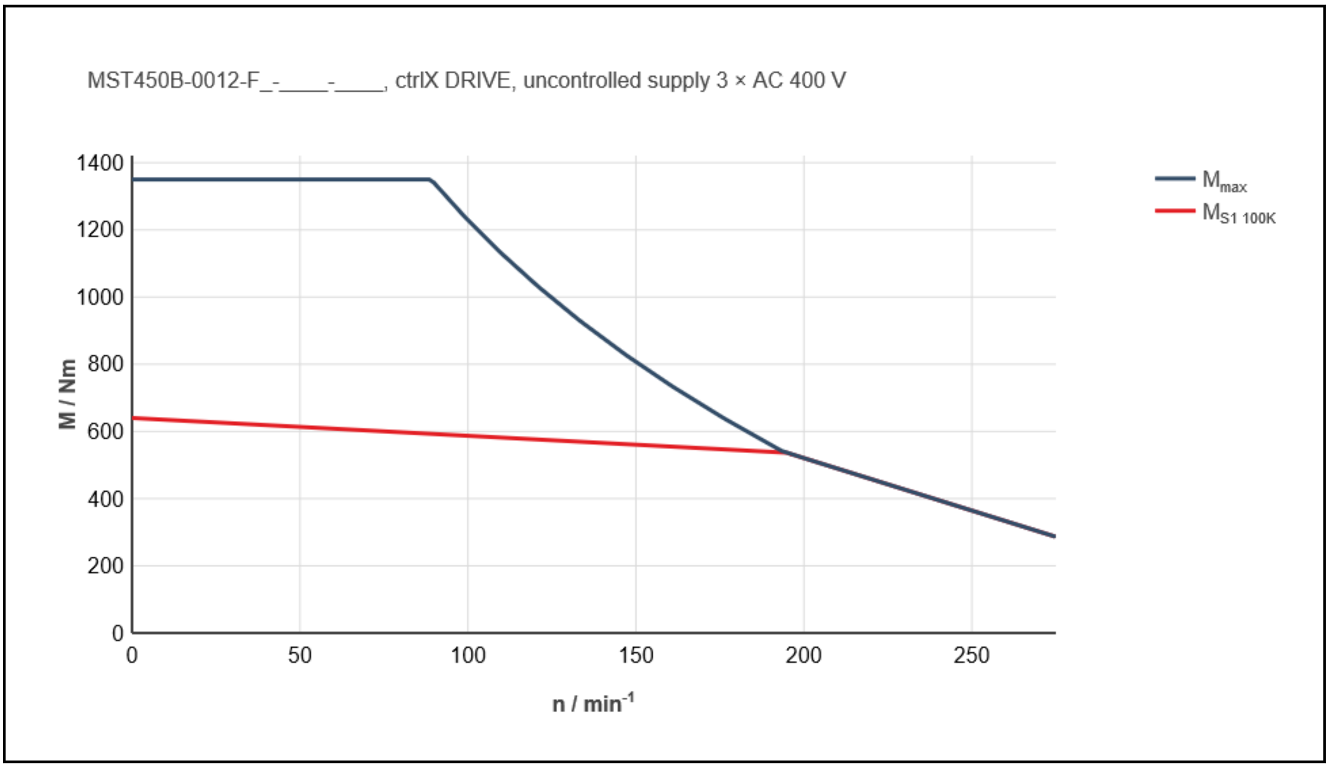


Fig. 4-53: Motor characteristic curve of MST450B-0012-F... at 540 V_{DC}

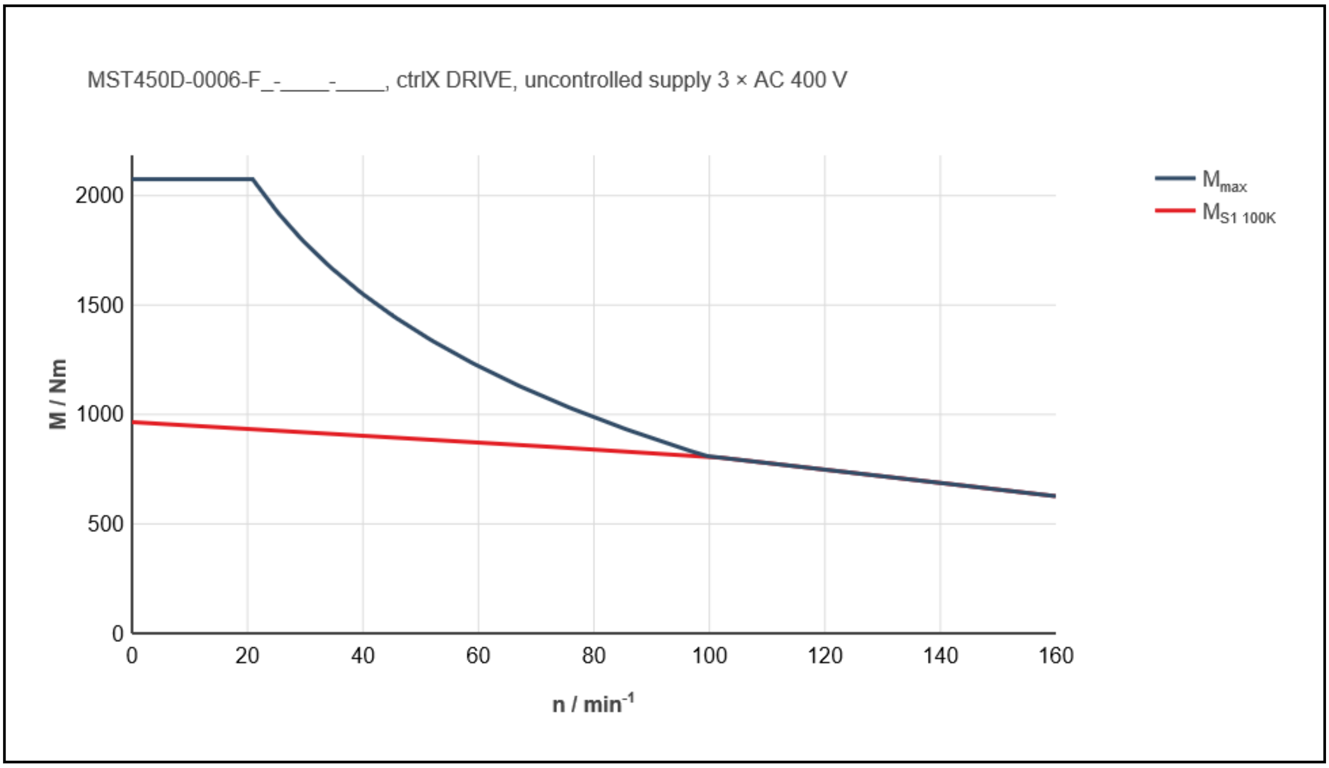


Fig. 4-54: Motor characteristic curve of MST450D-0006-F... at 540 V_{DC}

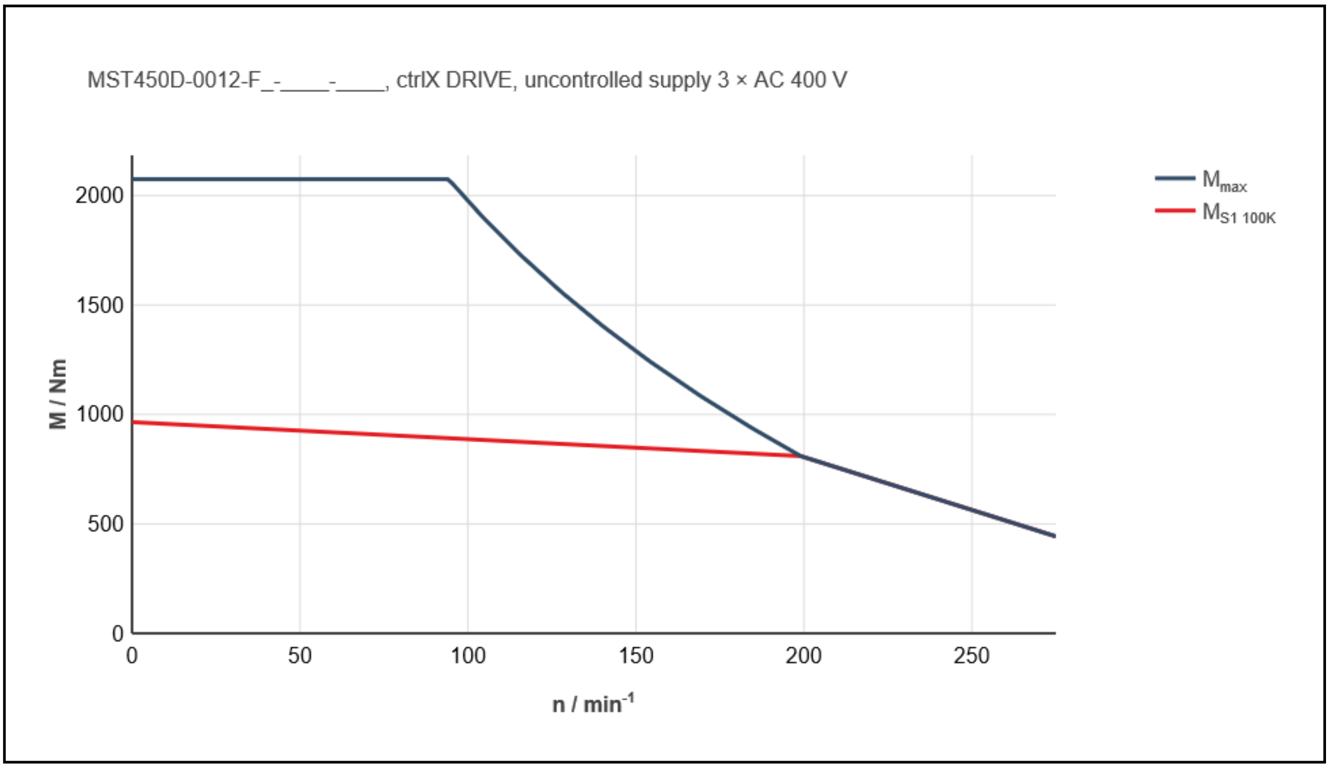


Fig. 4-55: Motor characteristic curve of MST450D-0012-F... at 540 V_{DC}

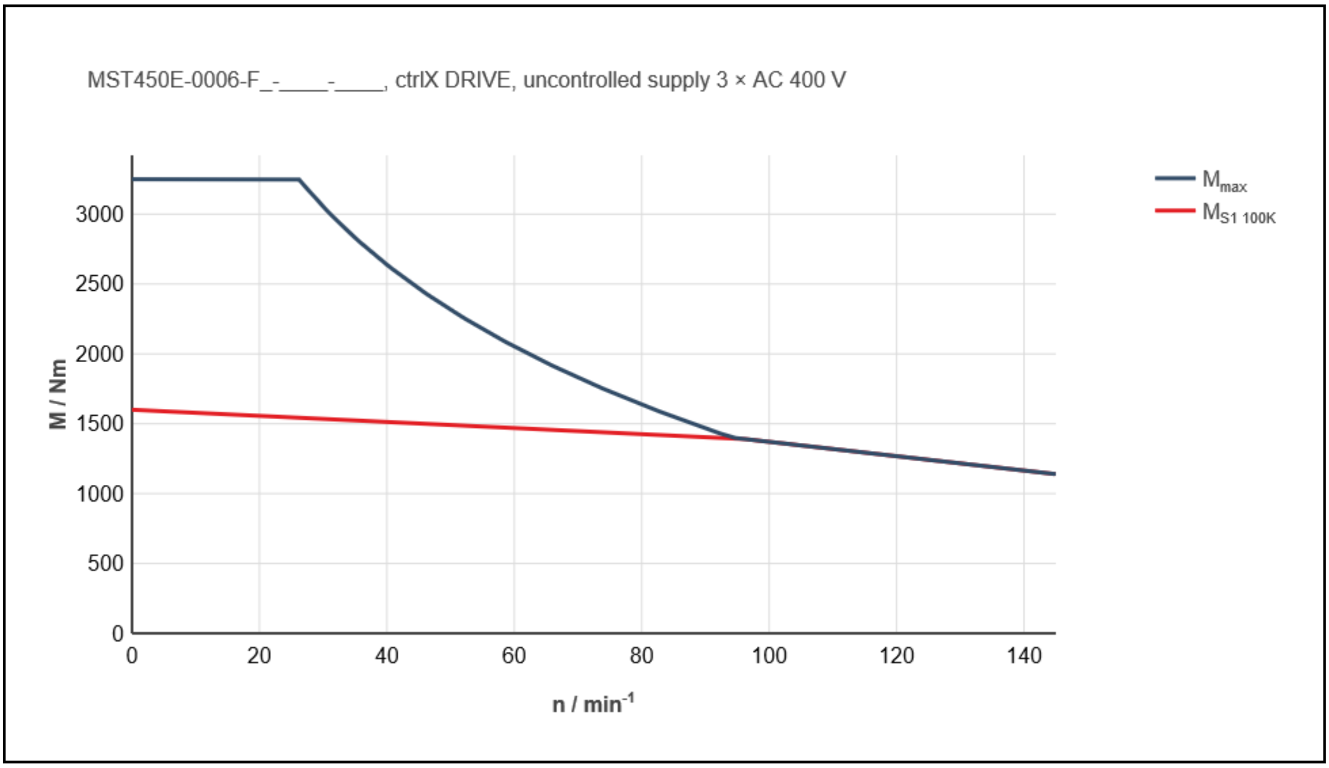


Fig. 4-56: Motor characteristic curve of MST450E-0006-F... at 540 V_{DC}

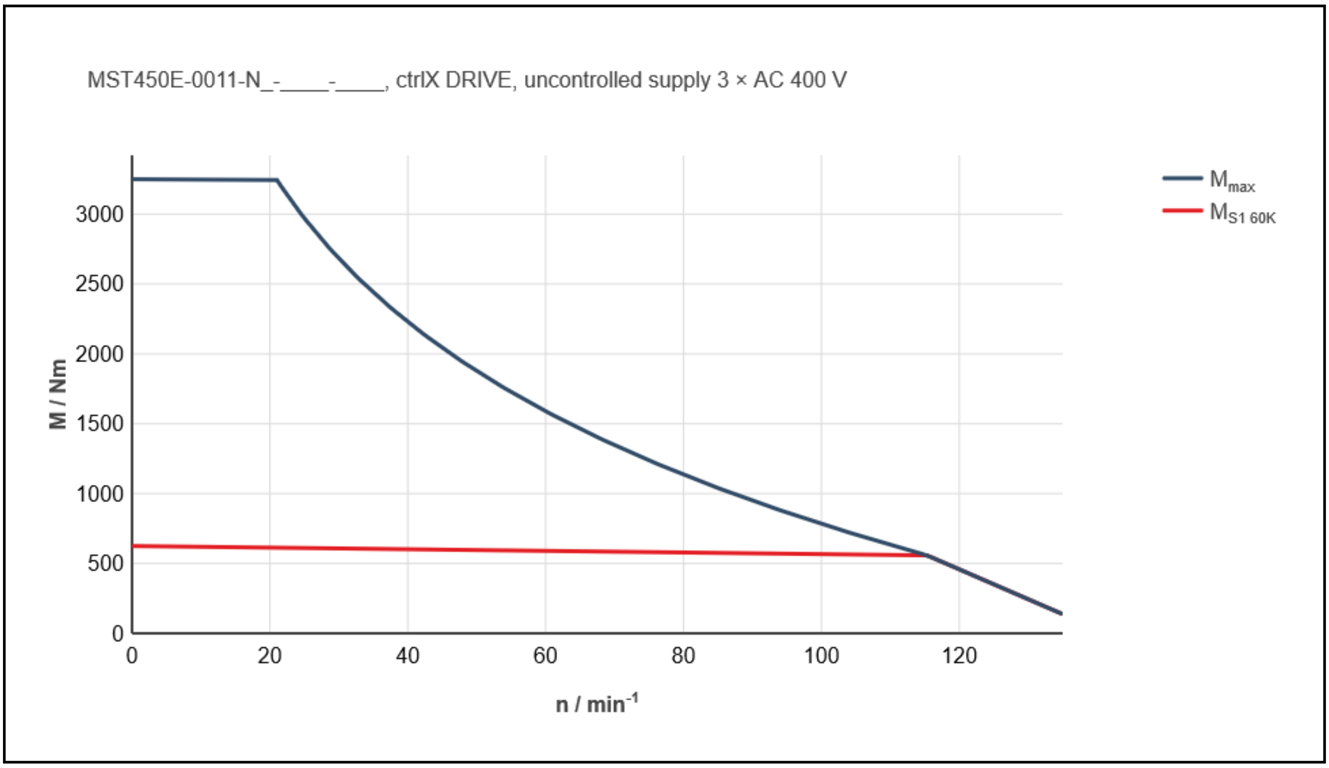


Fig. 4-57: Motor characteristic curve of MST450E-0011-N... at 540 V_{DC}

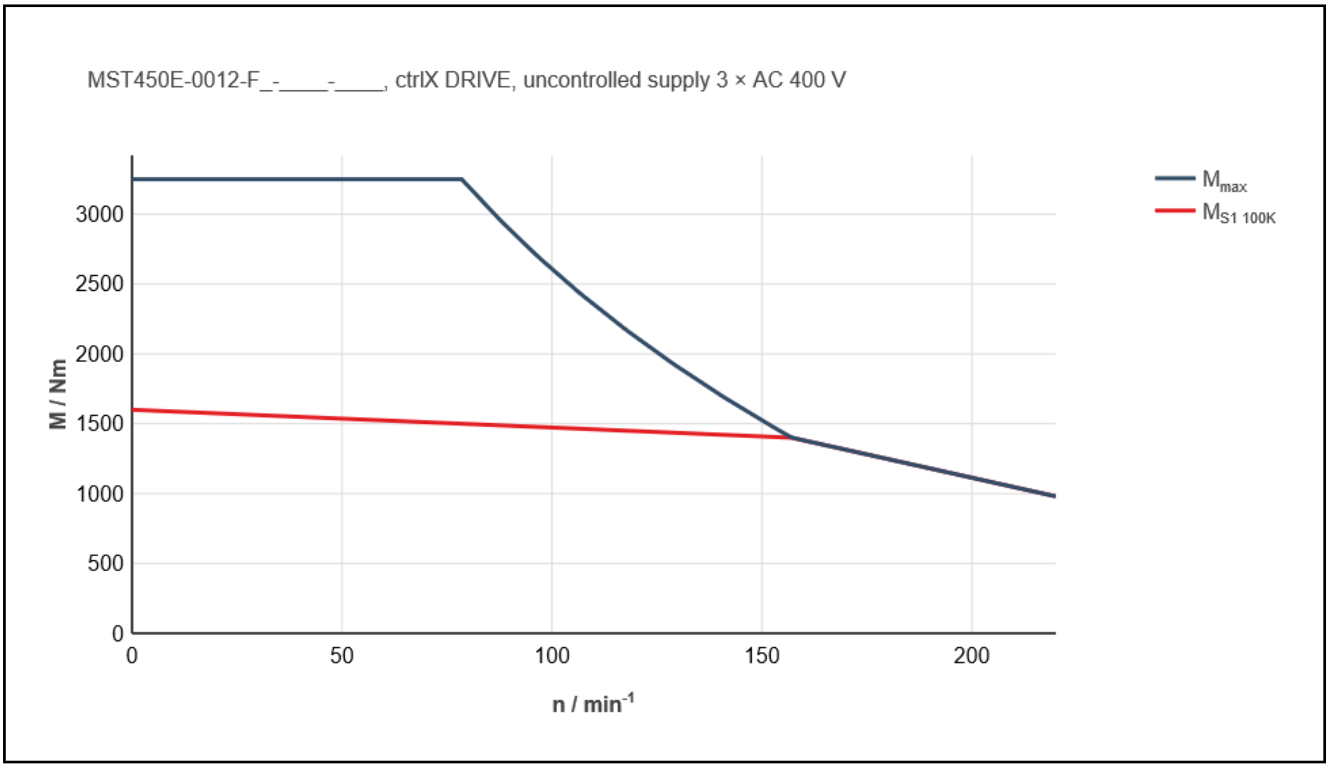


Fig. 4-58: Motor characteristic curve of MST450E-0012-F... at 540 V_{DC}

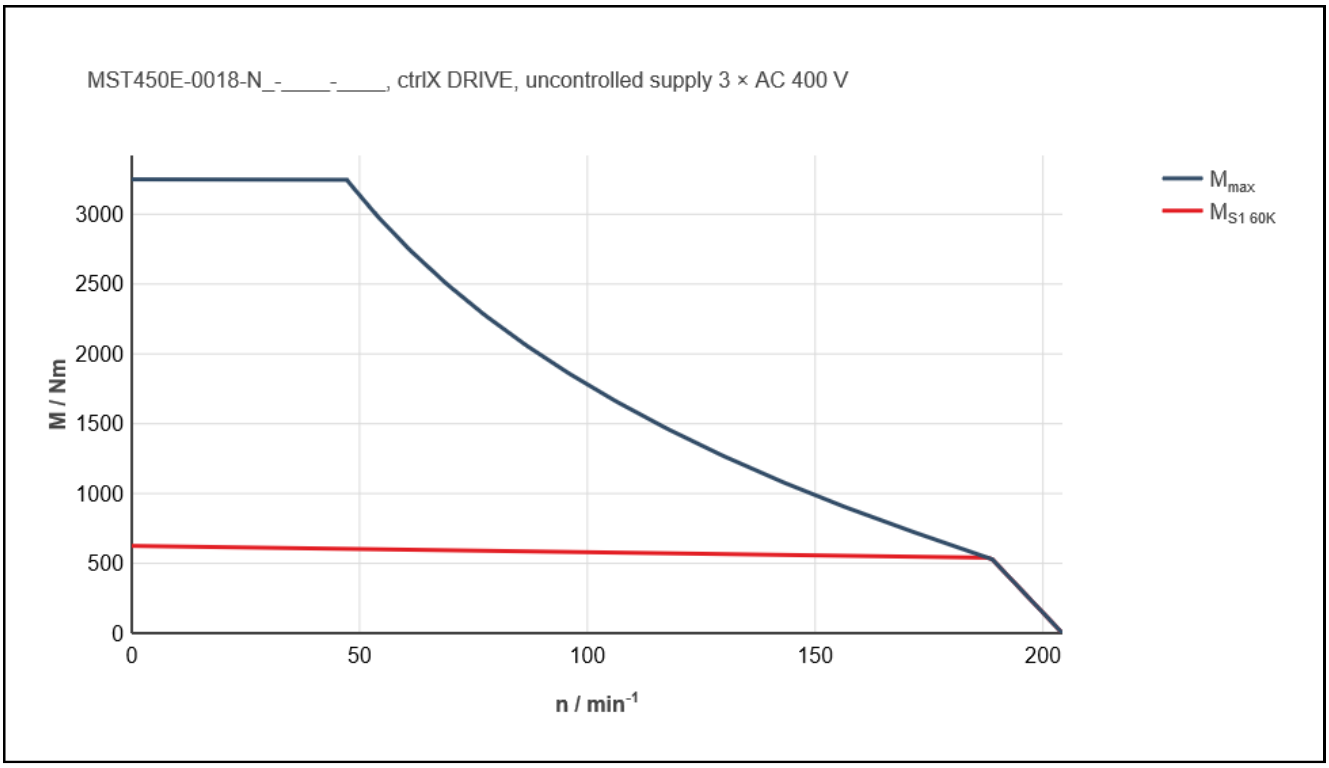


Fig. 4-59: Motor characteristic curve of MST450E-0018-N... at 540 V_{DC}

4.13 Frame size 530

4.13.1 Data sheet MST530

Designation	Symbol	Unit	MST530B	MST530C			MST530D
			0010-F	0010-F	0010-N	0014-F	0012-F
Standstill torque	M_0	Nm	960	1440	600	1440	1920
Standstill current	I_0	A	34.3	37.4	15.6	43.0	53.8
Rated torque	M_N	Nm	800.0	1,200.0	580.0	1,200.0	1,680.0
Rated power	P_N	kW	8.40	12.60	6.10	15.70	21.10
Rated current	I_N	A	28.6	31.2	15.0	35.8	47.2
Rated speed	n_N	min^{-1}	100			125	120
Maximum torque	M_{max}	Nm	1800	2,700			3760
Maximum current	I_{max}	A	71.0	88.0		100.0	156.4
Max. speed (electrical)	n_{max}	min^{-1}	200	140		175	170
Power wire cross-section	A	mm^2	4.0	6.0			10.0
Torque constant at 20 °C	K_{M_N}	Nm/A	28.00	38.50		33.52	35.59
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	1.890	2.810		1.486	2.531
Thermal time constant	T_{th_nom}	min	8.3		15.0	8.3	
Winding resistance at 20 °C	R_{12}	Ohm	1.4	2.0		1.187	1.017
Winding inductance	L_{12}	mH	16.2	24.6		14.1	11.91
Leakage capacitance of the component	C_{ab}	nF	10.1	15.2			18.4
Number of pole pairs	p	-	35				
Details about liquid cooling							
Power dissipation	P_V	kW	3.30	4.30	1.30	4.80	5.40
Coolant inlet temperature	T_{in}	°C	10 ... 40		-	10 ... 40	
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10		-	10	
Required coolant flow at P_V	Q_{min}	l/min	4.8		---	5.4	7.0
Pressure drop at Q_{min}	Δp	bar	0.1		-	0.1	0.2
Volume of coolant duct	V_{cool}	l	0.60	0.90	-	0.90	1.20
Maximum allowed inlet pressure	p_{max}	bar	6.0		-	6.0	
Latest amendment: 2019-12-05							

Tab. 4-26: MST530B/ -C/ -D - Technical data

Designation	Symbol	Unit	MST530E 0010-F	MST530F 0012-F	MST530P 0012-F	MST530R 0011-F
Standstill torque	M_0	Nm	2,400	2880	3300	4320
Standstill current	I_0	A	73.1	82.0	93.9	119.6
Rated torque	M_N	Nm	2100.0	2520.0	2940.0	3780.0
Rated power	P_N	kW	19.80	31.70	36.90	43.50
Rated current	I_N	A	64.0	71.3	83.8	104.7
Rated speed	n_N	min^{-1}	90	120		110
Maximum torque	M_{max}	Nm	4700	5640	6580	8460
Maximum current	I_{max}	A	212.0	253.0	284.0	339.0
Max. speed (electrical)	n_{max}	min^{-1}	200	175	180	175
Power wire cross-section	A	mm^2	16.0		25.0	2x16.0
Torque constant at 20 °C	K_{M_N}	Nm/A	32.80	35.30	35.10	36.10
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	2.090	2.430	3.128	4.139
Thermal time constant	T_{th_nom}	min	8.3			
Winding resistance at 20 °C	R_{12}	Ohm	0.59	0.546	0.485	0.397
Winding inductance	L_{12}	mH	7.5	6.45	5.76	5.5
Leakage capacitance of the component	C_{ab}	nF	23.0	27.6	32.2	41.4
Number of pole pairs	p	-	35			
Details about liquid cooling						
Power dissipation	P_V	kW	6.70	8.10	8.70	11.20
Coolant inlet temperature	T_{in}	°C	10 ... 40			
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10			
Required coolant flow at P_V	Q_{min}	l/min	9.5	11.5	12.5	16.1
Pressure drop at Q_{min}	Δp	bar	0.2		0.3	0.4
Coolant channel volume	V_{cool}	l	1.50	1.80	1.65	1.80
Maximum allowed inlet pressure	p_{max}	bar	6.0			
Latest amendment: 2020-12-01						

Tab. 4-27: MST530E/ -F/ -P/ -R - Technical data

Designation	Symbol	Unit	MST530G			MST530L		
			0006-F	0007-F	0010-F	0003-F	0006-F	0007-F
Standstill torque	M_0	Nm	4800			7200		
Standstill current	I_0	A	83.4	90.7	133.5	66.1	137.1	152
Rated torque	M_N	Nm	4,200.0			6,300.0		
Rated power	P_N	kW	26.40	30.80	44.00	19.80	39.60	46.20
Rated current	I_N	A	73.0	79.4	116.8	57.8	120.0	133.0
Rated speed	n_N	min^{-1}	60	70	100	30	60	70
Maximum torque	M_{max}	Nm	9200			11,000	13800	
Maximum current	I_{max}	A	240.0	305.0	350.0	120.0	279.0	308.0
Max. speed (electrical)	n_{max}	min^{-1}	105	115	160	55	110	
Power wire cross-section	A	mm^2	2x10.0	2x16.0	2x25.0	10.0	2x25.0	
Torque constant at 20 °C	K_{M_N}	Nm/A	55.30	43.80	32.70	109.00	52.50	47.40
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	4.400	3.650	2.700	6.700	3.350	3.000
Thermal time constant	T_{th_nom}	min	8.3					
Winding resistance at 20 °C	R_{12}	Ohm	0.833	0.706	0.336	1.9	0.46	0.52
Winding inductance	L_{12}	mH	12.0	8.8	4.5	25.9	6.4	5.3
Leakage capacitance of the component	C_{ab}	nF	50.7			76.1		
Number of pole pairs	p	-	35					
Details about liquid cooling								
Power dissipation	P_V	kW	11.50			15.00		
Coolant inlet temperature	T_{in}	°C	10 ... 40					
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10					
Required coolant flow at P_V	Q_{min}	l/min	16.5			21.5		
Pressure drop at Q_{min}	Δp	bar	0.4			0.7		
Volume of coolant duct	V_{cool}	l	2.00			3.20		
Maximum permissible inlet pressure	p_{max}	bar	6.0					
Latest amendment: 2020-01-07								

Tab. 4-28: MST530G/ -L - Technical data

4.13.2 Data sheet MRT530

Designation	Symbol	Unit	MRT530B	MRT530C	MRT530D	MRT530E	MRT530F
			_-0410				
Rotor inertia	J_{rot}	kg * m²	0.92	1.25	1.54	1.92	2.3
Rotor mass	m_{rot}	kg	22.0	27.5	34.3	38.5	48.8
Maximum speed of rotor	n_{max_mech}	1/min	1100				

Tab. 4-29: Technical data MRT530B, -C, -D, -E, -F

Designation	Symbol	Unit	MRT530P	MRT530R	MRT530G	MRT530L
			_-0410			
Rotor inertia	J_{rot}	kg * m²	2.69	3.46	3.84	5.76
Rotor mass	m_{rot}	kg	56.0	70.5	77.0	115.0
Maximum speed of rotor	n_{max_mech}	1/min	1100			

Tab. 4-30: Technical data MRT530G, -L, -P, -R

4.13.3 Motor characteristic curves MST530

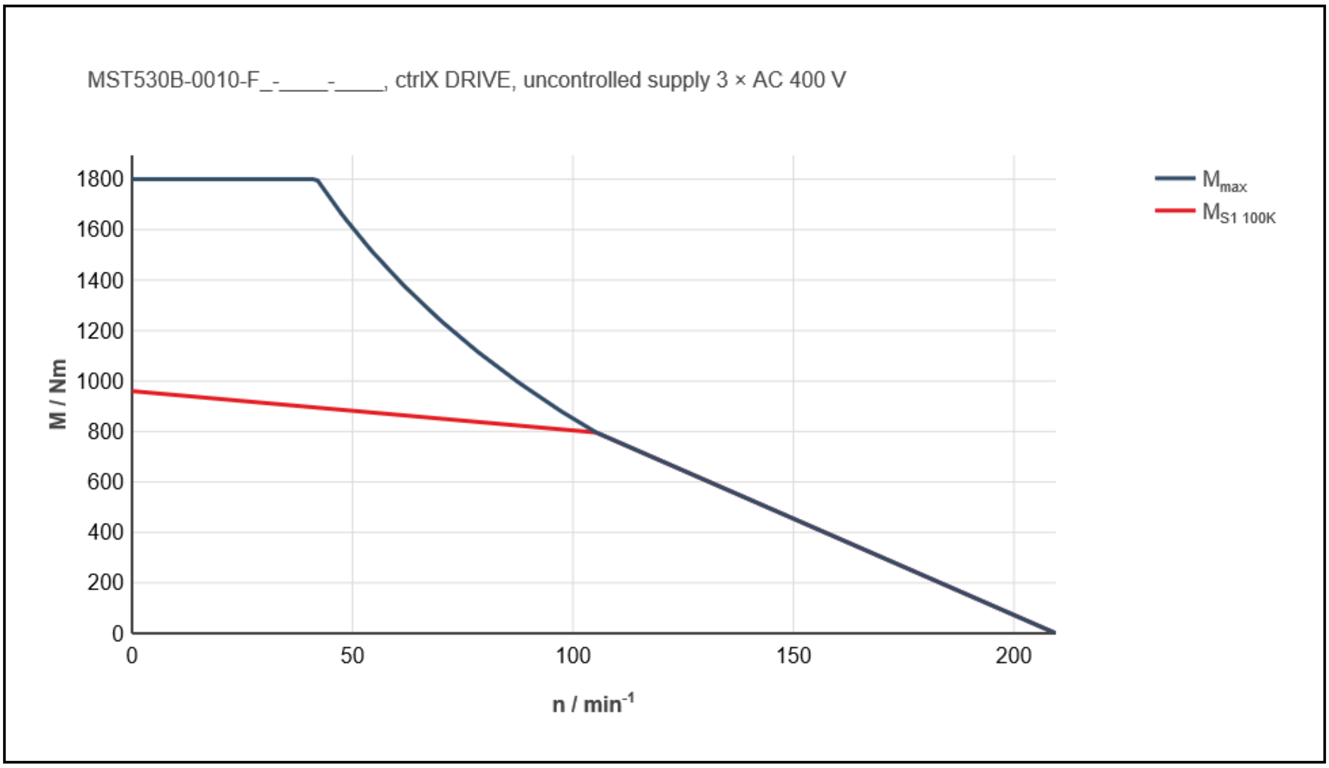


Fig. 4-60: Motor characteristic curve of MST530B-0010-F... at 540 V_{DC}

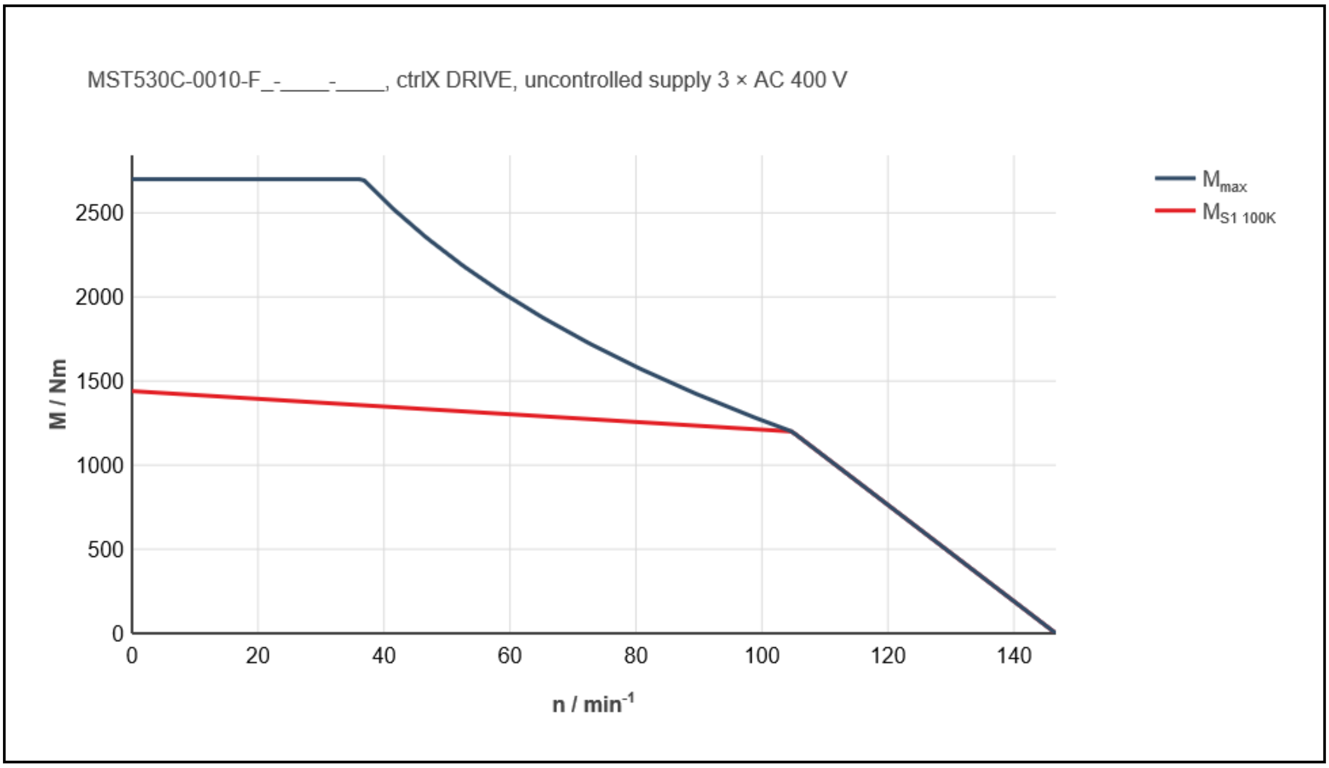


Fig. 4-61: Motor characteristic curve of MST530C-0010-F... at 540 V_{DC}

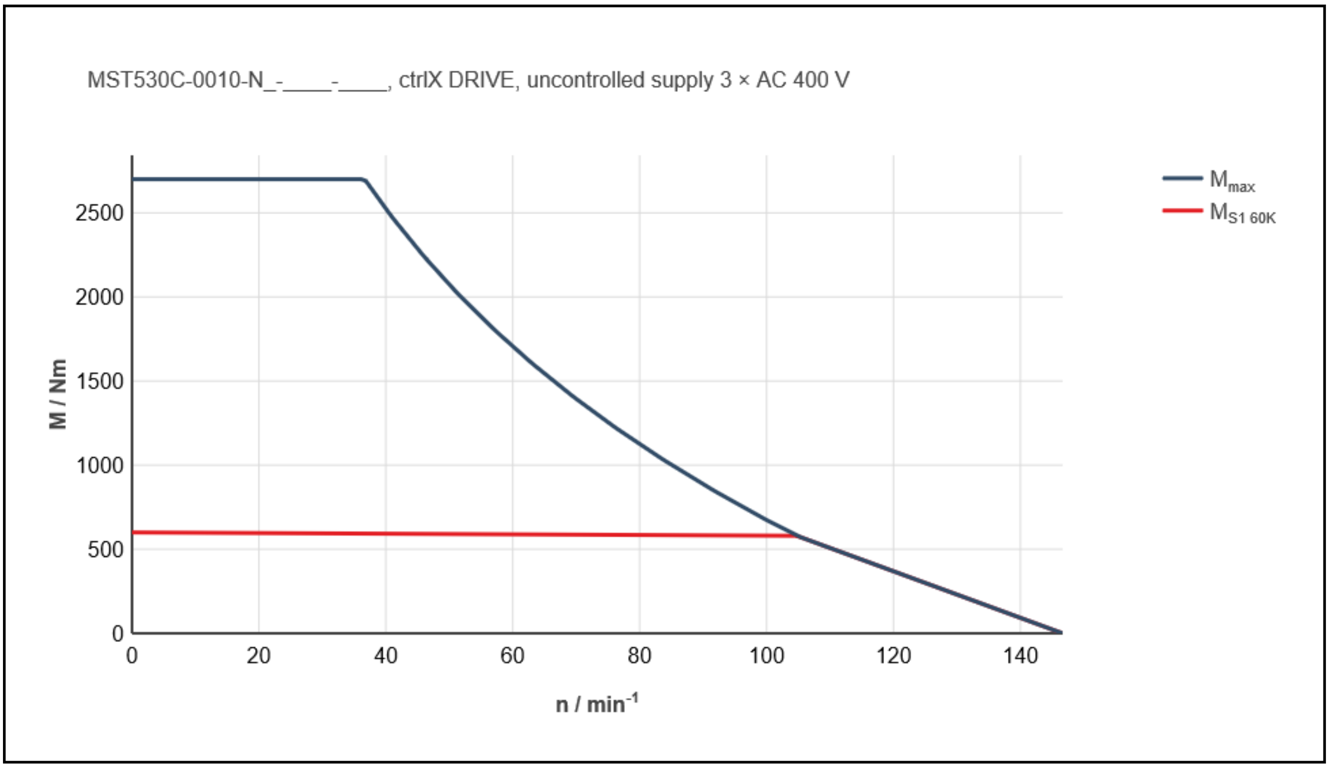


Fig. 4-62: Motor characteristic curve of MST530C-0010-N... at 540 V_{DC}

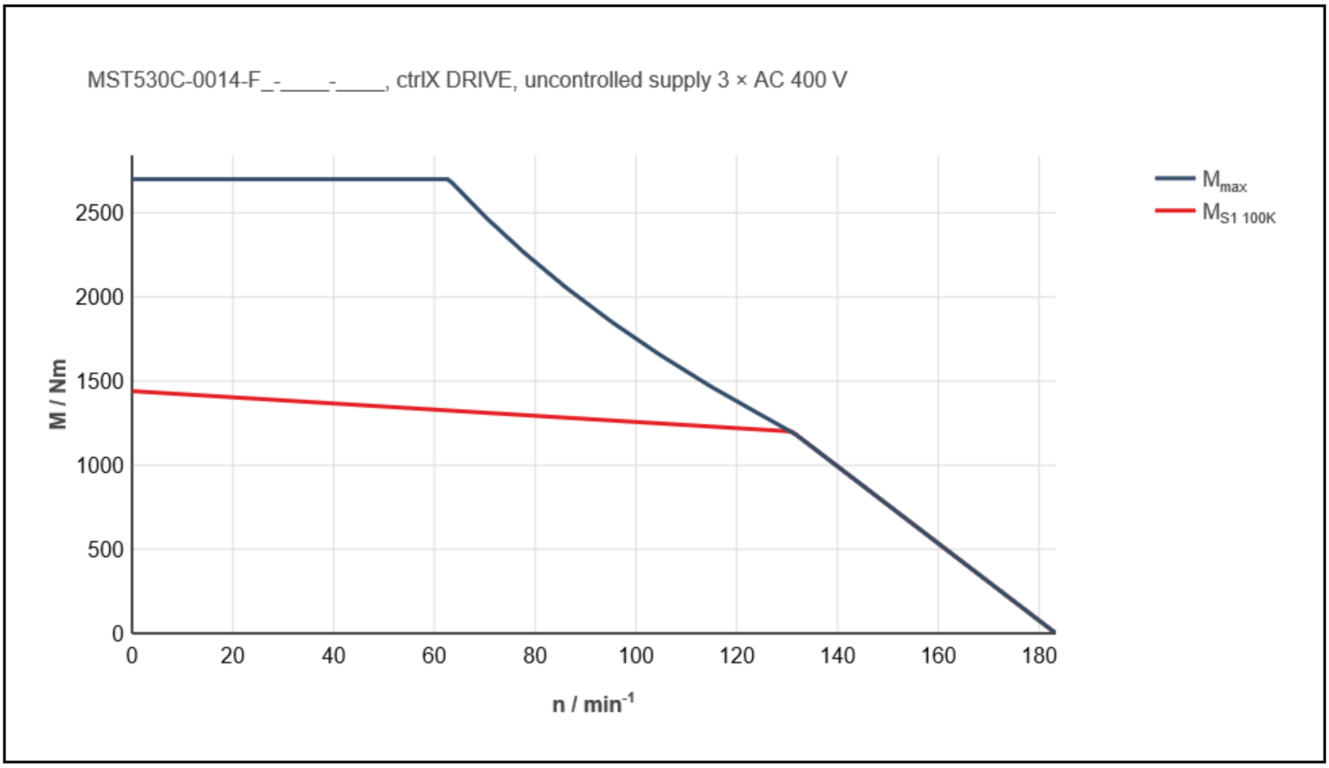


Fig. 4-63: Motor characteristic curve MT530C-0014-F... at 540 V_{DC}

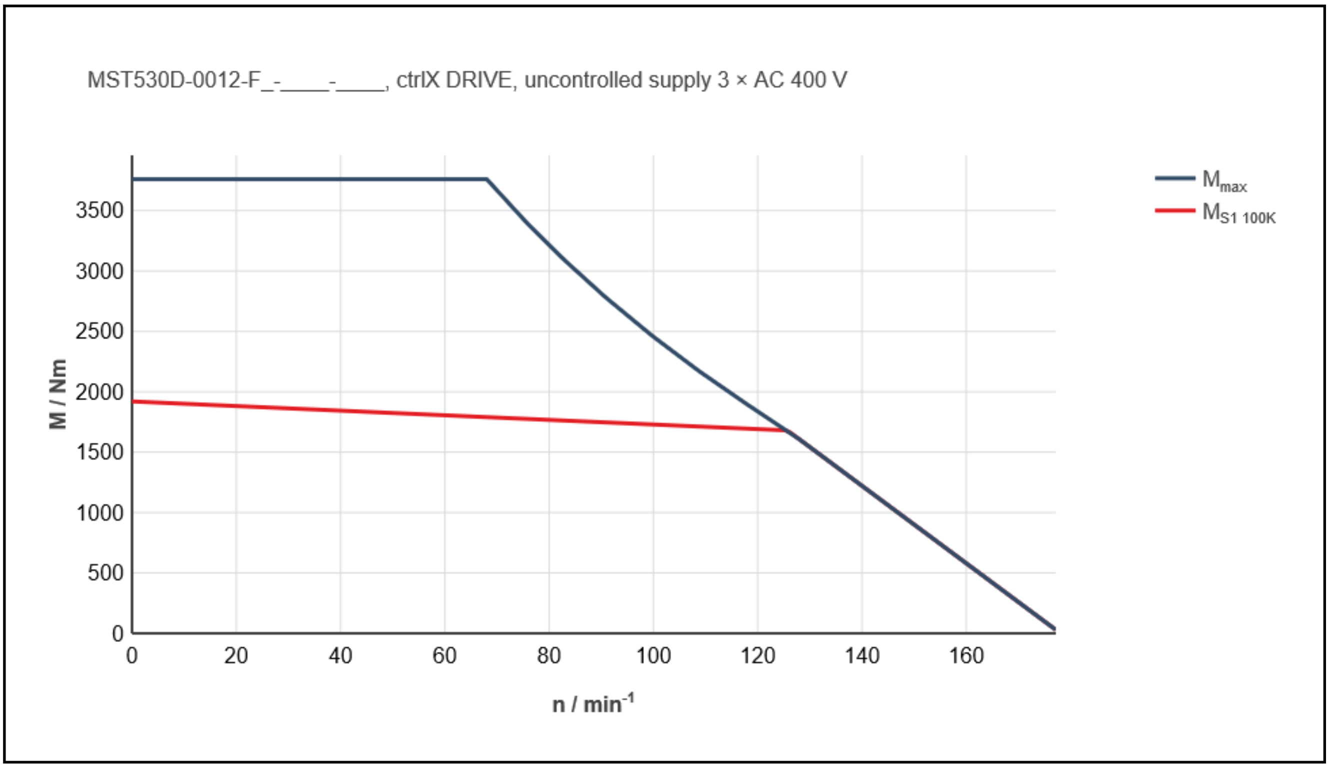


Fig. 4-64: Motor characteristic curve MST530D-0012-F... at 540 V_{DC}

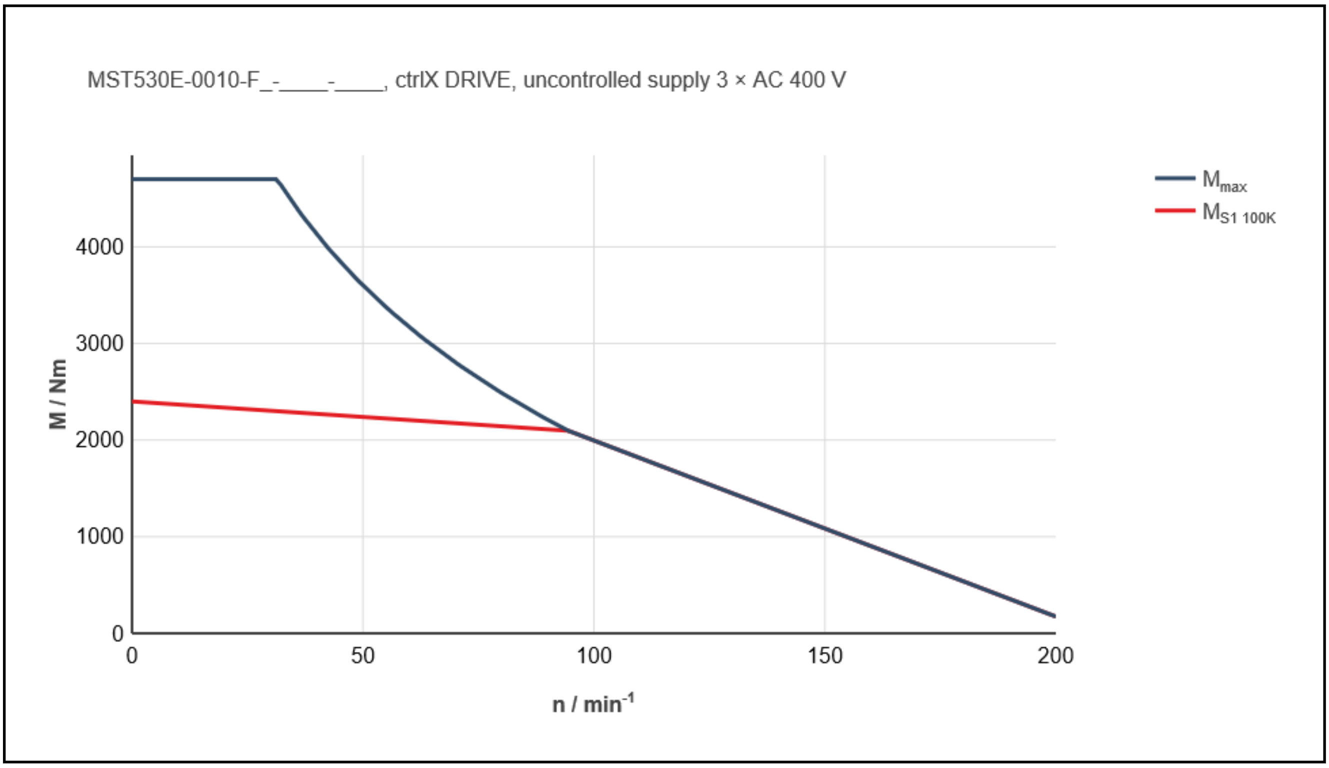


Fig. 4-65: Motor characteristic curve of MST530E-0010-F... at 540 V_{DC}

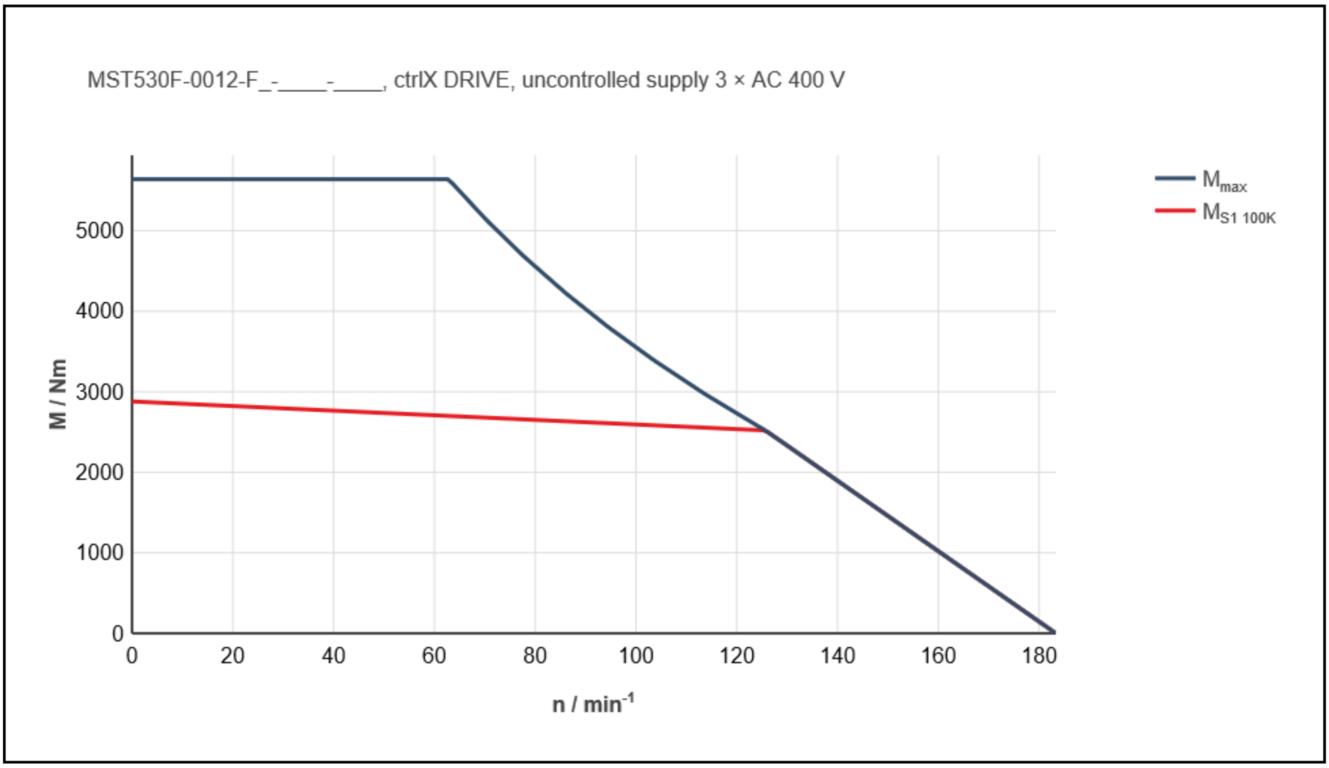


Fig. 4-66: Motor characteristic curve MST530F-0012-F... at 540 V_{DC}

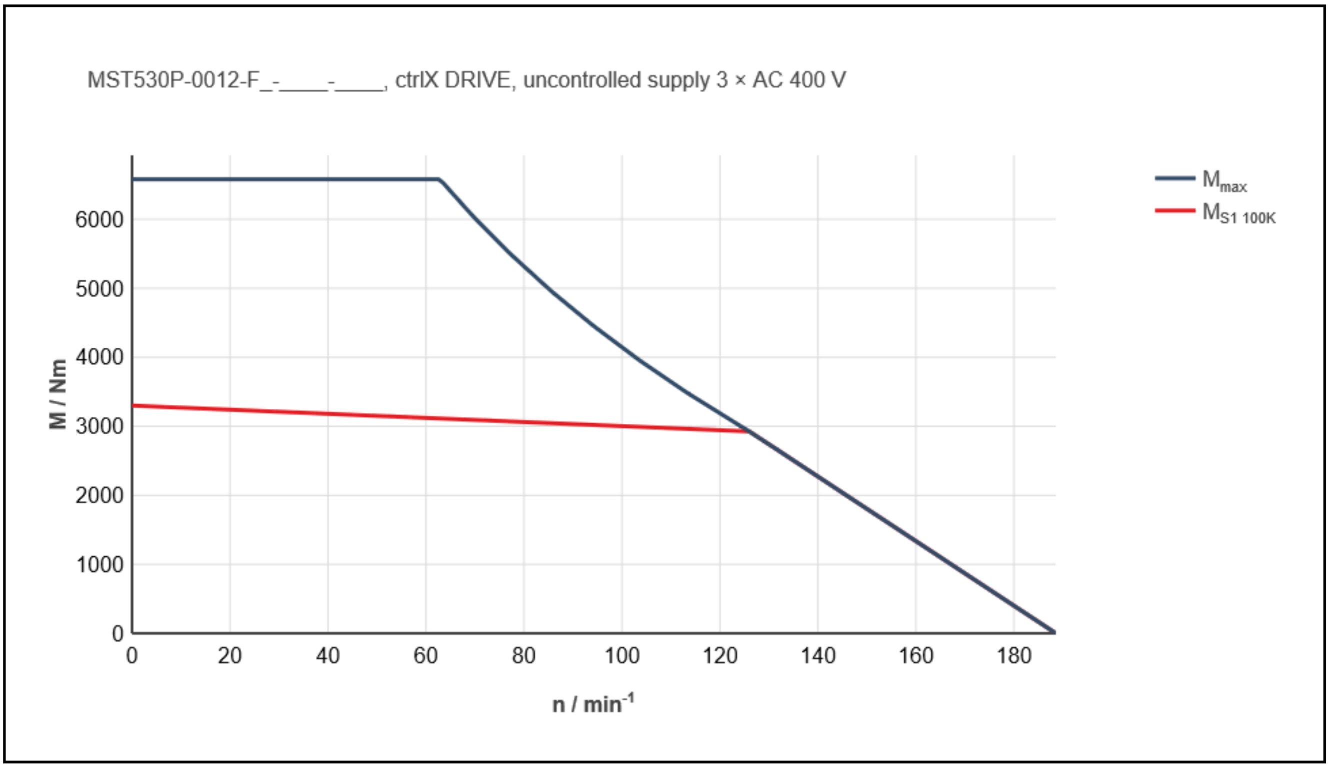


Fig. 4-67: Motor characteristic curve MST530P-0012-F... at 540 V_{DC}

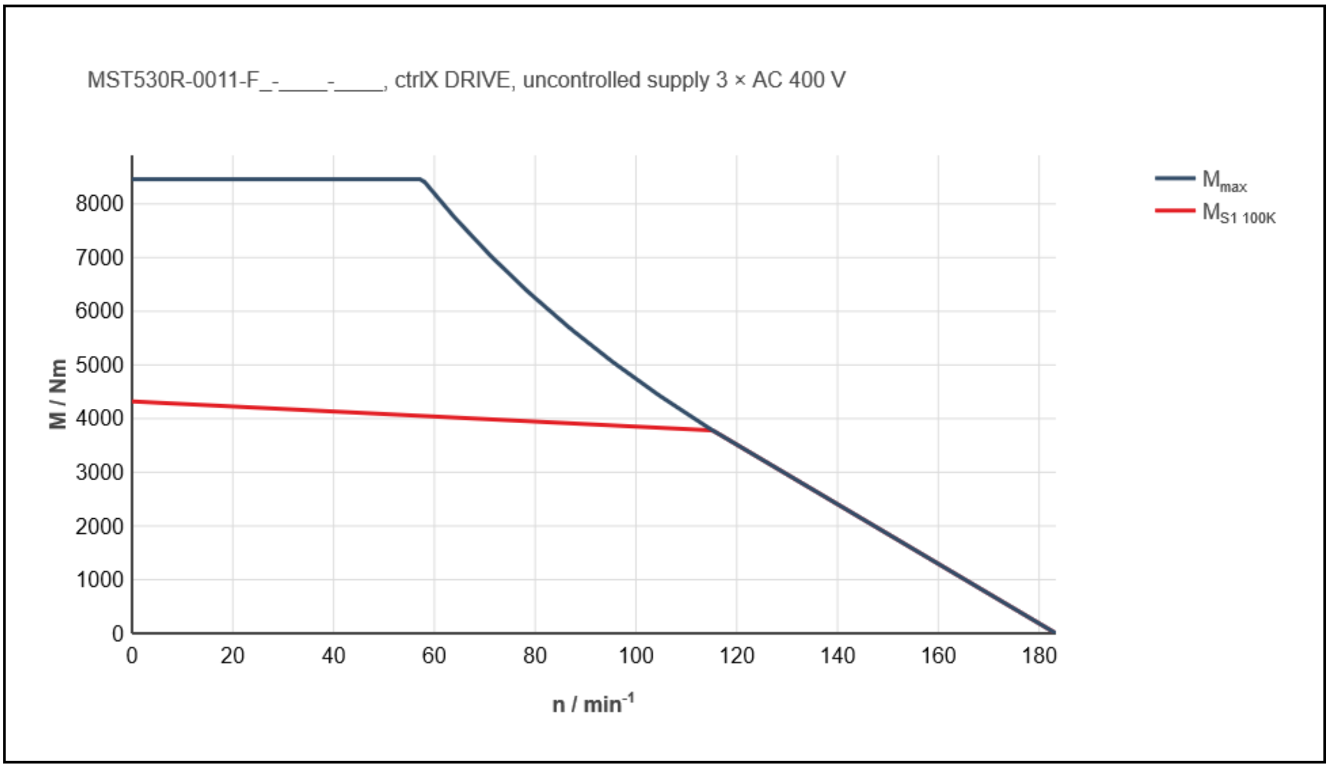


Fig. 4-68: Motor characteristic curve MST530R-0011-F... at 540 V_{DC}

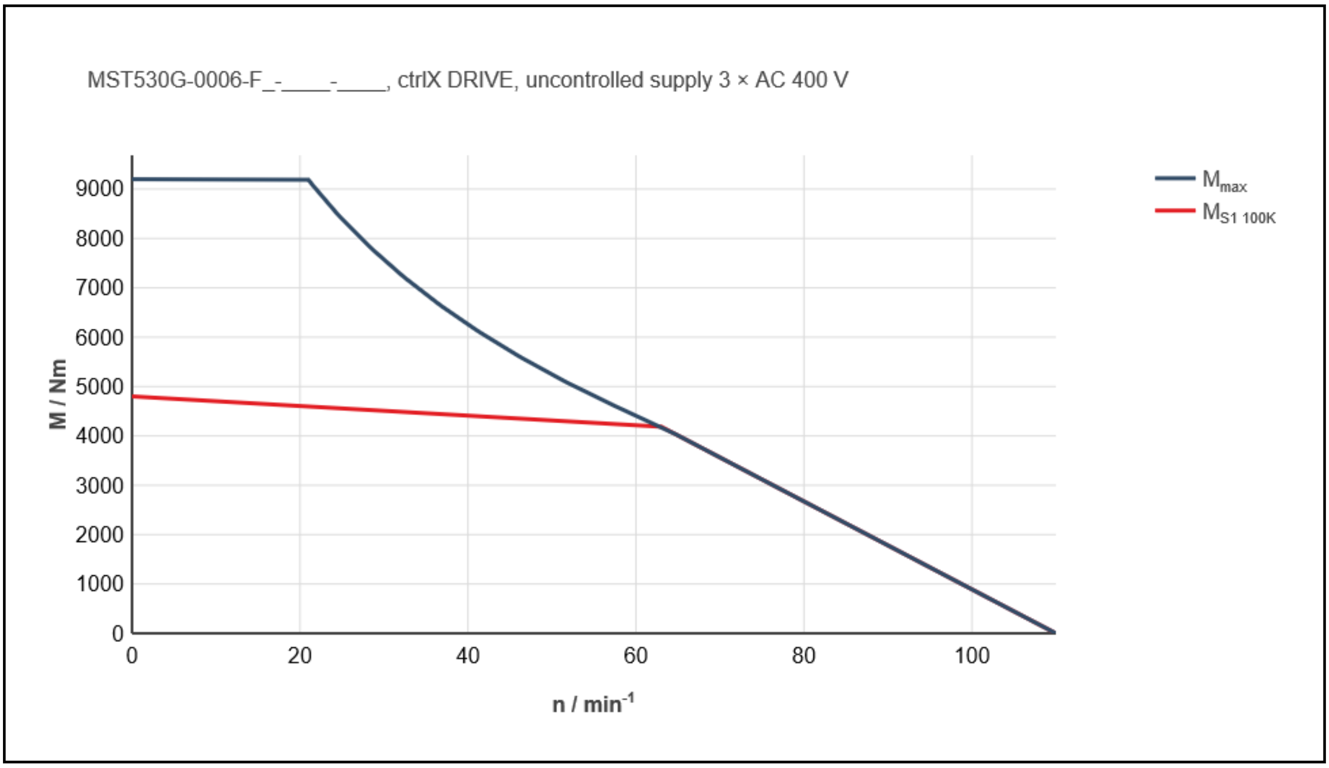


Fig. 4-69: Motor characteristic curve of MST530G-0006-F... at 540 V_{DC}

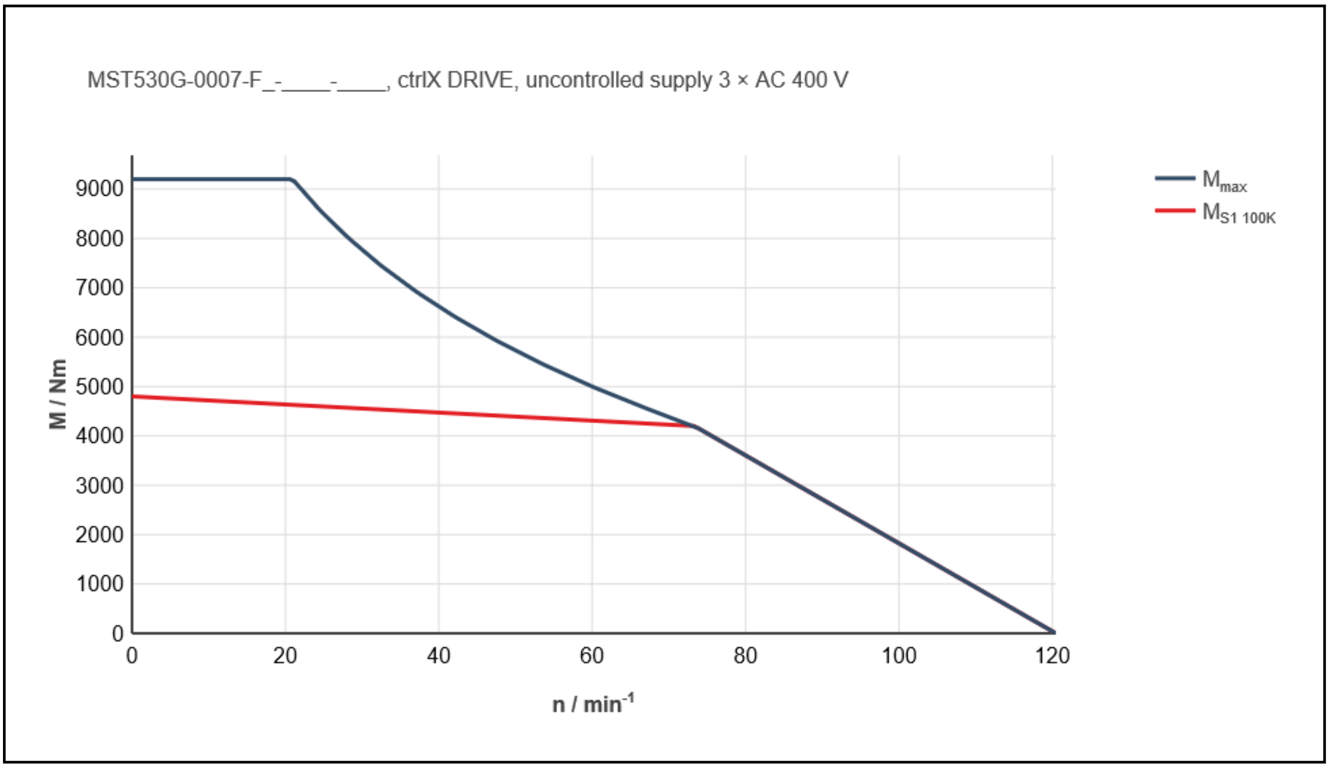


Fig. 4-70: Motor characteristic curve of MST530G-0007-F... at 540 V_{DC}

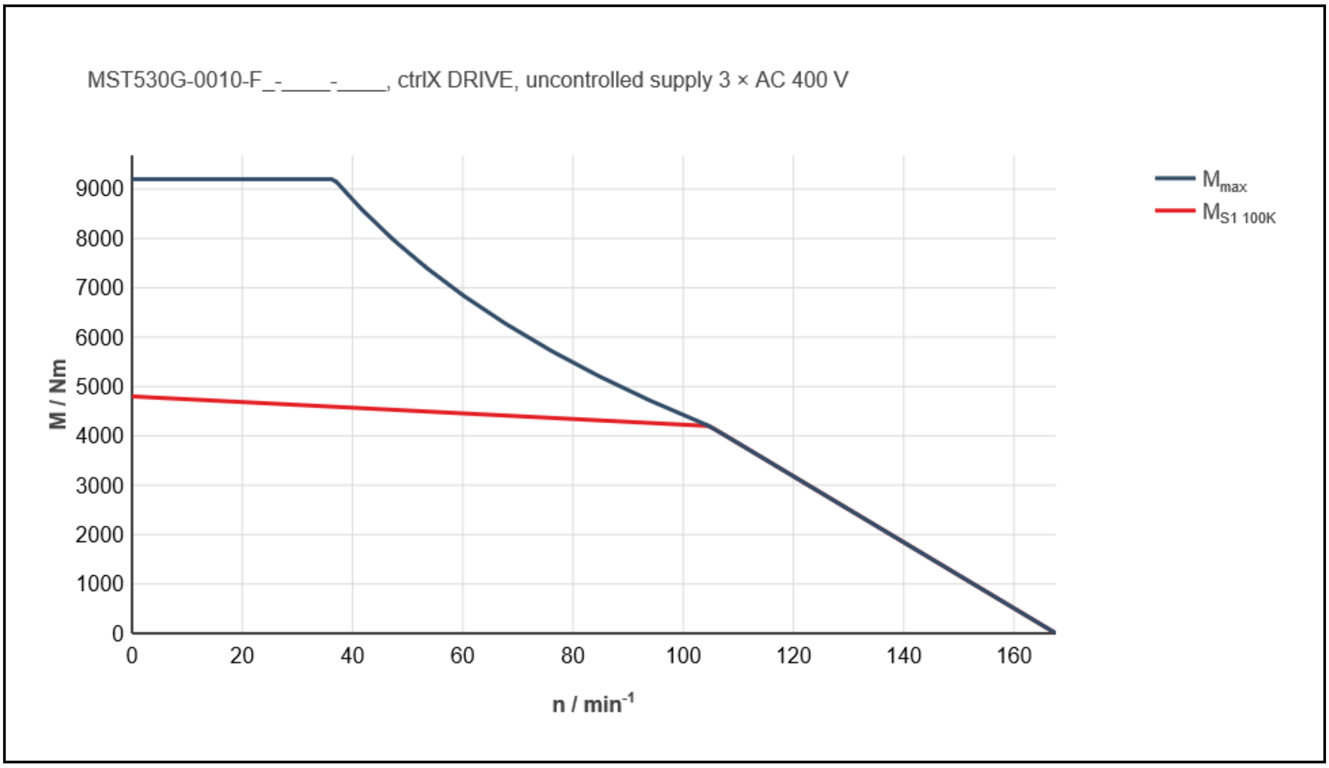


Fig. 4-71: Motor characteristic curve of MST530G-0010-F... at 540 V_{DC}

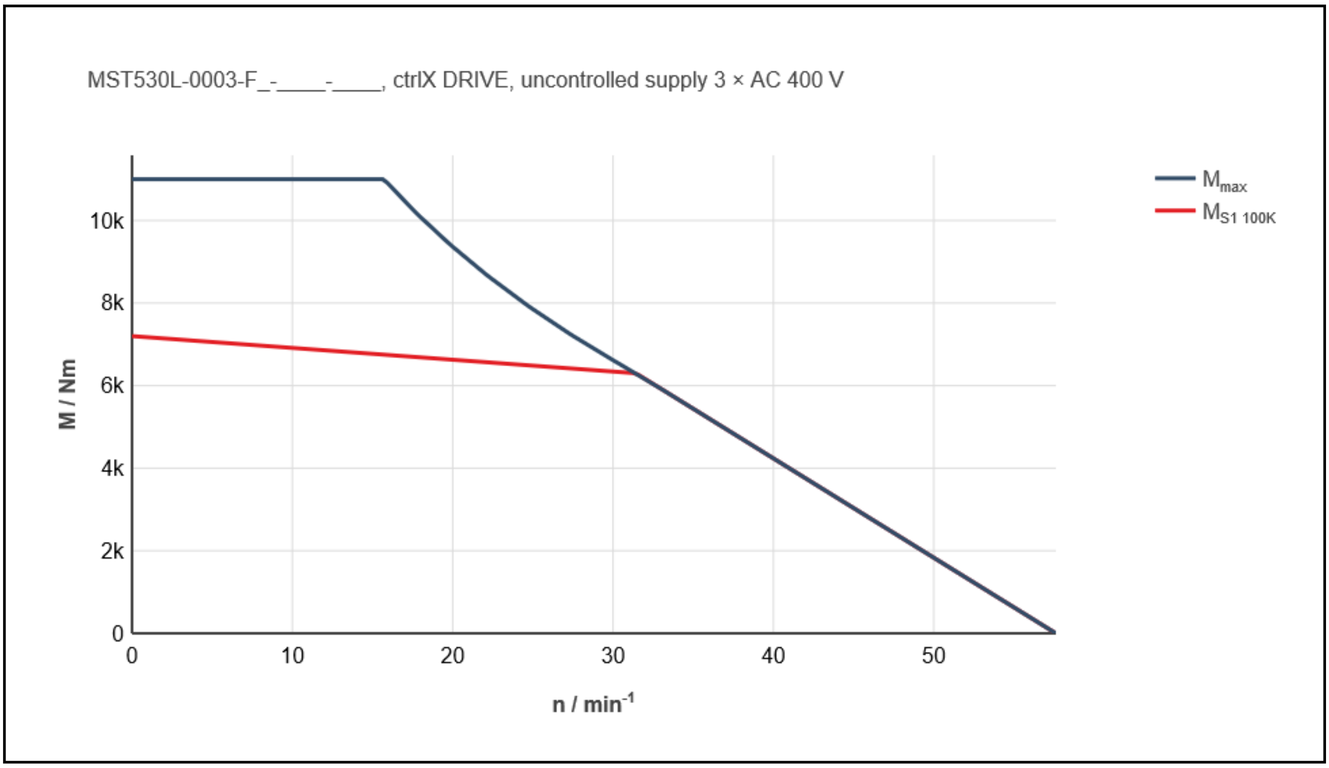


Fig. 4-72: Motor characteristic curve of MST530L-0003-F... at 540 V_{DC}

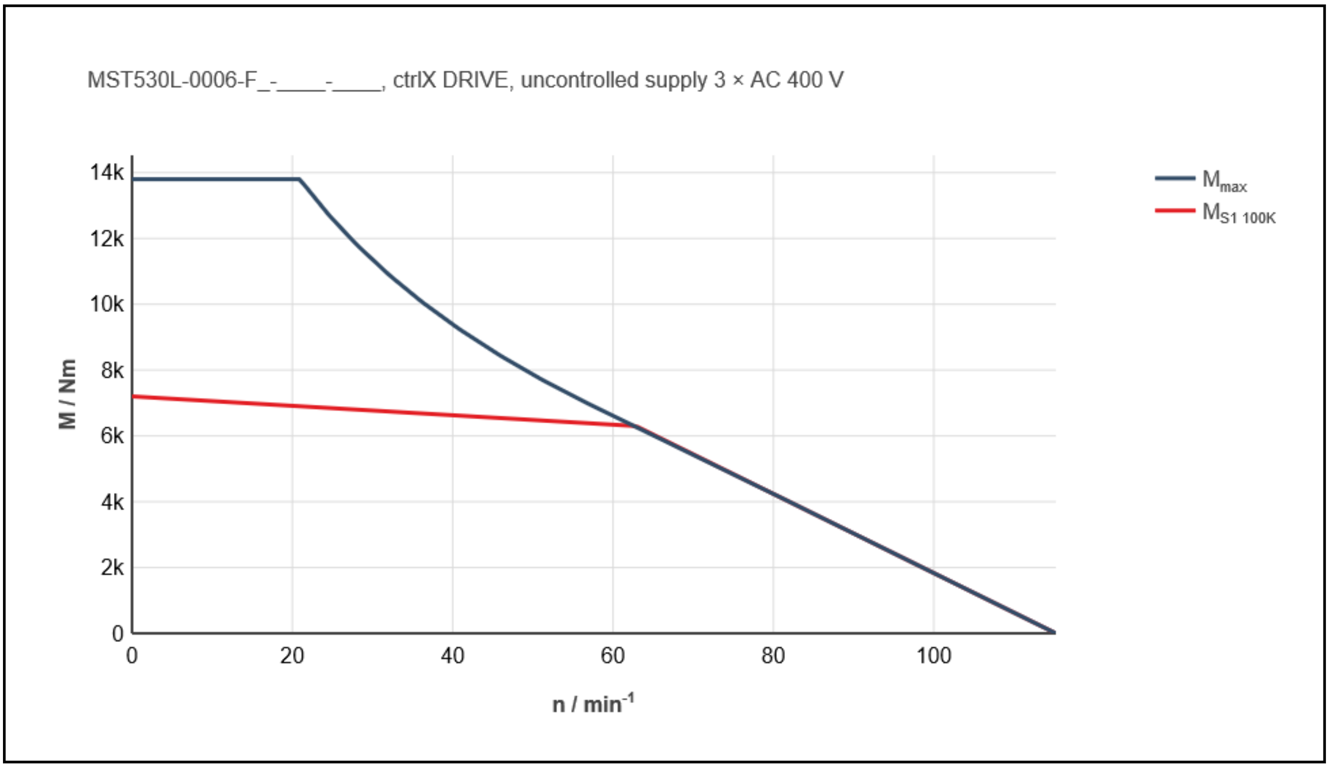


Fig. 4-73: Motor characteristic curve of MST530L-0006-F... at 540 V_{DC}

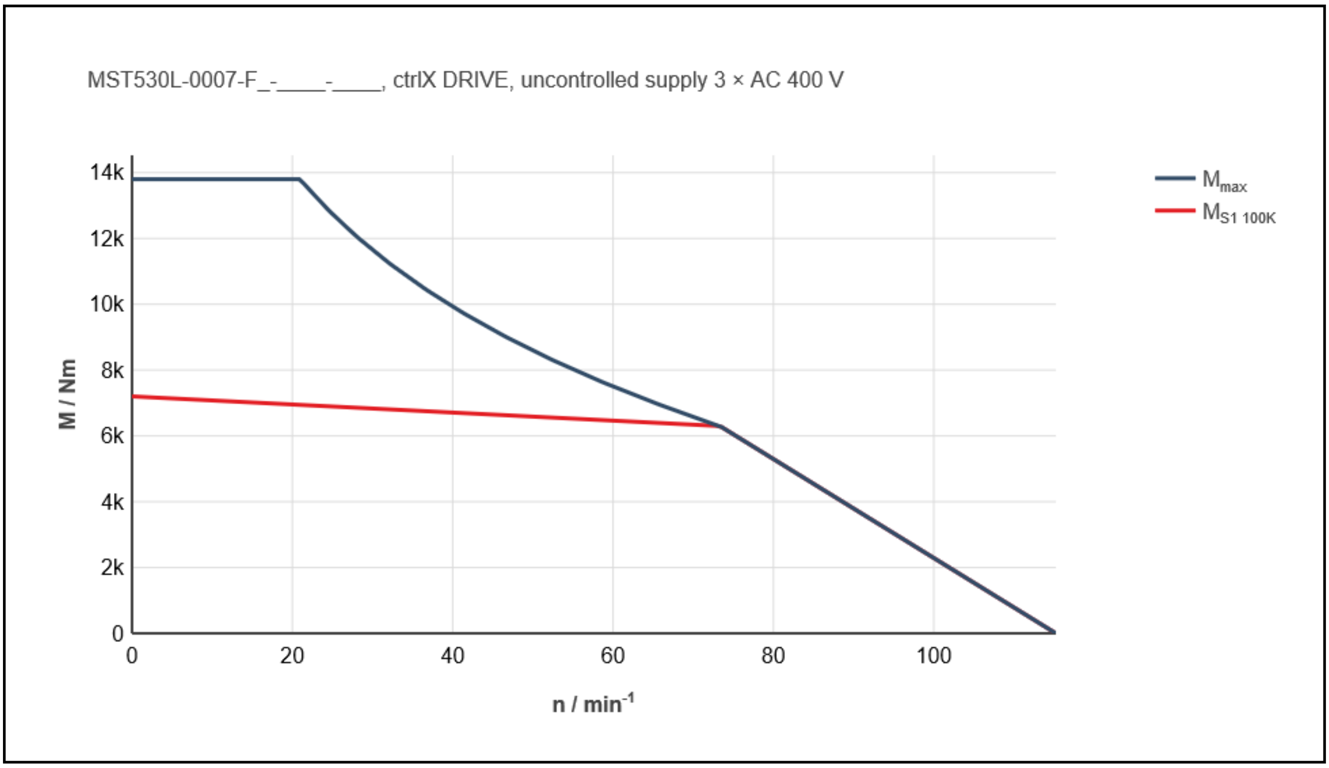


Fig. 4-74: Motor characteristic curve of MST530L-0007-F... at 540 V_{DC}

4.14 Frame size 531

4.14.1 Data sheet MST531

Designation	Symbol	Unit	MST531E		MST531L-
			0006-F	0018-F	0009-F
Standstill torque	M_0	Nm	2250		6750
Standstill current	I_0	A	38.2	95.6	132.3
Rated torque	M_N	Nm	2150.0	1800.0	5000.0
Rated power	P_N	kW	13.50	33.93	47.10
Rated current	I_N	A	36.5	76.5	98.0
Rated speed	n_N	min^{-1}	60	180	90
Maximum torque	M_{max}	Nm	5,000		12000
Maximum current	I_{max}	A	95.0	210.0	240.0
Max. speed (electrical)	n_{max}	min^{-1}	95	230	110
Power wire cross-section	A	mm^2	6.0	2x10.0	35.0
Torque constant at 20 °C	K_{M_N}	Nm/A	58.90	23.59	51.00
Voltage constant at 20 °C	K_{EMK_1}	V/min^{-1}	4.200	1.740	3.080
Thermal time constant	T_{th_nom}	min	7.0	6.0	
Winding resistance at 20 °C	R_{12}	Ohm	2.43	0.45	0.53
Winding inductivity	L_{12}	mH	37.5	6.6	8
Leakage capacitance of the component	C_{ab}	nF	30.2	30.7	81.1
Number of pole pairs	p	-	25		
Details about liquid cooling					
Power dissipation	P_V	kW	6.97	8.09	11.50
Coolant inlet temperature	T_{in}	°C	10 ... 40		
Permissible coolant temperature increase for P_V	ΔT_{max}	K	10		
Required coolant flow at P_V	Q_{min}	l/min	10.0	11.6	16.5
Pressure drop at Q_{min}	Δp	bar	0.9	0.5	0.2
Volume of coolant duct	V_{cool}	l	1.08		3.40
Maximum allowed inlet pressure	p_{max}	bar	6.0		
Latest amendment: 2018-04-26					

Tab. 4-31: MST531 - Technical data

4.14.2 Data sheet MRT531

Designation	Symbol	Unit	MRT531E	MRT531L
			_-0410	
Rotor inertia	J_{rot}	kg * m²	2.3	5.8
Rotor mass	m_{rot}	kg	47.0	130.0
Maximum speed of rotor	n_{max_mech}	1/rpm	300	

Tab. 4-32: Technical data MRT531

4.14.3 Motor characteristic curves MST531

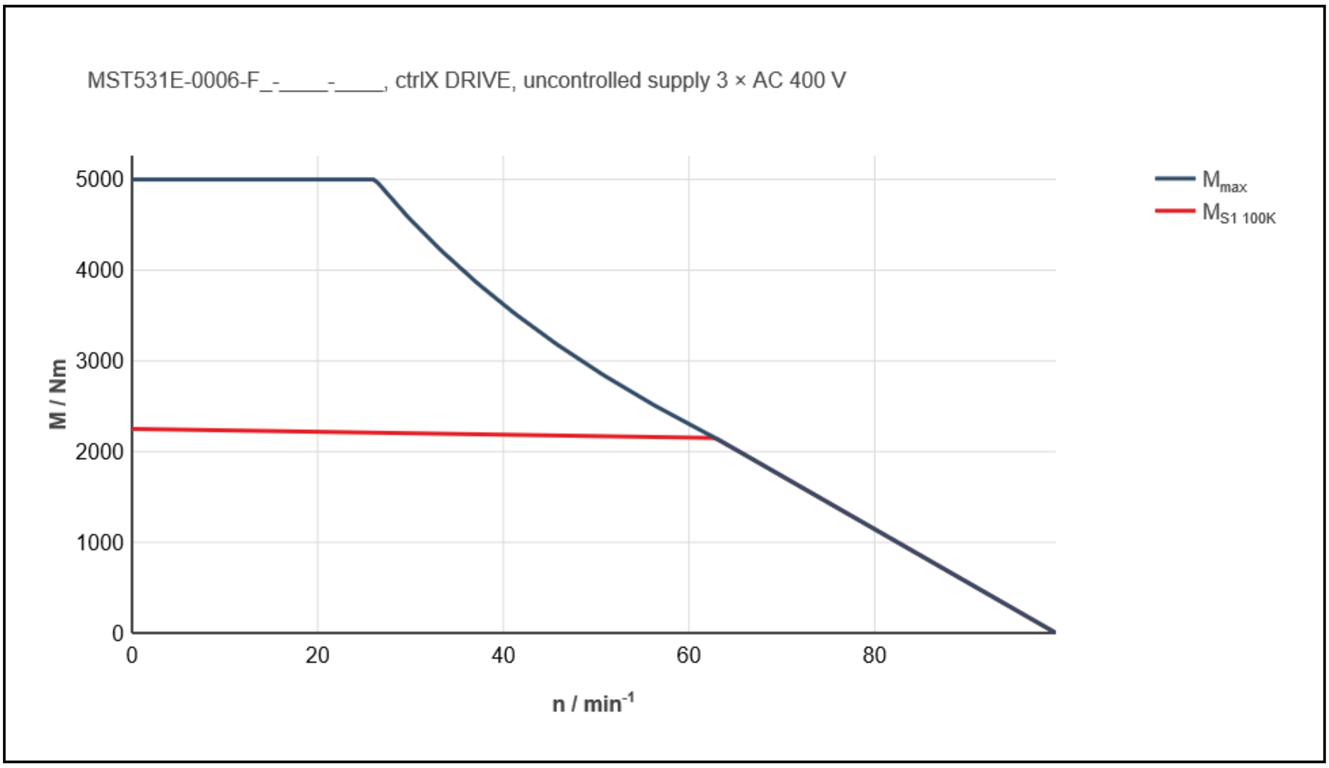


Fig. 4-75: Motor characteristic curve of MST531E-0006-F... at 540 V_{DC}

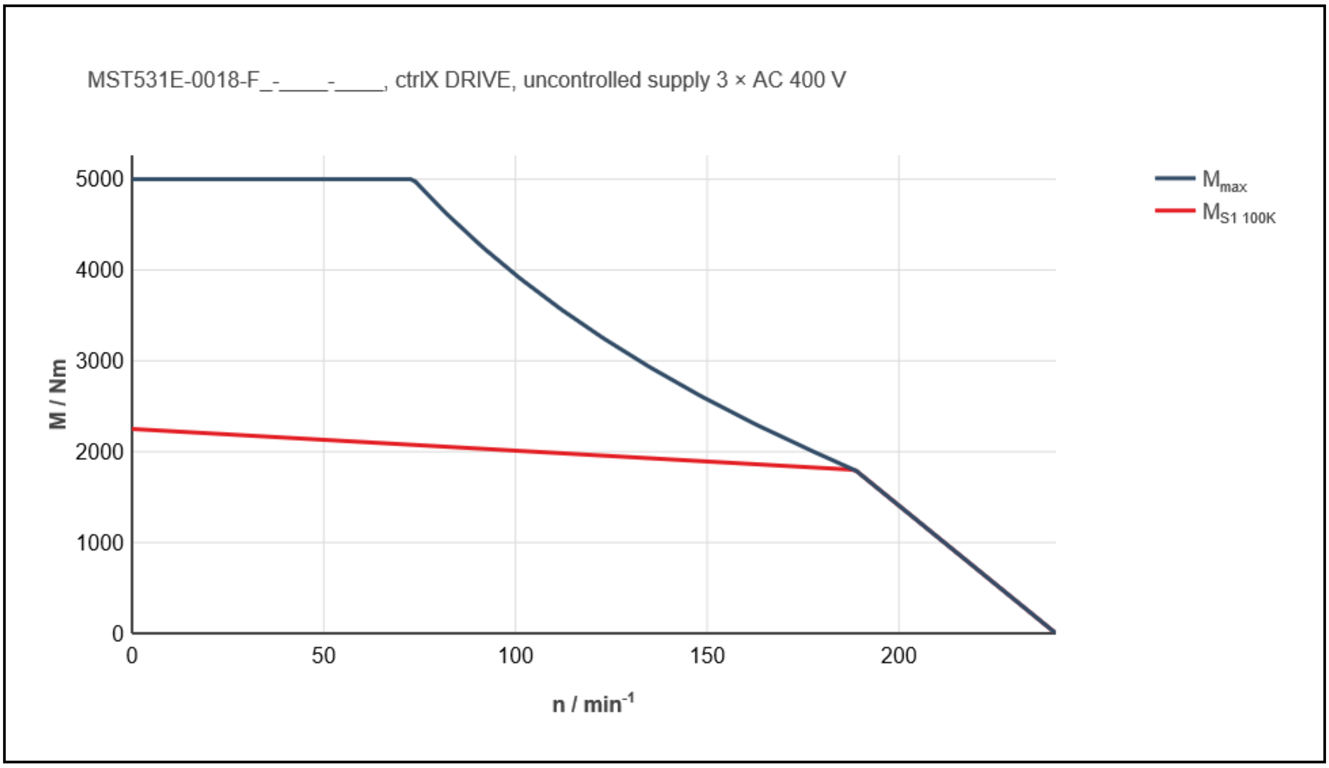


Fig. 4-76: Motor characteristic curve of MST531E-0018-F... at 540 V_{DC}

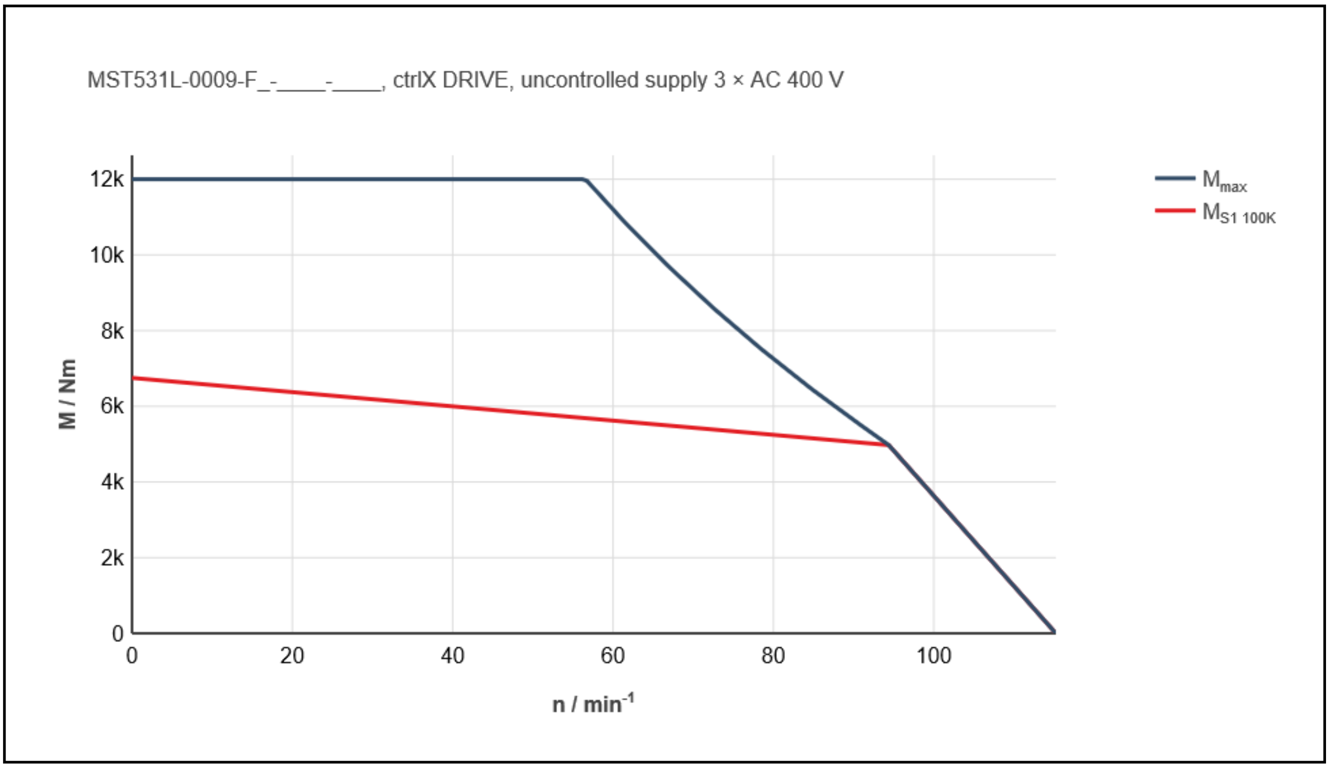


Fig. 4-77: Motor characteristic curve of MST531L-0009-F... at 540 V_{DC}

4.15 Mass of different stator designs

MST stators are availabe with different cooling modes and frame sizes or encapsulations. Please note the details within the type codes. In the following the available options of masses are specified.

Frame size MST	Mass [kg]		
	Casing "T"	Casing "S"	Casing "H"
130A	2.4	3.6	-
130C	5.1	5.9	-
130E	7.7	8.3	-
130G	-	10.6	-
160A	5.6	-	-
160C	9.6	-	-
160E	13.9	-	-
161C	6.6	-	-
161E	12.8	-	-
161G	14.4	-	-
201C	11.0	-	-
201D	14.6	-	-
201F	22.1	-	-
210A	7.2	-	12.0
210C	11.5	-	18.0
210D	13.8	-	21.7
210E	18.8	-	28.0
210U	25.0	-	-
251 F	28.0	-	-
290B	13.5	-	30.0
290D	20.0	-	33.6
290E	25.1	-	40.0
290 F	26.5	-	-
290G	30.6	-	-
291C	16.4	-	-
291D	18.9	-	-
291E	25.0	-	-
360B	23.0	-	37.0
360D	28.8	-	47.0
360E	40.3	-	61.7
450B	31.0	-	56.0

Frame size MST	Mass [kg]		
	Casing "T"	Casing "S"	Casing "H"
450D	38.7	-	70.0
450E	54.2	84.0	92.0
530B	36.0	-	68.0
530C	45.0	71.0	84.0
530D	61.2	-	101.0
530E	74.5	-	116.0
530F	87.8	-	134.0
530G	144.0	-	204.0
530L	205.0	-	280.0
530P	100.9	-	151.0
530R	127.4	-	184.0
531E	53.0	-	-
531L	158.0	-	-

Tab. 4-33: Masses of different stator designs

5 Dimension sheets

5.1 General information

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:

- Standard dimension sheet of the complete motor. One dimension sheet each per variant "electrical connection".
- Component part drawing of the rotor.
- Component part drawing of the stator. One dimension sheet each per variant "electrical connection".

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

Longitudinal dimensions: DIN ISO 2768-1

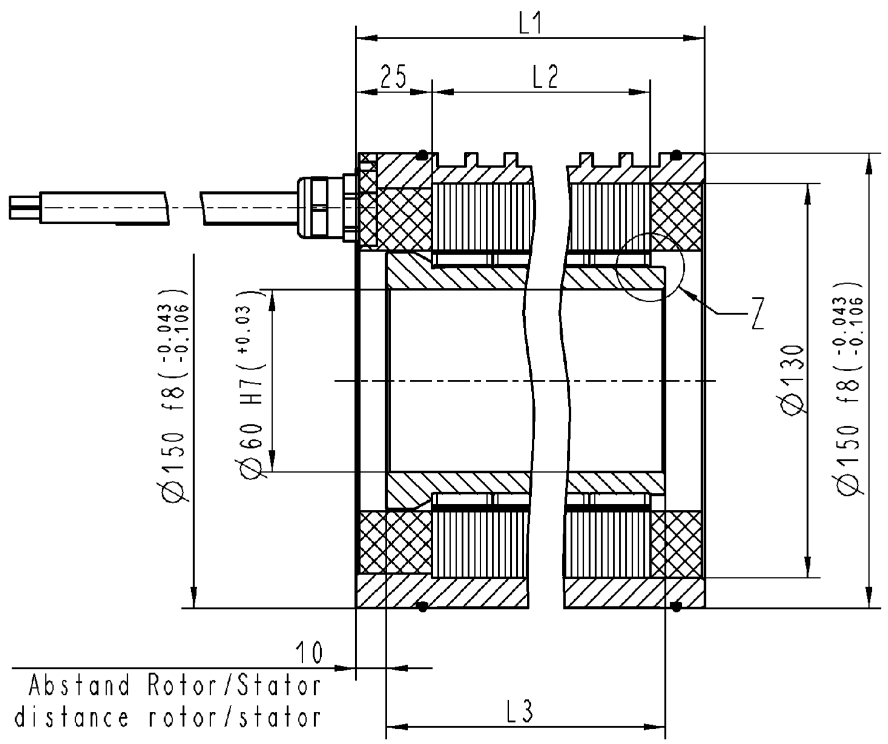
Angular dimensions: DIN 7168 (tolerance class m)

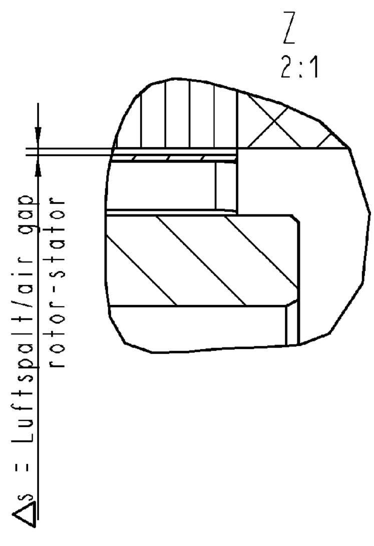
Form and position tolerances: DIN EN ISO 1101

☞ 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.

5.2 Dimension sheets 130

5.2.1 MBT130A/ -C/ -E with liquid cooling, "NNNN" design





	L1	L2	L3	Δs_1 min theoretical "air gap" without concentricity fault rotor-stator
MBT130A	63	20	40	0.45
MBT130C	103	60	80	
MBT130E	143	100	120	

Schutzvermerk DIN 34-1-D

	Datum	Name	Maßstab	x	Datum	Name	Ä-Nr.	Blatt	von	Benennung
veranlaßt	..		1 : 2	..	..	..	..	1	1	MASSBLATT MBT130 (FLUESSIGKEITSKUEHLUNG)
erst./geänd.	08.12.03	Dreyer		..	..	..	..			Zeich-Nr. 106-0455-4002-01
genehmigt	09.12.03	Steinbock		..	..	..	..			
Rexroth Indramat			Ers. für		106-0455-4002-00		Ä-Nr. 0	Ers. durch ..		Ä-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 5-1: MBT130A/ -C/ -E with liquid cooling, "NNNN" design

5.2.2 MBT130G with liquid cooling, “D303” design

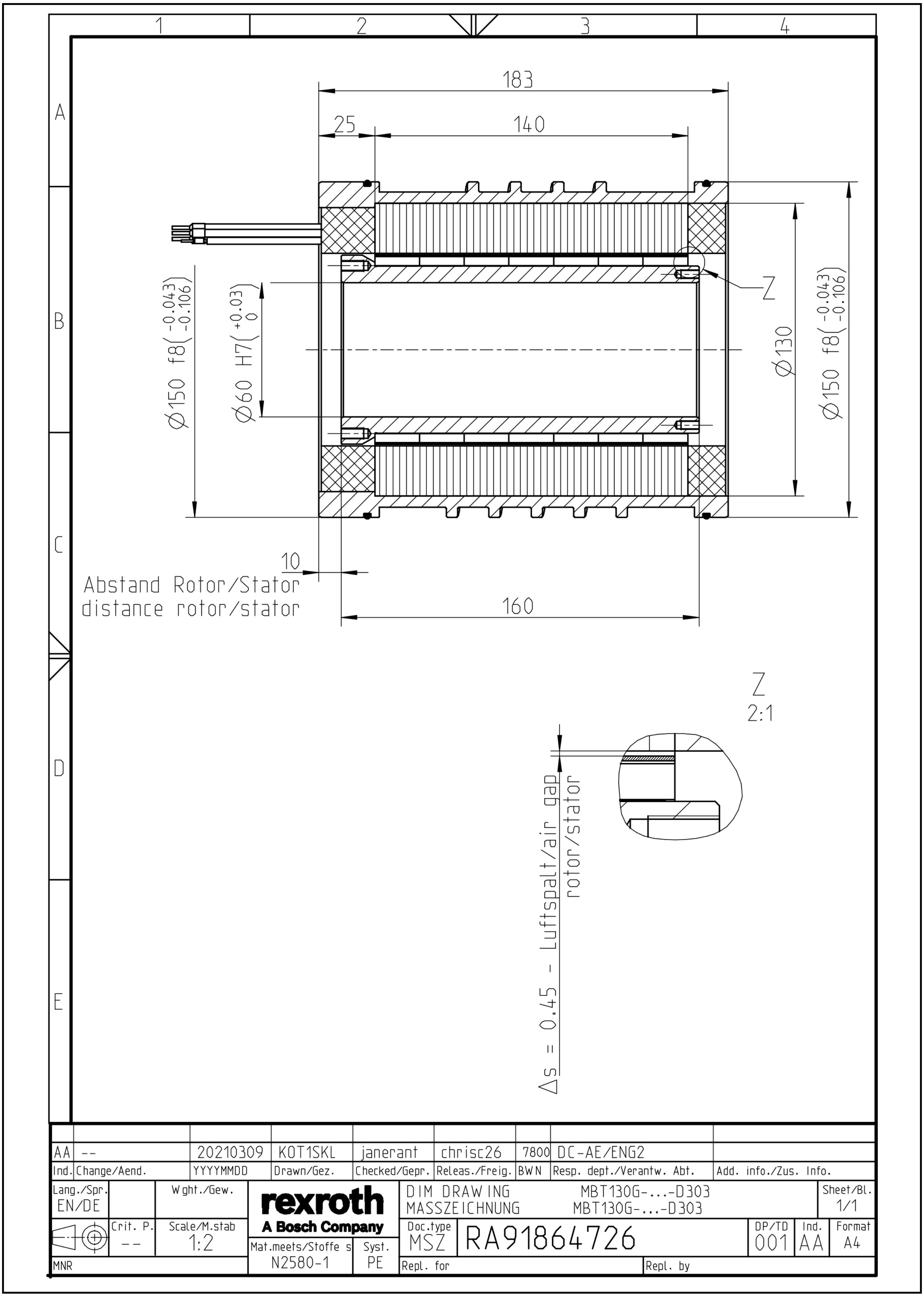
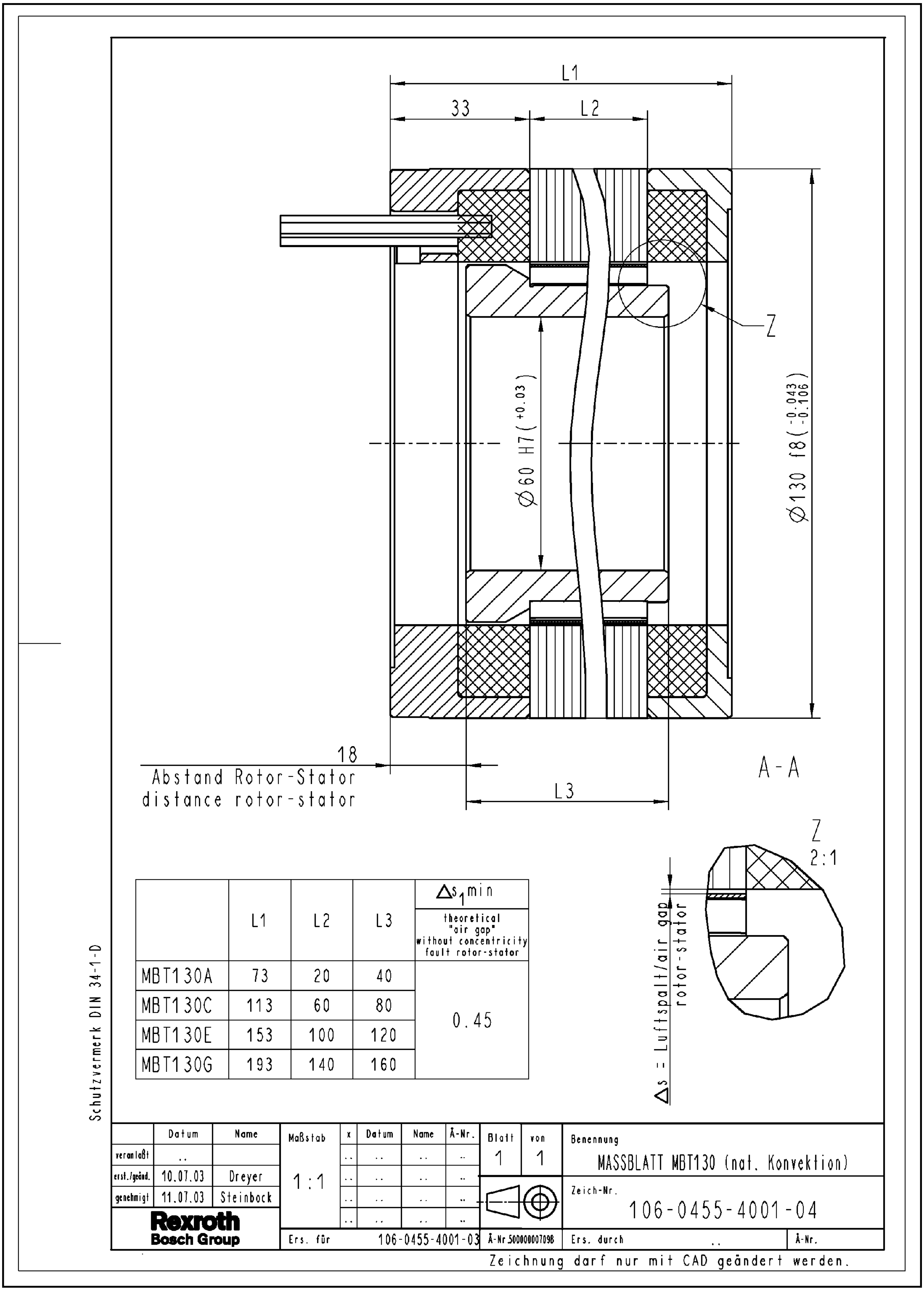


Fig. 5-2: MBT130G with liquid cooling, “D303” design

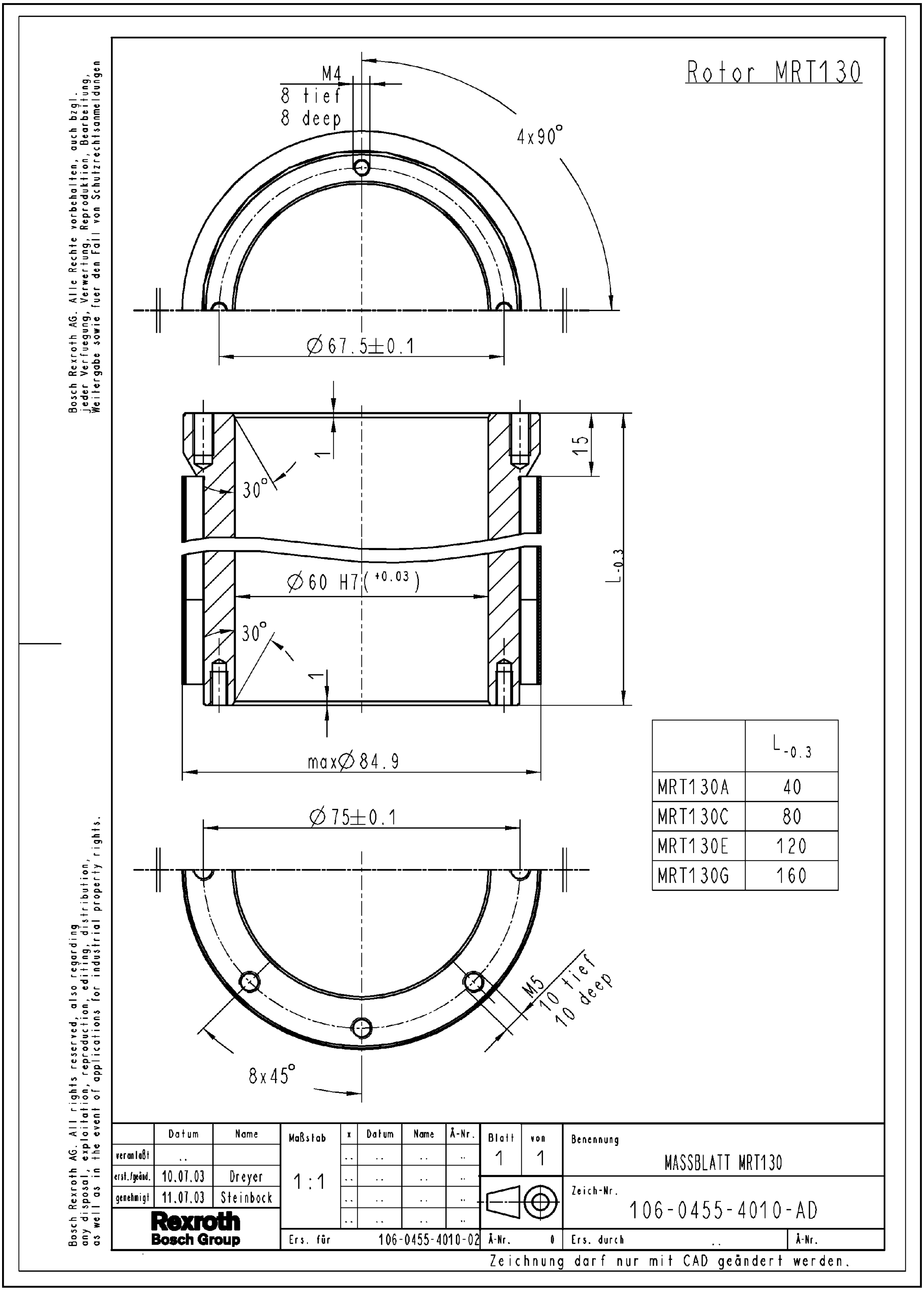
5.2.3 MBT130 with natural convection



	L1	L2	L3	Δs_1 min theoretical "air gap" without concentricity fault rotor-stator
MBT130A	73	20	40	0.45
MBT130C	113	60	80	
MBT130E	153	100	120	
MBT130G	193	140	160	

Fig. 5-3: MBT130 with natural convection

5.2.4 Rotor MRT130



	$L_{-0.3}$
MRT130A	40
MRT130C	80
MRT130E	120
MRT130G	160

Fig. 5-4: Rotor MRT130

5.2.5 Stator MST130A/ -C/ -E, liquid cooled, "NNNN" design

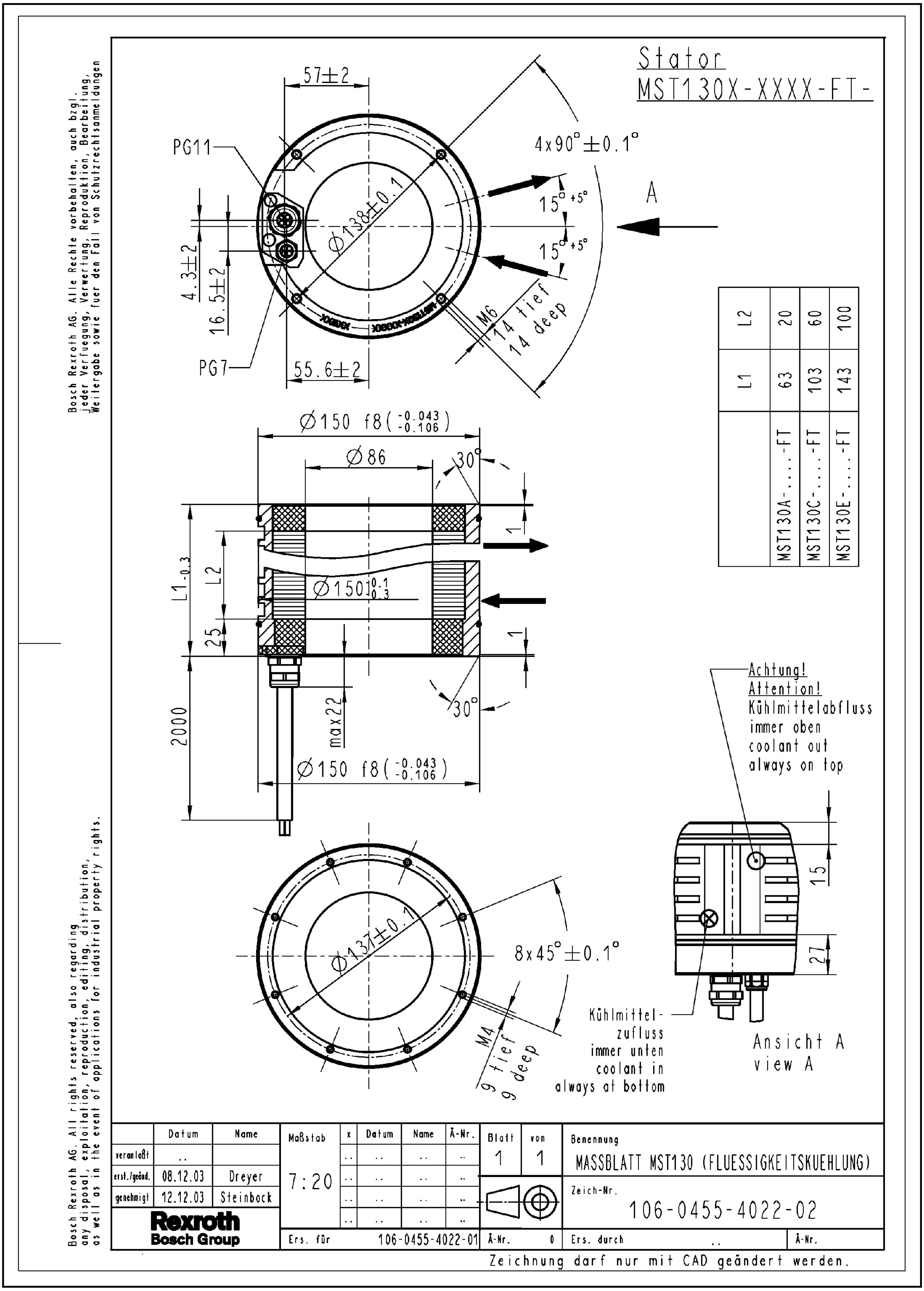


Fig. 5-5: MST130A/ -C/ -E, liquid cooled, "NNNN" design

5.2.6 Stator MST130A/ -C/ -E, liquid cooled, "D303" design

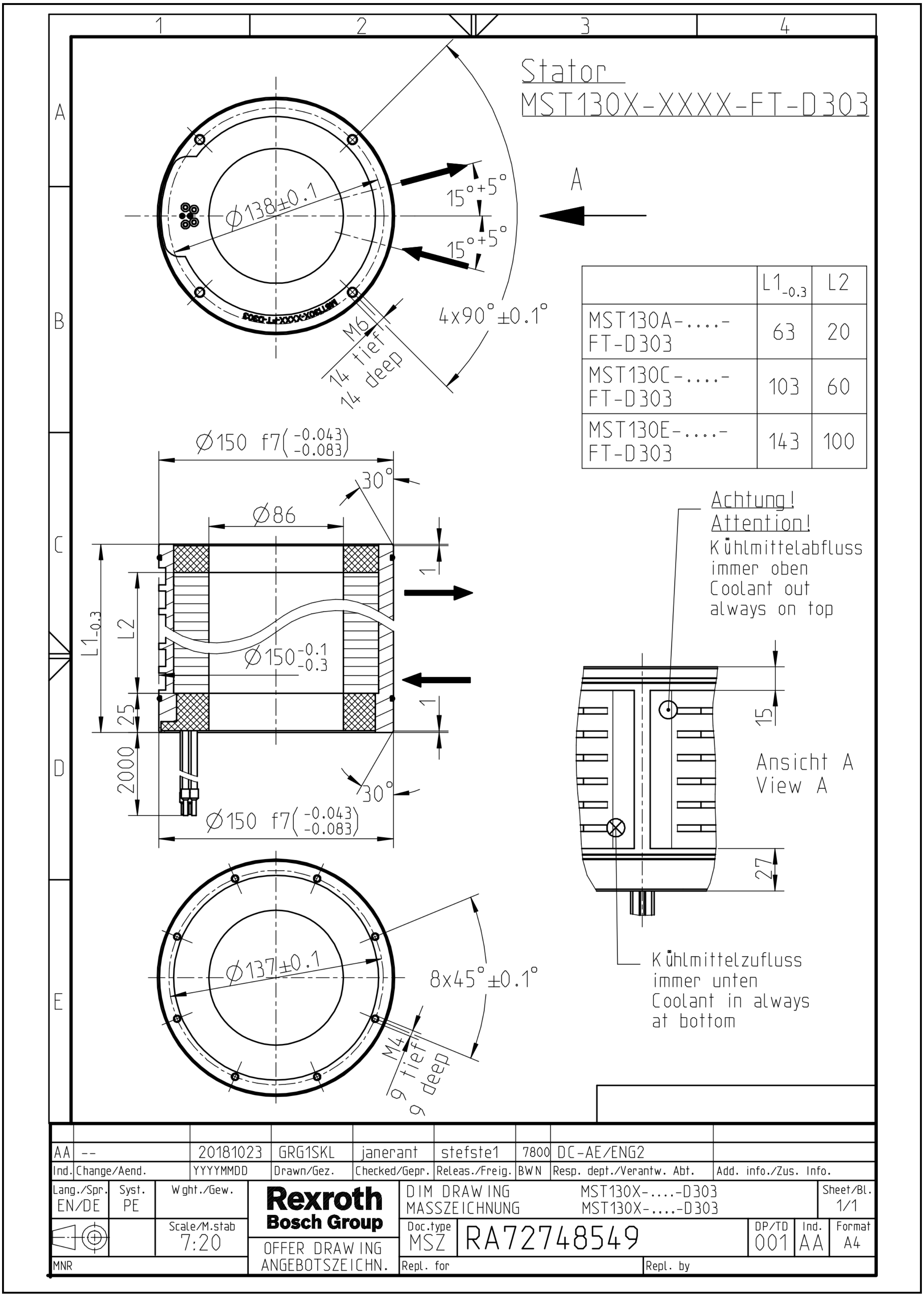


Fig. 5-6: MST130A, -C, -E, liquid cooled, "D303" design

5.2.7 Stator MST130G, liquid cooled, "D303" design

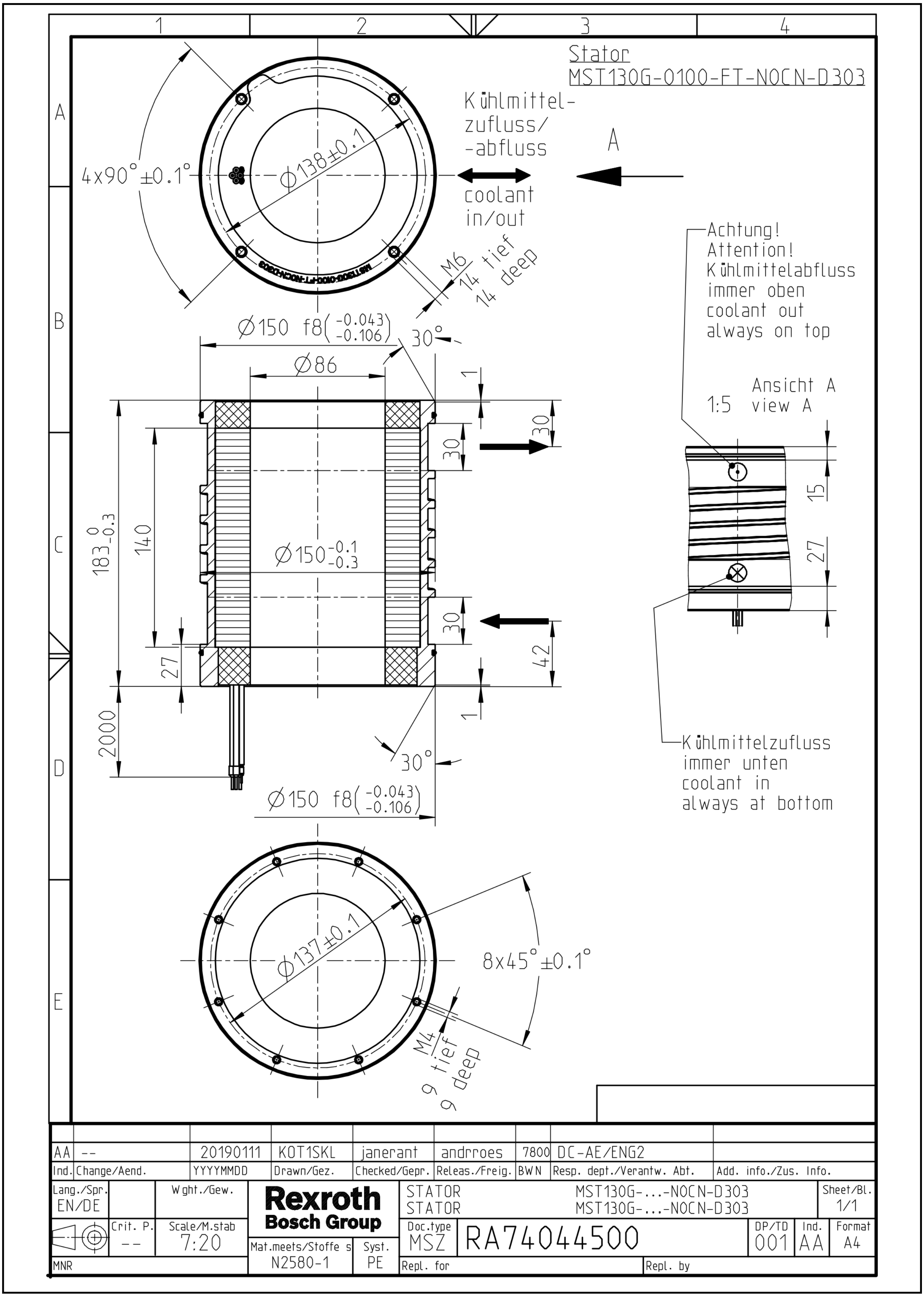
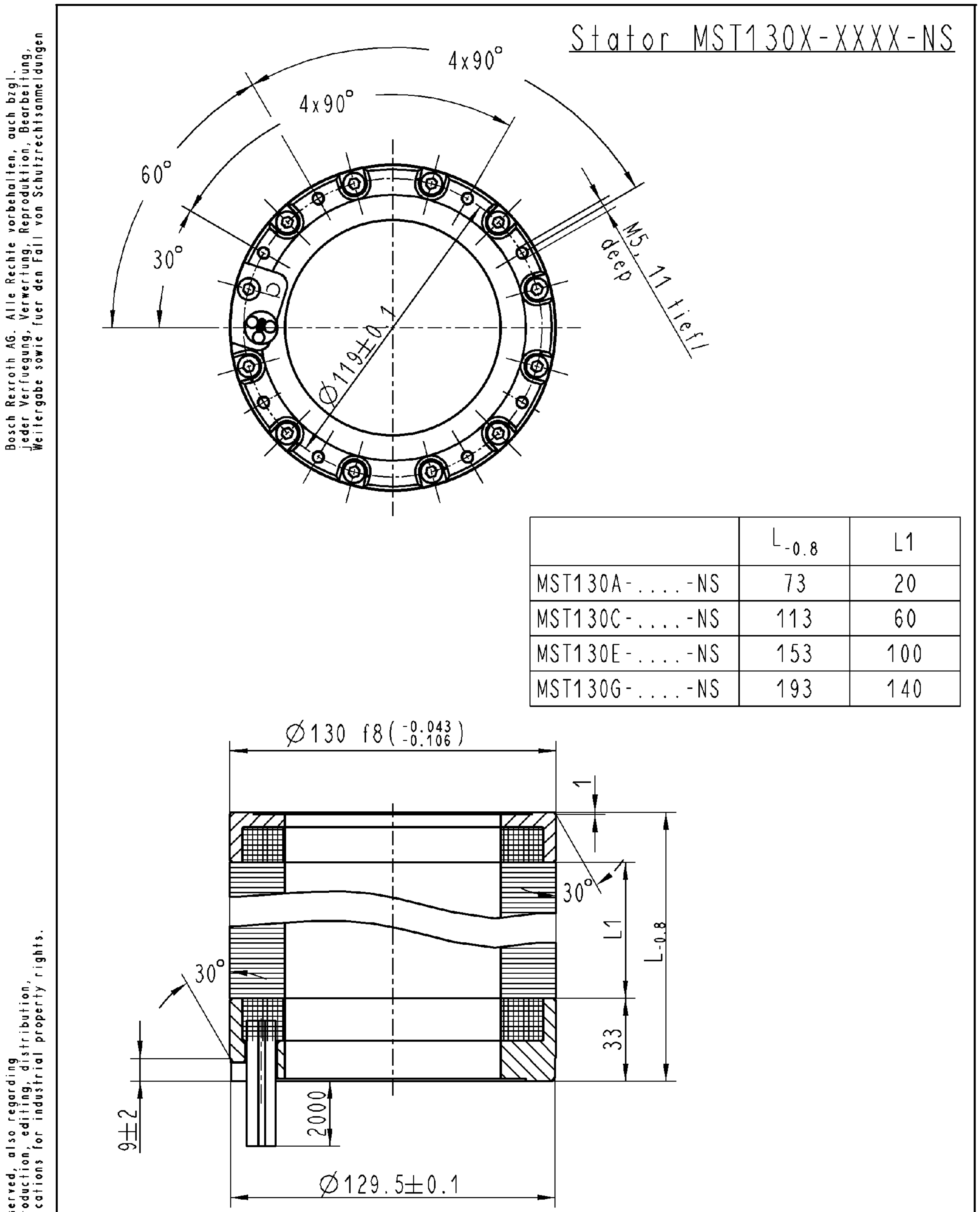


Fig. 5-7: MST130G, liquid cooled, "D303" design

5.2.8 Stator MST130, natural convection, "D303" design



	L-0.8	L1
MST130A-.....-NS	73	20
MST130C-.....-NS	113	60
MST130E-.....-NS	153	100
MST130G-.....-NS	193	140

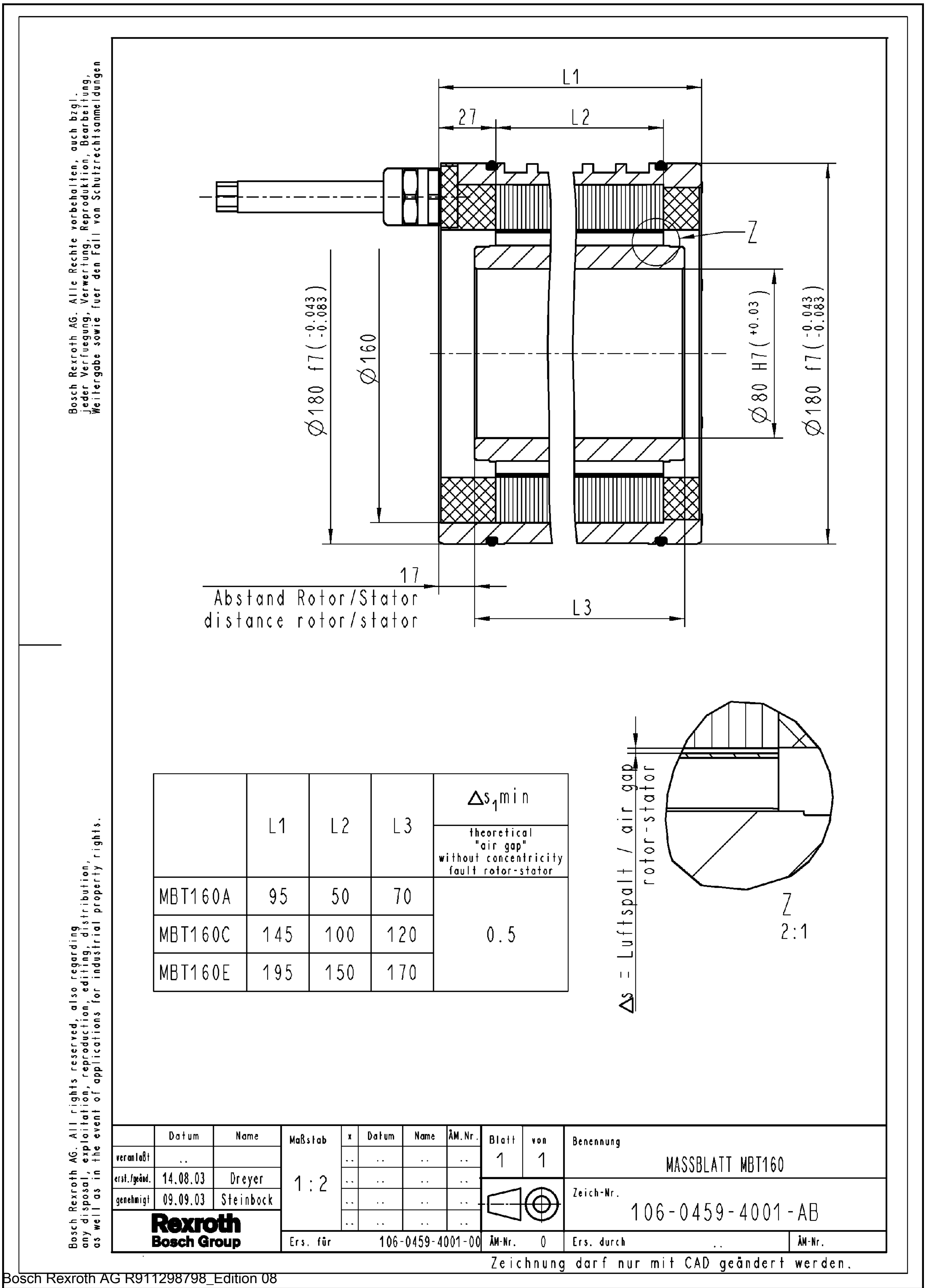
	Datum	Name	Maßstab	x	Datum	Name	Ä-Nr.	Blatt	von	Benennung
veranlaßt	..		1 : 2	..	..	..	..	1	1	MASSBLATT MST130 (nat. Konvektion)
erst./geänd.	11.07.03	Dreyer		..	..	..	..			Zeich-Nr. 106-0455-4020-05
genehmigt	14.07.03	Steinbock		..	..	..	..			
Rexroth Bosch Group			Ers. für 106-0455-4020-04				Ä-Nr. 0			Ers. durch .. Ä-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 5-8: MST130, natural convection, "D303" design

5.3 Dimension sheets 160

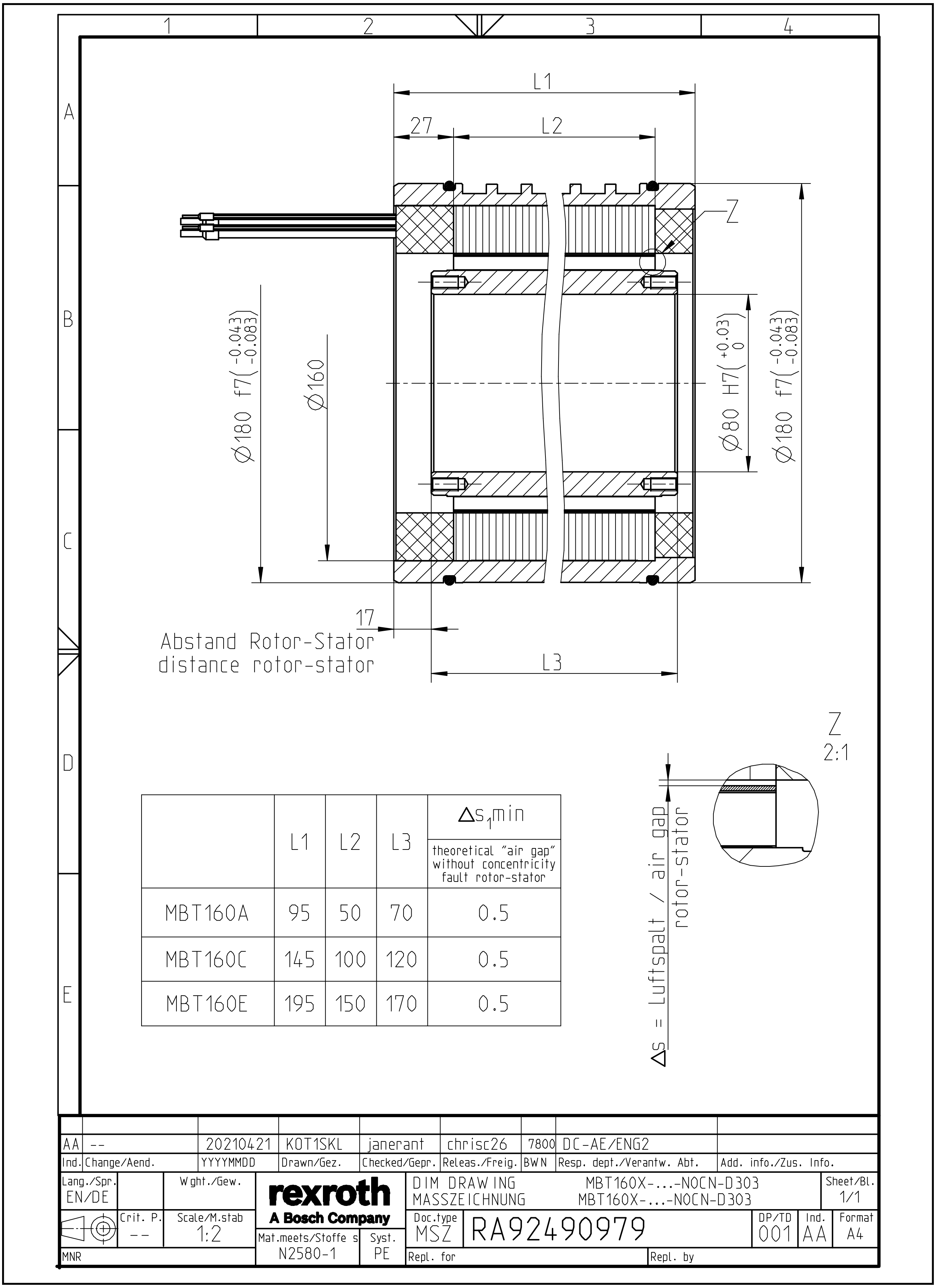
5.3.1 MBT160 with liquid cooling, “NNNN” design



	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT160A	95	50	70	0.5
MBT160C	145	100	120	
MBT160E	195	150	170	

Fig. 5-9: MBT160 with liquid cooling, “NNNN” design

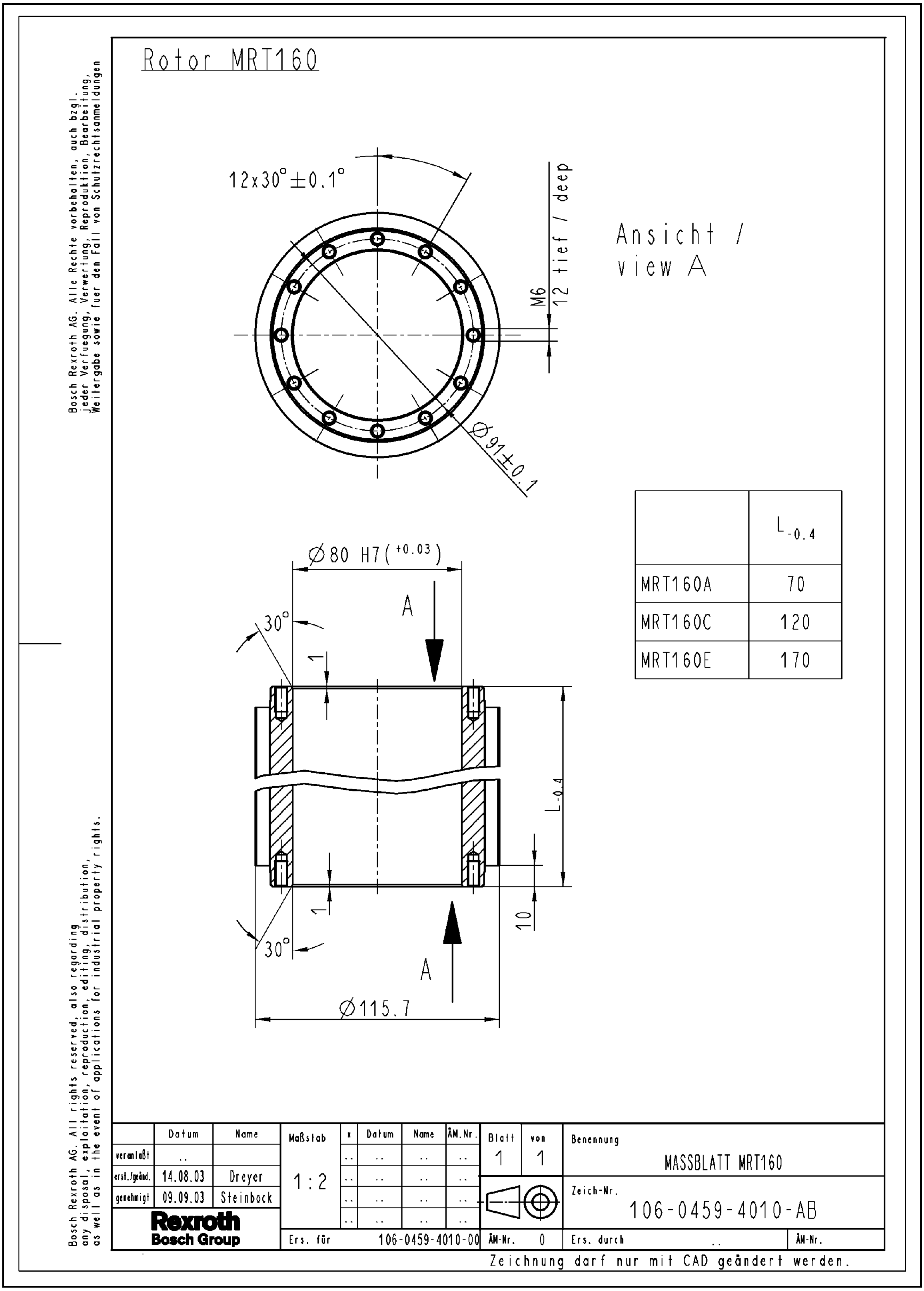
5.3.2 MBT160 with liquid cooling, “D303” design



	L1	L2	L3	Δs₁min theoretical “air gap” without concentricity fault rotor-stator
MBT160A	95	50	70	0.5
MBT160C	145	100	120	0.5
MBT160E	195	150	170	0.5

Fig. 5-10: MBT160 with liquid cooling, “D303” design

5.3.3 Rotor MRT160



	$L_{-0.4}$
MRT160A	70
MRT160C	120
MRT160E	170

Fig. 5-11: Rotor MRT160

5.3.4 Stator MST160 in "NNNN" design

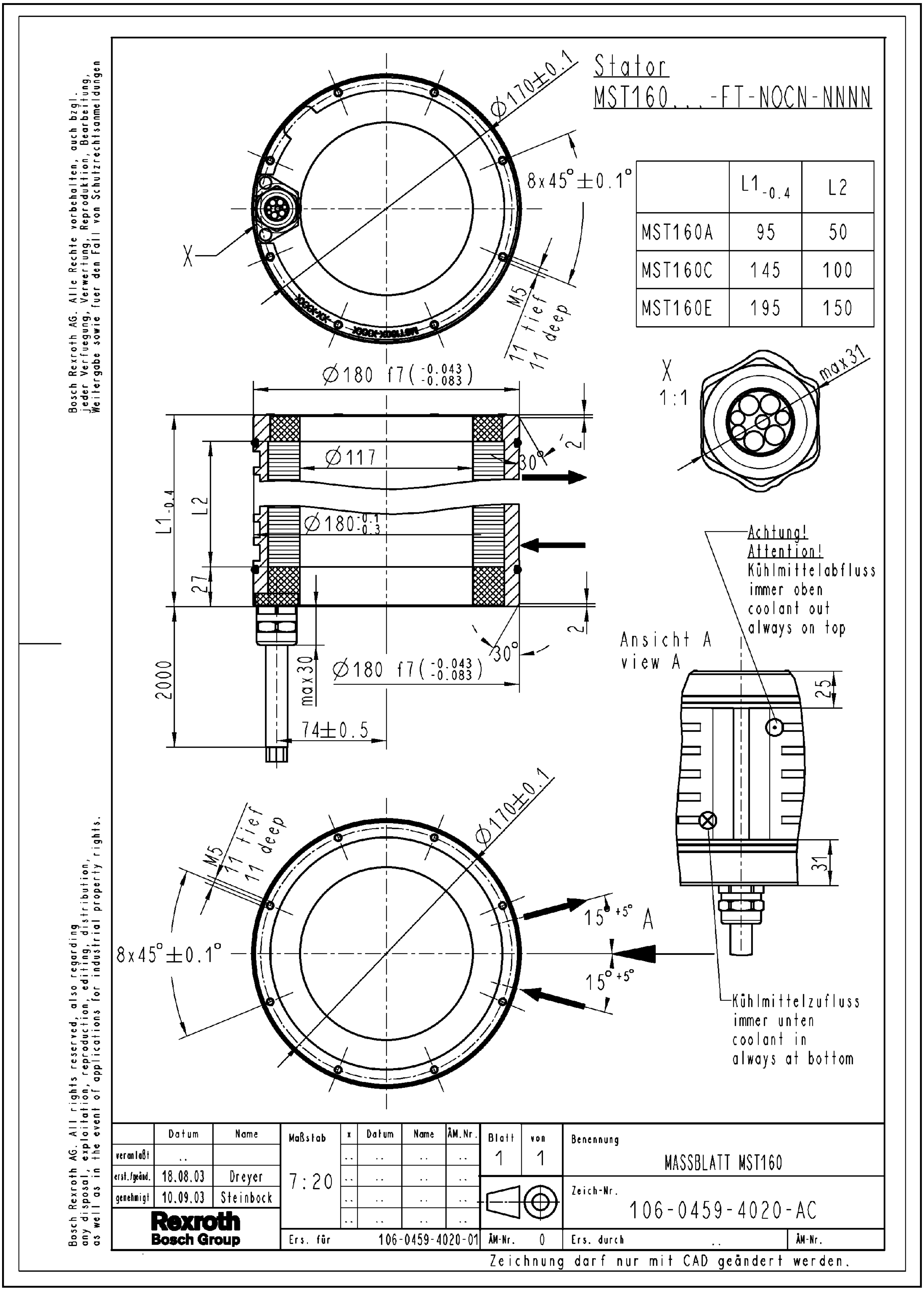


Fig. 5-12: Stator MST160

5.3.5 Stator MST160 in "D303" design

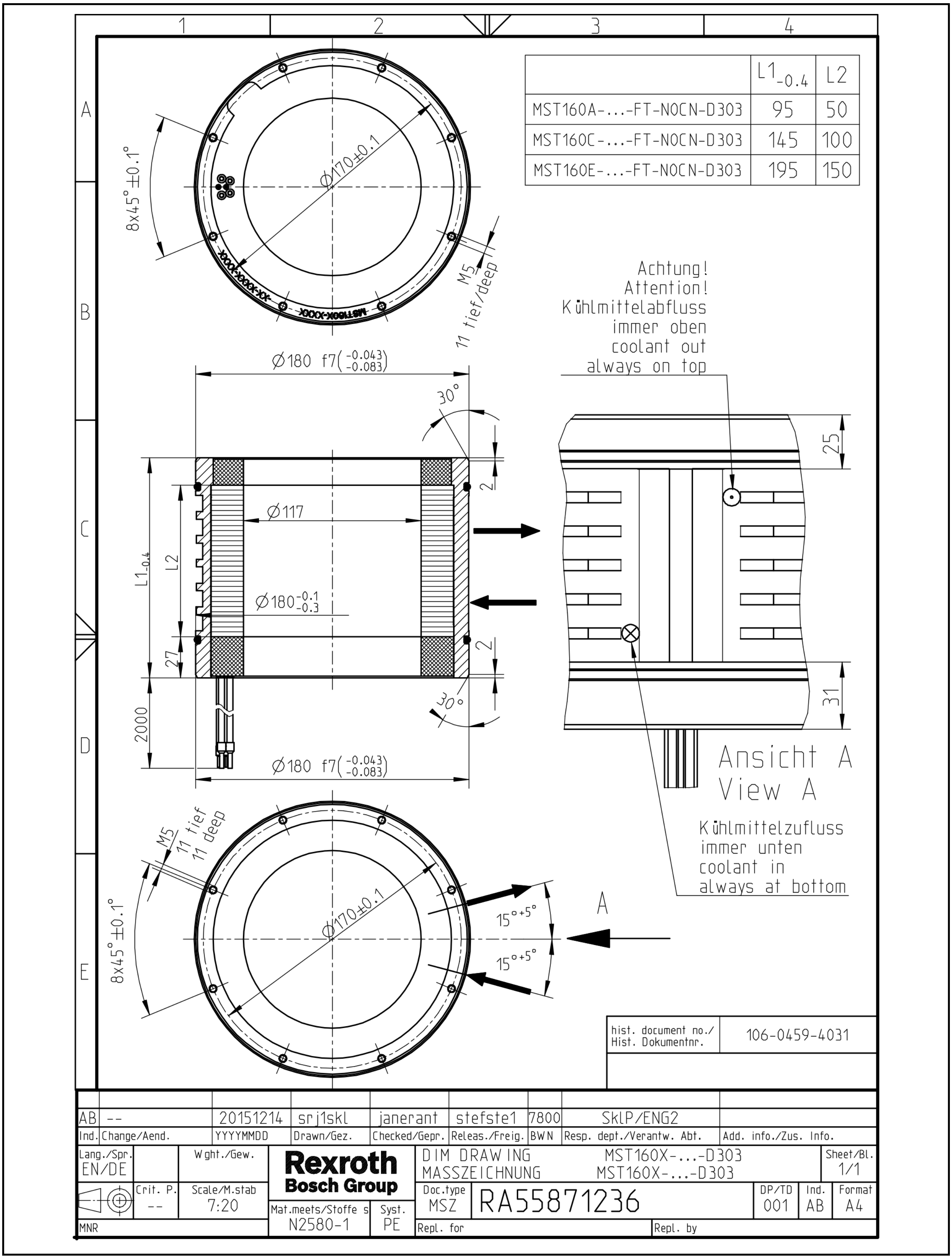


Fig. 5-13: MST160-....-D303

5.4 Dimension sheets 161

5.4.1 MBT161C/ -E, “NNNN” design

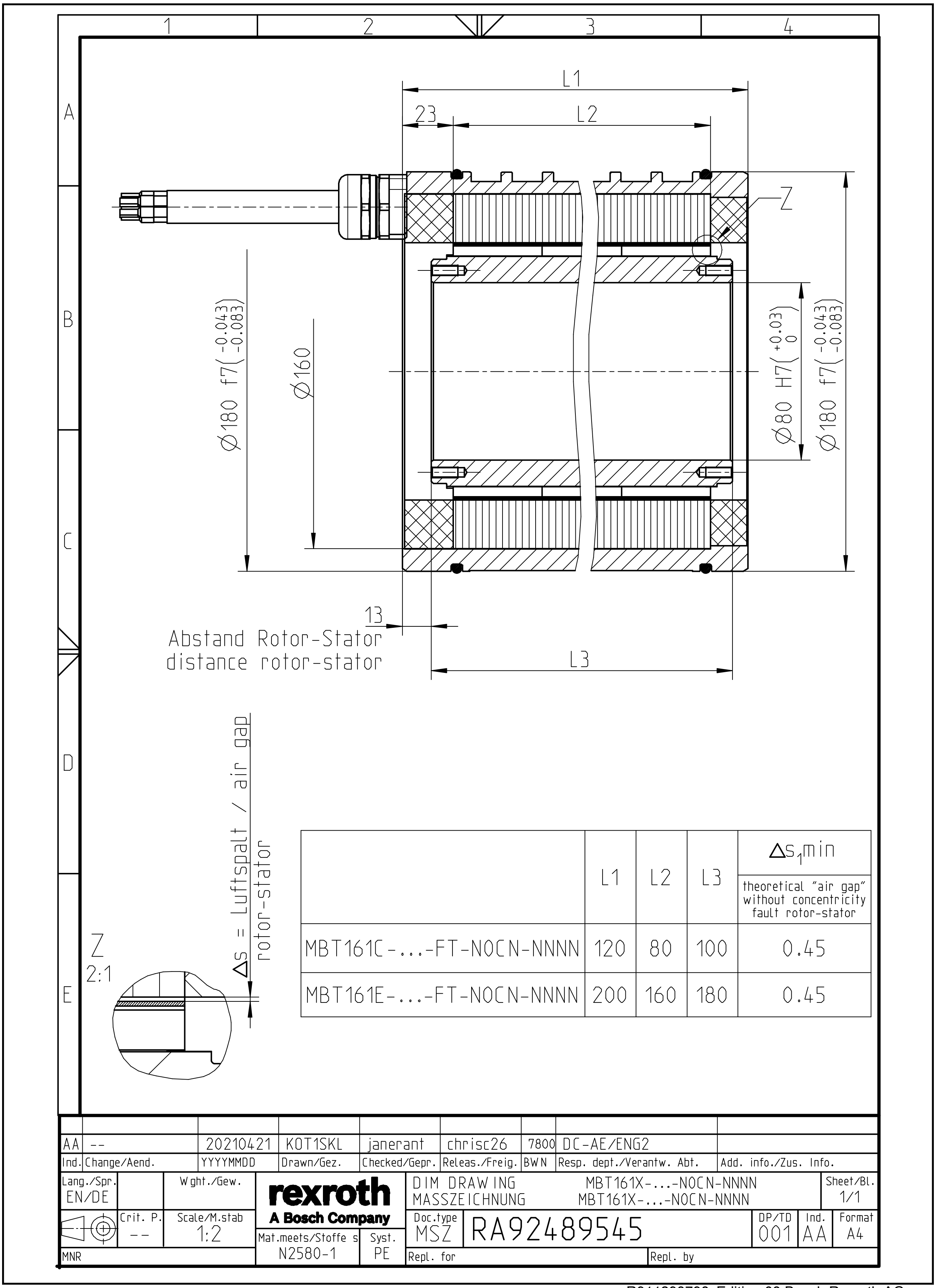
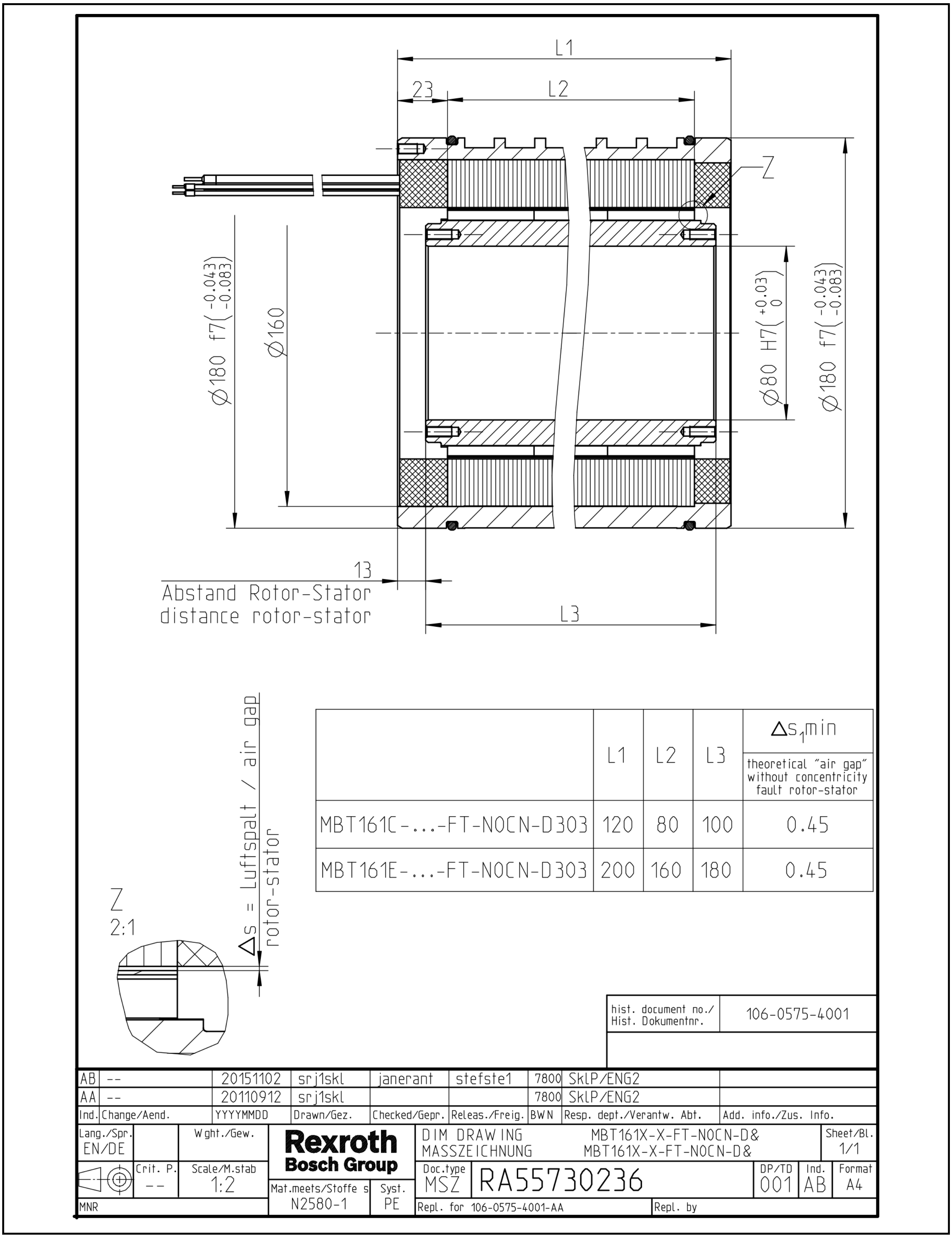


Fig. 5-14: MBT161C/ -E, “NNNN” design

5.4.2 MBT161C/ -E, "D303” design



	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT161C-...-FT-NOCN-D303	120	80	100	0.45
MBT161E-...-FT-NOCN-D303	200	160	180	0.45

Fig. 5-15: MBT161C/ -E, "D303" design

5.4.3 MBT161G, "D303" design

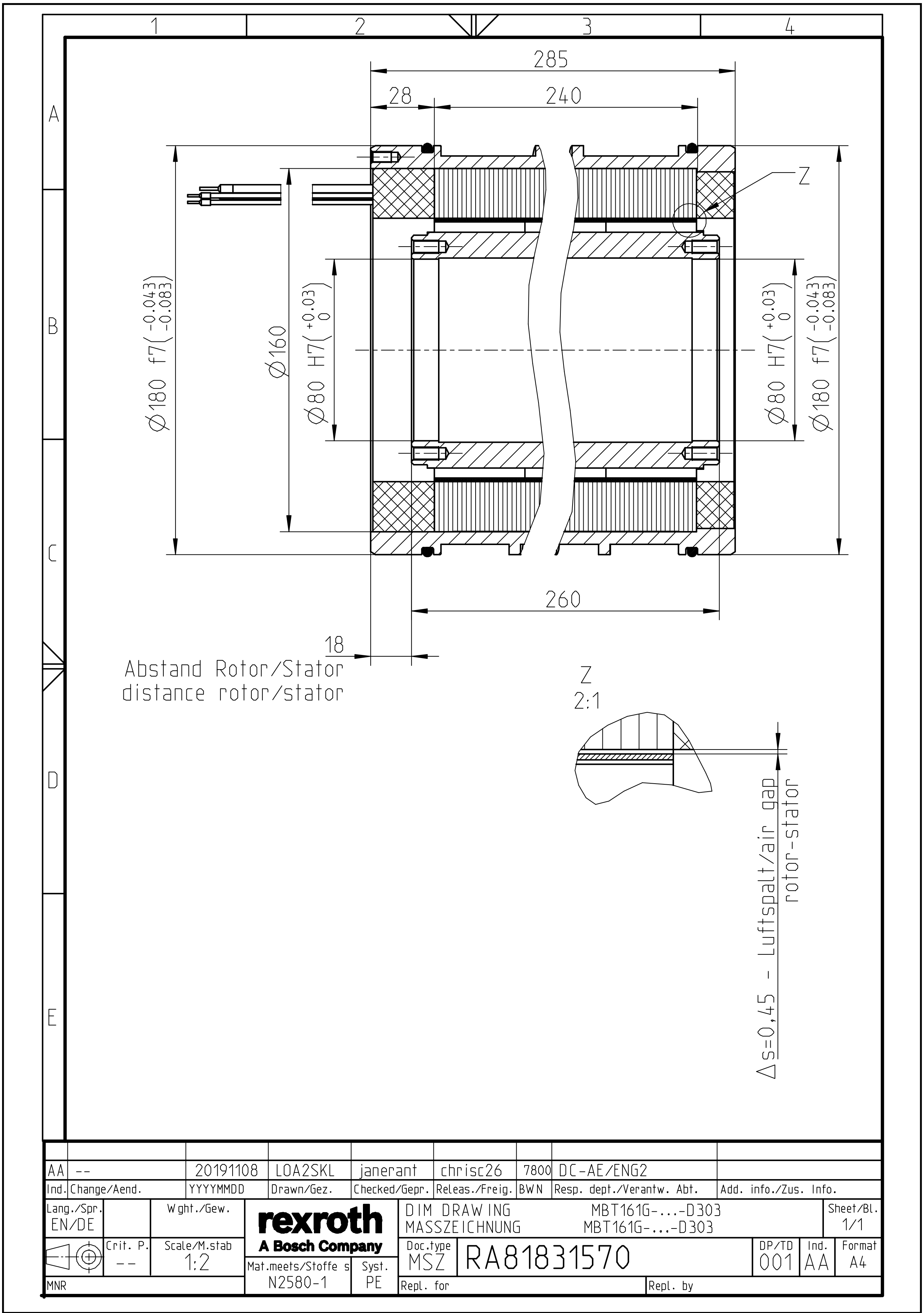


Fig. 5-16: MBT161G-...-D303

5.4.4 Rotor MRT161C/ -E

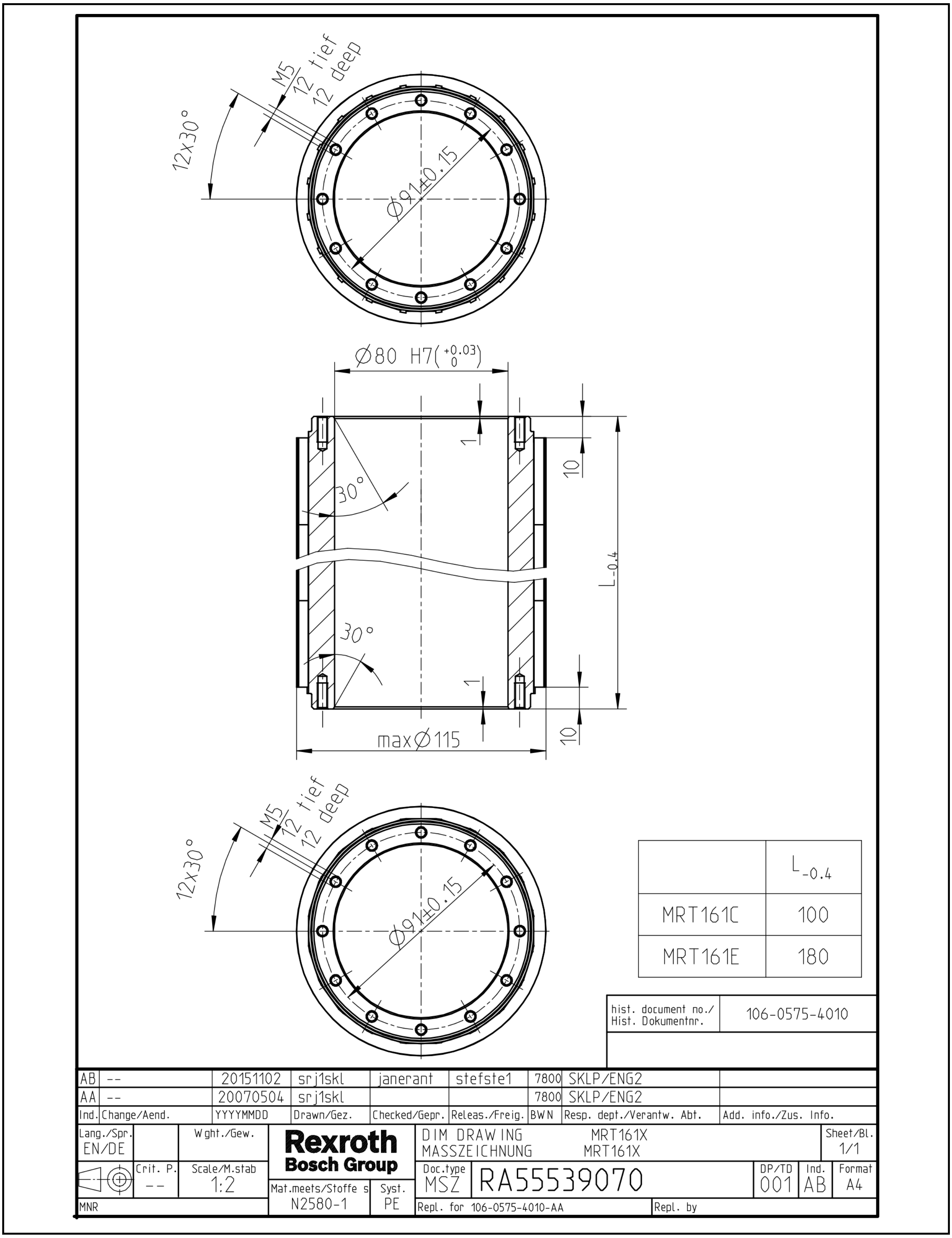


Fig. 5-17: MRT161C/ -E

5.4.5 Rotor MRT161G

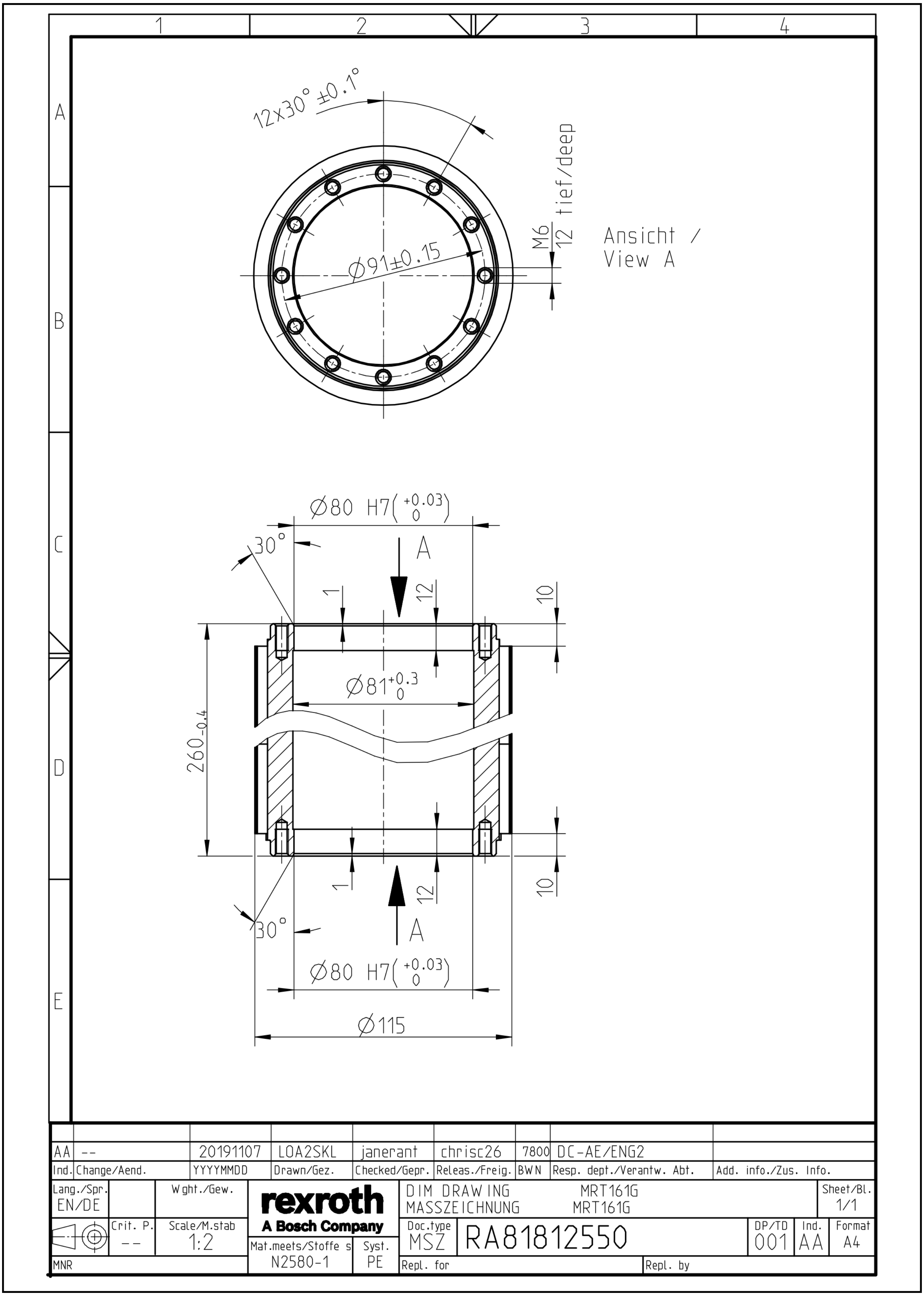


Fig. 5-18: MRT161G

5.4.6 Stator MST161_-...-NNNN

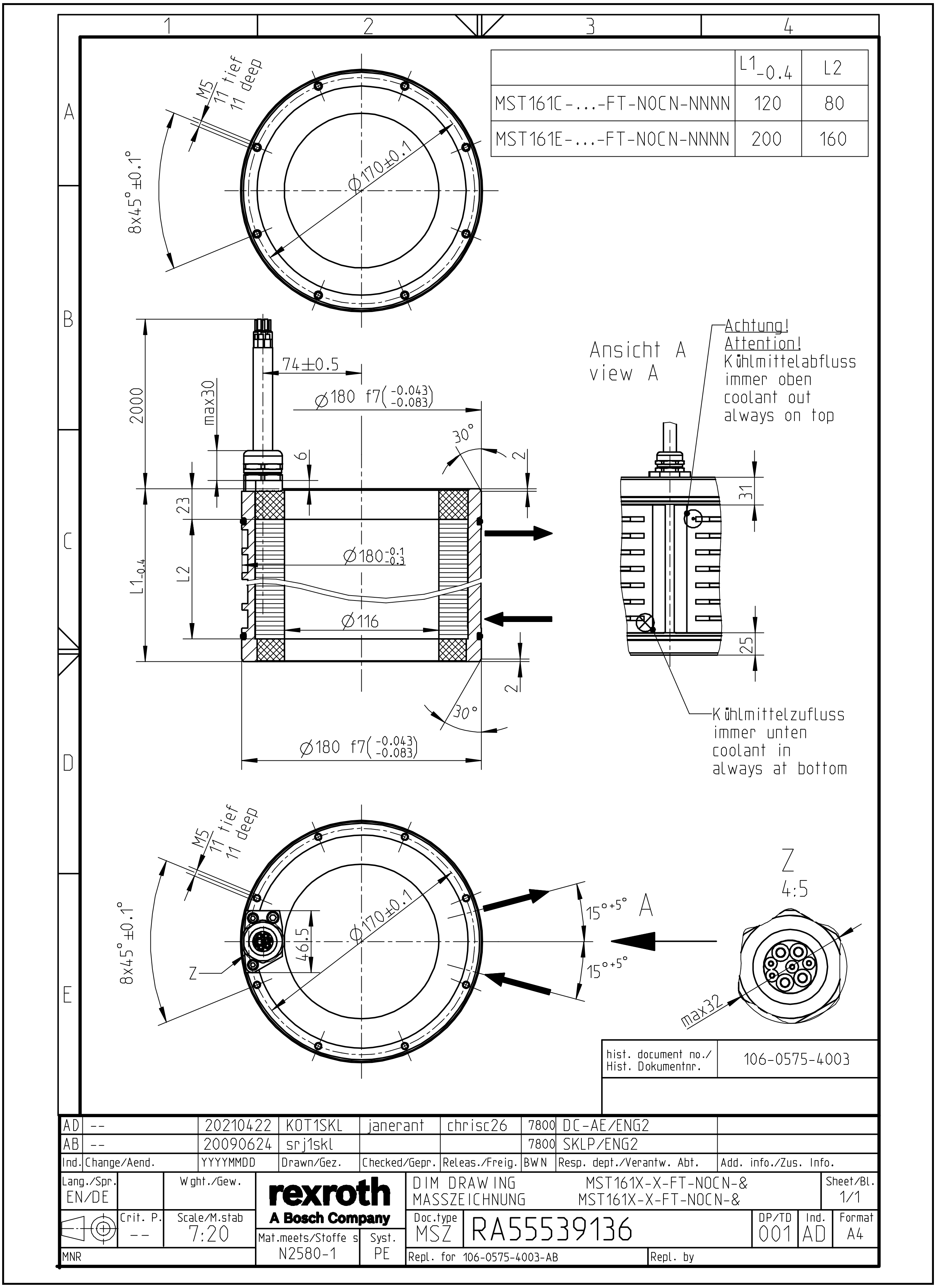


Fig. 5-19: MST161...-NNNN

5.4.7 Stator MST161C/ -E-...-D303

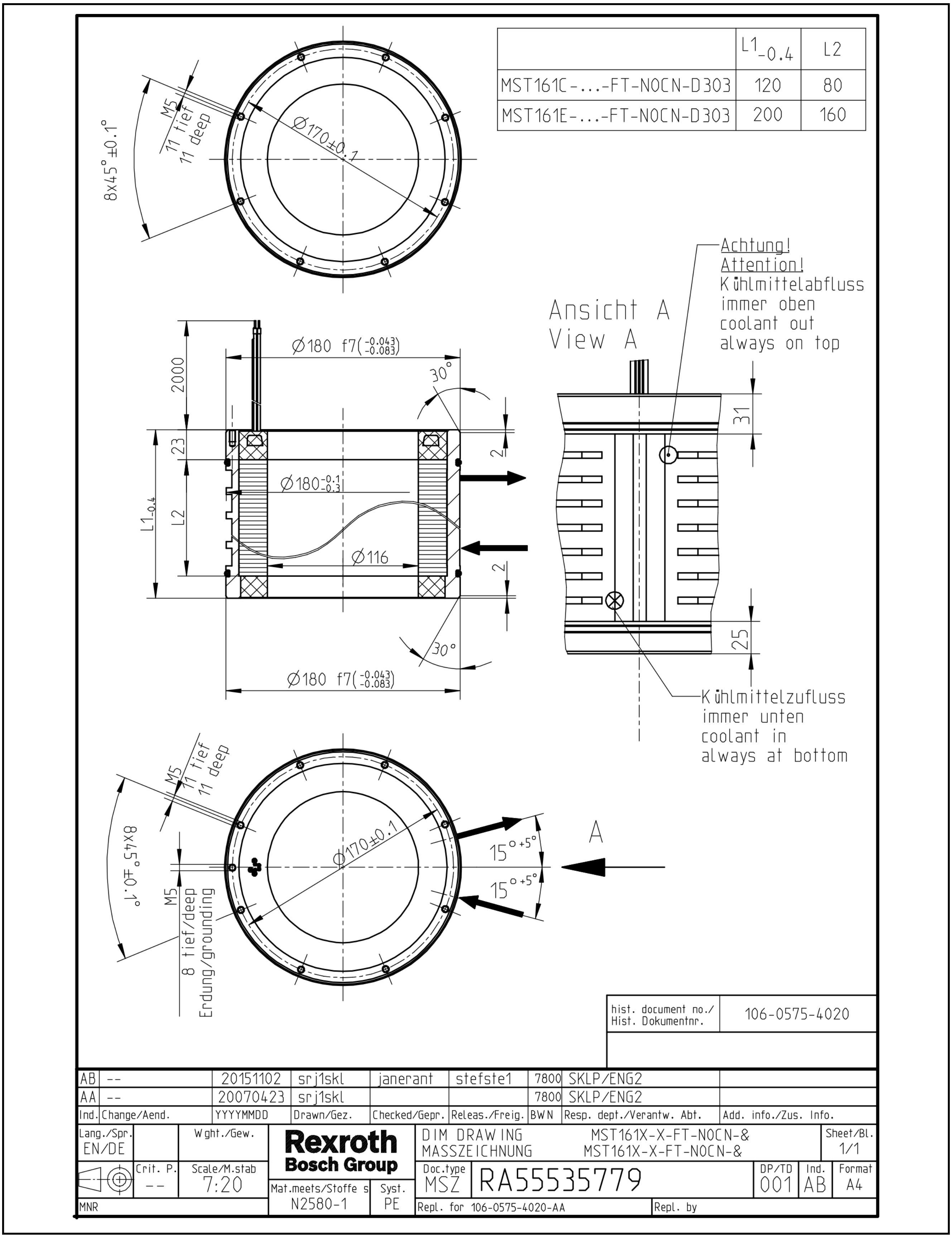


Fig. 5-20: MST161C/ -E-...-D303

5.4.8 Stator MST161G-...-D303

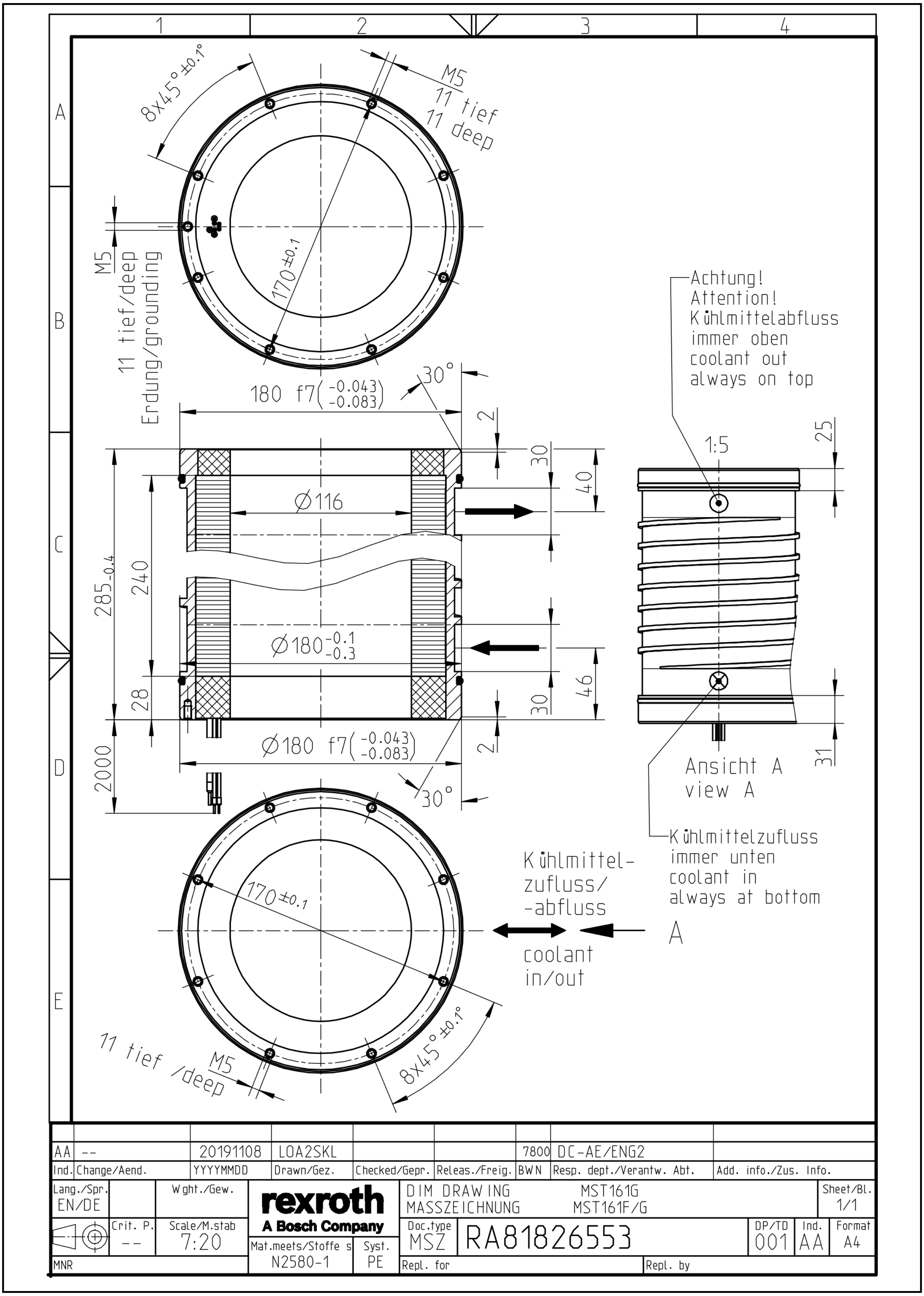
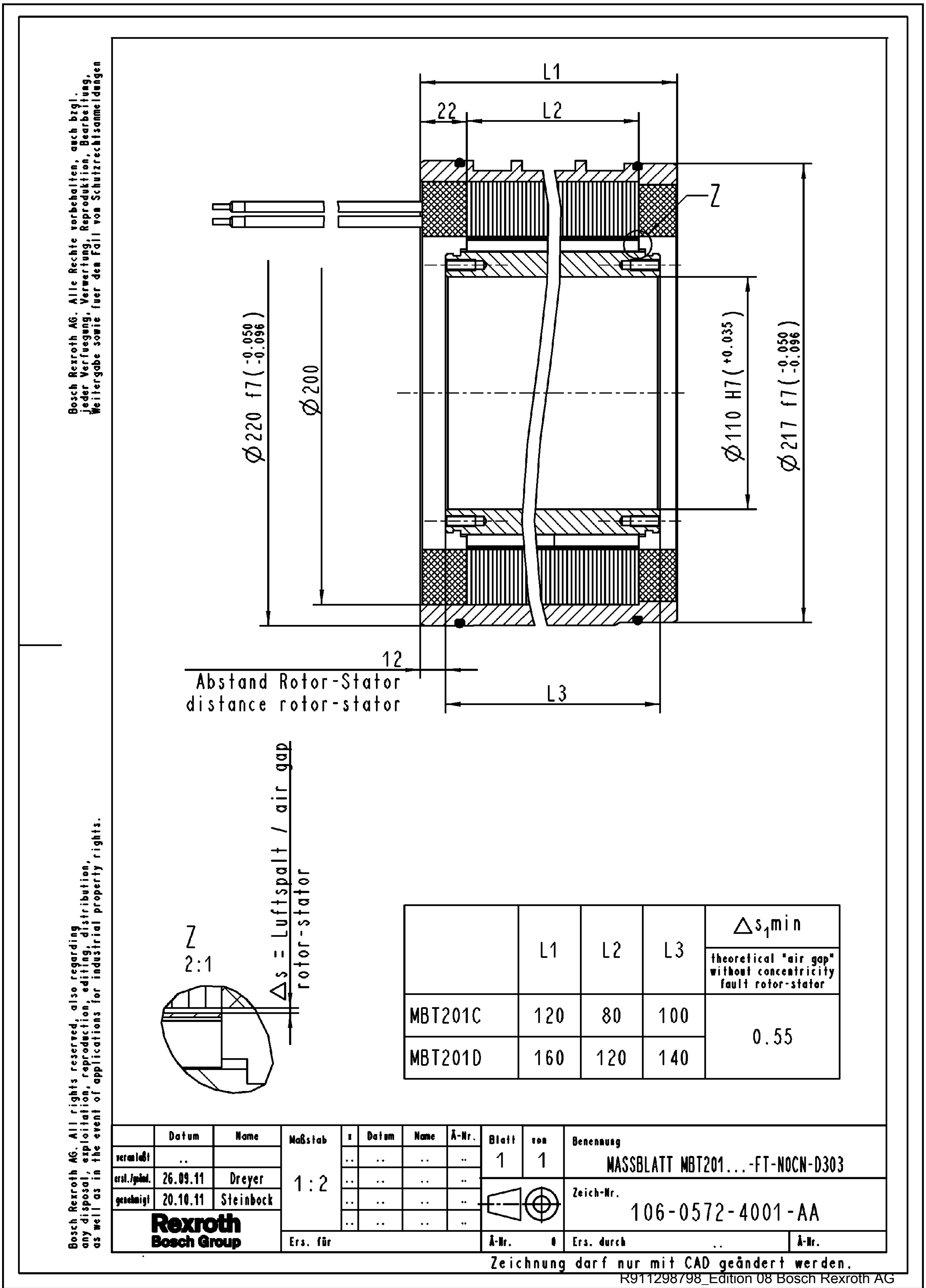


Fig. 5-21: MST161G-...-D303

5.5 Dimension sheets 201

5.5.1 MBT201C/ -D, electrical connection "-_CN-D303"



	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT201C	120	80	100	0.55
MBT201D	160	120	140	

Fig. 5-22: MBT201C/ -D, electrical connection "-_CN-D303"

5.5.2 MBT201F, electrical connection "-_CN-NNNN"

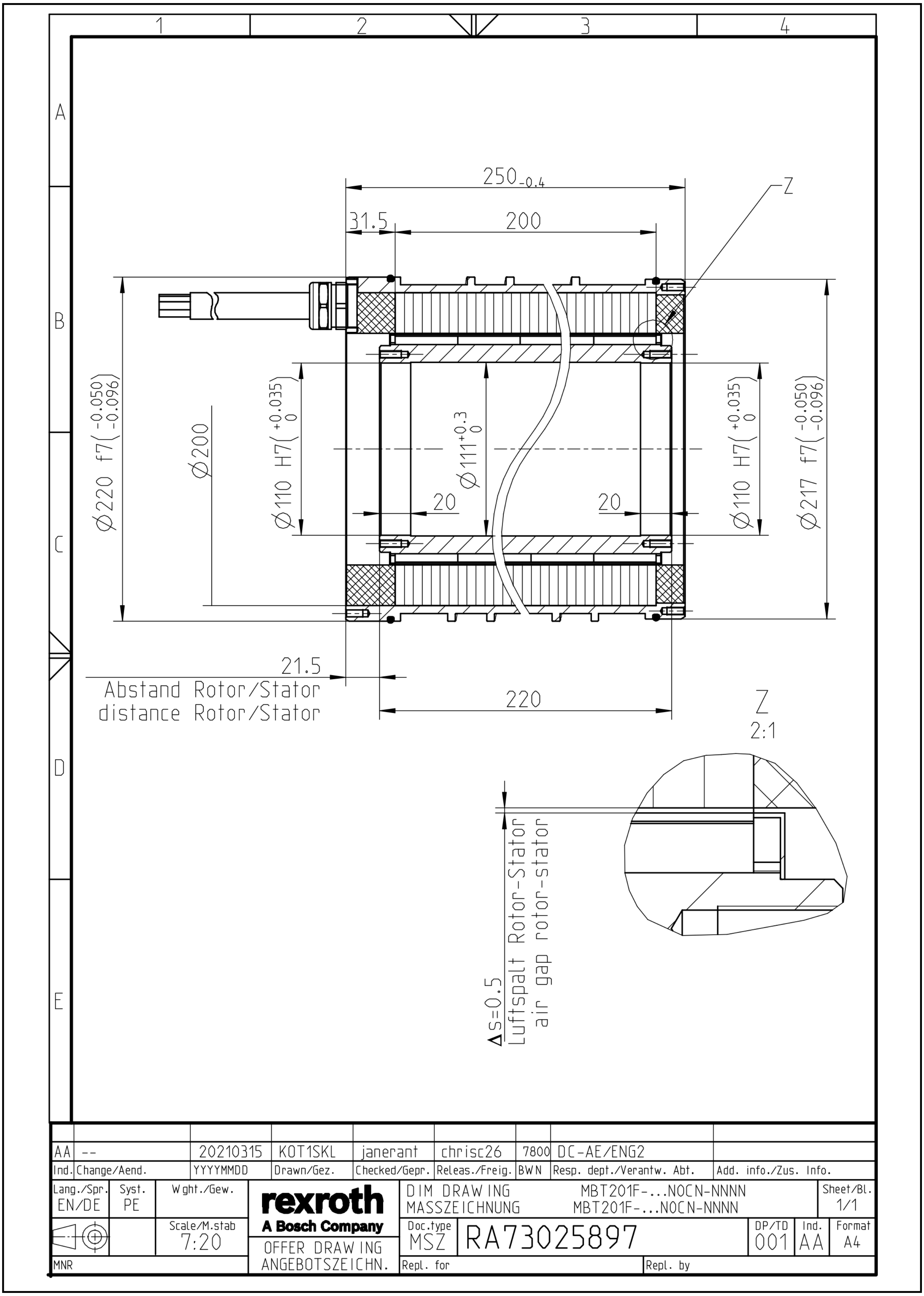
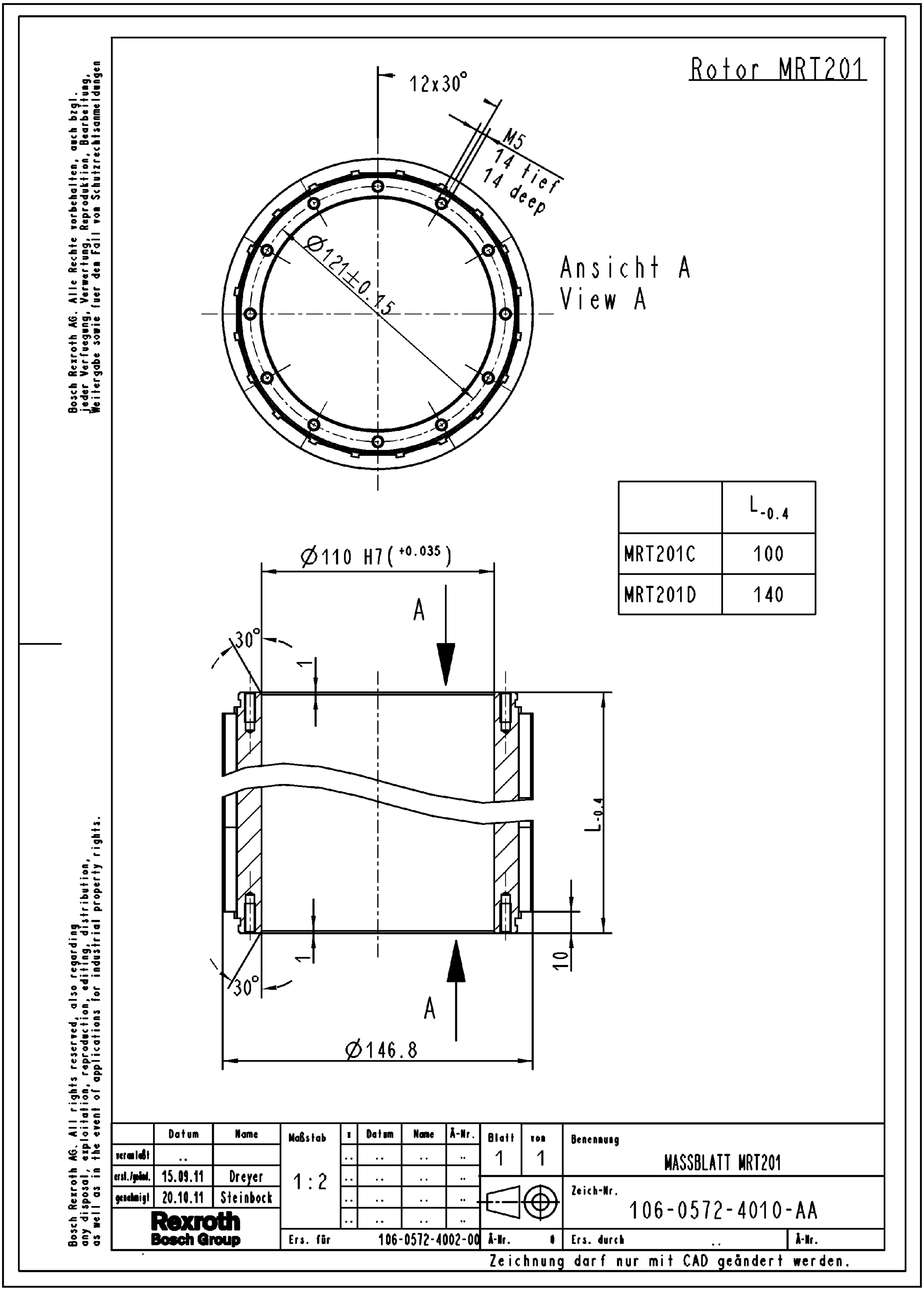


Fig. 5-23: MBT201F, electrical connection "-_CN-NNNN"

5.5.3 MRT201C/ -D



	$L_{-0.4}$
MRT201C	100
MRT201D	140

Fig. 5-24: MRT201C/ -D

5.5.4 MRT201F

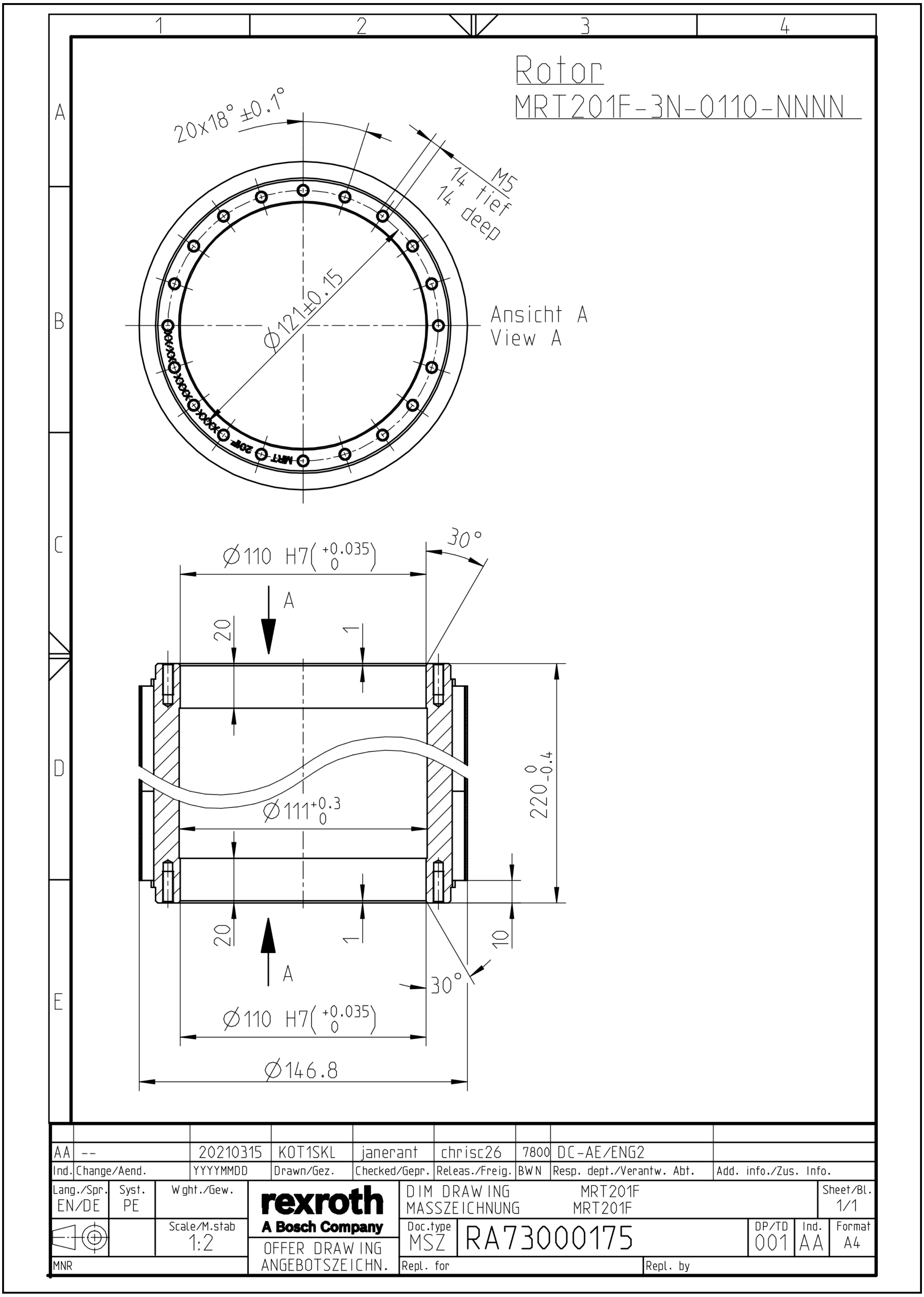


Fig. 5-25: MRT201F

5.5.5 MST201C/ -D, electrical connection "-_CN-D303"

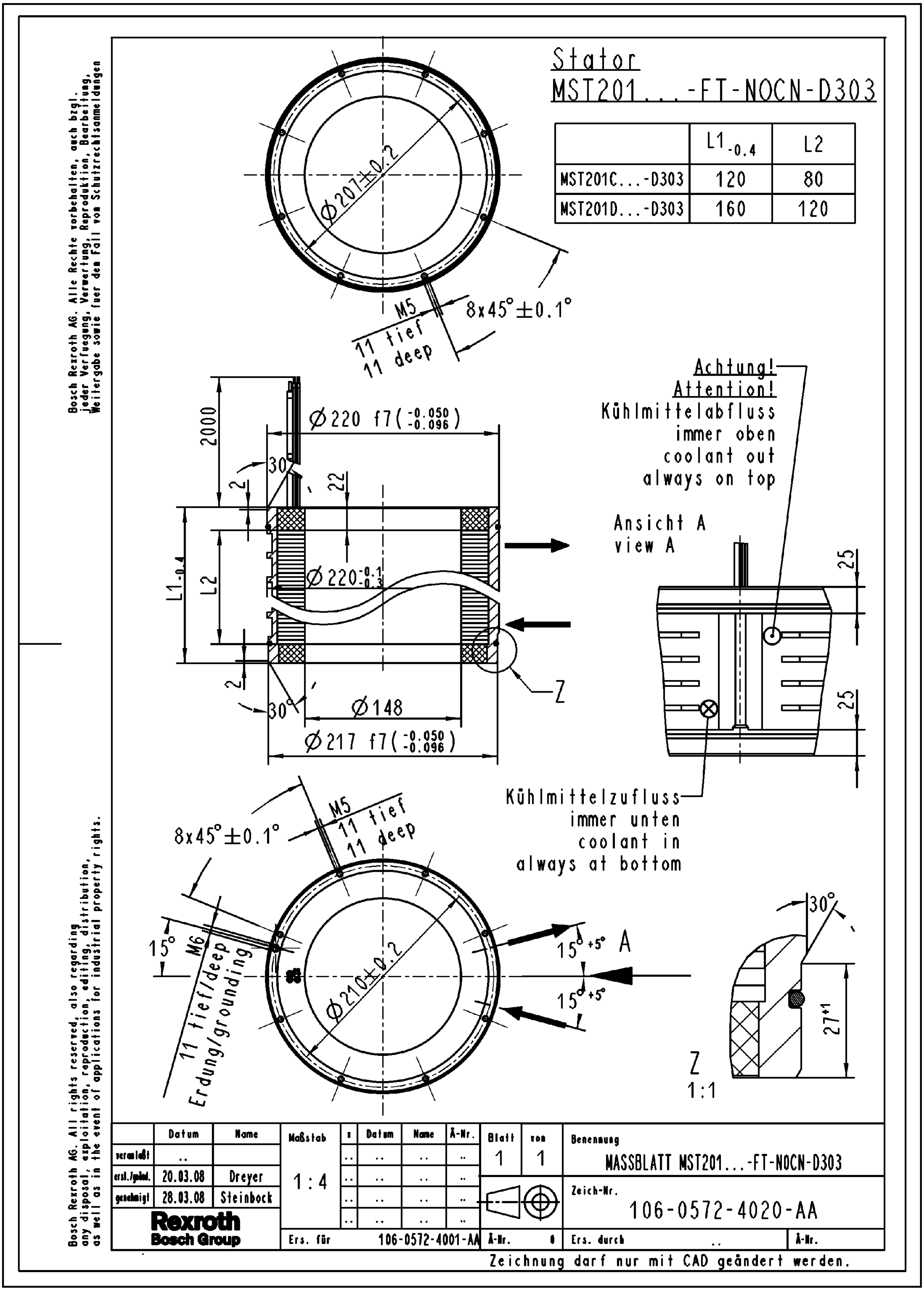


Fig. 5-26: MST201C/ -D, electrical connection "-_CN-D303"

5.5.6 MST201F, electrical connection "-_CN-NNNN"

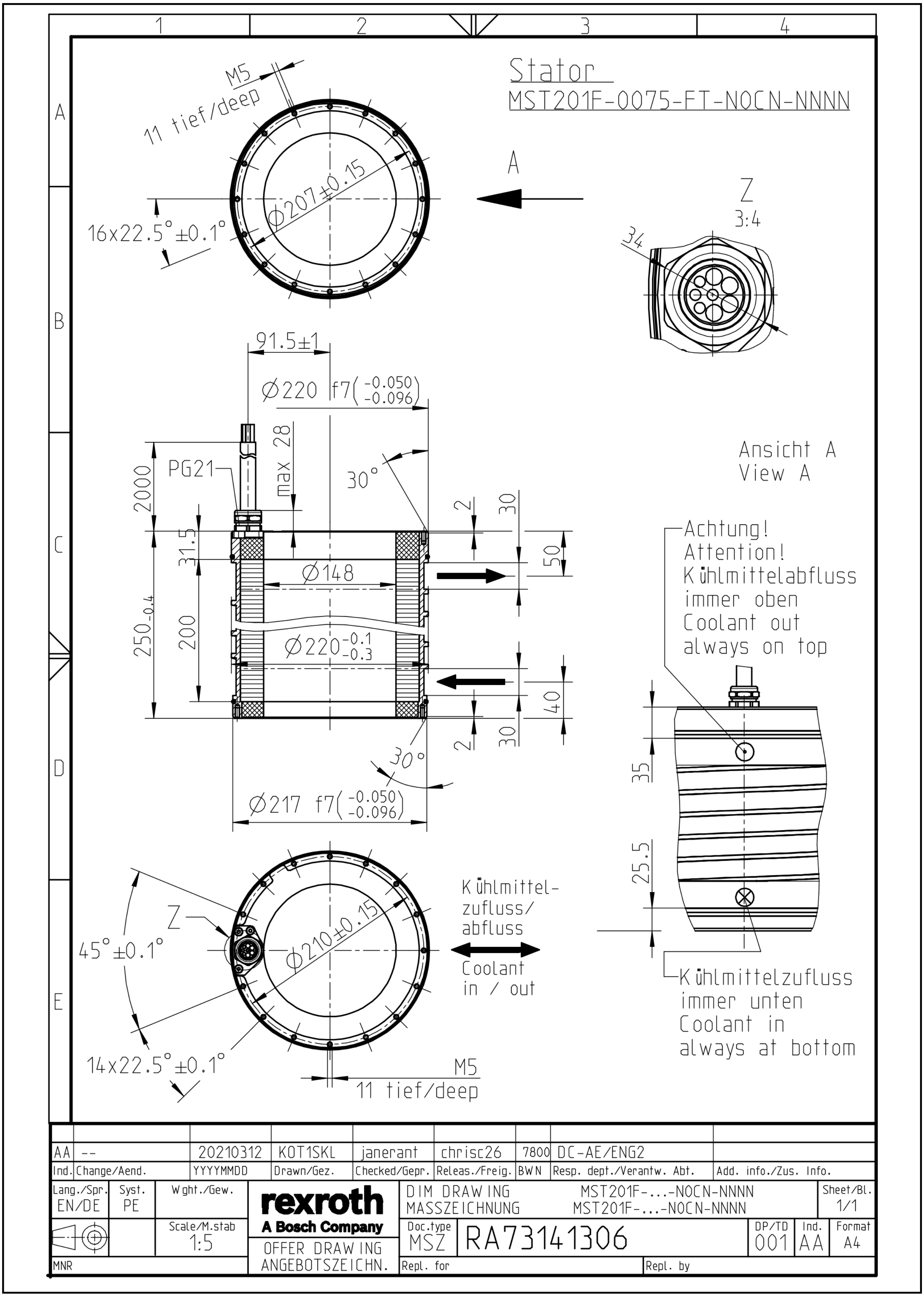
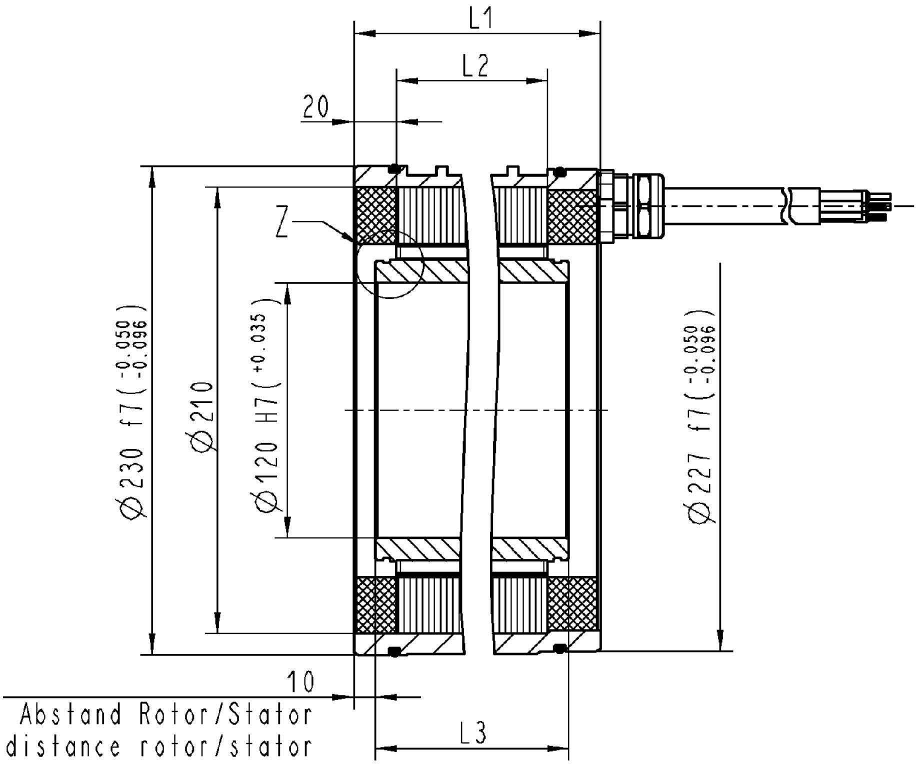


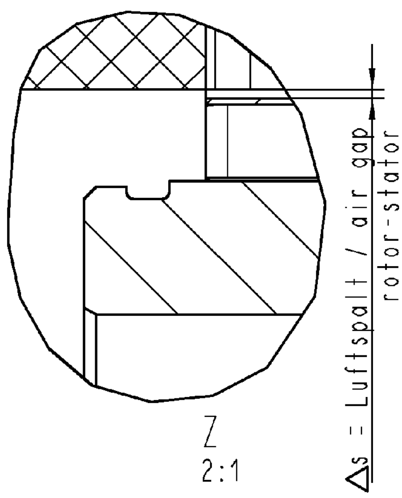
Fig. 5-27: MST201F, electrical connection "-_CN-NNNN"

5.6 Dimension sheets 210

5.6.1 MBT210A/ -C/ -D/ -E with electrical connection "_SN-NNNN"



	L1	L2	L3	Δs1min theoretical "air gap" without concentricity fault rotor-stator
MBT210A	75	30	50	0.5
MBT210C	120	75	95	
MBT210D	150	105	125	
MBT210E	195	150	170	

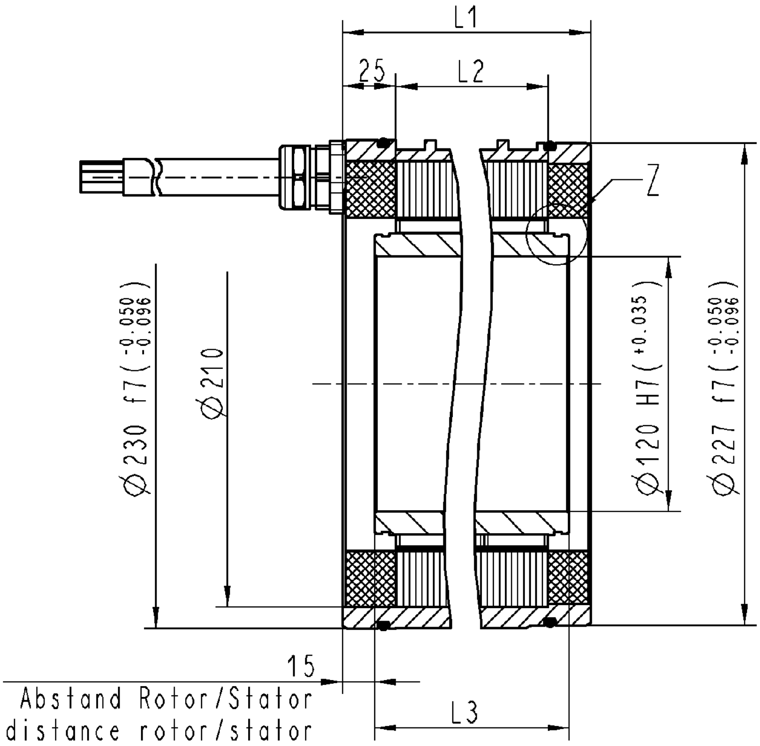


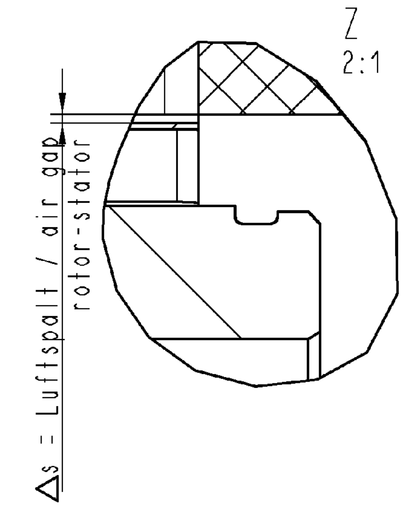
	Datum	Name	Maßstab	x	Datum	Name	Ä-Nr.	Blatt	von	Benennung
veranlaßt	..		7:20	..	..	..	..	1	1	MASSBLATT MBT210 (Kabel am D=227)
erst./geänd.	23.04.02	Dreyer		..	..	..	..			Zeich-Nr. 106-0393-4001-AC
genehmigt	04.06.02	Steinbock		..	..	..	..			
Rexroth Bosch Group			Ers. für	106-0393-4001-01			Ä-Nr. 0	Ers. durch ..		Ä-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 5-28: MBT210A/ -C/ -D/ -E, electrical connection "_SN-NNNN"

5.6.2 MBT210A/ -C/ -D/ -E with electrical connection "_CN-NNNN"





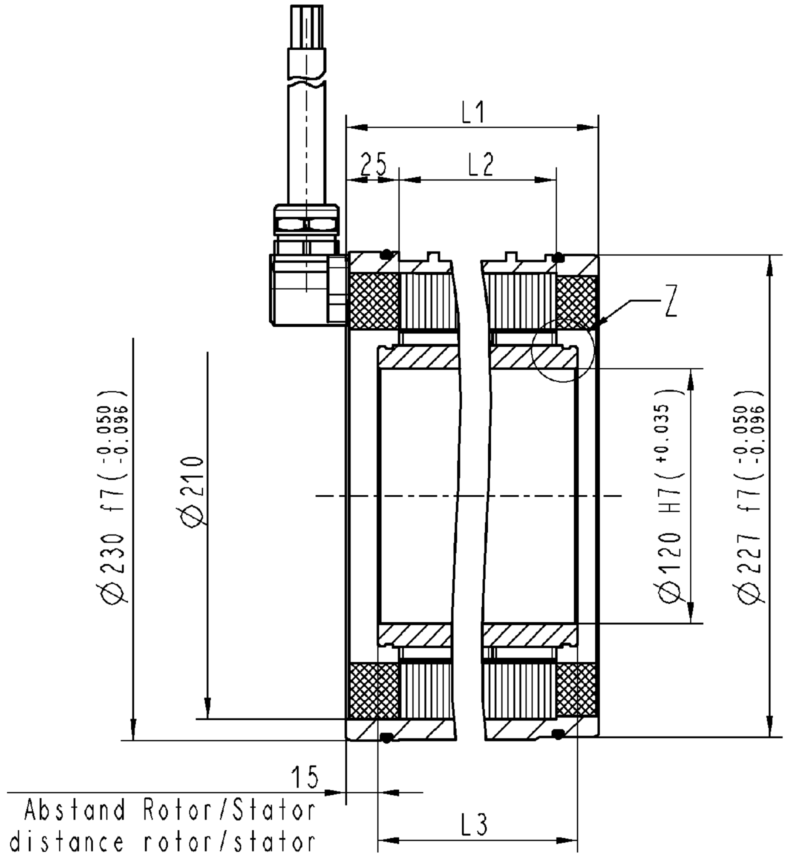
	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT210A	75	30	50	0.5
MBT210C	120	75	95	
MBT210D	150	105	125	
MBT210E	195	150	170	

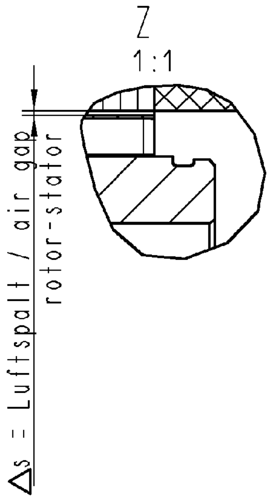
	Datum	Name	Maßstab	x	Datum	Name	Ä-Nr.	Blatt	von	Benennung
veranlaßt	..		7:20	..	..	..	..	1	1	MASSBLATT MBT210 (Kabel am D=230)
erst./geänd.	23.04.02	Dreyer		..	..	..	..			Zeich-Nr. 106-0393-4002-AC
genehmigt	04.06.02	Steinbock		..	..	..	..			
Rexroth Bosch Group			Ers. für 106-0393-4002-01				Ä-Nr. 0			Ers. durch .. Ä-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 5-29: MBT210A/ -C/ -D/ -E, electrical connection "_CN-NNNN"

5.6.3 MBT210A/ -C/ -D/ -E with electrical connection “_RN-NNNN"





	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT210A /RN	75	30	50	0.5
MBT210C /RN	120	75	95	
MBT210D /RN	150	105	125	
MBT210E /RN	195	150	170	

	Datum	Name	Maßstab	Blatt	von	Benennung
veranlaßt	..		7:20	1	1	MASSBLATT MBT210 /RN
erst./geänd.	14.07.03	Dreyer				Zeich-Nr. 106-0393-4003-AB
genehmigt	14.07.03	Steinbock				
Rexroth Bosch Group			Ers. für 106-0393-4003-00	ÄM-Nr. 0		Ers. durch .. ÄM-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 5-30: MBT210A/ -C/ -D/ -E, electrical connection "_RN-NNNN"

5.6.4 MBT210U with electrical connection "_CN-D303"

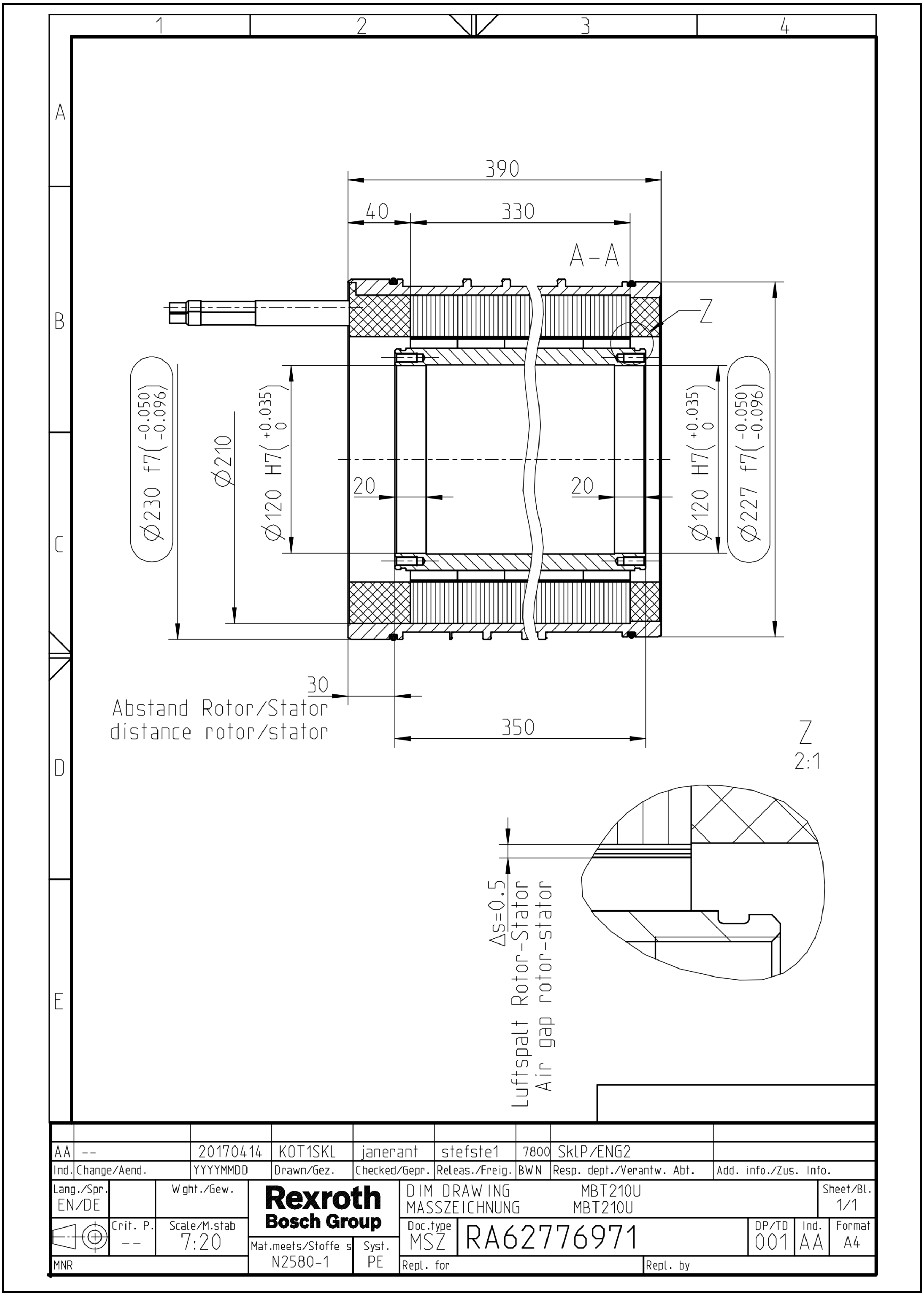
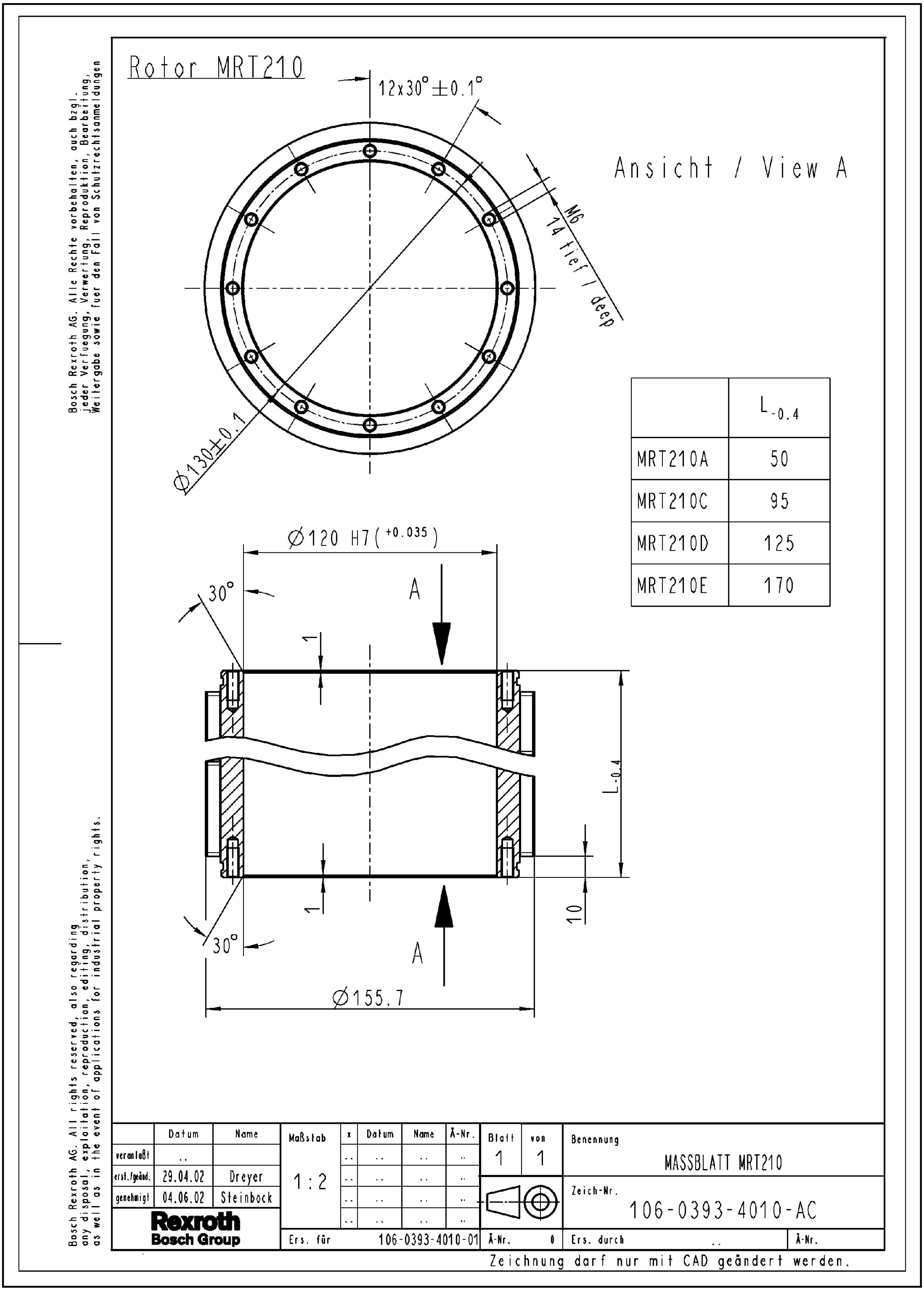


Fig. 5-31: MBT210U, electrical connection "_CN-D303"

5.6.5 Rotor MRT210A/ -C/ -D/ -E



	$L_{-0.4}$
MRT210A	50
MRT210C	95
MRT210D	125
MRT210E	170

Fig. 5-32: MRT210A/ -C/ -D/ -E

5.6.6 Rotor MRT210U

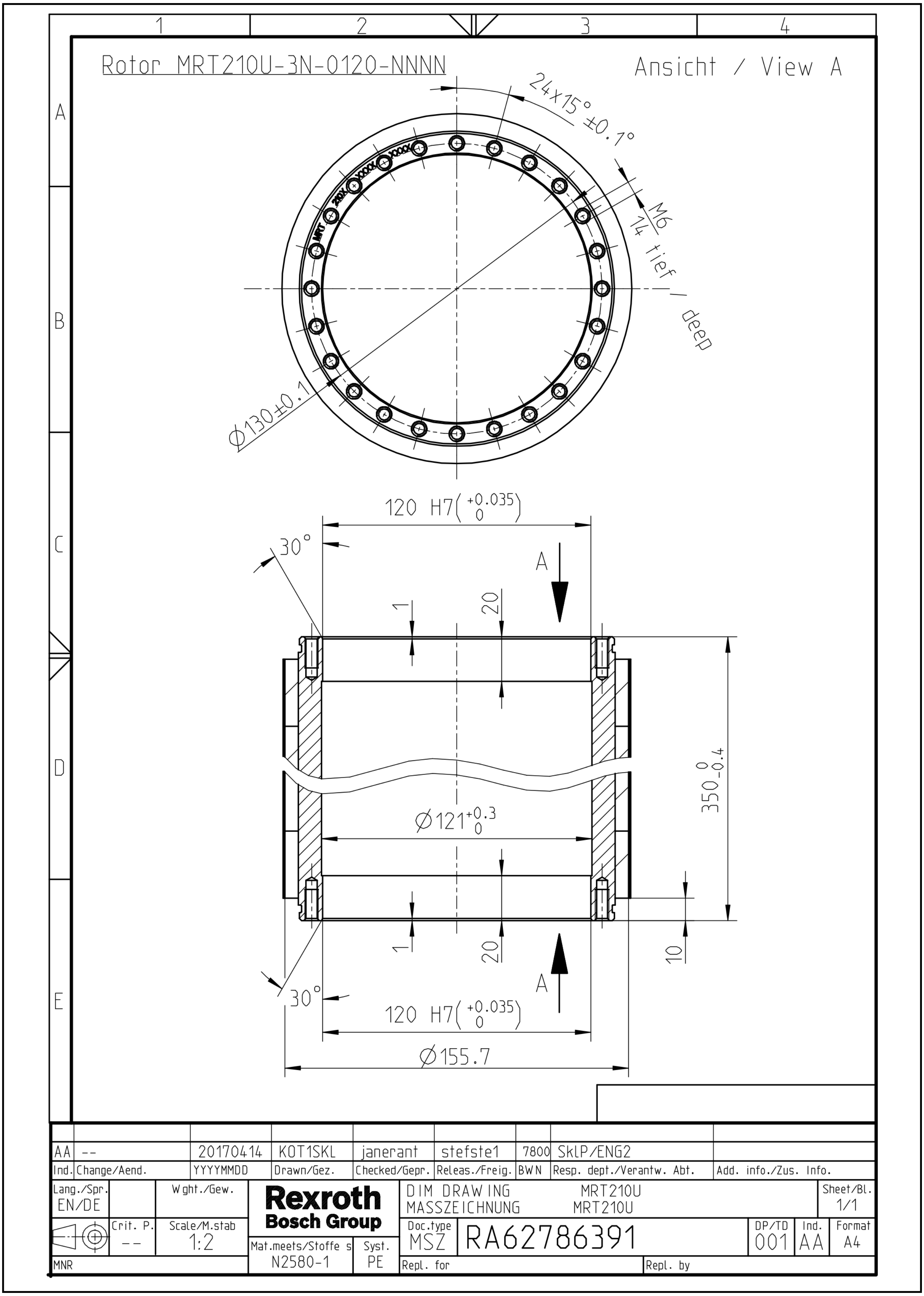


Fig. 5-33: MRT210U

5.6.7 Stator MST210A/ -C/ -D/ -E, electrical connection "_SN-NNNN"

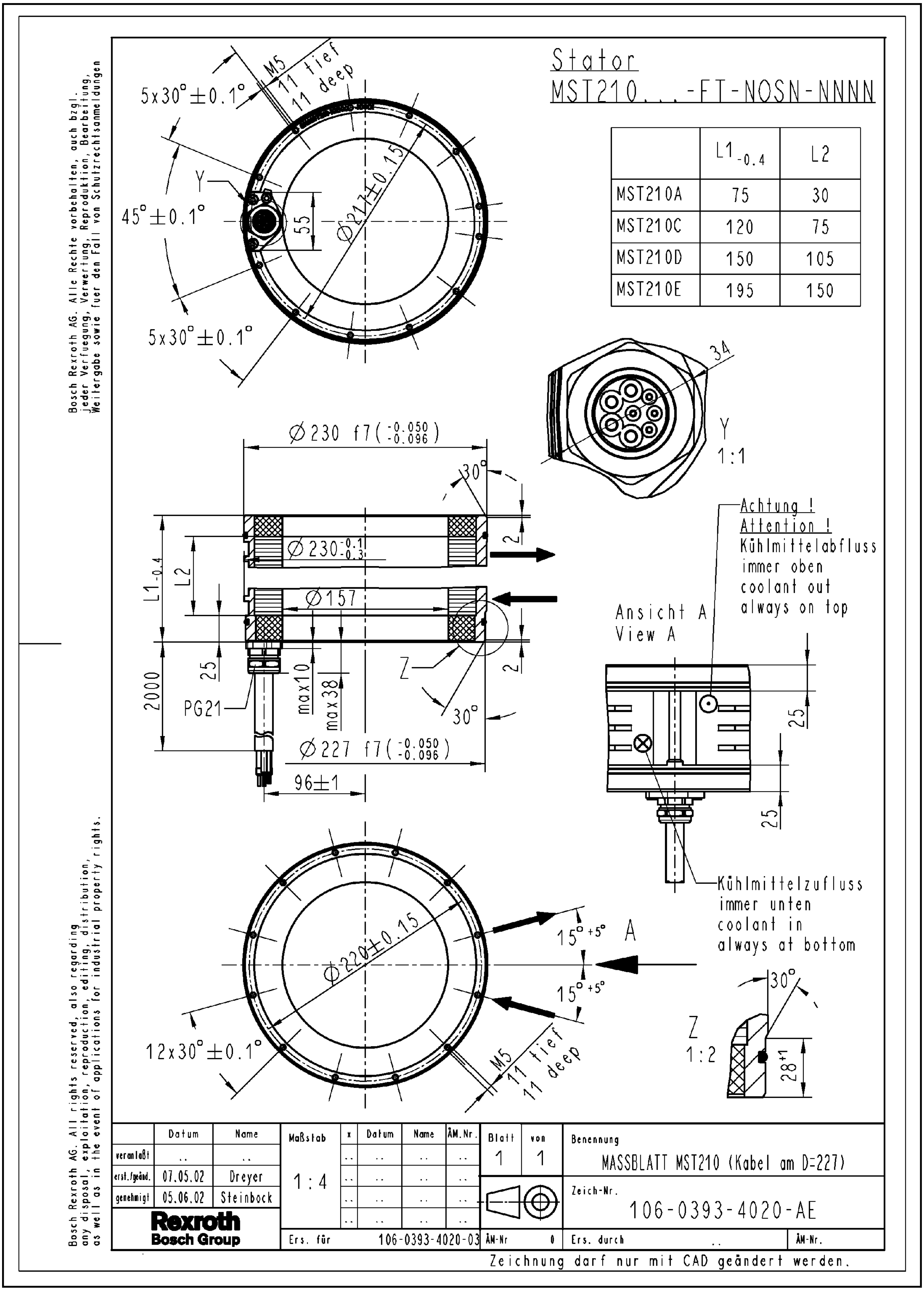
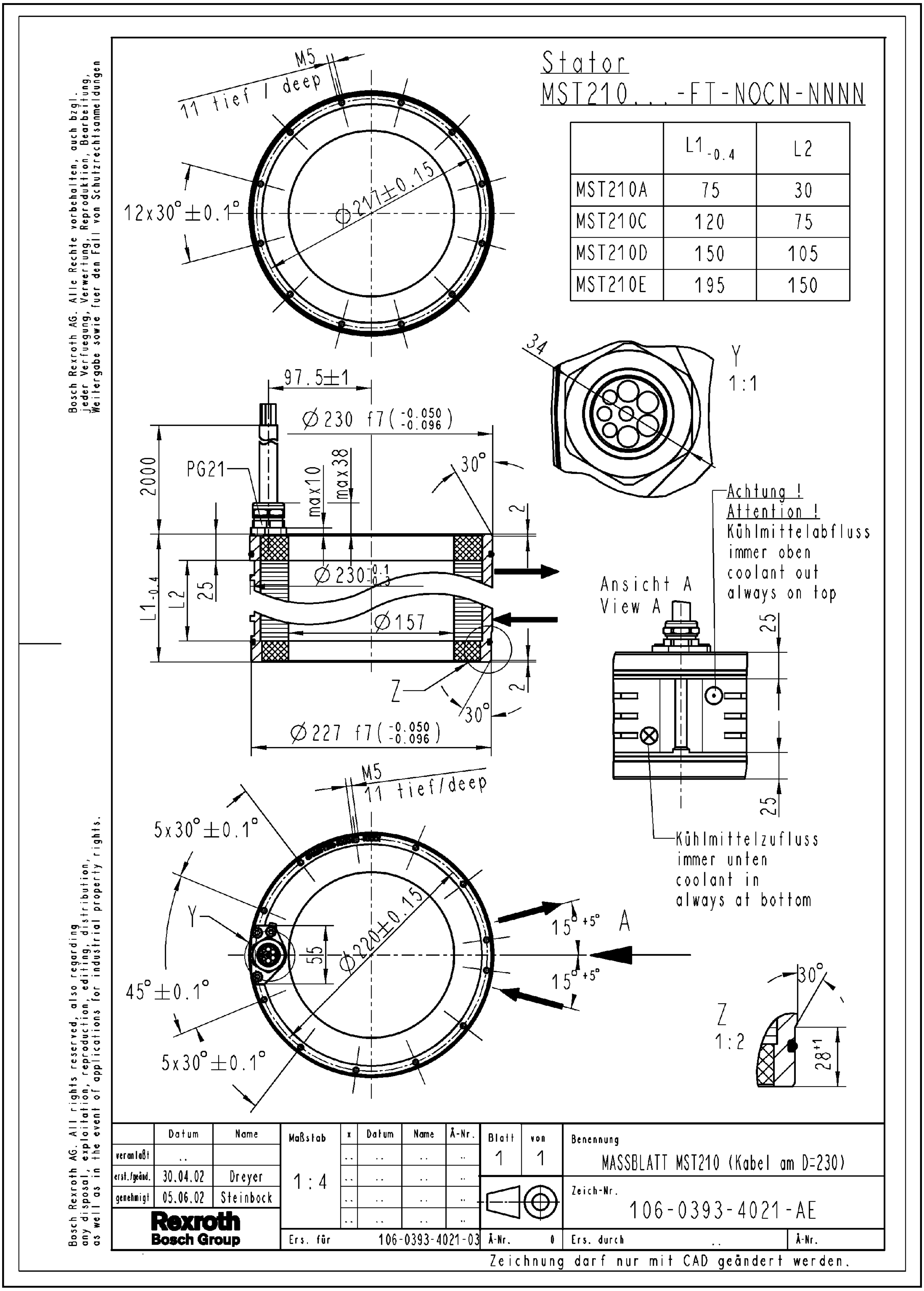


Fig. 5-34: MST210A/ -C/ -D/ -E, electrical connection "_SN-NNNN"

5.6.8 Stator MST210A/ -C/ -D/ -E, electrical connection "_CN-NNNN"



	L1 -0.4	L2
MST210A	75	30
MST210C	120	75
MST210D	150	105
MST210E	195	150

Fig. 5-35: MST210A/ -C/ -D/ -E, electrical connection "_CN-NNNN"

5.6.9 Stator MST210A/ -D, electrical connection "_CN-D301"

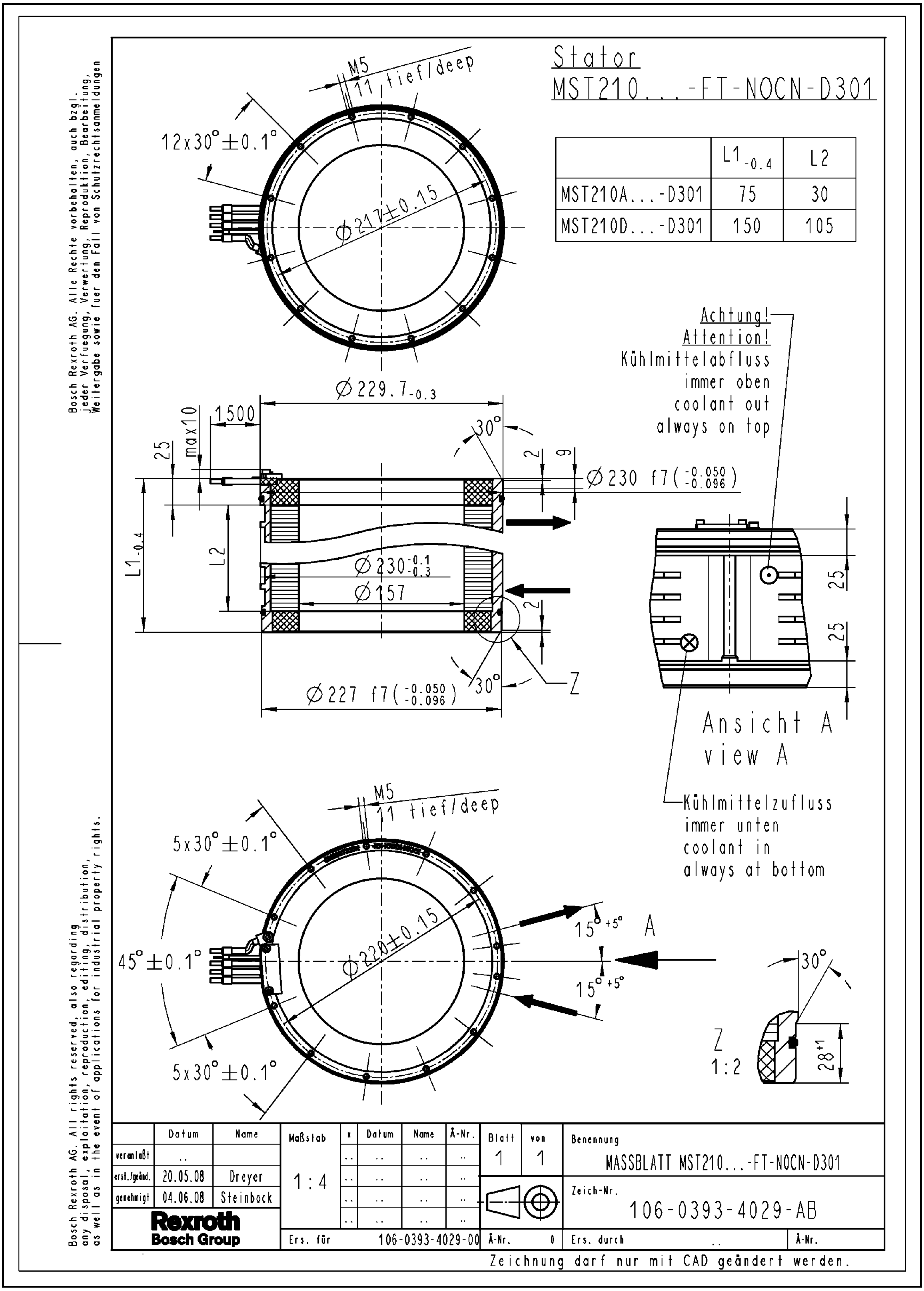


Fig. 5-36: Stator MST210A/ -D, electrical connection "_CN-D301"

5.6.10 Stator MST210A/ -C/ -D/ -E, electrical connection "_CN-D303"

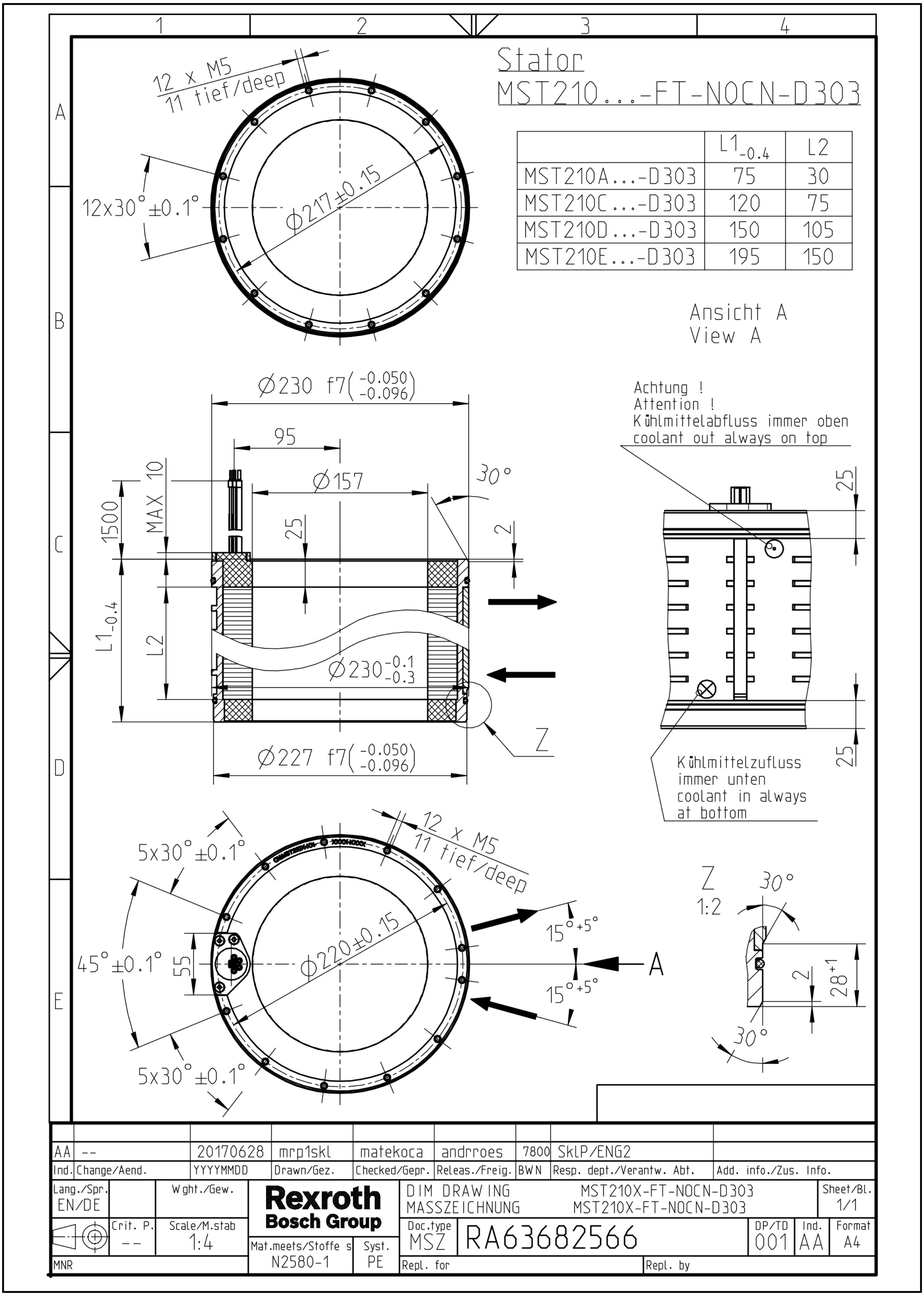


Fig. 5-37: Stator MST210A/ -C/ -D/ -E, electrical connection "_CN-D303"

5.6.11 Stator MST210U, electrical connection "_CN-D303"

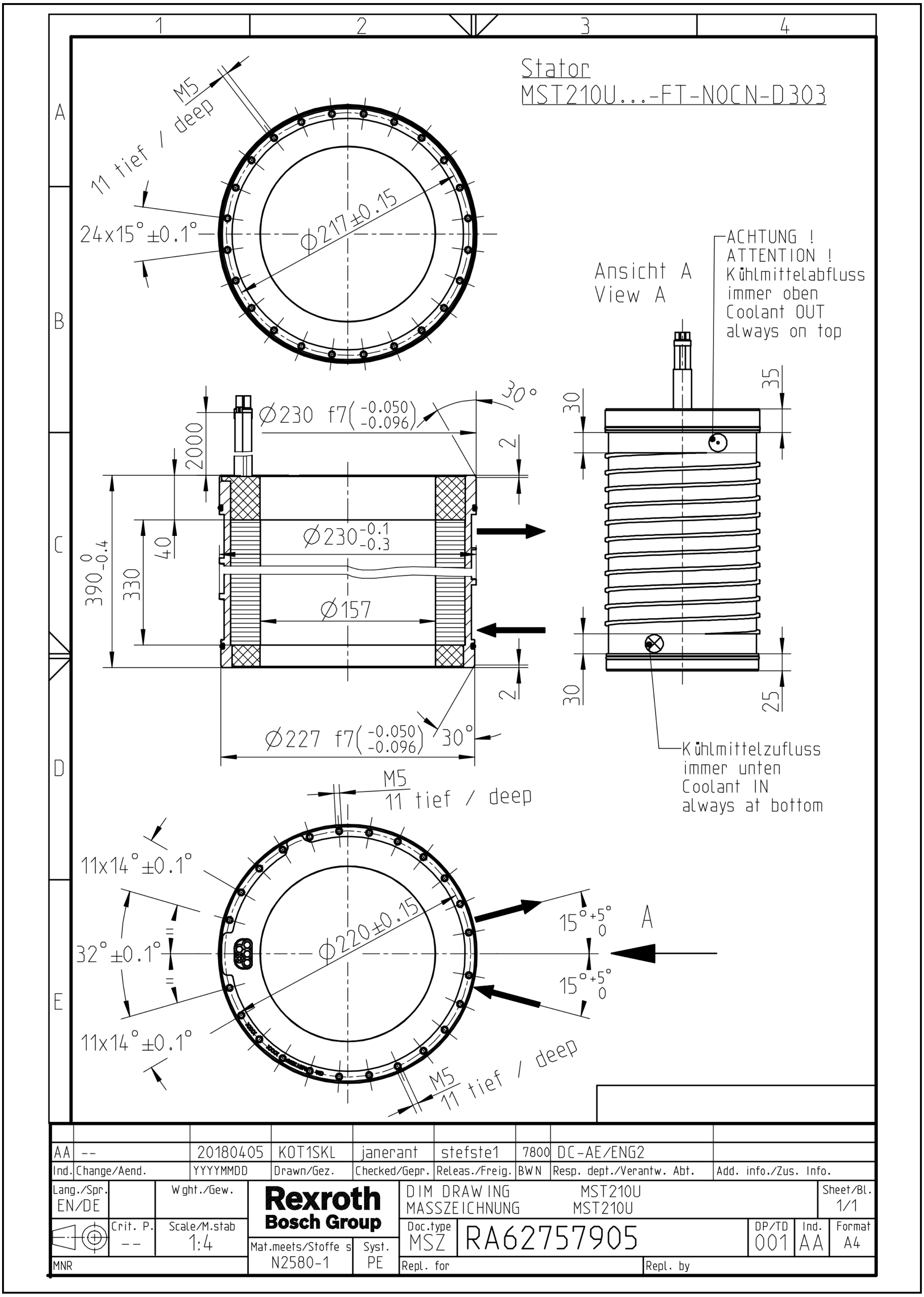
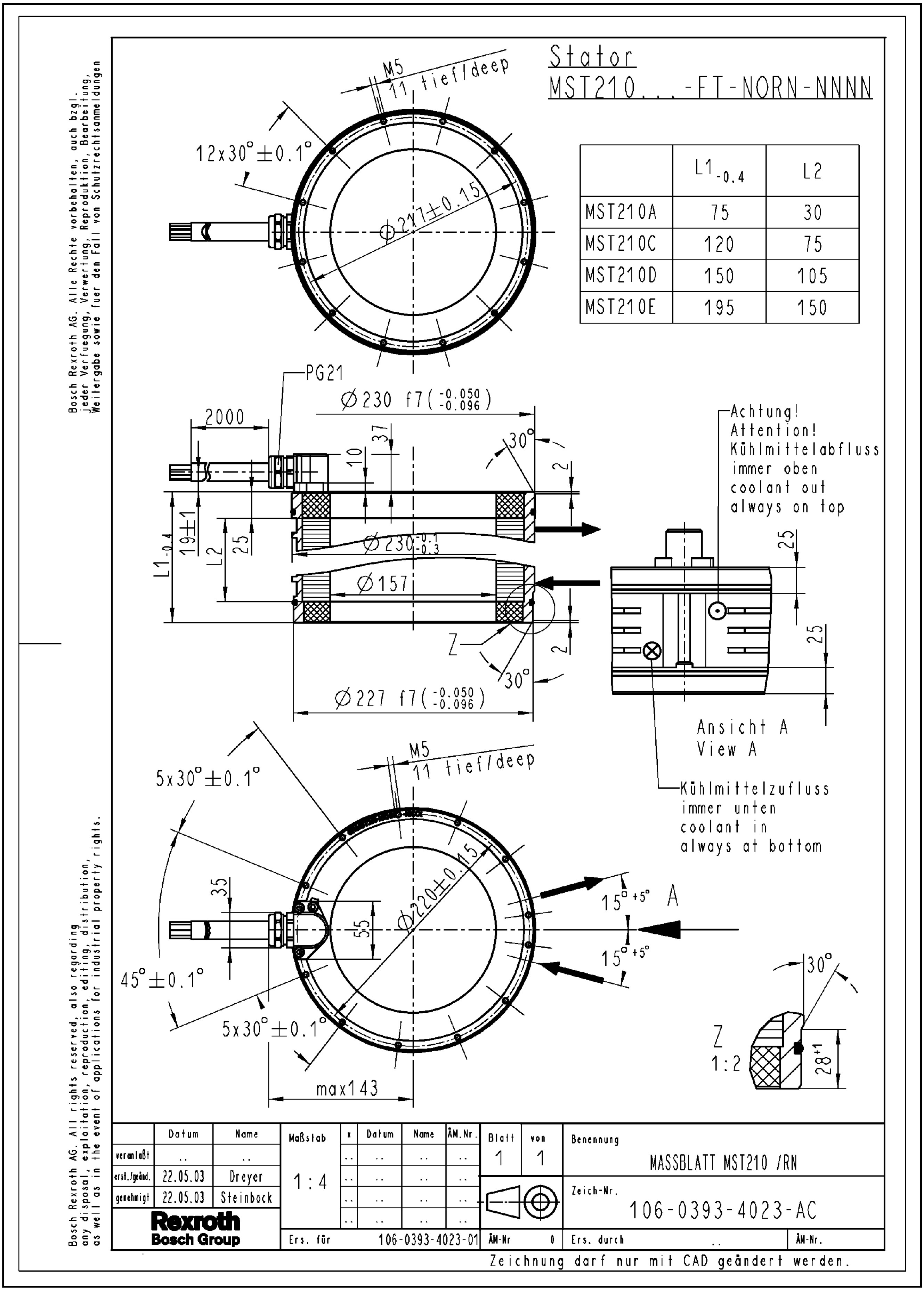


Fig. 5-38: Stator MST210U, electrical connection "_CN-D303"

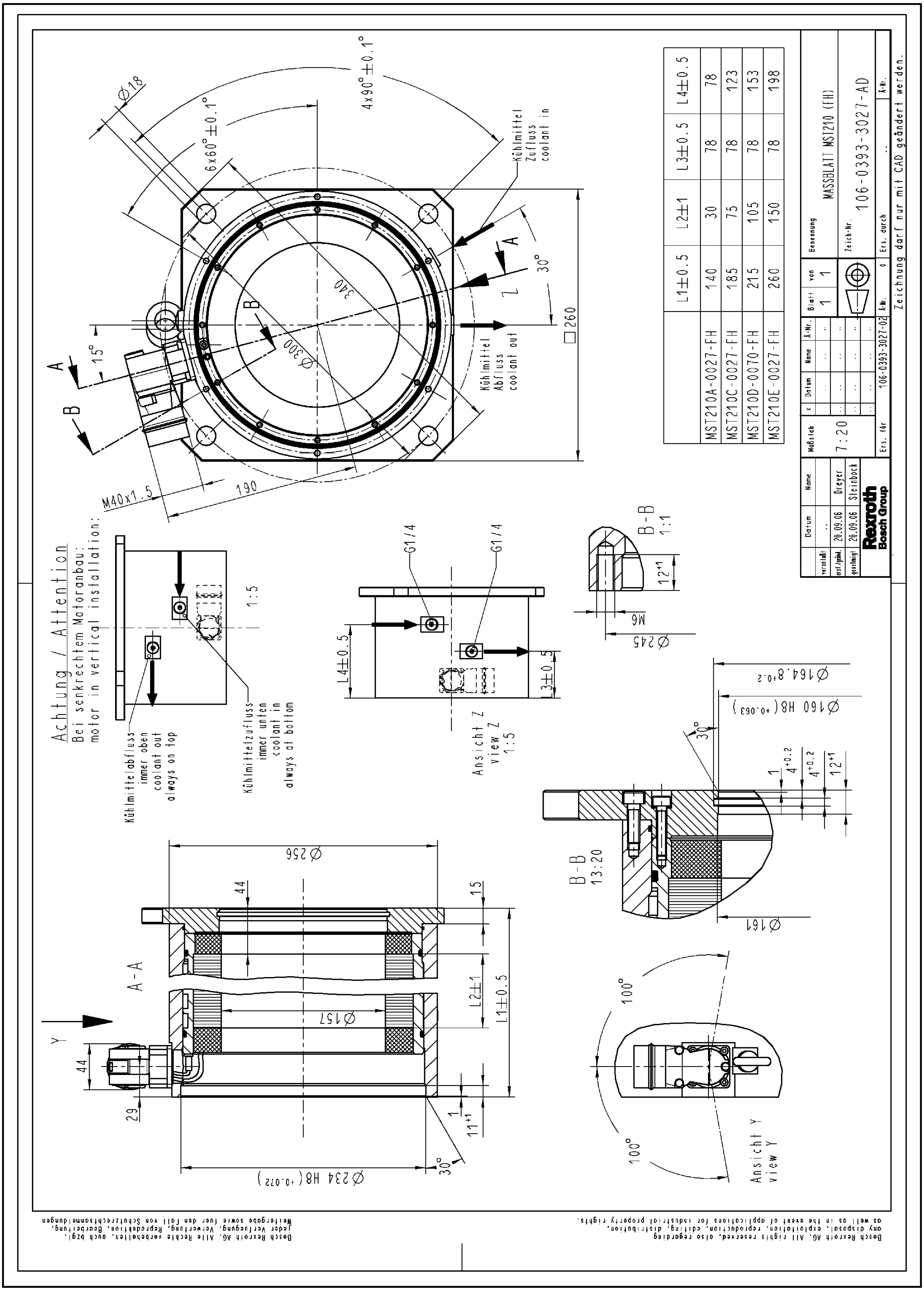
5.6.12 Stator MST210A/ -C/ -D/ -E, electrical connection "_RN-NNNN"



	$L1_{-0.4}$	L2
MST210A	75	30
MST210C	120	75
MST210D	150	105
MST210E	195	150

Fig. 5-39: MST210A/ -C/ -D/ -E, electrical connection "_RN-NNNN"

5.6.13 Stator MST210A/ -C/ -D/ -E with housing ("FH" design)

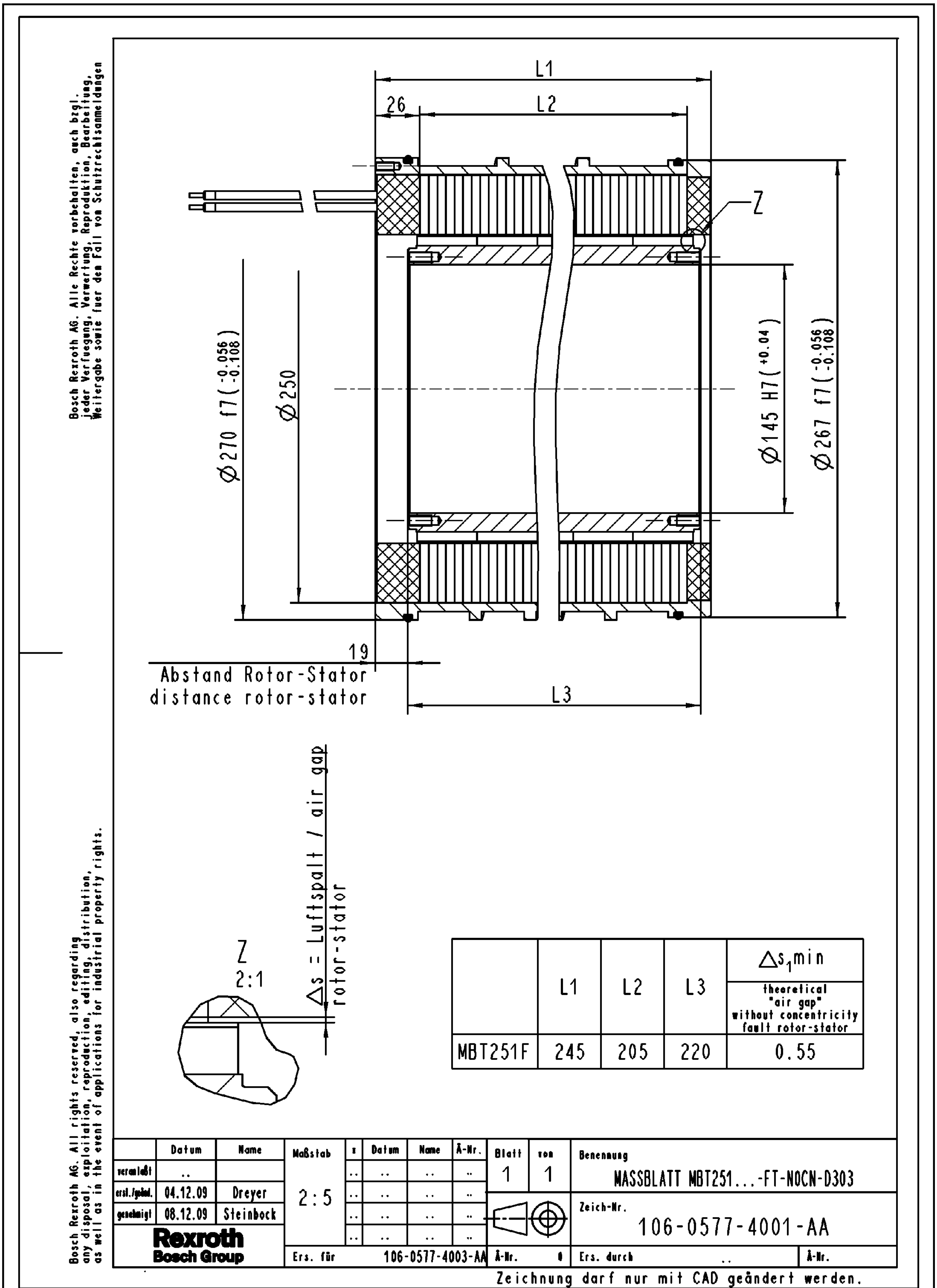


	L1±0.5	L2±1	L3±0.5	L4±0.5
MST210A-0027-FH	140	30	78	78
MST210C-0027-FH	185	75	78	123
MST210D-0070-FH	215	105	78	153
MST210E-0027-FH	260	150	78	198

Fig. 5-40: MST210A/ -C/ -D/ -E with housing ("FH" design)

5.7 Frame size 251

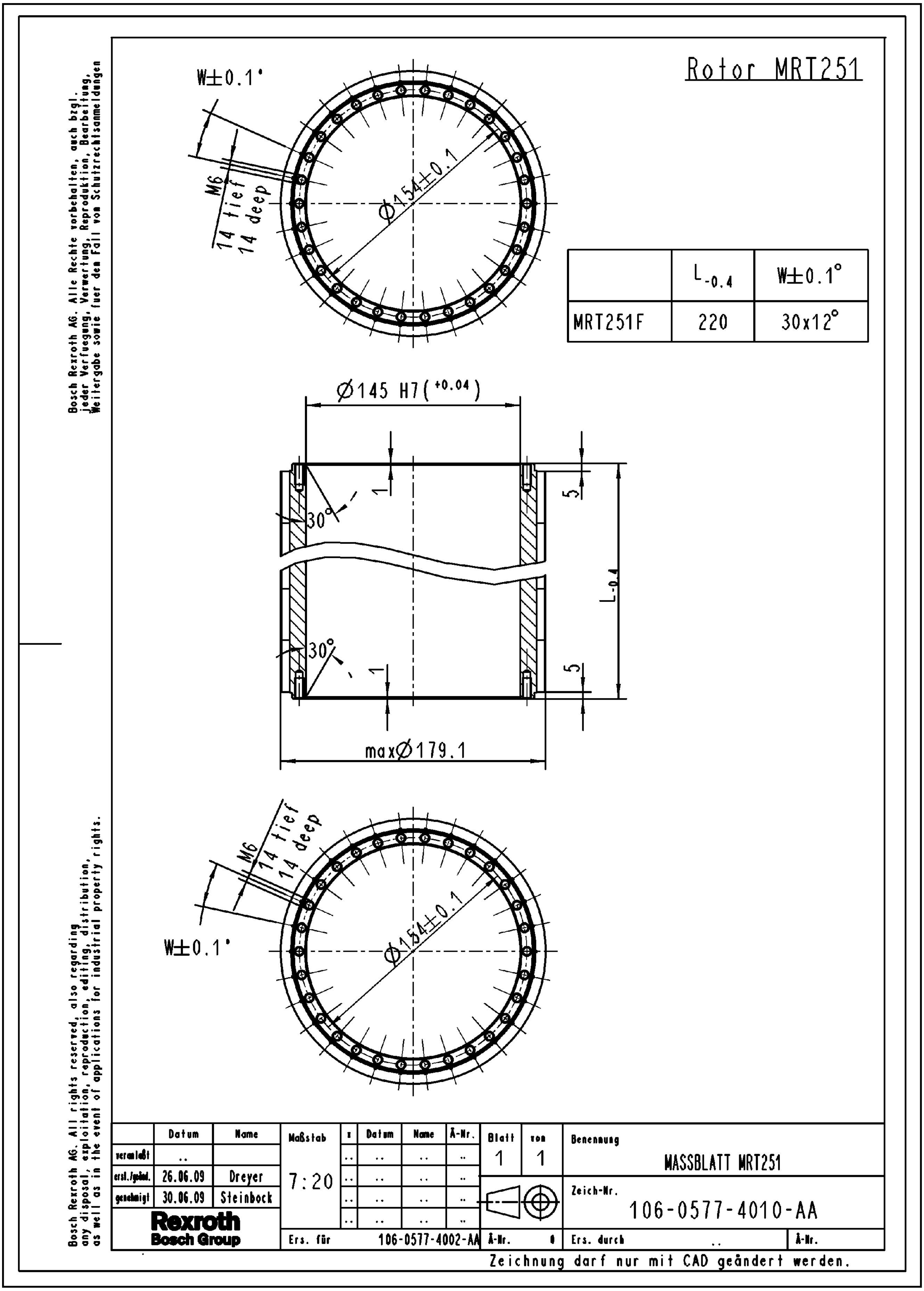
5.7.1 Motor MBT251



	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT251F	245	205	220	0.55

Fig. 5-41: MBT251

5.7.2 Rotor MRT251



	$L_{-0.4}$	W±0.1°
MRT251F	220	30x12°

Fig. 5-42: MRT251

5.7.3 Stator MST251

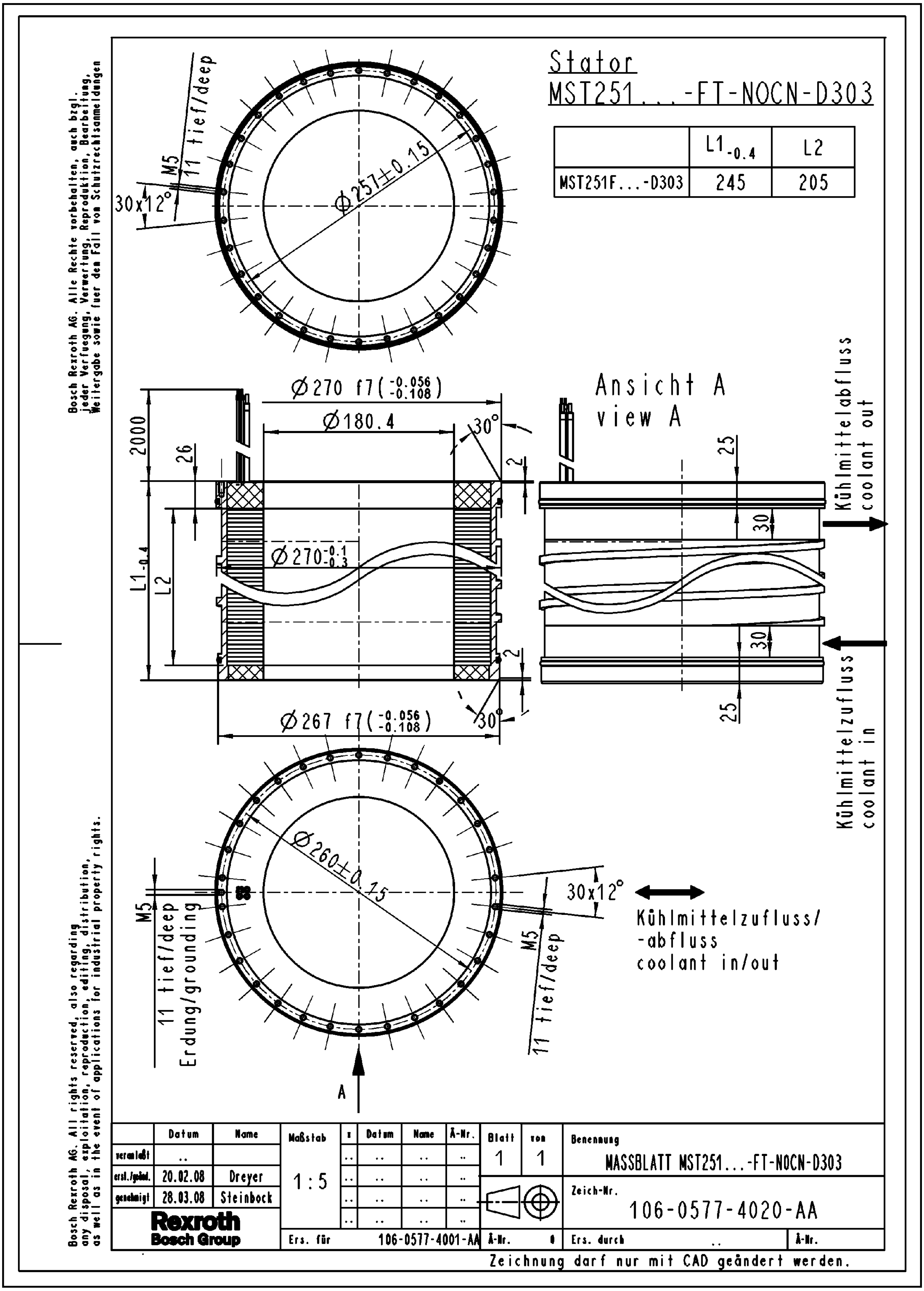
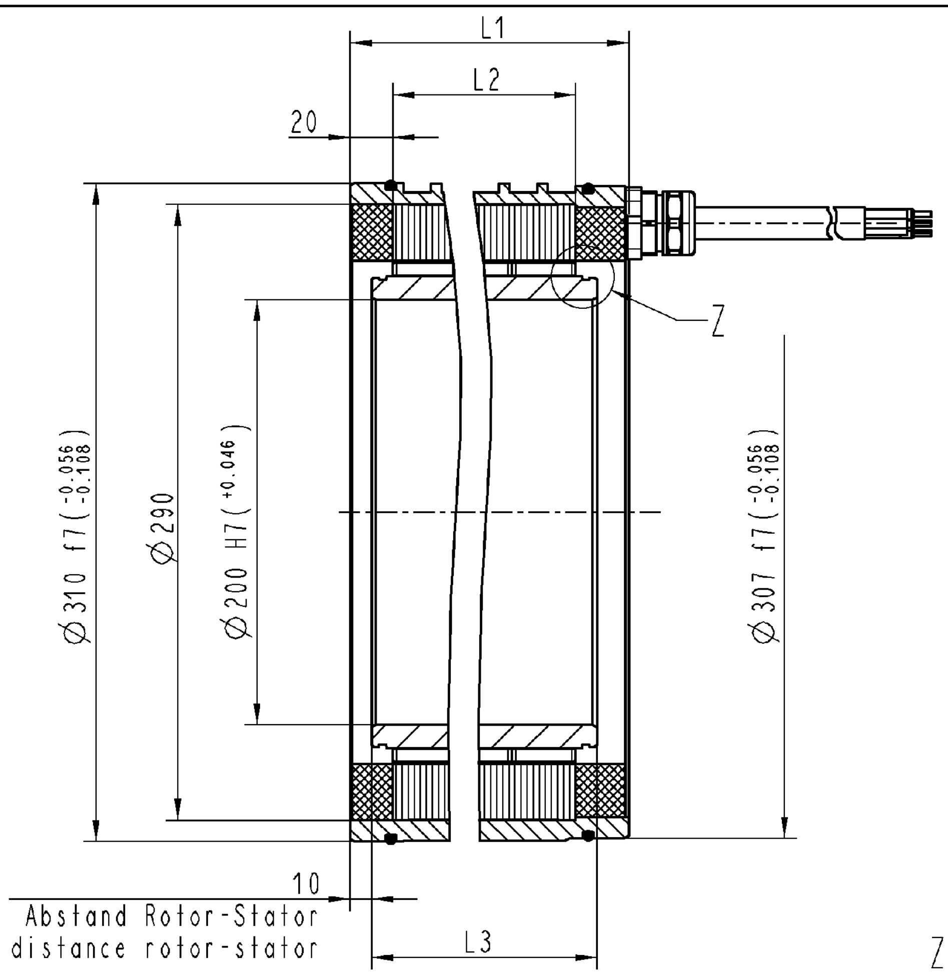
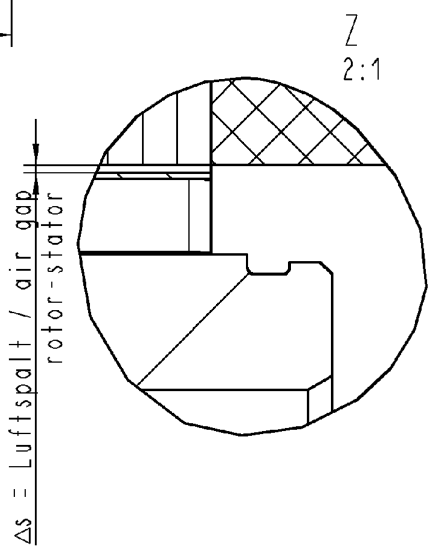


Fig. 5-43: MST251

5.8 Dimension sheets 290

5.8.1 MBT290B/ -D/ -E with electrical connection "_SN-NNNN"





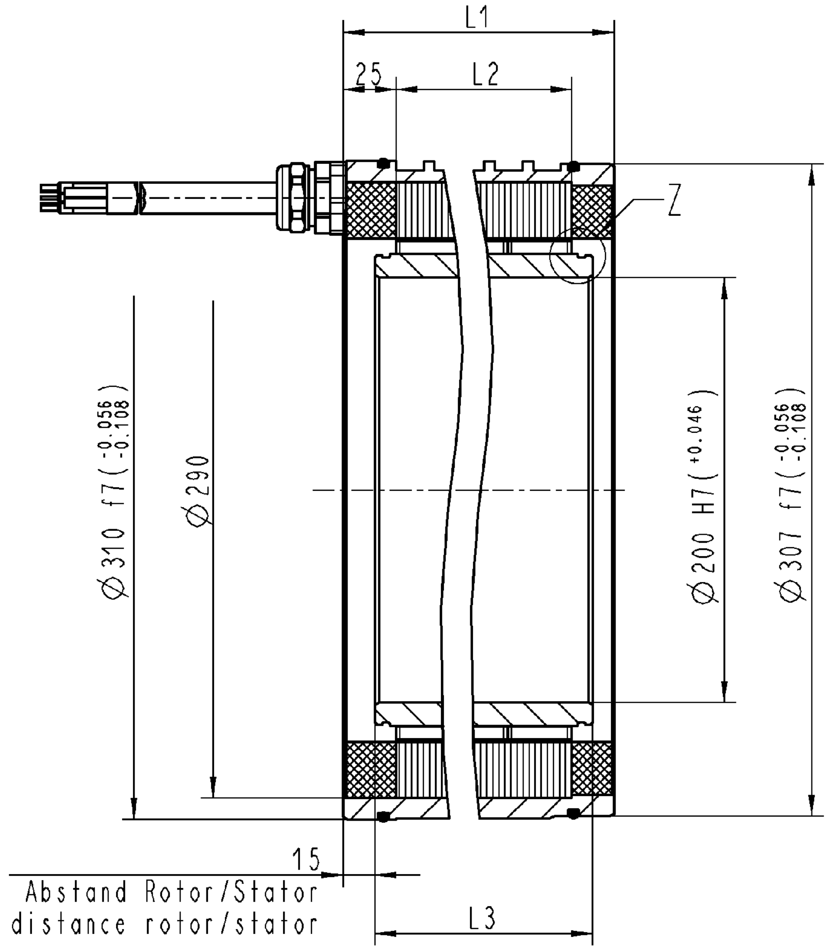
	L1	L2	L3	Δs_1 min theoretical "air gap" without concentricity fault rotor-stator
MBT290B	105	60	80	0.5
MBT290D	135	90	110	
MBT290E	195	150	170	

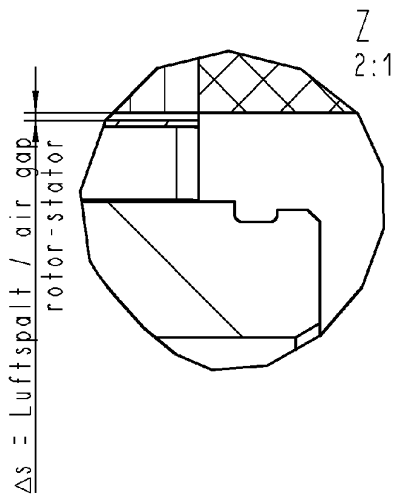
	Datum	Name	Maßstab	x	Datum	Name	Ä-Nr.	Blatt	von	Benennung
veranlaßt	..		7:20	..	..	..	..	1	1	MASSBLATT MBT290 (Kabel am D=307)
erst./geänd.	23.04.02	Dreyer		..	..	..	..			Zeich-Nr. 106-0394-4001-AC
genehmigt	24.04.02	Steinbock		..	..	..	..			
Rexroth Bosch Group			Ers. für 106-0394-4001-02				Ä-Nr. 0			Ers. durch .. Ä-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 5-44: MBT290B/ -D/ -E, electrical connection "_SN-NNNN"

5.8.2 MBT290B/ -D/ -E with electrical connection "_CN-NNNN"





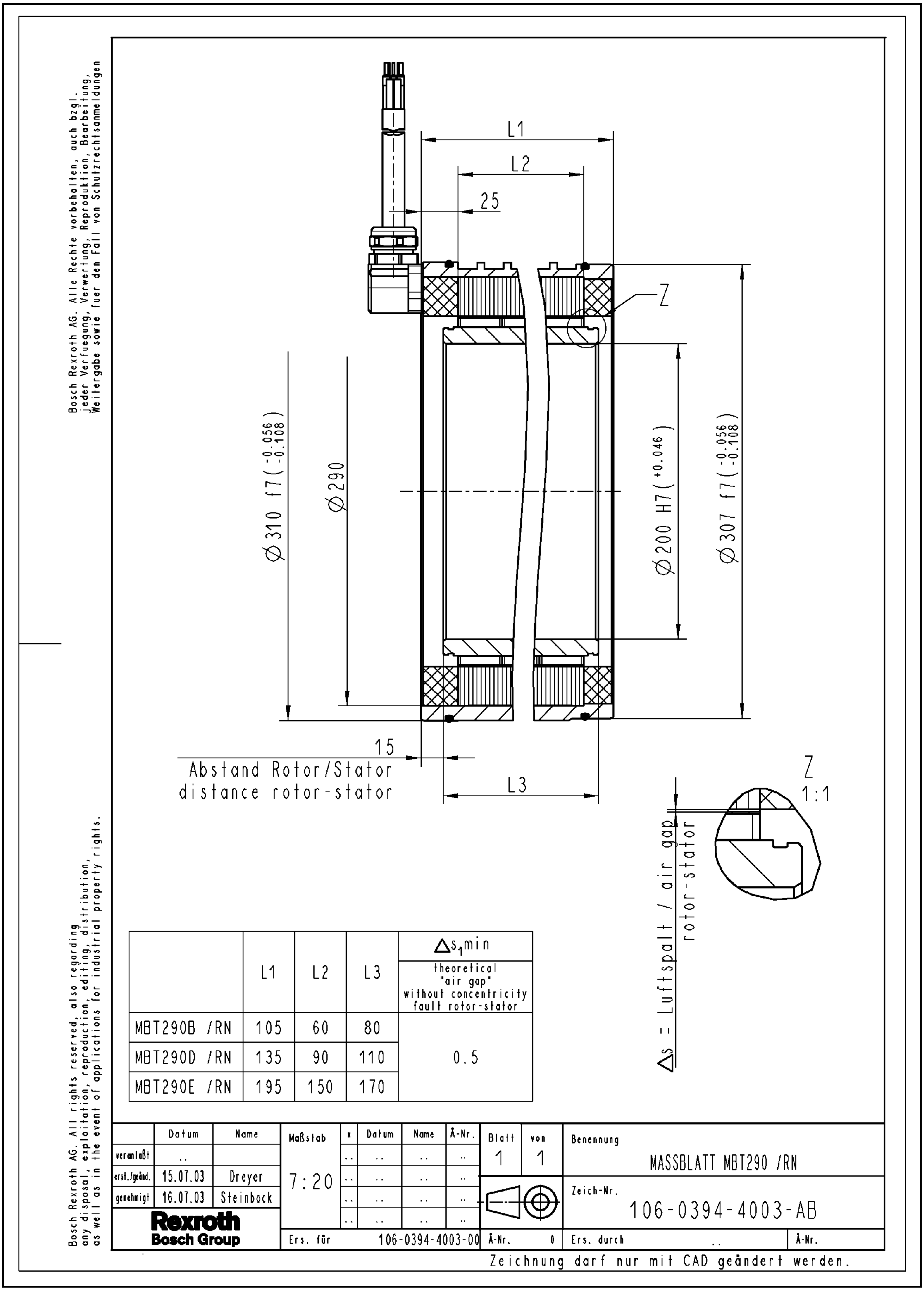
	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT290B	105	60	80	0.5
MBT290D	135	90	110	
MBT290E	195	150	170	

	Datum	Name	Maßstab	x	Datum	Name	Ä-Nr.	Blatt	von	Benennung
veranlaßt	..		7:20	..	..	..	..	1	1	MASSBLATT MBT290 (Kabel am D=310)
erst./geänd.	23.04.02	Dreyer		..	..	..	..			Zeich-Nr. 106-0394-4002-AC
genehmigt	25.04.02	Steinbock		..	..	..	..			
Rexroth Bosch Group				..	..	..	..			
			Ers. für	106-0394-4002-01		Ä-Nr.	0	Ers. durch	..	Ä-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 5-45: MBT290B/ -D/ -E with electrical connection "_CN-NNNN"

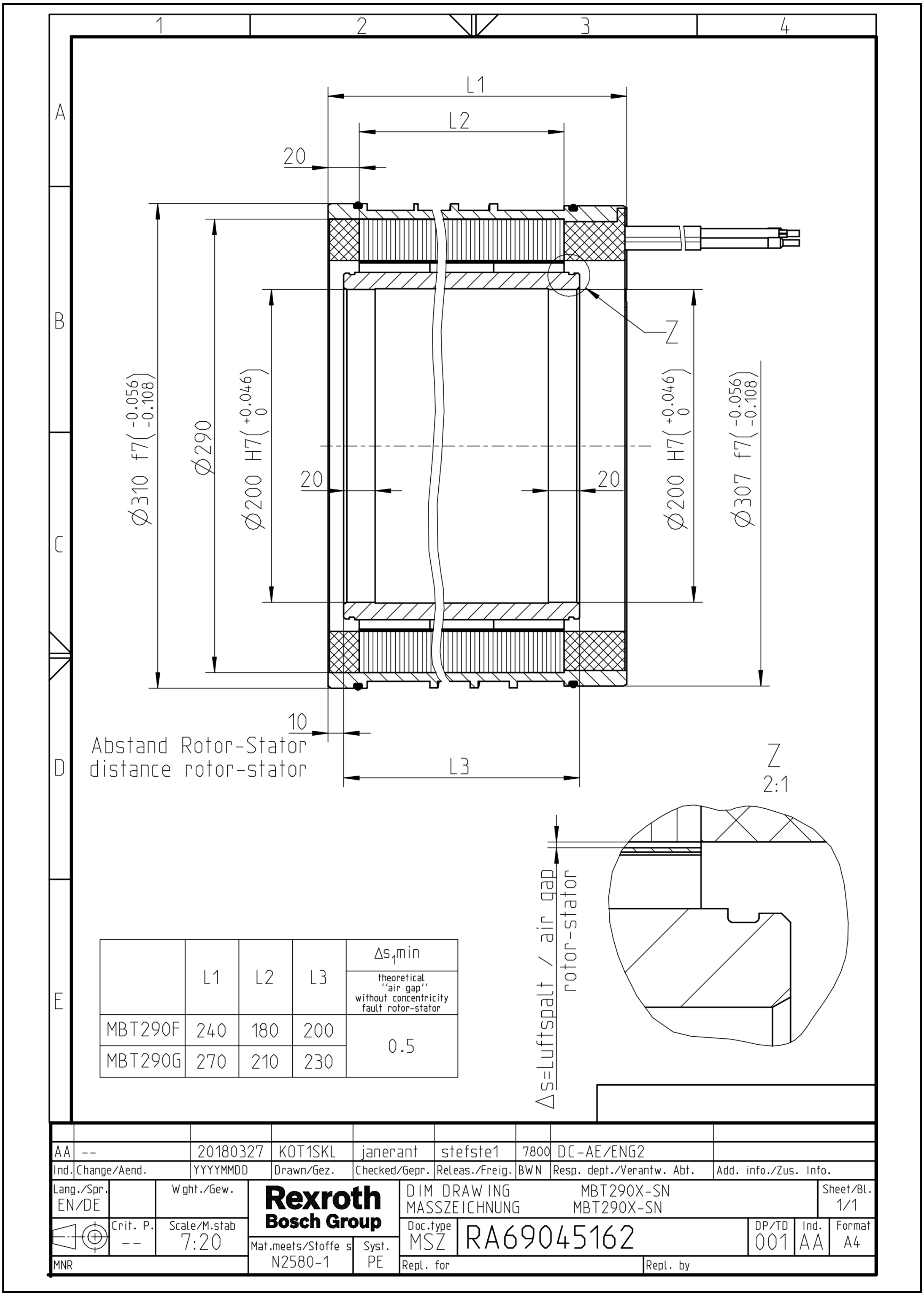
5.8.3 MBT290B/ -D/ -E with electrical connection "_RN-NNNN"



	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT290B /RN	105	60	80	0.5
MBT290D /RN	135	90	110	
MBT290E /RN	195	150	170	

Fig. 5-46: MBT290B/ -D/ -E with electrical connection "_RN-NNNN"

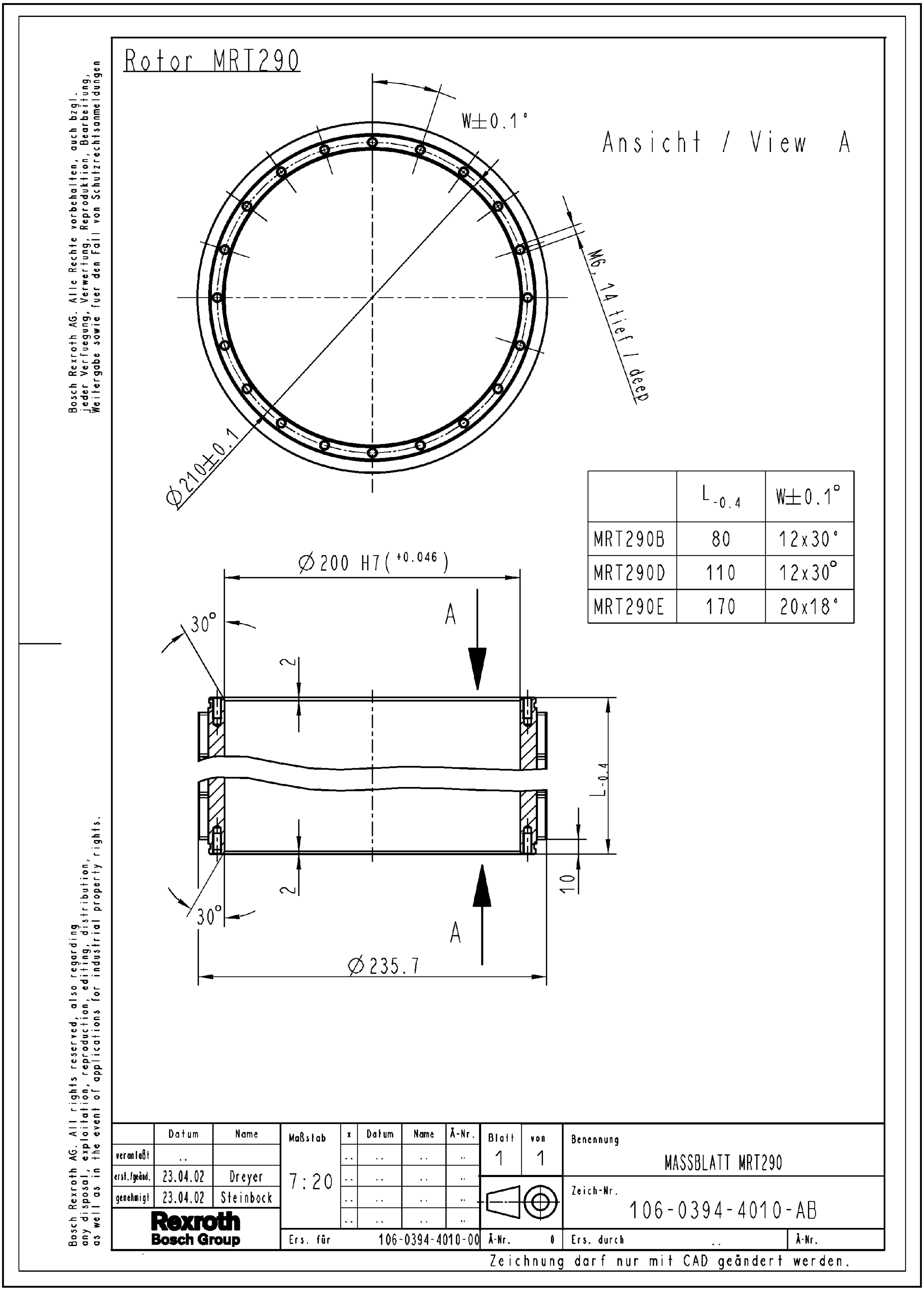
5.8.4 MBT290F/ -G with electrical connection "_SN-D303"



	L1	L2	L3	Δs_1min theoretical ''air gap'' without concentricity fault rotor-stator
MBT290F	240	180	200	0.5
MBT290G	270	210	230	

Fig. 5-47: MBT290F/ -G with electrical connection "_SN-D303"

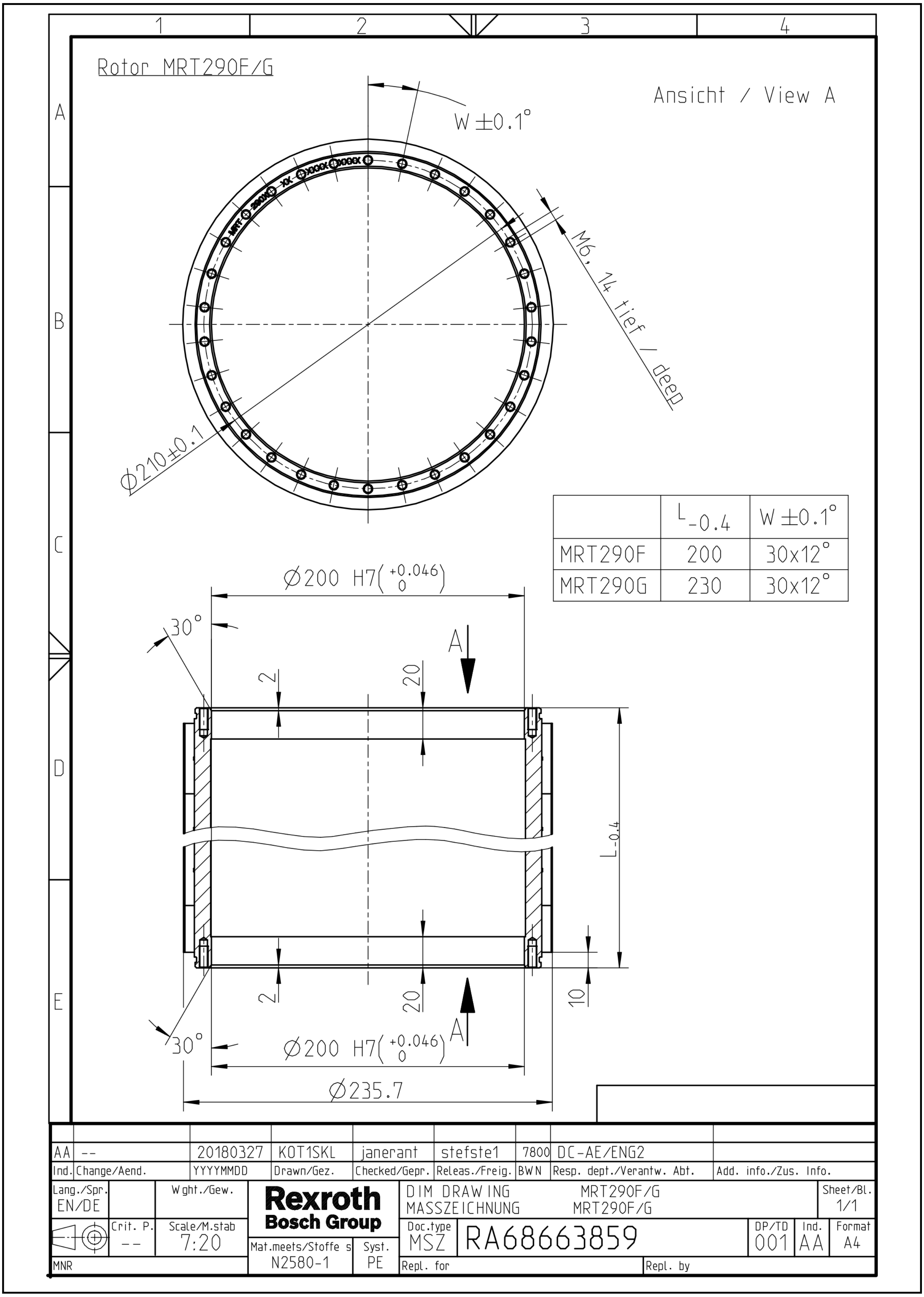
5.8.5 Rotor MRT290B/ -D/ -E



	$L_{-0.4}$	W±0.1°
MRT290B	80	12x30°
MRT290D	110	12x30°
MRT290E	170	20x18°

Fig. 5-48: Rotor MRT290B/ -D/ -E

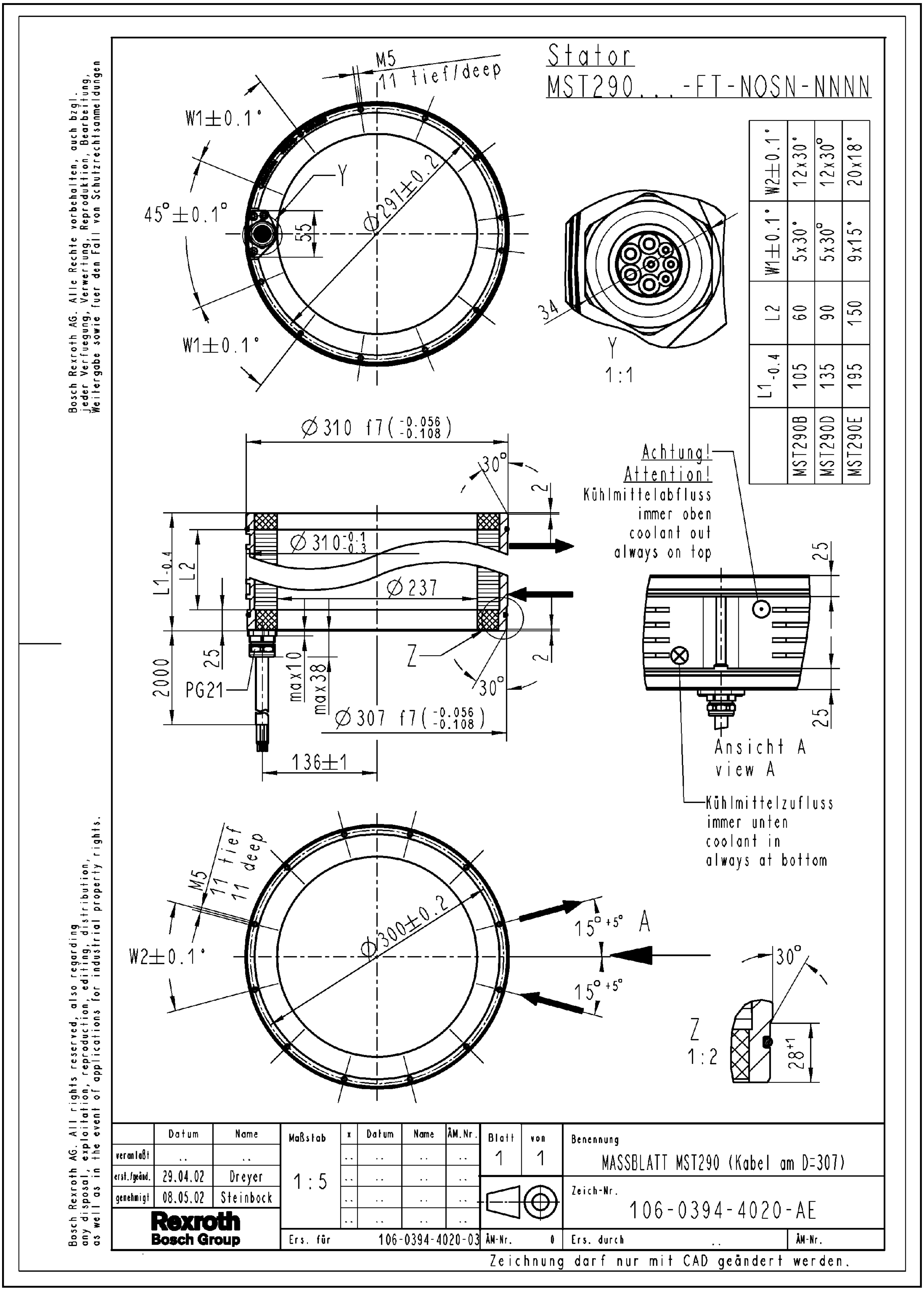
5.8.6 Rotor MRT290F/ -G



	$L_{-0.4}$	W ±0.1°
MRT290F	200	30x12°
MRT290G	230	30x12°

Fig. 5-49: Rotor MRT290F/ -G

5.8.7 Stator MST290B/ -D/ -E, electrical connection "_SN-NNNN"



	$L1_{-0.4}$	L2	W1±0.1°	W2±0.1°
MST290B	105	60	5x30°	12x30°
MST290D	135	90	5x30°	12x30°
MST290E	195	150	9x15°	20x18°

Fig. 5-50: MST290B/ -D/ -E, electrical connection "_SN-NNNN"

5.8.8 Stator MST290F/ -G, electrical connection "_SN-D303"

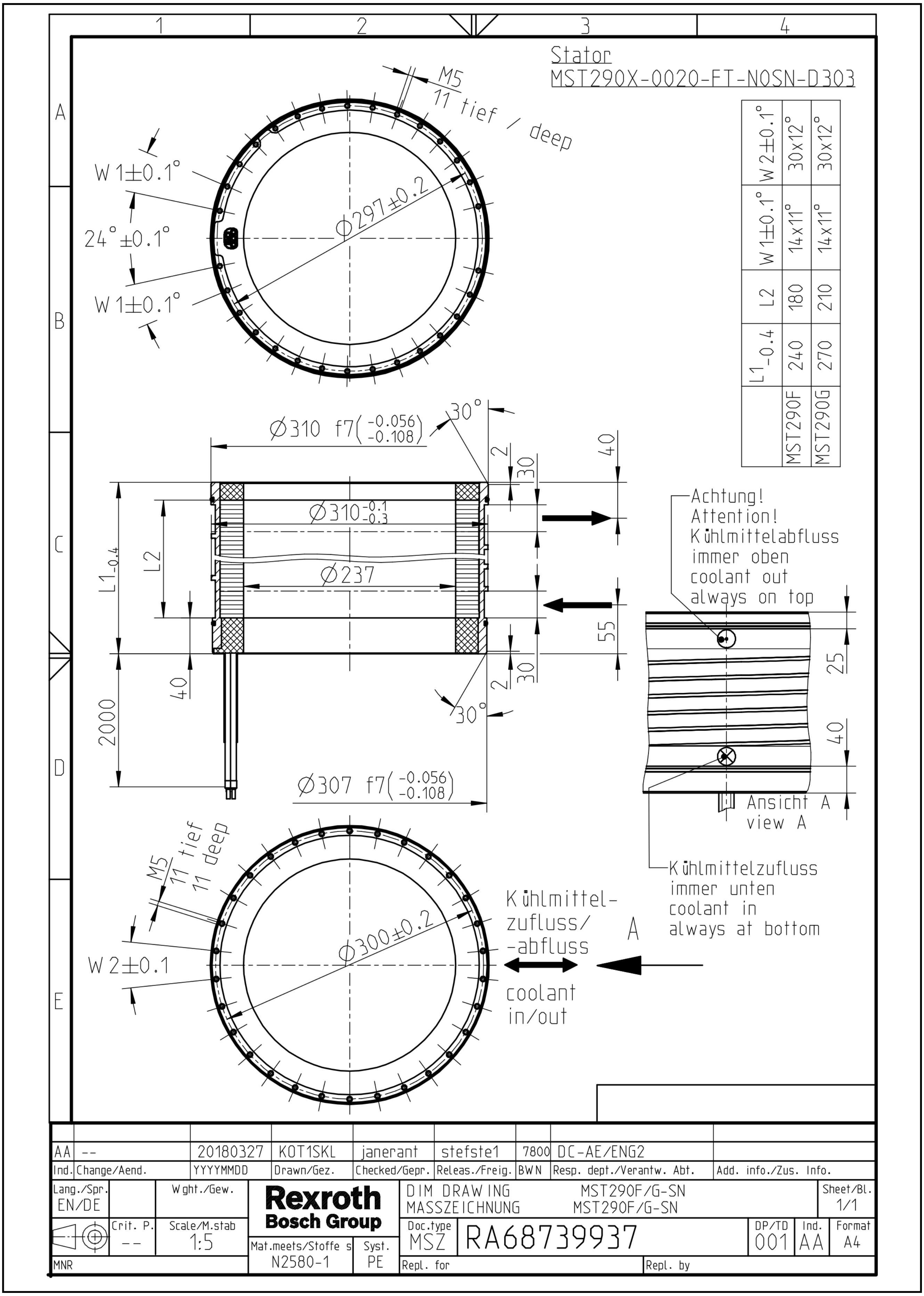


Fig. 5-51: MST290F/ -G, electrical connection "_SN-D303"

5.8.9 Stator MST290B/ -D/ -E, electrical connection "_CN-NNNN"

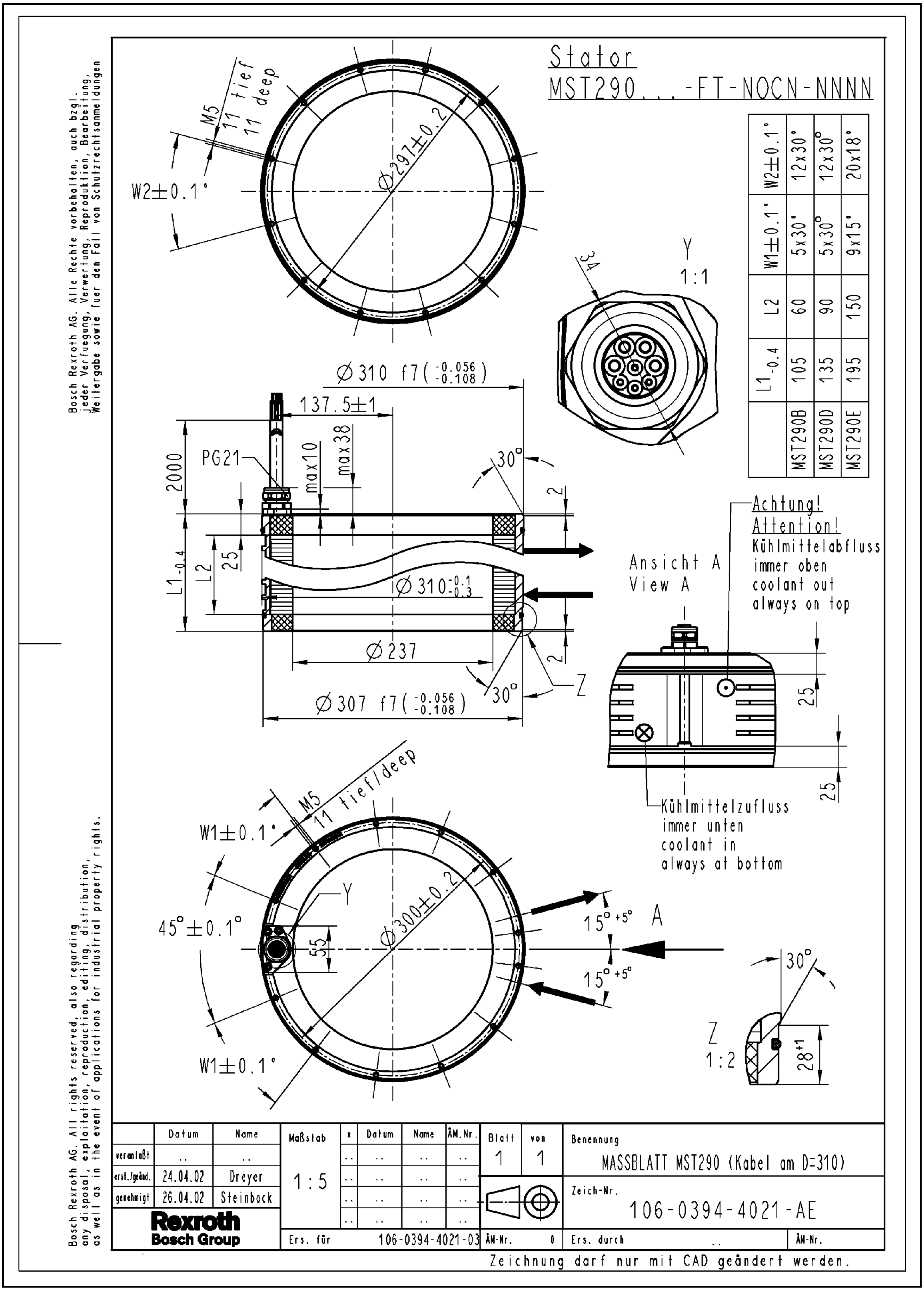
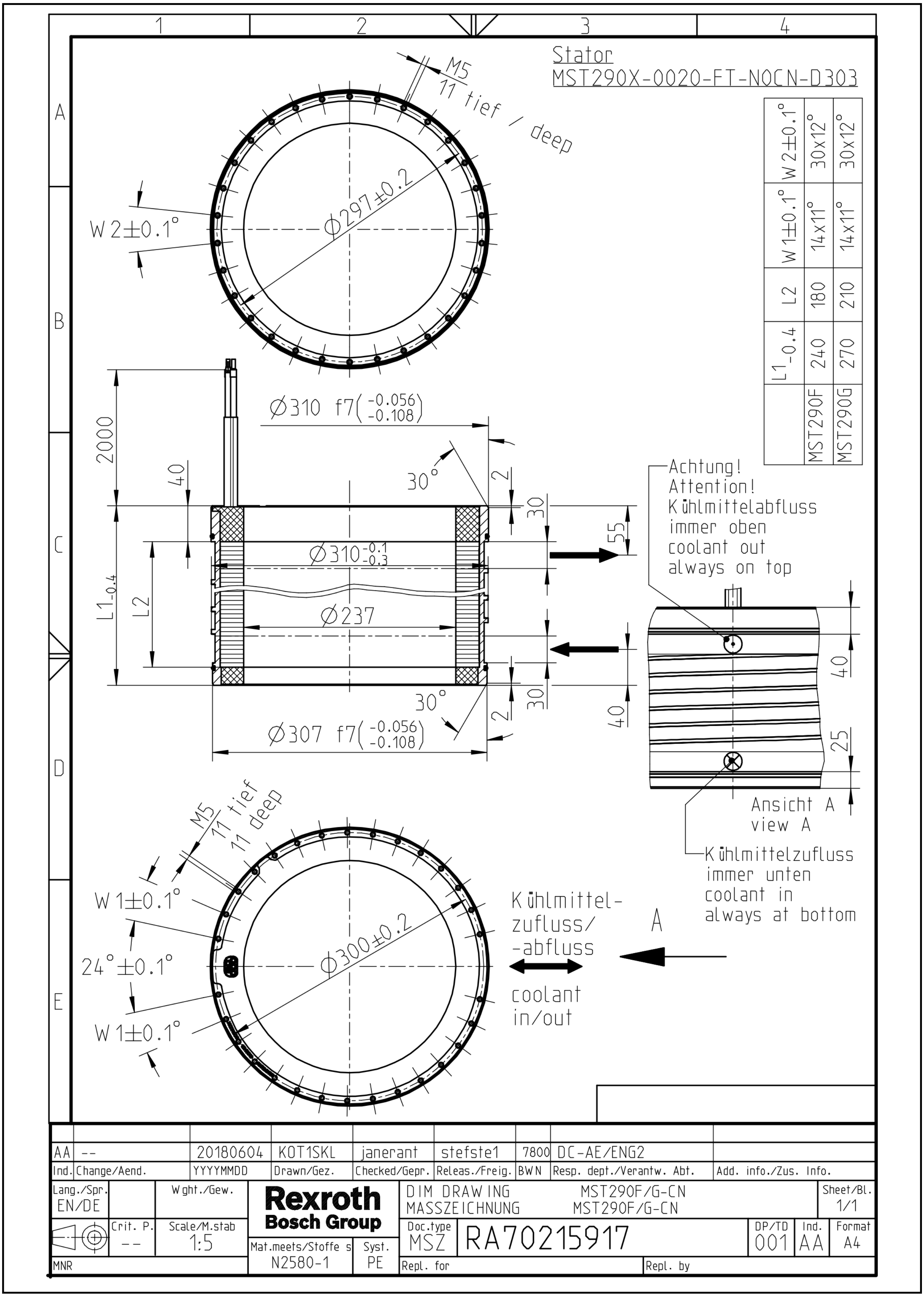


Fig. 5-52: MST290B/ -D/ -E, electrical connection "_CN-NNNN"

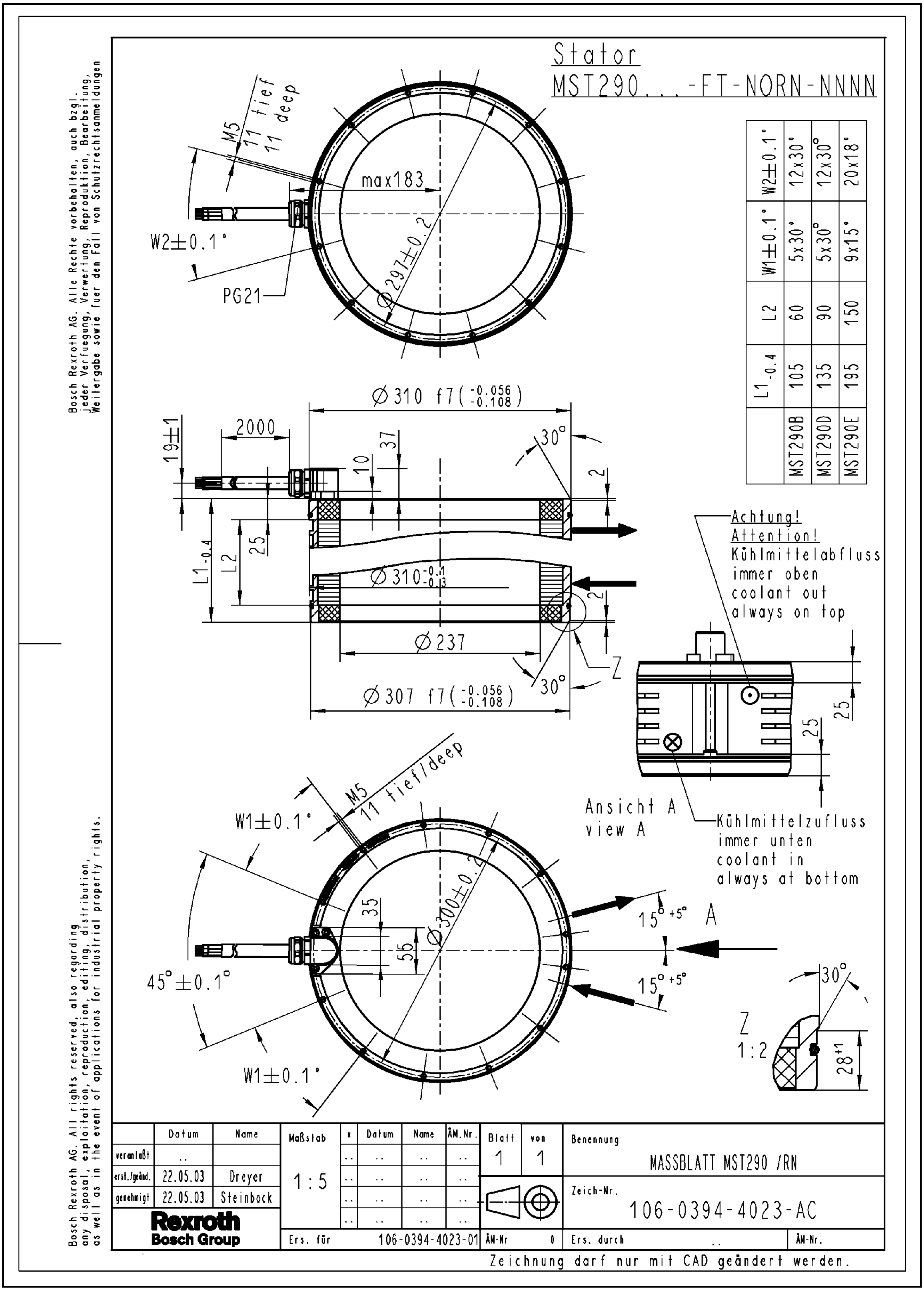
5.8.10 Stator MST290F/ -G, electrical connection "_CN-D303"



	W2±0.1°	W1±0.1°	L2	L1-0.4
MST290F	30x12°	14x11°	180	240
MST290G	30x12°	14x11°	210	270

Fig. 5-53: MST290F/ -G, electrical connection "_CN-D303"

5.8.11 Stator MST290B/ -D/ -E, electrical connection "_RN-NNNN"



	$L1_{-0.4}$	L2	W1±0.1°	W2±0.1°
MST290B	105	60	5x30°	12x30°
MST290D	135	90	5x30°	12x30°
MST290E	195	150	9x15°	20x18°

Fig. 5-54: MST290B/ -D/ -E, electrical connection "_RN-NNNN"

5.8.12 Stator MST290B/ -D/ -E with housing ("FH" design)

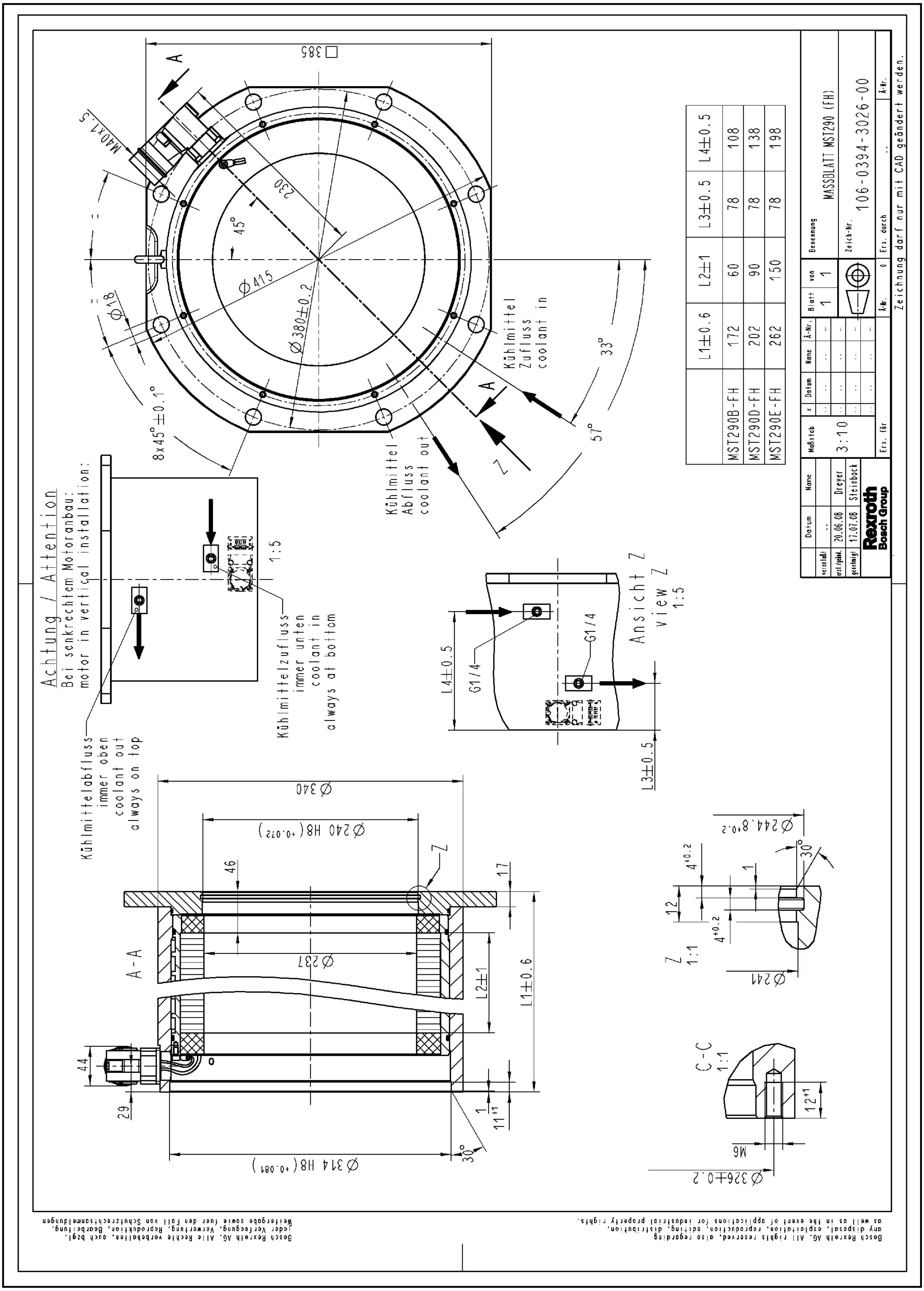
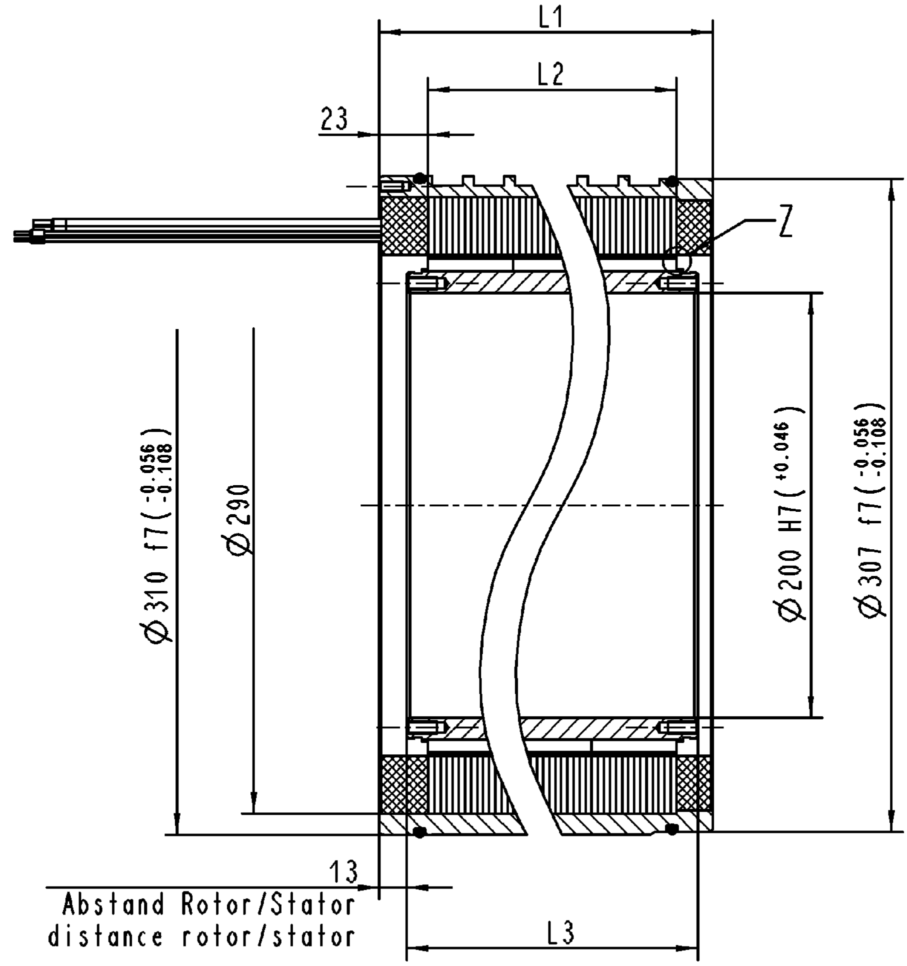
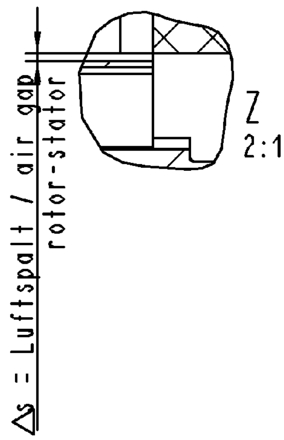


Fig. 5-55: MST290B/ -D/ -E with housing ("FH" design)

5.9 Dimension sheets 291

5.9.1 Motor MBT291





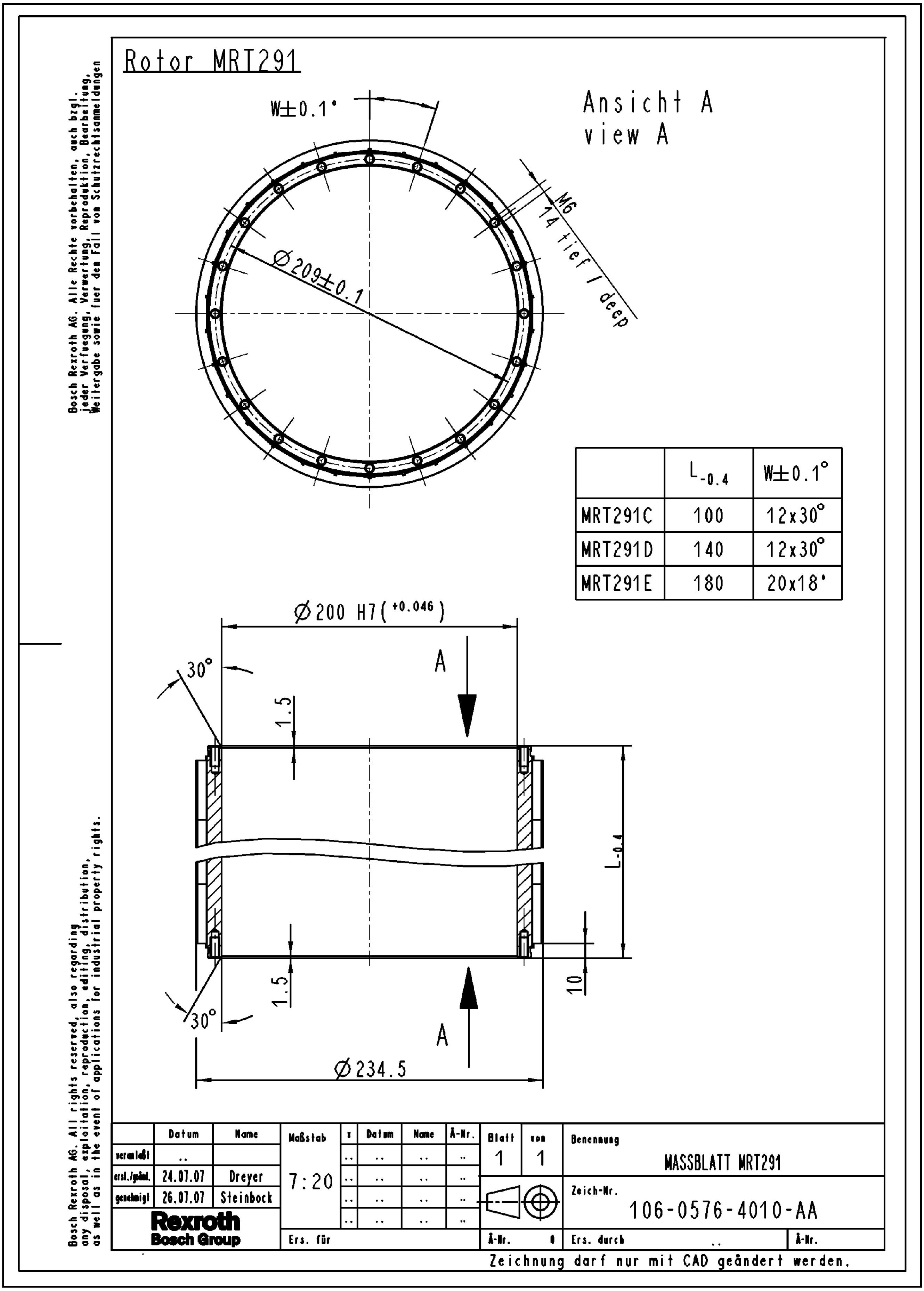
	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT291C	120	80	100	0.6
MBT291D	160	120	140	
MBT291E	200	160	180	

	Datum	Name	Maßstab		Datum	Name	Ä-Nr.	Blatt	von	Benennung
veranlaßt	..		7:20	..	..	..	..	1	1	MASSBLATT MBT291...-FT-NOCN-D303
erst./gezeichnet	08.05.08	Dreyer		..	..	..	..			Zeich-Nr. 106-0576-4001-AB
genehmigt	08.05.08	Steinbock		..	..	..	..			
Rexroth Bosch Group			Ers. für	106-0576-4001-00				Ä-Nr.		Ers. durch .. Ä-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 5-56: MBT291

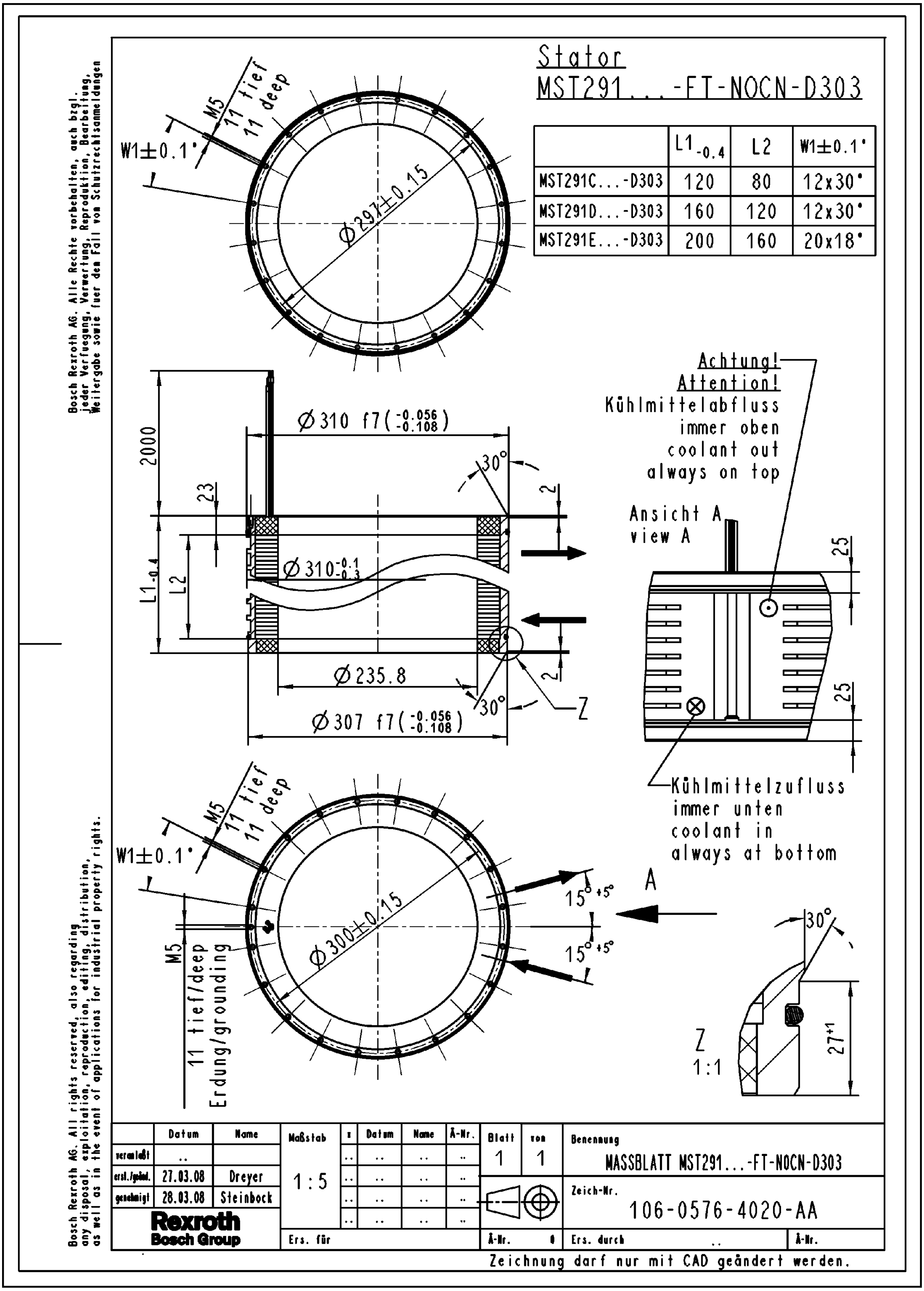
5.9.2 Rotor MRT291



	$L_{-0.4}$	W±0.1°
MRT291C	100	12x30°
MRT291D	140	12x30°
MRT291E	180	20x18°

Fig. 5-57: MRT291

5.9.3 Stator MST291

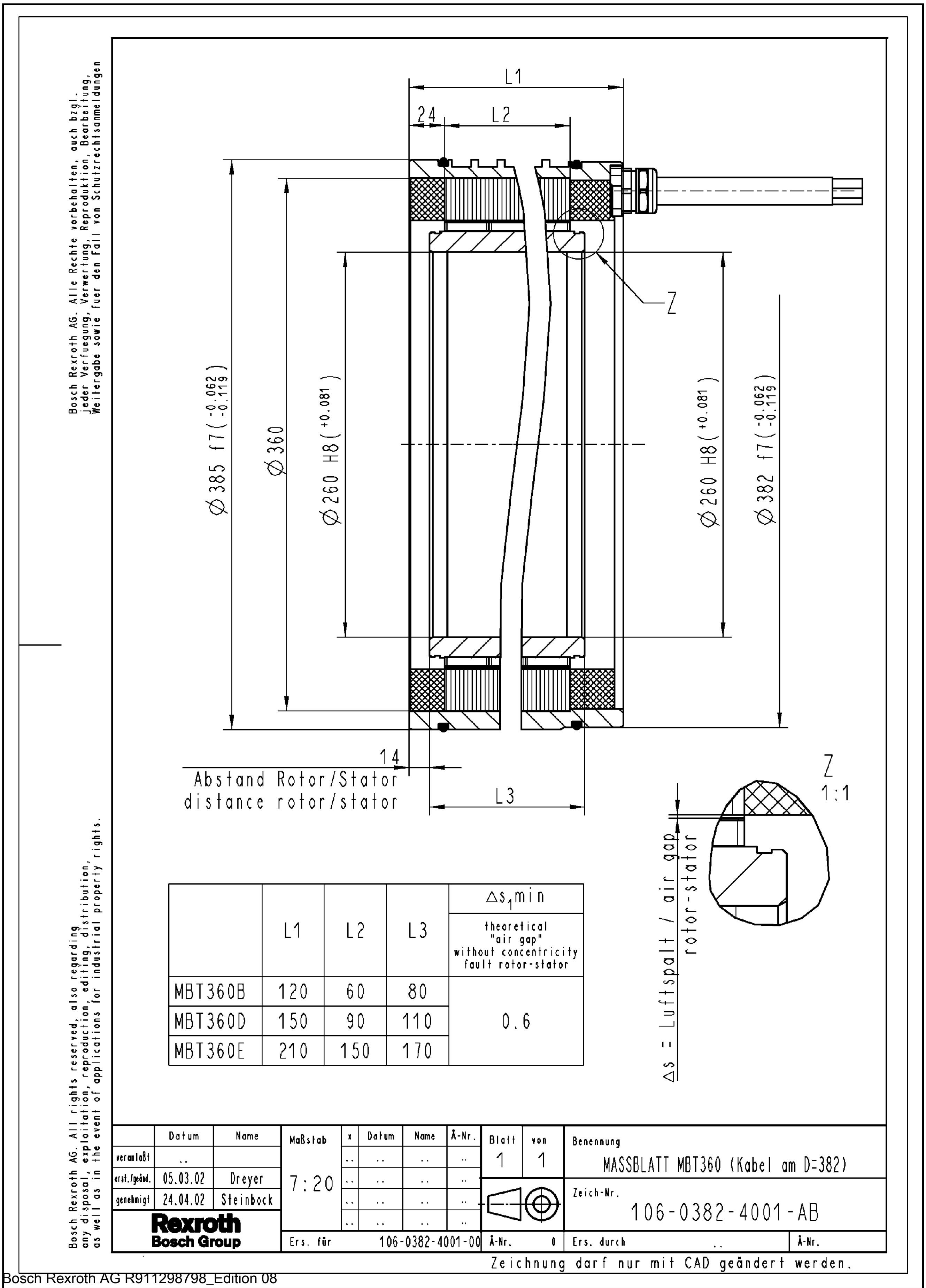


	L1-0.4	L2	W1±0.1°
MST291C...-D303	120	80	12x30°
MST291D...-D303	160	120	12x30°
MST291E...-D303	200	160	20x18°

Fig. 5-58: MST291

5.10 Dimension sheets 360

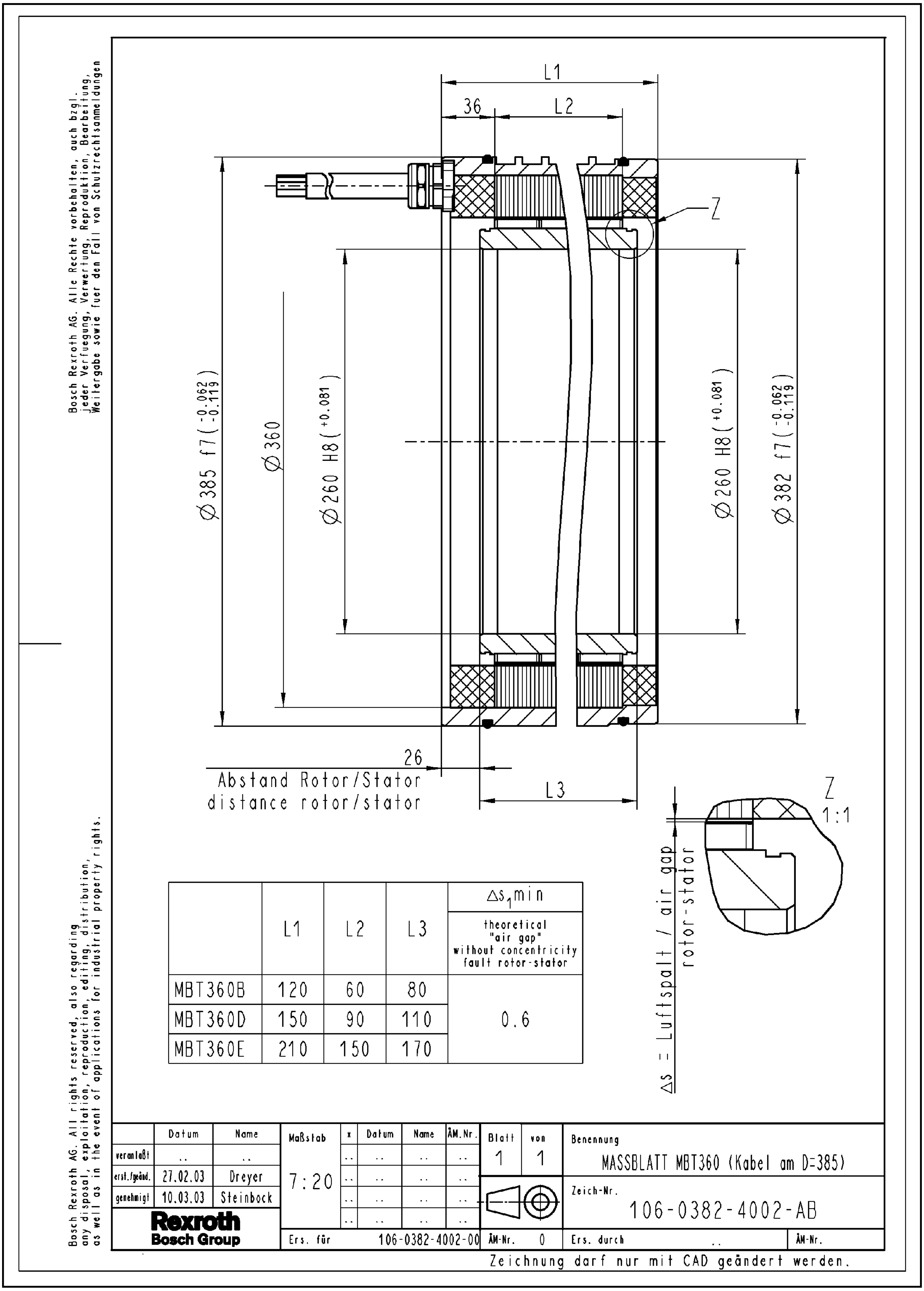
5.10.1 MBT360 with electrical connection "_SN-NNNN"



	L1	L2	L3	Δs₁min theoretical "air gap" without concentricity fault rotor-stator
MBT360B	120	60	80	0.6
MBT360D	150	90	110	
MBT360E	210	150	170	

Fig. 5-55: MBT360, electrical connection "_SN-NNNN"

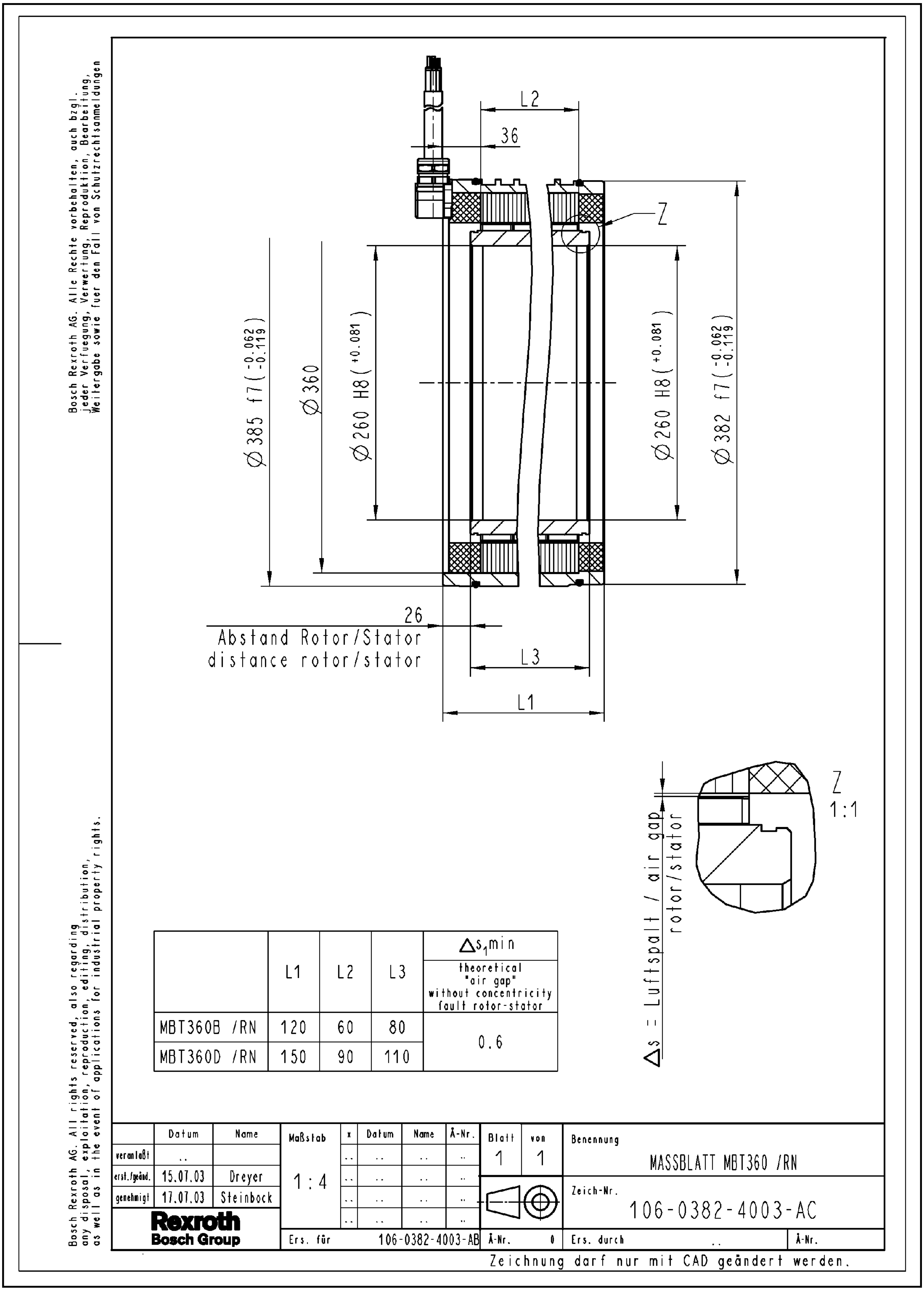
5.10.2 MBT360 with electrical connection "_CN-NNNN"



	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT360B	120	60	80	0.6
MBT360D	150	90	110	
MBT360E	210	150	170	

Fig. 5-60: MBT360, electrical connection "_CN-NNNN"

5.10.3 MBT360 with electrical connection "_RN-NNNN"



	L1	L2	L3	Δ$s_1$min theoretical "air gap" without concentricity fault rotor-stator
MBT360B /RN	120	60	80	0.6
MBT360D /RN	150	90	110	

Fig. 5-61: MBT360, electrical connection "_RN-NNNN"

5.10.4 Rotor MRT360

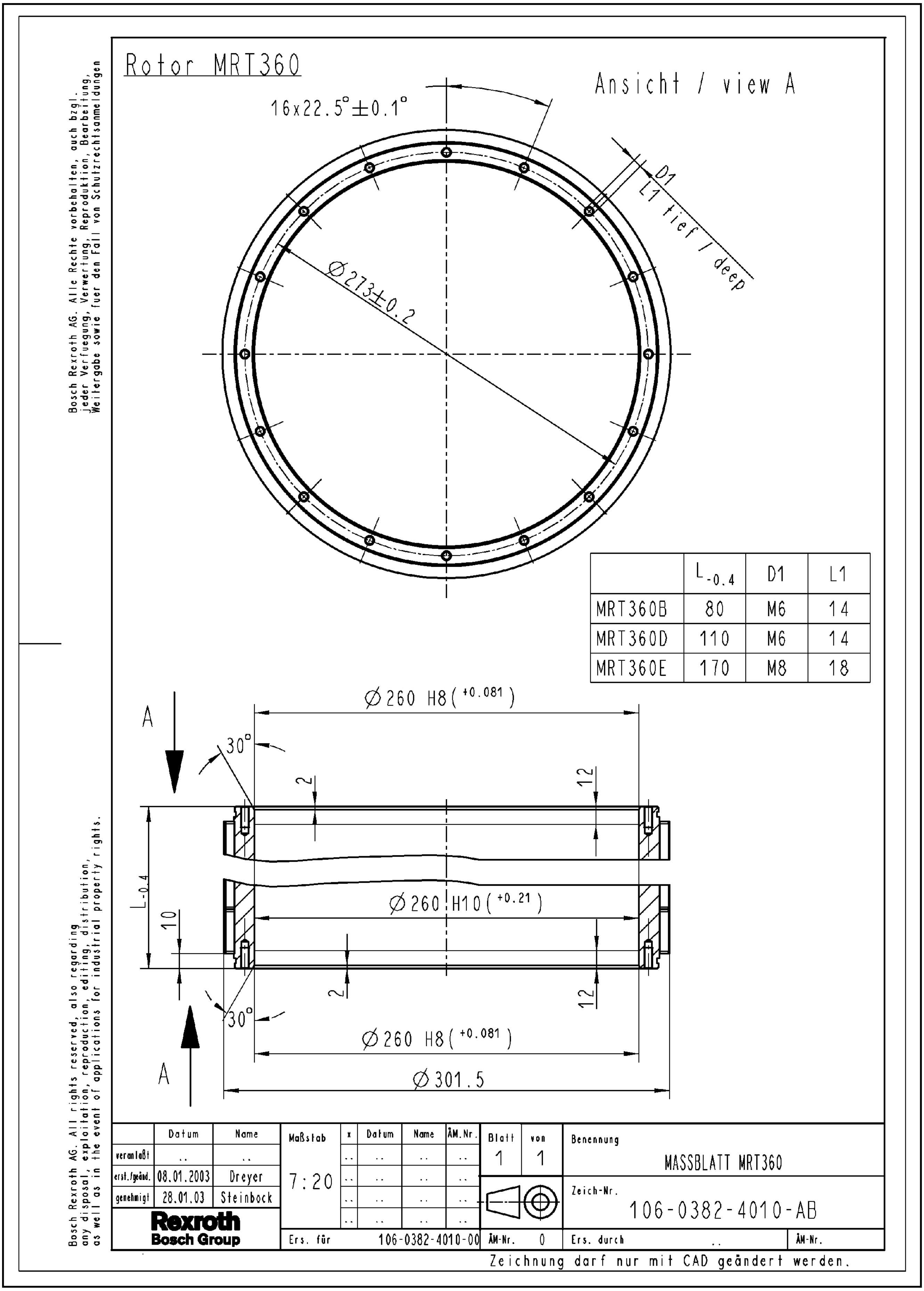


Fig. 5-62: Rotor MRT360

5.10.5 Stator MST360, electrical connection "_SN-NNNN"

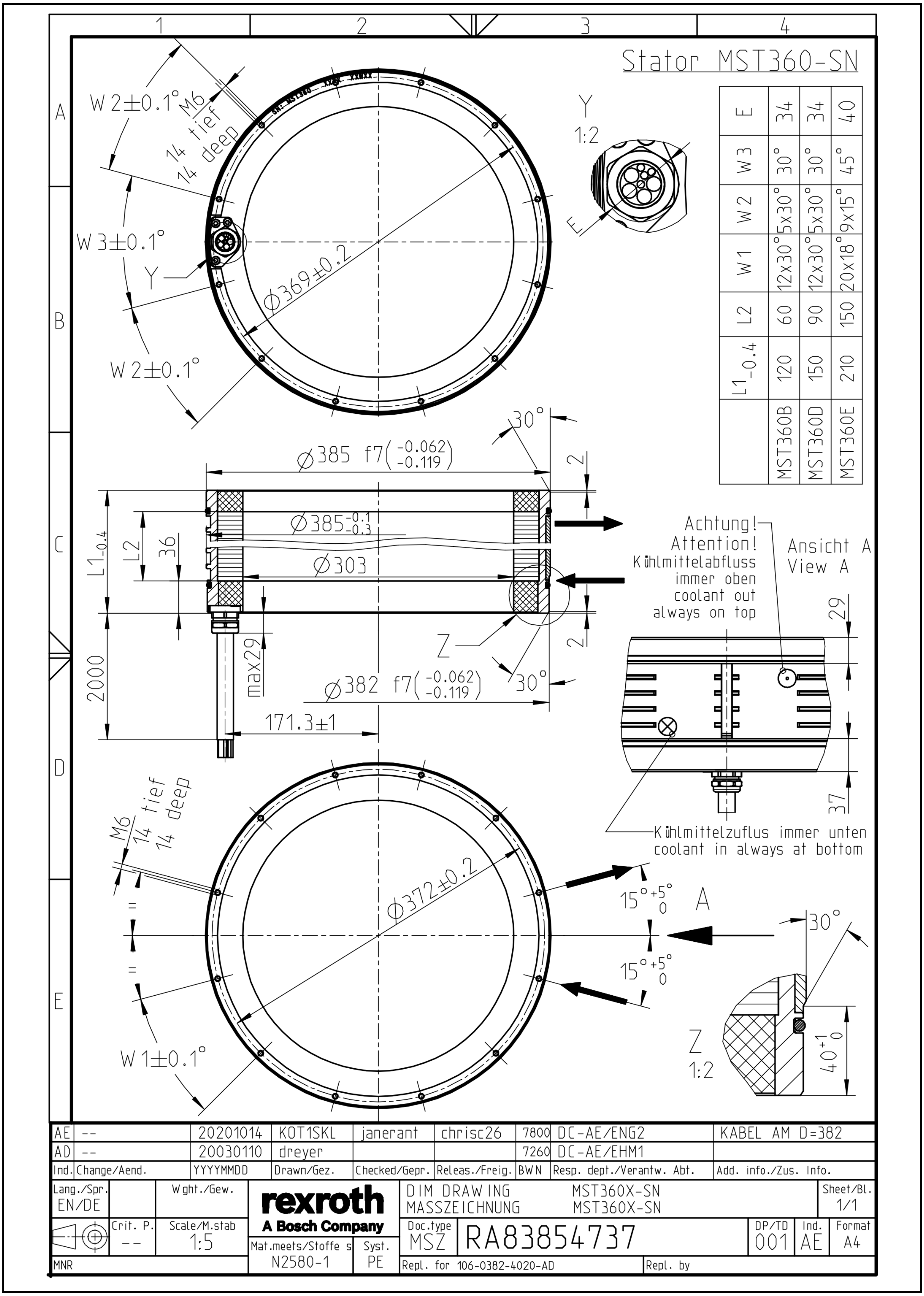
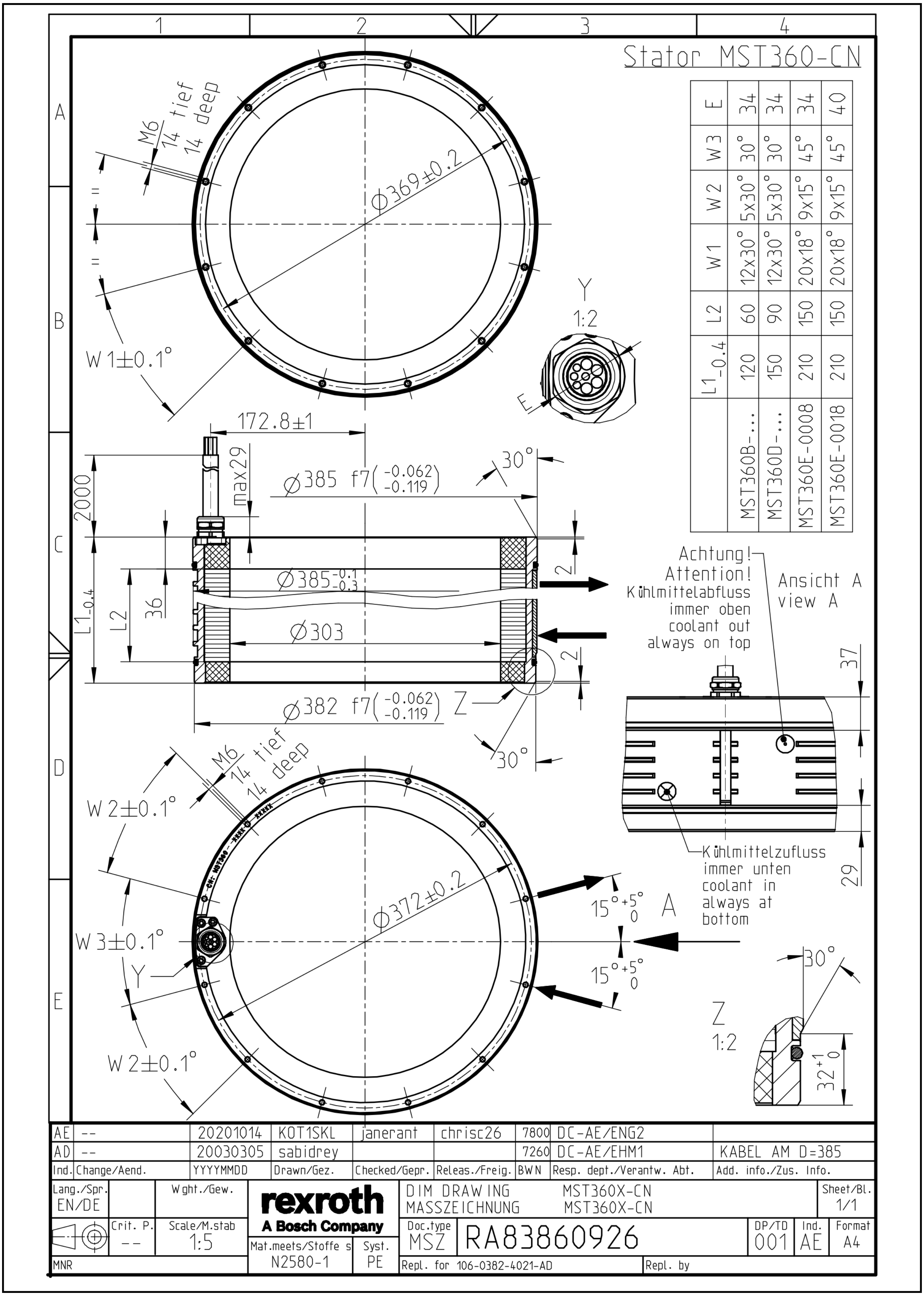


Fig. 5-63: Stator MST360, electrical connection "_SN-NNNN"

5.10.6 Stator MST360, electrical connection "_CN-NNNN"



	L1 -0.4	L2	W1	W2	W3	E
MST360B-...	120	60	12x30°	5x30°	30°	34
MST360D-...	150	90	12x30°	5x30°	30°	34
MST360E-0008	210	150	20x18°	9x15°	45°	34
MST360E-0018	210	150	20x18°	9x15°	45°	40

Fig. 5-64: Stator MST360, electrical connection "_CN-NNNN"

5.10.7 Stator MST360, electrical connection "_CN-D303"

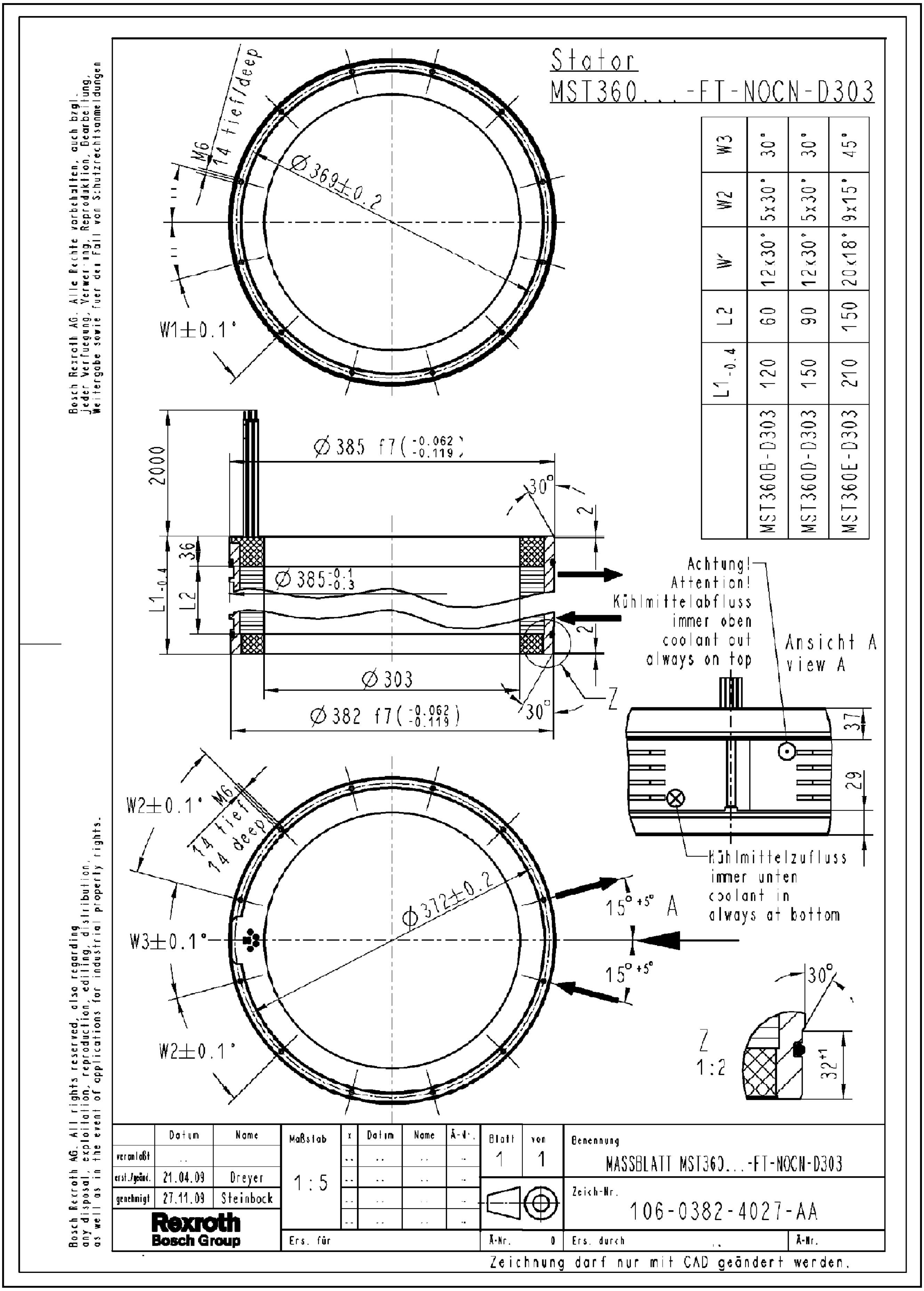
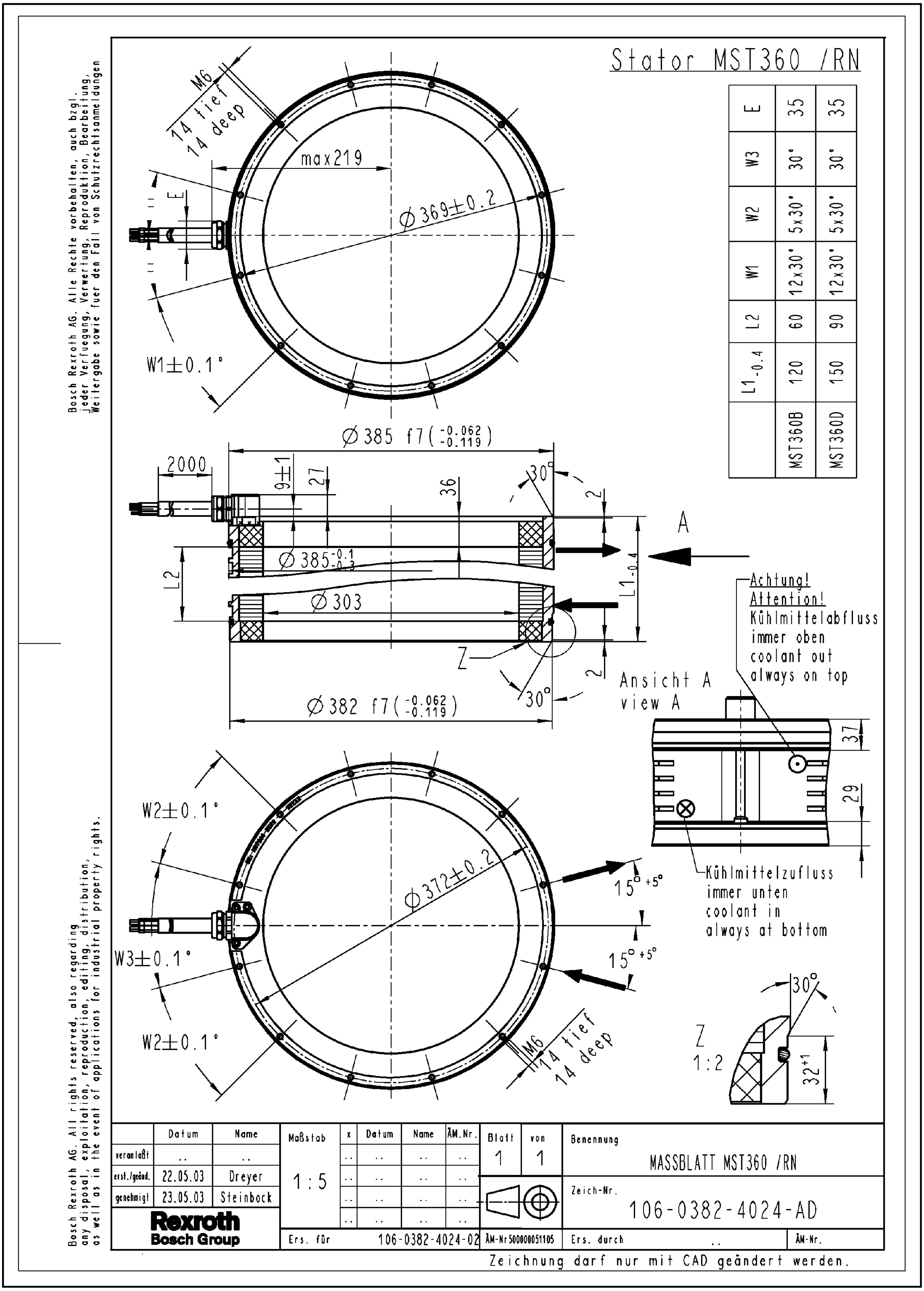


Fig. 5-65: Stator MST360, electrical connection "-_CN-D303"

5.10.8 Stator MST360, electrical connection "_RN-NNNN"



	L1-0.4	L2	W1	W2	W3	E
MST360B	120	60	12x30°	5x30°	30°	35
MST360D	150	90	12x30°	5x30°	30°	35

Fig. 5-66: MST360, electrical connection "_RN-NNNN"

5.10.9 MST360 with housing (design "FH")

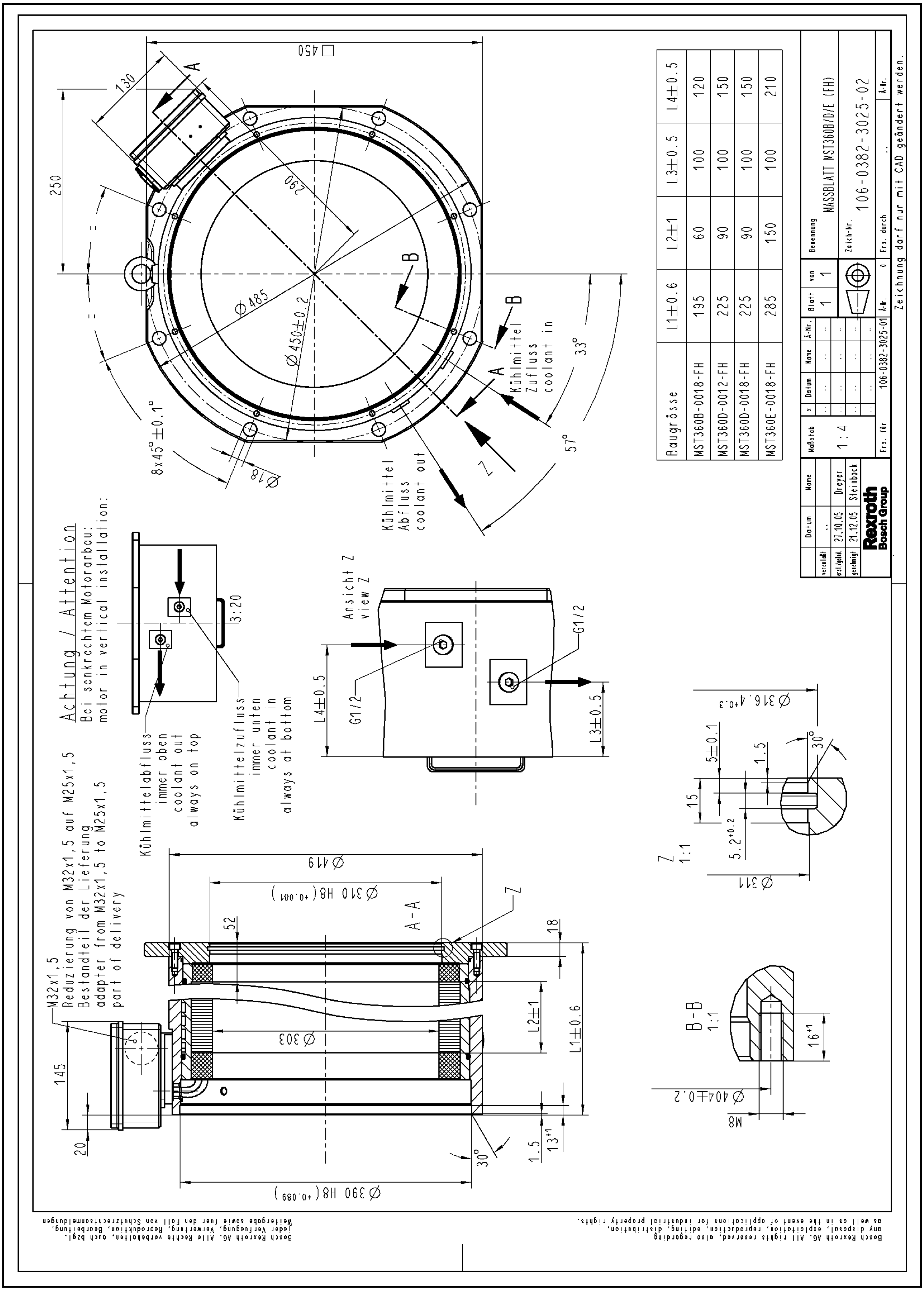
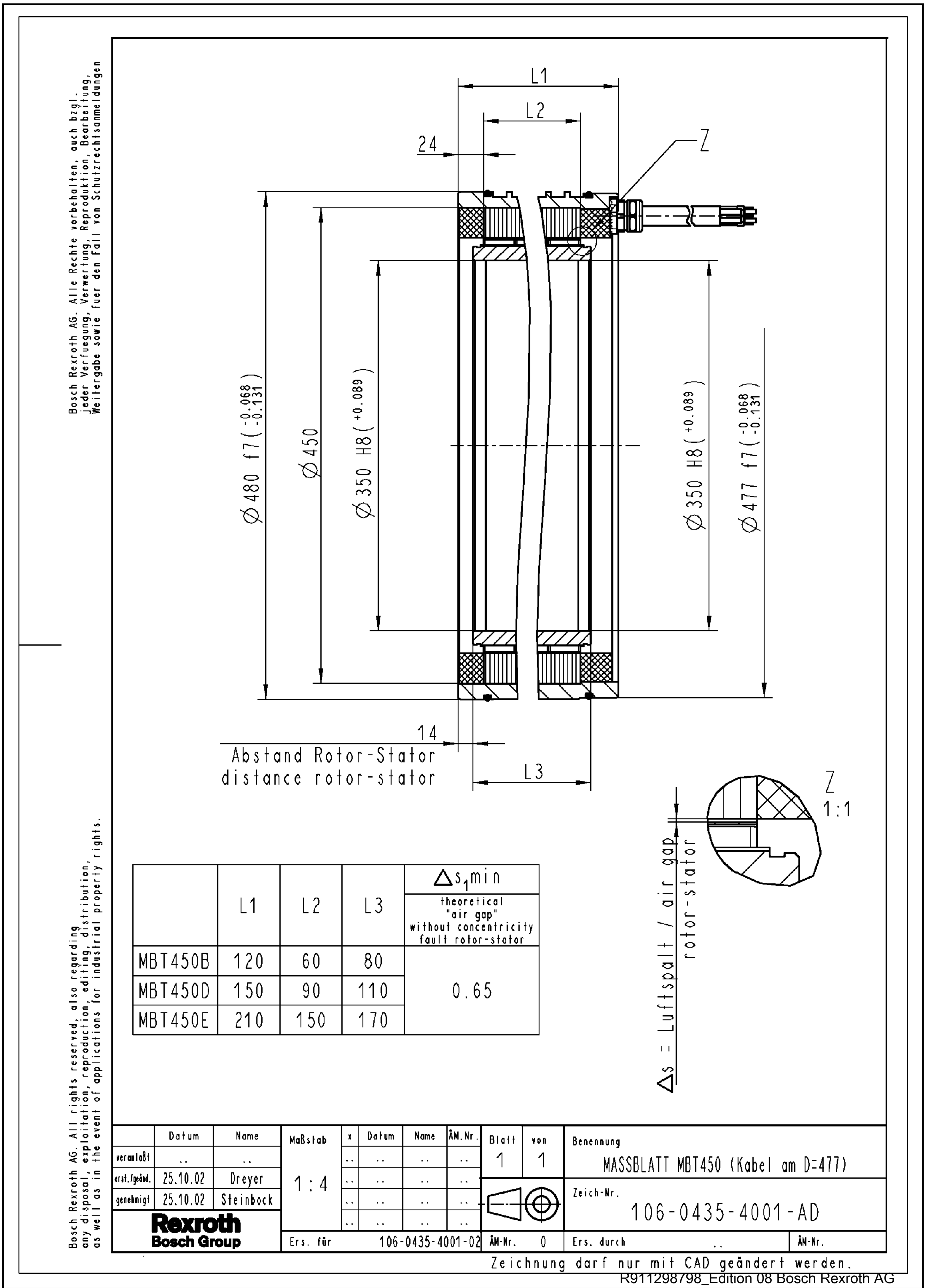


Fig. 5-67: MST360 with housing (design "FH")

5.11 Dimension sheets 450

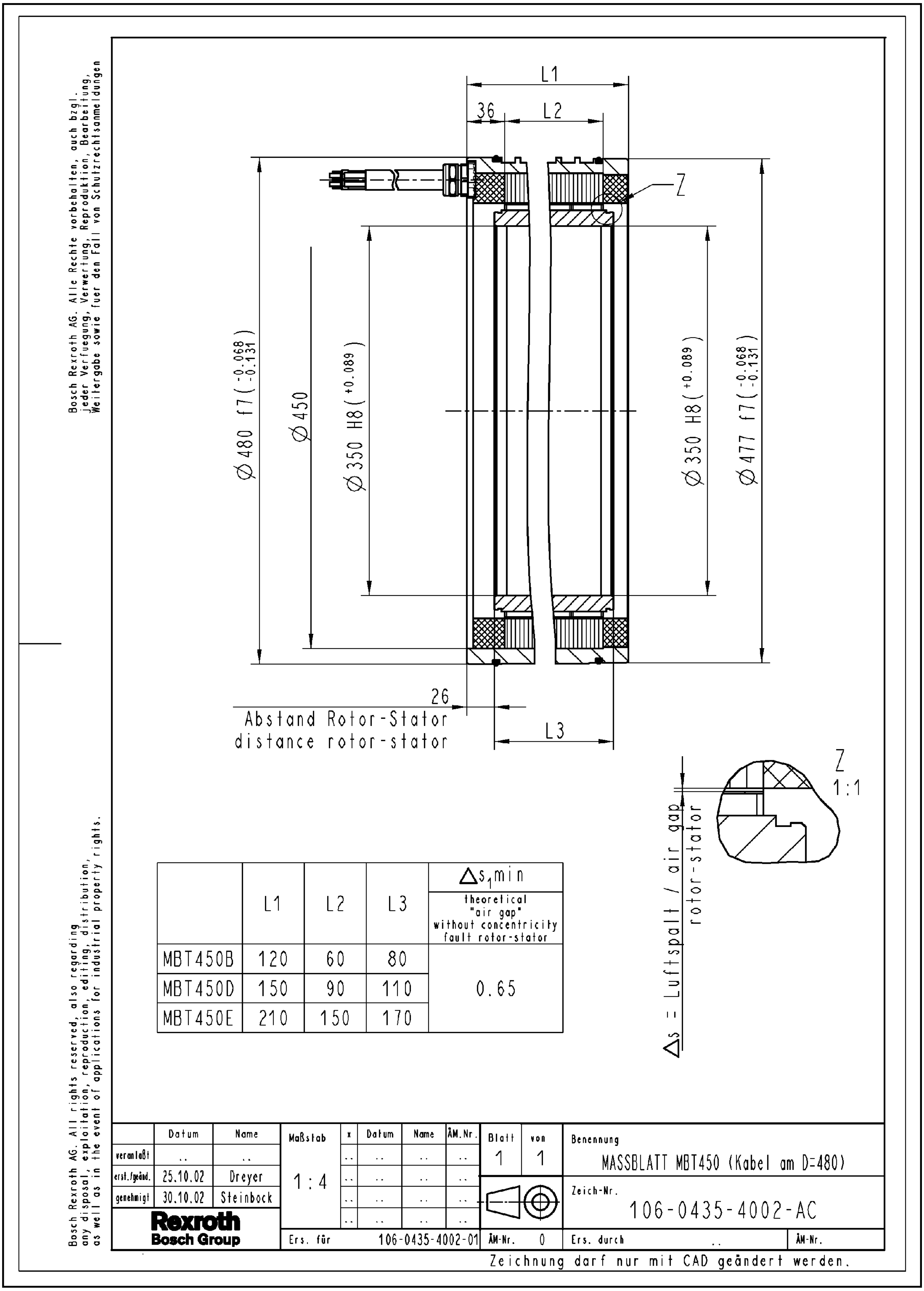
5.11.1 MBT450 with electrical connection "_SN-NNNN"



	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT450B	120	60	80	0.65
MBT450D	150	90	110	
MBT450E	210	150	170	

Fig. 5-68: MBT450, electrical connection "_SN-NNNN"

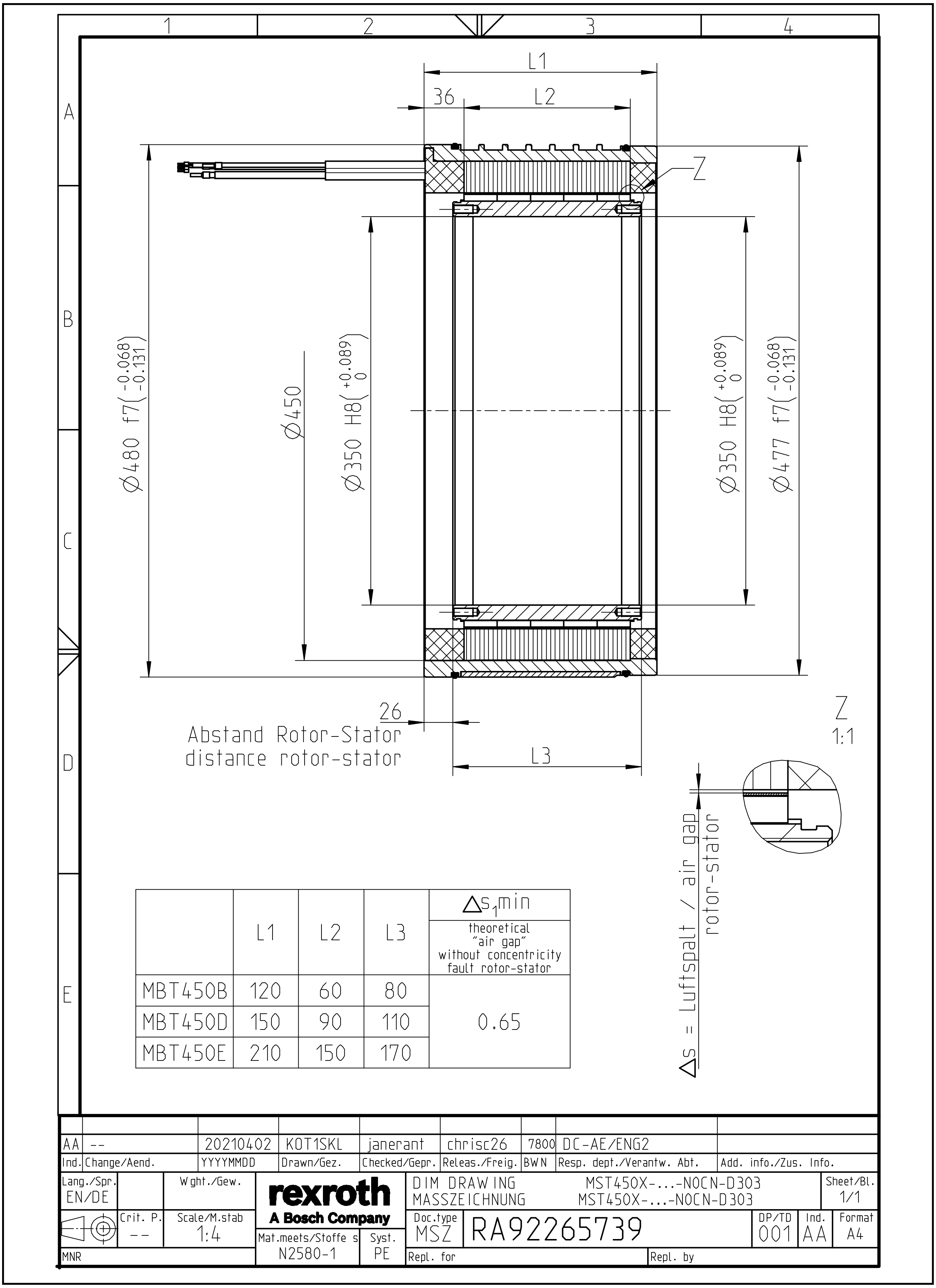
5.11.2 MBT450 with electrical connection "_CN-NNNN"



	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT450B	120	60	80	0.65
MBT450D	150	90	110	
MBT450E	210	150	170	

Fig. 5-69: MBT450, electrical connection "_CN-NNNN"

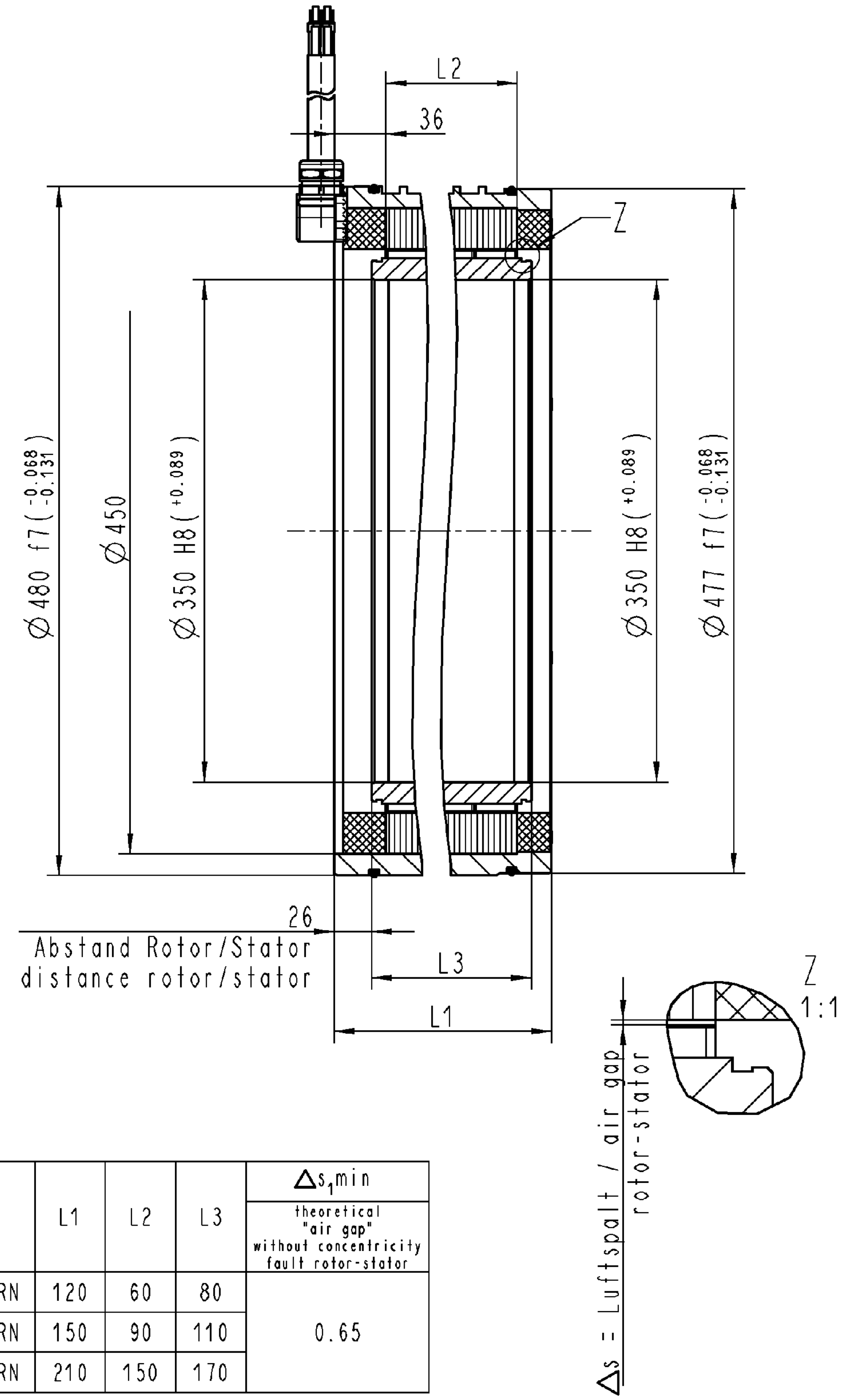
5.11.3 MBT450, electrical connection "_CN-D303"



	L1	L2	L3	Δs_1 min theoretical "air gap" without concentricity fault rotor-stator
MBT450B	120	60	80	0.65
MBT450D	150	90	110	
MBT450E	210	150	170	

Fig. 5-70: MBT450, electrical connection "_CN-D303"

5.11.4 MBT450 with electrical connection "_RN-NNNN"



	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT450B /RN	120	60	80	0.65
MBT450D /RN	150	90	110	
MBT450E /RN	210	150	170	

	Datum	Name	Maßstab	Blatt	von	Benennung
veranlaßt	..		1 : 4	1	1	MASSBLATT MBT450 /RN
erst./geänd.	15.07.03	Dreyer				Zeich-Nr. 106-0435-4003-AB
genehmigt	17.07.03	Steinbock				

Rexroth Bosch Group

Ers. für 106-0435-4003-00 ÄM-Nr. 0 Ers. durch .. ÄM-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 5-71: MBT450, electrical connection "_RN-NNNN"

5.11.5 Rotor MRT450

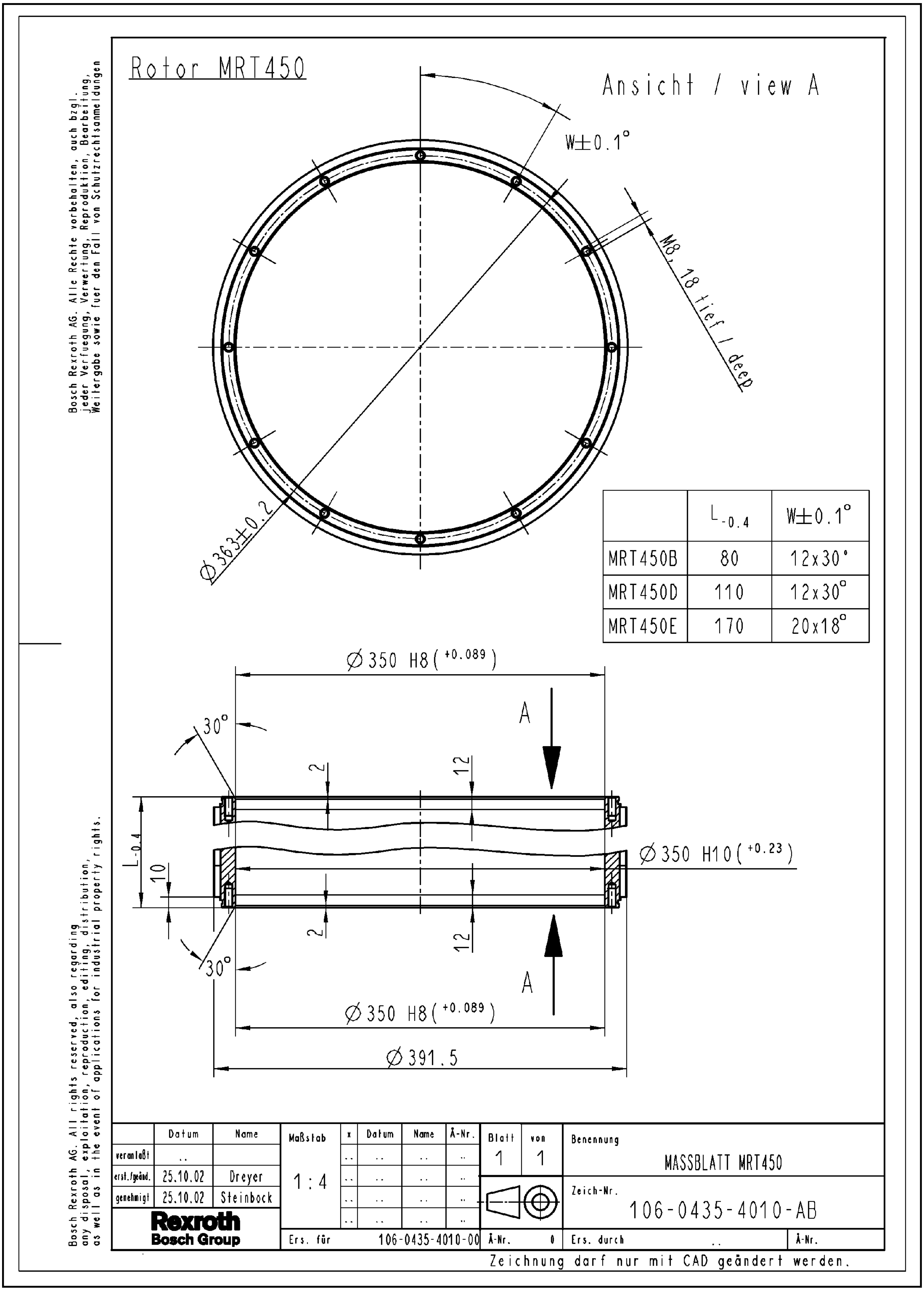
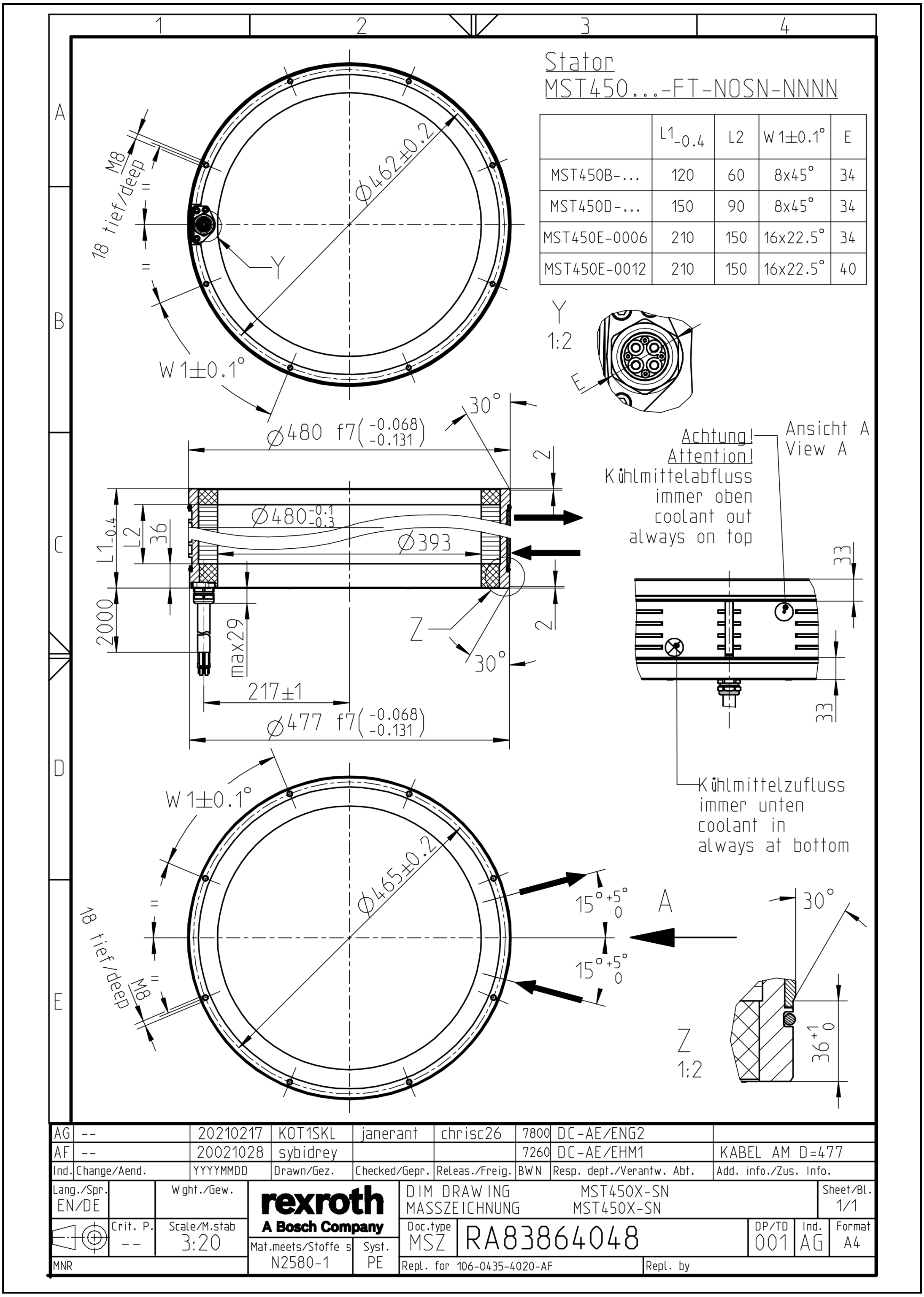


Fig. 5-72: MRT450

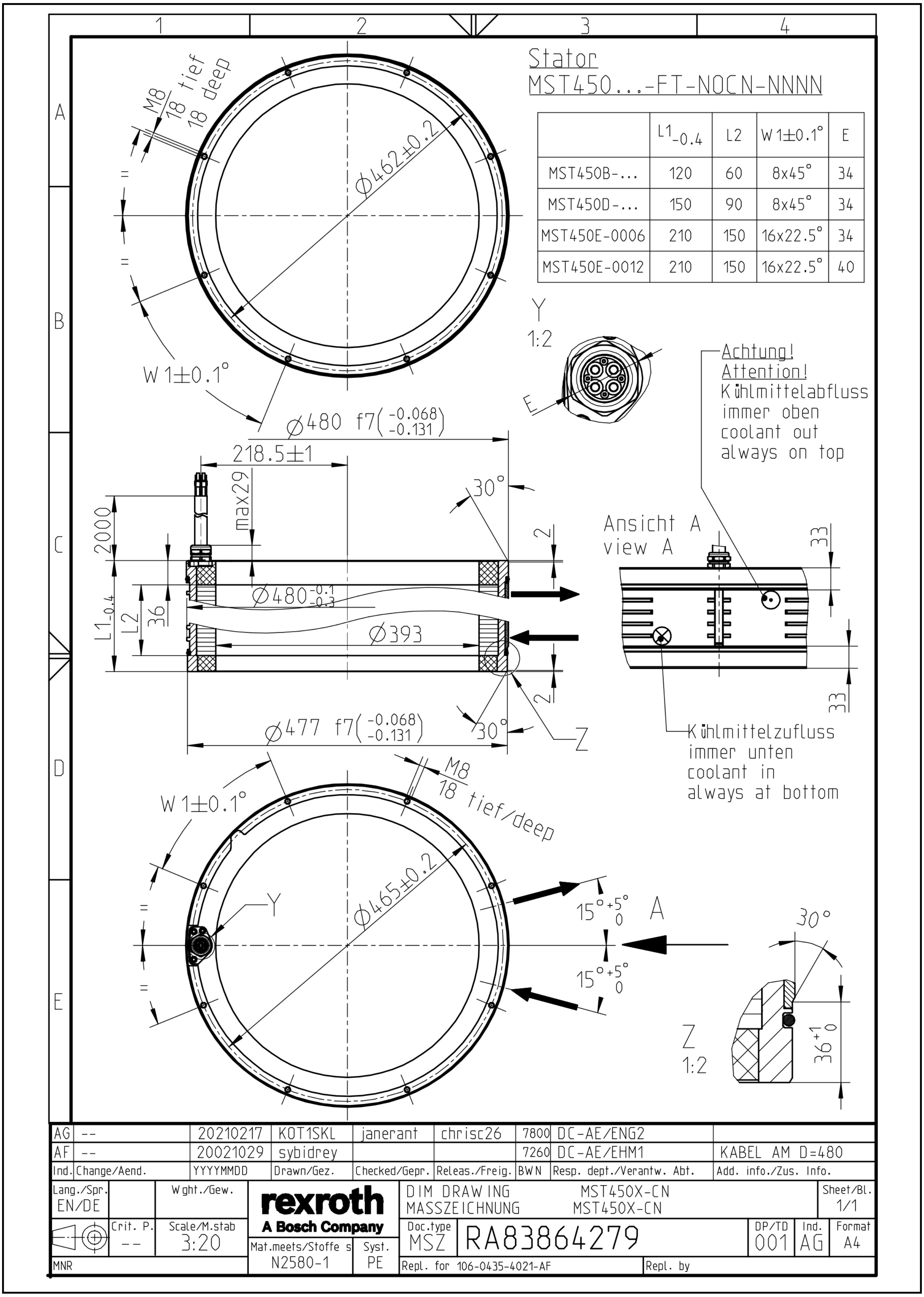
5.11.6 Stator MST450, electrical connection "_SN-NNNN"



	L1 -0.4	L2	W1±0.1°	E
MST450B-...	120	60	8x45°	34
MST450D-...	150	90	8x45°	34
MST450E-0006	210	150	16x22.5°	34
MST450E-0012	210	150	16x22.5°	40

Fig. 5-73: MST450, electrical connection "_SN-NNNN"

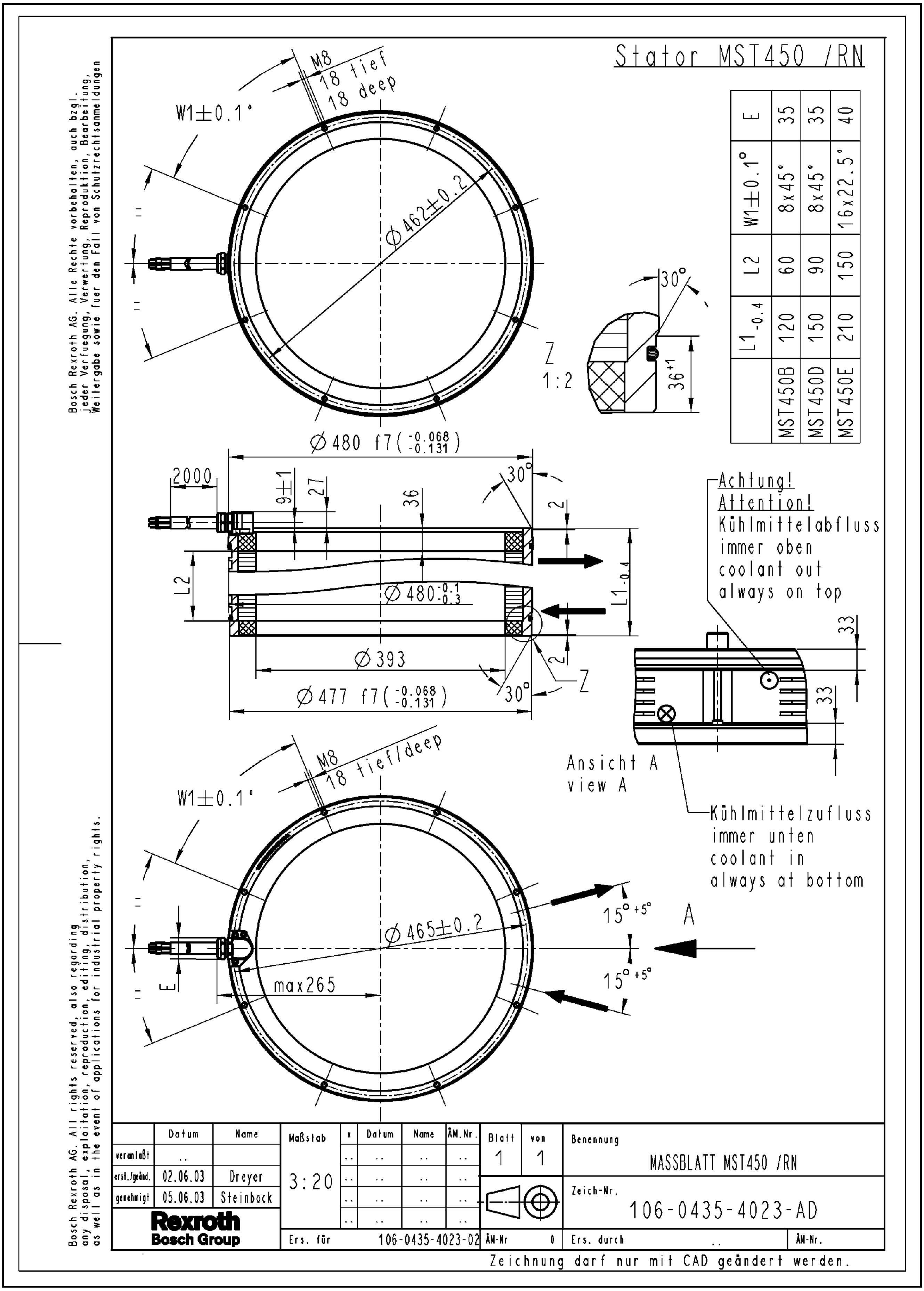
5.11.7 Stator MST450, electrical connection "_CN-NNNN"



	$L1_{-0.4}$	L2	W1±0.1°	E
MST450B-...	120	60	8x45°	34
MST450D-...	150	90	8x45°	34
MST450E-0006	210	150	16x22.5°	34
MST450E-0012	210	150	16x22.5°	40

Fig. 5-74: MST450, electrical connection "_CN-NNNN"

5.11.8 Stator MST450, electrical connection "_RN-NNNN"



	L1-0.4	L2	W1±0.1°	E
MST450B	120	60	8x45°	35
MST450D	150	90	8x45°	35
MST450E	210	150	16x22.5°	40

Fig. 5-75: MST450, electrical connection "_RN-NNNN"

5.11.9 Stator MST450, electrical connection "_CN-D303"

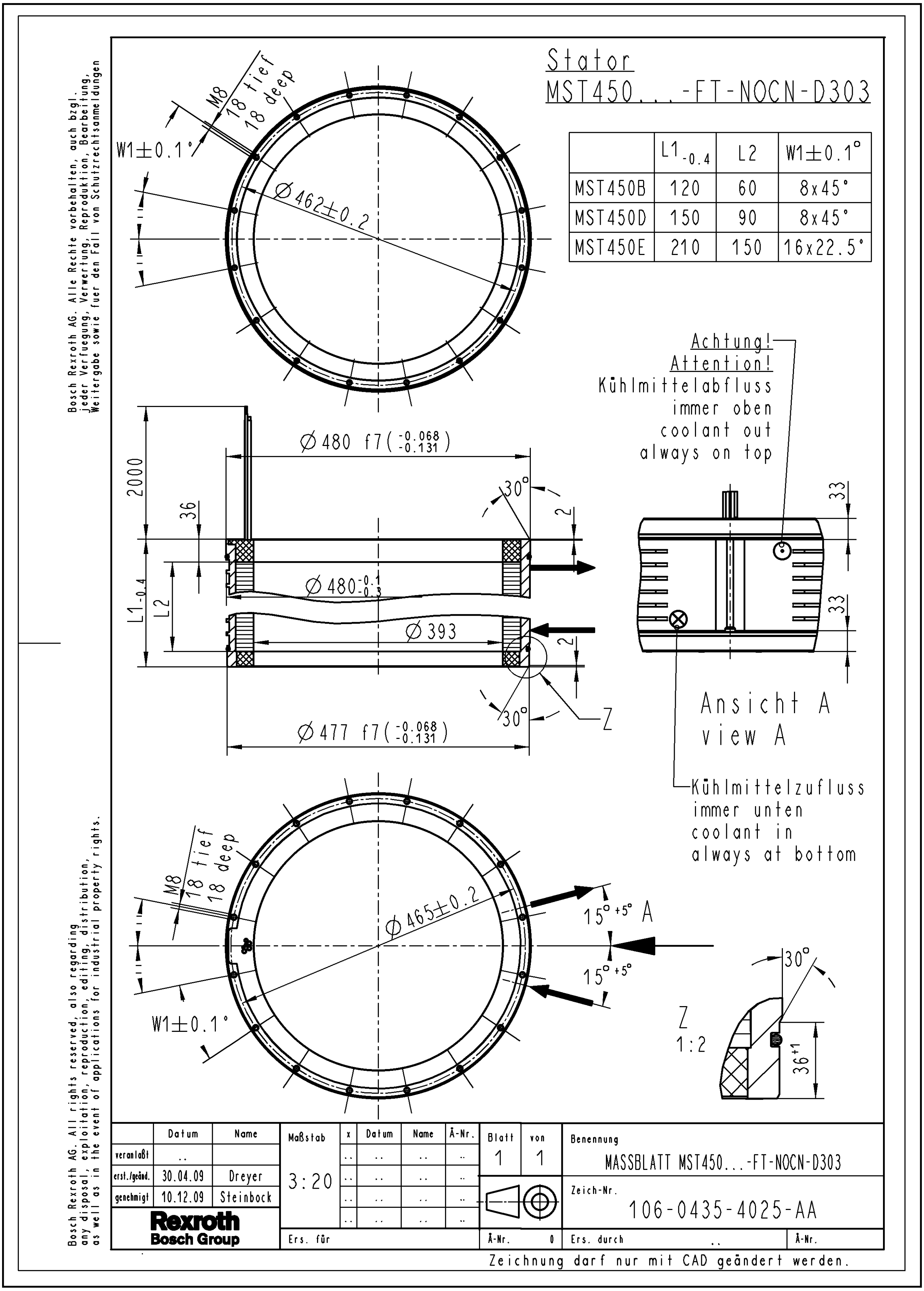


Fig. 5-76: MST450, electrical connection "_CN-D303"

5.11.10 Stator MST450E with natural convection ("NS" design)

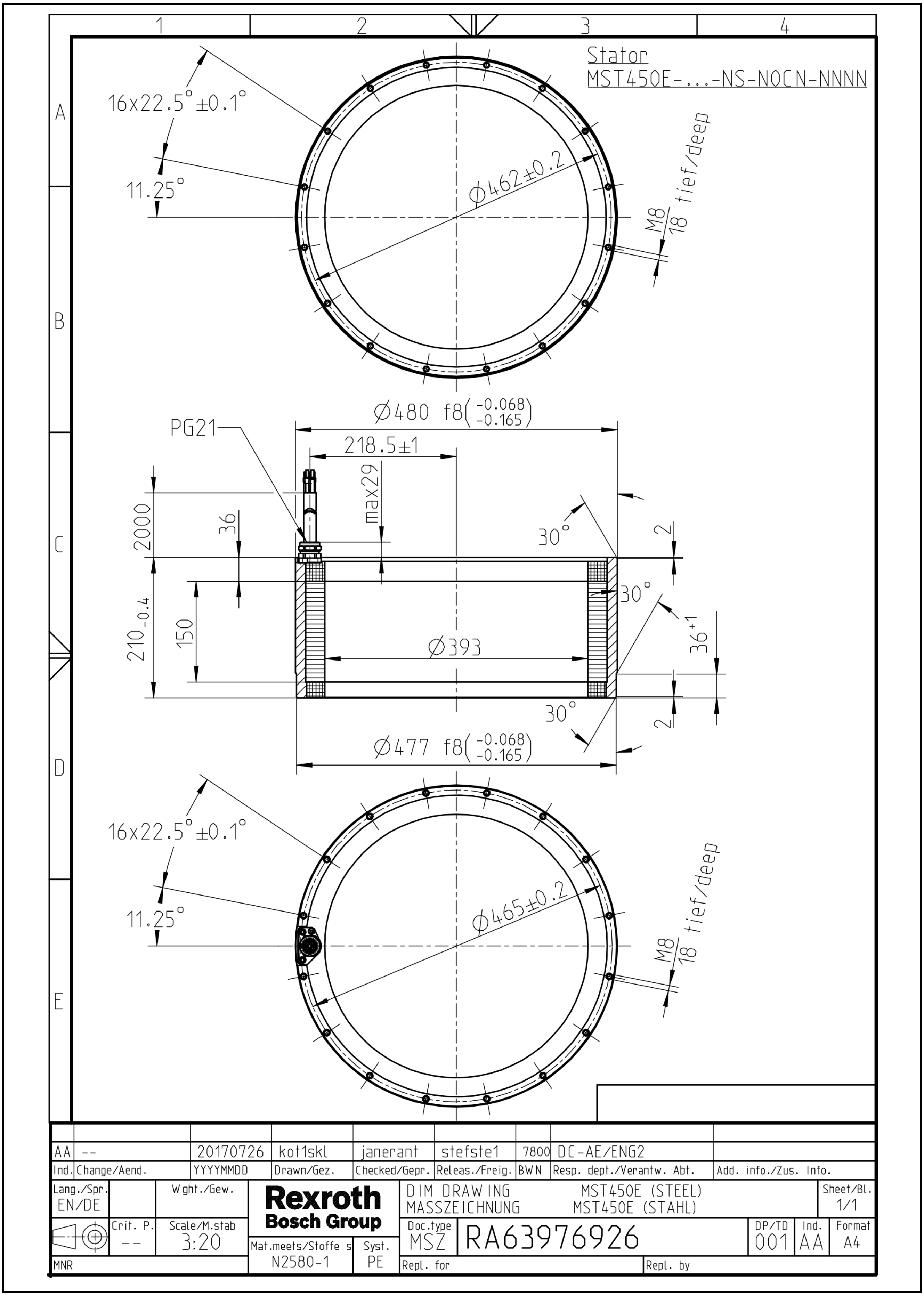


Fig. 5-77: Stator MST450E, natural convection

5.11.11 Stator MST450 with housing (design "FH")

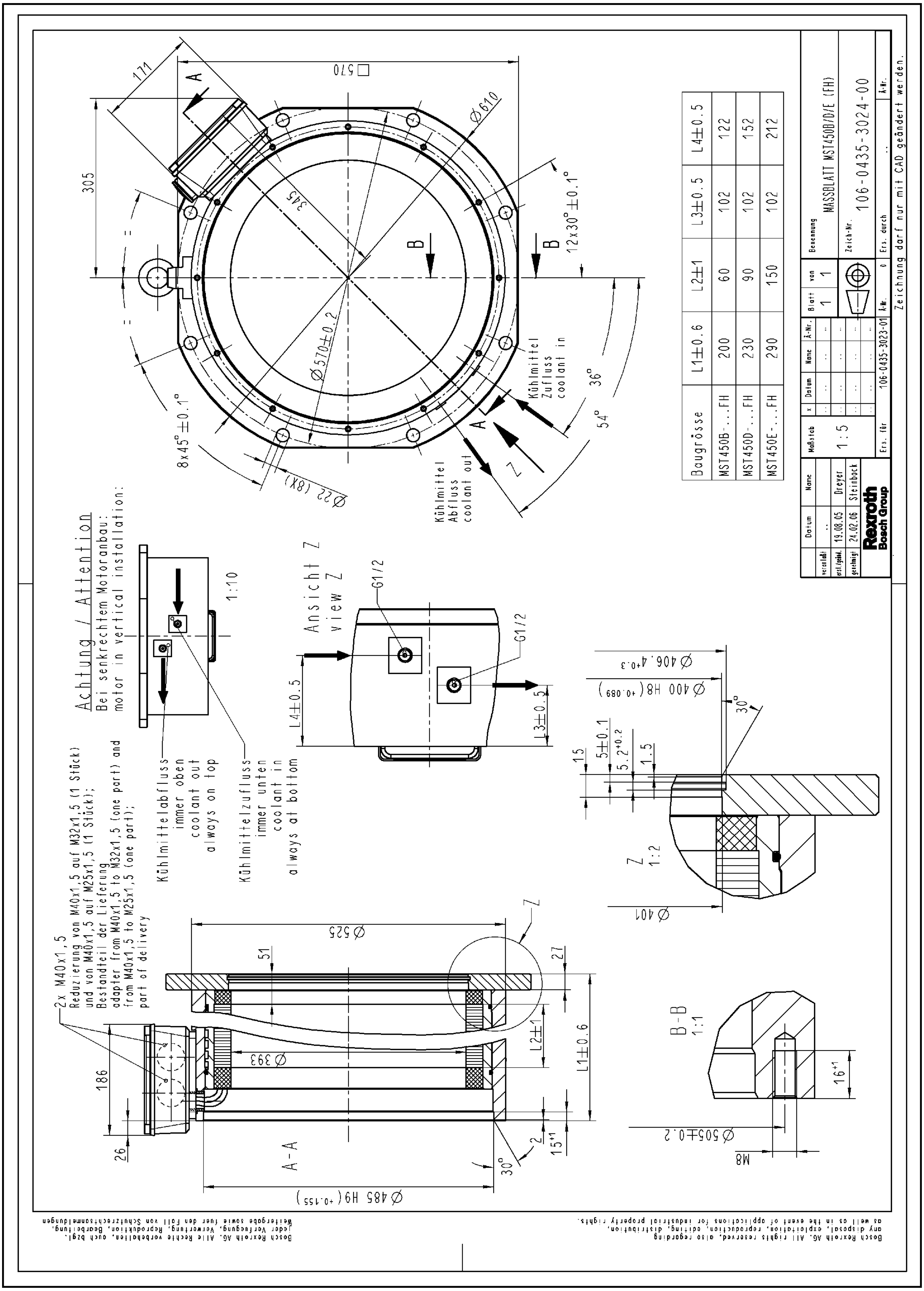
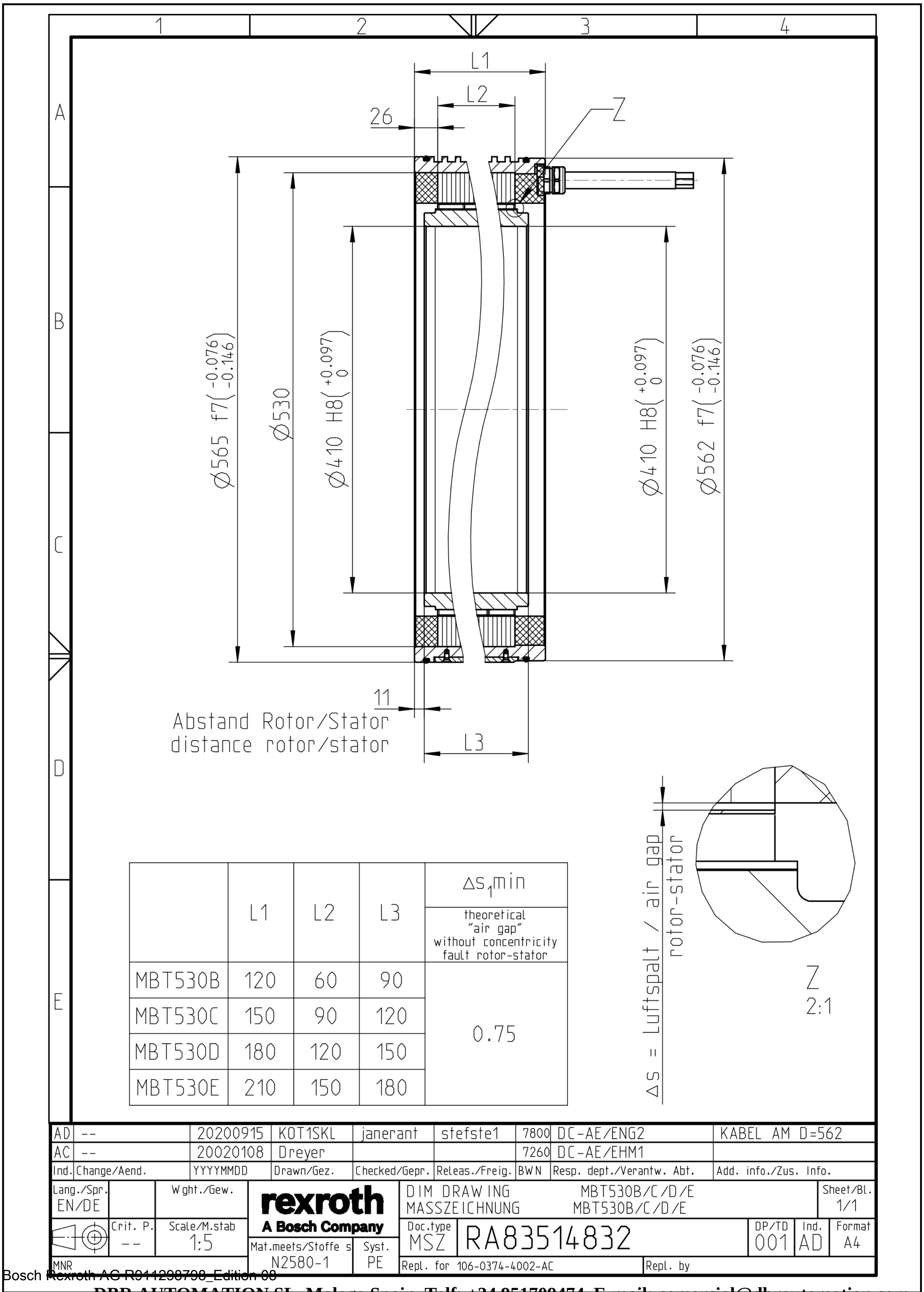


Fig. 5-78: MST450 with housing (design "FH")

5.12 Dimension sheets 530

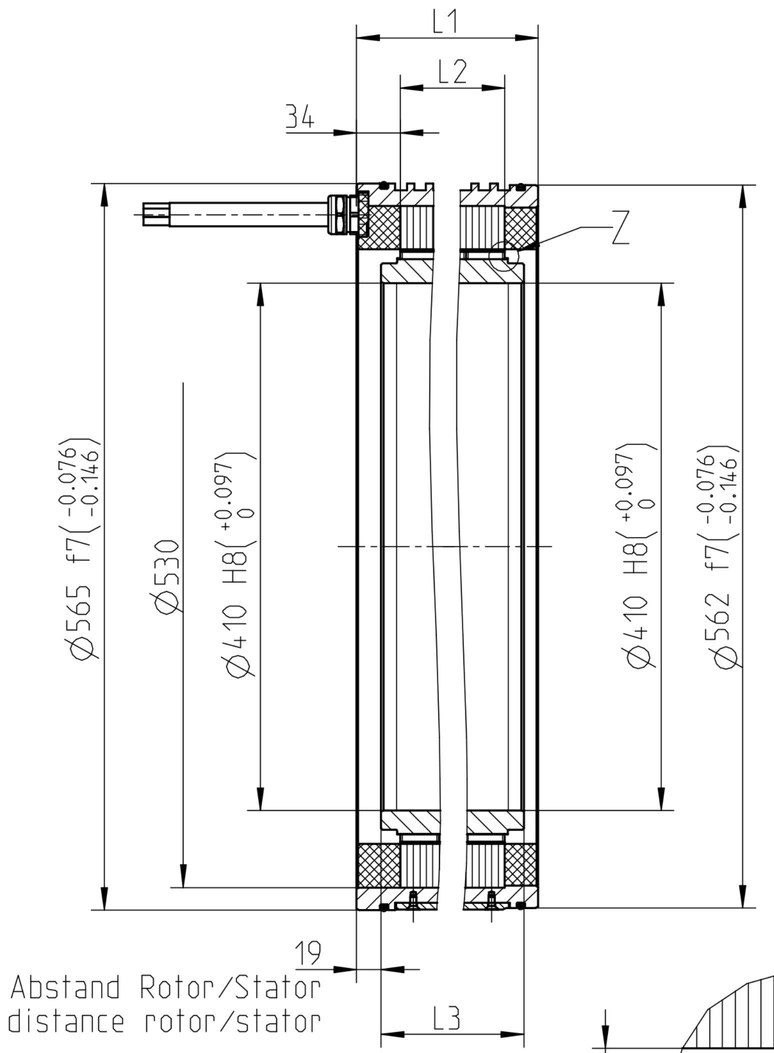
5.12.1 MBT530B/ -C/ -D/ -E with electrical connection "_SN-NNNN"

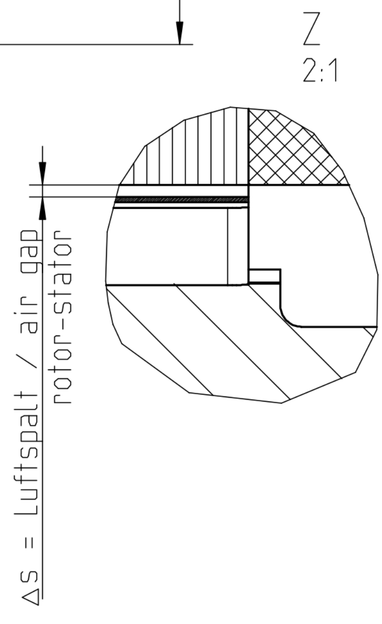


	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT530B	120	60	90	0.75
MBT530C	150	90	120	
MBT530D	180	120	150	
MBT530E	210	150	180	

Fig. 5-79: MBT530B/ -C/ -D/ -E with electrical connection "_SN-NNNN"

5.12.2 MBT530B/ -C/ -D/ -E with electrical connection "_CN-NNNN"





	L1	L2	L3	Δs_1 min theoretical "air gap" without concentricity fault rotor-stator
MBT530B	120	60	90	0.75
MBT530C	150	90	120	
MBT530D	180	120	150	
MBT530E	210	150	180	

Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.
AD	--	20200915	KOT1SKL	janerant	stefste1	7800	DC-AE/ENG2	KABEL AM D=565
AC	--	20000328	Dreyer			7260	DC-AE/EHM1	

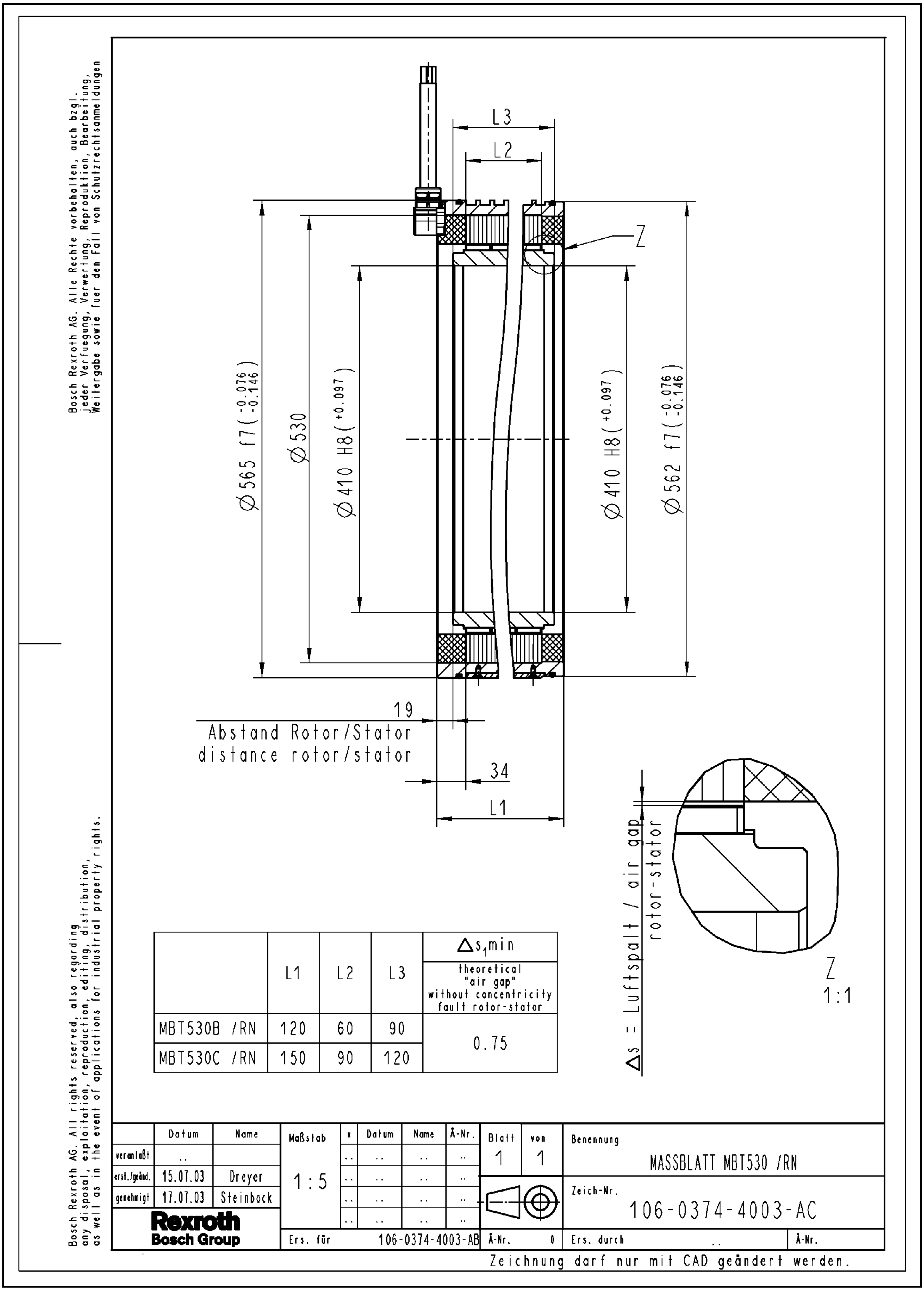
Lang./Spr. EN/DE | Wght./Gew. | rexroth A Bosch Company | DIM DRAWING MBT530B/C/D/E | MASSZEICHNUNG MBT530B/C/D/E | Sheet/Bl. 1/1

Crit. P. -- | Scale/M.stab 1:5 | Mat.meets/Stoffe s N2580-1 | Syst. PE | Doc.type MSZ | RA83514833 | DP/TD 001 | Ind. AD | Format A4

MNR | Repl. for 106-0374-4001-AC | Repl. by

Fig. 5-80: MBT530B/ -C/ -D/ -E with electrical connection "_CN-NNNN"

5.12.3 MBT530B/ -C with electrical connection "_RN-NNNN"



	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT530B /RN	120	60	90	0.75
MBT530C /RN	150	90	120	

Fig. 5-81: MBT530B/ -C, electrical connection "_RN-NNNN"

5.12.4 MBT530F with electrical connection "_CN-NNNN"

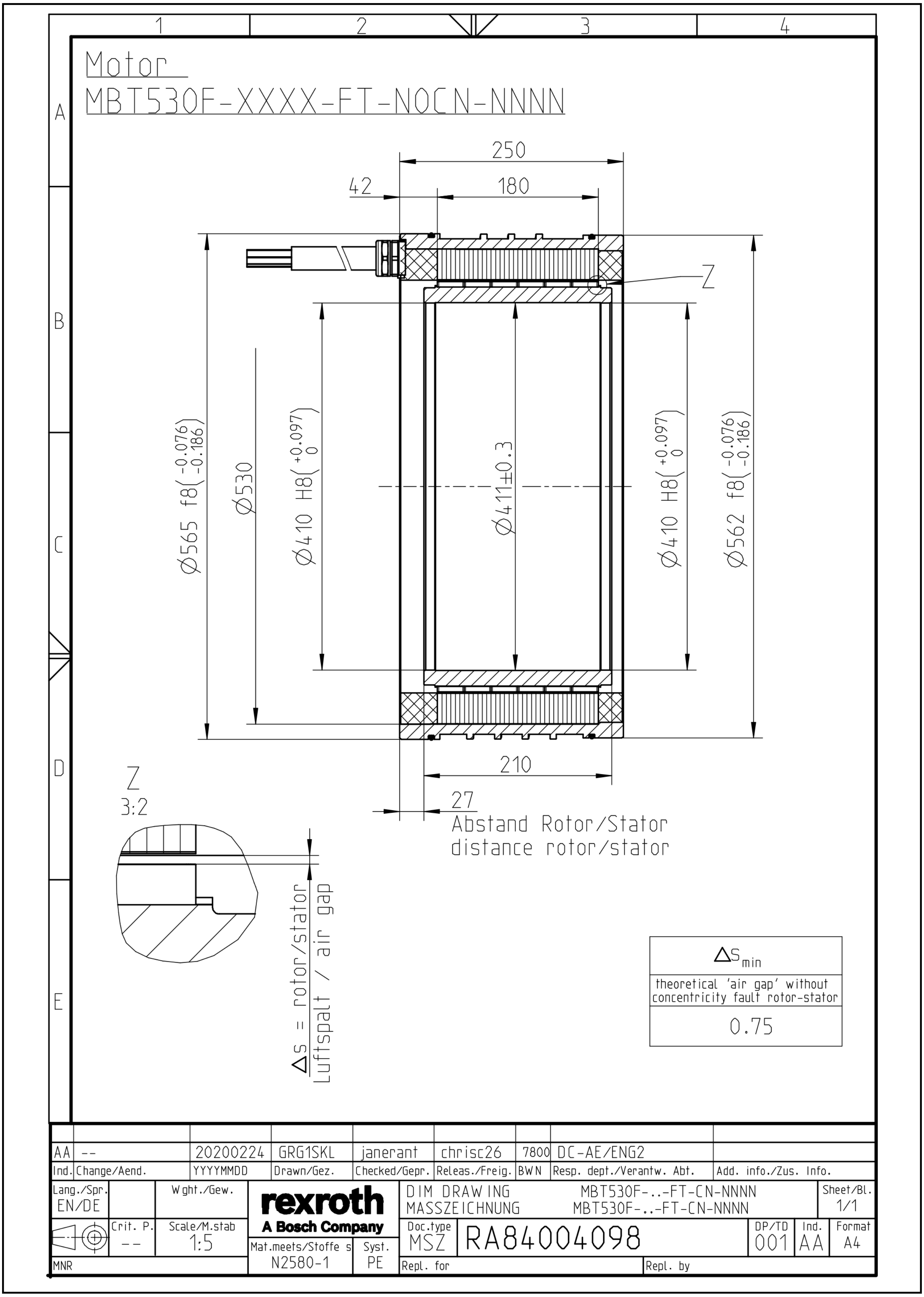


Fig. 5-82: MBT530F with electrical connection "_CN-NNNN"

5.12.5 MBT530F with electrical connection "_SN-D303"

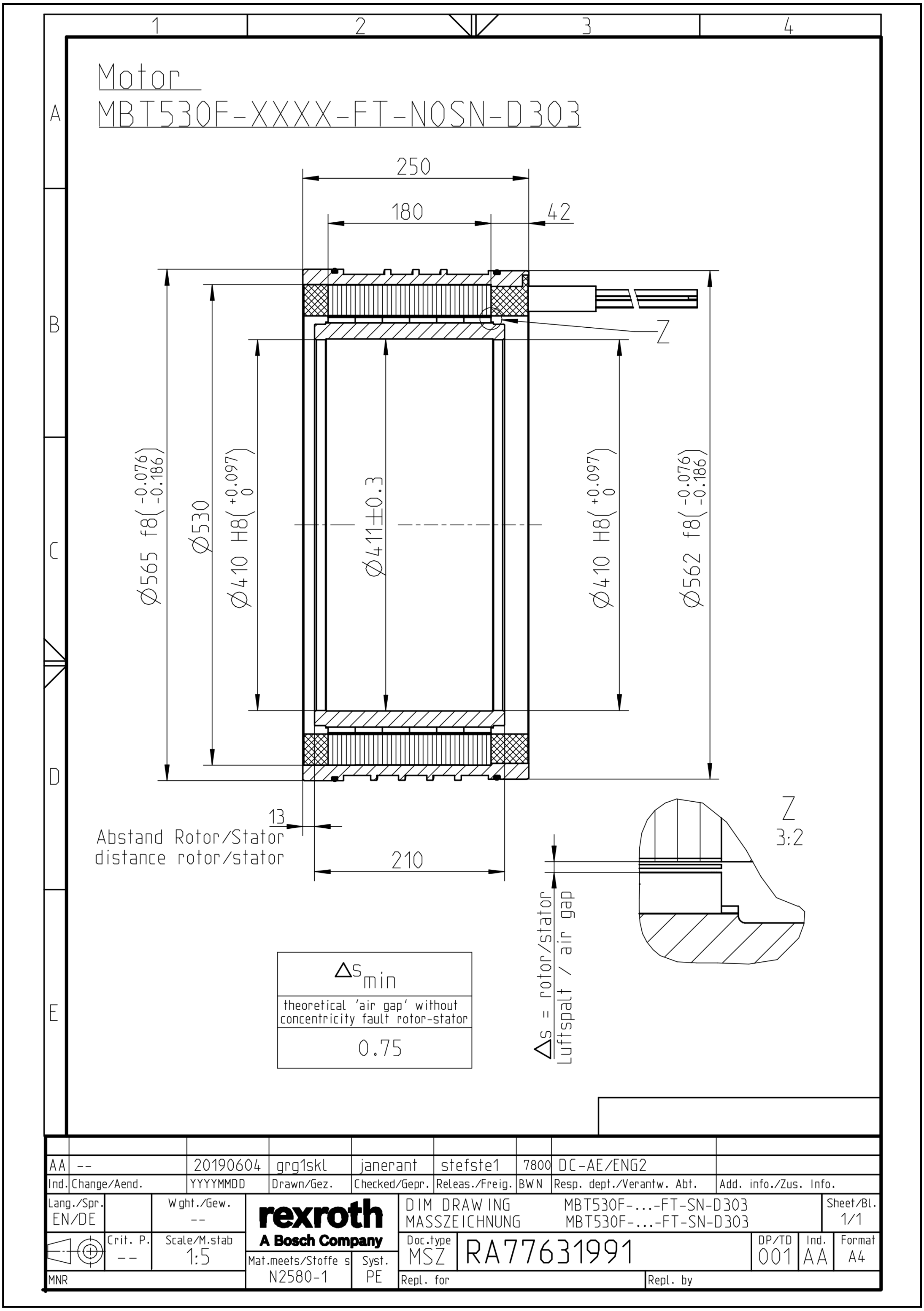


Fig. 5-83: MBT530F with electrical connection "_SN-D303"

5.12.6 MBT530F with electrical connection "_CN-D303"

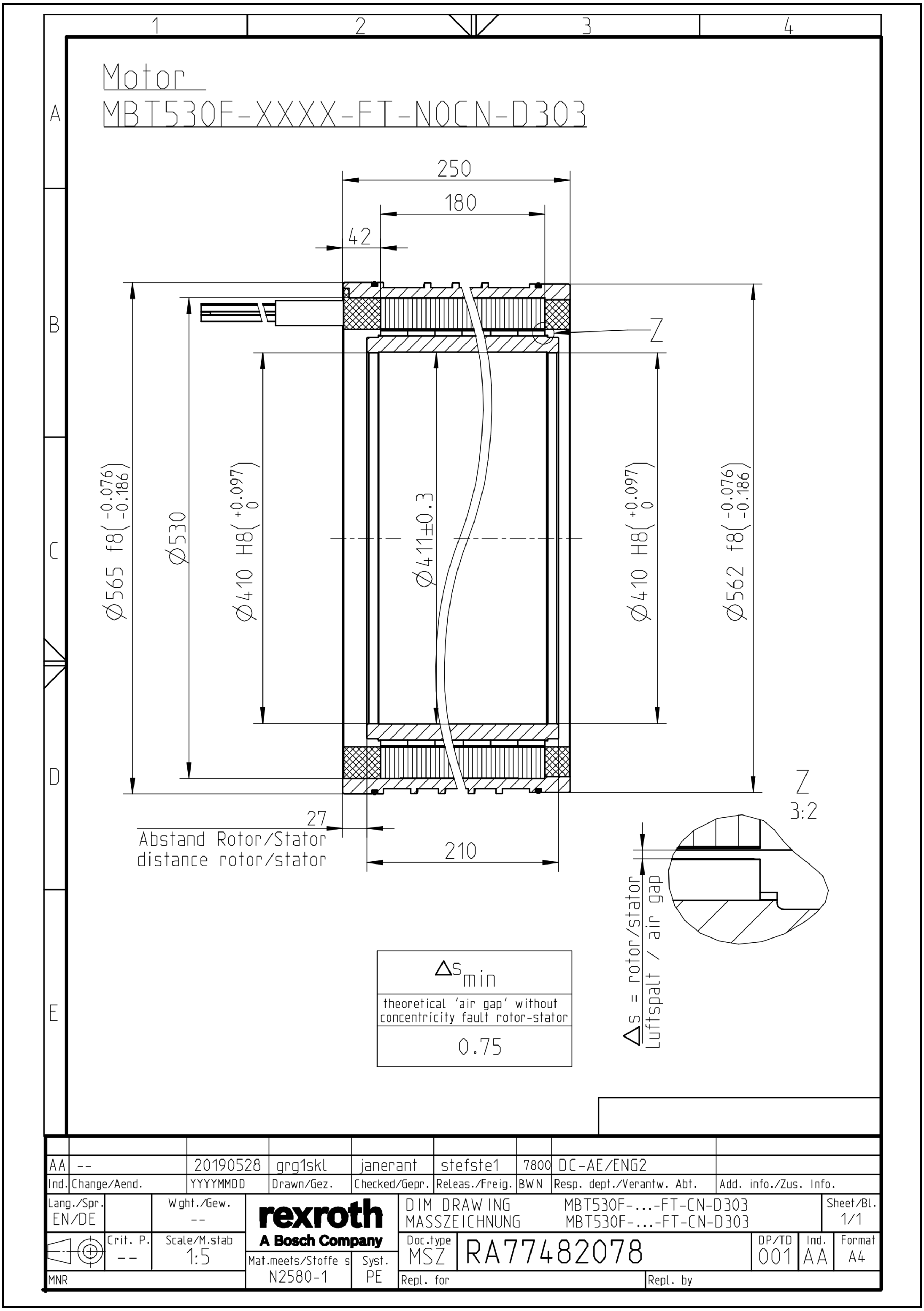
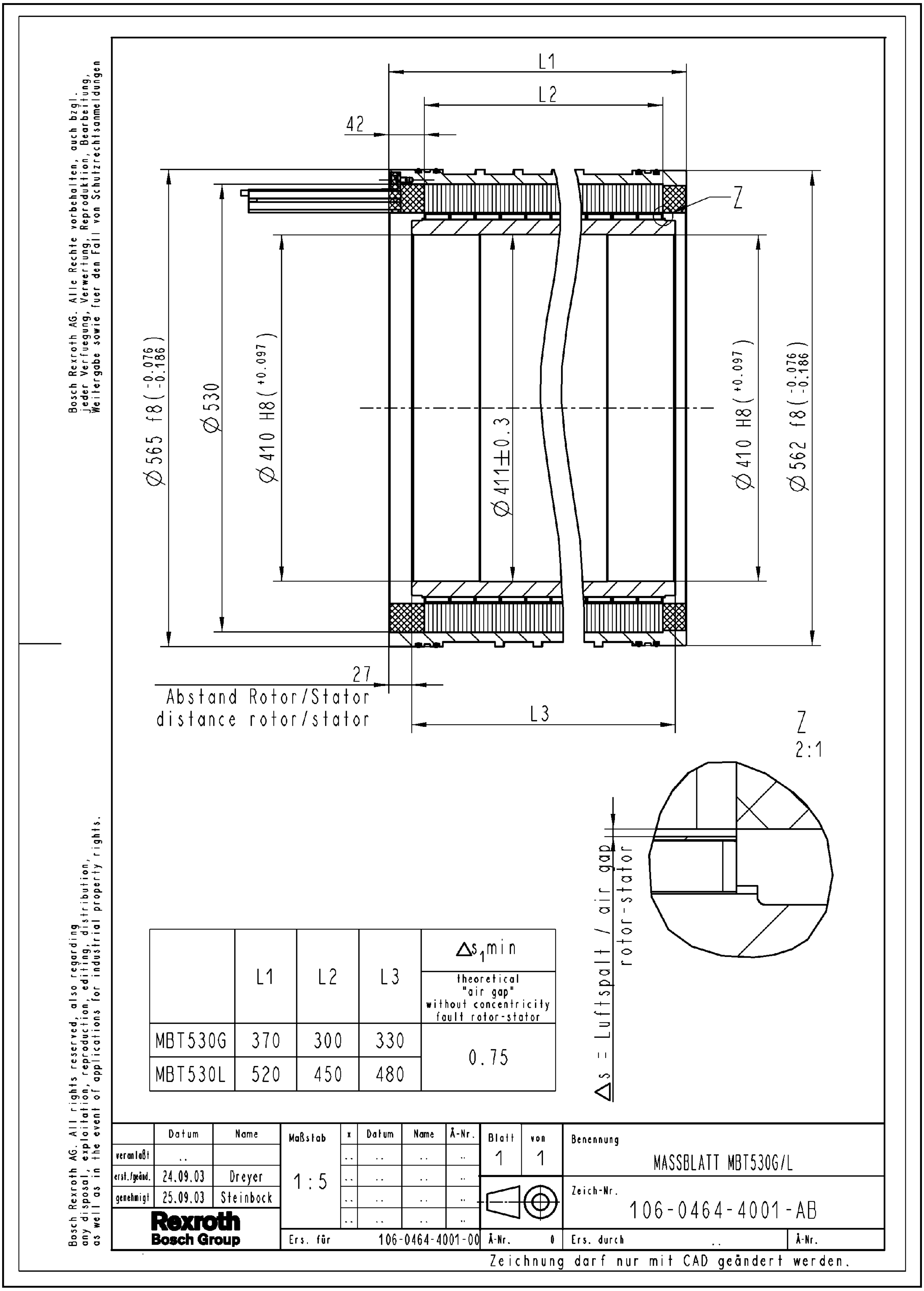


Fig. 5-84: MBT530F with electrical connection "_CN-D303"

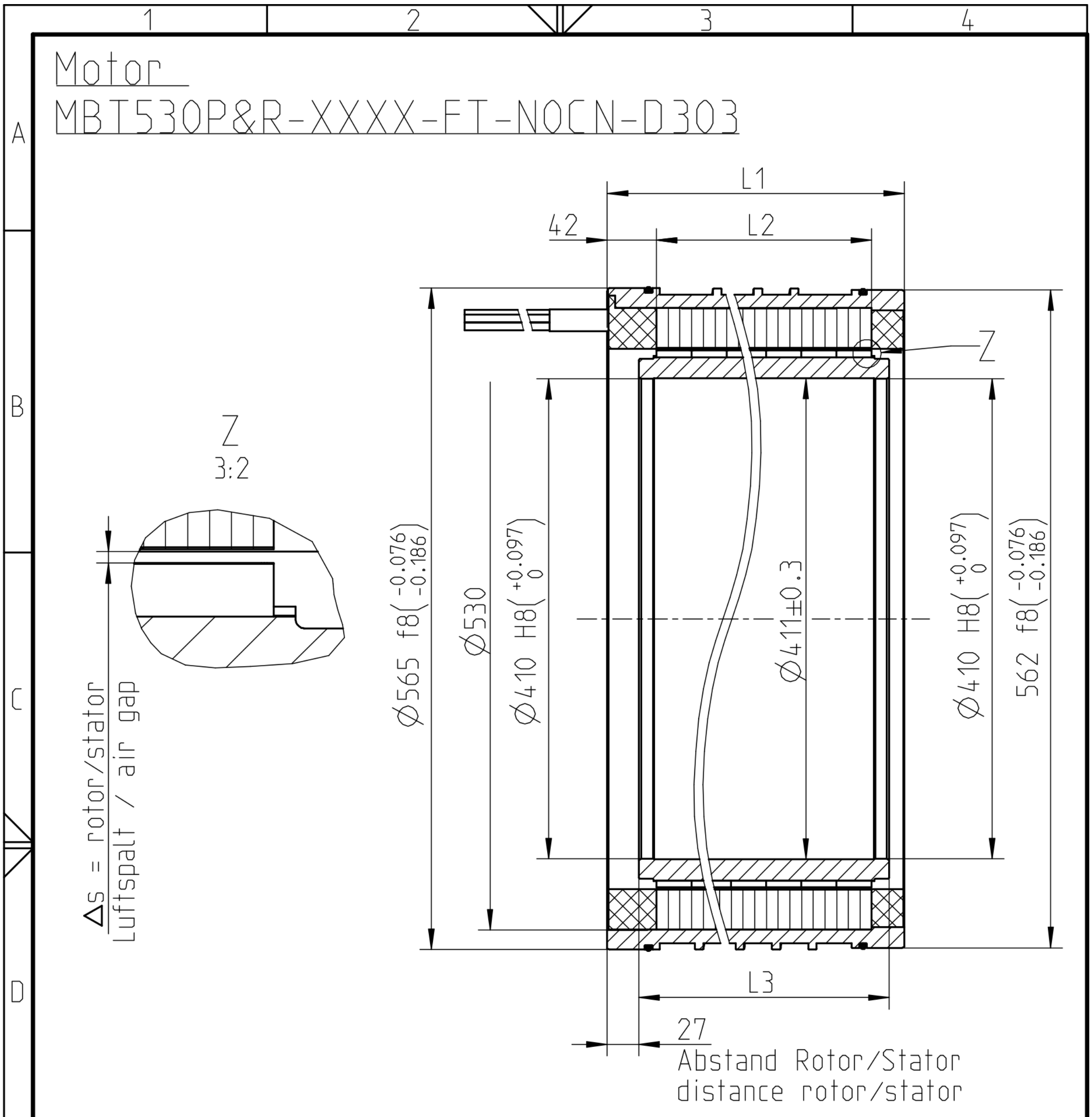
5.12.7 MBT530G/ -L with electrical connection "_CN-D303"



	L1	L2	L3	Δs1min theoretical "air gap" without concentricity fault rotor-stator
MBT530G	370	300	330	0.75
MBT530L	520	450	480	

Fig. 5-85: MBT530G/ -L with electrical connection "_CN-D303"

5.12.8 MBT530P/ -R with electrical connection "_CN-D303"

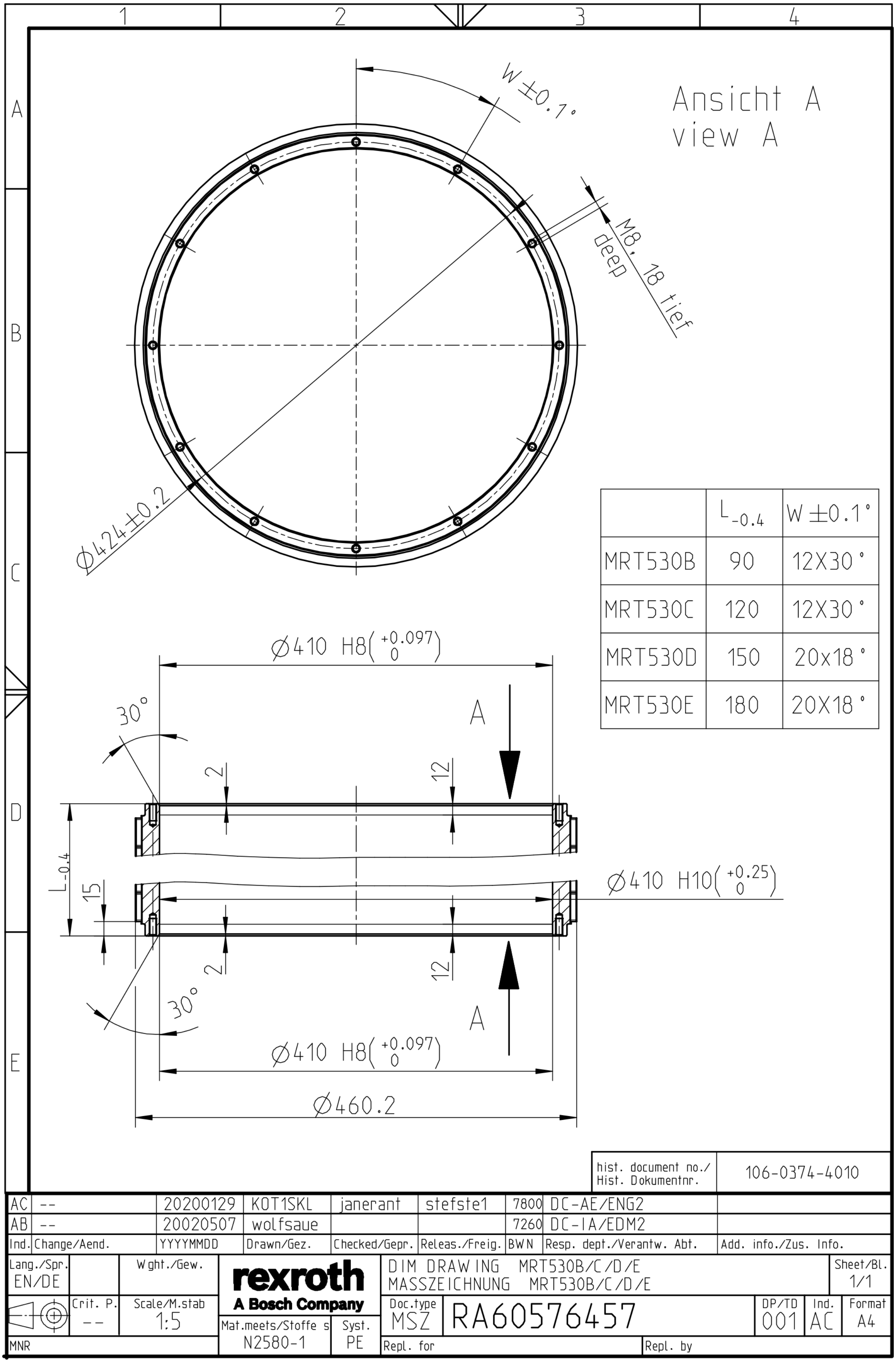


	L1	L2	L3	Δs min (theoretical 'air gap' without concentricity fault rotor-stator)
MBT530P	280	210	240	0.75
MBT530R	340	270	300	

AA -- 20200224 GRG1SKL janerant chrisc26 7800 DC-AE/ENG2
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 A Bosch Company DIM DRAWING MASSZEICHNUNG MBT530P/R-FT-CN-D303 MBT530P/R-FT-CN-D303 Sheet/Bl. 1/1
Crit. P. -- Scale/M.stab 1:5 Doc.type MSZ RA84020201 DP/TD 001 Ind. AA Format A4
Mat.meets/Stoffe s N2580-1 Syst. PE Repl. for Repl. by
MNR

Fig. 5-86: MBT530P/ -R with electrical connection "_CN-D303"

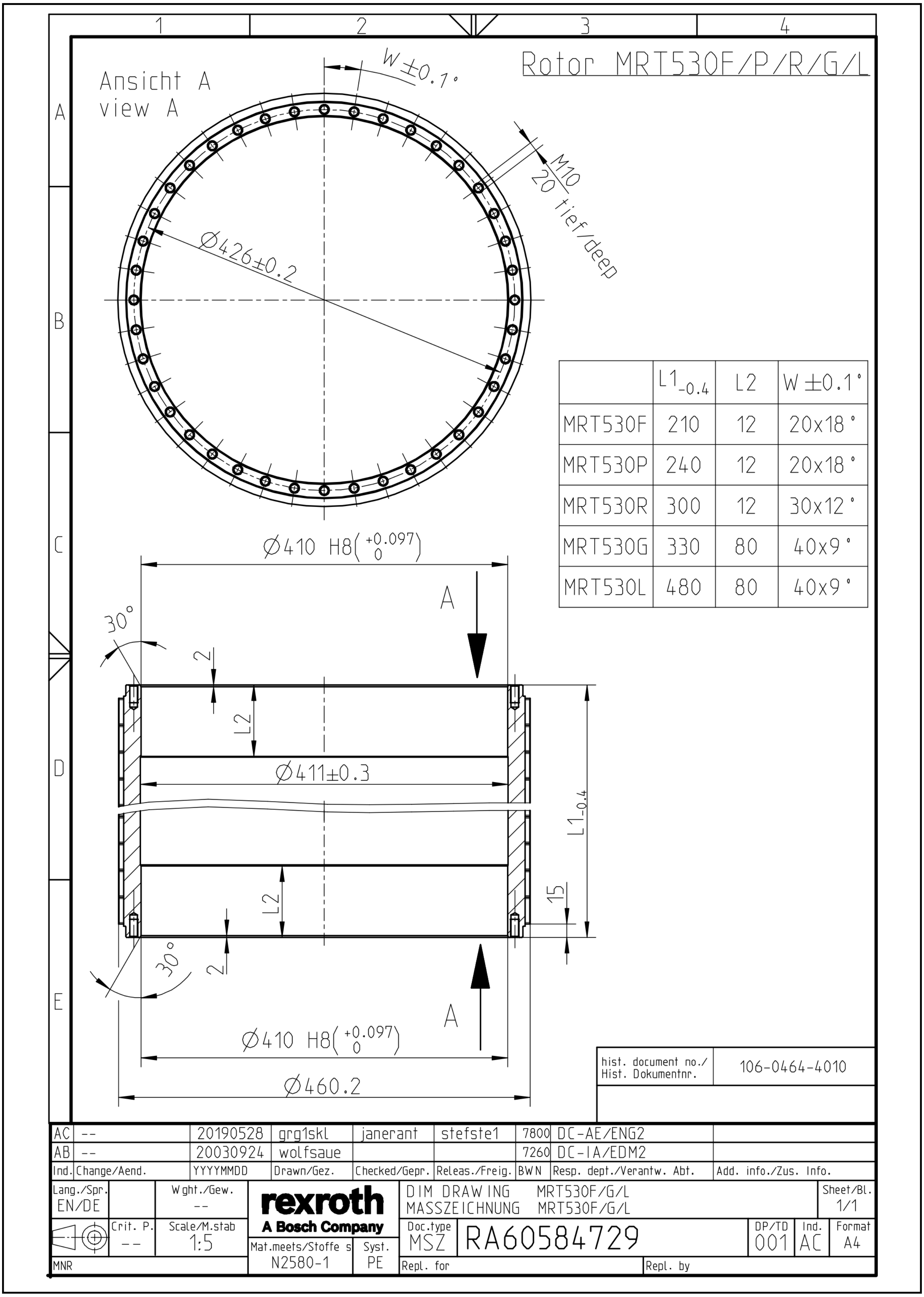
5.12.9 Rotor MRT530B/ -C/ -D/ -E



	$L_{-0.4}$	W ±0.1°
MRT530B	90	12X30°
MRT530C	120	12X30°
MRT530D	150	20x18°
MRT530E	180	20X18°

Fig. 5-87: MRT530B/ -C/ -D/ -E

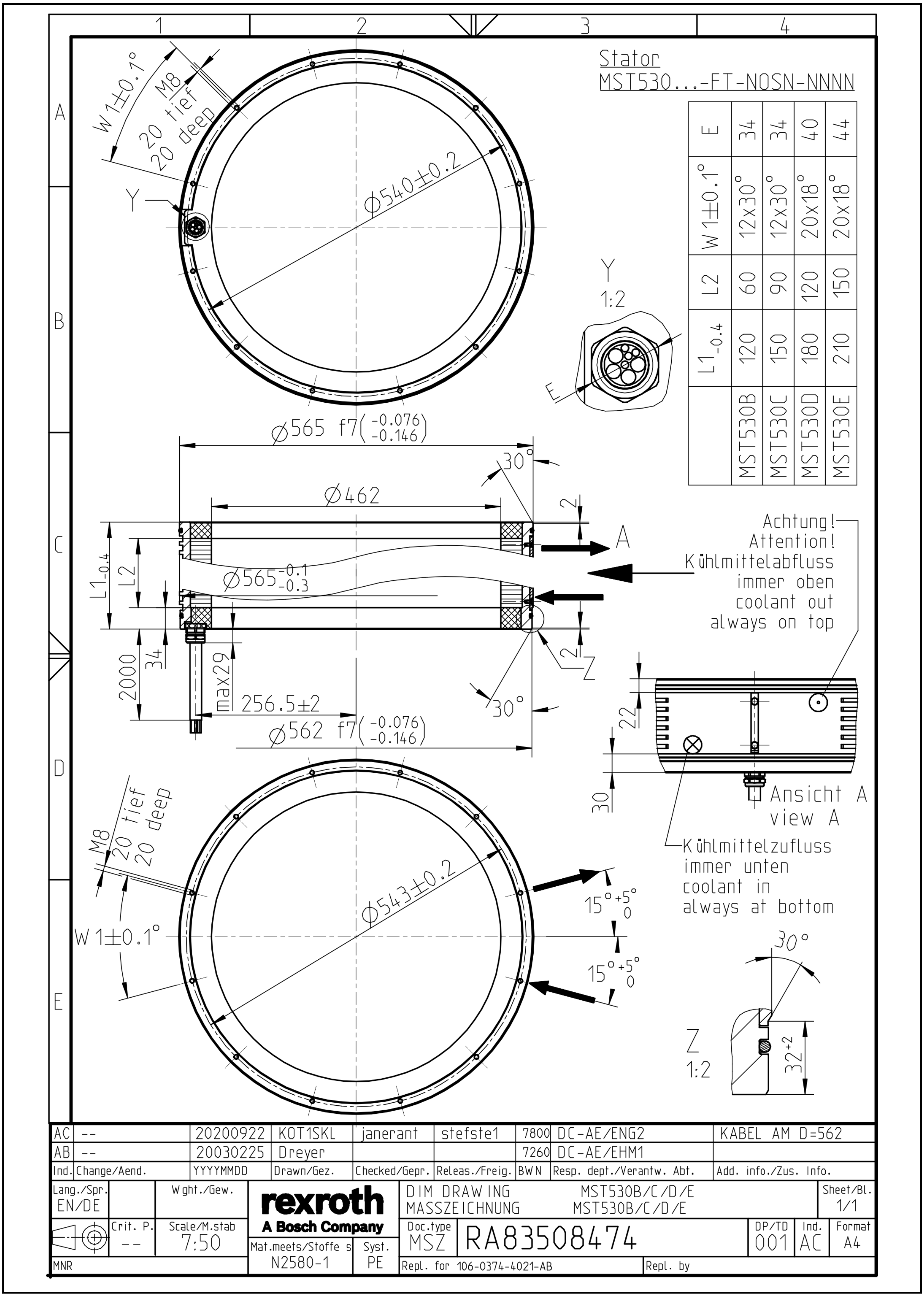
5.12.10 Rotor MRT530F/ -P/ -R/ -G/ -L



	$L1_{-0.4}$	L2	W ±0.1°
MRT530F	210	12	20x18°
MRT530P	240	12	20x18°
MRT530R	300	12	30x12°
MRT530G	330	80	40x9°
MRT530L	480	80	40x9°

Fig. 5-88: MRT530F/ -P/ -R/ -G/ -L

5.12.11 Stator MST530B/ -C/ -D/ -E, electrical connection "_SN-NNNN"



	$L1_{-0.4}$	L2	W1±0.1°	E
MST530B	120	60	12x30°	34
MST530C	150	90	12x30°	34
MST530D	180	120	20x18°	40
MST530E	210	150	20x18°	44

Fig. 5-89: MST530B/ -C/ -D/ -E, electrical connection "_SN-NNNN"

5.12.12 Stator MST530B/ -C/ -D/ -E, electrical connection "_CN-NNNN"

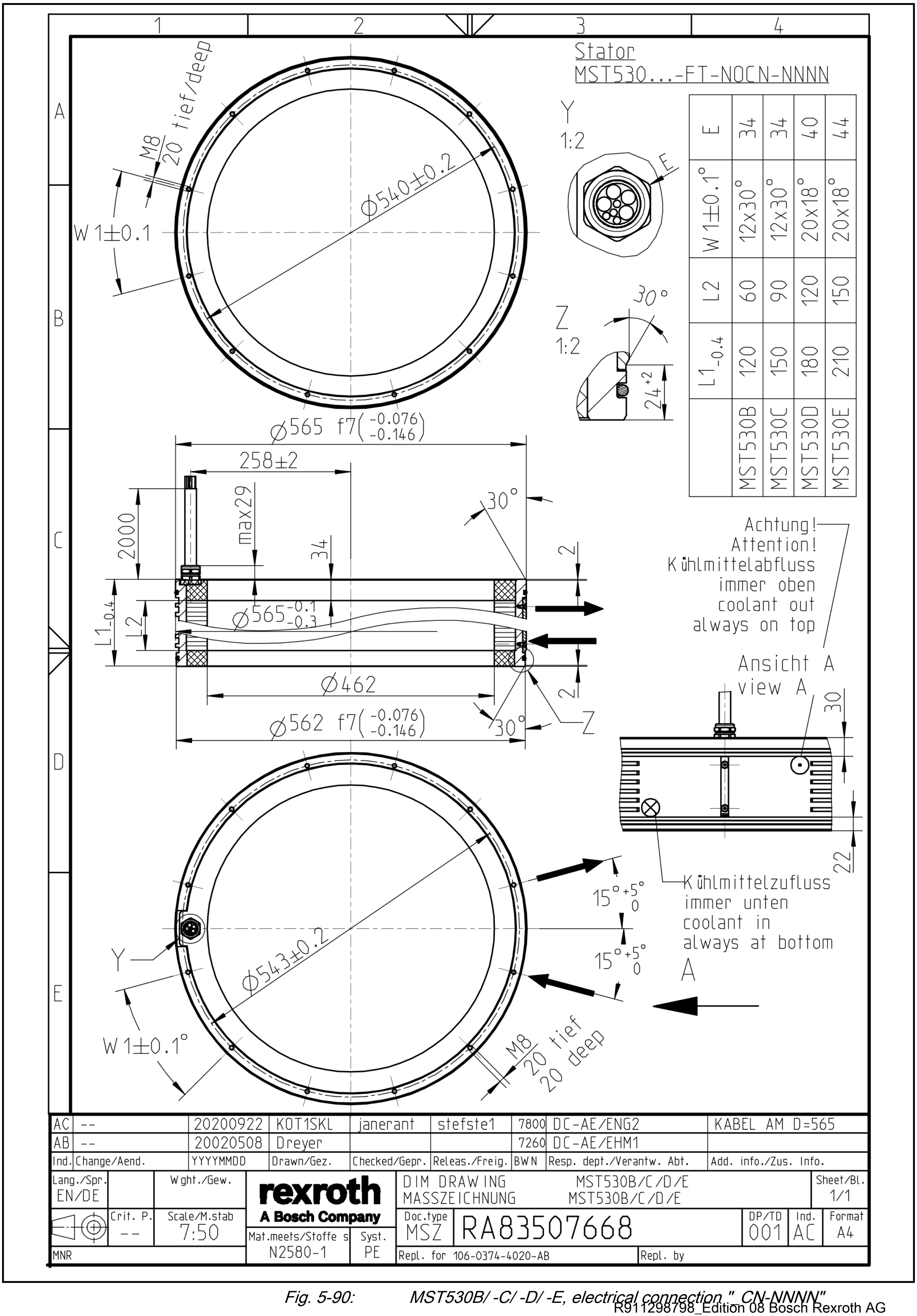


Fig. 5-90: MST530B/ -C/ -D/ -E, electrical connection "_CN-NNNN"

5.12.13 Stator MST530F, electrical connection "_SN-NNNN"

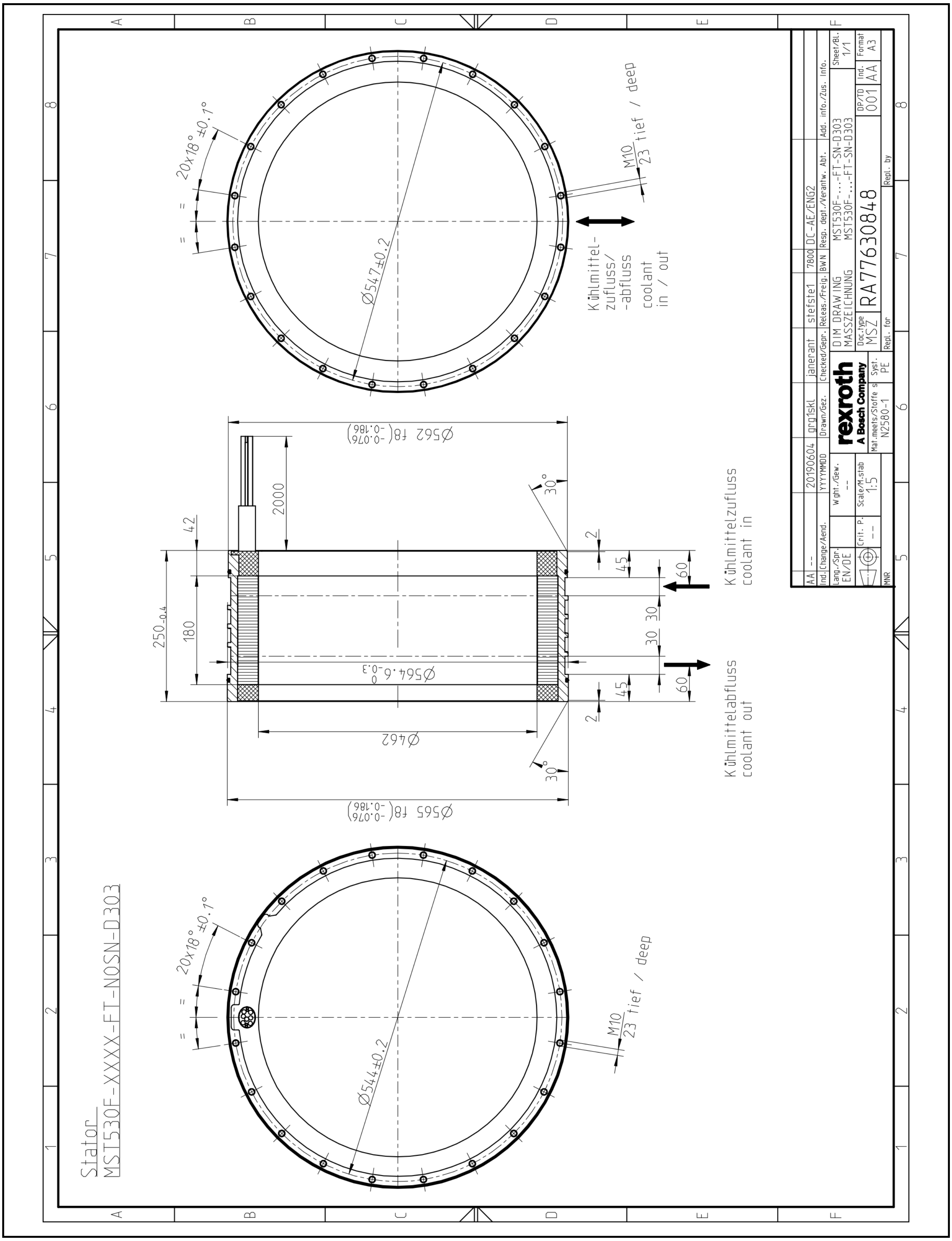


Fig. 5-91: MST530F, electrical connection "_SN-NNNN"

5.12.14 Stator MST530F, electrical connection "_CN-NNNN"

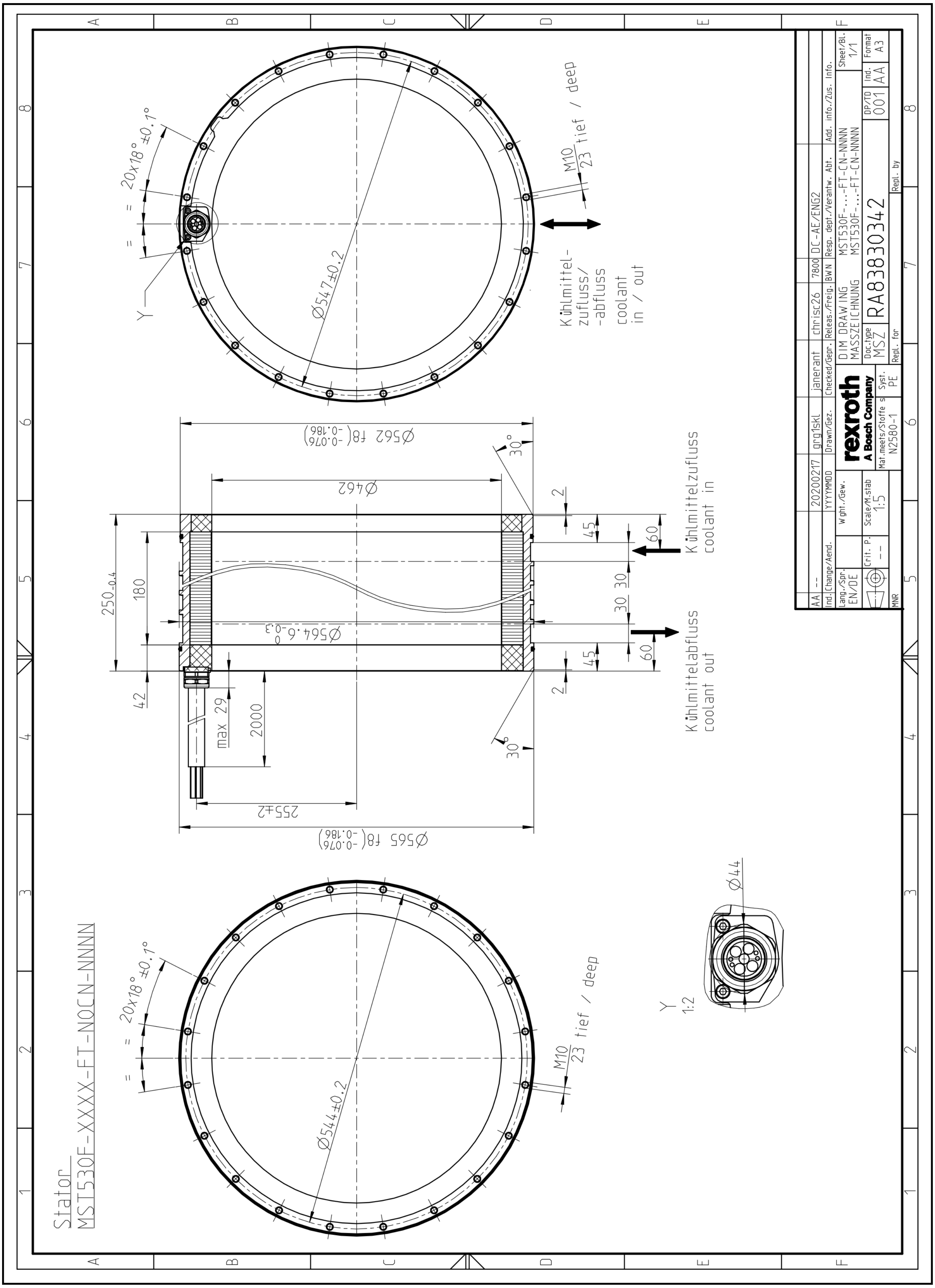


Fig. 5-92: MST530F, electrical connection "_CN-NNNN"

5.12.15 Stator MST530B/ -C, electrical connection "_RN-NNNN"

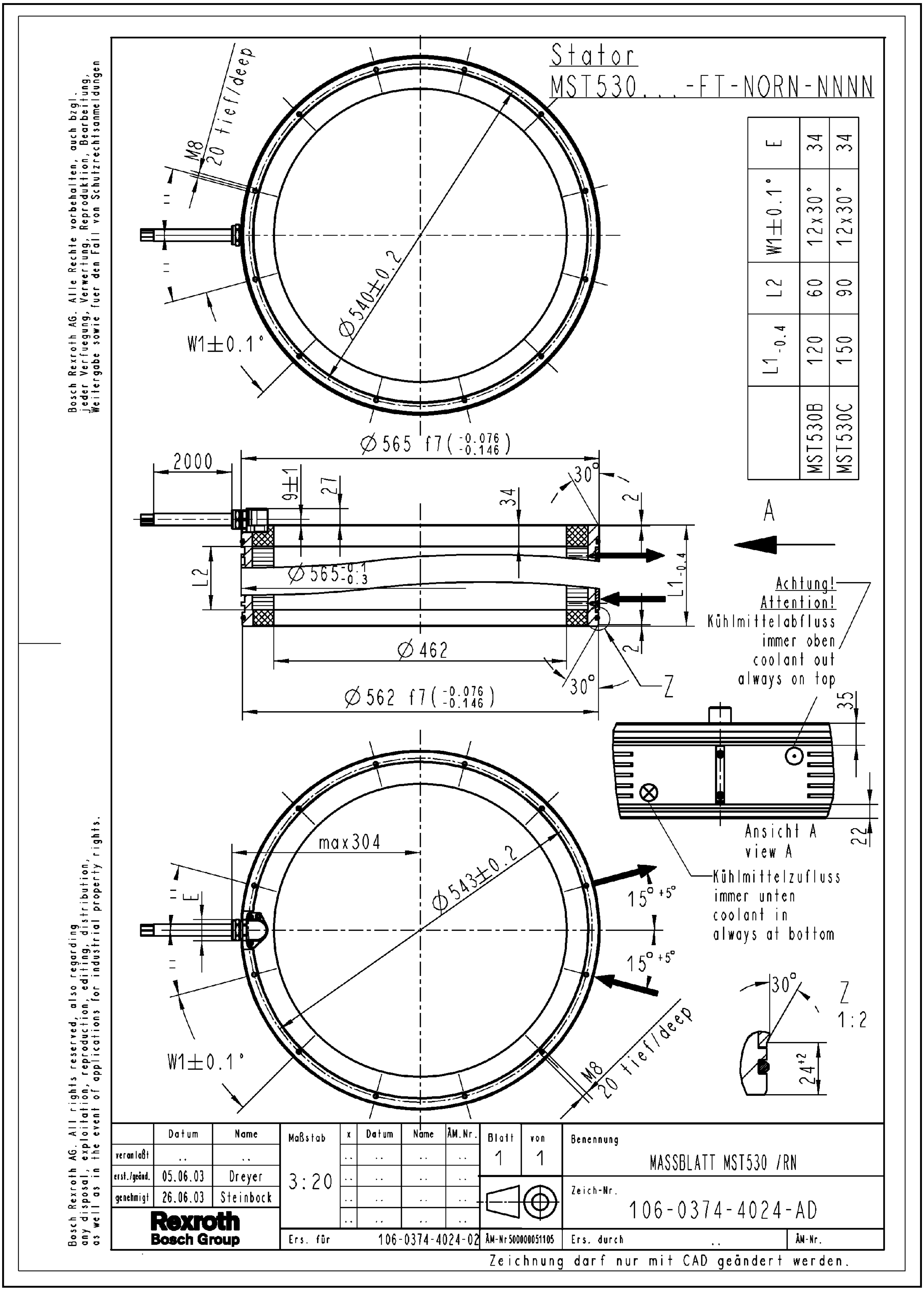


Fig. 5-93: MST530B/ -C, electrical connection "_RN-NNNN"

5.12.16 Stator MST530B/ -C/ -D/ -E, "-FH-_KR-NNNN" design

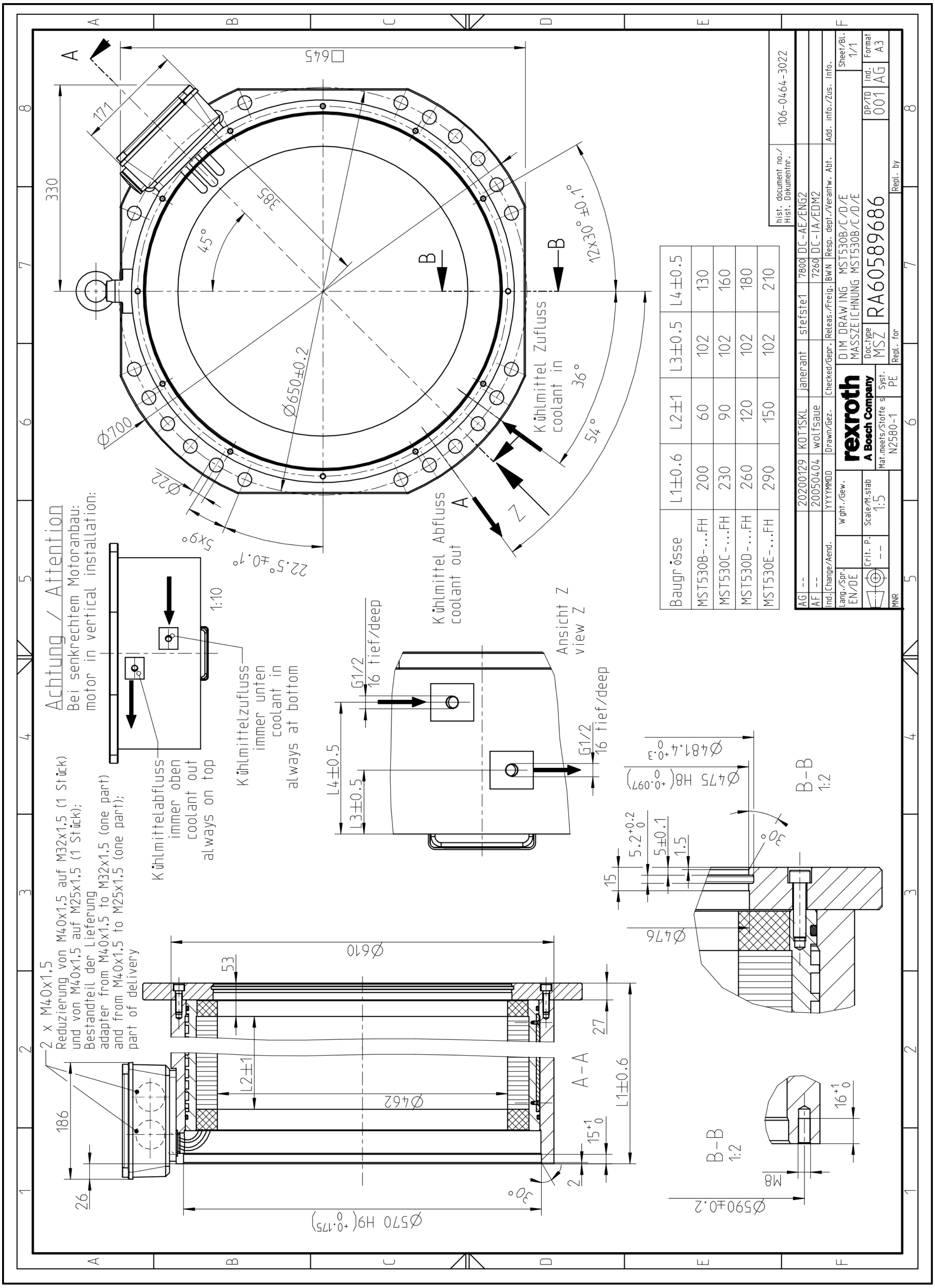


Fig. 5-94: *MST530B/ -C/ -D/ -E, design "-FH-_KR-NNNN"*

5.12.17 Stator MST530C in cooling mode ”NS”

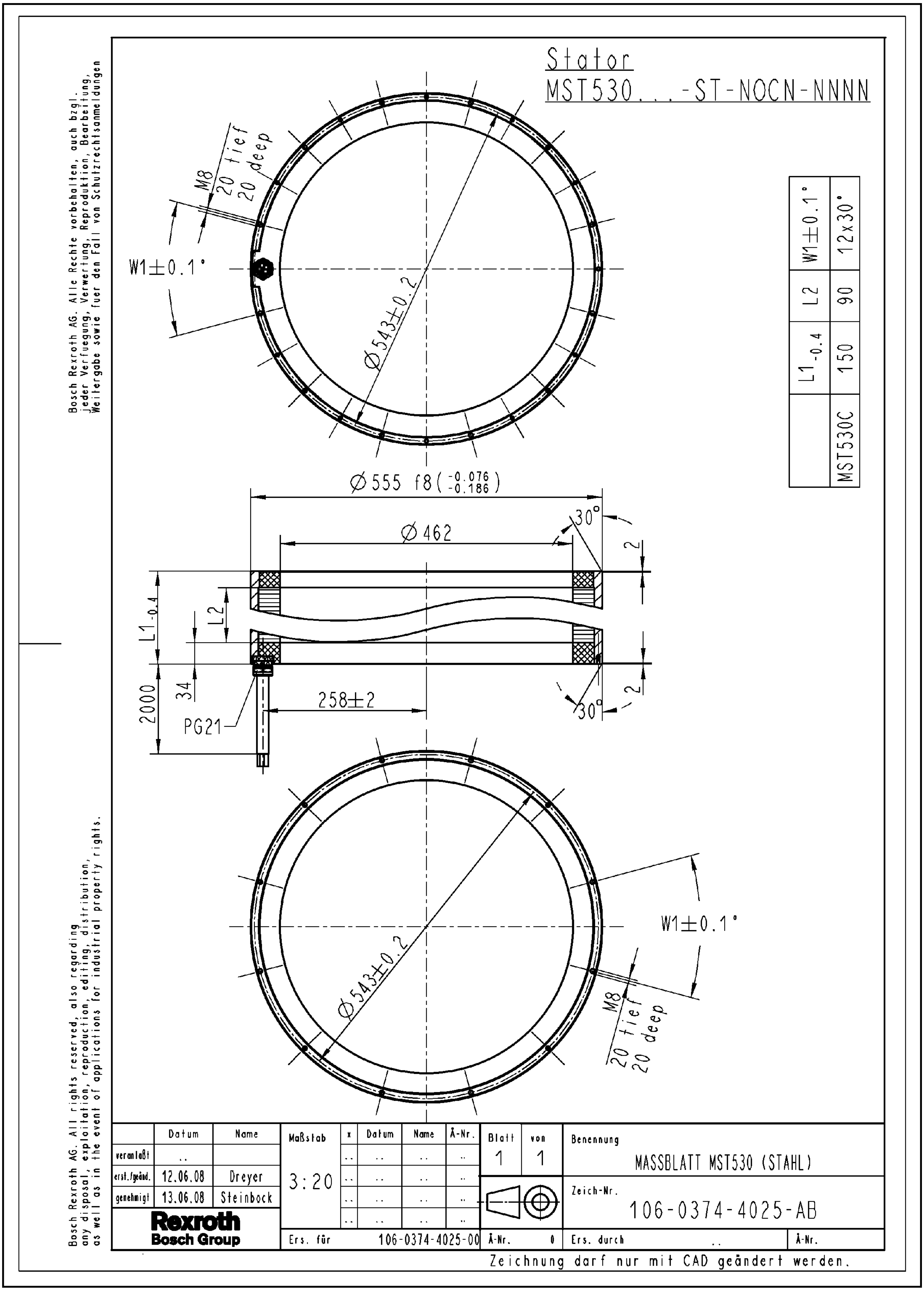


Fig. 5-95: MST530C in cooling mode ”NS”

5.12.18 Stator MST530F, electrical connection "_CN-D303"

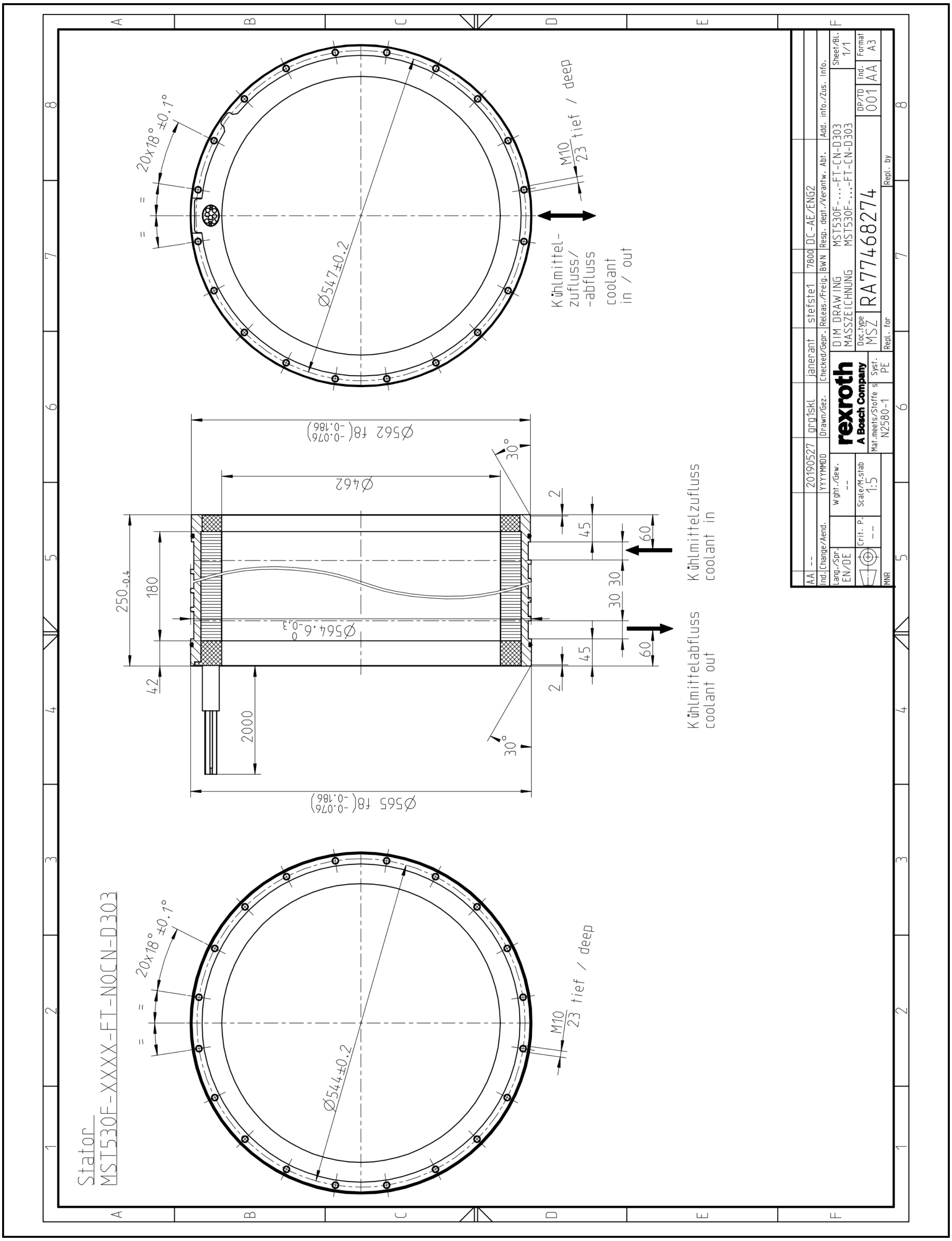


Fig. 5-96: MST530F, electrical connection "_CN-D303"

5.12.19 Stator MST530F/ -P/ -R, electrical connection "-_KR-NNNN"

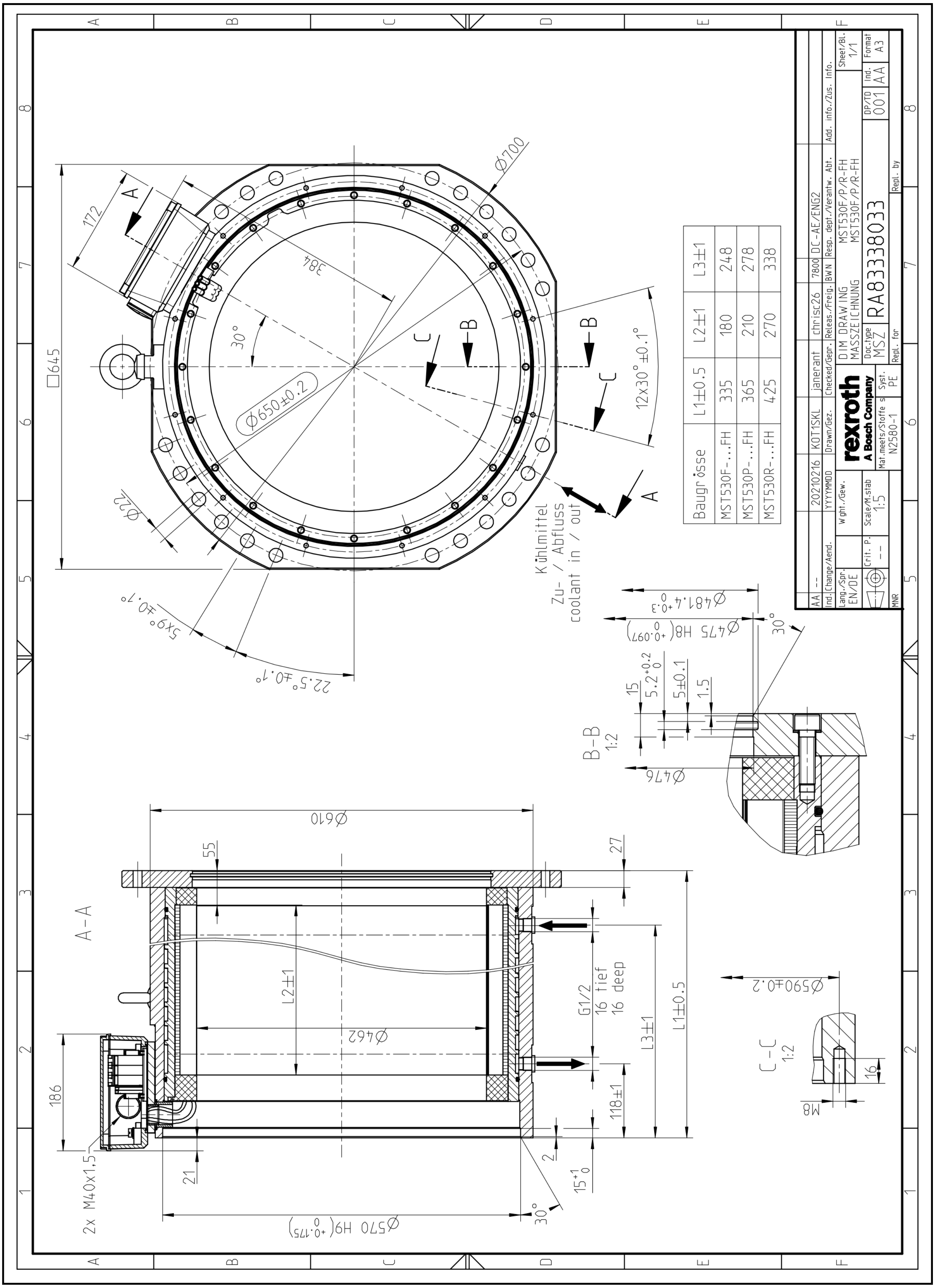


Fig. 5-97: MST530F/ -P/ -R, electrical connection "-_KR-NNNN"

5.12.20 Stator MST530P/ -R, electrical connection "_CN-D303"

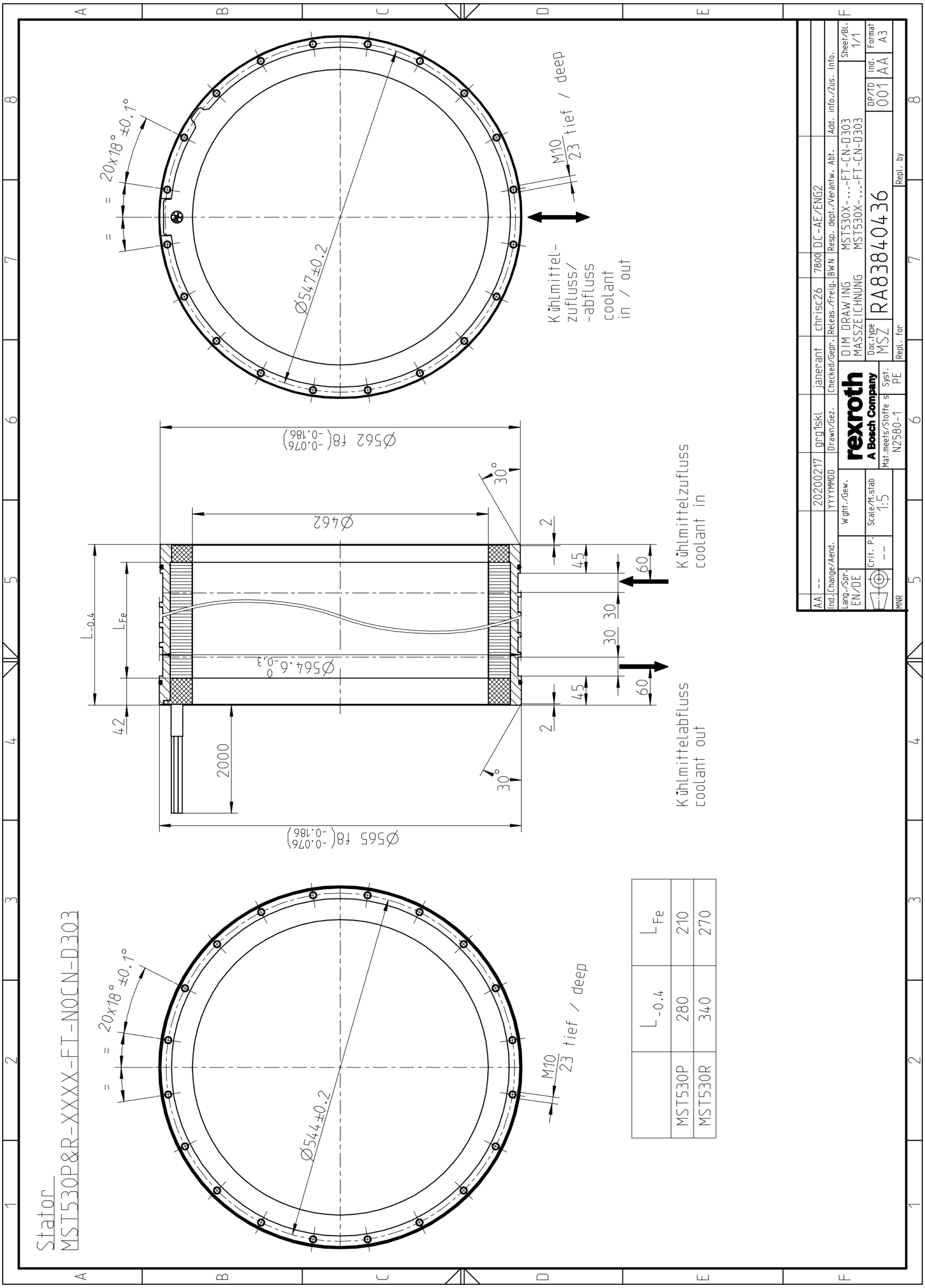


Fig. 5-98: MST530P/ -R, electrical connection "_CN-D303"

5.12.21 Stator MST530G/ -L, electrical connection "_SN-D303"

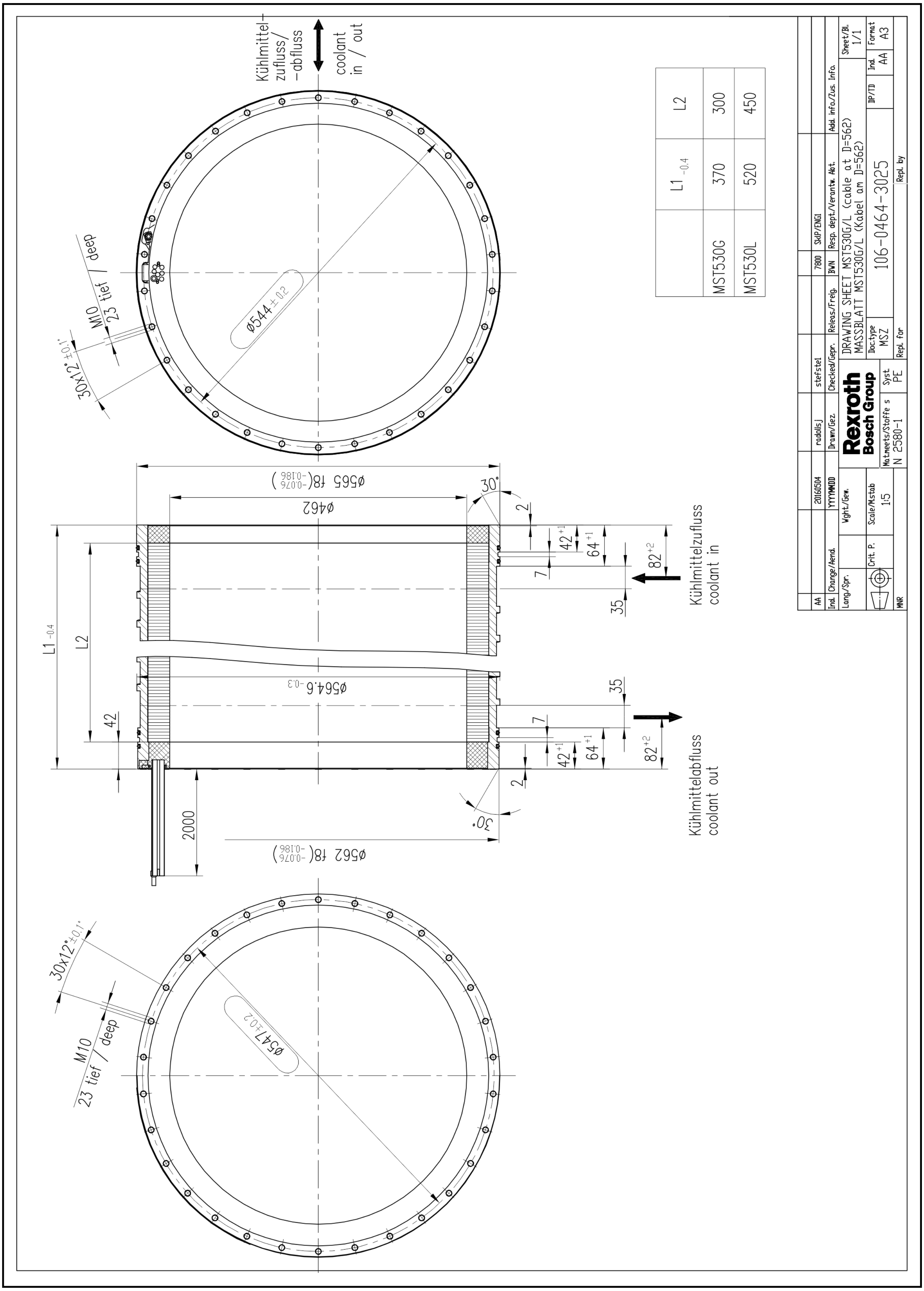


Fig. 5-99: MST530G/ -L, electrical connection "_SN-D303"

5.12.22 Stator MST530G/ -L, electrical connection "_CN-D303"

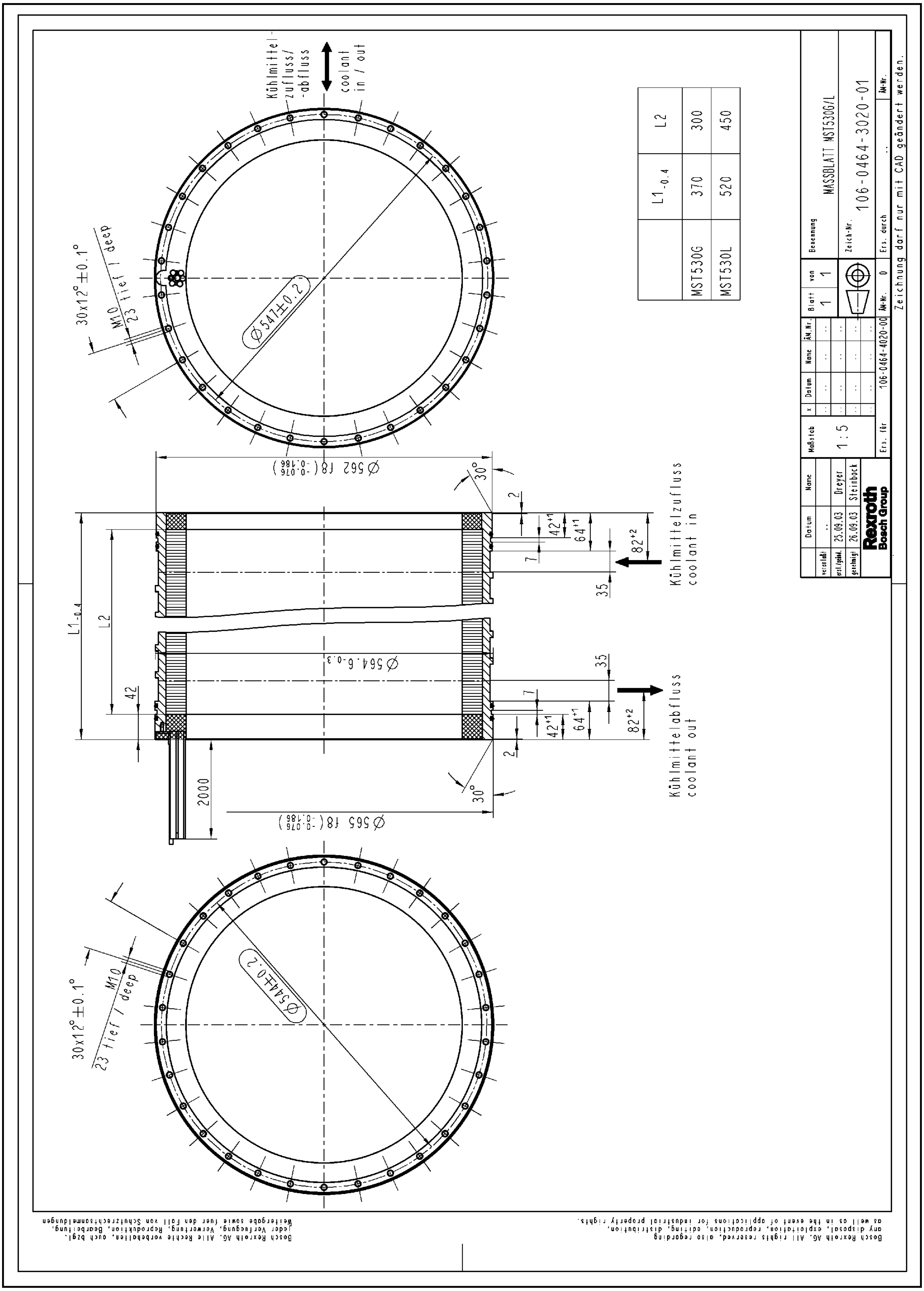


Fig. 5-100: MST530G/ -L, electrical connection "_CN-D303"

5.12.23 Stator MST530G/ -L, electrical connection "-_KR-NNNN"

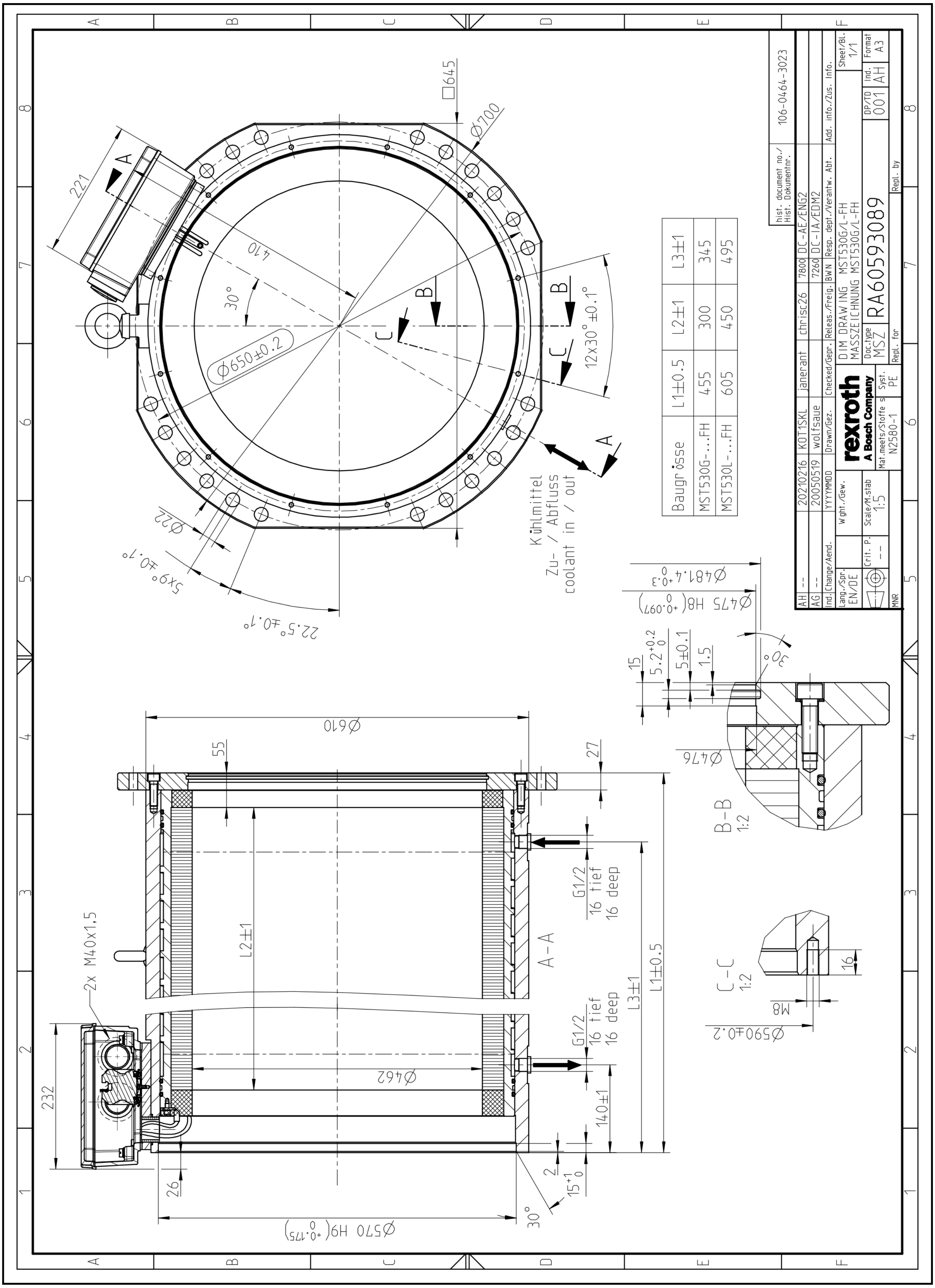


Fig. 5-101: MST530G/ -L with housing (design "FH")

5.13 Dimension sheets 531

5.13.1 MBT531E with electrical connection "-_CN-D303"

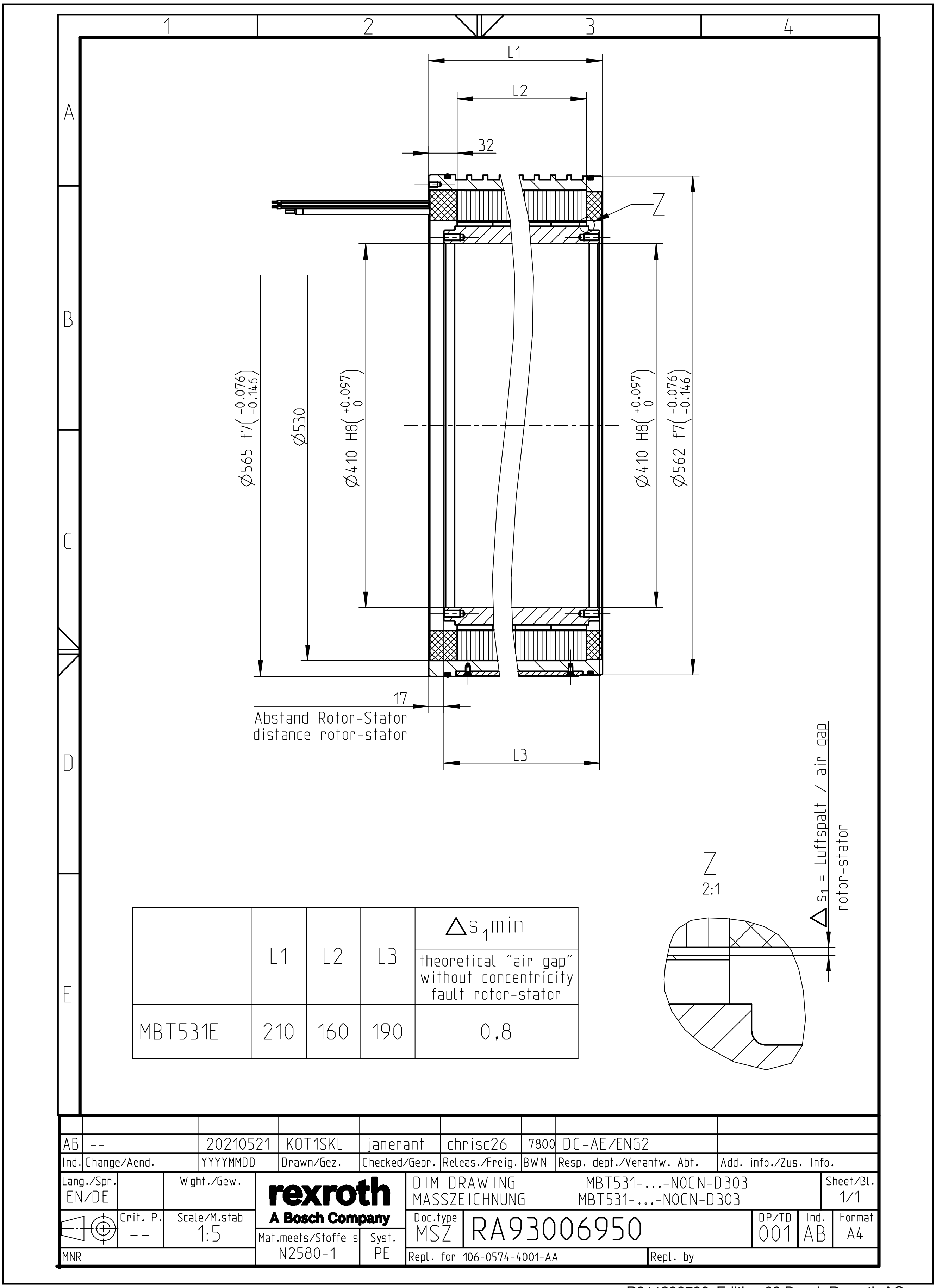
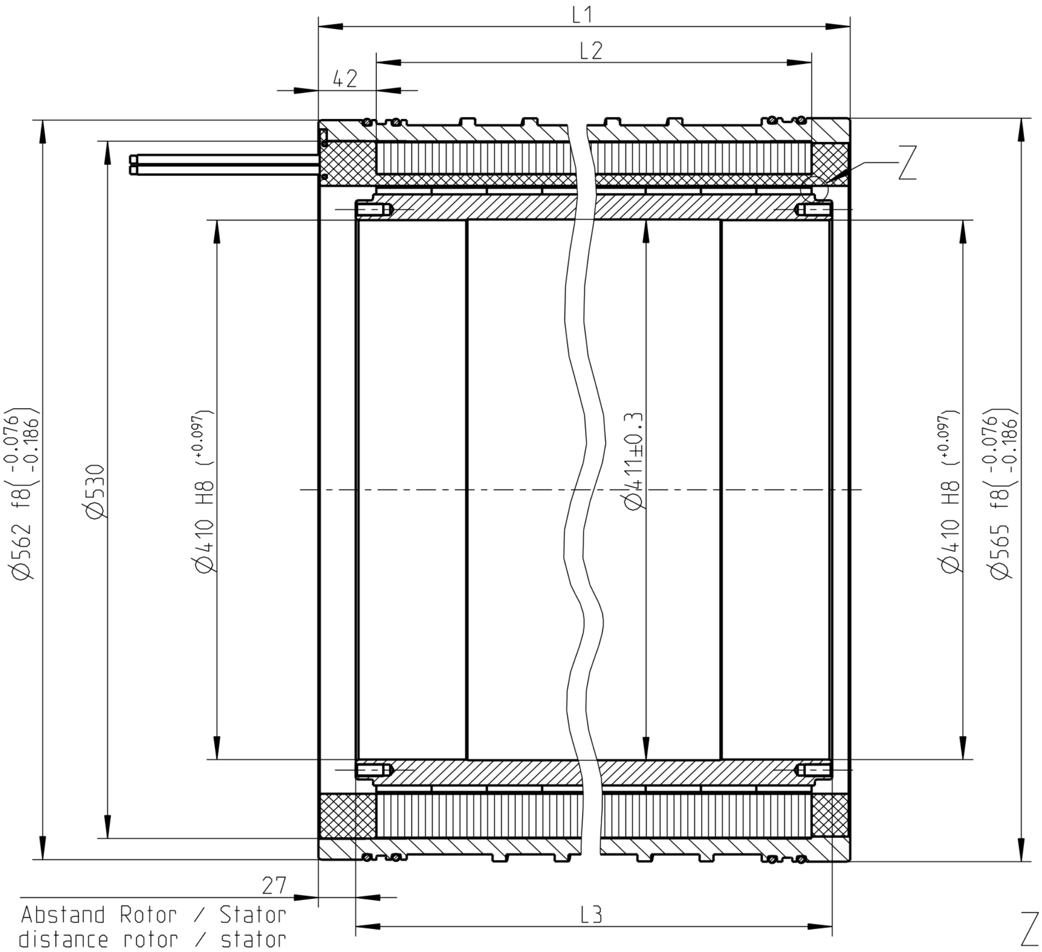
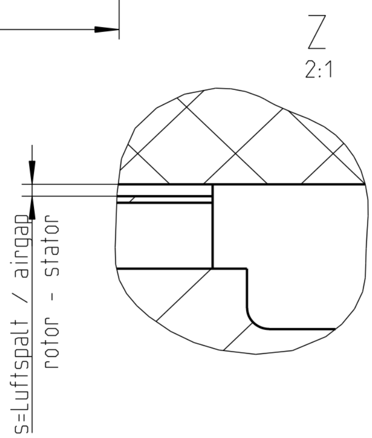


Fig. 5-102: MBT531E with electrical connection "-_CN-D303"

5.13.2 MBT531L with electrical connection "-_SN-D303"





	L1	L2	L3	Δ s1min theoretical ''airgap'' without concentricity fault rotor-stator
MBT531L	550	480	510	0.8

Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.
AB		20130902	tomajele			7800		

Lang./Spr. EN/DE | Wght./Gew. | Rexroth Bosch Group | DIM DRAWING MASSZEICHNUNG | MBT531L...NOSN-D303 MBT531L...NOSN-D303 | Sheet/Bl. 1/1

Crit. P. -- | Scale/M.stab 1:5 | Doc.type MSZ | 106-0574-4019 | DP/TD | Ind. AB | Format A4

MNR | Mat.meets/Stoffe s N 2580-1 | Syst. PE | Repl. for | Repl. by

 Fig. 5-103: MBT531L with electrical connection "-_SN-D303"

5.13.3 Rotor MRT531E

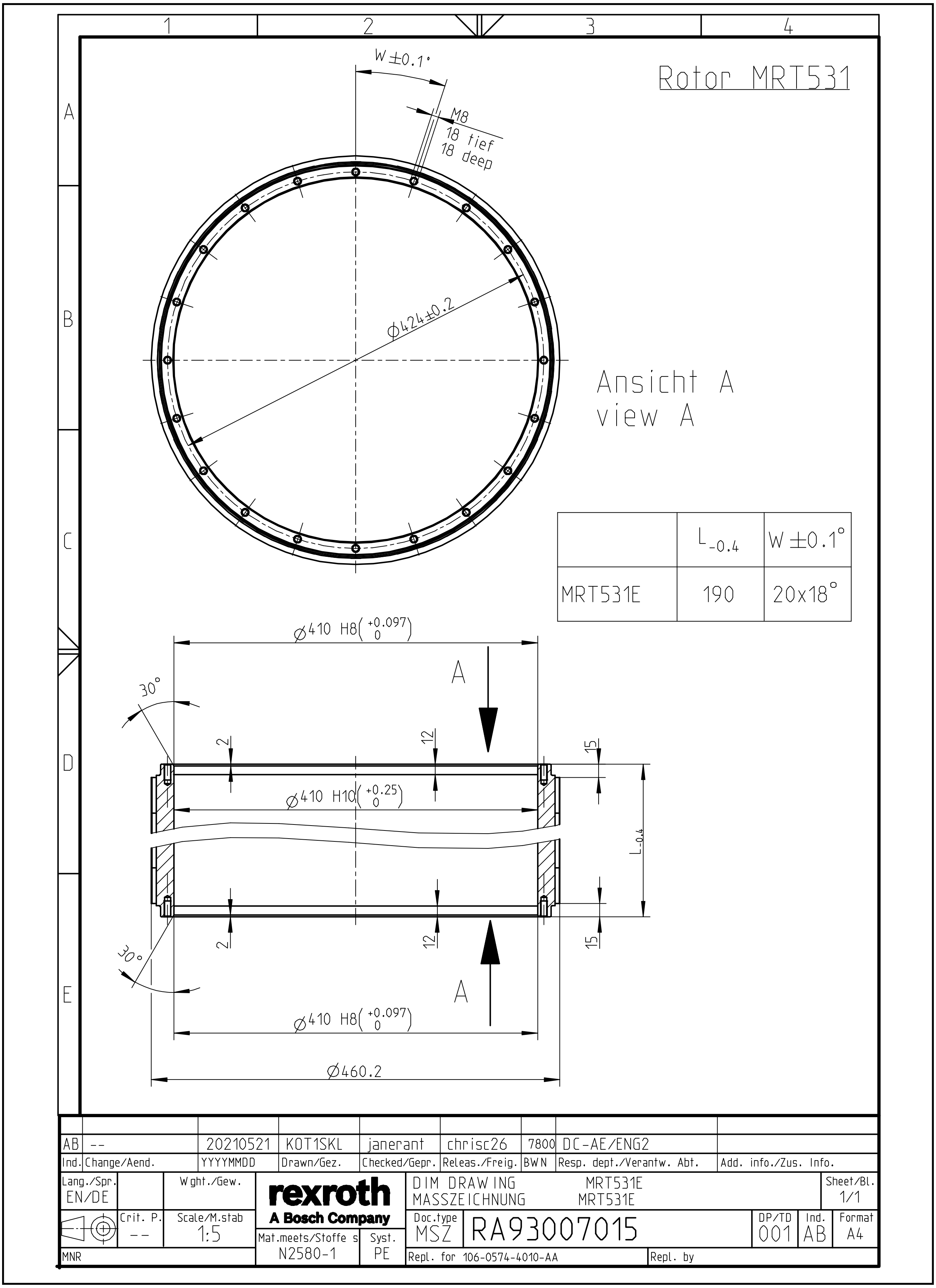


Fig. 5-104: MRT531E

5.13.4 Rotor MRT531L

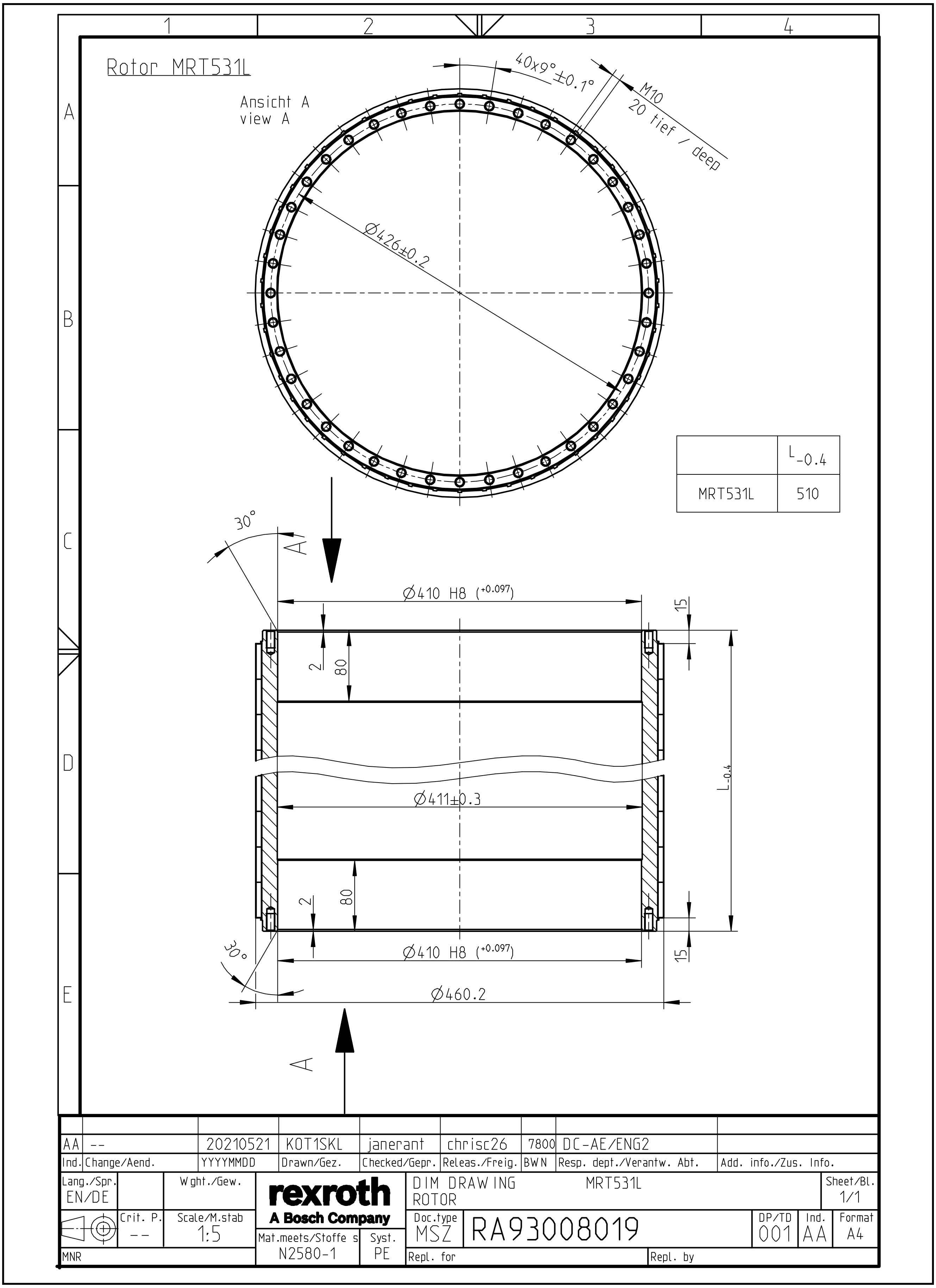


Fig. 5-105: MRT531L

5.13.5 Stator MST531E, electrical connection "-_CN-D303"

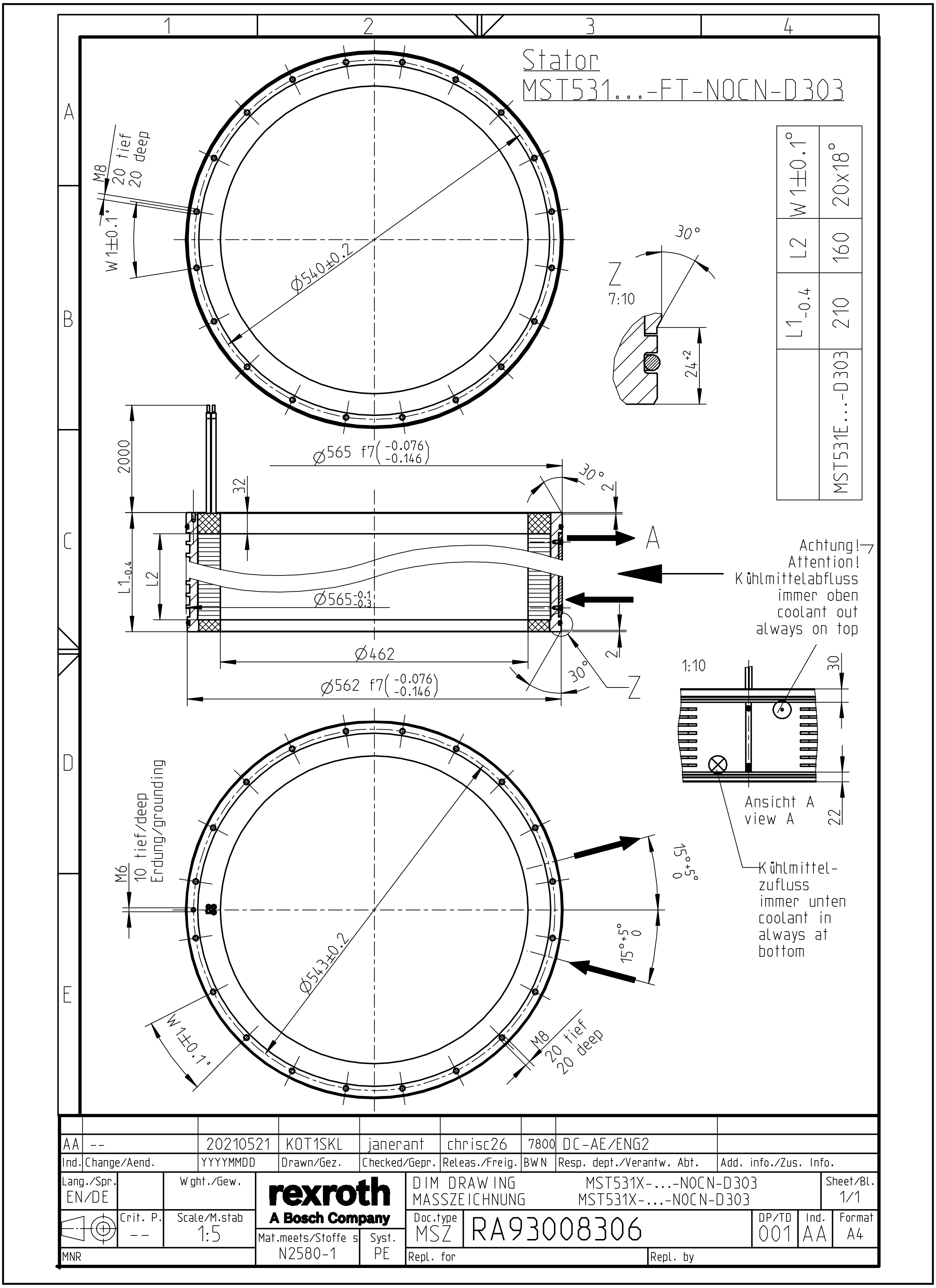


Fig. 5-106: MST531E, electrical connection "-_CN-D303"

5.13.6 MST531L, electrical connection "-_SN-D303"

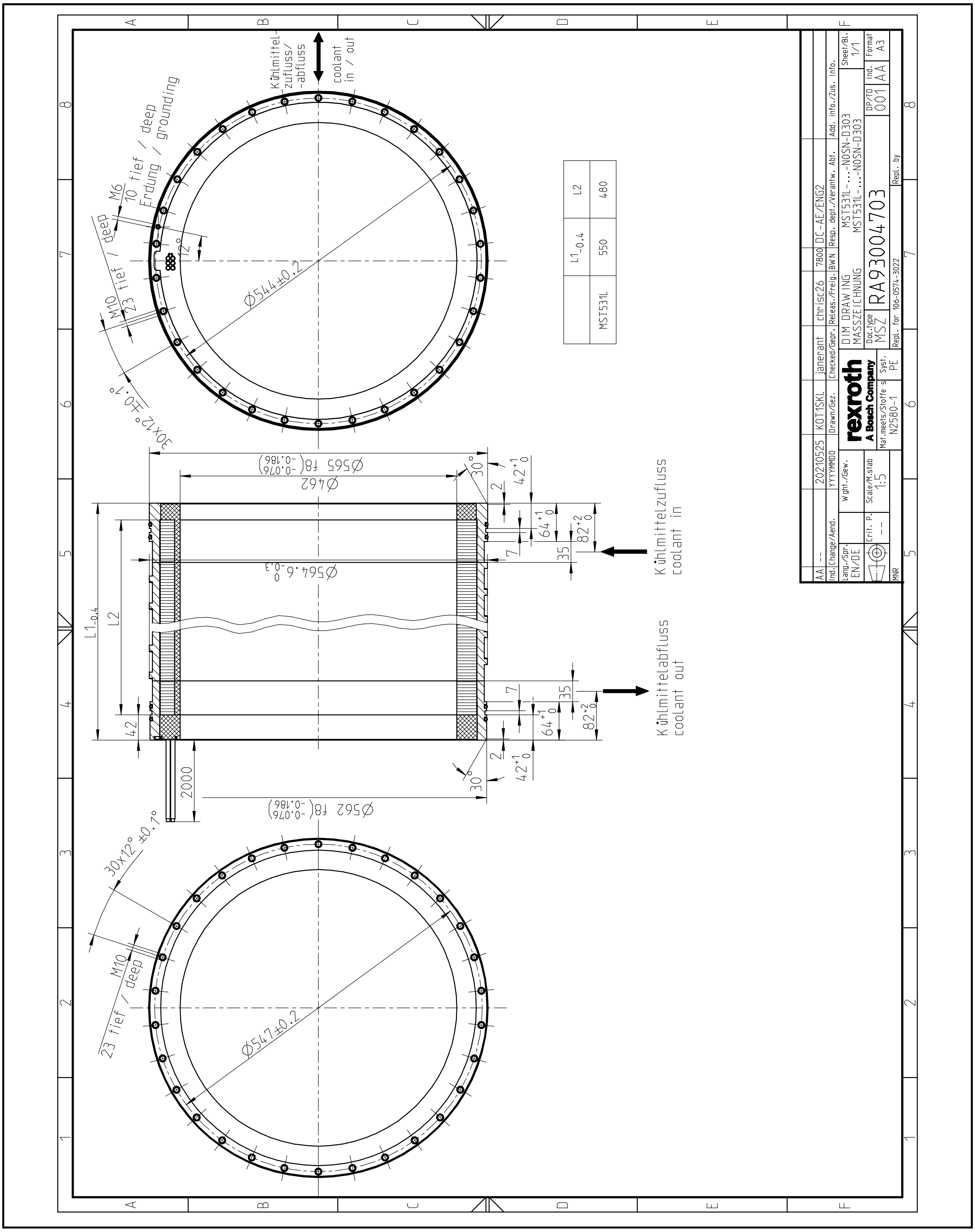


Fig. 5-107: MST531L, electrical connection "-_SN-D303"

6 Product identification

6.1 Type codes

6.1.1 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.

The torque motors MBT of Rexroth consist of the components "stator" and "rotor". The type code is divided into “Type code stator MST..." and “Type code rotor MRT...".

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.

6.1.2 Type code stator MST

Product

Example: **MST**□□□□-□□□□-□□-□□□□-□□□□

MST is the designation of the stator of a torque motor of the MBT series.

Frame size

Example: MST**360**□-□□□□-□□-□□□□-□□□□

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

Frame length

Example: MST360**B**-□□□□-□□-□□□□-□□□□

Within a series, increasing stator frame length is graded by means of code letters. The torque increases with increasing frame length while the nominal velocity decreases. Frame lengths are e.g. A, B, C, ...

Winding

Example: MST360B-**0018**-□□-□□□□-□□□□

The four-digit numerical sequence indicates the rated speed which applies to the respective winding variant.

Example: Winding "0018" stands for a rated velocity n_N = 180 min^{-1}. The reference value is a DC bus voltage of 540 V_{DC}.

Cooling type

Example: MST360B-0018-**F**□-□□□□-□□□□

Option	Design	Detail
F	Water cooling	Default cooling type. Operation of motors with cooling type "F" without water cooling is permitted under certain conditions. In this case, however, reduced performance data is generally applicable. For more information, please refer to chapter 9.7.8 "Operation without liquid cooling" on page 276.
N	Self-cooling	Only applicable to MST130 / 450 / 530.

Tab. 6-1: MST - Cooling types

Frame size / Enclosure

Example: MST360B-0018-FT-□□□□-□□□□

Option	Design	Detail
S	Standard encapsula-tion	This option is available for MST130 (only in con-nection with cooling type "natural convection"). In case of standard encapulation, the stator package is installed in the machine housing without cooling jacket.
T	Thermal encapsula-tion	This type of encapulation consists of an aluminum cooling jacket and ensures thermal decoupling of the motor from the machine.
H	Aluminum cooling jacket in the housing	In this case, the stator features an aluminum cool-ing jacket for liquid cooling, which is enclosed by a aluminum housing.

Tab. 6-2: MST encapsulation

Sensors

Example: MST360B-0018-FT-**N0**□□-□□□□

MBT motors are provided without motor encoder. For information on how to select the motor encoder, please refer to chapter 9.10.1 "Motor encoder" on page 282.

Electrical connection

Depending on the installation within the machine, the connection cables can either be lead out axially on the stator side with the larger or smaller diameter or radially on the stator side with the larger diameter.

If stators with a housing, frame sizes 360, 450 and 530 are electrically con-nected via a terminal box. Frame sizes 210 and 290 feature a rotary connec-tor.

For more information, please refer to chapter 8 "Connection technique" on page 237.

Example: MST360B-0018-FT-N0**CN**-□□□□

Option	Description
CN	Frame size 130...161: Axial connection cable (same outer diameter on both sides) Frame size 201...531: Axial connection cable at stator side with bigger outer diameter
KR	Terminal boxes with cable output at the right side.
RN	Connection cables coming out radially on stator side with larger outside diameter.
SN	Axial connection cables on stator side with smaller outside diameter.
PU	Power connection by means of device connector (only available for MST210 and MST290).

Tab. 6-3: MST - Electrical connection

Other designs

Example: MST360B-0018-FT-N0CN-**NNNN**

Option	Description
NNNN	Standard version
D301	A brief description of these options can be found in the appropriate type code, mechanical details are listed in the respective dimension sheet.
D302	
D303	

Tab. 6-4: MST - Other designs

Note

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.

6.1.3 Type code rotor MRT

Product

Example: **MRT**□□□-□□-□□□□-□□□□

MRT is the designation of the rotor of a torque motor of the MBT series.

Frame size

Example: MRT**360**□-□□-□□□□-□□□□

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

Frame length

Example: MRT360**B**-□□-□□□□-□□□□

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

Design

Example: MRT360B-**3N**-□□□□-□□□□

3N marks the fastening of the rotor by screws.

Inside rotor diameter

Example: MRT360B-3N-**0260**-□□□□

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

Other designs

Example: MRT360B-3N-0260-**NNNN**

Option	Description
NNNN	Standard version

Tab. 6-5: MRT - Other designs

Note

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.

6.1.4 Stator MST130

Type short description	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	S	T	1	3	0	C	-	0	0	5	0	-	F	T	-	N	0	C	N	-	N	N	N	N															

DCCS-40013-130_TCO_N_EN_2021-05-03

01 Product
MST .... = MST

02 Size a)
130 ....= 130

03 Length a)
Length........................ = A, C, E, G

04 Winding a)
MST130A.......... = 0200, 0250
MST130C .... = 0050, 0075, 0200, 0300
MST130E.......... = 0020, 0035
MST130G .... = 0035, 0100

05 Cooling mode a)
Water cooling.. = F
Self cooling.. = N

06 Encapsulation a)
Open aluminium cooling jacket............................= T
Steel jacket..= S

07 Sensoric
KTY84-130 + SNM-150 DK .... = N0

08 Electrical connection a)
Axial (same outer diameter)..= CN

09 Other design a)
None.. = NNNN
Stranded wires axial without cable gland.................................. = D303

Note:
a) Available combinations

	Length	Winding	Cooling mode	Encapsulation b)	Electrical connection	Other design	
					CN	NNNN	D303
Water cooling	A	0200	F	T	+	+	+
	C	0050	F	T	+	+	+
	C	0200	F	T	+	+	+
	E	0020	F	T	+	+	+
	G	0100	F	T	+	-	+
Self cooling	A	0250	N	S	+	-	+
	C	0075	N	S	+	-	+
	C	0300	N	S	+	-	+
	E	0035	N	S	+	-	+
	G	0035	N	S	+	-	+

+	available
-	not available

Fig. 6-1: Type code of stator MST130

6.1.5 Rotor MRT130

Abbreviation column	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	T	1	3	0	A	-	3	N	-	0	0	6	0	-	N	N	N	N																				

Product
MRT....................... = MRT

Series
130 .... = 130

Frame lengths
Frame lengths................... = A, C, E, G

Design / mechanical design
Screw fastening ....= 3N

Rotor internal diameter
60 mm.. = 0060

Other design
None ....= NNNN

ZN 40014-130: 2012-10-22

Fig. 6-2: Type code of rotor MRT130

6.1.6 Stator MST160

Type short description	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	S	T	1	6	0	C	-	0	0	5	0	-	F	T	-	N	0	C	N	-	N	N	N	N															

01 **Product**

MST .... = MST

02 **Size** a)

160................................ = 160

03 **Length** a)

Length...............................= A, C, E

04 **Winding** a)

MST160A............................... = 0050
MST160C .... = 0050
MST160E............................... = 0027, 0050

05 **Cooling mode** a)

Water cooling...= F

06 **Encapsulation** a)

Open aluminium cooling jacket .... = T

07 **Sensoric**

KTY84-130 + SNM 150.DK ....= N0

08 **Electrical connection** a)

Axial (same outer diameter) .... = CN

09 **Other design** a)

None .... = NNNN
Stranded wires axial without cable gland .... = D303

DCCS-40013-160_TCO_N_EN_2021-05-04

Note:

a) Available standard options:

Length	Winding	Cooling mode	Encapsulation	Electrical connection	Other design	
				CN	NNNN	D303
A	0050	F	T	+	+	+
C	0050	F	T	+	+	+
E	0027	F	T	+	+	+
E	0050	F	T	+	+	+

+	available
-	not available

Fig. 6-3: Type code of MST160

6.1.7 Rotor MRT160

Abbreviation column	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	T	1	6	0	A	-	3	N	-	0	0	8	0	-	N	N	N	N																				

Product
MRT....................... = MRT

Frame size
160 .... = 160

Frame lengths
Frame lengths......................= A, C, E

Design / mechanical design
Screw fastening .... = 3N

Rotor internal diameter
80 mm... = 0080

Other design
None .... = NNNN

RNC-41251-601: 2003-10-20

Fig. 6-4: Type code of rotor MRT160

6.1.8 Stator MST161

Type short description	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	S	T	1	6	1	E	-	0	0	5	0	-	F	T	-	N	0	C	N	-	D	3	0	3															

DCCS-40013-161_TCO_N_EN_2021-05-04

01 **Product**

MST................ = MST

02 **Size** a)

161 ....= 161

03 **Length** a)

Length ....= C, E, G

04 **Winding** a)

MST161C ....= 0140

MST161E ....= 0050, 0140

MST161G ....= 0100

05 **Cooling mode** a)

Water cooling.. = F

06 **Encapsulation** a)

Open aluminium cooling jacket............................= T

07 **Sensoric**

KTY 84-130 + SNM-150DK ....= N0

08 **Electrical connection** a)

Axial (same outer diameter)... = CN

09 **Other design** a)

Stranded wires axial without cable gland.................................. = D303

None... = NNNN

Note:

a) Available standard options:

Length	Winding	Cooling mode	Encapsulation	Electrical connection	Other design	
				CN	NNNN	D303
C	0140	F	T	+	+	+
E	0050	F	T	+	+	+
E	0140	F	T	+	-	+
G	0100	F	T	+	-	+

+	available
-	not available

Fig. 6-5: Type code of stator MST161

6.1.9 Rotor MRT161

Type short designation	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	T	1	6	1	E	-	3	N	-	0	0	8	0	-	N	N	N	N																				

01 **Product**

MRT .... = MRT

02 **Frame size**

161 .... = 161

03 **Frame lengths**

Frame lengths .... = C, E, G

04 **Design / mech. design**

Fastening by screws .... = 3N

05 **Rotor internal diameter**

80 mm .... = 0080

06 **Other design**

None .... = NNNN

DCCS-40014-161_TCO_N_DE_2020-01-13

Fig. 6-6: Type code of rotor MRT161

6.1.10 Stator MST201

Type short description										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	T	2	0	1	C	-	0	0	1	0	-	F	T	-	N	0	C	N	-	D	3	0	3															

01 Product
MST................ = MST

02 Size a)
201 ....= 201

03 Length a)
Length .... = C, D, F

04 Winding a)
MST201C ....= 0010, 0027
MST201D ....= 0010, 0027
MST201F.............................= 0075

05 Cooling mode a)
Water cooling.. = F

06 Encapsulation a)
Open aluminium cooling jacket...........................= T

07 Sensoric
KTY 84-130 + SNM-150DK .... = N0

08 Electrical connection a)
Axial on larger side with a larger
outer diameter .... = CN

09 Other design a)
Stranded wires axial without cable gland.................................. = D303
None.. = NNNN

DCCS-40013-201_TCO_N_EN_2021-05-04

Note:
a) Available standard options:

Length	Winding	Cooling mode	Encapsulation	Electrical connection	Other design	
				CN	NNNN	D303
C	0010	F	T	+	-	+
C	0027	F	T	+	-	+
D	0010	F	T	+	-	+
D	0027	F	T	+	-	+
F	0075	F	T	+	+	-

+	available
-	not available

Fig. 6-7: Type code MST201

6.1.11 Rotor MRT201

Type short designation	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	T	2	0	1	D	-	3	N	-	0	1	1	0	-	N	N	N	N																				

01 Product
MRT .... = MRT

02 Frame size
201 .... = 201

03 Frame lengths
Frame lengths .... = C, D, F

04 Design/ mech. design
Fastening by screws .... = 3N

05 Rotor internal diameter
110 mm .... = 0110

06 Other design
None .... = NNNN

DCCS-40014-201_TCO_N_DE_2018-11-12

Fig. 6-8: Type code of rotor MRT201

6.1.12 Stator MST210

Type short description	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	S	T	2	1	0	C	-	0	0	5	0	-	F	T	-	N	0	C	N	-	N	N	N	N															

01 **Product**

MST....................= MST

02 **Size** a)

210...............................= 210

03 **Length** a)

Length.....................= A, C, D, E, U

04 **Winding** a)

MST210A............................ = 0027
MST210C .... = 0027, 0050
MST210D .... = 0070
MST210E............................ = 0027
MST210U .... = 0030

05 **Cooling mode** a)

Water cooling ....= F

06 **Encapsulation** a)

Open aluminium cooling jacket .... = T b)
Closed aluminium cooling jacket
(incl. housing and flange) .... = H b)

07 **Sensoric**

KTY84-130 + SNM-150.DK...= N0

08 **Electrical connection** a)

Axial on stator side with larger outer diameter....................= CN
Axial on stator side with smaller outer diameter ....= SN c)
Radial on stator side with larger outer diameter..................= RN c)
Plug, rotatable ....= PU b)

09 **Other design** a)

Stranded wires radial without cable gland..................................= D301 d)
Stranded wires axial without cable gland...................................= D303 d)
None ....= NNNN

Note:

a) Available standard options:

Length	Winding	Cooling mode	Encapsulation b)	Electrical connection				Other design		
				PU b)	RN c)	SN c)	CN	NNNN	D303 d)	D301 d)
A	0027	F	T, H	+	+	+	+	+	+	+
C	0027	F	T, H	+	+	+	+	+	+	-
C	0050	F	T, H	+	+	+	+	+	+	-
D	0070	F	T, H	+	+	+	+	+	+	+
E	0027	F	T, H	+	+	+	+	+	+	-
U	0030	F	T	-	-	-	+	-	+	-

+	available
-	not available

b) Encapsulation "H" and Electrical connection "PU" only in combination as well as Cooling mode "F" and Other design "NNNN" available. Encapsulation "T" only available with Electrical connection "RN", "SN" and "CN"

c) Electrical connection "RN" and "SN" only with Other design "NNNN" available

d) Other design "D303" and “D301” only with electrical connection "CN" available

DCCS-40013-210_TCO_N_EN_2021-05-04

Fig. 6-9: Type code of stator MST210

6.1.13 Rotor MRT210

Type short designation	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	T	2	1	0	A	-	3	N	-	0	1	2	0	-	N	N	N	N																				

01 **Product**

MRT .... = MRT

02 **Frame size**

210 .... = 210

03 **Frame lengths**

Frame lengths ......= A, C, D, E, U

04 **Design/ mech. design**

Fastening by screws .... = 3N

05 **Rotor internal diameter**

120 mm .... = 120

06 **Other design**

None .... = NNNN

DCCS-40014-210_TCO_N_DE_2018-04-12

Fig. 6-10: Type code of rotor MRT210

6.1.14 Stator MST251

Type short description	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	S	T	2	5	1	F	-	0	0	4	0	-	F	T	-	N	0	C	N	-	D	3	0	3															

01 **Product**

MST................ = MST

02 **Size** a)

251 ....= 251

03 **Length** a)

Length .... = F

04 **Winding** a)

MST251F...................................... = 0040

05 **Cooling mode** a)

Water cooling...= F

06 **Encapsulation** a)

Open aluminium cooling jacket............................= T

07 **Sensoric**

KTY 84-130 + SNM-150DK .... = N0

08 **Electrical connection** a)

Axial on the larger side with a larger outer diameter .... = CN

09 **Other design** a)

Stranded wires axial without cable gland................................... = D303

DCCS-40013-251_TCO_N_EN_2021-05-04

Note:

a) Available standard options:

Length	Winding	Cooling mode	Encapsulation	Electrical connection	Other design
				CN	NNNN
F	0040	F	T	+	+

+	available
-	not available

Fig. 6-11: Type code of stator MST251

6.1.15 Rotor MRT251

Type short designation	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	T	2	5	1	F	-	3	N	-	0	1	4	5	-	N	N	N	N																				

01 **Product**
MRT .... = MRT

02 **Frame size**
251 ....= 251

03 **Frame length**
Frame length.......................... = F

04 **Design / mech. design**
Fastening by screws .... = 3N

05 **Rotor internal diameter**
145 mm .... = 0145

06 **Other design**
None ....= NNNN

DCCS-40014-251_TCO_N_DE_2018-11-12

Fig. 6-12: Type code of rotor MRT251

6.1.16 Stator MST290

Type short description (positions 1–40)

Example: M S T 2 9 0 E - 0 0 1 8 - F T - N 0 S N - N N N N

01 **Product**

MST.................. = MST

02 **Size** a)

290 ....= 290

03 **Length** a)

Lengths.................. = B, D, E, F, G

04 **Windings** a)

MST290B.................... = 0018
MST290D .... = 0002, 0004, 0018
MST290E.................... = 0004, 0018
MST290F.................... = 0020
MST290G .... = 0020

05 **Cooling mode** a)

Water cooling.. = F

06 **Encapsulation** a)

Open aluminium cooling jacket............................ = T b)
Closed aluminium cooling jacket
(incl. housing and flange)..................................... = H b)

07 **Sensoric**

KTY84-130 + SNM-150.DK ....= N0

08 **Electrical connection** a)

Axial on stator side with larger outer diameter...................= CN
Axial on stator side with smaller outer diameter.................= SN
Radial on stator side with larger outer diameter.................= RN
Connector, rotatable ....= PU b)

09 **Other design** a)

Stranded wires axial without cable gland...................................= D303
None..= NNNN

DCCS-40013-290_TCO_N_EN_2021-05-04

Hinweis:

a) Available standard options:

Length	Winding	Cooling mode	Encapsulation b)	Electrical connection				Other design	
				PU b)	RN	SN	CN	NNNN	D303
B	0018	F	T, H	+	+	+	+	+	-
D	0002	F	T, H	+	+	+	+	+	-
D	0004	F	T, H	+	+	+	+	+	-
D	0018	F	T, H	+	+	+	+	+	-
E	0004	F	T, H	+	+	+	+	+	-
E	0018	F	T, H	+	+	+	+	+	-
F	0020	F	T	-	-	+	+	-	+
G	0020	F	T	-	-	+	+	-	+

+	available
-	not available

b) Encapsulation "H" and Electrical connection "PU" only in combination as well as Cooling mode "F" and Other design "NNNN" available. Encapsulation "T" only available with Electrical connection "RN", "SN" and "CN"

Fig. 6-13: Type code of stator MST290

6.1.17 Rotor MRT290

Type short designation	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	T	2	9	0	E	-	3	N	-	0	2	0	0	-	N	N	N	N																				

01 **Product**
MRT.................. = MRT

02 **Frame size**
290 .... = 290

03 **Frame lengths**
Frame lengths ....= B, D, E, F, G

04 **Design / mechanical design**
Fastening by screws .... = 3N

05 **Rotor internal diameter**
200 mm .... = 0200

06 **Other design**
None .... = NNNN

DCCS-40014-290_TCO_N_DE_2018-04-18

Fig. 6-14: Type code of rotor MRT290

6.1.18 Stator MST291

Type short description	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	S	T	2	9	1	C	-	0	0	1	0	-	F	T	-	N	0	C	N	-	D	3	0	3															

01 **Product**
MST................ = MST

02 **Size** a)
291 ....= 291

03 **Length** a)
Length .... = C, D, E

04 **Winding** a)
MST291C .... = 0018
MST291D .... = 0010
MST291E .... = 0010

05 **Cooling mode** a)
Water cooling.. = F

06 **Encapsulation** a)
Open aluminium cooling jacket............................= T

07 **Sensoric**
KTY 84-130 + SNM-150DK .... = N0

08 **Electrical connection** a)
Axial larger outer side with a larger outer diameter .... = CN

09 **Other design** a)
Stranded wires axial without cable gland................................... = D303

Hinweis:
a) Available standard options:

Length	Winding	Cooling mode	Encapsulation	Electrical connection CN	Other design NNNN
C	0018	F	T	+	+
D	0010	F	T	+	+
E	0010	F	T	+	+

+	available
-	not available

DCCS-40013-291_TCO_N_EN_2021-05-04

Fig. 6-15: Type code of stator MST291

6.1.19 Rotor MRT291

Type short designation:	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	T	2	9	1	C	-	3	N	-	0	2	0	0	-	N	N	N	N																				

01 **Product**
- MRT .... = MRT

02 **Frame size**
- 291 .... = 291

03 **Frame lengths**
- Frame lengths .... = C, D, E

04 **Design / mech. design**
- Fastening by screws .... = 3N

05 **Rotor internal diameter**
- 200 mm .... = 0200

06 **Other design**
- None .... = NNNN

DCCS-40014-291_TCO_N_DE_2018-11-12

Note:

All features combined, are only available in the following motor variants:

```
MRT291C-3N-0200-NNNN
MRT291D-3N-0200-NNNN
MRT291E-3N-0200-NNNN
```

Fig. 6-16: Type code of rotor MRT291

6.1.20 Stator MST360

Type short description	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	S	T	3	6	0	B	-	0	0	1	8	-	F	T	-	N	0	C	N	-	N	N	N	N															

DCCS-40013-360_TCO_N_EN_2021-04-29

01 **Product**

MST.................. = MST

02 **Size**

360 ....= 360

03 **Length** a)

Lengths........................... = B, D, E

04 **Windings** a)

MST360B.................... = 0006, 0018

MST360D .... = 0009, 0012, 0018

MST360E.................... = 0008, 0018

05 **Cooling mode** a)

Water cooling... = F

06 **Encapsulation** a)

Open aluminium cooling jacket............................ = T b)

Closed aluminium cooling jacket
(incl. housing and flange).................................... = H b)

07 **Sensoric**

KTY84-130 + SNM-150.DK ....= N0

08 **Electrical connection** a)

Axial on stator side with larger outer diameter ....= CN

Axial on stator side with smaller outer diameter.................= SN c)

Radial on stator side with larger outer diameter.................= RN c)

Terminal box, connection right..= KR b)

09 **Other design** a)

Stranded wires axial without cable gland ....= D303 d)

None...= NNNN

Hinweis:

a) Available standard options:

Length	Winding	Cooling mode	Encapsulation b)	Electrical connection				Other design	
				KR b)	RN c)	SN c)	CN	NNNN	D303 d)
B	0006	F	T, H	+	+	+	+	+	+
B	0018	F	T, H	+	+	+	+	+	+
D	0009	F	T, H	+	+	+	+	+	+
D	0012	F	T, H	+	+	+	+	+	+
D	0018	F	T, H	+	+	+	+	+	+
E	0008	F	T, H	+	+	+	+	+	+
E	0018	F	T, H	+	-	+	+	+	+

+	available
-	not available

b) Encapsulation "H" and Electrical connection "KR" only in combination as well as Cooling mode "F" and Other design "NNNN" available. Encapsulation "T" only available with Electrical connection "RN", "SN" and "CN"

c) Electrical connection "RN" and "SN" only with Other design "NNNN" available

d) Other design "D303" only with electrical connection "CN" available

Fig. 6-17: Type code of stator MST360

6.1.21 Rotor MRT360

Abbreviation column	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	T	3	6	0	B	-	3	N	-	0	2	6	0	-	N	N	N	N																				

Product

MRT...................... = MRT

Frame size

360...................................... = 360

Frame lengths

Frame lengths .... = B, D, E

Design / mechanical design

Screw fastening.................................... = 3N

Rotor internal diameter

260 mm.. = 0260

Other design

None .... = NNNN

RNC-41253-601: 2002-09-20

Fig. 6-18: Type code of rotor MRT360

6.1.22 Stator MST450

Type short description	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	S	T	4	5	0	E	-	0	0	1	2	-	F	T	-	N	0	C	N	-	N	N	N	N															

DCCS-40013-450_TCO_N_EN_2021-04-20

01 Product

MST .... = MST

02 Size

450................................ = 450

03 Length a)

Lengths............................= B, D, E

04 Windings a)

MST450B.........= 0012

MST450D ....= 0006, 0012

MST450E.........= 0006, 0011, 0012, 0018

05 Cooling mode a)

Water cooling.. = F

Self cooling... = N d)

06 Encapsulation a)

Open aluminium cooling jacket ....= T b)

Closed aluminium cooling jacket (incl. housing and flange) ....= H b)

Steel jacket..= S

07 Sensoric

KTY84-130 + SNM-150.DK... = N0

08 Electrical connection a)

Axial on stator side with larger outer diameter................... = CN

Axial on stator side with smaller outer diameter................. = SN c)

Radial on stator side with larger outer diameter................. = RN c)

Terminal box, connection right.. = KR b)

09 Other design

None ....= NNNN

Stranded wires axial without cable gland ....= D303 d)

Hinweis:

a) Available standard options:

	Length	Winding	Cooling mode	Encapsulation b)	Electrical connection				Other design	
					KR b)	RN c)	SN c)	CN	NNNN	D303 d)
Water cooling	B	0012	F	T, H	+	+	+	+	+	+
	D	0006	F	T, H	+	+	+	+	+	+
	D	0012	F	T, H	+	+	+	+	+	+
	E	0006	F	T, H	+	+	+	+	+	+
	E	0012	F	T, H	+	-	+	+	+	+
Self cooling	E	0011	N	S	-	-	-	+	+	-
	E	0018	N	S	-	-	-	+	+	-

+	available
-	not available

b) Encapsulation "H" and Electrical connection "KR" only in combination as well as Cooling mode "F" and Other design "NNNN" available. Encapsulation "T" only available with Electrical connection "RN", "SN" and "CN"

c) Electrical connection "RN" and "SN" only with Other design "NNNN" available

d) Other design "D303" only with electrical connection "CN" available

Fig. 6-19: Type code of stator MST450

6.1.23 Rotor MRT450

Abbreviation column	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	T	4	5	0	B	-	3	N	-	0	3	5	0	-	N	N	N	N																				

Product
MRT....................... = MRT

Frame size
450....................................... = 450

Frame lengths
Frame lengths .... = B, D, E

Design / mechanical design
Screw fastening .... = 3N

Rotor internal diameter
350 mm... = 0350

Other design
None .... = NNNN

RNC-41254-501: 2002-09-23

Fig. 6-20: Type code of rotor MRT450

6.1.24 Stator MST530

Type short description	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	S	T	5	3	0	G	-	0	0	0	7	-	F	T	-	N	0	C	N	-	D	3	0	3															

01 Product
MST.....................= MST

02 Size
530....................................= 530

03 Length a)
Length.....................= B, C, D, E, F
Length.....................= P, R, G, L

04 Winding a)
30 min^{-1}.. = 0003
60 min^{-1}.. = 0006
70 min^{-1}.. = 0007
100 min^{-1}.. = 0010
110 min^{-1}.. = 0011
120 min^{-1}.. = 0012
140 min^{-1}.. = 0014

05 Cooling mode a)
Water cooling.. = F
Self cooling... = N

06 Encapsulation a)
Open aluminium cooling jacket ....= T b)
Closed aluminium cooling jacket
(incl. housing and flange). ....= H b)
Steel jacket...= S

07 Sensoric
KTY84-130 + SNM-150 DK... = N0

08 Electrical connection a)
Axial on stator side with larger outer diameter.................... = CN d)
Axial on stator side with smaller outer diameter.................. = SN d)
Radial on stator side with larger outer diameter.................. = RN c)
Terminal box with cable output to the right .... = KR b)

09 Other design a)
Stranded wires axial without cable gland..= D303 d)
None ....= NNNN c) e)

DCCS-40013-530_TCO_N_EN_2021-04-20

Fig. 6-21: Type code of stator MST530 (page 1/2)

Note:
a) Available Standard options

	Length	Winding	Cooling mode	Encapsulation[b)]	Electrical connection				Other design	
					KR[b)]	RN[c)]	SN	CN	NNNN	D303
Water cooling	B	0010	F	T, H	+	+	+	+	+	-
Water cooling	C	0010	F	T, H	+	+	+	+	+	-
Water cooling	C	0014	F	T, H	+	+	+	+	+	-
Water cooling	D	0012	F	T, H	+	-	+	+	+	-
Water cooling	E	0010	F	T, H	+	-	+	+	+	-
Water cooling	F	0012	F	T, H	+	-	-	+	+	-
Water cooling	P	0012	F	T, H	+[e)]	-	-	+[d)]	+	+
Water cooling	R	0011	F	T, H	+[e)]	-	-	+[d)]	+	+
Water cooling	G	0006	F	T, H	+[e)]	-	+[d)]	+[d)]	+	+
Water cooling	G	0007	F	T, H	+[e)]	-	-	+[d)]	+	+
Water cooling	G	0010	F	T, H	+[e)]	-	-	+[d)]	+	+
Water cooling	L	0003	F	T, H	+[e)]	-	-	+[d)]	+	+
Water cooling	L	0006	F	T, H	+[e)]	-	-	+[d)]	+	+
Water cooling	L	0007	F	T, H	+[e)]	-	-	+[d)]	+	+
Self cooling	C	0010	N	S	-	-	-	+	+	-

+	available
-	not available

b) Encapsulation "H" and Electrical connection "KR" only in combination as well as Cooling mode "F" and Other design "NNNN" available. Encapsulation "T" only available with Electrical connection "RN", "SN" and "CN"
c) Electrical connection "RN" only with Other design "NNNN" available
d) Length "P, R, G and L" only with other design "D303" available
e) Length "P, R, G and L" only with other design "NNNN" available

Fig. 6-22: Type code of stator MST530 (page 2/2)

6.1.25 Rotor MRT530

Type short description	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	T	5	3	0	B	-	3	N	-	0	4	1	0	-	N	N	N	N																				

01 **Product**
MRT................... = MRT

02 **Frame size**
530 .... = 530

03 **Frame lengths**
Frame lengths......... = B, D, C, E, F
Frame lengths .... = P, R, G, L

04 **Design / mechanical design**
Fastening by screws .... = 3N

05 **Rotor internal diameter**
410 mm .... = 410

06 **Other design**
None .... = NNNN

DCCS-40014-530_TCO_N_DE_2018-10-08

Fig. 6-23: Type code of rotor MRT530

6.1.26 Stator MST531

Type short description	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	S	T	5	3	1	L	-	0	0	0	9	-	F	T	-	N	0	S	N	-	D	3	0	3															

01 **Product**
MST.................. = MST

02 **Size**
531 .... = 531

03 **Length** a)
Length .... = E, L

04 **Winding** a)
MST531E....................................... = 0006
MST531E....................................... = 0018
MST531L....................................... = 0009

05 **Cooling mode** a)
Water cooling.. = F

06 **Encapsulation** a)
Open aluminium cooling jacket............................ = T

07 **Sensoric**
KTY84-130 + SNM-150 DK .... = N0

08 **Electrical connection** a)
Axial on larger outer side with larger
outer diameter ....= CN
Axial on stator with smaller
outer diameter ....= SN

09 **Other design** a)
Stranded wires axial without cable gland.................................. = D303

DCCS-40013-531_TCO_N_EN_2021-04-20

Note:
a) Available standard options:

Length	Winding	Cooling mode	Encapsulation b)	Electrical connection	Other design	
				CN	NNNN	D303
E	0006	F	T	-	+	+
E	0018	F	T	-	+	+
L	0009	F	T	+	-	+

+	available
-	not available

Fig. 6-24: Type code of stator MST531

6.1.27 Rotor MRT531

Type short designation	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	20	1	2	3	4	5	6	7	8	9	30	1	2	3	4	5	6	7	8	9	40
Example:	M	R	T	5	3	1	L	-	3	N	-	0	4	1	0	-	N	N	N	N																				

01 **Product**
MRT .... = MRT

02 **Frame size**
531 ....= 531

03 **Frame lengths**
Frame lengths .... = E, L

04 **Design / mech. design**
Fastening by screws...................... = 3N

05 **Rotor internal diameter**
410 mm .... = 0410

06 **Other design**
None ....= NNNN

DCCS-40014-531_TCO_N_DE_2018-11-13

Fig. 6-25: Type code of rotor MRT531

6.2 Identification

6.2.1 Motor component marking

Rotor and stator are each delivered with two type plates with peel-off foils for paint 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.

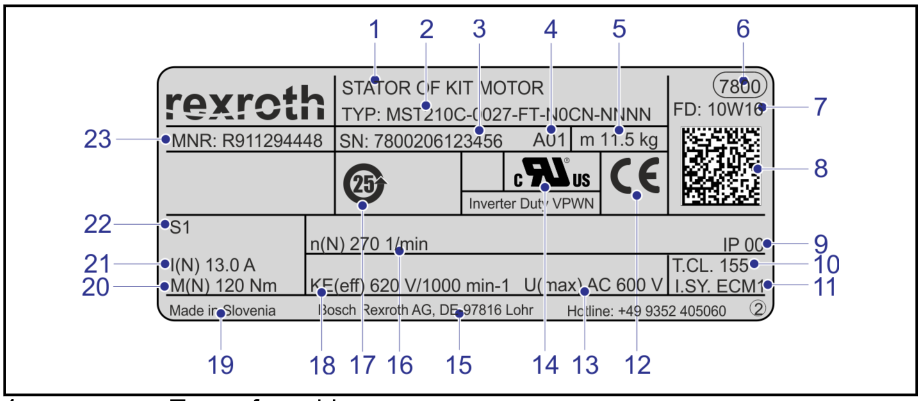
☞ Each Bosch Rexroth product can be unequivocally identified by the designation and the serial number. Before contacting Bosch Rexroth, always specify the full type designations and serial numbers of the products involved.

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.

6.2.2 Type plate stator

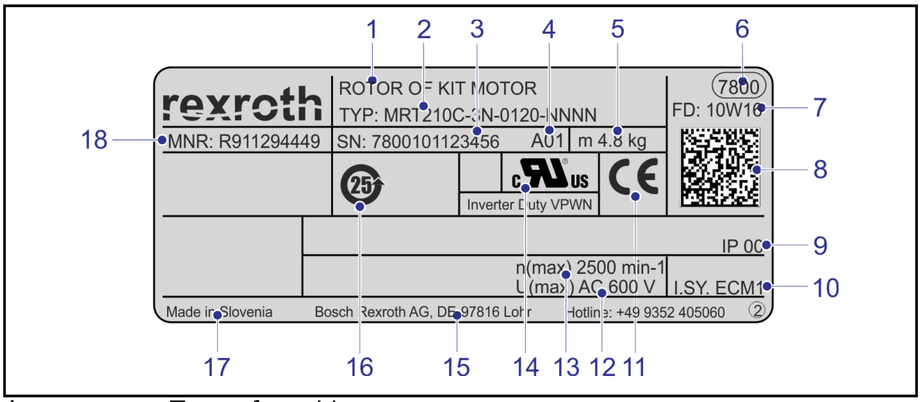
An individual type plate with the exact type designation and technical data are enclosed for each stator. Attach the type plate to an easily visible position at the machine. This way, you can read the motor data at any time without having to work in areas that are difficult to access and where the motor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



1	Type of machine
2	Type designation
3	Serial number
4	Change status
5	Stator mass
6	Manufacturing plant
7	Date of manufacture
8	Rexroth barcode
9	Degree of protection by housing
10	Thermal class
11	Insulation system
12	CE mark of conformity
13	Maximum input voltage
14	UL label
15	Company address
16	Rated velocity in mode S1
17	China RoHS 2 label
18	R.m.s. voltage constant
19	Designation of origin
20	Rated torque in mode S1
21	Rated current in mode S1
22	Operation mode S1
23	Material number

Fig. 6-26: Example type plate MST

6.2.3 Type plate rotor



1 Type of machine
2 Type designation
3 Serial number
4 Change status
5 Rotor mass
6 Manufacturing plant
7 Date of manufacture
8 Rexroth barcode
9 Degree of protection by housing
10 Thermal class
11 CE mark of conformity
12 Maximum input voltage
13 Highest allowed velocity (mechanical)
14 UL label
15 Company address
16 China RoHS 2 label
17 Designation of origin
18 Material number

Fig. 6-27: Example of type plate MRT

6.2.4 Certification mark

Certification mark	Significance
CE	Conformity with applicable EC Directives
c UR US	Approval according to UR, cUR listing
25	RoHS 2 conformity

Tab. 6-6: Certification mark at type plate

7 Accessories

7.1 Mounting ring

7.1.1 General

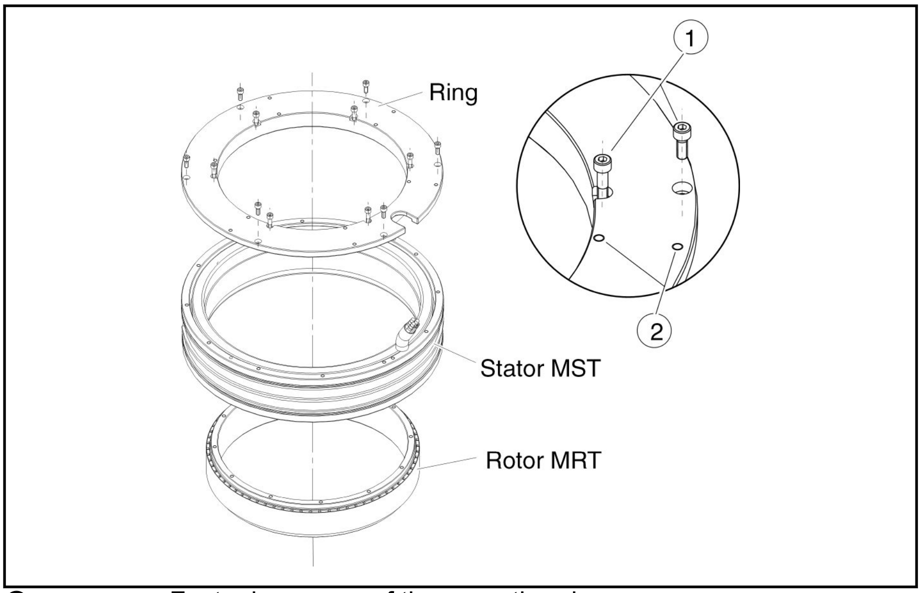
To simplify the handling, transport and mounting of the Rexroth synchronous-torque motors of type MBT, a mounting fixture should be installed by the machine manufacturer. This could reduce the workload considerable, in particular in case of larger frame sizes 450 and 530. Required specifications are contained in the data sheets at the end of the chapter.

With his self-construction, the machine manufacturer can account for design-engineering details and special work flows at the machine during mounting, commissioning and service.

Against extra charge, Rexroth can provide mounting rings for frame sizes 450 and 530 upon request. Depending on the purchase order, stator and rotor are connected via a mounting ring and supplied in premounted state ex works.

☞
- Special design engineering features of the machine or special-purpose solutions cannot be taken into account for Rexroth mounting rings.
- The mounting ring by Rexroth is only intended as a mounting or application aid and has to be removed before the motor is started.
- Please note the safety notes to handle magnetic parts.

7.1.2 Schematic design



① Fastening screw of the mounting ring
② Borings for ring screws for transport (refer to the transport information in chapter 10)

Fig. 7-1: Mounting rings for MST/MRT

7.1.3 Purchase order

The assignment of the mounting rings for MBT motors depends on the stator used: If specified in the order, the MRT, MST and mounting ring are premounted ex works. Without this information, the mounting rings are delivered unassembled.

SUP - designation	MNR	for stator
SUP-M01-MBT450	R911296645	MST450.-...-FT-N0CN-NNNN
SUP-M02-MBT450	R911298825	MST450.-...-FT-N0SN-NNNN
SUP-M01-MBT530	R911296536	MST530.-...-FT-N0CN-NNNN MST530.-....-FT-N0RN-NNNN
SUP-M02-MBT530	R911296537	MST530.-...-FT-N0SN-NNNN
SUP-M03-MBT530	R911296538	MST530.-...-NS-N0CN-NNNN
Frame size 530 with encapulation “H” as well as frame sizes 530G an 530L cannot be delivered with a mounting ring!		

Tab. 7-1: Order designations mounting rings, premounted

7.1.4 Handling

General information

The mounting ring can be used several times. Undamaged mounting rings can be send back to the manufacturer.

Comply with the following procedure:

Purchase order

The offer by the Bosch Rexroth AG contains a particular quotation text that can be copied to your purchase order. The assignment of stator type and the order processing of the mounting ring is documented. The surrender value for the mounting ring is accounted for in the offer.

Accompanying document

Upon delivery of a mounting ring, an "Accompanying document SUP-MBT" with further information is contained in the packing unit. Please keep it safe for return of goods.

Return of goods

1. Contact the Rexroth branch which arranged your delivery and inquire about an RGA number (Returned Goods Authorization).
2. Completely fill out the data on the back of the accompanying document.
3. Send the undamaged goods together with the completed accompanying document delivered free to the place of destination.
   - Only return the goods according to the incoterm **DDU**. Other Incoterms will not be accepted.
4. A credit note about the stipulated value for undamaged and reusable goods will be remitted to your customer account after receipt and validation. Inquire about stipulated credit note amounts with your responsible Rexroth branch.

In case of serial use in larger quantities, it is advisable to store a sufficient amount of these mounting rings at the place of installation. This ensures that service and installation work can be completed efficiently. In these cases, keep the accompanying documents in a safe place for a return of the mounting ring at a later point.

7.1.5 Dimension sheet of mounting ring in SUP-M01-MBT450

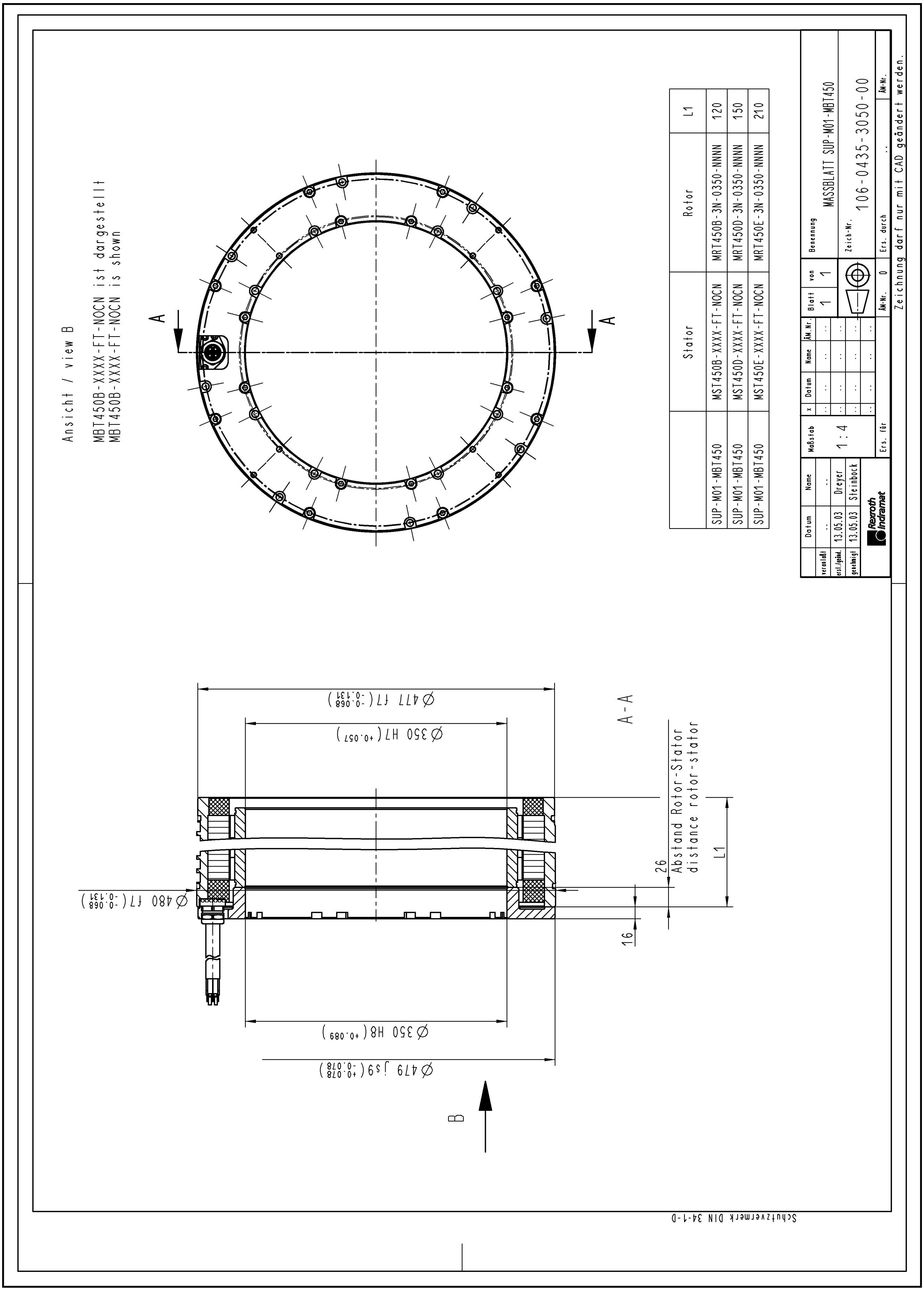


Fig. 7-2: Dimension sheet of mounting ring in SUP-M01-MBT450

7.1.6 Dimension sheet of mounting ring in SUP-M02-MBT450

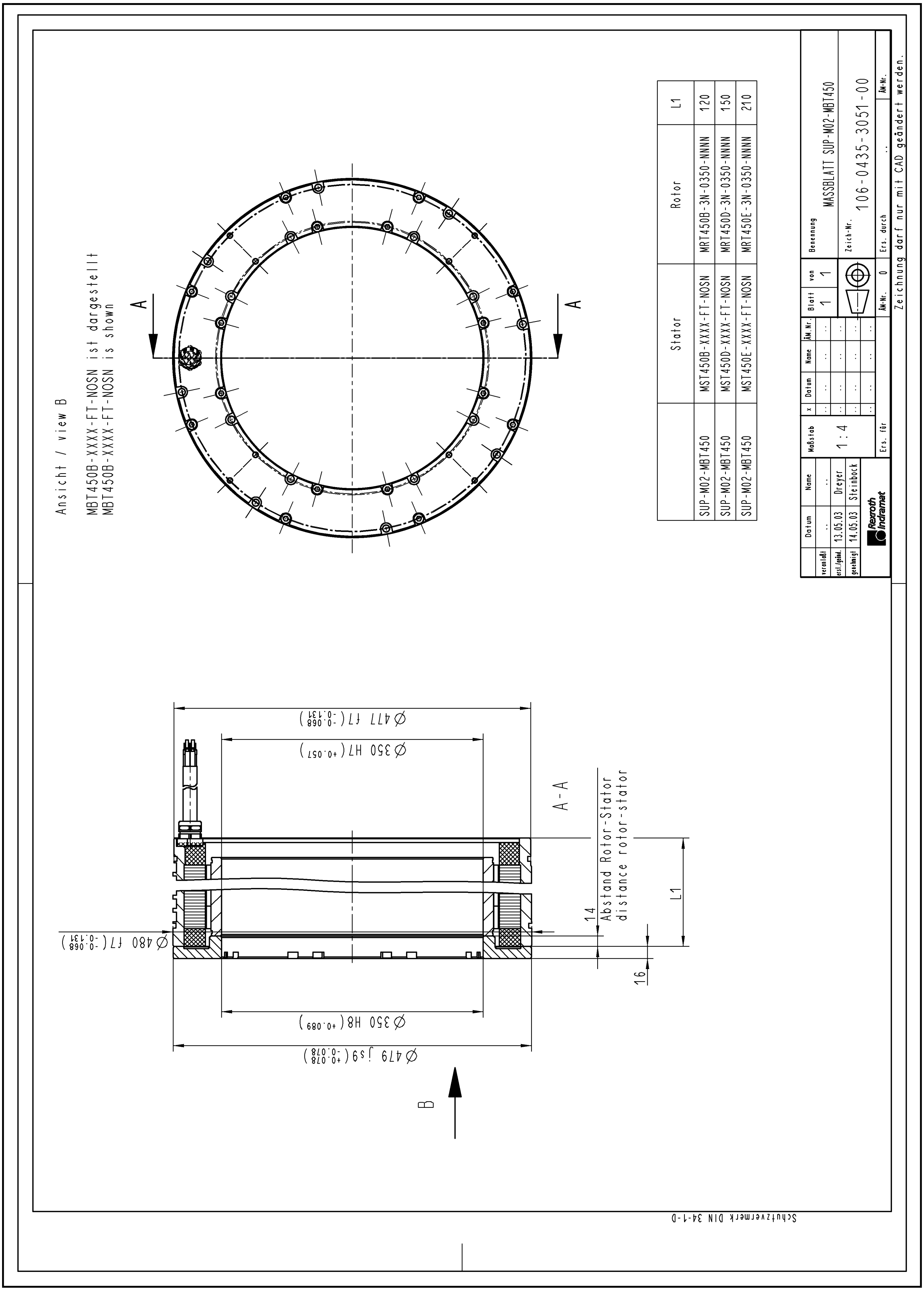


Fig. 7-3: Dimension sheet of mounting ring in SUP-M02-MBT450

7.1.7 Dimension sheet of mounting ring in SUP-M01-MBT530

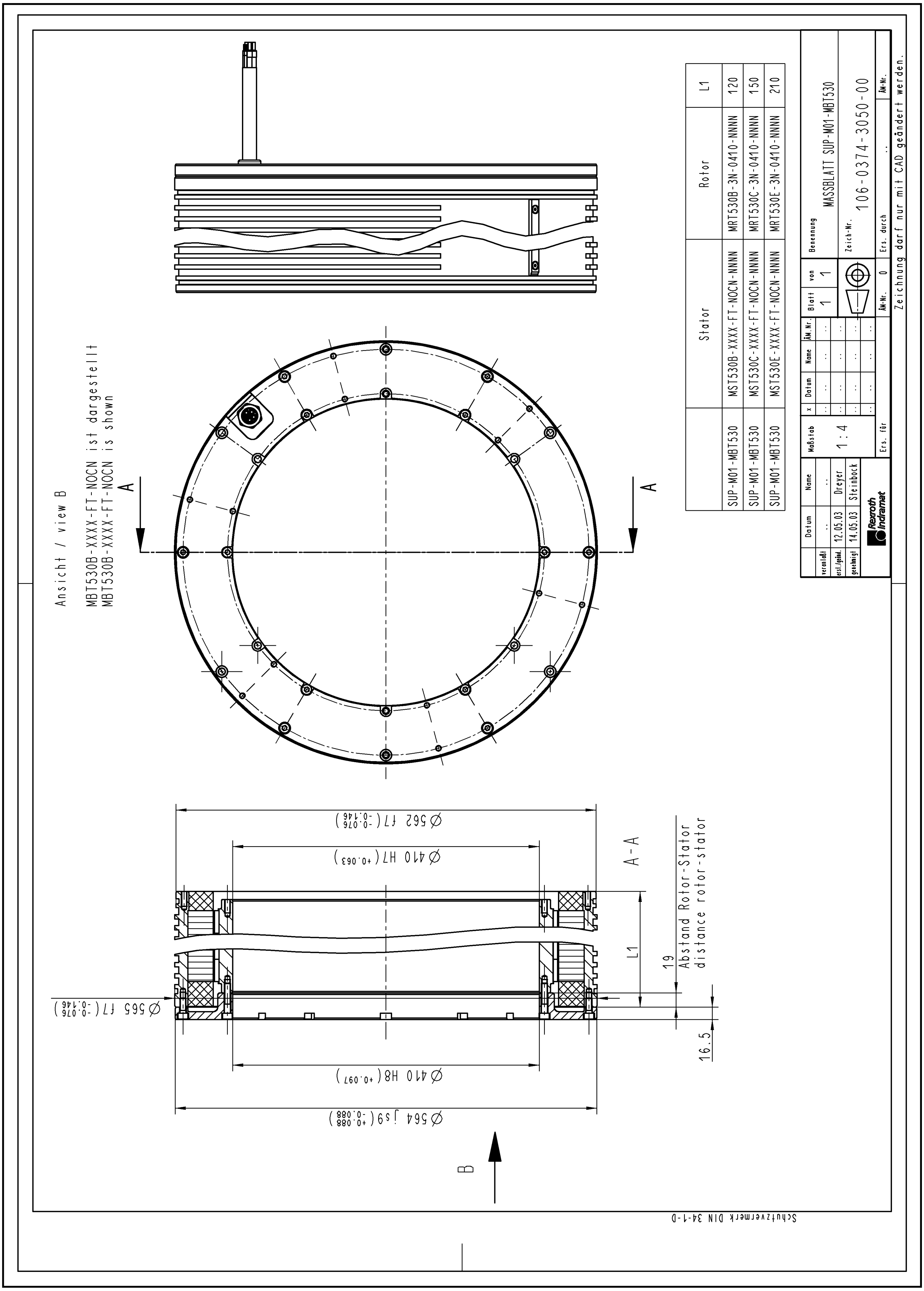
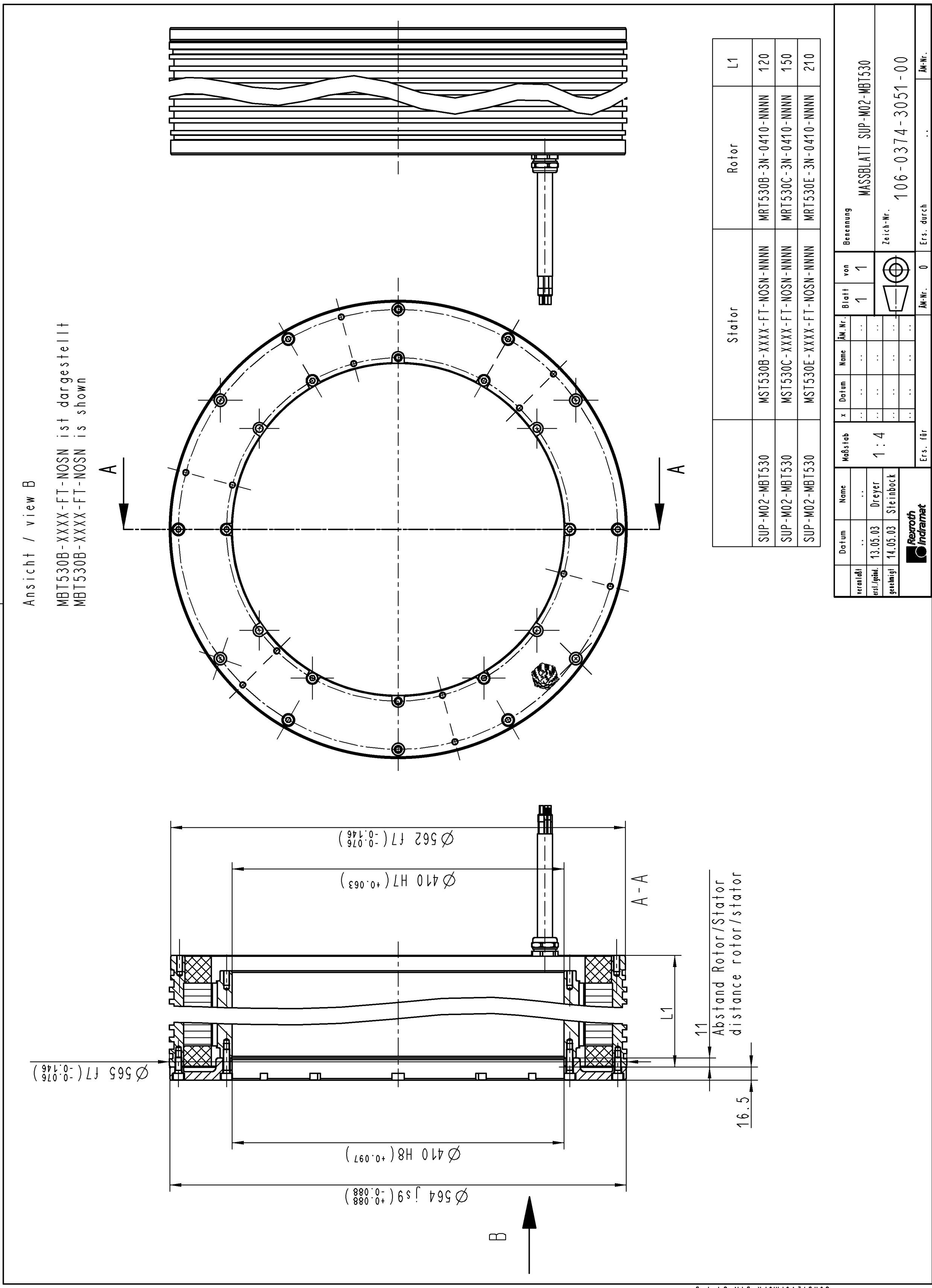


Fig. 7-4: Dimension sheet of mounting ring in SUP-M01-MBT530

7.1.8 Dimension sheet of mounting ring in SUP-M02-MBT530



	Stator	Rotor	L1
SUP-M02-MBT530	MST530B-XXXX-FT-NOSN-NNNN	MRT530B-3N-0410-NNNN	120
SUP-M02-MBT530	MST530C-XXXX-FT-NOSN-NNNN	MRT530C-3N-0410-NNNN	150
SUP-M02-MBT530	MST530E-XXXX-FT-NOSN-NNNN	MRT530E-3N-0410-NNNN	210

Fig. 7-5: Dimension sheet of mounting ring in SUP-M02-MBT530

7.1.9 Dimension sheet of mounting ring in SUP-M03-MBT530

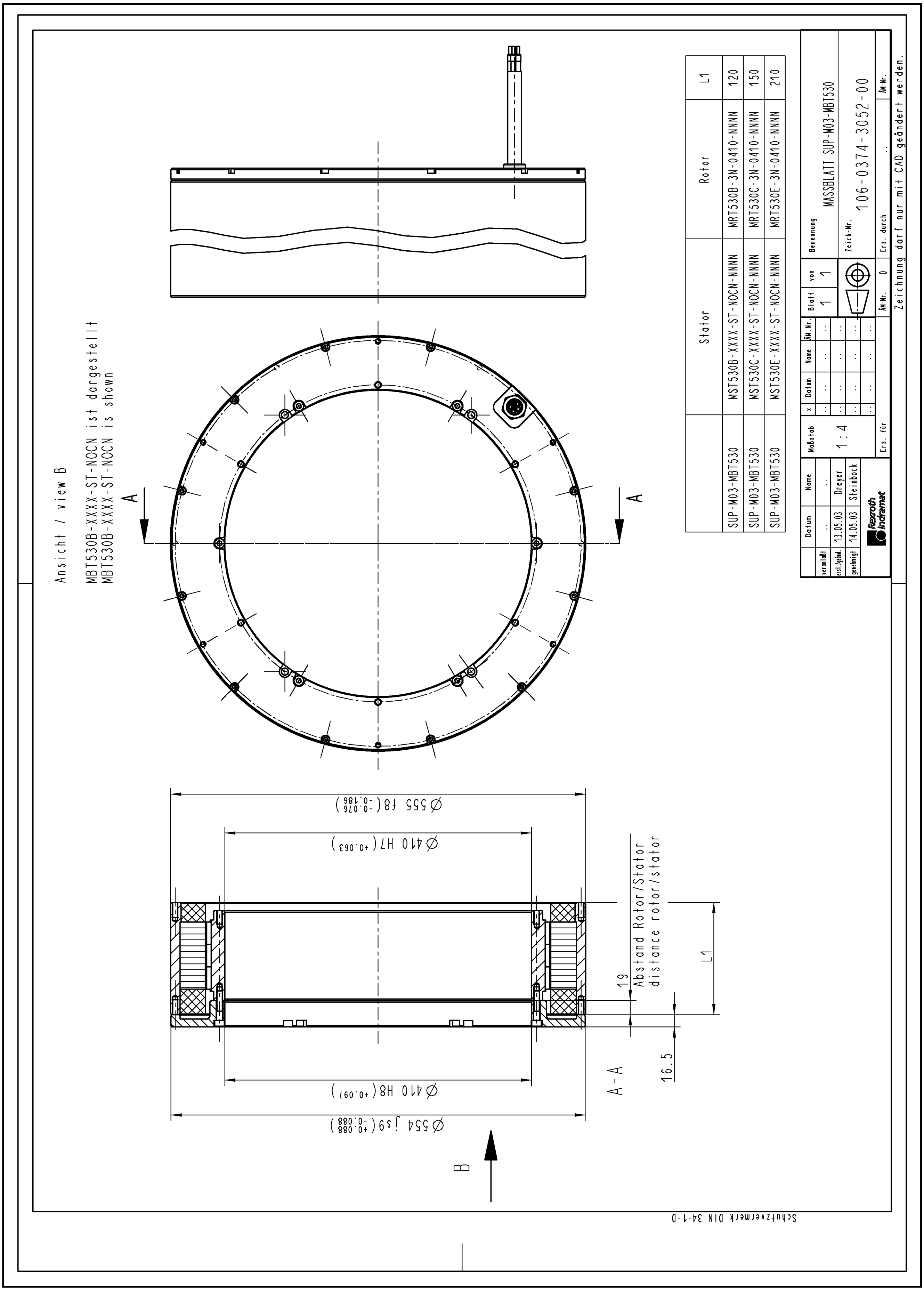


Fig. 7-6: Dimension sheet of mounting ring in SUP-M03-MBT530

8 Connection technique

8.1 Notes

NOTICE **Motor destruction by direct connection to the 50/60 Hz mains power supply (three phase or single phase net)!**

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

Rexroth offers a wide range of cables with connectors for connecting MBT motors. These cables are optimally adapted to the products and to different requirements.

☞

- **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.**

☞ Additional information...

- For **selection** of power and encoder cables for MBT motors in the "Rexroth Connection Cables IndraDrive and IndraDyn" (DOK-CONNEC-CABLE*INDRV-AU□□-□□-P).
- about the **assembly** of cables and plugs as well as technical data, in documentation "Rexroth Connection Techniques, Assembling and Tools..." (DOK-CONNEC-CAB*INSTR02-MA□□-□□-P).
- on "**Electromagnetic Compatibility** in Drive and Control Systems" (DOK-GENERL-EMC********-PR□□-□□-P).

8.2 Power connection of stators with connection cable

8.2.1 General information

The power connection of the stators can be achieved via

- a **terminal box** or
- a **device connector or power connector**.

Starting from this junction, a power cable can be laid to supply power to the controller. Rexroth provides power cables.

8.2.2 Connecting the stators

Depending on the selected type code option, there are two variants for electrical connection of the stators with connection cable.

1. Stators with a 2 m long connection cable with wire end ferrules (other design "NNNN")
2. Stators with a 2 m long connection harness consisting of individual stranded wires with wire end ferrules (design "D30x") or a 1.5 m long connection harness for MST210 in design "D301"

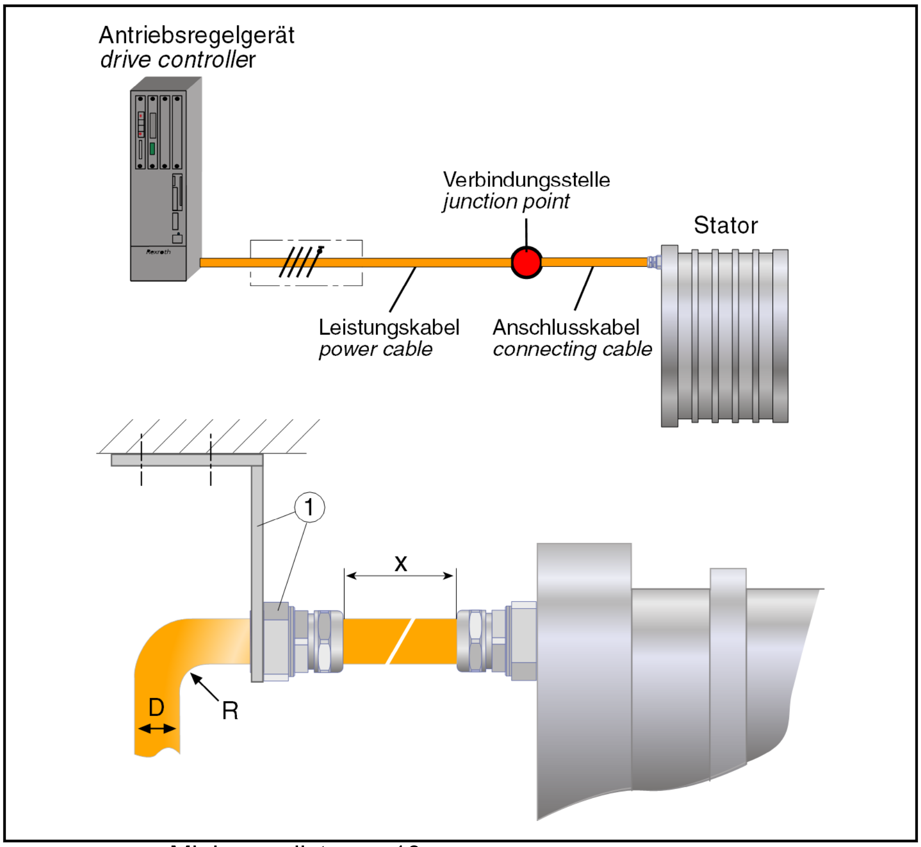
☞ The term connection cable is used for both connection variants.

The cable is lead out either at the stator with the greater or the smaller outside diameter.

NOTICE

Avoid bending, pulling and pushing loads as well as continuous movements of the connection cable at the point at the cable outlet at the stator. Loads of this type may lead to irreversible damage (e.g. by cable break or ingressing fluids) at the stator.

For example, a suitable protection of the connection cable is a strain relief in the form of a metal angle in connection with a second cable gland (see Fig. 8-1). However, the customer may also take other protective measures, depending on the installation situation.



x	Minimum distance 10 mm
D	Diameter of connection cable
R	Bending radius
①	Strain relief of cable gland at stator

Fig. 8-1: Cable gland with strain relief

Bending radius

Cable type	Smallest permissible bending radius R* [mm]
REL (INK...)	5 x D
Stranded wires	3 x D

* permanent installation

Tab. 8-1: Smallest permissible bending radius

Cross section sensor wires at stator design "D30_"

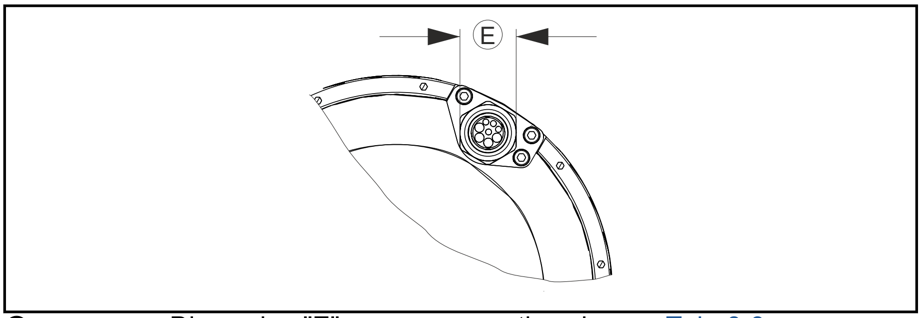
For stators with wires, the cross-sections of the wires for the sensors differ depending on the selected temperature sensor. The assignment of the cross sections can be taken by Tab. 8-2

Temperature sensor	Cross section power wires
SNM.150.DK	0.5 mm²
KTY84-130	AWG24

Tab. 8-2: Cross section of sensor connection wires

The following table provides data on the connection cables and connection wires for the individual stator frame sizes. In addition, the table provides information on the power cable and the power wire cross section required for connecting the stator to the controller.

Cable glands at stators with connection cables



Ⓔ Dimension "E", screw connection size seeTab. 8-3

Fig. 8-2: Cable gland at the stator

Stator	Connection type[1]	Cross section [mm²]		Ø D [mm] [2]	Dimension "E" [mm][3]	Minimum cross section Continuative power cable [mm²]
		Power	Sensors			
MST130A-0200-F... -D303	Stranded wires	AWG[4] 16	see Tab. 8-2	2.85 ±0.2	/	1.0
MST130A-0250-N... -D303						
MST130C-0050-F... -D303						
MST130C-0075-N... -D303						
MST130C-0200-F... -D303						1.5
MST130C-0300-N... -D303						1.0
MST130E-0020-F... -D303						
MST130E-0035-N... -D303						
MST130G-0035-N... -D303						
MST130A-0200-F... -NNNN	INK0678 + 5xTTZ18-1930Z11Y	1.5	- / -	9.8 ±0.3	23	1.0
MST130C-0050-F... -NNNN						1.5
MST130C-0200-F... -NNNN		- / -	1.0	6.0 ±0.2		
MST130E-0020-F... -NNNN						1.0
MST160A-0050-F... -NNNN	REL0107 (INK0602)	2.5	1.0	14.8 ±1	32	1.0
MST160C-0050-F... -NNNN						
MST160E-0027-F... -NNNN						2.5
MST160E-0050-F... -NNNN						
MST160A-0050-F... -D303	Stranded wires	AWG 14	see Tab. 8-2	3.5 ±0.2	/	1.0
MST160C-0050-F... -D303						
MST160E-0027-F... -D303						2.5
MST160E-0050-F... -D303						
MST161C-0140-F...-NNNN	REL0107 (INK0602)	2.5	1.0	14.8 ±1	32	2.5
MST161E-0050-F...-NNNN						

Stator	Connection type[1]	Cross section [mm²]		Ø D [mm] [2]	Dimension "E" [mm][3]	Minimum cross section Continuative power cable [mm²]
		Power	Sensors			
MST161C-0140-F...-D303	Stranded wires	AWG 14	see Tab. 8-2	3.5 ±0.2	/	2.5
MST161E-0050-F...-D303		AWG 12		4.0 ±0.2		
MST161E-0140-F...-D303		AWG 10		4.7 ±0.2		6.0
MST161G-0100-F...-D303						
MST201C-0010-F...-D303	Stranded wires	AWG 16	see Tab. 8-2	2.85 ±0.2	/	1.0
MST201C-0027-F...-D303						1.5
MST201D-0010-F...-D303						1.0
MST201D-0027-F...-D303						
MST201F-0075-F...-NNNN	REL0109 (INK0604)	6.0	2 x 1.0 2 x 1.5	18.5 ±1	33	6.0
MST210A-0027-F... -D30x	Stranded wires	AWG 14	see Tab. 8-2	3.5 ±0.2	/	1.0
MST210D-0070-F... -D301		AWG 10		4.68 ±0.2		6.0
MST210U-0030-F...-D303		AWG 8		6.4 ±0.2		10.0
MST210A-0027-F... -NNNN	REL0107 (INK0602)	2.5	1.0	14.8 ±1	34	1.0
MST210C-0027-F... -NNNN						
MST210C-0050-F... -NNNN	REL0108 (INK0603)	4.0	2 x 1.0 2 x 1.5	17 ±0.5	33	4.0
MST210E-0027-F... -NNNN						
MST210D-0070-F... -NNNN	REL0109 (INK0604)	6.0		18.5 ±1		6.0
MST251F-0040-F...-D303	Stranded wires	16.0	see Tab. 8-2	9 ±0.3	/	16.0
MST290B-0018-F... -NNNN	REL0107 (INK0602)	2.5	1.0	14.8 ±1	34	1.5
MST290D-0002-F... -NNNN						1.0
MST290D-0004-F... -NNNN						
MST290D-0018-F... -NNNN	REL0108 (INK0603)	4.0	2 x 1.0 2 x 1.5	17.0 ±0.5	33	4.0
MST290E-0004-F... -NNNN						1.0
MST290E-0018-F... -NNNN	REL0109 (INK0604)	6.0	2 x 1.0 2 x 1.5	18.5 ±1		6.0
MST290F-0020-F...-D303	Stranded wires	AWG 8	see Tab. 8-2	6.4 ±0.2	/	10.0
MST290G-0020-F...-D303						
MST291C-0018-F...-D303	Stranded wires	AWG 12	see Tab. 8-2	4.0 ±0.2	/	2.5
MST291D-0010-F...-D303						
MST291E-0010-F...-D303						

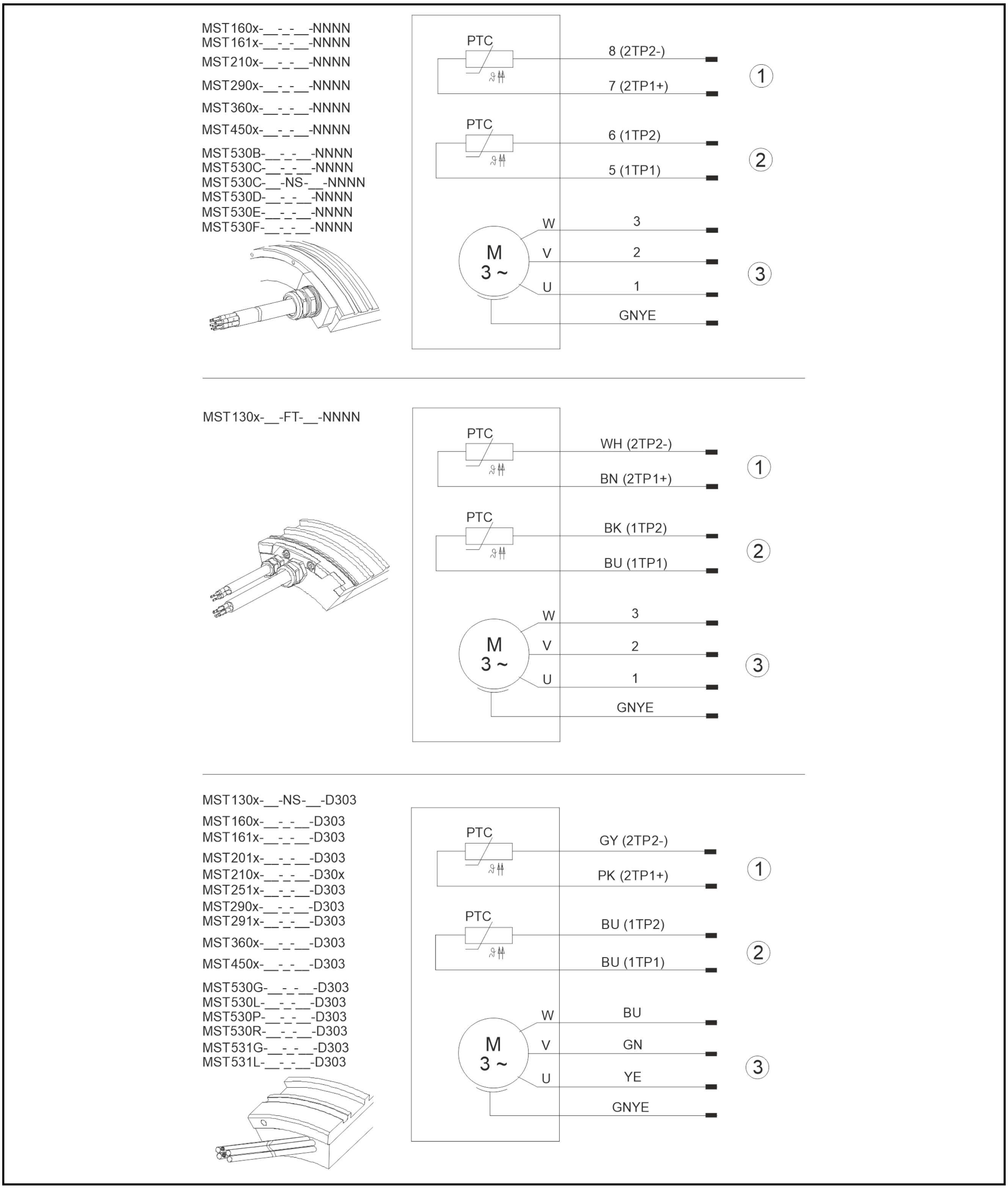
Stator	Connection type[1]	Cross section [mm²]		Ø D [mm] [2]	Dimension "E" [mm][3]	Minimum cross section Continuative power cable [mm²]
		Power	Sensors			
MST360B-0006-F... -NNNN	REL0107 (INK0602)	2.5	1.0	14.8 ±1	34	1.0
MST360B-0018-F... -NNNN	REL0108 (INK0603)	4.0	2 x 1.0 2 x 1.5	17.0 ±0.5	33	2.5
MST360D-0009-F... -NNNN	REL0107 (INK0602)	2.5	1.0	14.8 ±1	34	1.0
MST360D-0012-F... -NNNN	REL0108 (INK0603)	4.0	2 x 1.0 2 x 1.5	17.0 ±0.5	33	2.5
MST360D-0018-F... -NNNN						4.0
MST360E-0008-F... -NNNN	REL0107 (INK0602)	2.5	1.0	14.8 ±1	39	2.5
MST360E-0018-F... -NNNN	REL0110 (INK0605)	10.0	1.0	22.2 ±1	40	10.0
MST360B-0006-F... -D303	Stranded wires	AWG 14	see Tab. 8-2	4.0 ±0.2	/	1.0
MST360B-0018-F... -D303		AWG 12				2.5
MST360D-0009-F... -D303		AWG 14				1.0
MST360D-0012-F... -D303		AWG 12				2.5
MST360D-0018-F... -D303		AWG 10		4.7 ±0.2		4.0
MST360E-0008-F... -D303		AWG 14		4.0 ±0.2		2.5
MST360E-0018-F... -D303		AWG 8		6.4 ±0.2		10.0
MST450B-0012-F... -NNNN	REL0109 (INK0604)	6.0	2 x 1.0 2 x 1.5	18.5 ±1	33	2.5
MST450D-0006-F... -NNNN	REL0108 (INK0603)	4.0		17.0 ±0.5		
MST450D-0012-F... -NNNN	REL0109 (INK604)	6.0		18.5 ±1		6.0
MST450E-0006-F... -NNNN						
MST450E-0011-N... -NNNN	(REL0107 (INK0602)	2.5	1.0	14.8 ±1	34	1.0
MST450E-0012-F... -NNNN	REL0110 (INK0605)	10.0	1.0	22.2 ±1	40	10.0
MST450E-0018-N... -NNNN	REL0108 (INK0603)	4.0	2 x 1.0 2 x 1.5	17.0 ±0.5	33	2.5

Stator	Connection type[1]	Cross section [mm²]		Ø D [mm] [2]	Dimension "E" [mm][3]	Minimum cross section Continuative power cable [mm²]
		Power	Sensors			
MST450B-0012-F... -D303	Stranded wires	AWG 12	see Tab. 8-2	4.0 ±0.2	/	2.5
MST450D-0006-F... -D303		AWG 14		3.5 ±0.2		
MST450D-0012-F... -D303		AWG 10		4.7 ±0.2		6.0
MST450E-0006-F... -D303						
MST450E-0012-F... -D303		AWG 8		6.4 ±0.2		10.0
MST530B-0010-F... -NNNN	REL0109 (INK0604)	6.0	2 x 1.0 2 x 1.5	18.5 ±1	33	4.0
MST530C-0010-F... -NNNN						6.0
MST530C-0010-N... -NNNN						
MST530C-0014-F... -NNNN						
MST530D-0012-F... -NNNN	REL0110 (INK0605)	10.0	1.0	22.2 ±1	40	10.0
MST530E-0010-F... -NNNN	REL0111 (INK0606)	16.0	1.5	25.5 ±1	44	16.0
MST530F-0012-F... -NNNN						
MST530G-0006-F... -D303	Stranded wires	2 x 16.0	see Tab. 8-2	2 x 9 ±0.3	/	2 x 10.0
MST530G-0007-F... -D303						2 x 16.0
MST530G-0010-F... -D303						2 x 25.0
MST530L-0003-F... -D303		16.0		9 ±0.3		10.0
MST530L-0006-F... -D303		2 x 16.0		2 x 9 ±0.3		2 x 25.0
MST530L-0007-F... -D303						
MST530P-0012-F... -D303		25.0		9 ±0.3		25.0
MST530R-0011-F... -D303						35.0
MST531E-0006-F...-D303	Stranded wires	AWG 8	see Tab. 8-2	6.4 ±0.2	/	6.0
MST531E-0018-F...-D303		16.0		9 ±0.3		2 x 10.0
MST531L-0009-F...-D303		2 x 16.0		2 x 9 ±0.3		35.0

1) For the amount of stranded wires refer to Fig. 8-3
2) Layout according to DIN VDE 0298-4. The required power wire cross sections apply to laying type B2 (single laying). Laying type E (multiple installation) and a reduction factor of 0.8 was taken into account for double cabling.
3) When using motors with connection mode "stranded wires", the biggest diameter of the cables (normally of a power wire) is specified. This allows the minimum bending radius to be determined. The diameter of a bundle of the eight stranded wires (4x power + 4x temperature sensor) can be assumed to be 3 times the specified diameter.
4) AWG = American Wire Gauge: codes for wire diameters of electrical lines which are predominately used in North America.

Tab. 8-3: Connection cables at the stator

The wire designation at the motors with connection cable depends on the selected stator design and has to be done as follows:



①	KTY84-130 for external use (temperature measurement)
②	SNM.150.DK (S01.155.05.****) for connection at the Rexroth controller (thermal motor protection)
③	Power connection

Fig. 8-3: Wire identification at MST stators with connection cable

Before connecting the motor, the following steps have to be taken by the machine manufacturer:

1. Decision about connection type **terminal box** or **device connector** as well as acquisition of the components required.
2. Shortening the power cable to the desired length (only if required).
3. Cutting the cables to length for the connection at the motor, according to documentation "Rexroth Connection Cables IndraDrive and IndraDyn" (DOK-CONNEC-CABLE*INDRV-AU□□-□□-P).
4. Fastening the coupling and the cable harness to the machine.

Pay particular attention to the following issues when cutting the cables to length and installing the connections:

- Careful execution of the ground connection and the shield connection to meet EMC directives.
- Careful execution of the tightening and plug-in connections to comply with the safety class.
- Power cables for connection to the controller or drive are not included in the scope of delivery of the motor and have to be ordered separately.
- Do not open or loosen the factory-assembled cable glands at the stator.
- The coolants, lubricants and fuels used at the machine should not damage the lines and connection cables used nor modify them chemically or with regard to the structure.

Terminal box

Terminal boxes or single components for connecting stators with connection cable are not delivered by Rexroth. Possible suppliers are:

Components	Supplier
Terminal box	**KIENLE & SPIESS** GmbH Bahnhofstrasse 23 74343 Sachsenheim, Germany Phone: +49 (0) 71 47 29 - 0 Fax: +49 (0) 71 47 29 - 1488 Internet: www.kienle-spiess.de
Terminal board	**REKOFA WENZEL** GmbH & Co. KG Walporzheimer Strasse 100 53474 Bad Neuenahr - Ahrweiler, Germany Phone: +49 (0) 26 41 / 387 - 0 Fax: +49 (0) 26 41 / 387 - 33 95
Terminal strip	**WIELAND ELECTRIC** GmbH Benzstrasse 9 96052 Bamberg, Germany Internet: www.wieland-electric.com

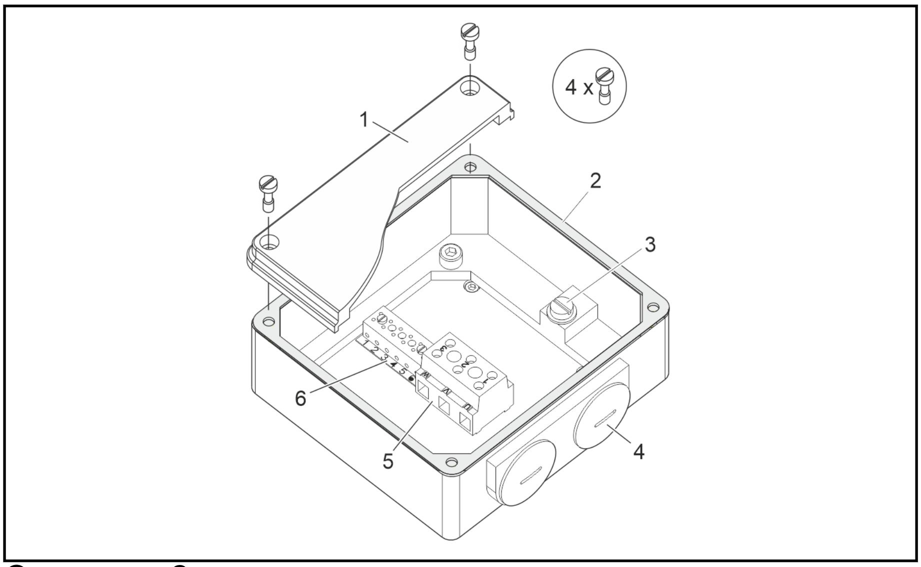
Tab. 8-4: Suppliers of terminal boxes

When selecting the components, take the following into consideration...

- 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 the cable gland.
- tightness of the housing. Minimum protection class IP65 is recommended.

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

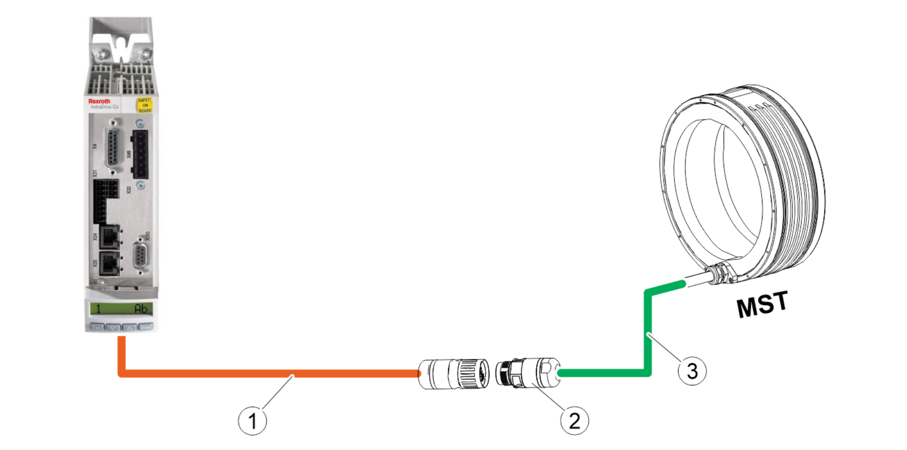


① Cover
② Seal
③ PE connection
④ Cable entry
⑤ U-V-W power connection
⑥ Terminal strip

Fig. 8-4: Terminal box

Device connector

A coordinated range of connector sets and ready-made RL2 power cables is available for connecting the motors to our Rexroth controllers. In order to be able to connect RL2 power cables to the motor, the motor connection cable must first be assembled by the customer, taking into account the installation situation.



① Power cable RL2...
② Connector (for order designation of connector sets refer to Tab. 8-5)
③ Motor connection cable at the stator (see Tab. 8-3 and Tab. 8-5)

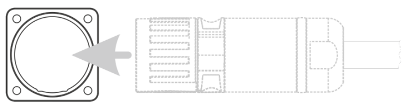
Fig. 8-5: Motor connection with device connector

Connection cables at the stator	Connector size	Connector set	Power and Power extenstion cable	Mounting flange for Connector gland (Optional)
INK0678	M23	On request	see product information “Motor cables and connectors” R911401938	Z-SONS**-FLANGE M23 R911403772
REL0107 (INK0602)	M23	RLS2309/CM03 R911381143		
	M40	RLS4032/CM03 R911380334		Z-SONS**-FLANGE M40 R911388659
REL0108 (INK0603)	M40	RLS4012/CM04 R911388432		
REL0109 (INK0604)	M40	RLS4012/CM06 R911388433		
REL0110 (INK0605)	M40	On request		
	M58	RLS5822/CM10 R911383999		Z-SONS**-FLANGE M58 R911410541
REL0111 (INK0606)	M58	RLS5832/CM16 R911384000		

Tab. 8-5: Ordering designation connector sets for connecting on RL2 power cables

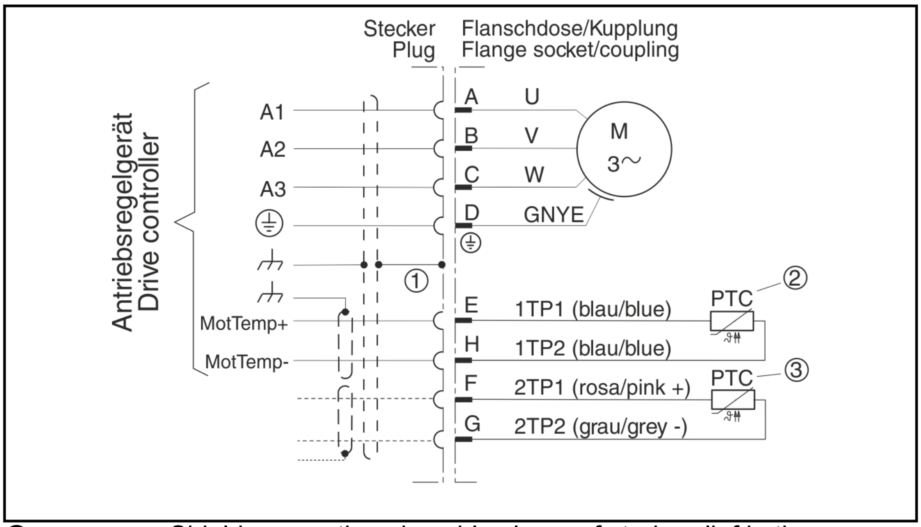
Mounting flange for connector gland

To feed the connector through to the machine, the connectors listed in Tab. 8-5 can be fitted with a flange. The flange can be ordered as an accessory.

Mounting flange for Connector gland	Designation
	see Tab. 8-5 “Mounting flange connector gland”

Tab. 8-6: Mounting flange for connector gland

Connection diagram



①	Shield connection via cable clamp of strain relief in the screwed cable connection
②	Connect temperature sensor SNM.150.DK to the drive controller for motor protection
③	Temperature sensor KTY84-130 can be used for external temperature measurement

Fig. 8-6: Connection diagram of device connector

8.3 Power connection of stators with housing

8.3.1 General information

Depending on the stator design, the power connection of the stators with a housing for flange mounting is realized via

- a **terminal box** or
- a **device connector.**

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

Please note the data in the type code and the dimension sheet of the particular stator design.

8.3.2 Stators with housing and device connector

Frame size	Device connector	Minimum cross section Continuative power cable [mm²]
MST210A-0027-FH-xxPU-...	RLS1200	see Tab. 8-3
MST210C-0027-FH-xxPU-...		
MST210C-0050-FH-xxPU-...		
MST210D-0070-FH-xxPU-...		
MST210E-0027-FH-xxPU-...		
MST290B-0018-FH-xxPU-...		
MST290D-0002-FH-xxPU-...		
MST290D-0004-FH-xxPU-...		
MST290D-0018-FH-xxPU-...		
MST290E-0004-FH-xxPU-...		
MST290E-0018-FH-xxPU-...		

Tab. 8-7: Overview of stators with housing and device connector

Device connector RLS1200

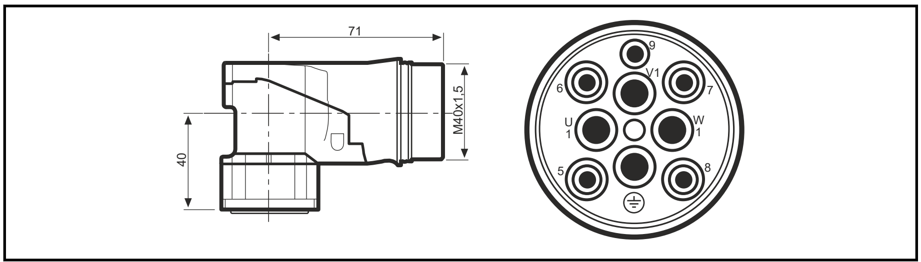


Fig. 8-7: Device connector RLS1200

RLS1200 contact assignment

U1	Power
V1	Power
W1	Power
PE	Grounding
5	Temperature sensor SNM150 (1TP1+)
6	Temperature sensor SNM150 (1TP2-)
7	Temperature sensor KTY84 (2TP1+)
8	Temperature sensor KTY84 (2TP2-)
9	n.c.

Tab. 8-8: RLS1200-pin assignment

Device connector (coupling) RLS120x for device connector RLS1200

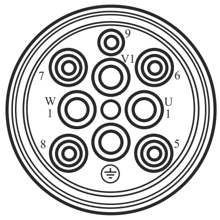


Fig. 8-8: View coupling RLS120x

RLS1201 contact assignment

U1	Power
V1	Power
W1	Power
PE	Grounding
5	Temperature sensor SNM150 (1TP1+)
6	Temperature sensor SNM150 (1TP2-)
7	Temperature sensor KTY84 (2TP1+)
8	Temperature sensor KTY84 (2TP2-)
9	Brake/temperature sensor shield

Tab. 8-9: RLS1201 - contact assignment

8.3.3 Stators with housing and terminal box

Frame size	Terminal box					Minimum cross section Continuative power cable [mm²]
	Designation	U-V-W	Connection cross section [mm²]	∅PE	Connection thread	
MST360B-0006-FH-xxKR-...	RLK0003	WEF[1]	2.5 ... 10	RTE[2] for thread M6	See motor dimension sheet	see Tab. 8-3
MST360B-0018-FH-xxKR-...						
MST360D-0009-FH-xxKR-...						
MST360D-0012-FH-xxKR-...						
MST360D-0018-FH-xxKR-...						
MST360E-0008-FH-xxKR-...						
MST360E-0018-FH-xxKR-...						
MST450B-0012-FH-xxKR-...	RLK0004		2.5 ... 16	RTE for thread M8		
MST450D-0006-FH-xxKR-...						
MST450D-0012-FH-xxKR-...						
MST450E-0006-FH-xxKR-...						
MST450E-0012-FH-xxKR-...						
MST530B-0010-FH-xxKR-...	RLK0004		2.5 ... 16	RTE for thread M8		
MST530C-0010-FH-xxKR-...						
MST530C-0014-FH-xxKR-...						
MST530D-0012-FH-xxKR-...						
MST530E-0010-FH-xxKR-...						
MST530F-0012-FH-xxKR-...			2.5 ... 35			
MST530G-0006-FH-xxKR-...	RLK1300		2.5 ... 35	RTE for thread M8		
MST530G-0007-FH-xxKR-...						
MST530G-0010-FH-xxKR-...						
MST530L-0003-FH-xxKR-...						
MST530L-0006-FH-xxKR-...						
MST530L-0007-FH-xxKR-...						
MST530P-0012-FH-xxKR-...	RLK0004		2.5 ... 35			
MST530R-0011-FH-xxKR-...						

1) WEF = wire end ferrule

2) RTE = ring terminal end

Tab. 8-10: Stators with housing and terminal box

- Do not remove or damage the seal glued in the cover of the terminal box.
- Note the size of the cable gland and connection thread for the cable inlet into the terminal box.
- In particular, make sure that the connection cables are correctly installed in the terminal box, without tension to avoid abrasion or pressure marks on the cables.
- The connections of the internal motor windings in the terminal box must not be loosened.

8.3.4 Terminal box connection for frame size 360 / 450 / 530

Terminal box example

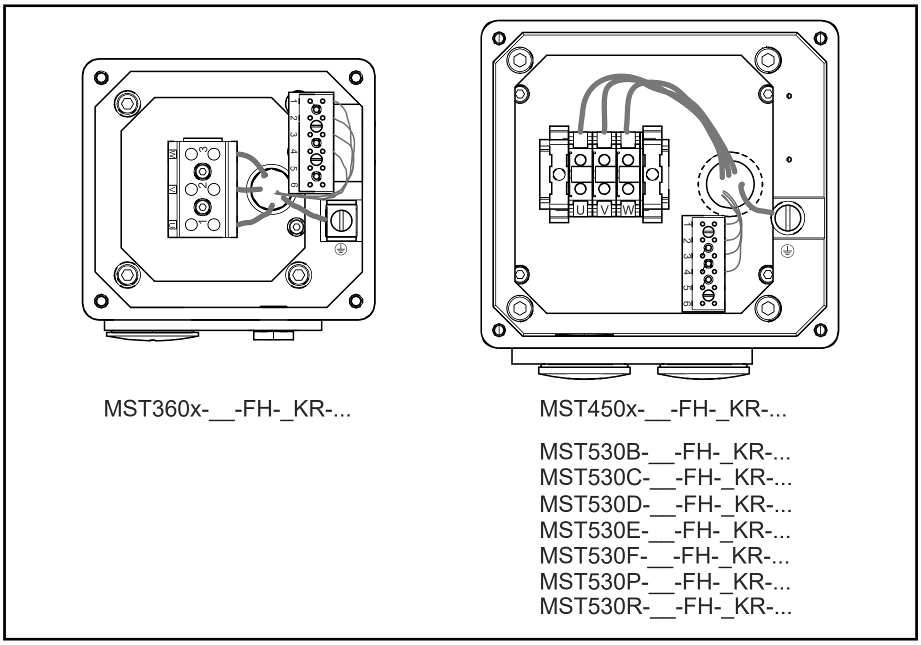
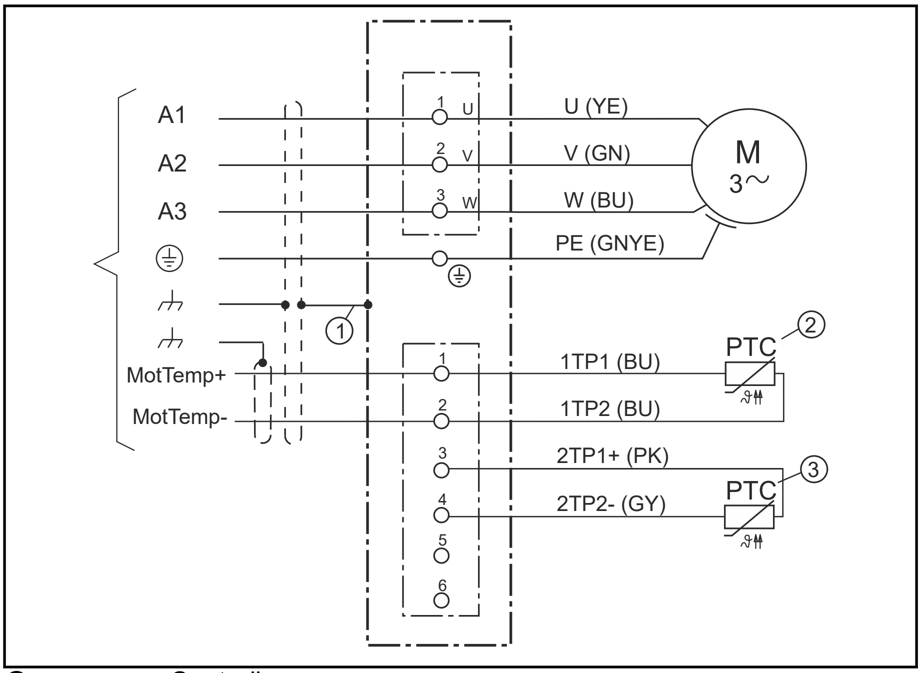


Fig. 8-9: Terminal boxes MST360 / -450 / -530B, -C, -D, -E, -F, -P, -R

Connection overview



Ⓐ Controller
Ⓑ Terminal box
① Total shield connection via cable clamp of strain relief in the cable gland
② Connect temperature sensor SNM.150.DK to the drive controller for motor protection
③ Temperature sensor KTY84-130 can be used for external temperature measurement

Fig. 8-10: Overview of connections to the terminal box

8.3.5 Terminal boxes for double cabling - frame size 530G, -L

Stators of frame sizes 530G and 530L are connected to the motor via two power cables.

Terminal box RLK1300

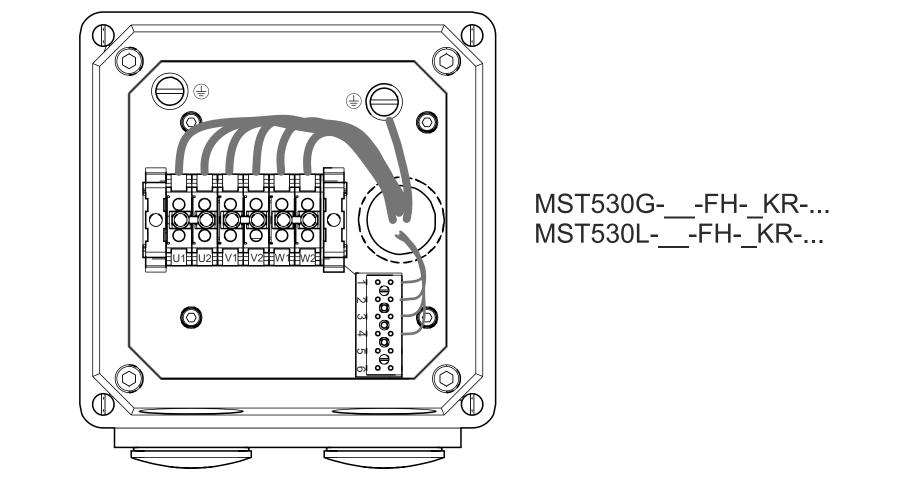
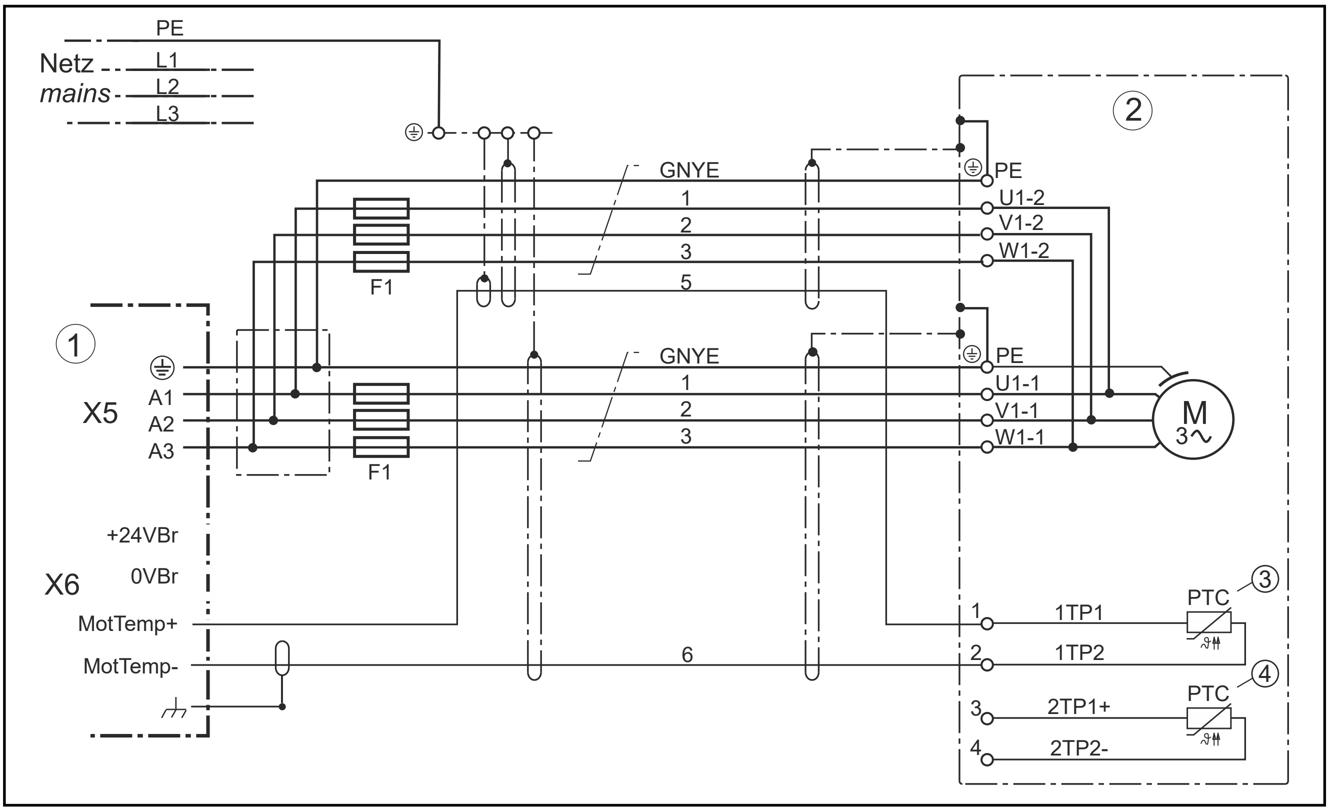


Fig. 8-11: Terminal box RLK1300

Overview of double cabling



①	Bosch Rexroth controller
②	Terminal box at the motor
③	Temperature sensor SNM.150.DK (have to be connected to controller for thermal motor protection)
④	Temperature sensor KTY84-130

Fig. 8-12: Double cabling connection diagram

☞

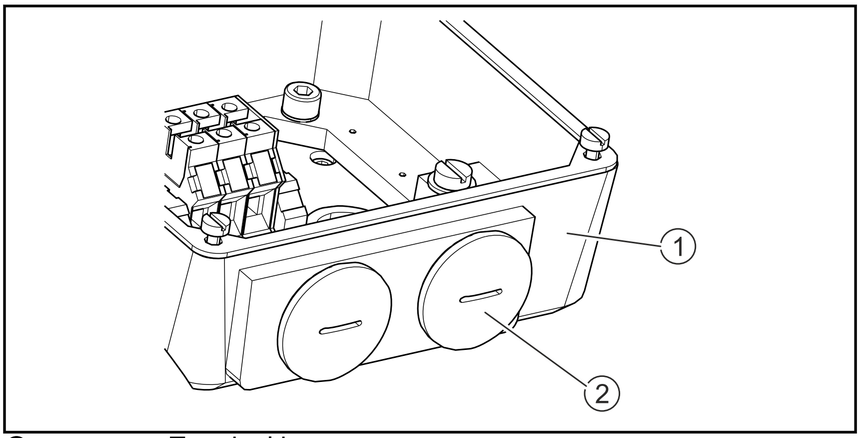
- The terminal box can only be used for double cabling for power connection.
- The double cabling connection diagram shows a possible circuit. When planning the double cabling, please note the applicable installation regulations at the installation site of the machine.
- Temperature sensor 1TPx (SNM.150.DK*) has to be connected to the controller for thermal protection of the motor.

  Temperature sensor 2TPx (KTY84*) is only available for external motor temperature monitoring.
- Fuses F1 (NH…) protecting the wires from overload in case of cable break are dimensioned according to the current carrying capacity of the respective line cross section.
- The fuses should be installed in the control cabinet as close as possible to the power output of the controller.
- The shield of the power cables should be connected to the switch cabinet on a large scale!
- Cable pairs have to be connected correctly to series terminal strips or to the terminal studs of the controllers and have to comply with the relevant safety requirements.
- Finished power cables are not available for double cabling. To install the fuses, standard Rexroth power cables have to be opened and cut to the appropriate length on site.

Power cable connection at the terminal box

The output direction of the power cable is defined in the type code of the motor. The terminal box is mounted to the motor according to this output direction which cannot be changed at a later point. Connecting the power cable to the terminal box requires the following steps:

1. Open the terminal box cover.

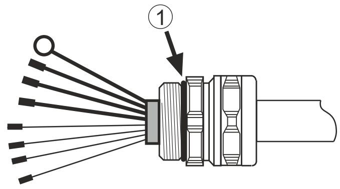


① Terminal box
② Safety cover of cable gland

Fig. 8-13: Cable gland at terminal box

2. Unscrew the safety cover of the cable gland ②.
3. Run the power cable through the opening into the terminal box up to the cable gland and attach the cable including cable gland to the terminal box.

The cable gland of the power cable features an O-ring. Ensure that the O-ring is positioned correctly in the gland of the power cable during mounting.



① O-ring position

Fig. 8-14: O-ring at cable gland

NOTICE **If seals are inserted incorrectly or not at all, the degree of protection of the motor will be lost!**

Before attaching the power cable to the terminal box, visually inspect the O-ring to verify that it is in a proper state and correctly positioned at the power cable gland.

If the O-ring is missing, do not use the power cable. In this case, contact your Rexroth sales or service partner.

4. Connect the wires according to the connection diagram for standard or double cabling.

   Comply with the following tightening torques:

   Screw tightening torques in Nm (±10%) for power connection

Stator	Terminal box	U-V-W	PE	
		M4	M6	M8
MST360x-xxxx-FH-xx**KR**-...	RLK0003	1.5	2.5	-/-
MST450x-xxxx-FH-xx**KR**-...	RLK0004	1.5	-/-	3.5
MST530B-xxxx-FH-xx**KR**-... MST530C-xxxx-FH-xx**KR**-... MST530D-xxxx-FH-xx**KR**-... MST530E-xxxx-FH-xx**KR**-... MST530F-xxxx-FH-xx**KR**-...	RLK0004	1.5	-/-	3.5
MST530G-xxxx-FH-xx**KR**-... MST530L-xxxx-FH-xx**KR**-...	RLK1300	1.5	-/-	3.5
MST530P-xxxx-FH-xx**KR**-... MST530R-xxxx-FH-xx**KR**-...	RLK0004	1.5	-/-	3.5

Tab. 8-11: Screw tightening torque in Nm within the terminal box

5. Close the cover of the terminal box.

   Moisten the thread of the mounting screws for the cover with liquid screwlock Loctite 243 and attach the cover using all of the mounting screws.

   Tightening torque of the screws: 6.5 Nm (±10%)

   Before tightening the screws, make sure that the seal between the cover and the terminal box housing is positioned correctly.

NOTICE **If seals are inserted incorrectly or not at all, the degree of protection of the motor will be lost!**

Before attaching the terminal box cover to the terminal box, check the glued-in seal at the terminal box cover to verify that it is in a proper state and at the correct position.

8.4 Sensors

8.4.1 Temperature sensors

By default, MST stators are equipped with an 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 fig. 8-3 "Wire identification at MST stators with connection cable" on page 245).
- 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 appropriate measures for ESD protection (ESD = electrostatic discharge).

Also note the information on motor temperature monitoring in chapter 9 "Application notes" on page 259.

8.4.2 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 13.6 "Determining the polarity of the encoder system" on page 389.

For information on encoder manufacturers, please refer to chapter 9.10.1 "Motor encoder" on page 282.

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.

8.5 Motor cooling

8.5.1 Coolant connection

Stators with cooling jacket without housing

If MBT torque motors are delivered as kit motors without motor housing for installation in machines, the connection technology has to be selected and dimensioned by the machine manufacturer.

For more information about motor cooling, please refer to chapter chapter 9.7 "Motor cooling" on page 264 and chapter chapter 9.8 "Motor temperature monitoring" on page 277.

Stators with cooling jacket and housing

MST stators can also be order pre-assembled in the stator housing. This motor design has two connection threads an the stator housing for connecting the liquid coolant. Note the particular dimension sheet of the stator with regard to dimension, position and allowed use (inlet and outlet connection) of the borings.

For more information about motor cooling, please refer to chapter 9.7 "Motor cooling" on page 264 and chapter 9.8 "Motor temperature monitoring" on page 277.

☞

- Note that inlet and outlet are only allowed in the position specified in the dimension sheet.
- Monitoring systems for flow rate, pressure and temperature should be installed within the cooling circuit.

8.5.2 Operating pressure

The maximum coolant supply pressure of **6 bar** applies to all MBT motors based on the effective current pressure directly at the coolant connection of the motor. Pressure fluctuations in the cooling circuit must not exceed ± 1 bar during engine operation.

☞ Please note that additional glands or branches in the cooling circuit can reduce the flow and supply pressure of the coolant. Therefore select amply dimensioned connection glands and line cross sections.

⚠ WARNING **Motor destruction!**

- Observe the permissible inlet pressure of the coolant.
- Eliminate impermissible pressure fluctuations and pressure peaks by design measures.

9 Application notes

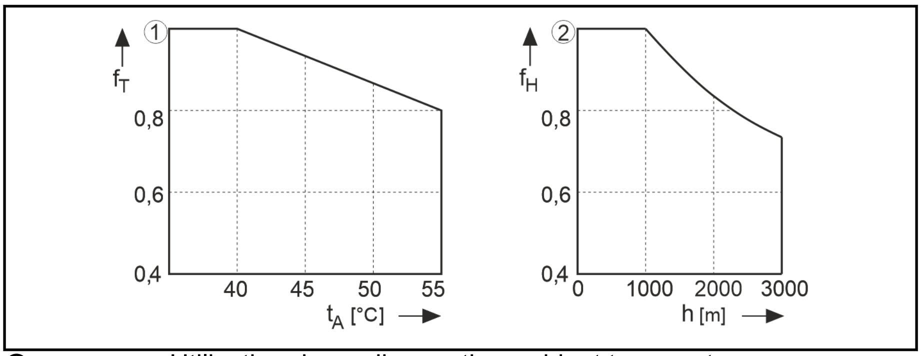
9.1 Installation altitude and ambient temperature

The performance data specified for the drive system applies to

Convection-cooled motors

- Ambient temperatures from 0 ºC to +40 ºC
  (+5 °C to +40 °C for liquid-cooled motors)
- Installation altitudes from 0 m to 1000 m above sea level

When using these drive systems outside these ranges, reduce the performance data according to the following illustration.



①	Utilization depending on the ambient temperature
②	Utilization depending on the installation altitude
f_T	Temperature utilization factor
t_A	Ambient temperature in degrees Celsius
f_H	Height utilization factor
h	Installation altitude in meters

Fig. 9-1: Load factors/derating

If **either** the ambient temperature **or** the installation altitude is above the nominal data:

1. Multiply the motor data specified in the selection data by the determined utilization factor.
2. Ensure that the reduced data are not exceeded by your application.

If **both** the ambient temperature **and** the installation altitude exceed the nominal data:

1. Multiply the determined utilization factors f_T and f_H.
2. Multiply the resulting value by the motor data specified in the selection data.

Ensure that your application does not exceed the reduced motor data.

☞ The maximum allowed installation altitude of the motors above MSL is

- 3000 m in case of stators with housing and device connector or terminal box
- 5000 m in case of stators with connection cable

9.2 Environmental conditions

9.2.1 General information

According to DIN EN 60721-3-3, MBT motors in stationary and weather-protected applications may be operated under the following mechanical and climatic environmental conditions.

9.2.2 Mechanical environmental conditions

Vibration/sinusoidal vibrations

Direction	Maximum allowed load due to vibrations (10-2000 Hz)
Axial	10 m/s²
Radial	30 m/s²

Tab. 9-1: Maximum values for sinusoidal vibrations

Shock/impacts

Motor frame size	Maximum allowed shock load (6 ms)	
	Axial	Radial
130 ... 531	100 m/s²	100 m/s²

Tab. 9-2: Maximum values for shock load

☞

- Ensure that the maximum values specified above for vibrations and impacts are not exceeded during storage, transport, and operation of the motors.
- The design and effectiveness of shock-absorbing or shock-decoupling accessories depend on the particular application and have to be determined by measurement. This is not lie in the responsibility of the motor manufacturer.

  Modifications of the motor design result in loss of the warranty.

9.2.3 Climatic environmental conditions

Humidity/temperature

Climatic environmental conditions are defined according to different classes as specified in DIN EN 60721-3-3, Table 1. They are based on long-term experiences and take all influencing variables into account, e.g., air temperature and air humidity.

On the basis of this table, Rexroth recommends Class 3K4 for permanent use of the motors.

The following table provides extracts of this class.

Environmental influences	Unit	Class 3K4
Low air temperature	°C	+5 [1])
High air temperature	°C	+40
Low rel. air humidity	%	5
High rel. air humidity	%	95
Low absolute air humidity	g/m³	1
High absolute air humidity	g/m³	29

Environmental influences	Unit	Class 3K4
Temperature change rate	°C/min	0.5
[1]) Rexroth allows 0 °C for non-liquid-cooled motors.		

Tab. 9-3: Classification of climatic environmental conditions according to DIN EN 60721-3-3, Table 1

9.3 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** applies to the stator (MST) and the rotor (MRT) according to DIN EN 60034-5. 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 under 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.

9.4 Acceptances and approvals

9.4.1 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.

9.4.2 UR/cUR listing

MBT motors have been presented by the UL authority “Underwriters Laboratories Inc.®” and have been registered with this authority. The E-file number issued is E341734.

The appropriate identification of the motors is specified on the motor type plate.

The following designs are not UR/cUR listed:

- MST360E-0018-FT-N0CN-NNNN - R911323252
- MST360E-0018-FT-N0SN-NNNN - R911297878

A non-UL-compliant cable thread is used for this products.

9.4.3 China RoHS 2

Mounting of the MBT series according to the specifications of standard SJ/T11364 and they have an EFUP (Environmentally friendly use period) of 25 years. For more information, refer to https://www.boschrexroth.com.cn/zh/cn/home_2/china_rohs2 www.boschrexroth.com.cn/zh/cn/home_2/china_rohs2 in section "Kit motors".

9.5 Compatibility test

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

As it is not possible to follow the continuing development of all materials (e. g. lubricants in machine tools) which may interact with our controls and drives, it cannot be completely ruled out that any reactions with the materials used by Bosch Rexroth might occur.

For this reason, before using the respective material a compatibility test has to be carried out for new materials (e. g. lubricants and cleaning agents) and our housing or our housing materials.

9.6 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 (Germany: DIN EN 50 499, DIN VDE 0808-499)
- Standard EN 50527 (Germany: 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 exposition. 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 exposition 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.

9.7 Motor cooling

9.7.1 General information

The motor power loss P_V is converted into heat and then dissipated via the liquid cooling system. MBT motors can only be operated if the coolant supply is ensured. 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!**

⇒ Follow the motor data and explanations on the concept of cooling systems contained in the documentation "Liquid Cooling of Rexroth Indramat Drive Components", DOK-DIAX01-DRIVE***LIQ-AU□□-□□-P.

⇒ Comply with the manufacturer's instructions when designing and operating cooling systems.

⇒ Do not use any cooling lubricants or cutting materials of machining processes.

⇒ Avoid contamination of the cooling medium as well as modifications of chemical composition and pH level,

9.7.2 Coolant

General information

All specifications and technical data refer to water as coolant. When using other coolants, this data is no longer valid and has to 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 ≤ 100 µm.
- 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.

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.

9.7.3 Coolant additives

Coolant additives

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

Nalco Deutschland GmbH	http://www.nalco.com
FUCHS PETROLUB AG	http://www.fuchs-oil.com
Clariant Produkte (Germany) GmbH	http://www.antifrogen.de
hebro chemie GmbH	http://www.hebro-chemie.de
TYFOROP Chemie GmbH	http://www.tyfo.de
Schweizer-Chemie GmbH	http://www.schweitzer-chemie.de

Tab. 9-4: Manufacturer of chemical additives

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. The water 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.

9.7.4 Materials used

At MBT motors, the coolant comes into contact with the following materials:

Frame size MST	Cooling jacket	Housing	O-ring
130 ... 531	AlSi5Mg	-	Viton
360 ... 530		AlSi5Mg	

Tab. 9-5: Materials coming into contact with the coolant

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.

9.7.5 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

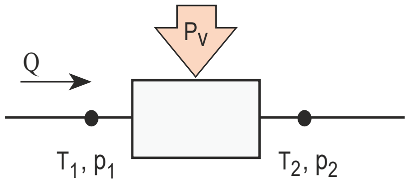
Coolant inlet temperature to be set: +25 ... +40 °C

☞ 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.

9.7.6 Dimensioning the cooling circuit

General information

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.



Q	Flow quantity
T_1	Coolant inlet temperature
T_2	Coolant outlet temperature
p_1	Inlet pressure
p_2	Outlet pressure

Fig. 9-2: Liquid-cooled component

Coolant temperature rise

$$\Delta T = T_2 - T_1$$

ΔT	Coolant temperature rise in K
T_2	Coolant outlet temperature in K
T_1	Coolant inlet temperature in K

Fig. 9-3: Coolant temperature rise in K

Pressure drop

$$\Delta p = p_1 - p_2$$

Δp	Pressure drop
p_1	Inlet pressure
p_2	Outlet pressure

Fig. 9-4: Pressure drop via flown through component

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. 9-5 "Coolant flow required for removing power loss." on page 268 and tab. 9-6 "Substance values of different coolants at 20°C" on page 269:

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

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

Fig. 9-5: Coolant flow required for removing power loss.

Coolant	Specific heat capacity c in J / kg · K	Density ρ in kg/m³
Water	4,183	998.3
Thermal oil (example)	1000	887
Air	1007	1188

Tab. 9-6: Substance values of different coolants at 20°C

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:

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

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

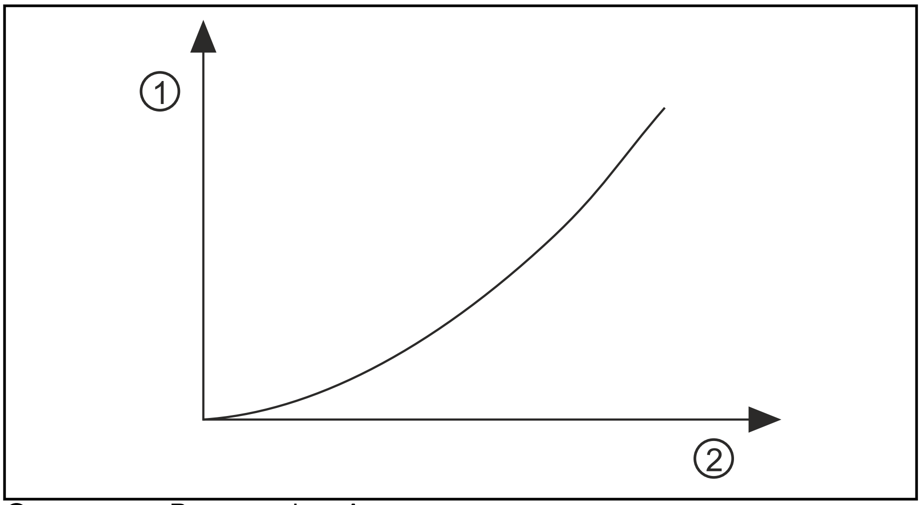
Fig. 9-6: Reduced motor torque with non-water coolant at identical flow rate

Pressure drop

The flow resistance at the pipe walls, deflections and changes in cross section leads to a pressure drop in the flown through component (see fig. 9-4 "Pressure drop via flown through component" on page 268).

The pressure drop Δp is increased with an increase in flow rate (see fig. 9-7 "Pressure drop depending on the flow rate; general representation" on page 269).

☞ 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.



① Pressure drop Δp
② Flow rate Q

Fig. 9-7: Pressure drop depending on the flow rate; general representation

Cooling system principle

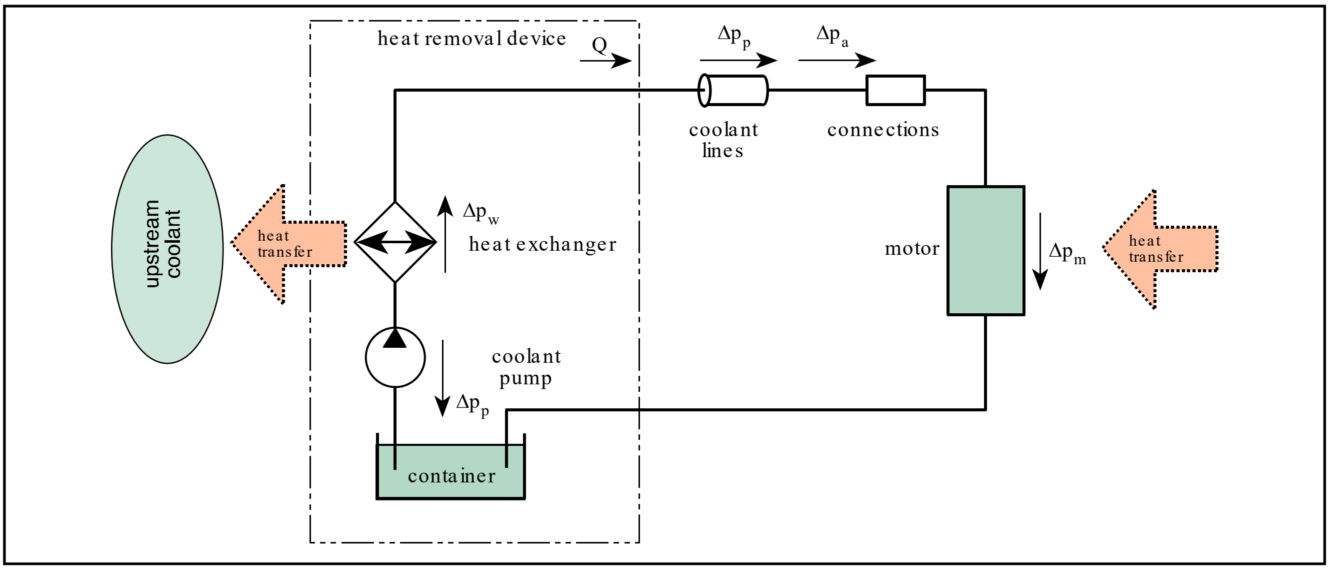


Fig. 9-8: General arrangement of a liquid cooled motor with heat removal facility

9.7.7 Liquid cooling system

General information

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 removal device via a distribution unit.

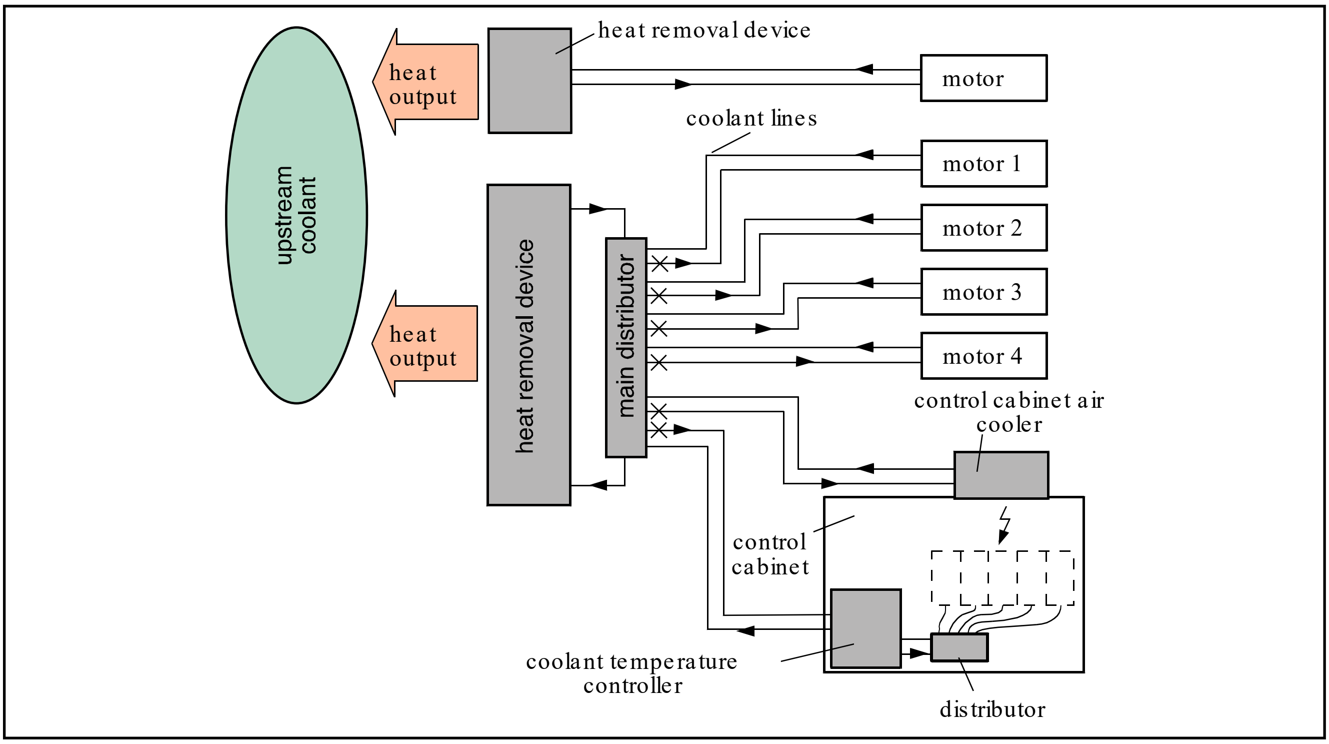


Fig. 9-9: General arrangement of cooling systems with one and more drive components

Heat removal device

The heat removal 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 removal devices. They are identified by the type of the heat exchanger between the different media:

1. **Air-to liquid cooling unit**
2. **Liquid-to-liquid cooling unit**
3. **Cooling unit**

A heat removal device includes a heat exchanger, a coolant pump and a coolant container (see fig. 9-10 "Heat removal devices" on page 272).

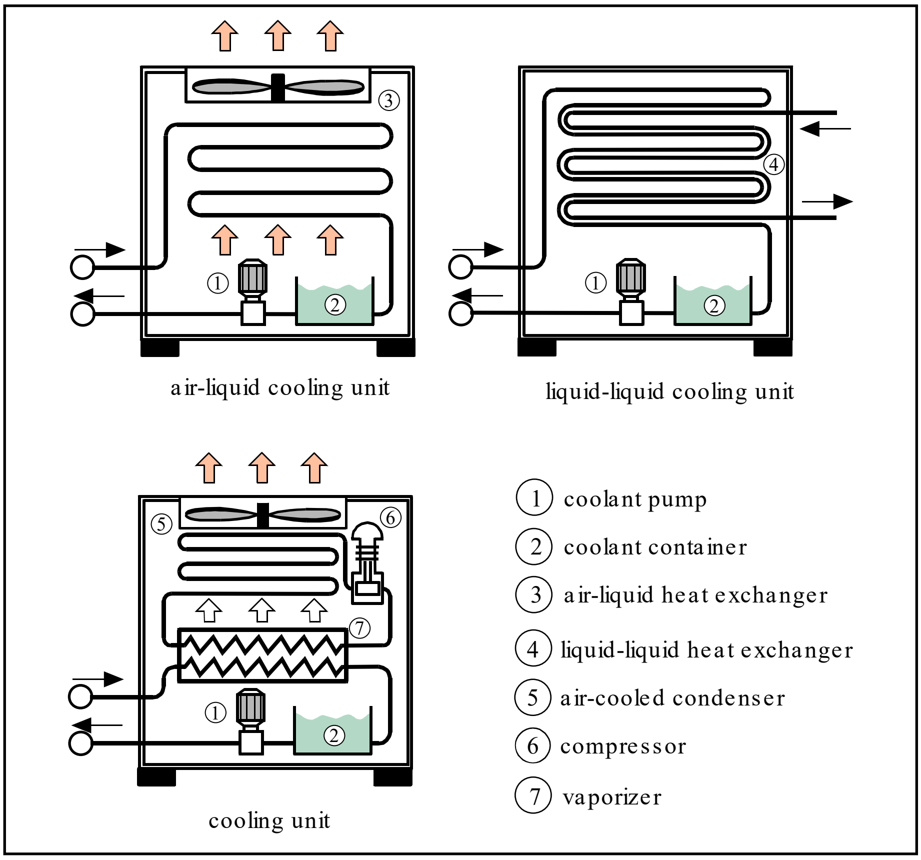


Fig. 9-10: Heat removal devices

	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
Notes on operational criteria	Particularly suitable for stand-alone machines that do not have an 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 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.

Tab. 9-7: Overview of the heat removal devices according to utilization criteria

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

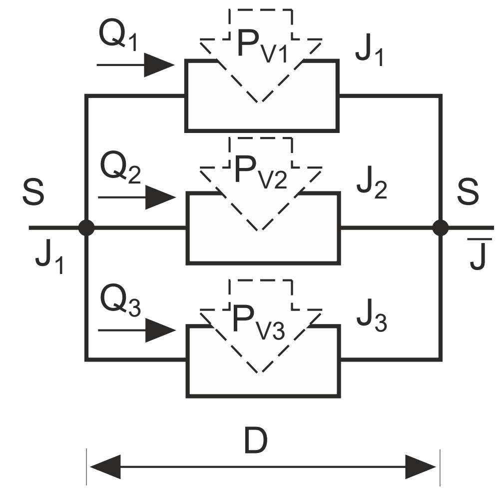


Fig. 9-11: Parallel connection of liquid-cooled drive components

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.

$$Q = Q_1 + Q_2 \; \ldots + Q_n$$

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

Δp Pressure drop
Q Flow quantity

Fig. 9-12: Pressure drop and flow rate in the parallel connection of hydraulic components

When several working components are cooled, a 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

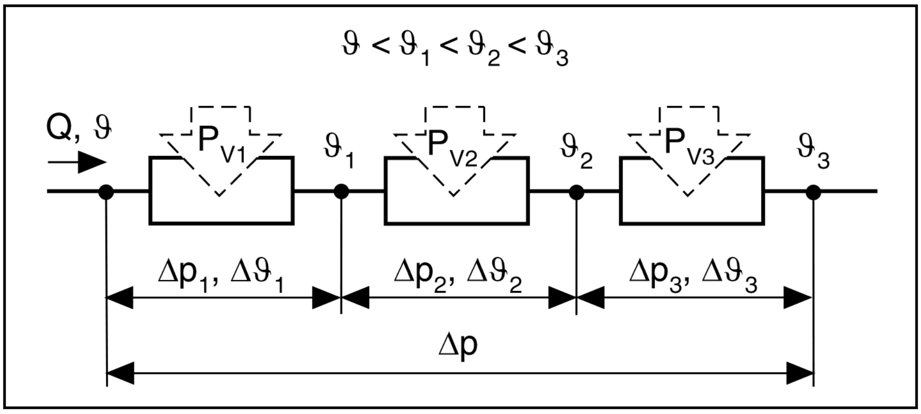


Fig. 9-13: Series connection of liquid-cooled drive components

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 quantity and only cause a small pressure drop or if they are installed very far away from the heat removal device.

$$Q = Q_1 = Q_2 = Q_n$$

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

Δp	Pressure drop
Q	Flow quantity

Fig. 9-14: Pressure drop and flow rate in series connection of hydraulic components

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 incresaes 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.

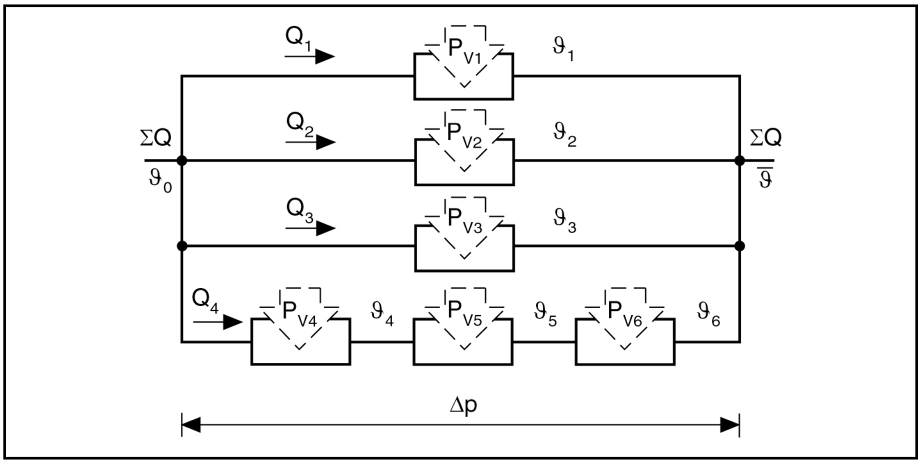


Fig. 9-15: Combination of series and parallel connection

9.7.8 Operation without liquid cooling

Theoretically, an operation of MBT motors without any liquid coolant is possible. Without liquid cooling, however, the performance data available is reduced considerably.

- For operation without liquid cooling, only motors of frame size 130 "cooling type N" (natural convection) and frame size 530C "cooling type S" (surface cooling) are approved.

☞ Operation without liquid coolant is only allowed with an application test and explicit approval by Bosch Rexroth. Without verification and approval, this operating mode is not intended and excludes any warranty.

If required, please contact the responsible Bosch Rexroth regional office. Please refer to the appendix for the addresses.

9.7.9 Rotor temperature

The max. permissible rotor temperature during motor operation is +100 °C. If this temperature limit can be exceeded, e.g. if heat enters the motor via parts attached on the rotor, the user has to provide additional cooling of these parts.

9.8 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.

Stators of synchronous torque motors type MBT are provided with integrated temperature sensors for motor protection by default. Each motor phase contains one of three ceramic PTCs connected in series to enable reliable thermal monitoring of the motor in every phase of operation. These temperature sensors (referred to as motor protection temperature sensor below) have a switching characteristic (chapter 9.7.6 "Dimensioning the cooling circuit" on page 267) and are evaluated at all Rexroth drive controllers.

Furthermore all stators feature an additional temperature sensor for temperature measurement. This sensor (referred to as Temperature measurement sensor below) has an approximately linear characteristic curve (see fig. 9-17 "Characteristic temperature sensor KTY84-130" on page 278).

Motor protection temperature sensor

Type	PTC SNM.150.DK.***
Rated response temperature ϑ_{NAT}	150 °C
Resistance at 25 °C	≈ 100 ... 250 Ohm

Tab. 9-8: Motor protection temperature sensor

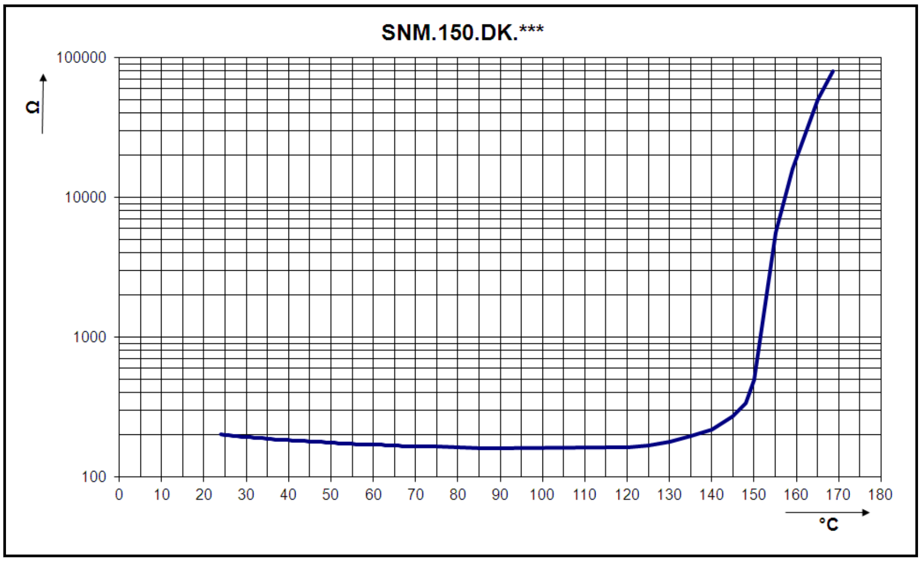


Fig. 9-16: Motor protection sensor characteristics (PTC)

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

Tab. 9-9: Standard values at temperature sensors KTY84-130

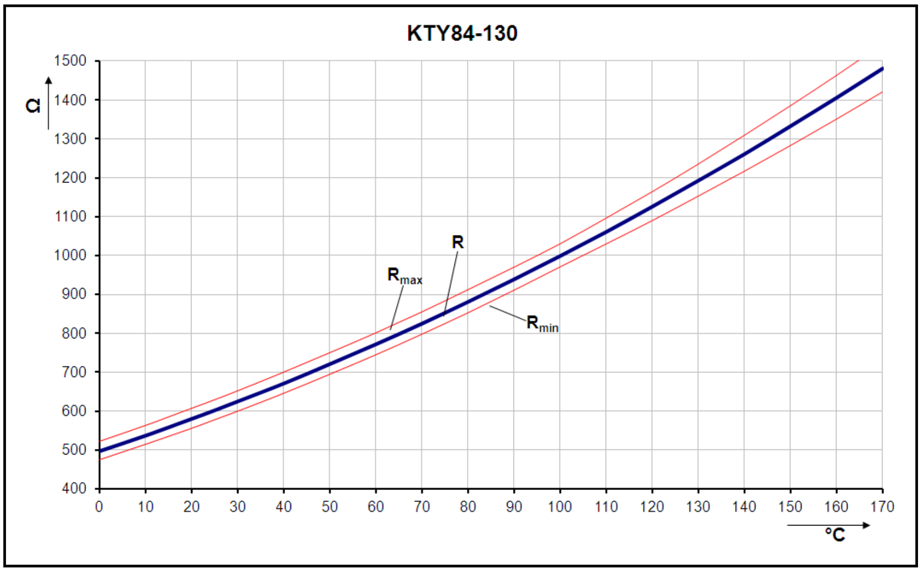


Fig. 9-17: Characteristic temperature sensor KTY84-130

☞ • Temperature sensor KTY84-130 is a component that might by damaged by ESD! For this reason, the wires of the sensor are protected by a protective foil at the connection cable. Before connecting the sensor, take appropriate measures for ESD protection (ESD = electrostatic discharge).

Protection from thermal overload during standstill operation

In the motor is to be operated at standstill or close to standstill, special conditions apply. For means of simplification, this operation is indicated as standstill operation in the following. The standstill operation is marked by the following aspects:

- The duration of the standstill operation is longer than 10 % of the respective thermal time constant T_{th}
- Motor does not move
- Motor performs only very small strokes (≤ 2 * T_p)
- Motor moves only at very low frequency (f ≤ 0.1 Hz)

Due to the 3-phase system, during standstill operation in one of the three phases there is always an instantaneous value of the current, the amount of which is higher than the permissible continuous current. Does the current flow continuously, the motor is overheated and thermally damaged. Also refer to chapter 9 "Application notes" on page 259). The peak value of the instantaneous current is equal with the amplitude of the sinusoidal assumed phase current. Its value is higher by root 2 than the effective value of the continuous current (I_N). The power loss P_V, created in the coil, is calculated using

$$P_V = 1{,}5 \cdot I^2 \cdot R_{12} \cdot (1 + \Delta\vartheta \cdot \alpha_{Cu})$$

Δθ	Temperature difference between operation temperature and 20 °C
α_{Cu}	Temperature coefficient of the specific resistance of copper = 0.0039 Ohm * m / mm²

Fig. 9-18: Power loss coil

For the nominal current, a double power loss occurs in the affected coil.

Differentiate between the following cases:

1. Use tripple sensor SNM.150.DK

If the tripple sensor SNM.150.DK used to monitor the winding temperature, all three phases are monitored. The motor winding is protected.

2. Use a single-phase sensor KTY84-130

The KTY84-130 is mounted in one phase only. Due to the utilization of the KTY84-130, the other phases cannot be protected from thermal overload at standstill operation.

☞ If the KTY84-130 is used for thermal motor protection, the standstill current I_0 specified in the motor data sheet must be reduced to **71%** of the specified value.

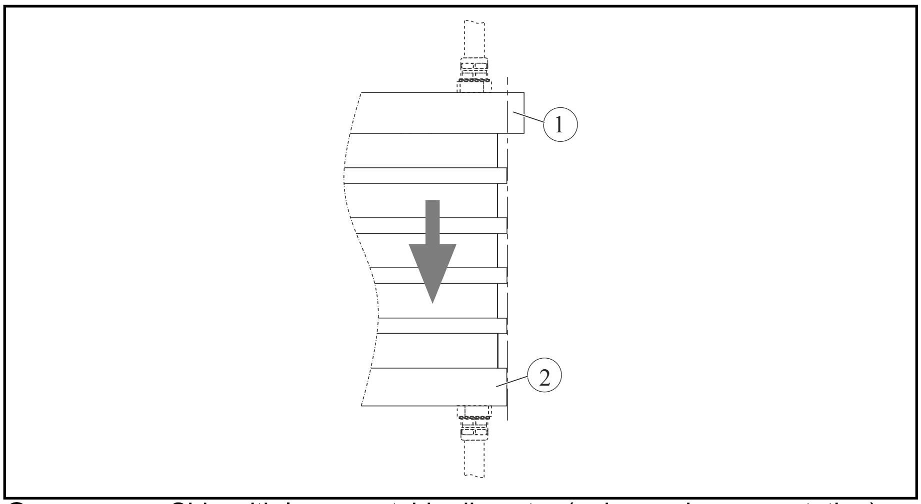
9.9 Attachment

9.9.1 Stators with cooling jacket (without housing)

The stator is attached by screwed connections to one of the two front faces of the stator. Under no circumstances should both front faces be screwed down. The diameters of the front faces of the stator may vary depending on the selected stator type, this facilitating assembly (see fig. 9-19 "Example: Stator assembly" on page 280).

When planning the mounting process, refer to the selected output direction of the power cable as well as the details of the dimension sheets referring to

- the quantity and type of the mounting thread,
- the tightening torque,
- the screw-in depth.



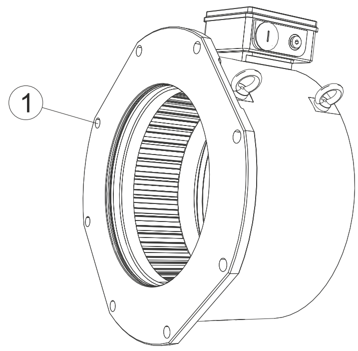
① Side with larger outside diameter (enhanced representation)
② Side with smaller outside diameter

Fig. 9-19: Example: Stator assembly

- The screw length required depends on the machine construction.
- Under no circumstances should both stator front faces be screwed down.
- The screwed connections have to be able to take up both the force due to the weight of the motor and the forces acting during operation.
- Comply with the minimum screw-in depth for screwed connections on the stator MST.
- For more information on assembly of motors with cooling jacket, please refer to chapter 12.4 "Mechanical assembly" on page 310.

9.9.2 Stators with cooling jacket and housing

Stators which have already been ordered with the housing option can be attached via the mounting holes in the flange on the machine. Mounting is facilitated considerably due to lower effort during mounting.



① Mounting holes (8 pieces) for flange mounting, example of MST360 with housing

Fig. 9-20: Illustration example MST360 with housing

When planning the output direction of the power connection, refer to the details in the dimension sheets referring to quantity and type of the mounting holes.

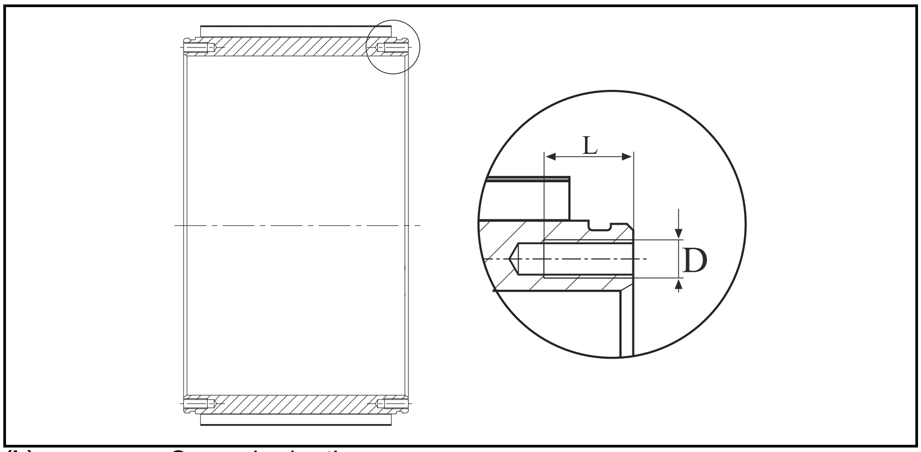
☞
- The screwed connections have to be able to take up both the force due to the weight of the motor and the forces acting during operation.
- The required tightening torque and screw length depend on the machine construction.
- Please note the specified mass of the individual types in Tab. 4-33.
- For more information on assembly of motors with cooling jacket and housing, please refer to chapter chapter 12.7 "Mounting stators with cooling jacket and housing" on page 318.

9.9.3 Rotor

The rotor is connected to the machine or a spacer sleeve via screwed connections.

During assembly, comply with the details in the dimension sheets referring to

- the quantity and type of the mounting holes,
- the tightening torque,
- the screw-in depth.



(L) Screw-in depth
(D) Thread diameter

Fig. 9-21: Rotor attachment

- The screw length required depends on the machine construction.
- The screwed connections have to be able to take up both the force due to the weight of the motor and the forces acting during operation.
- Comply with the minimum screw-in depth for screwed connections on the rotor MRT.
- The rotor may not be heated.
- For more information on assembly of rotors of frame sizes 360 and 530, please refer to chapter chapter 12 "Installation" on page 309.

9.10 Foreign bodies

9.10.1 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 is not included in the scope of delivery of MBT motors. 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.

Selection

The accuracy of the motors is generally defined by the

- mechanical rigidity of the overall system.

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.

For more information on encoder systems, encoder signals and corresponding interface connections, please refer to the control units documentation DOK-INDRV*-CSH********-PR□□-□□-P. For detailed information on the individual encoder types, please refer to the respective publications of the encoder manufacturers.

☞ If used in connection with the DIAX04 and ECODRIVE03 drives by Rexroth, MBT motors may only be operated togerther with an absolute measuring system. In this case, all current firmware versions of DIAX04 and ECODRIVE03 can be used!

The combination of an incremental measuring system with MBT motors cannot be used for DIAX04 and ECODRIVE03! These kind of applications are not supported!

In connection with the new IndraDrive generation, MBT motors can be combined both with incremental and with absolute measuring systems!

Suppliers for encoder systems include:

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: 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: www.renishaw.de
Geared encoder GEL....	**Lenord, Bauer &Co.GmbH** Dohlenstraße 32 46145 Oberhausen, Germany Tel.: +49 (0) 208 / 9963 - 0 Fax: +49 (0) 208 / 6762 - 92 Internet: www.lenord.de

Tab. 9-10: Motor encoder suppliers

9.10.2 Bearings

☞ Bearings are not included in the scope of delivery of an MBT motor. Suitable bearings have to be selected by the machine manufacturer based on the requirements of your application or machinery.

Selection

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:

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
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

Tab. 9-11: Motor bearing suppliers

10 Motor dimensioning

10.1 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.

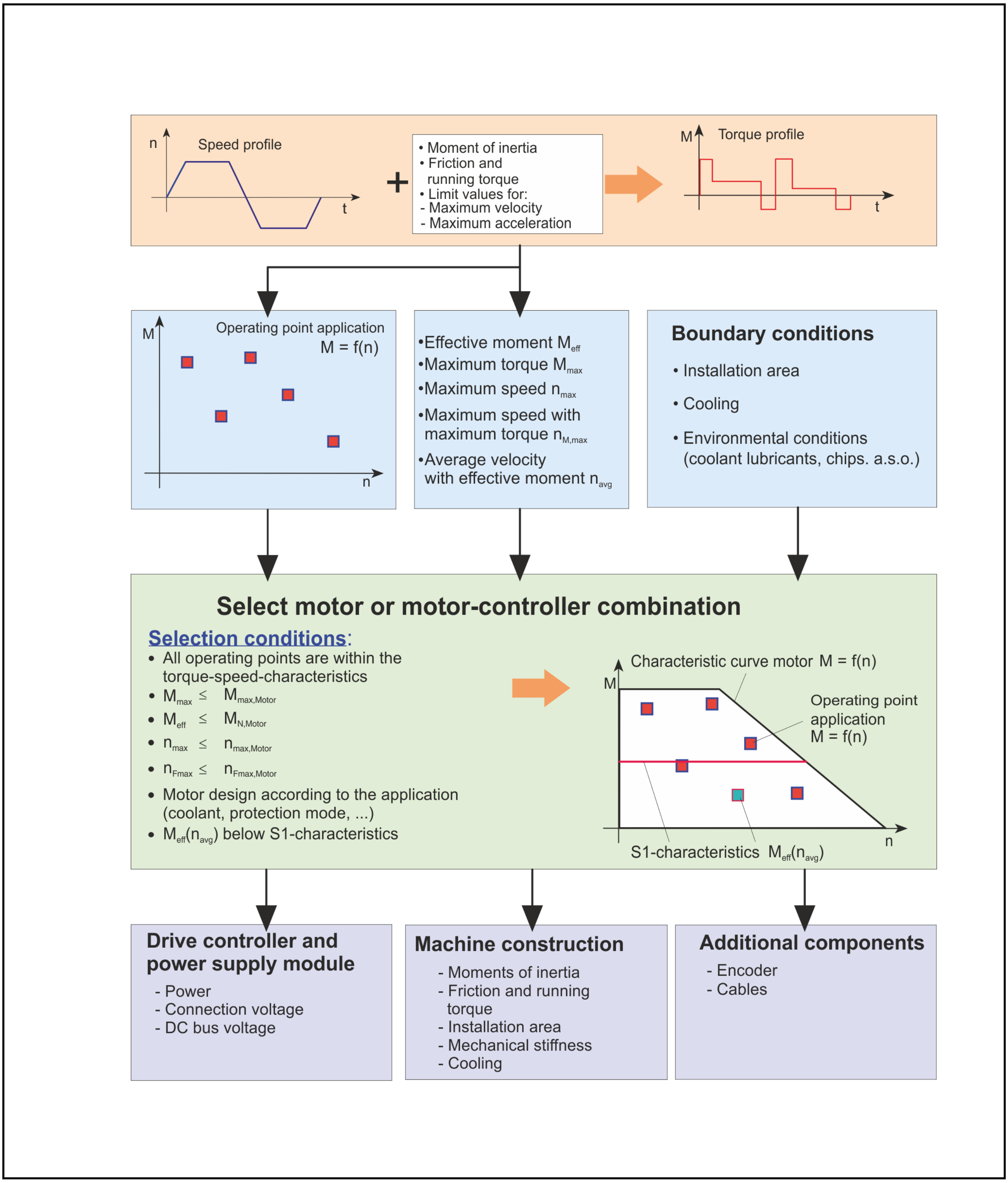


Fig. 10-1: Sequence of torque drive dimensioning

10.2 Basic formulae

10.2.1 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.

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

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

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

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

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

n(t)	Speed profile in time characteristic
a(t)	Acceleration profile vs. time in m/s²
M(t)	Torque profile in time characteristic in N
J_{rot}	Rotor inertia torque in kg*m²
$F_0(t)$	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

Fig. 10-2: General equations of motion

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.

10.2.2 Torques

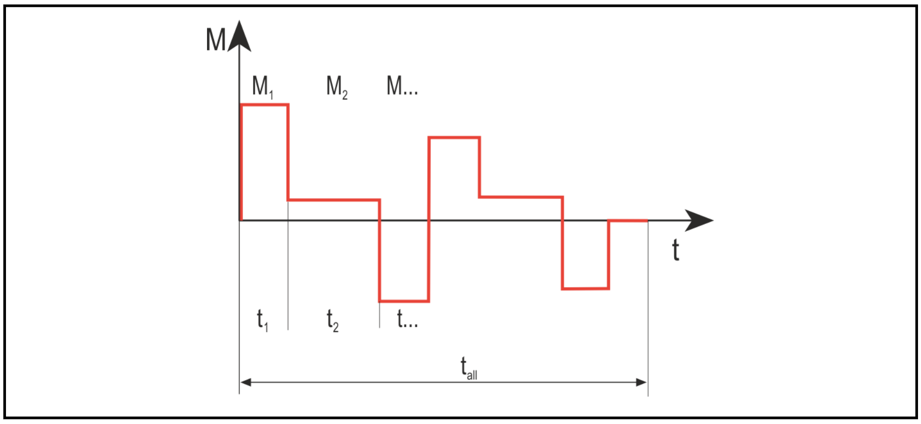


Fig. 10-3: Determining torques

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

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

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

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/s²
J_{rot}	Moment of inertia of rotor
t_{all}	Total duty cycle time in s

Fig. 10-4: Determining torques

☞ 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.

10.2.3 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:

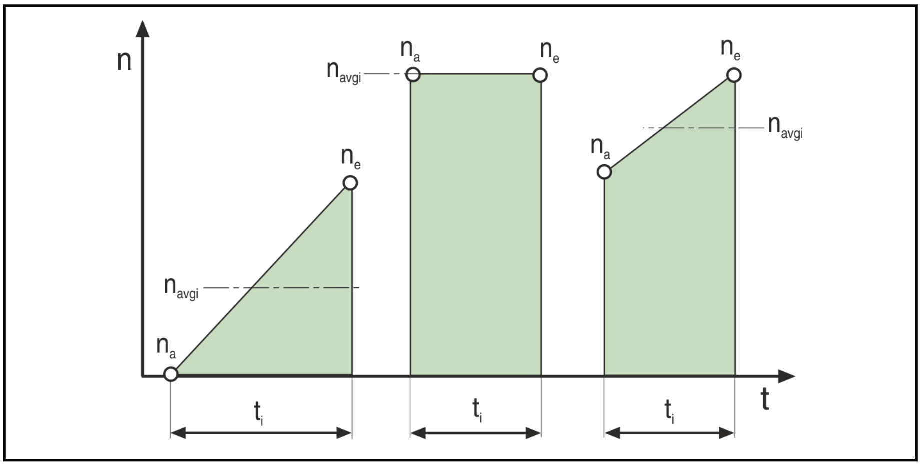


Fig. 10-5: Triangular or trapezoidal velocity profile

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

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

n_{avgi}	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

Fig. 10-6: Determining the mean speed of triangular or trapezoidal speed profiles

10.2.4 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.

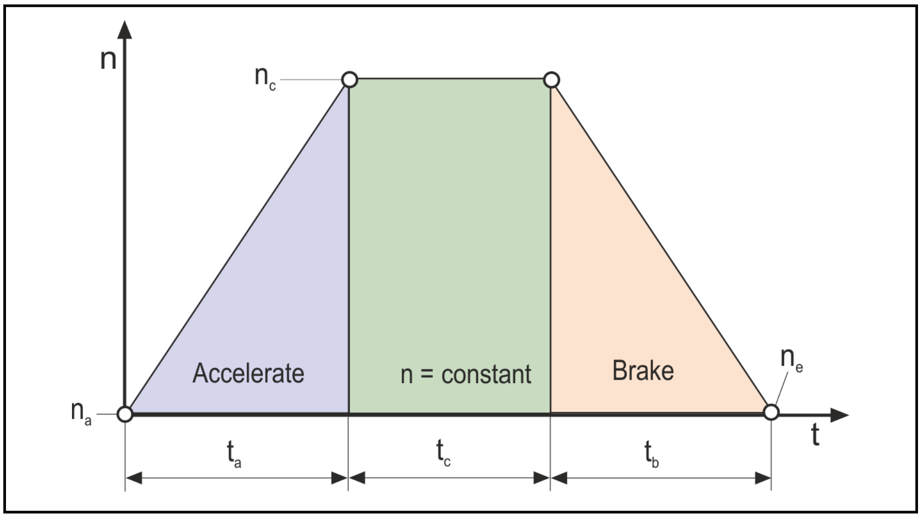


Fig. 10-7: Trapezoidal speed profile

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

☞
- Speed n ≠ constant
- Initial velocity n_a = 0 min^{-1}
- Acceleration a = constant and positive

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

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

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

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

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

Fig. 10-8: Uniformly accelerated motion, initial speed = 0 (for trapezoidal speed profile)

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

☞
- Speed n ≠ constant
- Initial velocity n_a ≠ 0 min^{-1}
- Acceleration a = constant and positive

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

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

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

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

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 ° (' ")

Fig. 10-9: Uniformly accelerated motion, initial speed ≠ 0 (for trapezoidal speed profile)

Constant speed

- Speed n = constant
- Acceleration a = 0

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

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

$$\varphi_c = n_c \times t_c$$

n_c	Constant speed in min^{-1}
t_c	Time during constant speed in s
φ_c	Phase during constant speed in ° (' ")

Fig. 10-10: Constant speed (for trapezoidal speed profile)

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

- Speed n ≠ constant
- Final speed n_e = 0 min^{-1}
- Acceleration a = constant and negative

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

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

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

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

a	Acceleration in m/s²
v_c	Final speed in min^{-1}
t_b	Braking time in s
φ	Phase during deceleration in ° (' ")

Fig. 10-11: Constantly decelerated motion, final speed = 0 (for trapezoidal speed profile)

Decelerate, final speed ≠ 0 min^{-1}

☞
- Speed n ≠ constant
- Final speed n_e ≠ 0 min^{-1}
- Acceleration a = constant and negative

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

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

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

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

a	Acceleration in m/s²
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 ° (' ")

Fig. 10-12: Constantly decelerated motion, final speed ≠ 0 min^{-1} (for trapezoidal speed profile)

10.2.5 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.

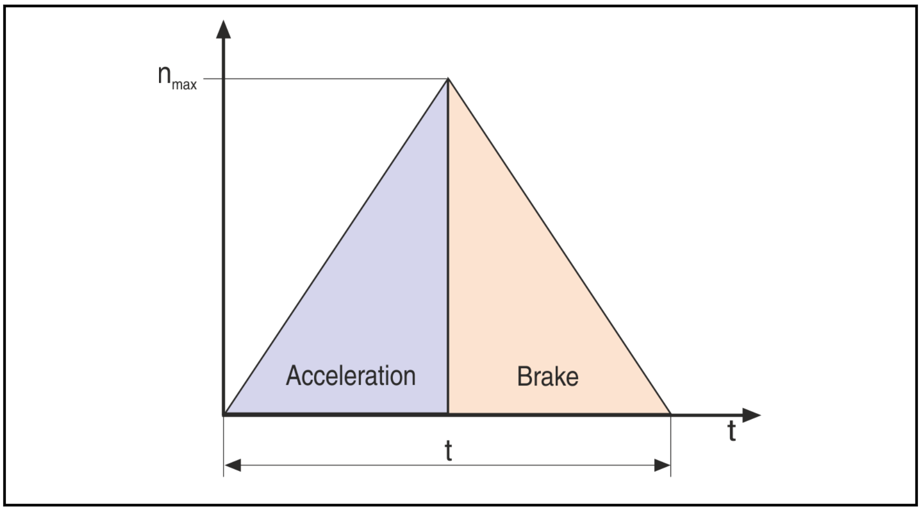


Fig. 10-13: Triangular speed profile

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

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

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

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

n_{max}	Maximum reachable speed in min^{-1}
a	Acceleration in m/s²
φ_{all}	Total travel path
t	Positioning time in s

Fig. 10-14: Calucation of triangular speed profile

10.3 Duty cycle and torque

10.3.1 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. 10-15).

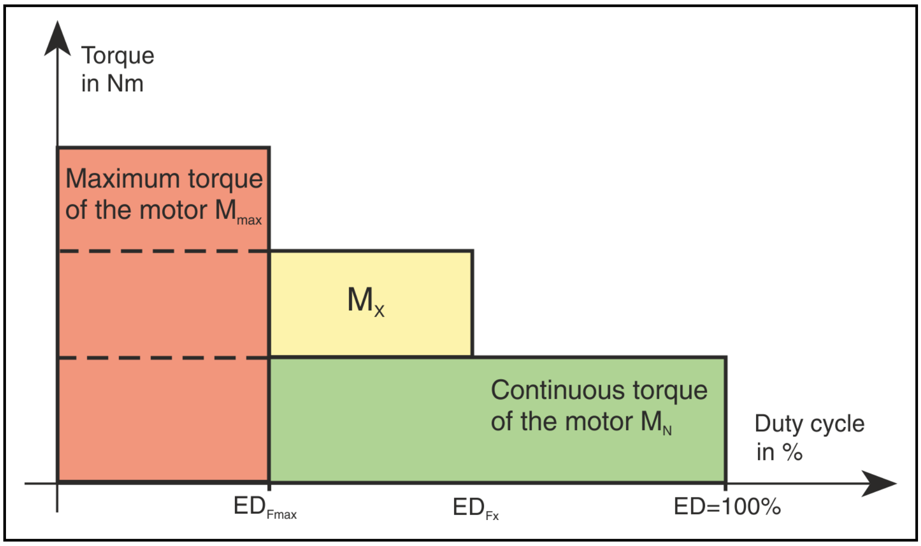


Fig. 10-15: Correlation between duty cycle and torque.

10.3.2 Determining the duty cycle

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

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

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

Fig. 10-16: Approximate determination of duty cycle ED

Prerequisites: Linear correlation between torque and current.

For MBT motors acc. to Fig. 10-16, 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 $M_{KB} \leq 1.5\ M_N$, this calculation is valid.

☞ For an exact determination of the relative duty cycle of the synchronous torque motors MBT, use Fig. 10-17 or Fig. 10-18.

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. 10-16.

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

ED_{real}	Possible relative duty cycle in %
P_{vN}	Maximum heat dissipation of the motor in W (for continuous power loss see chapter 4 “Technical data”).
$P_{AVG\ a}$	Average motor power loss in application over a duty cycle time including idle time in W

Fig. 10-17: Determining the duty cycle ED

Prerequisites: Duty cycle time ≤ Thermal time constant of motor

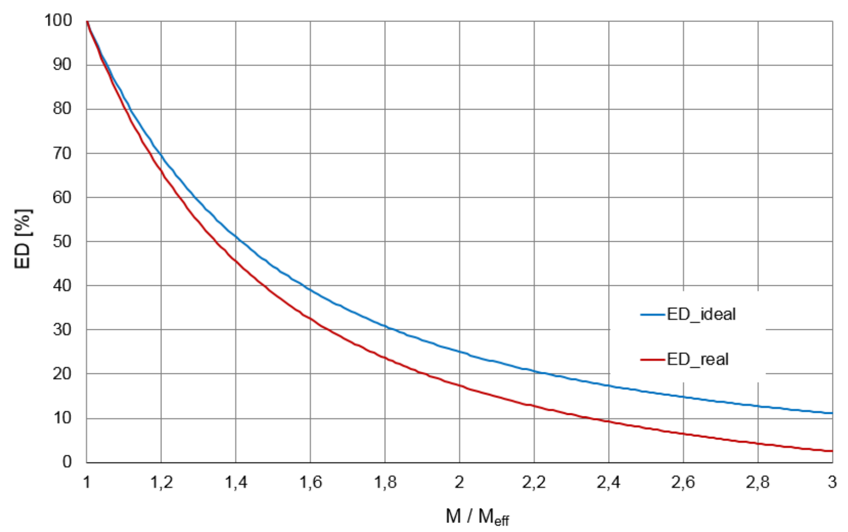


Fig. 10-18: Duty cycle via force for synchronous torque motors MBT

10.4 Determining the drive power

10.4.1 General

To size the power supply module or the mains rating, 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.

10.4.2 Continuous power

The continuous power corresponds to the sum of the mechanical and electrical motor power.

Total rated output: $P_c = P_{cm} + P_{ce}$

Mechanical rated output: $P_{cm} = F_{eff} \cdot v_{avg}$

Rated electrical output: $P_{ce} = \left(\frac{F_{eff}}{F_{dn}} \right)^2 \cdot P_{vn} \quad with \quad F_{eff} \leq F_{dn}$

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}	Rated force of the motor in N (see chapter 4 ”Technical data”)
P_{vn}	Rated power loss of the motor in W (see chapter 4 ”Technical data”)

Fig. 10-19: Continuous power of the linear motor

☞ When reducing the continuous torque, the electirc continuous poweris also reduced (seefig. 10-19).

10.4.3 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.

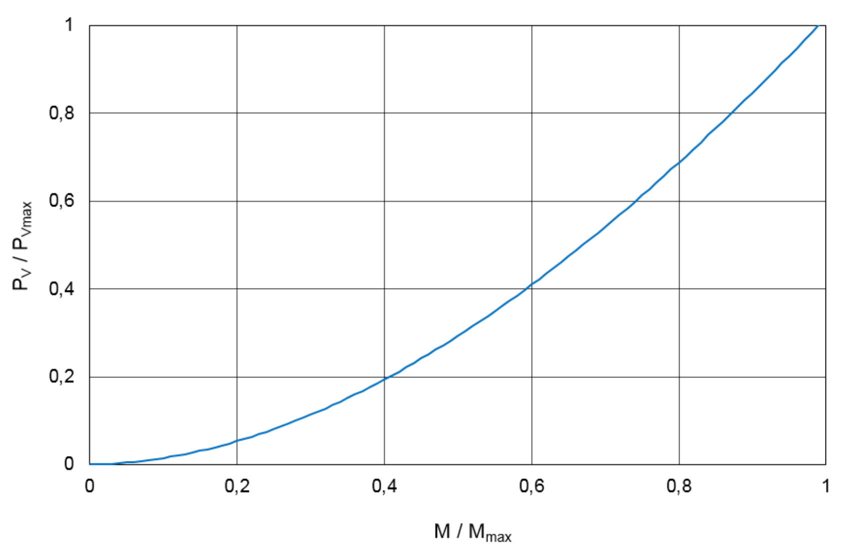
Total maximum power: $P_{max} = P_{max\,m} + P_{max\,e}$

Mechanical maximum power: $P_{max\,m} = F_{max} \cdot v_{F\,max}$

P_{max}	Total maximum power in W
P_{maxm}	Mechanical maximum power in W
P_{maxe}	Electrical maximum power in W (see the following diagram)
F_{max}	Maximum feed force in N
v_{Fmax}	Maximum velocity with Fmax in N

Fig. 10-20: Maximum power of the linear motor

☞ When reducing the maximum torque compared to the maximum torque of the motor, the electric maximum power is also reduced P_{maxe}. To determine the reduced electrical maximum output P_{maxe}, use Fig. 10-21.



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_{Vmax}	Maximum power loss of the motor in W

Fig. 10-21: Diagram used for determining the reduced electrical power loss

10.4.4 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.

$$P_{co} = P_{ce} = \left(\frac{M_{eff}}{M_N}\right)^2 \times P_V$$

$$P_{ce} = P_{Cu} = \frac{3}{2} \times R_{12} \times \left(1 + \Delta\vartheta \times \alpha_{Cu}\right)^2$$

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 chap. 4 Technical data)
P_V	Power loss of motor in kW (see chap. 4 Technical data)
P_{Cu}	Copper loss
R_{12}	Winding resistance at 20 °C (see chap. 4 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

Fig. 10-22: Required cooling capacity of the motor

The required flow rate to dissipate the cooling capacity ofchapter 10.4.4 "Cooling capacity " on page 299 for the cooling medium water is calculated from:

$$Q = \frac{P_{co} \times 60}{C_{H2O} \times \Delta\vartheta} = \frac{P_{co} \times 60}{4186{,}8 \frac{J}{kg \times K} \times \Delta\vartheta}$$

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

Fig. 10-23: Required flow rate

11 Handling and transport

11.1 Delivery status

11.1.1 General information

MBT motors are delivered in wooden crates.

⚠ CAUTION **Injuries due to uncontrolled movement of the tightening straps when cutting them!**

Maintain a sufficient distance and carefully cut the tightening straps.

Mounting ring

Upon delivery, the stator and rotor of frame sizes 450 and 530 are optionally connected to a mounting ring. During transport and storage, the mounting ring has to remain a the motor.

- Remove the mounting ring only after completion and assembly inspection.
- Use the mounting ring for securing the motor during disassembly and return of goods.

Corrosion protection

Stators MST of design “...-NS-..." are protected with corrosion protection wax RIVOLTA K.S.P. 317. Corrosion protection must be maintained for transport and storage.

Prior to mounting, the contact surface of these stators have to be cleaned with a suitable cleaning agent (e.g. RIVOLTA A.C.S.3).

11.1.2 Factory testing

All 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
- Geometric measurement of all mounting sizes

11.1.3 Customer testing

Since all motors undergo a standardized test procedure, high-voltage tests on the customer side are not required. Motors and components could be damaged if they are subjected to repeated high-voltage tests.

⚠ CAUTION **Destruction of motor components due to improperly executed high-voltage test! Loss of warranty!**

⇒ Avoid repeated inspections.

⇒ Comply with the guidelines of DIN EN 60034-1.

11.1.4 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.

A data sheet is included for stator and rotor in addition to the , containing information about the handling.

In addition, the scope of delivery includes O-rings for coolant sealing if stators with liquid cooling are used.

If motors are provided with an optional mounting ring, an additional accompanying slip with appropriate details is enclosed.

☞ After having received the goods, compare the ordered type to the supplied type. Immediately complain about any deviations.

11.2 Transport and storage

11.2.1 General information

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 chapter 3)!**

⇒ 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 ring screw.

⇒ 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.

Permissible temperature range **-20 °C to +80 °C**.

⇒ **Store** the motors horizontally in a dry, vibration-free, dust-free and corrosion-protected condition.

Permissible temperature range **-20°C to +60°C.**

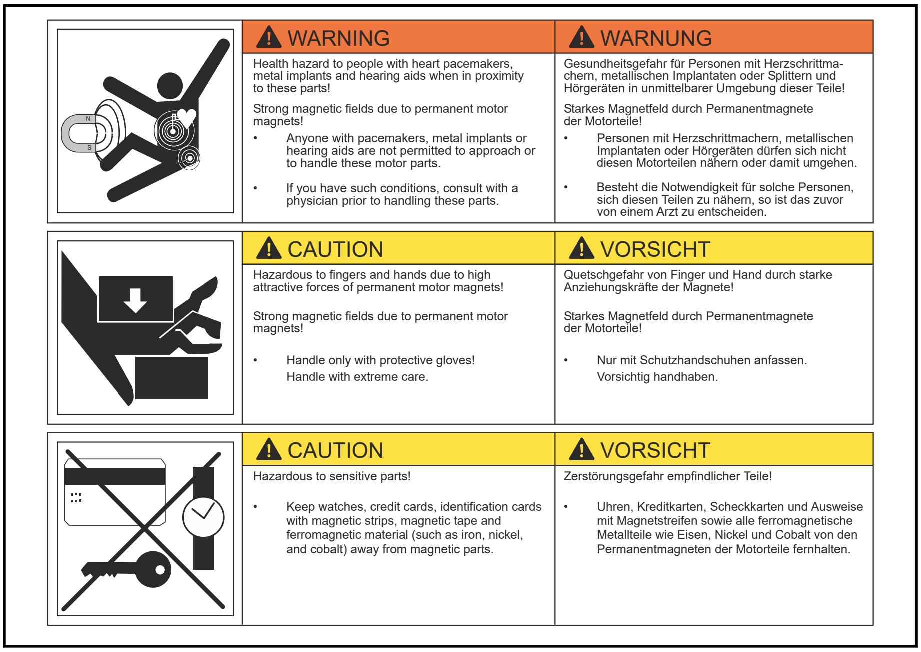


Fig. 11-1: Warning label on and in the packaging.

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.

11.2.2 Transport instructions

Transport our products only in their original package. Also refer to the specific ambient factors to protect the products from transport damage.

Based on DIN EN 60721-3-2, 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.

Allowed classes of environmental conditions during transport acc. to DIN EN 60721-3-2

Classification type	Allowed class
Classification of climatic environmental conditions	2K11
Classification of biological environmental conditions	2B1
Classification of chemically active materials	2C1
Classification of mechanically active materials	2S5
Classification of mechanical environmental conditions	2M4

Tab. 11-1: Allowed classes of environmental conditions during transport

For a better overview, some essential environmental influencing variables of the previously mentioned classifications are listed. Unless otherwise specified, the specified values 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.

Deviating from DIN EN 60721-3-2 permissible ambient conditions

Environmental factor	Unit	Value [1)]
Temperature	°C	-25 ... +70
Relative air humidity	%	5 ... 75
Absolute air humidity	g/m³	1 ... 29
Occurrence of salt mist	-	Not permitted

1) Differs from DIN EN 60721-3-2

Tab. 11-2: Deviating permissible storage conditions

☞ Before transport, empty the liquid coolant from the liquid-cooled motors to avoid damage.

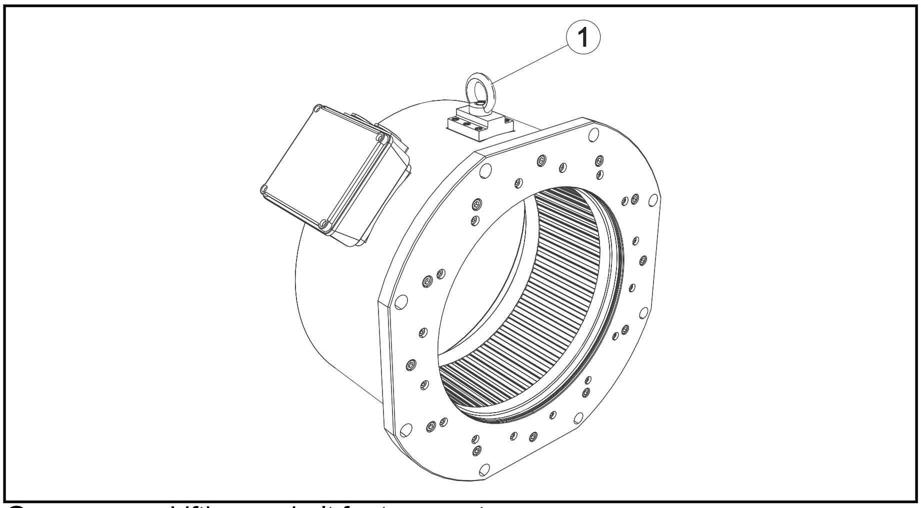
To lift the motor out of the transport crate or to install it in the machine, use the transport or lifting eyebolts at the motor.

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.

Transporting stators in the Rexroth housing

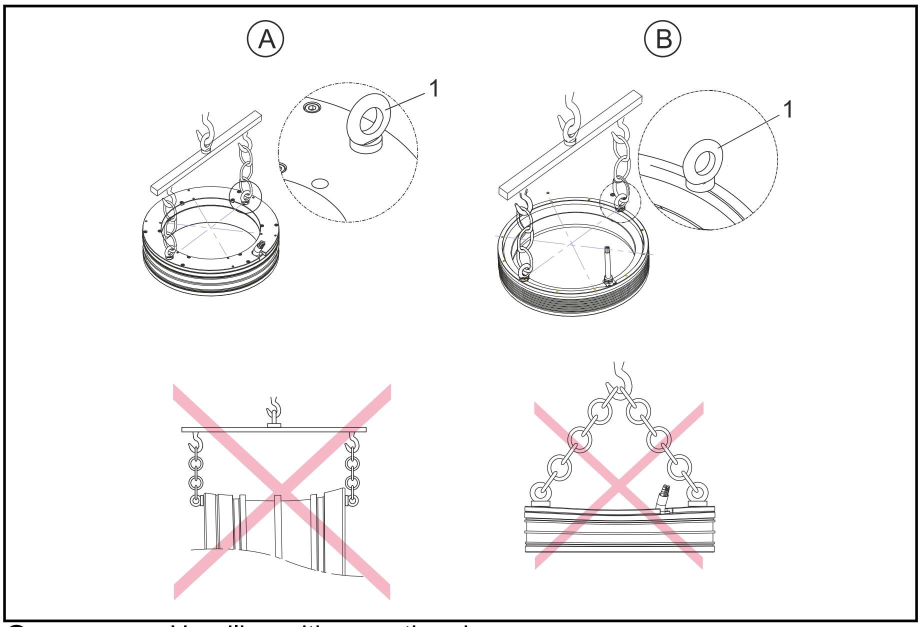
Stators which have already been ordered with housing ex factory feature one or two lifting eyebolts on the upper face of the housing (see dimension sheet of the stator), depending on the stator length or size, for transport. These lifting eyebolts also have to be used to lift and position the stators during assembly.



① Lifting eyebolt for transport

Fig. 11-2: Lifting eyebolt on MST450E with housing (example)

Transporting stators with and without mounting ring



Ⓐ Handling with mounting ring
Ⓑ Handling without mounting ring
① Lifting eyebolt for transport

Fig. 11-3: Transport of the MST stators

Please note:

- Use only suitable lifting gear.
- Use lifting eyebolts during transport in opposite holes only.
- Put down the motor components only on a clean, straight base in lying position.
- The stator will be unusable if the fits on the cooling jacket are damaged.

Instructions on transport by air

If motor components with permanent magnets aare 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.

11.2.3 Storage instructions

Store the motor only horizontally according to the following figure.

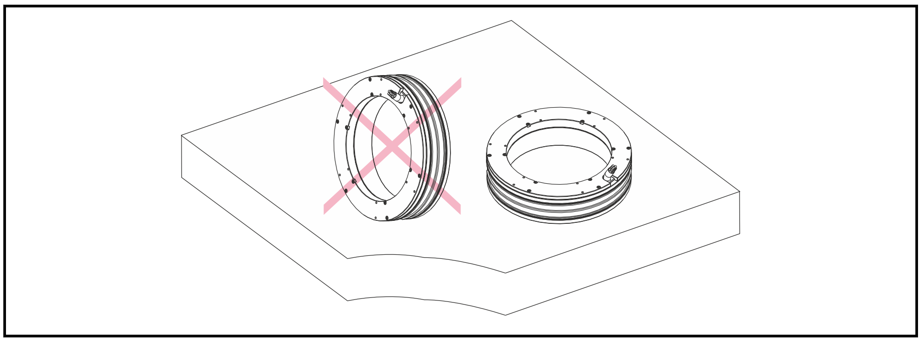


Fig. 11-4: Storing of motor components

Please note:

- Put down the motor only on a clean, straight surface in a horizontal position.
- Before storing or shipping the parts, remove the residual coolant and other contaminants.
- Use the transport crate to store the motor over a longer time and to protect it against damage and contamination.

Generally, Bosch Rexroth recommends to store all components until they are actually installed in the machine as follows:

- in their original packaging
- at a dry and dust-free location
- at room temperature
- free from vibrations and oscillations
- protected against light or direct sunlight

Upon delivery, protective sleeves and covers can be attached to Bosch Rexroth motors. They have to remain on the motor for transport and storage. Do not remove these parts until shortly before assembly.

Based on DIN EN 60721-3-1, 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.

Allowed classes of ambient conditions during storage acc. to DIN EN 60721-3-1

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

Tab. 11-3: Allowed classes of environmental conditions during storage

For a better overview, some essential environmental influencing variables of the previously mentioned classifications are listed. Unless otherwise specified, the specified values 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.

Deviating from DIN EN 60721-3-1 permissible ambient conditions

Environmental factor	Unit	Value 1)
Air temperature	°C	-25 ... +55
Relative air humidity	%	5 ... 75
Absolute air humidity	g/m³	1 ... 29
Insolation	-	Not permitted

1) Differs from DIN EN 60721-3-1

Tab. 11-4: Deviating permissible storage conditions

NOTICE **Damage due to moisture and humidity!**

- Use coverings to protect the products from moisture.
- Store them only in rainproof and dry rooms.
- Before storage, discharge the liquid coolant from liquid-cooled motors to avoid damage.

Irrespective of the storage duration - which can exceed the warranty period of our products - the function is retained provided additional measures are taken into account and carried out during commissioning. However, this does not entail any additional warranty claims.

Storage time for motors

Storage time	Measures for commissioning
< 1 year	No measures required
1 ... 5 years	Check the electric contacts to verify that they are free from corrosion
> 5 years	Check the electric contacts to verify that they are free from corrosion

Tab. 11-5: Measures before commissioning motors that have been stored over a prolonged period of time

Storage time for cables and connectors

Storage time	Measures prior to commissioning
< 1 year	None
1 ... 5 years	⇒Check the electric contacts to verify that they are free from corrosion
> 5 years	⇒If the cable or the cable jacket has porous parts, replace it; otherwise check the electric contacts to verify that they are free from corrosion

Tab. 11-6: Measures before commissioning of cables and connectors that have been stored over longer periods of time

12 Installation

12.1 General information

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 insulated on one side, e.g. insulation of the stator.

Safety instructions

The "Safety instructions" specified in chapter 3 and the safety instructions in this chapter have to be complied with at all times. They support the prevention of accidents and damage at material due to incorrect handling.

In addition, special safety instructions are provided in the assembly instructions. They are specified directly at the location of the hazard or where hazards may occur.

12.2 General safety instructions

⚠ WARNING **Injuries caused by live parts! Lifting of heavy loads! Risk of damage!**

⇒ Carry out all working 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 to the power supply.

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

Working area, handling and transport

Attach sufficient signs in your working area according to fig. 11-1 "Warning label on and in the packaging." on page 303 and comply with the handling and transport instructions under chapter 11 "Handling and transport" on page 301.

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 plant and apparatus has 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 plant. 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, provide emergency tools such as wedges (angle 10°-15°) and a hammer made of non-magnetic material.

12.3 Screw lock

All screwed connections have to 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 http://www.loctite.de. The manufacturer's homepage also provides information on hardening accelerators or other screw locks.

12.4 Mechanical assembly

12.4.1 General information

⚠ WARNING **The rotor is highly magnetic! Risk of injury and danger of crushing body parts by magnetic forces!**

⇒ Remove or secure any movable metal objects.

⇒ Handle all magnetic components with care.

⇒Wear protecting clothes and use mounting implements.

The following mounting instructions describe a noncommittal, schematic construction without considering the special structural features of the machine and serve only for general orientation.

The machine manufacturer has to consider the special character of his construction and has to prepare special mounting instructions. The machine manufacturer's mounting instructions are the only binding guidelines.

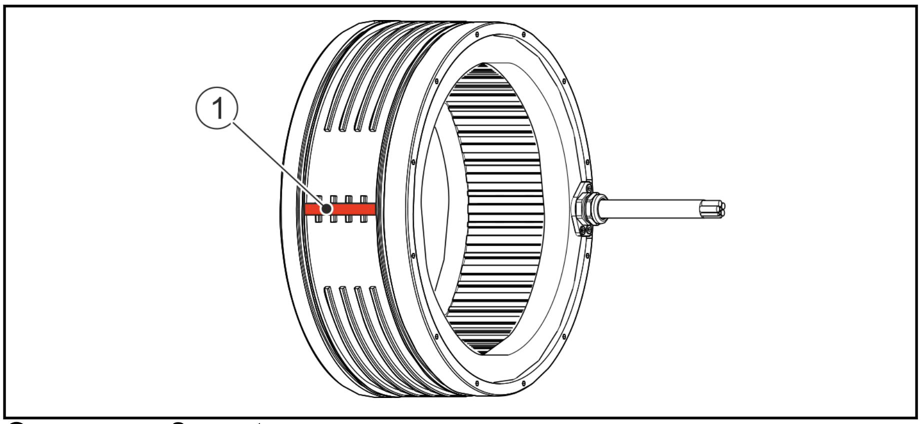
☞
- The rotor has to be mounted at room temperature and as described below. The rotor must not be heated.
- All screwed connections are equipped with a liquid screw lock. Refer to Chap.12.3 .

Installation of stators with encapulation “T”

Prior to stator installation, ensure that the coolant pipes of the cooling system and the cooling ducts of the stator function correctly (see chapter 12.10 "Coolant connection" on page 328).

⚠ CAUTION **Damage of stator due to insufficient cooling!**

If stator that is already in use or a previously disassembled stator is assembled again, check if the separator between inlet and outlet of the coolant is available (see fig. 12-1). If the stator has been commissioned without a separator, insufficient cooling can result in damaging the stator.



① Separator

Fig. 12-1: Glued in separator taking the example ol MST360

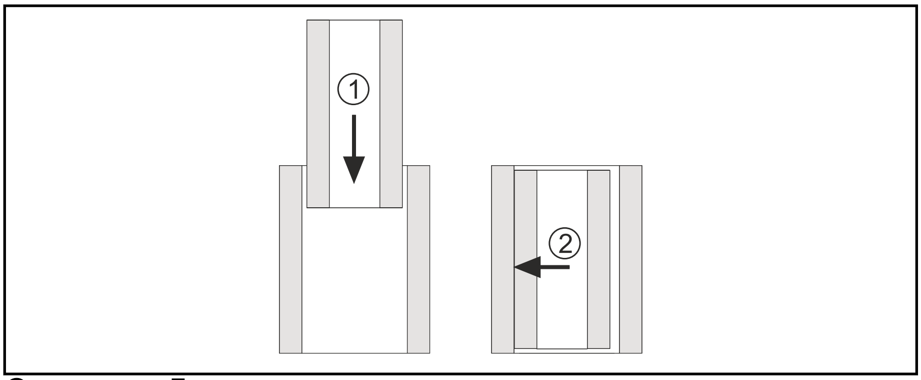
12.4.2 Preparation

Initial state: The motor lies on a clean and a flat surface.

1. Check whether the components are damaged. Damaged components must not be mounted.
2. Provide tools, auxiliary material, measuring and test equipment and make sure that the rotor can be mounted in a clean, dry and dust-free environment.
3. Check all components and mounting surfaces, holes and threads, as well as the O-ring grooves on the stator to verify that they are clean and free from burrs. Everything must be **clean, stainless and completely free from burrs.** Clean and deburr such areas if necessary.
4. Prior to assembly, clean the contact surfaces of the stators design "...-NS-.." with a suitable cleaning agent (e.g., RIVOLTA A.C.S.3).
5. Grease the O-rings with an ordinary lubricant grease and mount the O-rings in the stator grooves provided. Avoid twisting and soiling of the O-rings.
6. Screw the lifting eye bolts which are required for transport in mutually opposite threads. Check the machine construction to find out whether longer eye bolts with distance sleeves are required.

Ensure cleanliness during all working steps!

When inserting the rotor into the stator, take the radial and axial forces caused by magnetic force into account. Use an appropriate mounting tool to ensure that the rotor is prevented from coming into contact with the stator hole when it is inserted into the stator.



① F_{axial}
② F_{radial}

Fig. 12-2: Attractive forces during mounting

Rotor size MRT...		F_{axial} [N]	F_{radial} [N]
130	A	105	120
	C		370
	E		610
	G		850
160	A	145	410
	C		820
	E		1230
161	C	106	650
	E		1,300
	G		1,950
201	C	165	690
	D		1040
	F		1740
210	A	195	330
	C		830
	D		1160
	E		1650
	U		3630
251	F	220	2530
290	B	290	1000
	D		1500
	E		2,500
	F		3000
	G		3500

Rotor size MRT...		F_{axial} [N]	F_{radial} [N]
291	C	288	1320
	D		1990
	E		2650
360	B	370	1280
	D		1910
	E		3190
450	B	480	1,660
	D		2480
	E		4130
530	B	565	1940
	C		2920
	D		3890
	E		4860
	F		5830
	G		9710
	L		14560
	P		6,800
	R		8760
531	E	565	5200
	L		15600

Tab. 12-1: Magnetic attractive forces during mounting

12.5 Mounting stators with cooling jacket, without mounting ring

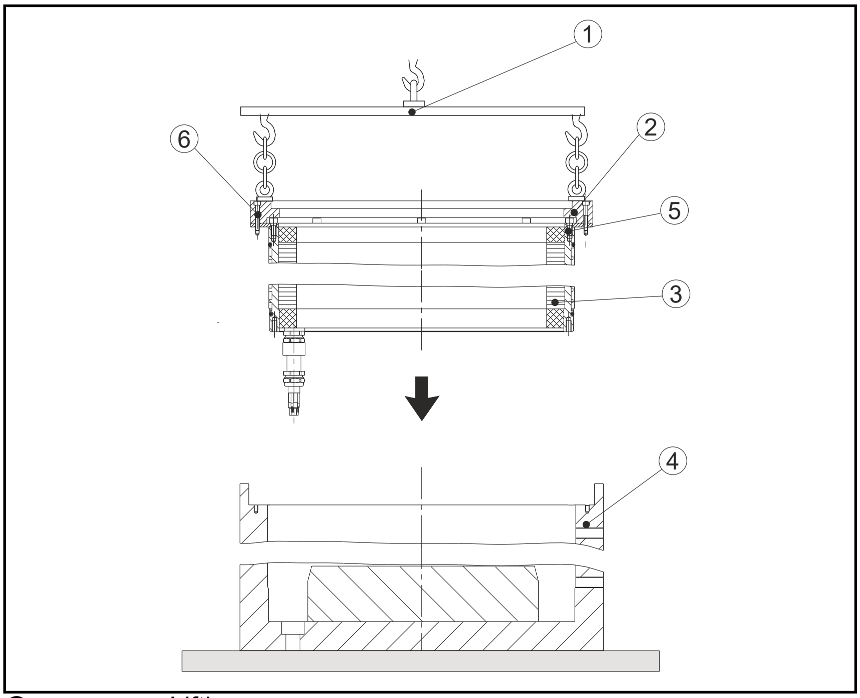
The following figures show the general mounting sequence. Comply with the machine manufacturer's special mounting instructions. All of the screwed connections mentioned below have to be secured with liquid screwlock. Refer to Chap.12.3 .

For details about existing threaded holes, tightening torques and screw-in depths, please refer to the particular rotor or stator dimension sheet

Initial state: The stator and rotor lie on a clean and flat surface. All of the steps described above have been complied with and have been executed.

Mount the motor according to the following schematic procedure:

1. Fasten the stator flange ② with the fastening screws ⑤ to the stator ③.
2. Center the stator with a suitable tool ① in the machine housing ④ and bring it into its final position without jam.



①	Lifting gear
②	Stator flange
③	Stator
④	Machine housing
⑤	Mounting screws for stator flange
⑥	Mounting screws for stator flange - machine housing

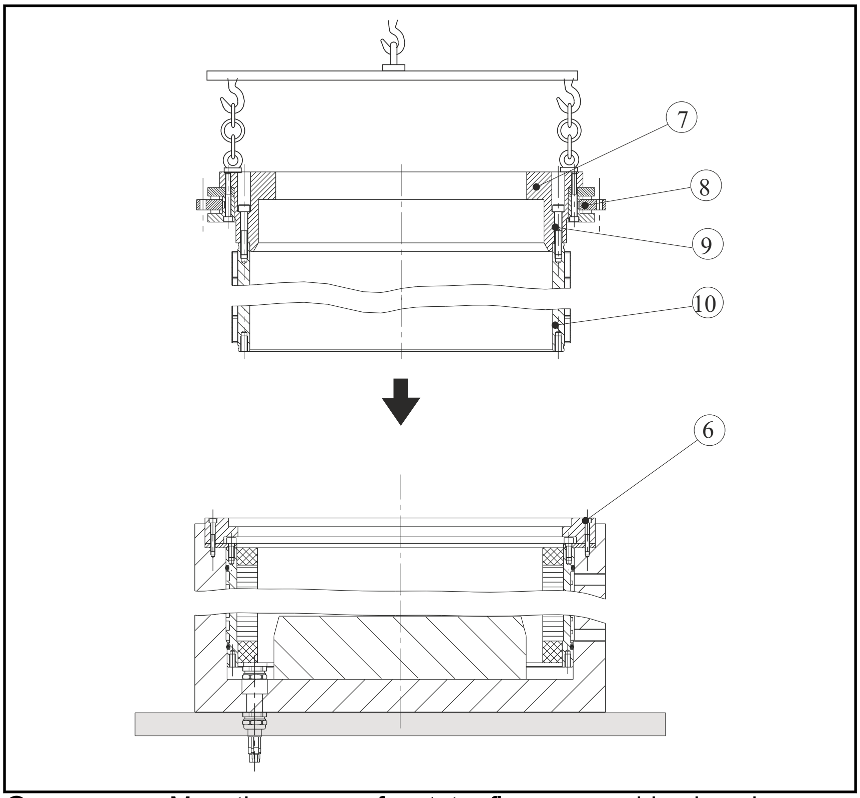
Fig. 12-3: Stator installation

3. Fasten the stator flange to the machine housing using the mounting screws ⑥.
4. Fasten the rotor flange ⑦ with the mounting screws ⑨ to the rotor ⑩.
5. Fasten the motor bearing ⑧ to the rotor flange.
6. Secure the machine housing including the installed stator against lift-off from the work table.

⚠ WARNING **Strong magnetic forces may cause injury/damage!**

⇒ The permanent magnets at the rotor and the resulting magnetic forces can cause the rotor to be abruptly pulled into the stator. Therefore, fasten the machine housing to the work table and only use lifting gear (e.g. crane with hoisting chains) which avoids uncontrolled movements of the rotor package while it is lowered into the stator.

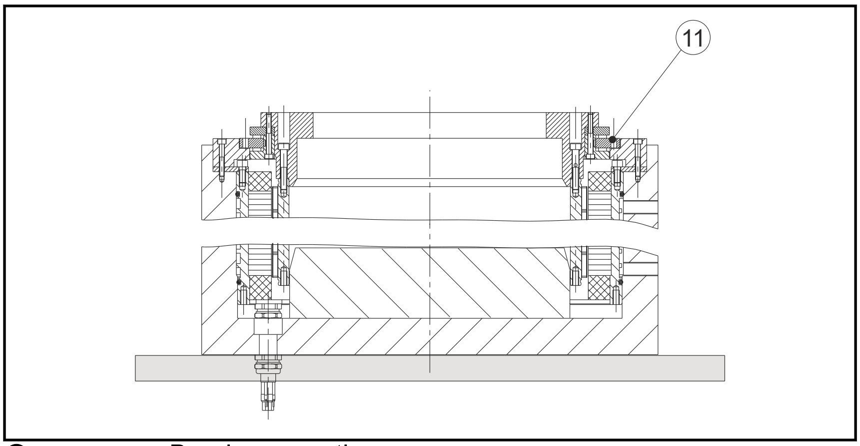
7. Insert the rotor package centered (make forced guidance) into the stator until it reaches its final position.



⑥ Mounting screws for stator flange - machine housing
⑦ Rotor flange
⑧ Axial radial bearing
⑨ Rotor mounting screws
⑩ Rotor

Fig. 12-4: Rotor installation

8. Fasten the bearing ring by using fastening screws ⑪ at the stator flange.



⑪ Bearing mounting screws

Fig. 12-5: MBT installation

9. Check the accuracy and stability of all mounted parts and mechanical connections.

   Detach the machine housing from the working surface.

After proper mechanical assembly, continue with the other connections.

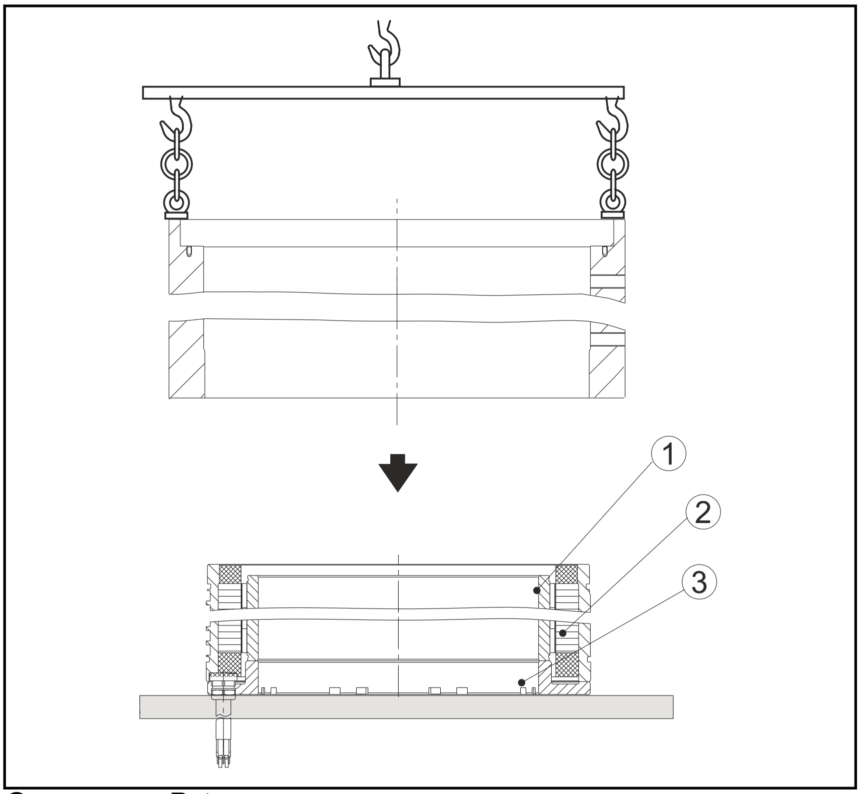
12.6 Mounting stators with cooling jacket and mounting ring (Optional)

☞
- To facilitate assembly, Bosch Rexroth provides a mounting ring for frame sizes 450 and 530. For more information on the mounting ring, please refer to chapter 7 "Accessories" on page 229.
- All screwed connections are equipped with a liquid screw lock. Refer to Chap.12.3 .

The following figures show the general mounting sequence. Comply with the machine manufacturer's special mounting instructions. For details about existing threaded holes, tightening torques and screw-in depths, please refer to the particular rotor or stator dimension sheet.

Mount the motor according to the following schematic procedure:

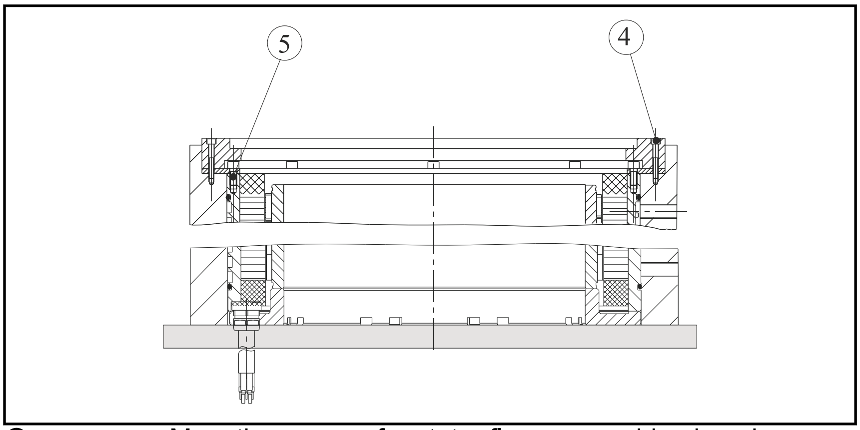
1. Lower the prepared machine housing down to its final position while it is centered over the stator-rotor package. While doing so, ensure that the stator centering device appropriately guides the housing and that the housing does not get jammed.



① Rotor
② Stator
③ Mounting ring

Fig. 12-6: Mounting the stator-rotor package

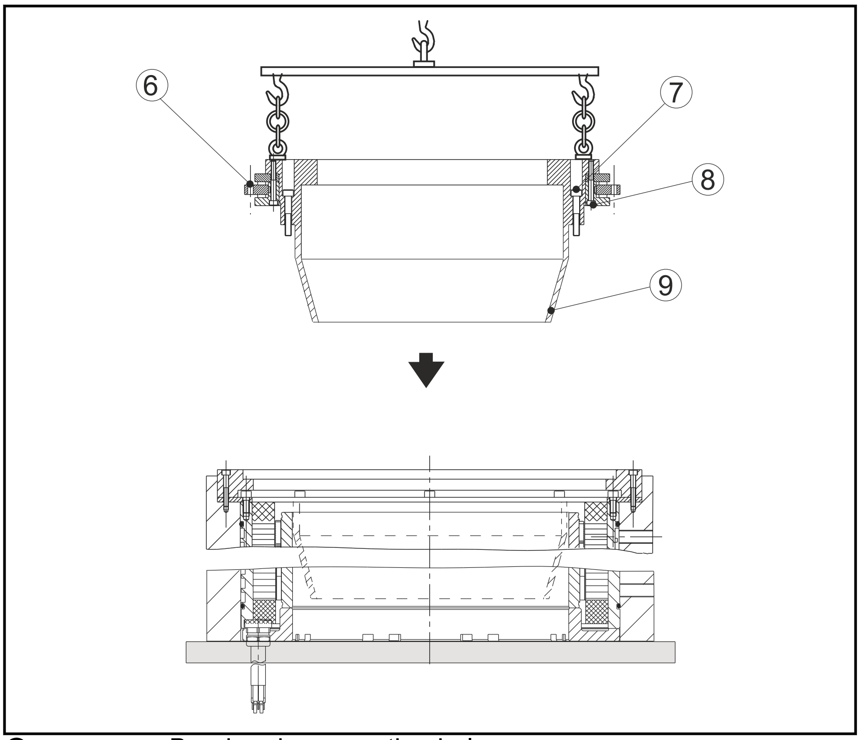
2. Fasten the stator flange to the stator and also to the machine housing using the mounting screws ④ and ⑤.



④ Mounting screws for stator flange - machine housing
⑤ Mounting screws for stator flange - stator

Fig. 12-7: Mounting the stator flange

3. Screw in the motor bearing ring (bearing ring) and rotor flange using the mounting screws ⑧.
4. Lower the rotor flange including mounted bearing into the rotor until the centering device ⑨ on the rotor flange engages the rotor hole.
5. Loosen the mounting screws of the mounting ring on the stator (**not on the rotor**). Do not unscrew them completely yet.



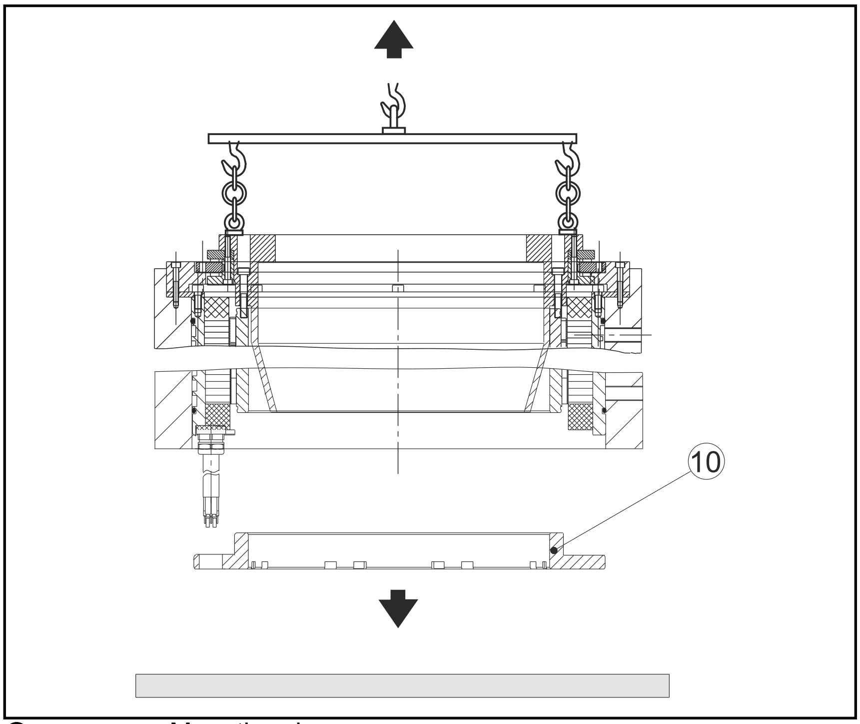
⑥ Bearing ring mounting holes
⑦ Rotor flange mounting screws
⑧ Rotor bearing ring mounting screws
⑨ Centering collar

Fig. 12-8: Mounting the rotor flange with bearing

6. Lower the rotor flange with mounted bearing down to its end position while centering it over the rotor.

   Screw the rotor flange and the rotor using the mounting screws ⑦.
7. Screw the bearing ring and stator flange using the mounting screws ⑥.

8. Loosen and remove all mounting screws from the mounting ring ⑩ and remove it.



⑩ Mounting ring

Fig. 12-9: Disassembling the mounting ring

9. Check the accuracy and stability of all mounted parts and mechanical connections.

After proper mechanical assembly, continue with the other connections.

12.7 Mounting stators with cooling jacket and housing

12.7.1 General information

Depending on the intended use of the motor, certain stators can be ordered which are already installed in a stator housing (type code option "H"). This has the advantage that the supplied stator is ready to be mounted to the machine.

For details about type, quality and position of the mounting holes, please refer to the relevant dimension sheet.

☞

- In general, the stator housing has to be connected to the machine via all of the mounting holes in the motor flange.
- All screwed connections are equipped with a liquid screw lock. Refer to Chap.12.3 .

The following mounting instructions serve only for general orientation purposes and use an example MST530 to describe a noncommittal, schematic construction without considering the special structural features of the machine.

The machine manufacturer has to consider the special character of his construction and has to prepare special mounting instructions. The machine manufacturer's mounting instructions are the only binding guidelines.

The installation dimension sheets in "Chapter 4, Dimension sheets" provide additional instructions and recommendations about general motor assembly. For this reason, the figures also show parts that are required but are maybe not included in the Bosch Rexroth delivery and have to be appropriately dimensioned and provided by the user. Including:

- Motor encoder
- Spacer sleeve (for rotor assembly)
- Clamping ring and clamping plate (for rotor assembly)

We recommend to follow the steps described below for motor assembly:

1. Mount the stator to the machine.
2. Connect rotor and spacer sleeve to the clamping plate.
3. Position the rotor with spacer sleeve on the shaft and fasten it with a clamping ring.
4. Attach the motor encoder.
5. Mount the housing lid and the encoder cover.
6. Make the electrical connection and the coolant connection.

12.7.2 Dimensioning the shaft end

Maybe the rotor is not coaxially installed in the stator, due to installation tolerances of the system. During operation, radial forces may therefore act in the motor and, thus, also on the shaft end to which the rotor is mounted.

To ensure sufficient stiffness of the drive system, the following factors must be taken into account during dimensioning of the required shaft diameter:

- Required minimum air gap after assembly of rotor and stator
- Radial forces acting during operation due to the permanent magnets on the rotor (see the table below)
- Weight of the rotor and where applicable further radial forces acting depending on the particular application

the following dependencies are taken into consideration:

Therefore, the shaft diameter (see Table 12-2) have to be dimensioned taking the bending of the shaft into account, the air gap S_2 never falls below the minimum value after installation between rotor and stator.

Frame size MRT...	Air gap s_2 min [mm] (rotor and stator mounted)	Radial force $F_{radial, operation}$ [N]
130A	0.25	70
130C		210
130E		340
130G		470
160A		210
160C		410
160E		620
161C		190
161E		380
161G		570
201C		280
201D		410
201F		615
210A		170
210C		420
210D		580
210E		830
210U		1870
251 F		1380
290B		500
290D		750
290E		1250
290 F		1,500
290G		1750
291C		530
291D		800
291E		1060
360B		540
360D		800
360E		1330
450B	0.30	770
450D		1150
450E		1910

Frame size MRT...	Air gap s_2 min [mm] (rotor and stator mounted)	Radial force $F_{radial, operation}$ [N]
530B	0.35	910
530C		1360
530D		1820
530E		2270
530F		2,730
530G		4560
530L		6840
530P		3180
530R		4090
531E		1960
531L		5860

Tab. 12-2: Radially acting magnetic forces during operation

☞ Dimension the shaft diameter which is to receive the spacer sleeve for the rotor so that bending is limited.

Also refer to the data on the radial forces which can occur during assembly (see table 12-1).

12.7.3 Mounting the stator

Stators which have already been ordered with a housing according to the motor type code can be mounted to the machine directly via the mounting holes in the flange.

When configuring the screwed connection, observe the data in the dimension sheet referring to the quantity and size of the flange mounting holes.

☞

- In general, the stator has to be connected to the machine via all mounting holes.
- All screwed connections have to be provided with a liquid screwlock. See also chap. 12.3 .
- The necessary screw length for fastening the stator depends on the machine construction.
- The screwed connections has to be able to take up both the force due to the weight of the motor and the forces acting during operation.

Ensure cleanliness during all working steps!

Preparation

Refer to the instruction on how to prepare mounting in chapter 12.4 "Mechanical assembly" on page 310.

Mounting the stator

1. Lift and position the stator on the machine via suitable lifting tools and the lifting eye bolt on the stator housing.

☞

Avoid...

- jamming or clamping the housing while mounting it to the machine,
- damaging the centering collar on the housing and the machine.

2. Center the stator housing on the machine using the centering collar provided on the housing. Because of the enormous torque development of the motors, all of the mounting holes on the motor flange must always be used to fasten the motor.

   An exception are frame sizes 530B, 530C and 530E where at least the two outer mounting holes must be used per quarter hole circle diameter on the motor flange.

   Use screws with property class 8.8 or higher.

☞

The property class of the screws and the hardness category of the washers has to be equivalent in order to transmit the required tightening torques (see table 12-3).

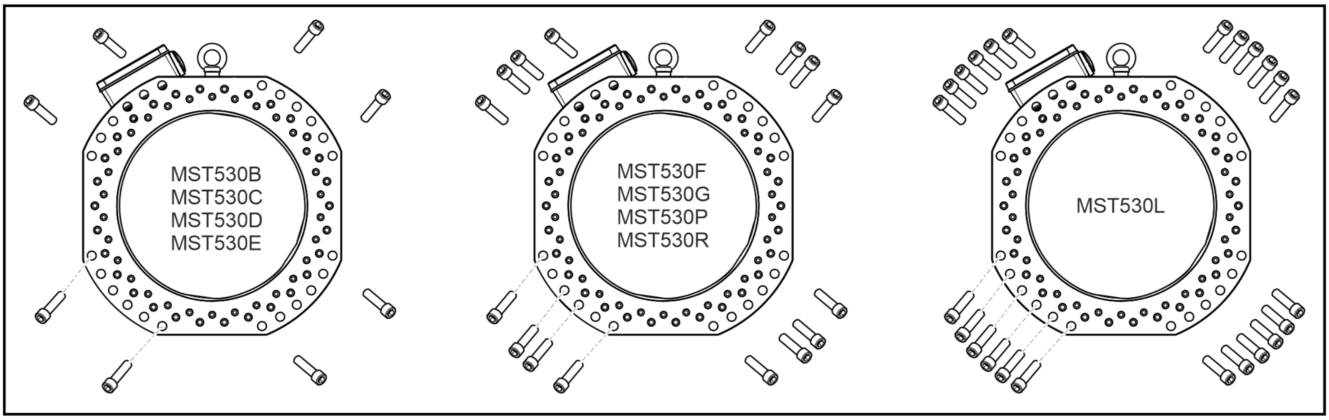


Fig. 12-10: Mounting holes on motor flange MST530

3. Check the correct position of the stator and tighten all mounting screws crosswise to the required tightening torque.

Screws (property class 8.8)	M_{GA} [Nm] at μ_G 0.12
M16 x ...	206
M20 x ...	415

M_{GA} Tightening torque in Newton meters
μ_G Coefficient of friction

Tab. 12-3: Mounting screws with tightening torque

12.7.4 Mounting the rotor

The rotor assembly procedure described below is intended to present a possible proposal for rotor assembly. This suggestion can be understood as a guideline to estimate the necessary assembly efforts and to provide the mounting tools required, such as spacer sleeve, clamping ring, insertion and centering tool.

Essentially, the rotor is guided on a spacer sleeve over two insertion fittings in the rotor hole and fastened with a clamping plate. Subsequently, it has to be inserted into the stator centered over the shaft to be driven and fastened with a clamping ring.

⚠ WARNING **The rotor is magnetic! Risk of injury and danger of crushing body parts by magnetic forces!**

⇒ Remove or secure any movable metal objects.

⇒ Handle all magnetic components with care.

⇒ Wear protecting clothes and use installation aids

Comply with the details in the particular dimension sheet during assembly, such as

- the quantity and type of the mounting holes,
- the min. screw-in depth and tightening torque.

☞

- The screw length required depends on the machine construction.
- The screwed connections have to be able to take up both the force due to the weight of the motor and the forces acting during operation.
- All screwed connections have to be provided with a liquid screwlock. See also chap. 12.3 .

Mounting the rotor

Ensure cleanliness during all working steps!

1. Connect the rotor and the spacer sleeve to a clamping plate. After fastening, it has to be ensured that both centering diameters of the rotor hole (see Fig. 12-48) are guided on the spacer sleeve.

   Connect the rotor to a mounting tool for inserting the rotor into the stator (for example see Fig. 12-57).
2. Using the mounting tool, push the rotor over the shaft end to its end position. We recommend to provide a friction bearing (bronze bushing, etc.) on one side of the shaft end, which allows axial length compensation due to the slightly increased heating of the rotor as compared with the shaft during motor operation.

   ⚠ WARNING **Strong magnetic forces may cause injury/damage!**

   The permanent magnets on the rotor and the resulting magnetic forces cause the rotor ...

   ⇒ is promptly pulled into the stator (axial force). use appropriate mounting tools to prevent uncontrolled movements of the rotor during assembly

   ⇒ is attracted by the stator hole (radial force). Refer to the information on occurring radial forces in tab. 12-1 "Magnetic attractive forces during mounting" on page 312 and table 12-2.
3. Clamp the spacer sleeve onto the shaft end using a clamping ring. The clamping ring causes safe power transmission of the motor to the shaft to be driven.

12.8 Mounting motor encoder and covers

After the stator has been fastened to the machine and the rotor to the shaft, the encoder can be connected.

☞ The motor encoder is not included in the scope of delivery of the motor and must be provided by the user.

Essentially, the following steps have to be carried out:

1. Mount the motor encoder to the shaft.
2. Close the motor housing and the encoder installation space with the provided covers.
3. Make the electric connection and the coolant connection according to chapter 8 "Connection technique" on page 237.

12.9 Parallel arrangement: Two motors on one shaft in connection with a controller and an encoder

In a parallel arrangement, the motors are arranged on a shaft to be driven one after the other.

The advantage of this mounting type is that it doubles the output motor torque, provided the motors are properly arranged and correctly activated.

☞ The following examples start from the assumption that a radial cable outlet is used on the stators. Because of bending radiuses that have to be retained, an axial cable outlet or connection cable with wires might require longer distances between two motors. Also refer to the instructions in chapter 8.2.2 "Connecting the stators" on page 238.

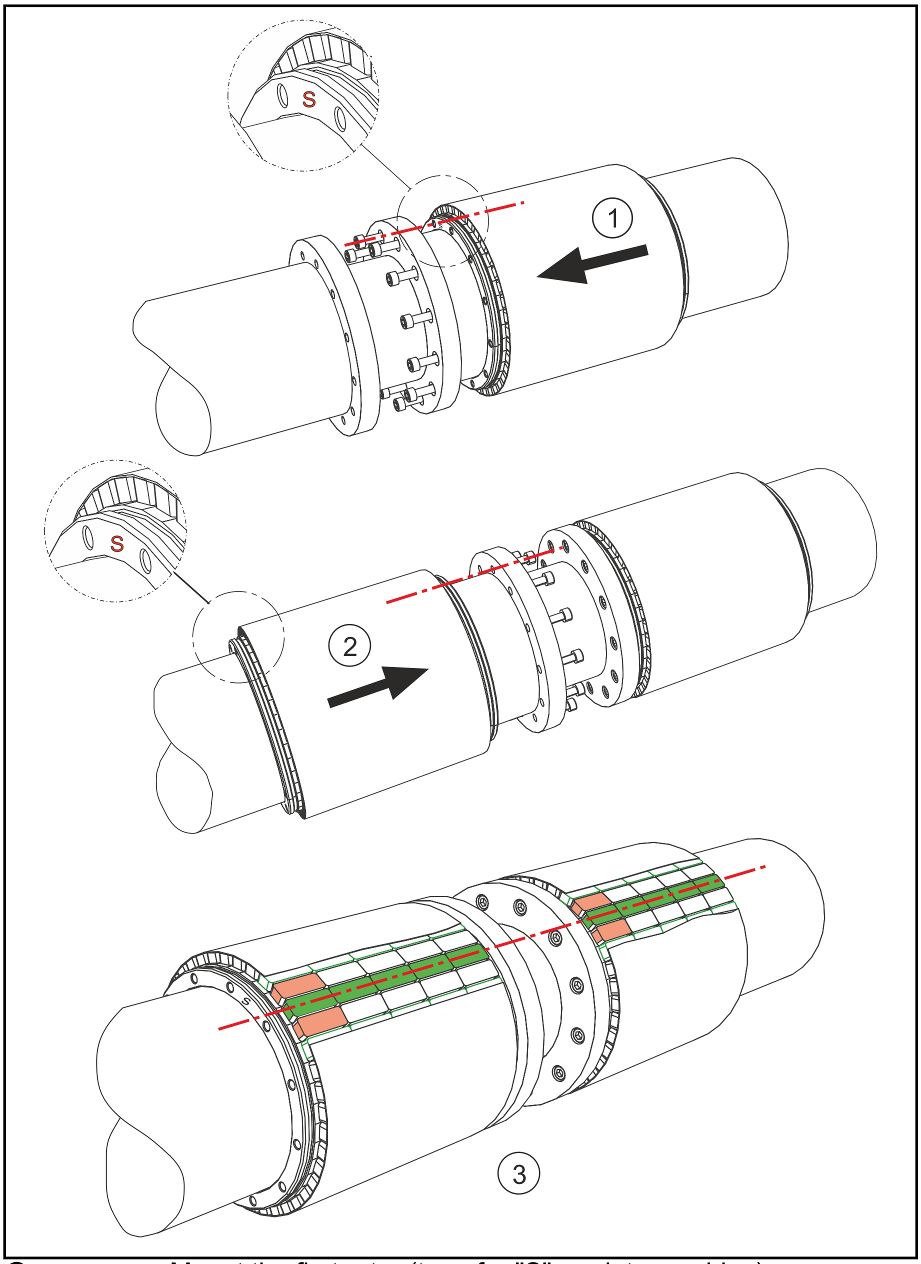
Parallel arrangement - rotor assembly

At a point on their front face, all rotor sleeves are marked with an "S" (south pole) for the row of magnets above them. This mark is at the same position on all of the rotors.

☞ If the rotor mark on the front face is covered after installation, mark the point where the "S" is positioned on the rotor on your machine for further assembly.

Both rotors have to be positioned on the shaft such that the "S" mark on the rotors is always positioned on the same side (left or right) and at the same point in the circumference.

This ensures that the hole pattern (front-face hole circle diameter with threaded holes) as well as the polarity of the magnets are aligned. This is the only position in which the resulting motor torque can be transmitted optimally.



① Mount the first rotor (transfer "S" mark to machine)

② Mount the second rotor (align "S" mark according to "S" position of first rotor)

③ Correct assembly = aligned pole rows of the magnets

Fig. 12-11: Mounting the rotor with parallel motor arrangement

Parallel arrangement -stator assembly

During stator assembly, both stators have to be aligned in the axis construction (as the two rotors), For stators with radial cable output that should be used for parallel alignment, the cable output position is the mark for the alignment (see fig.12-12 and fig.12-13.

Parallel arrangement - power cable connection (cable outlet in the same direction)

If the stator is mounted with cable outlet in the same direction, the connection wires of the stators must be applied according to the instructions in chapter "Connection technology" or in fig.12-12

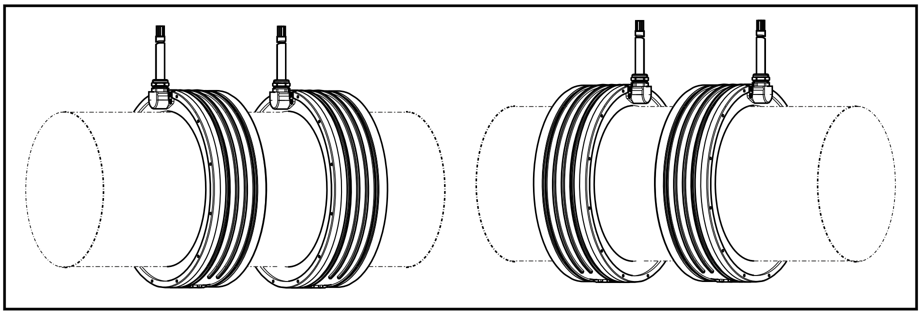


Fig. 12-12: Parallel motor arrangement (cable outlet in the same direction)

Connection in case of arrangement with cable outlet in the same direction			
Drive controller (slot designation at X5)	A1	A2	A3
Stator 1	1 (U)	2 (V)	3 (W)
Stator 2	1 (U)	2 (V)	3 (W)

Tab. 12-4: Connecting the power wires in case of parallel arrangement of stators with equal cable outlet direction on a drive controller

Parallel arrangement - power cable connection (cable outlet in opposite directions)

If the stator is mounted with cable outlet in opposite directions, two phases must be rotated and applied according to fig.12-13.

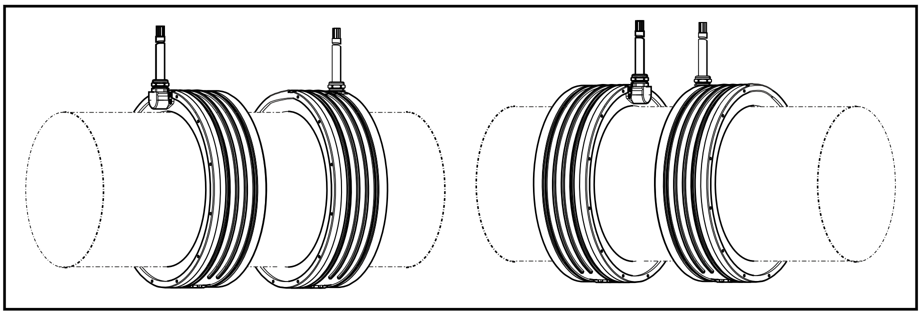


Fig. 12-13: Parallel motor arrangement (cable outlet in opposite directions)

Connection in case of stator arrangement with cable outlet in opposite directions			
Drive controller (slot designation at X5)	A1	A2	A3
Stator 1	1 (U)	2 (V)	3 (W)
Stator 2	1 (U)	3 (W)	2 (V)

Tab. 12-5: Connection of the power wires in case of parallel arrangement of primary parts on a drive controller

12.10 Coolant connection

Establish the connection of the coolant supply for the motor according to chapter 8.5 "Motor cooling" on page 258 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. The drive components have to be connected in the machine exclusively according to the machine manufacturer's system circuit diagrams. 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.

12.11 Electrical connection

Connect the motor electrically according to the connection diagrams and the instructions in chapter 8 "Connection technique" on page 237. 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. The drive components have to be connected in the machine exclusively according to the machine manufacturer's system circuit diagrams.

12.12 Mounting examples

12.12.1 Basic information

The installation drawings are only examples for one installation option. It is not possible to show all variants of installation in the different machines or applications.

☞ The binding installation drawings for a specific machine or application are made by the machine manufacturer himself.

☞ 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.

The order of the drawings for each frame size complies with the following scheme:

- Installation drawing of a mounted rotor (example).
- Installation drawing of a mounted stator (example).
- Installation drawing of completely mounted rotor and stator (example).

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

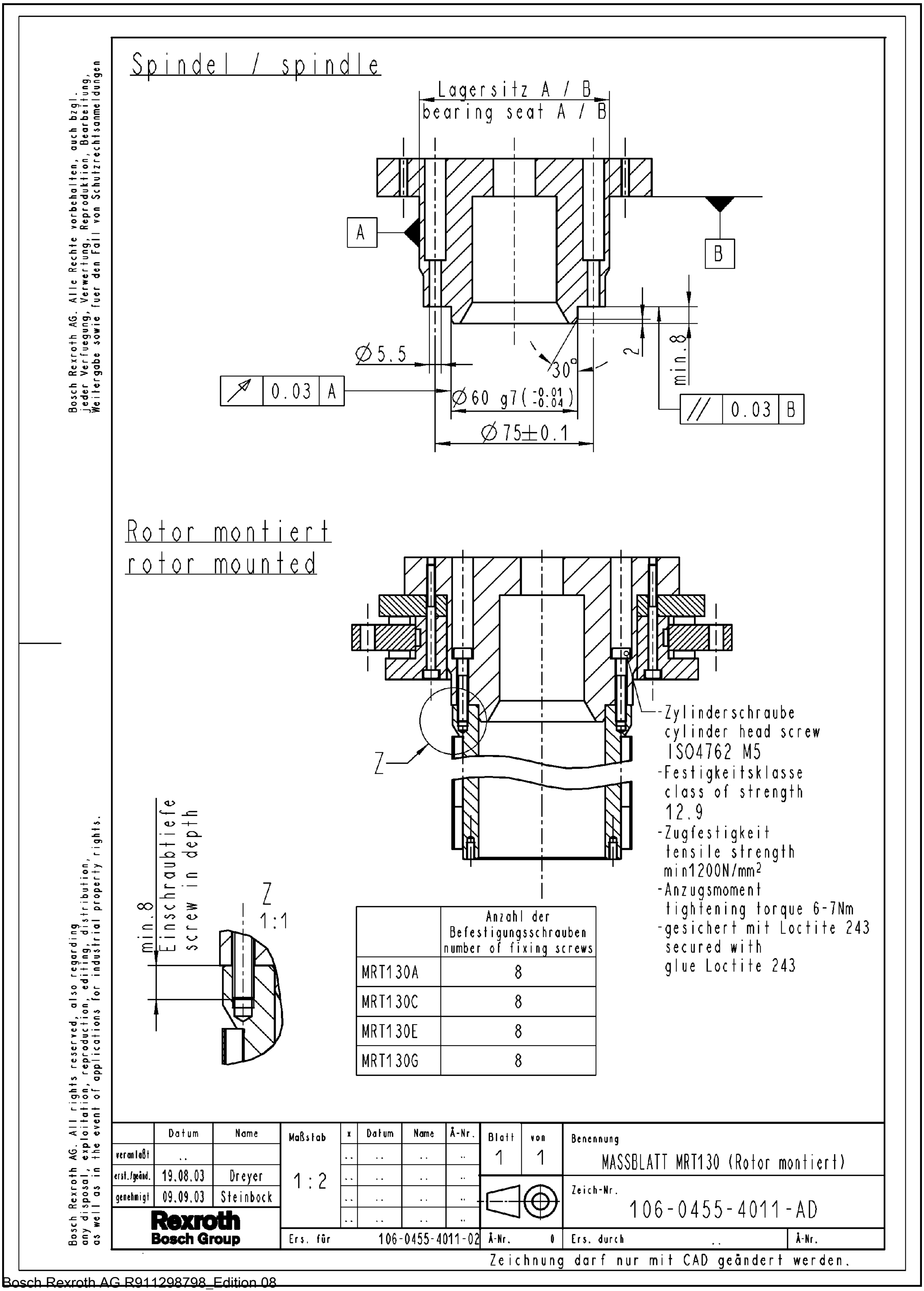
Longitudinal dimensions: DIN ISO 2768-1

Angular dimensions: DIN 7168 (tolerance class m)

Form and position tolerances: DIN EN ISO 1101

12.12.2 Mounting example MBT130

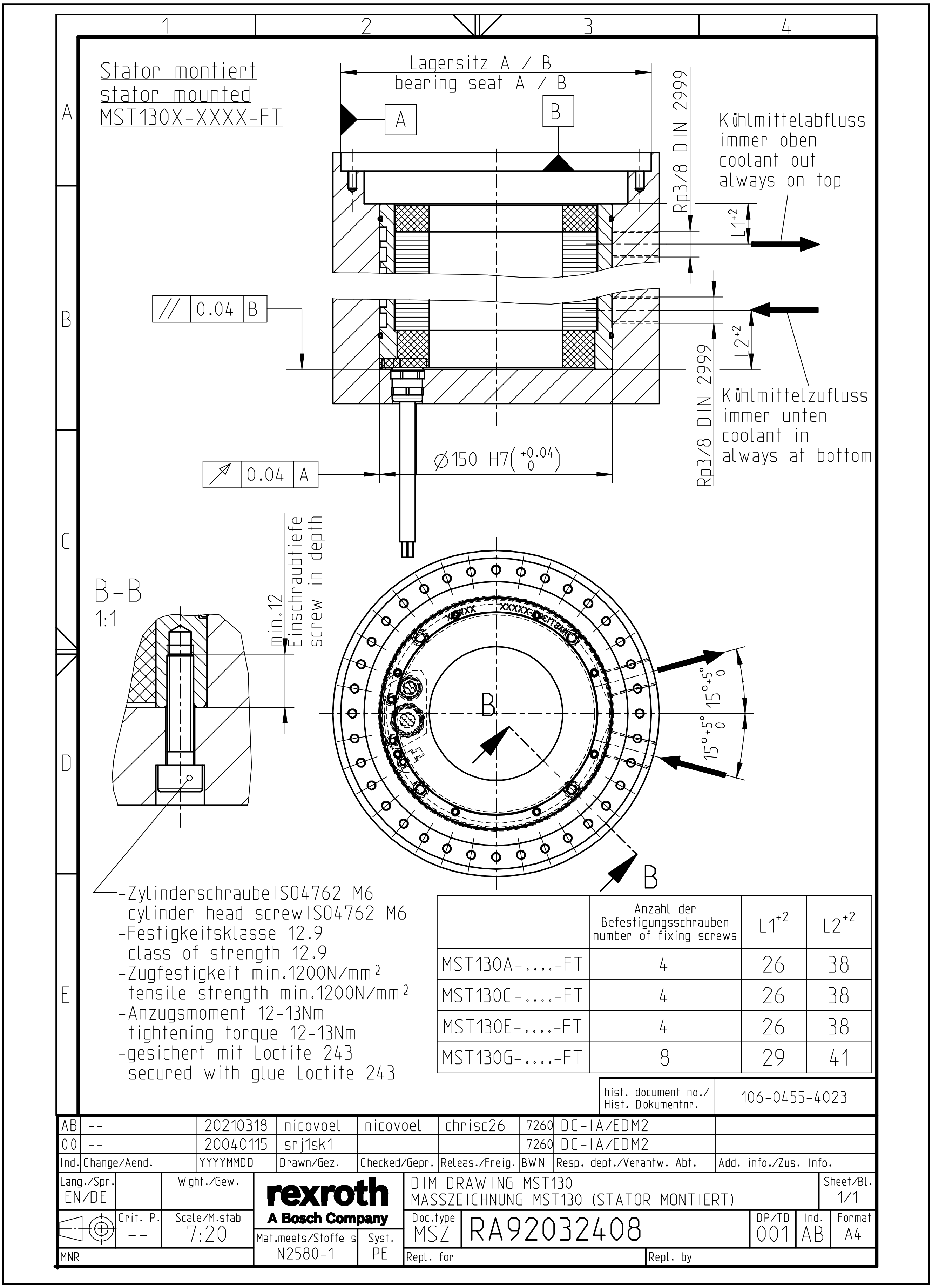
Rotor MRT130, mounted



	Anzahl der Befestigungsschrauben number of fixing screws
MRT130A	8
MRT130C	8
MRT130E	8
MRT130G	8

Fig. 12-44: Rotor MRT130, mounted

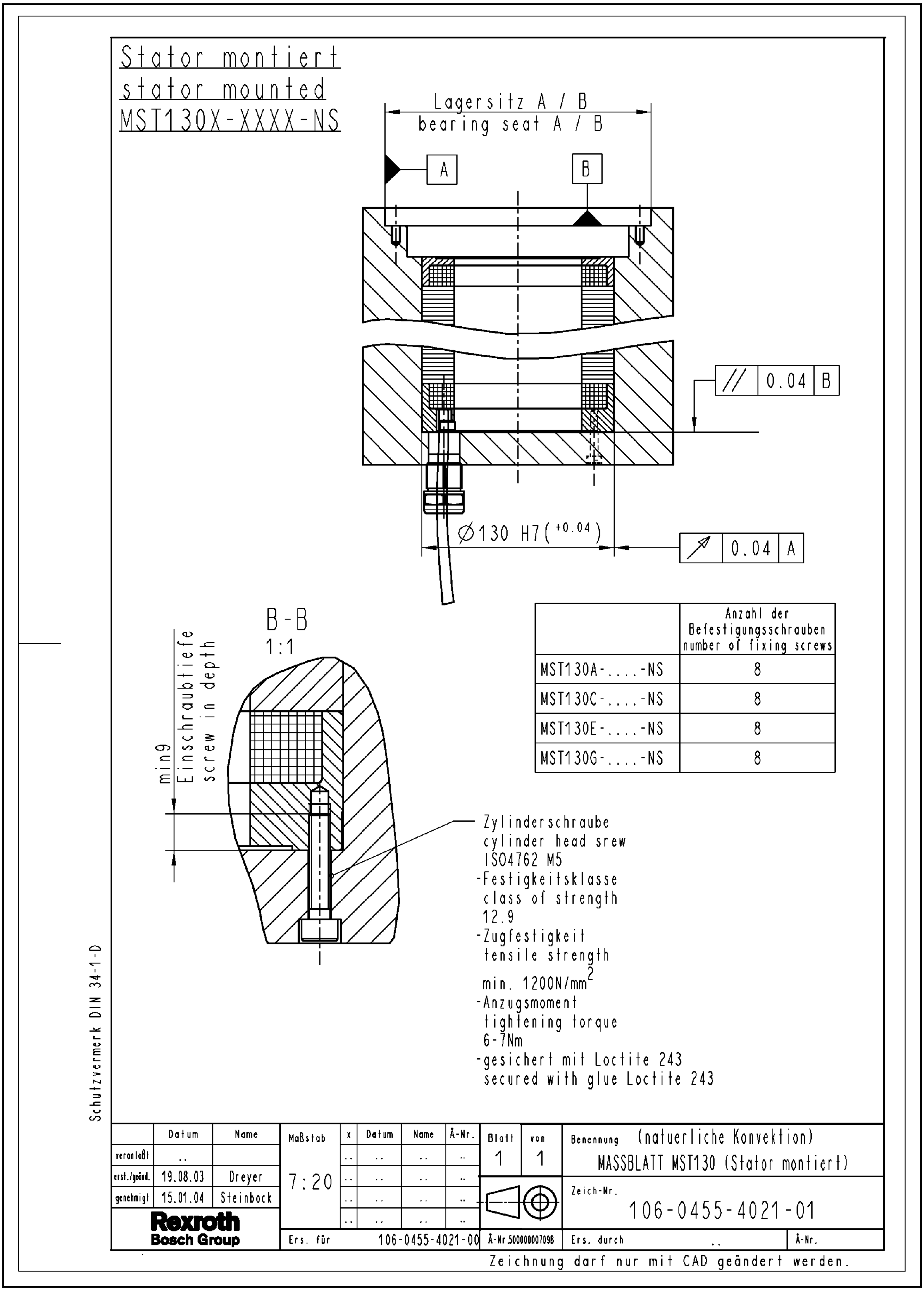
Stator MST130, liquid-cooled, mounted



	Anzahl der Befestigungsschrauben number of fixing screws	L1+2	L2+2
MST130A-....-FT	4	26	38
MST130C-....-FT	4	26	38
MST130E-....-FT	4	26	38
MST130G-....-FT	8	29	41

Fig. 12-15: MST130, liquid-cooled, mounted

Stator MST130, natural convection, mounted



	Anzahl der Befestigungsschrauben number of fixing screws
MST130A-....-NS	8
MST130C-....-NS	8
MST130E-....-NS	8
MST130G-....-NS	8

Fig. 12-16: MST130, natural convection, mounted

Rotor and stator, natural convection, mounted

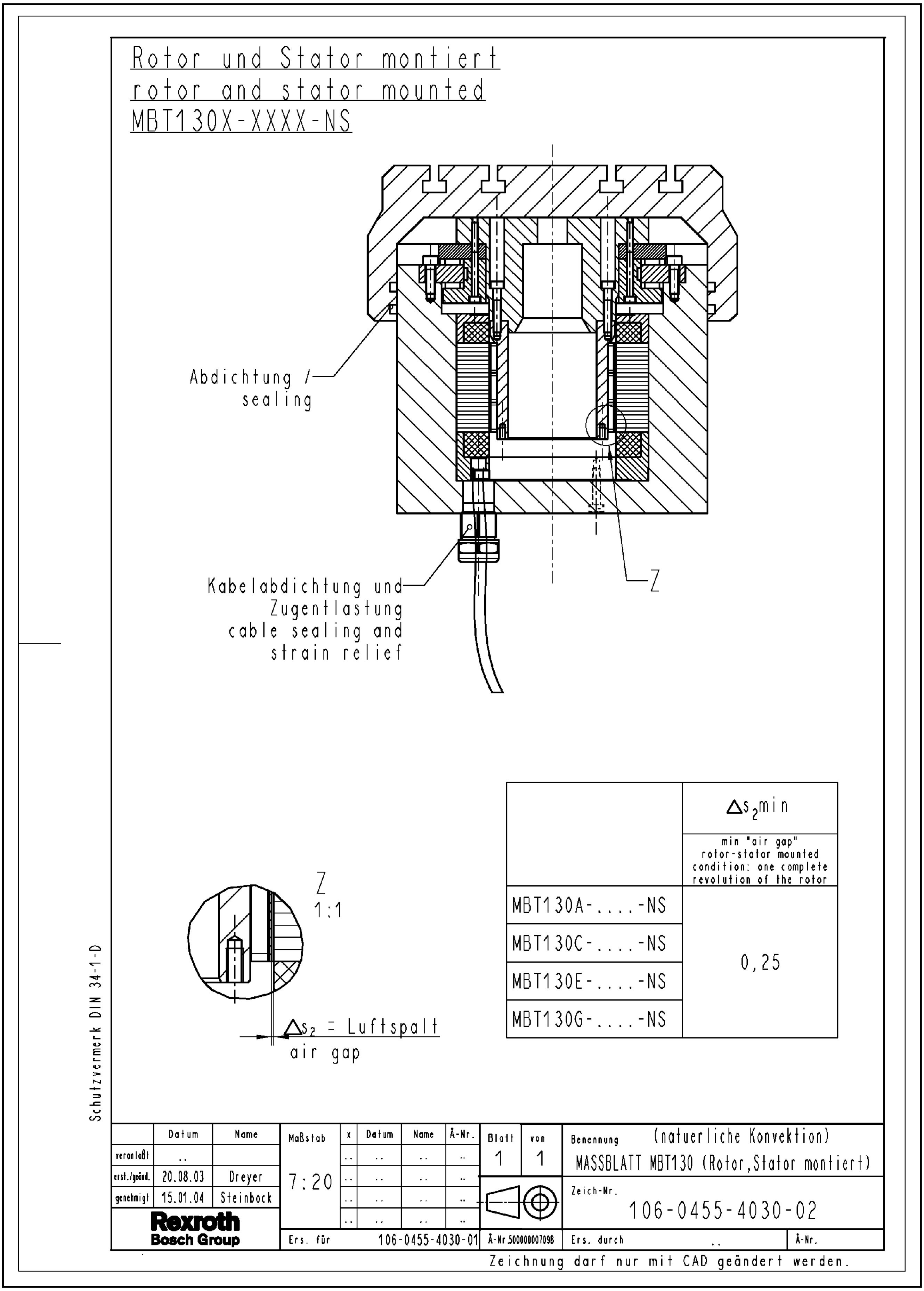


Fig. 12-17: Rotor and stator, natural convection, mounted

12.12.3 Mounting example MBT160

Rotor MRT160, mounted

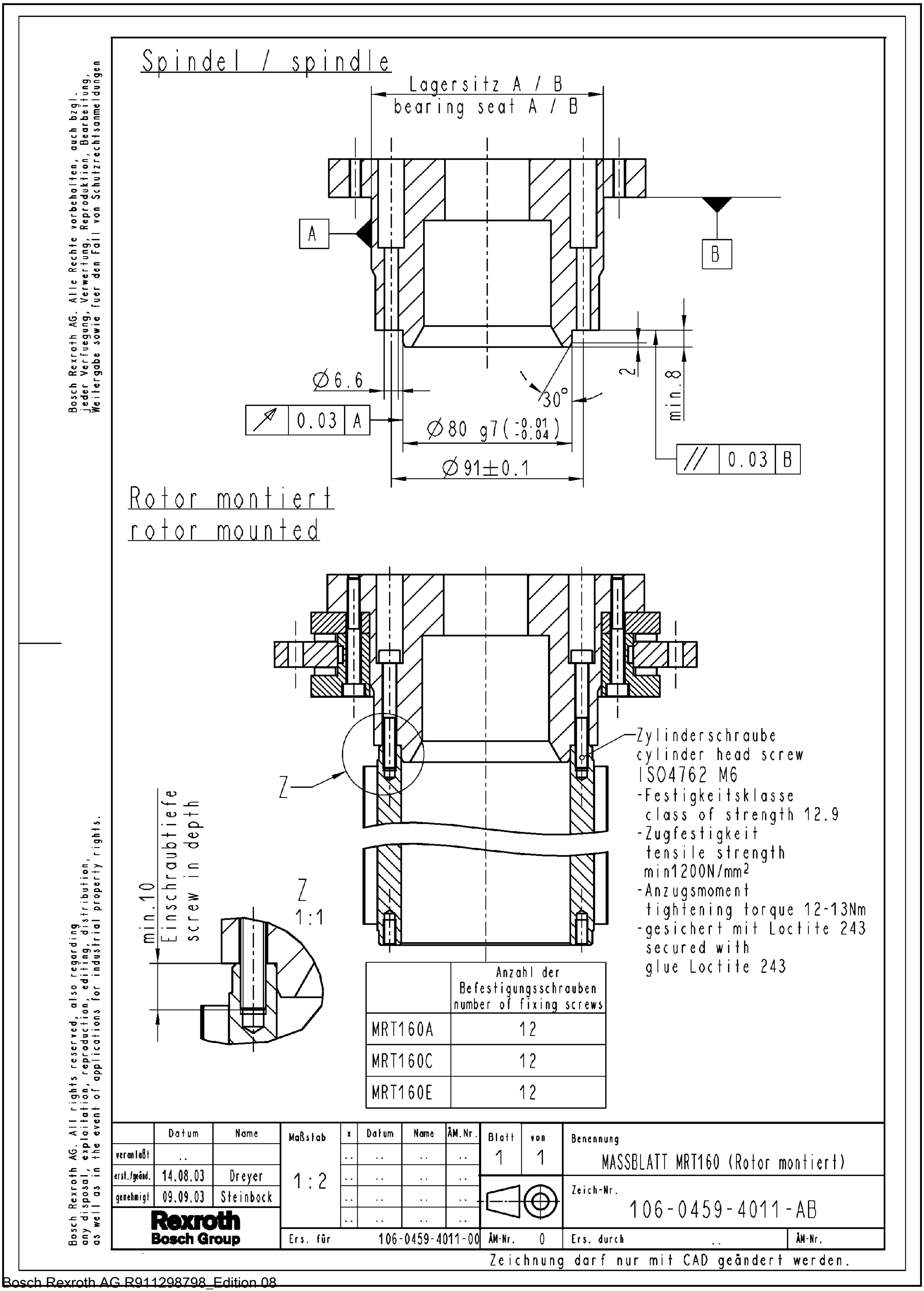
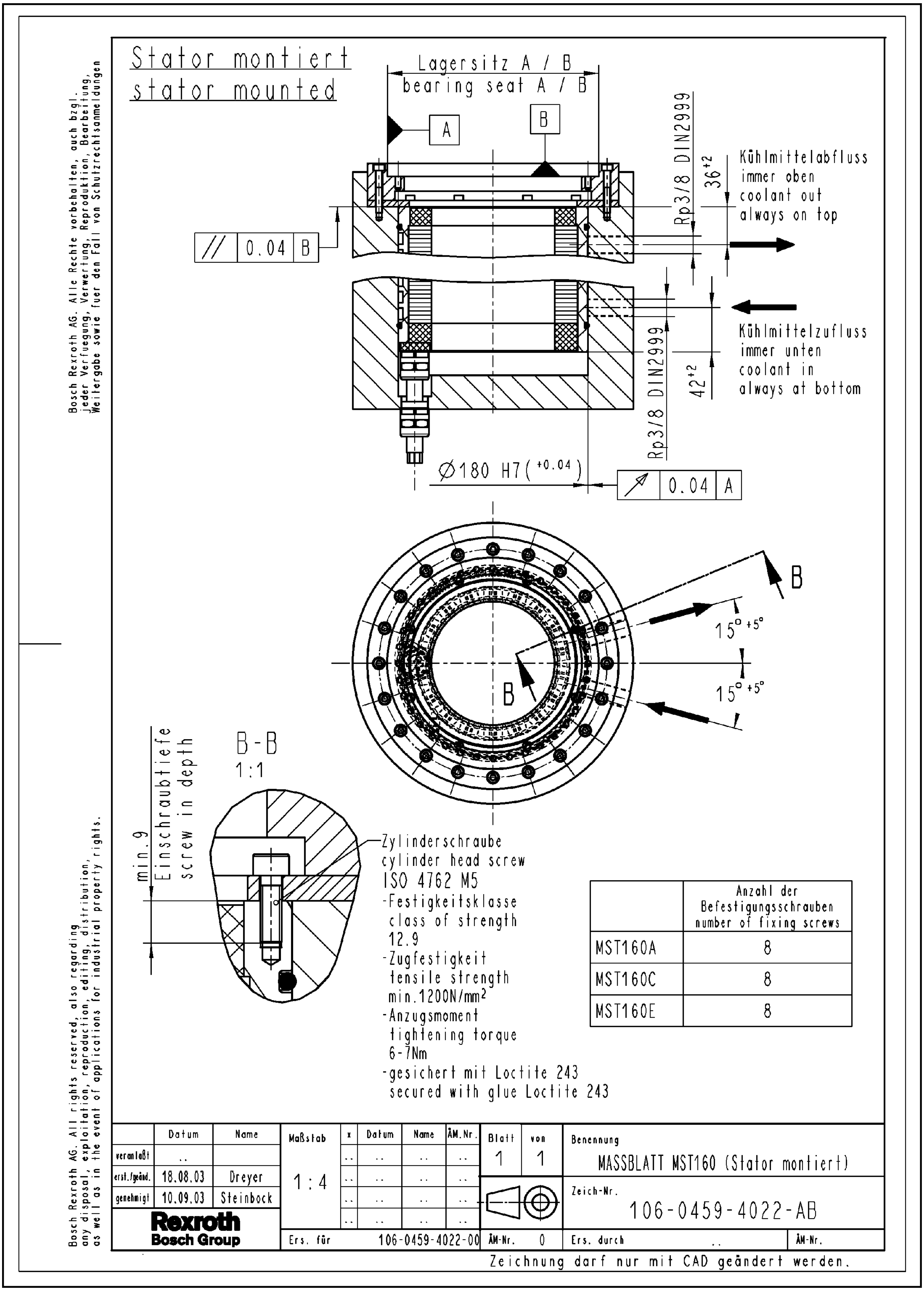


Fig. 12-12: Rotor MRT160, mounted

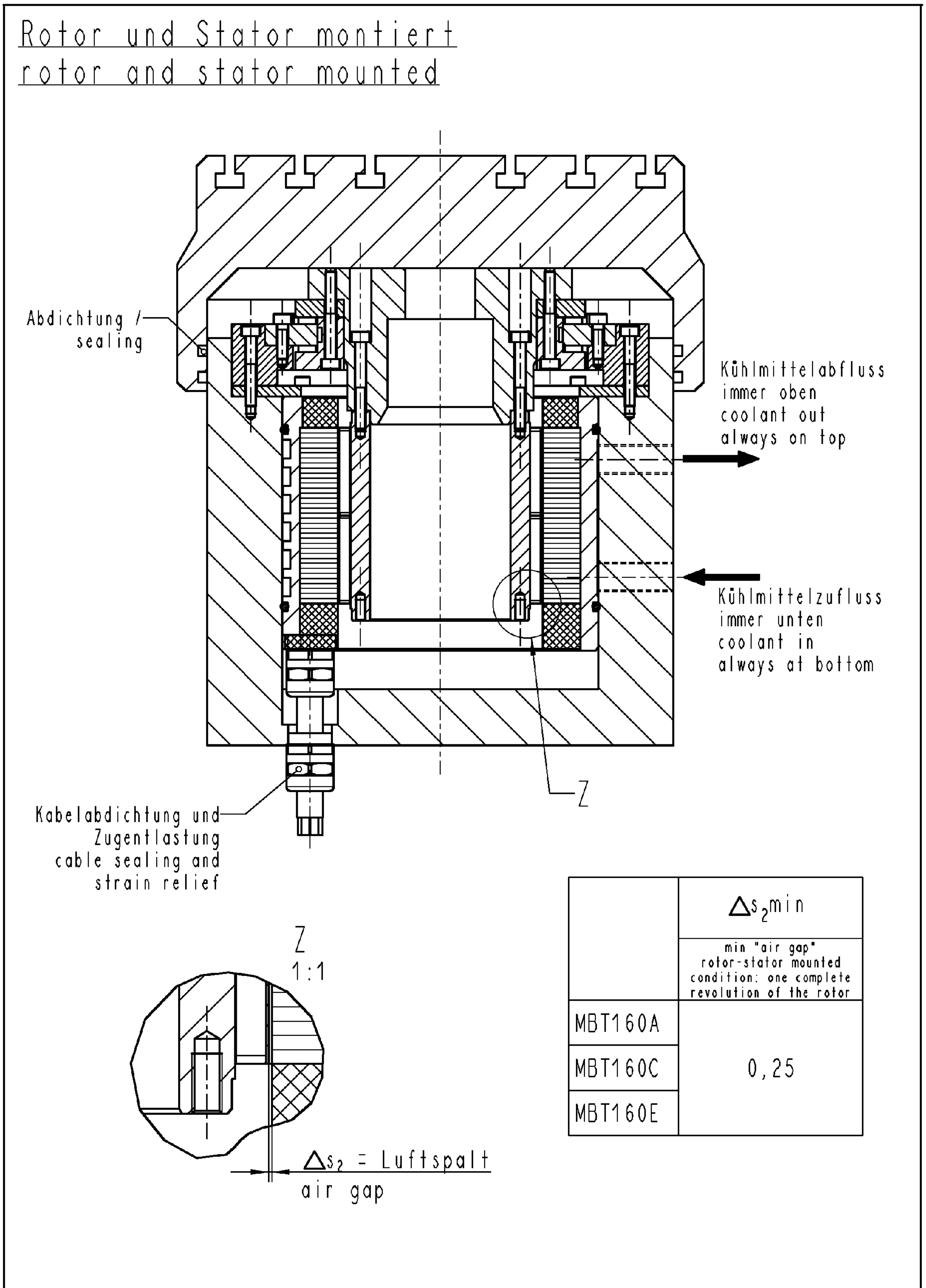
Stator MST160, mounted



	Anzahl der Befestigungsschrauben number of fixing screws
MST160A	8
MST160C	8
MST160E	8

Fig. 12-19: Stator MST160, mounted

Rotor and stator, mounted



	Δs2 min min "air gap" rotor-stator mounted condition: one complete revolution of the rotor
MBT160A	0,25
MBT160C	
MBT160E	

	Datum	Name	Maßstab	Blatt	von	Benennung
veranlaßt	..		7:20	1	1	MASSBLATT MBT160 (Rotor,Stator montiert)
erst./geänd.	18.08.03	Dreyer				Zeich-Nr. 106-0459-4030-AB
genehmigt	16.01.04	Steinbock				
Rexroth Bosch Group			Ers. für 106-0459-4030-00	ÄM-Nr. 0		Ers. durch .. ÄM-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 12-20: Rotor and stator mounted

12.12.4 Mounting example MBT161

Rotor MRT161, mounted

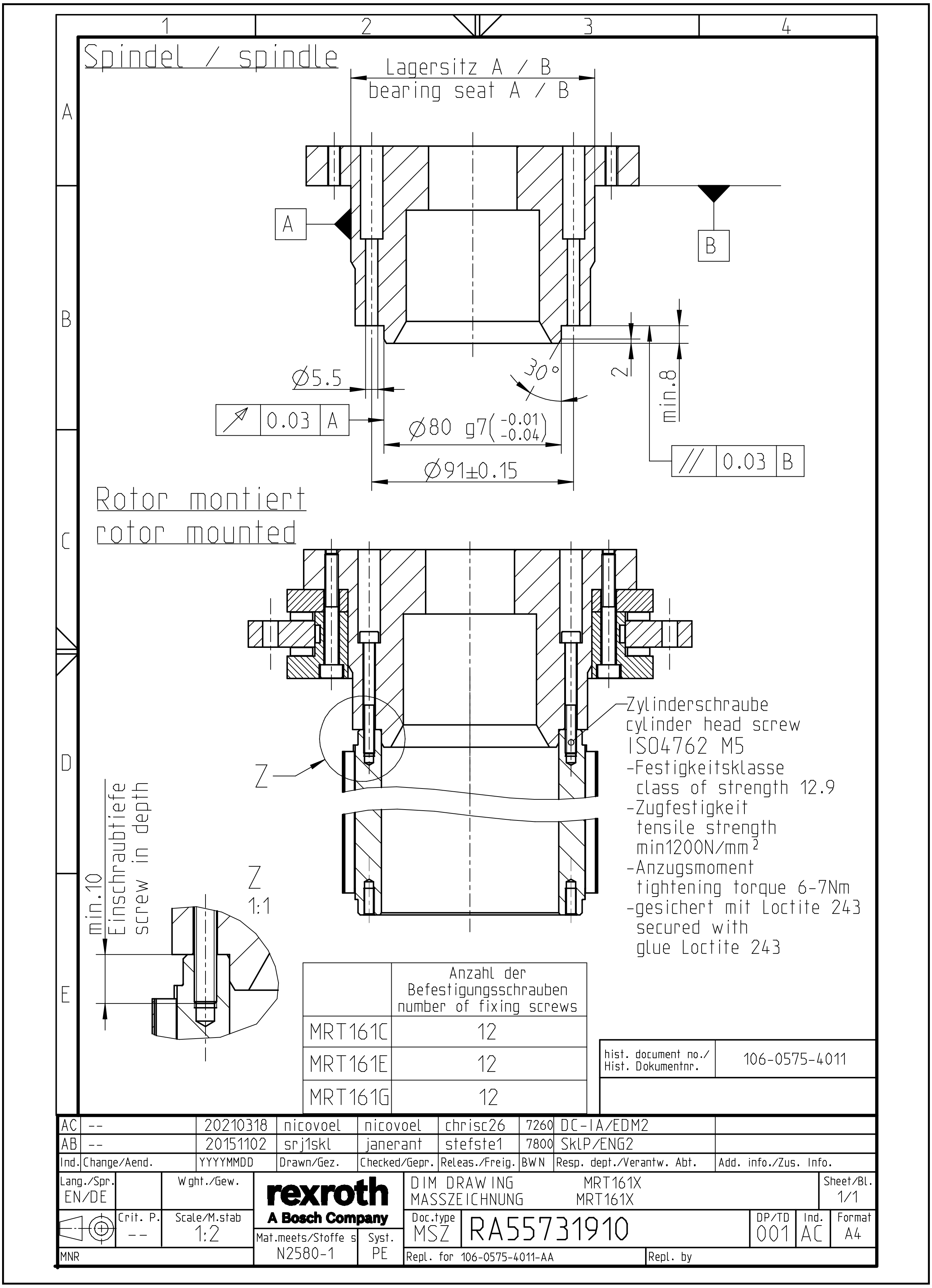
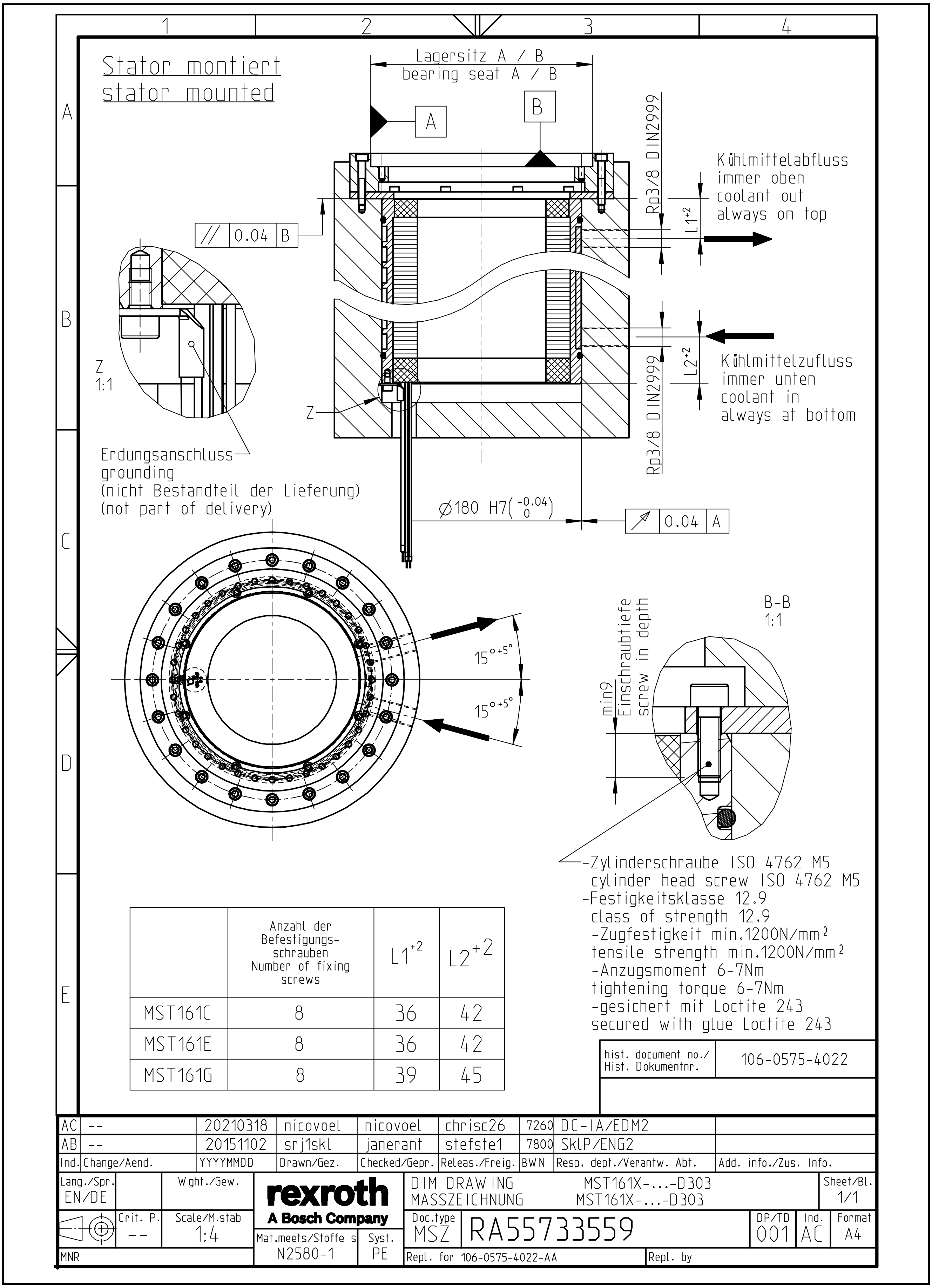


Fig. 12-21: MRT161 (rotor mounted)

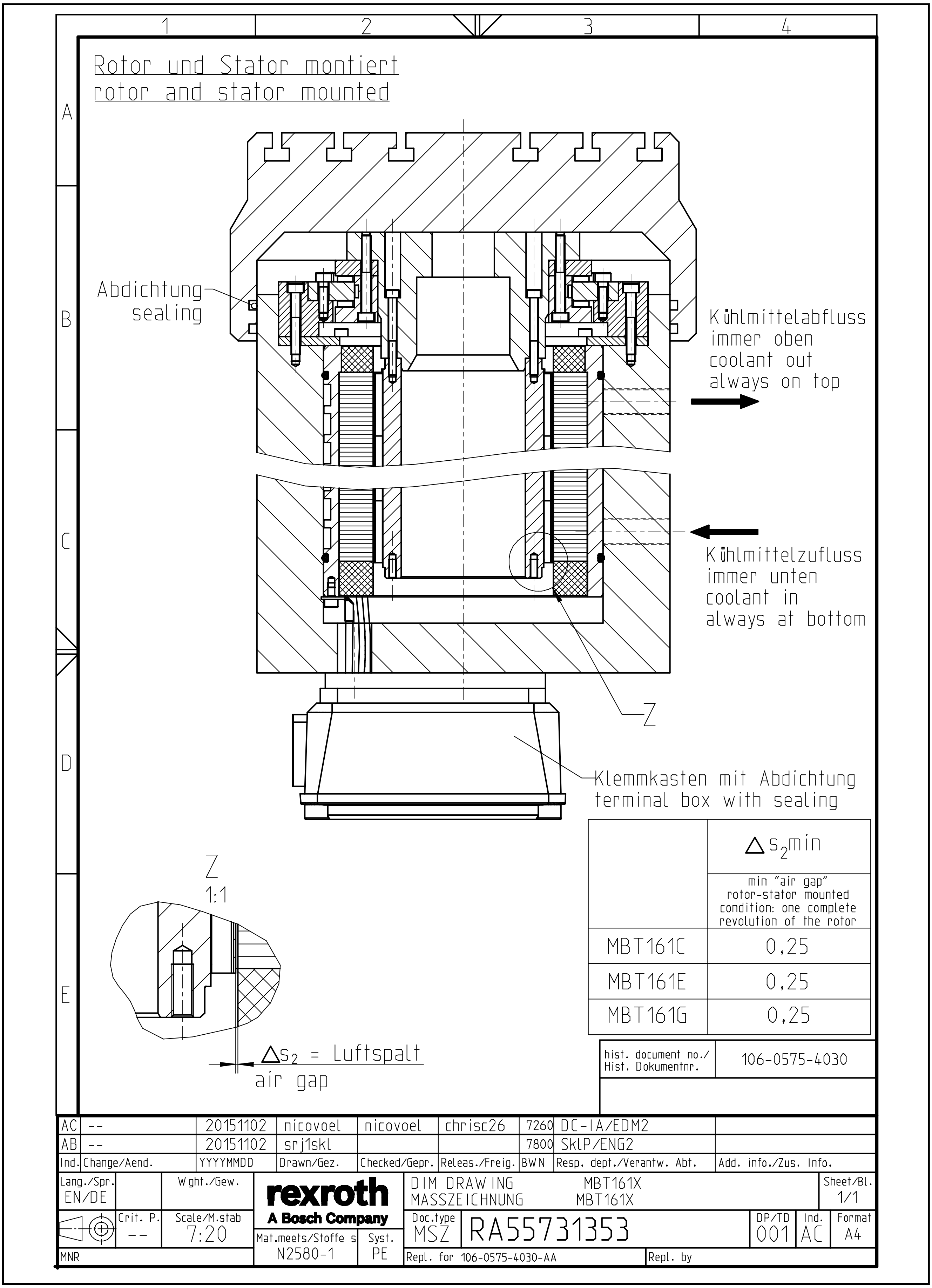
Stator MST161, mounted



	Anzahl der Befestigungs-schrauben Number of fixing screws	L1+2	L2+2
MST161C	8	36	42
MST161E	8	36	42
MST161G	8	39	45

Fig. 12-22: MST161 (stator mounted)

Motor MBT161, rotor and stator, mounted

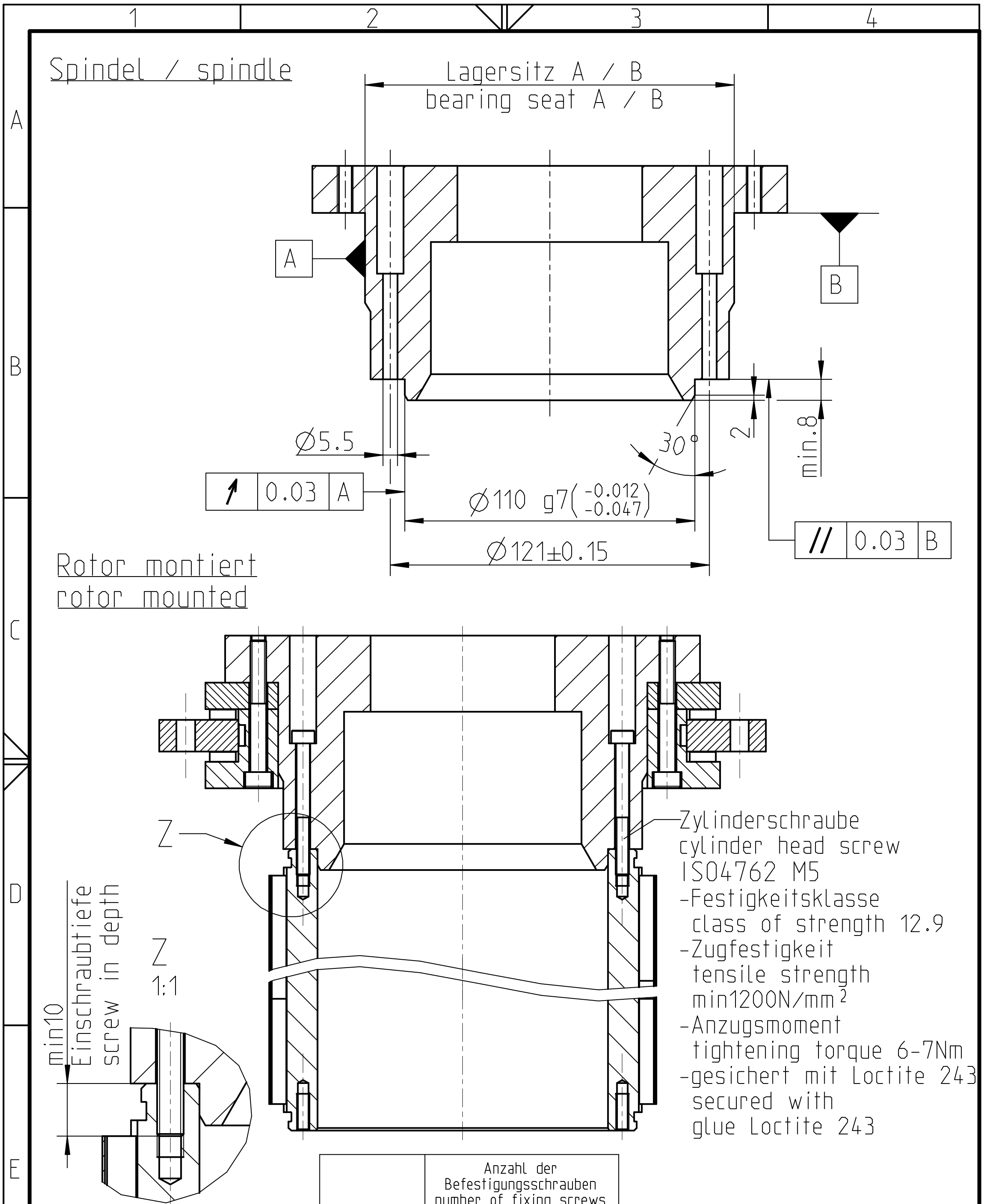


	△ $s_2$min min "air gap" rotor-stator mounted condition: one complete revolution of the rotor
MBT161C	0,25
MBT161E	0,25
MBT161G	0,25

Fig. 12-23: MBT161 (rotor and stator mounted)

12.12.5 Mounting example MBT201

Rotor MRT201, mounted



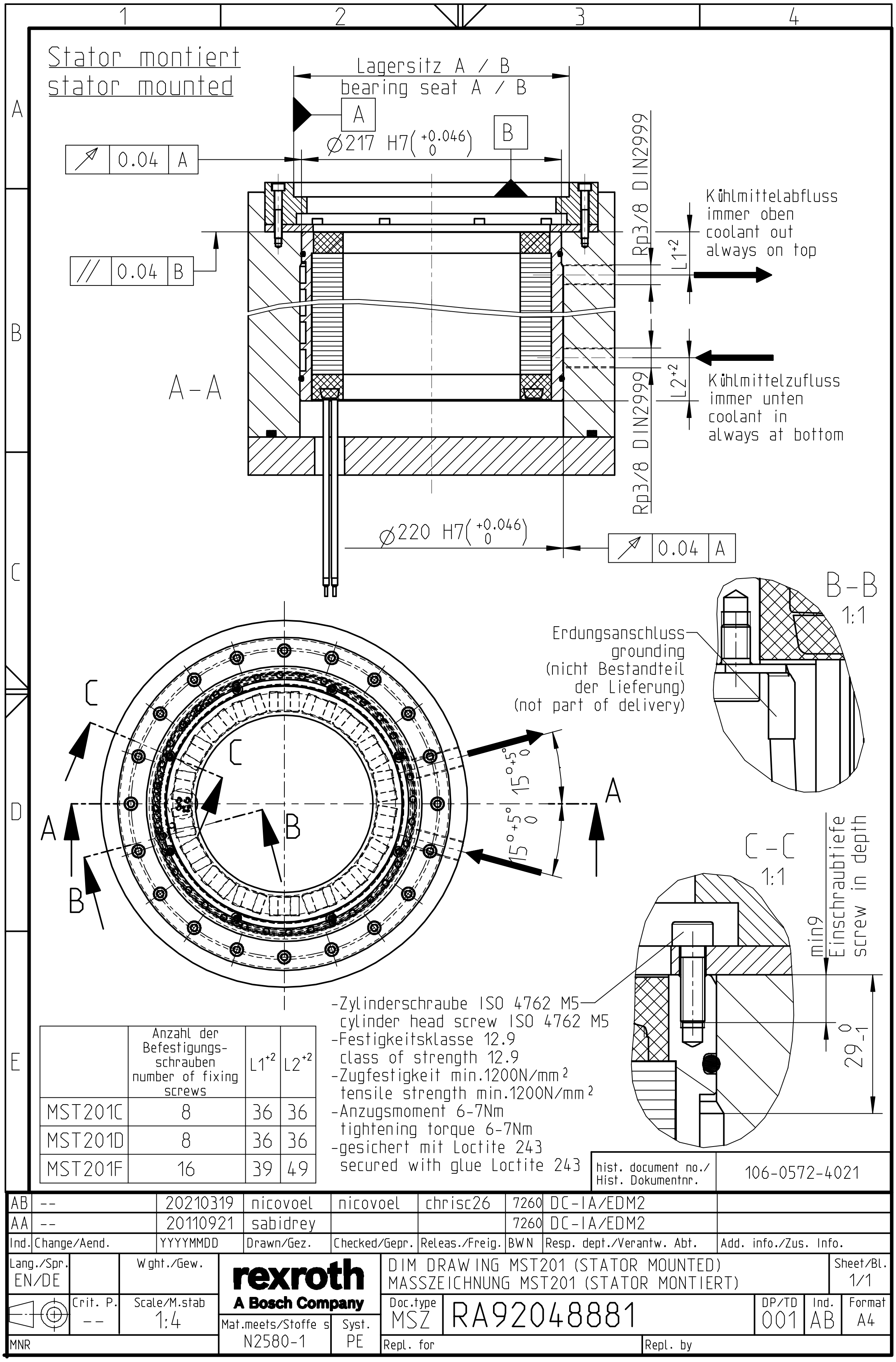
	Anzahl der Befestigungsschrauben number of fixing screws
MRT201C	12
MRT201D	12
MRT201F	20

Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.
AB	--	20210319	nicovoel	nicovoel	chrisc26	7260	DC-IA/EDM2	
AA	--	20110923	sabidrey			7260	DC-IA/EDM2	

Lang./Spr. EN/DE	Wght./Gew.	Crit. P. --	Scale/M.stab 1:2	Mat.meets/Stoffe s N2580-1	Syst. PE	Sheet/Bl. 1/1
Doc.type MSZ	RA92048837	DP/TD 001	Ind. AB	Format A4	Repl. for	Repl. by
MNR						

Fig. 12-24: MRT201 (rotor mounted)

Stator MST201, mounted



	Anzahl der Befestigungs-schrauben number of fixing screws	L1 $^{+2}$	L2 $^{+2}$
MST201C	8	36	36
MST201D	8	36	36
MST201F	16	39	49

Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.
AB	--	20210319	nicovoel	nicovoel	chrisc26	7260	DC-IA/EDM2	
AA	--	20110921	sabidrey			7260	DC-IA/EDM2	

Lang./Spr. EN/DE; Wght./Gew.; Crit. P. --; Scale/M.stab 1:4; Mat.meets/Stoffe s N2580-1; Syst. PE; Doc.type MSZ; RA92048881; DP/TD 001; Ind. AB; Format A4; Sheet/Bl. 1/1; MNR; Repl. for; Repl. by

Fig. 12-25: MST201 (stator mounted)

Motor MBT201, rotor and stator, mounted

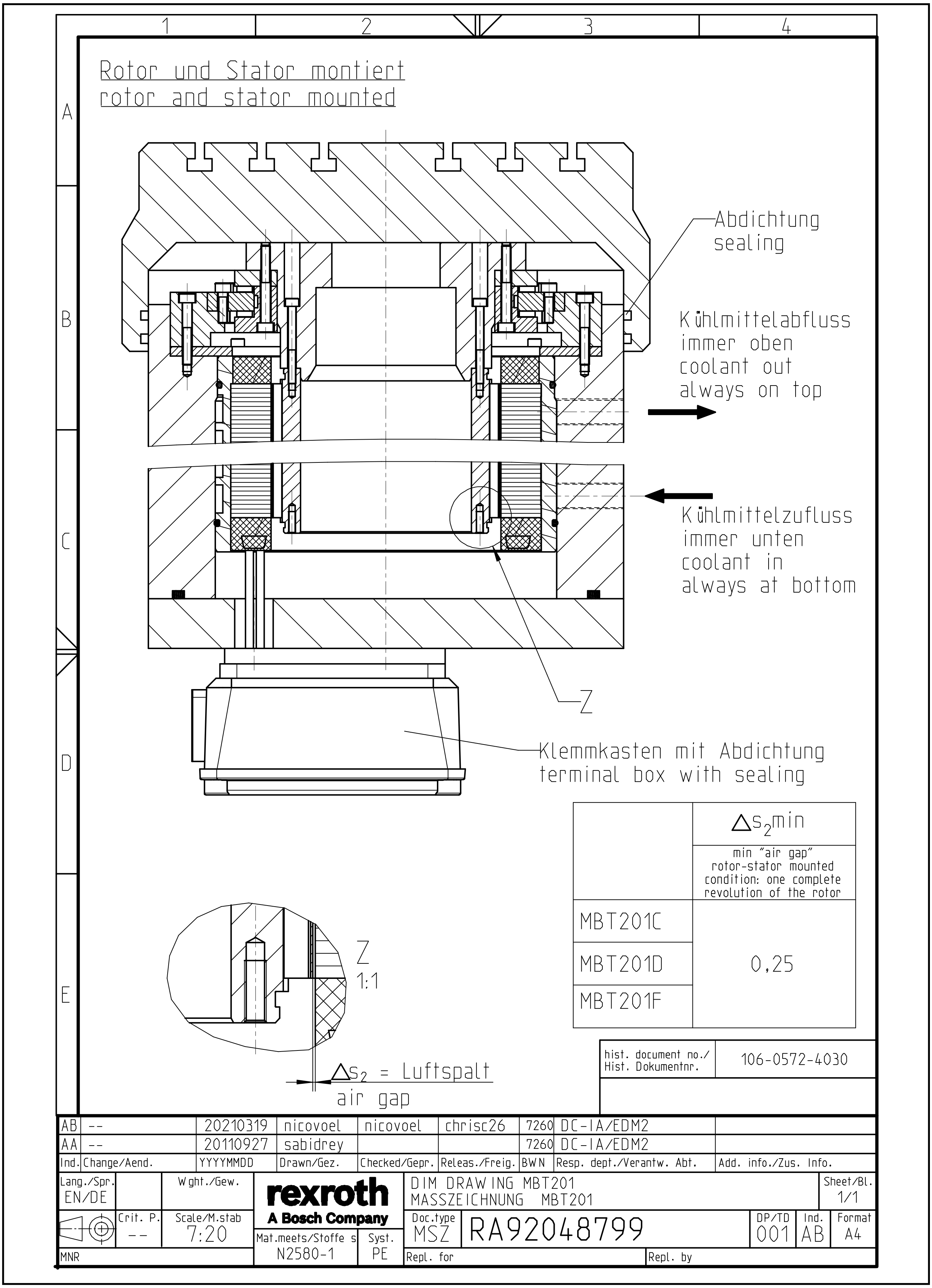
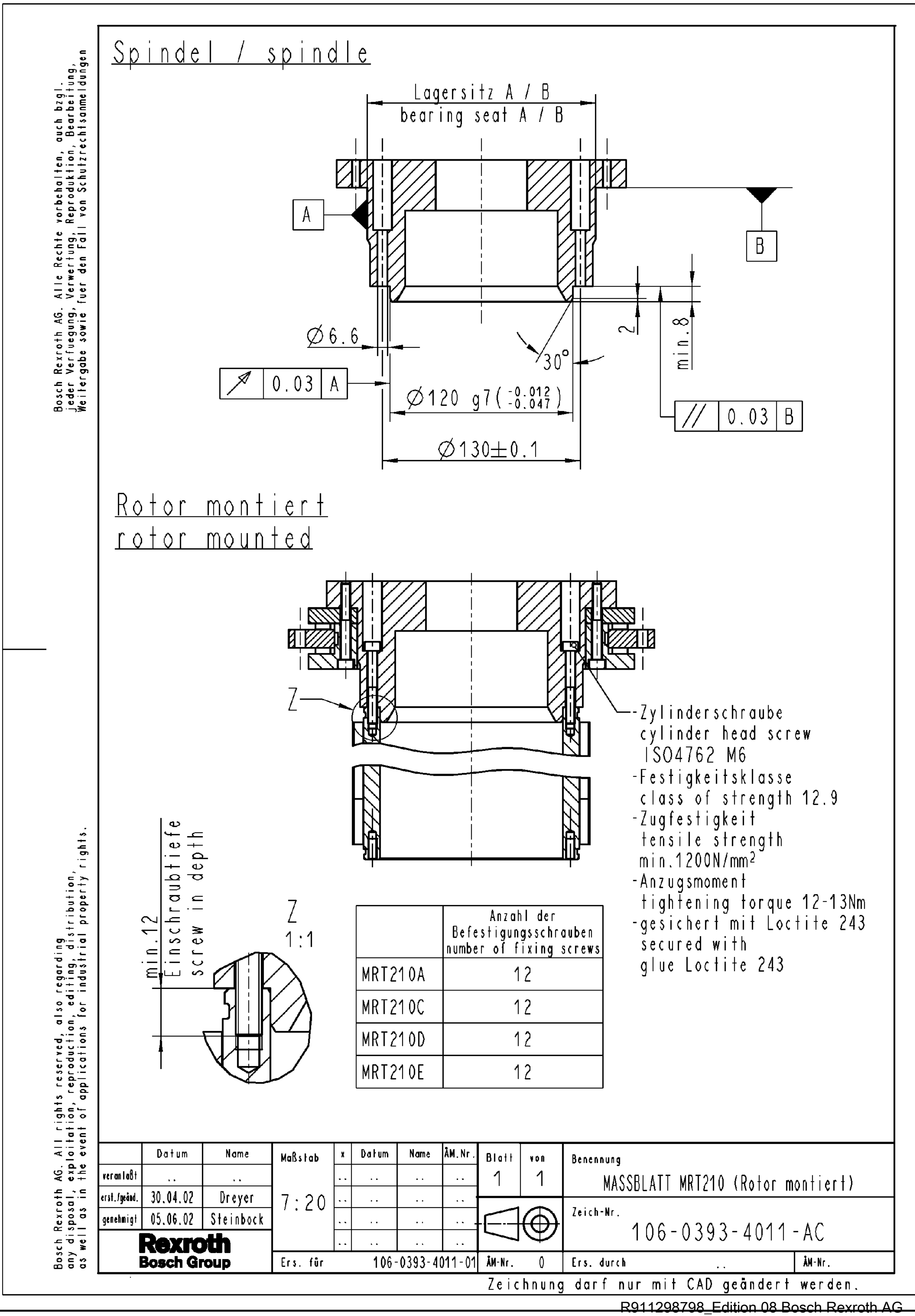


Fig. 12-26: MBT201 (rotor and stator mounted)

12.12.6 Mounting example MBT210

Rotor MRT210, mounted



	Anzahl der Befestigungsschrauben number of fixing screws
MRT210A	12
MRT210C	12
MRT210D	12
MRT210E	12

Stator, mounted ("SN")

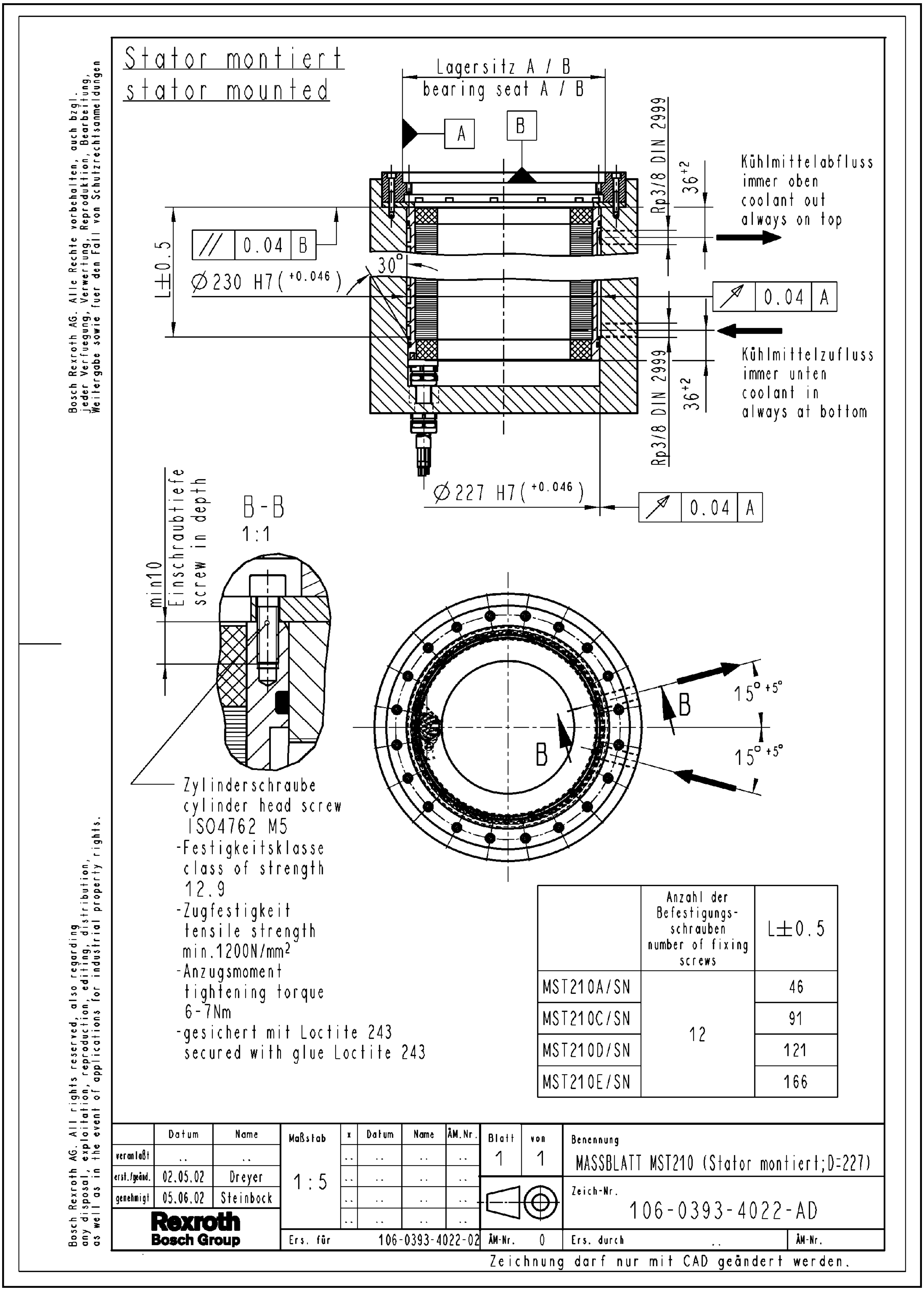


Fig. 12-28: MST210, stator mounted ("SN")

Stator, mounted ("CN")

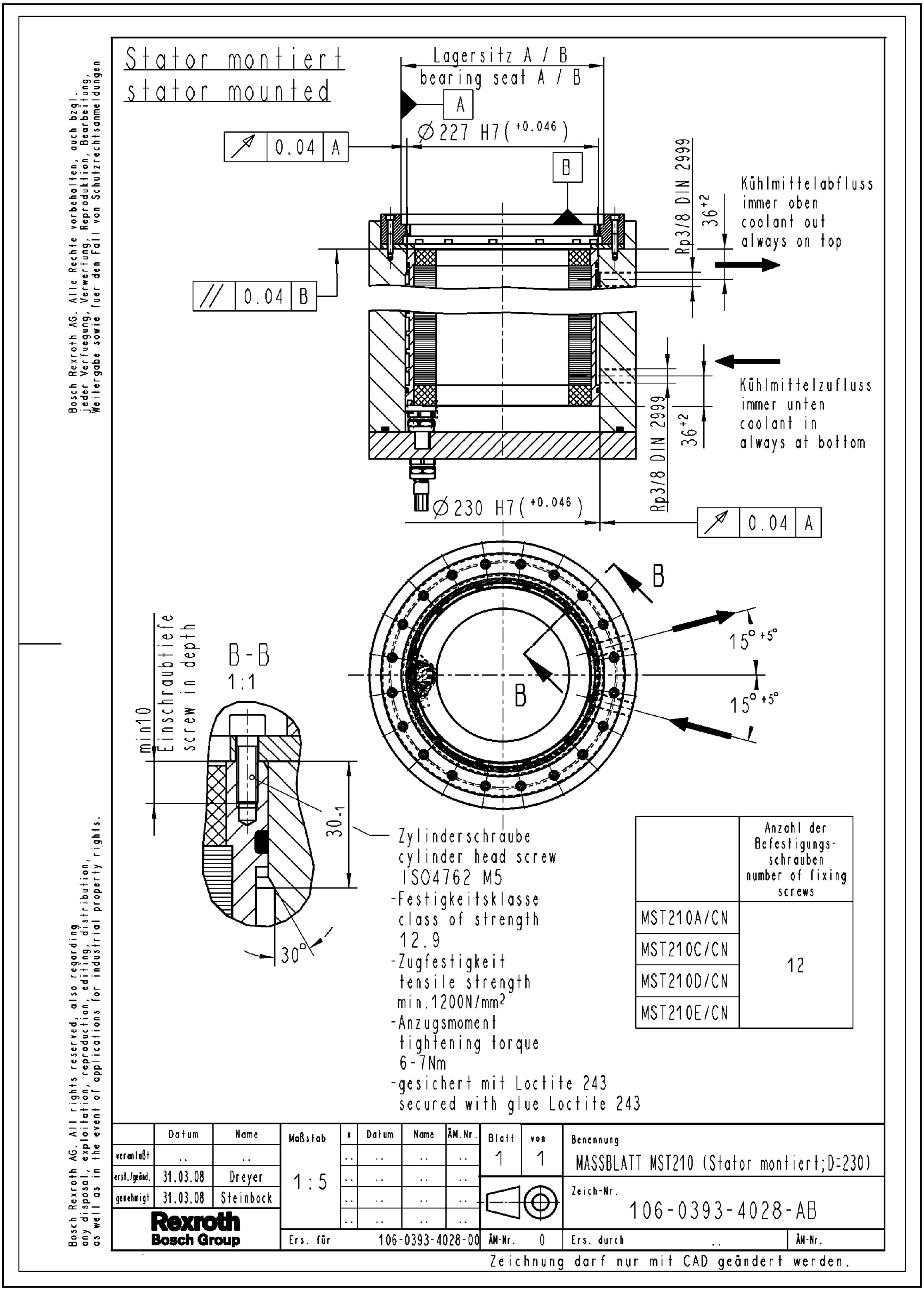
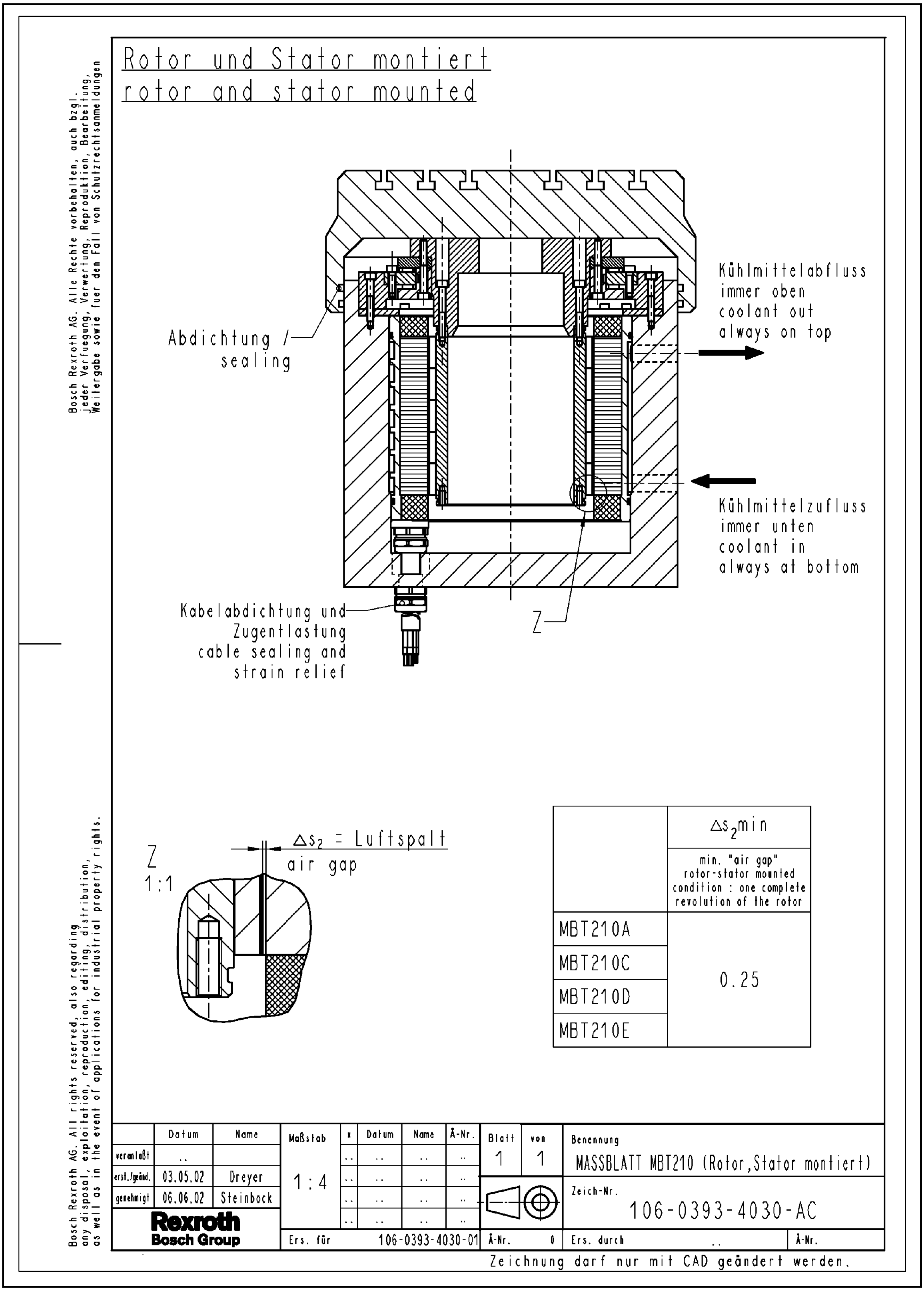


Fig. 12-29: MST210, stator mounted ("CN")

Motor MBT210, rotor and stator, mounted

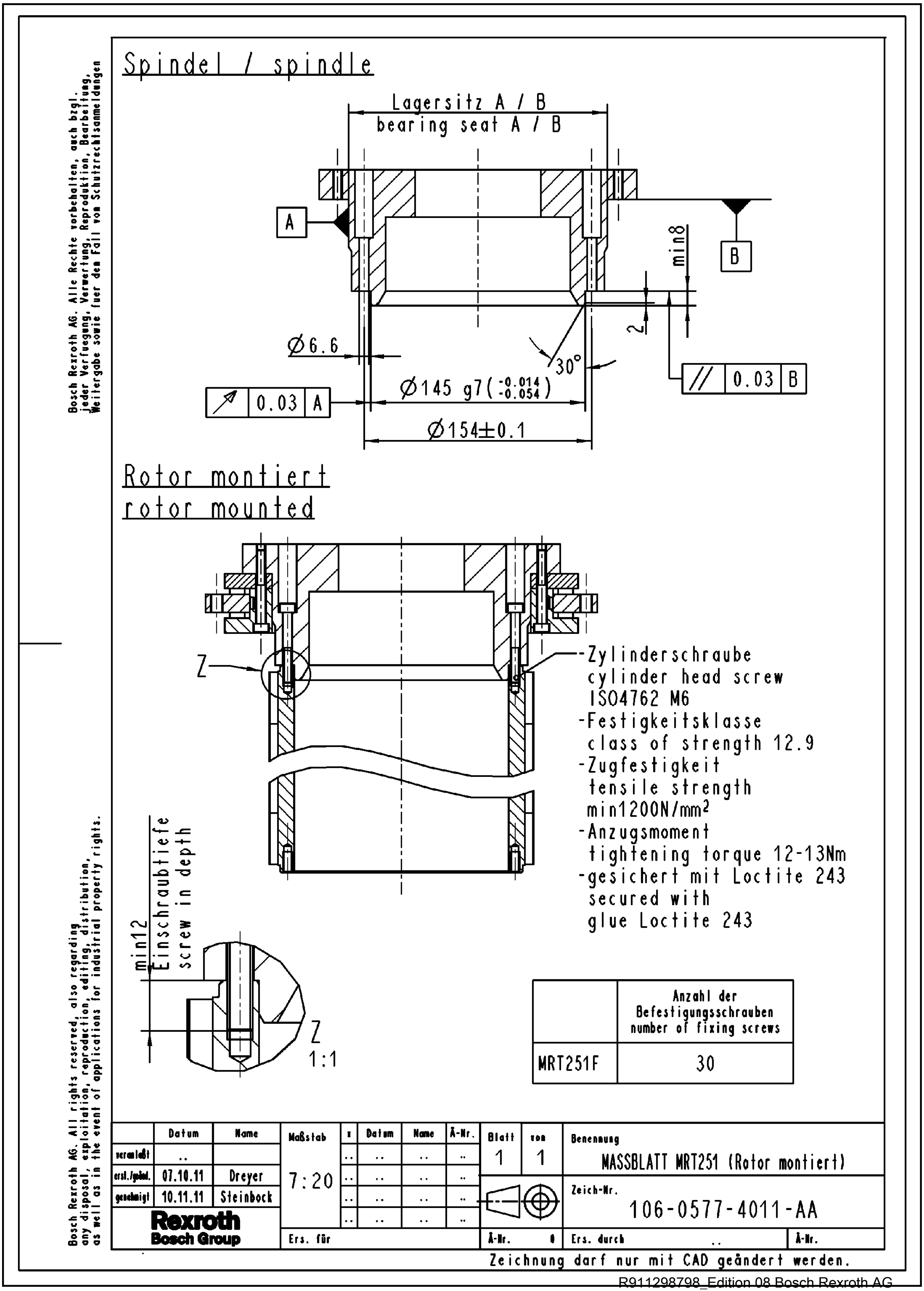


	$\Delta s_2 min$
	min. "air gap" rotor-stator mounted condition : one complete revolution of the rotor
MBT210A	0.25
MBT210C	
MBT210D	
MBT210E	

Fig. 12-30: MBT210, rotor and stator mounted

12.12.7 Mounting example MBT251

Rotor MRT251, mounted



Stator MST251, mounted

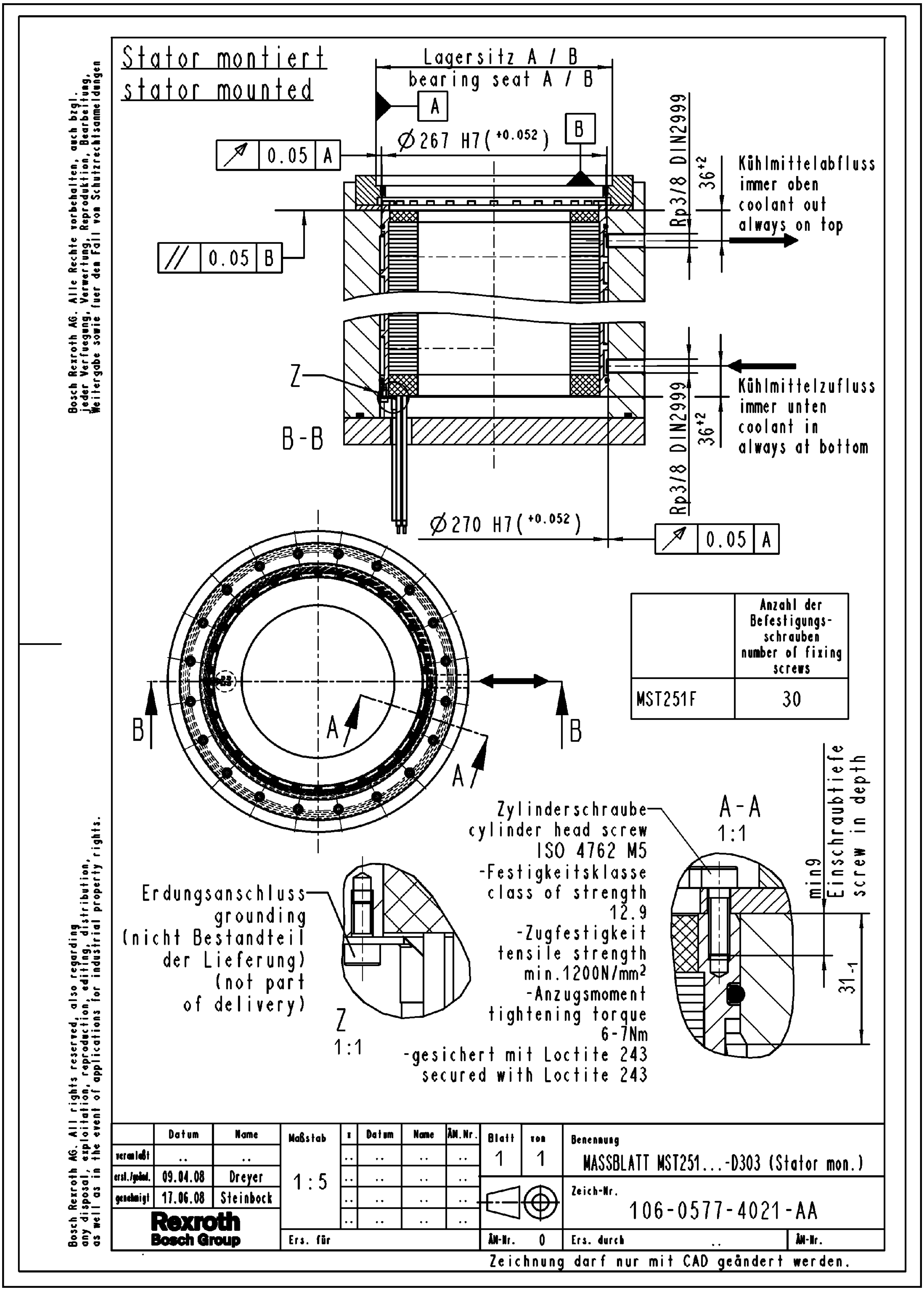


Fig. 12-32: MST251 (stator mounted)

Motor MBT251, rotor and stator, mounted

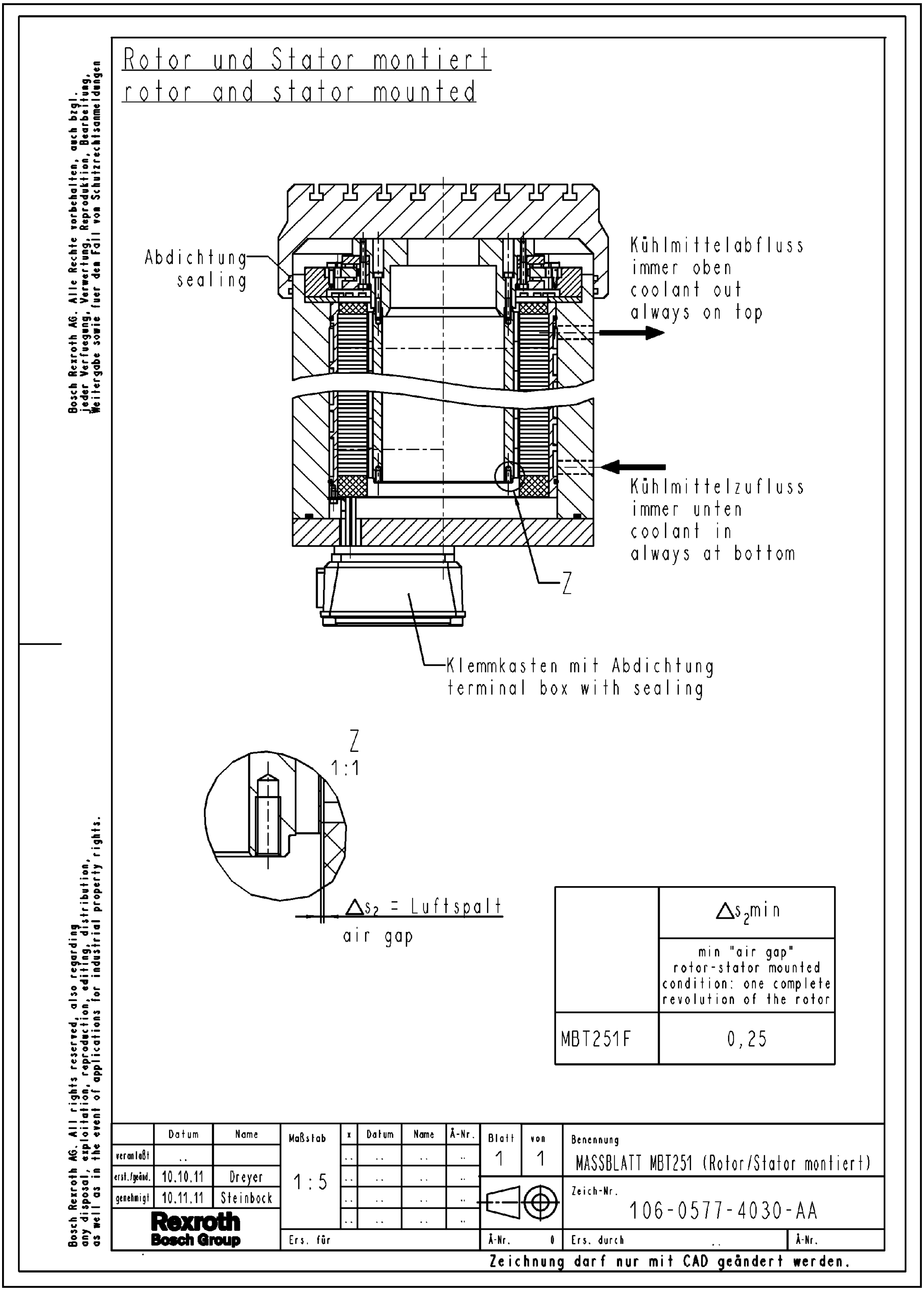


Fig. 12-33: MBT251 (rotor and stator mounted)

12.12.8 Mounting example MBT290

Rotor MRT290, mounted

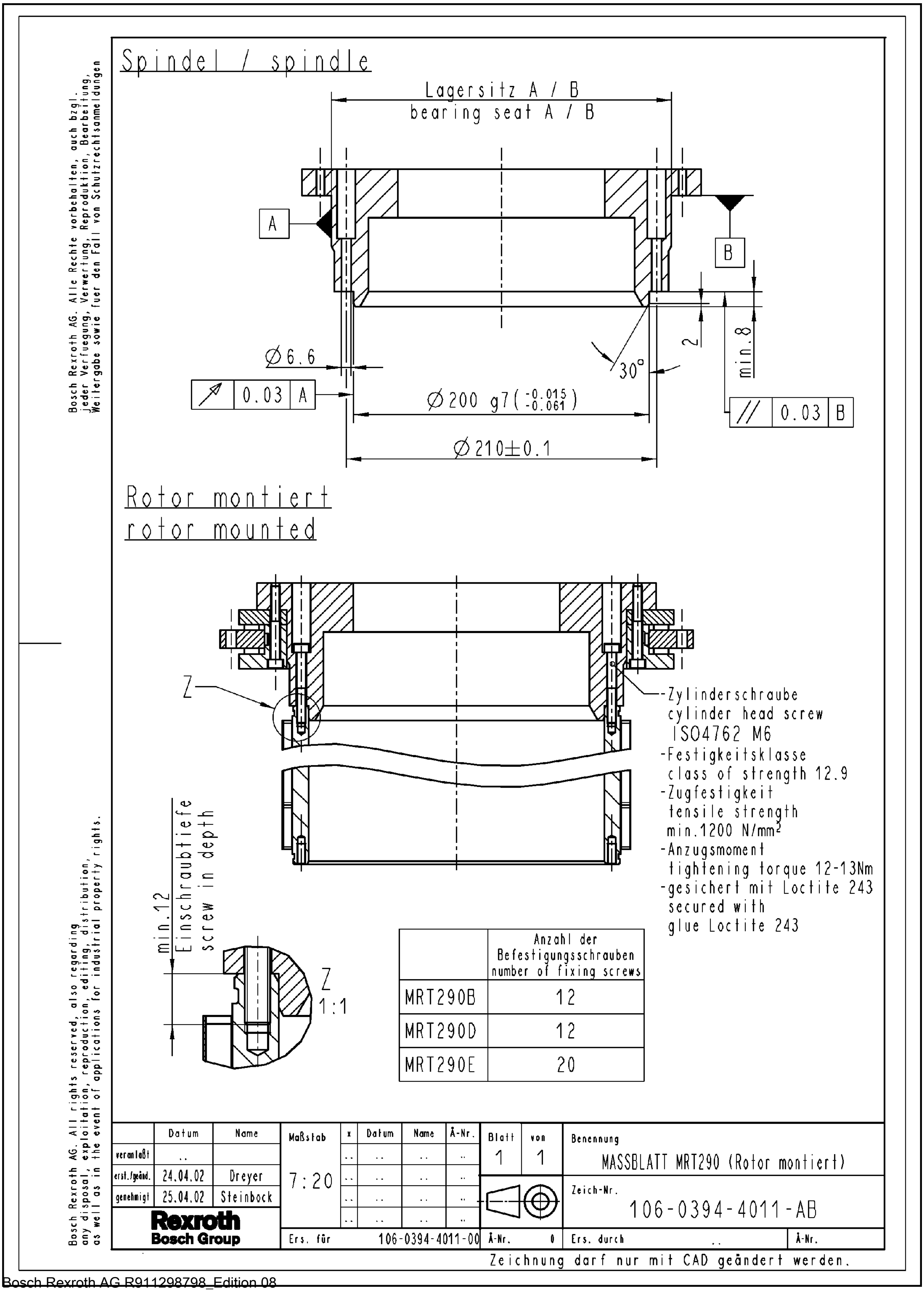
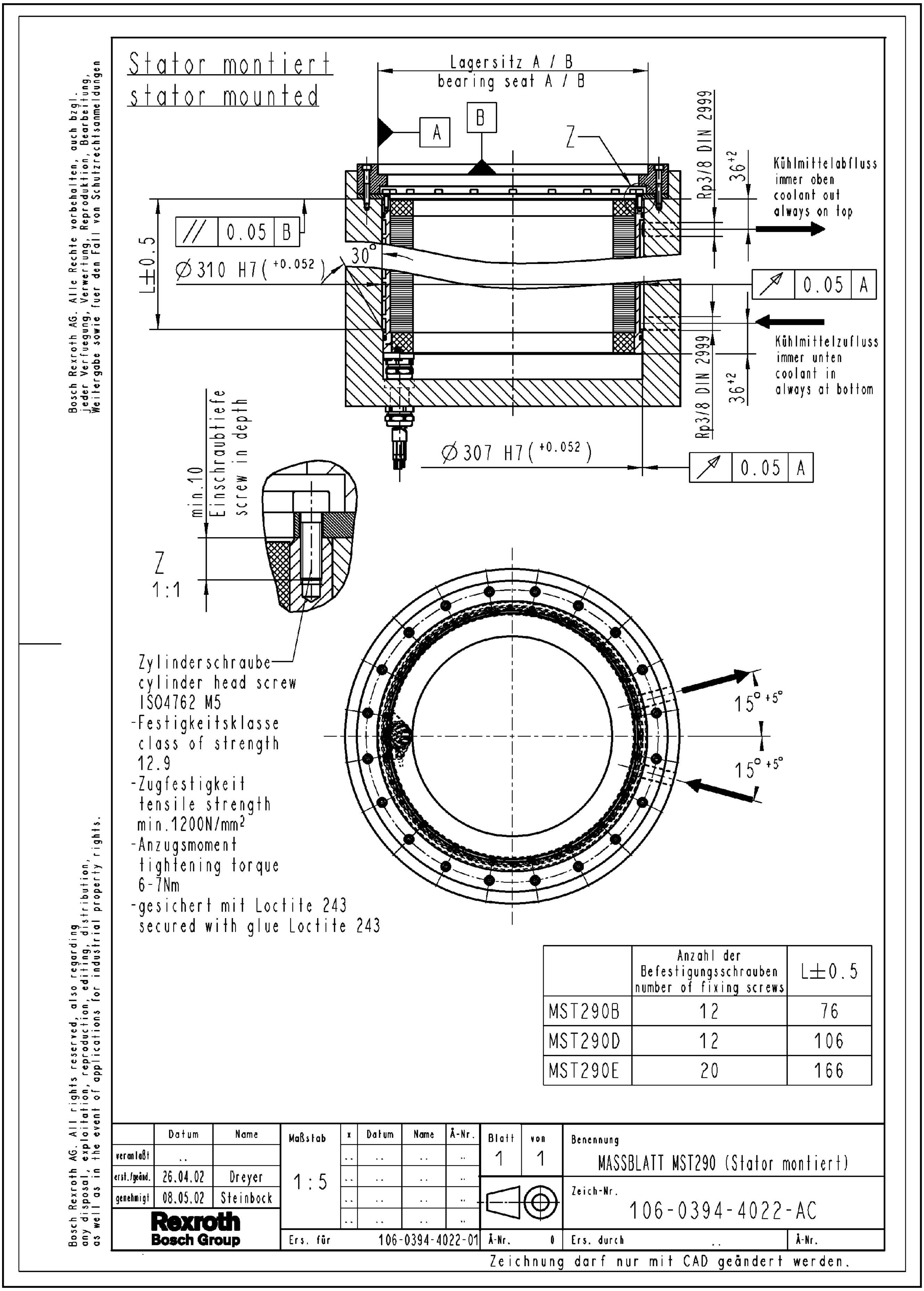


Fig. 12-34: MRT290 rotor mounted

Stator MST290, mounted



	Anzahl der Befestigungsschrauben number of fixing screws	L±0.5
MST290B	12	76
MST290D	12	106
MST290E	20	166

Fig. 12-35: MST290, stator mounted

Motor MBT290, rotor and stator, mounted

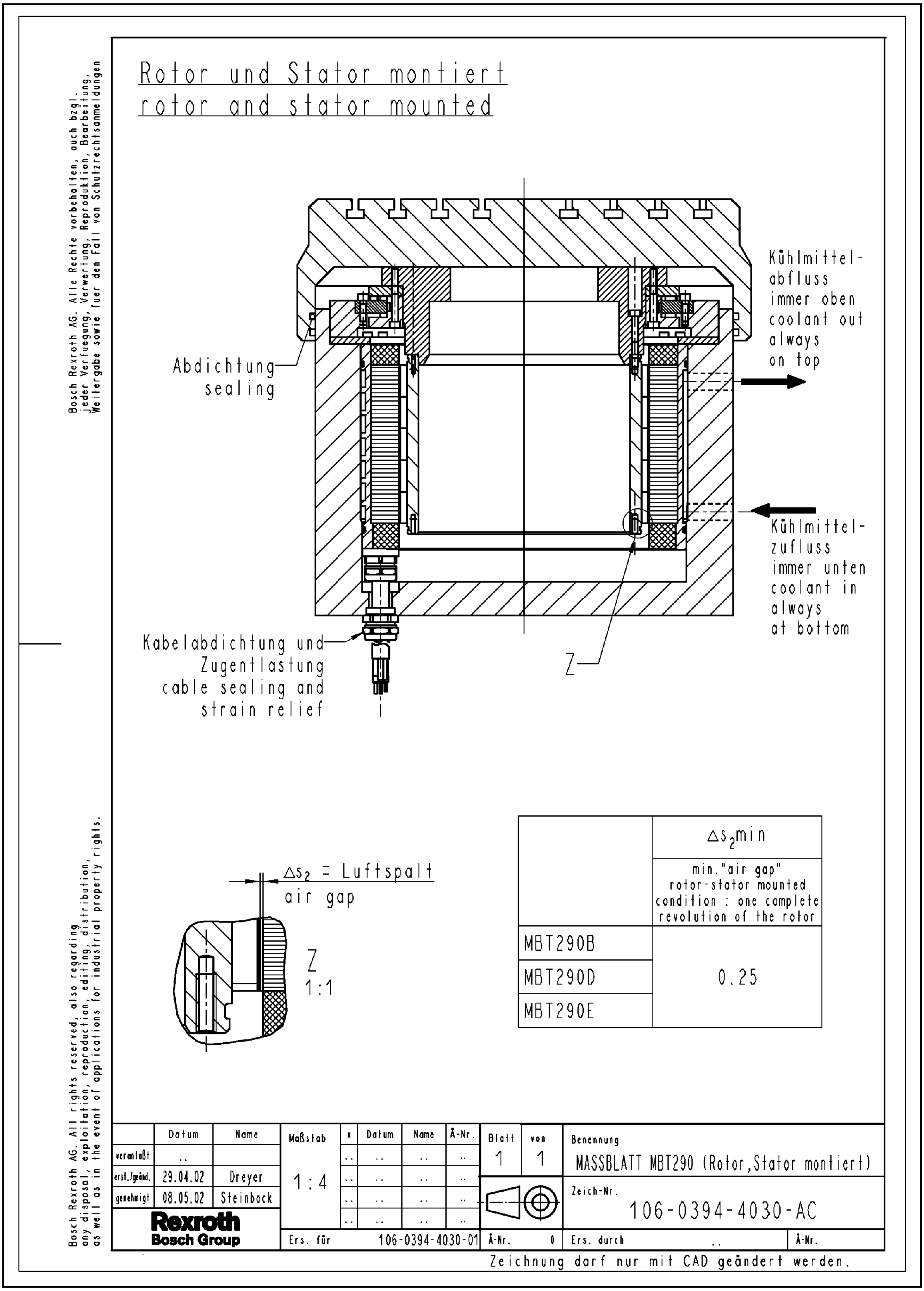
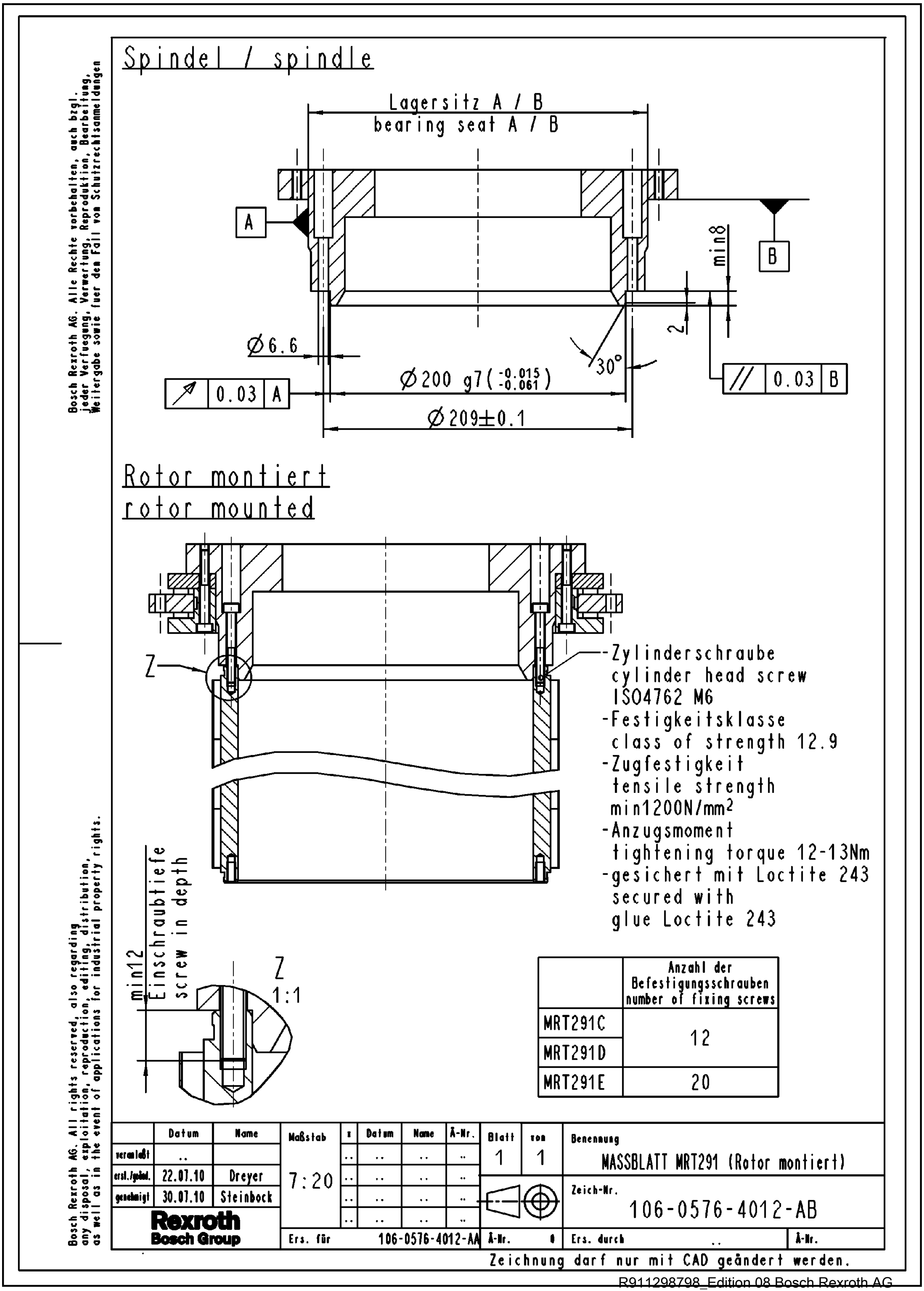


Fig. 12-36: MBT290, rotor and stator mounted

12.12.9 Mounting example MBT291

Rotor MRT291, mounted



Stator MST291, mounted

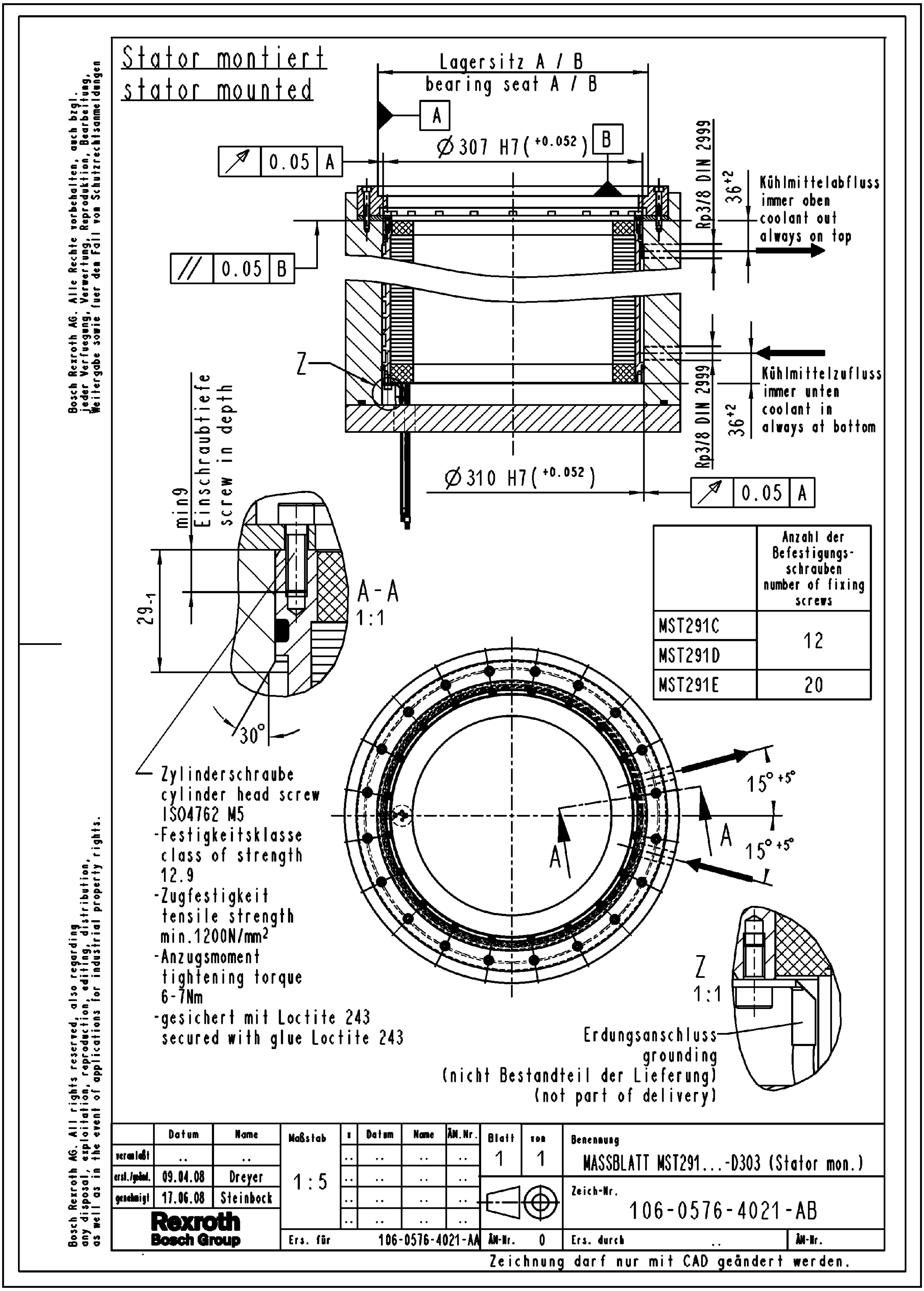


Fig. 12-38: MST291 (stator mounted)

Motor MBT291, rotor and stator, mounted

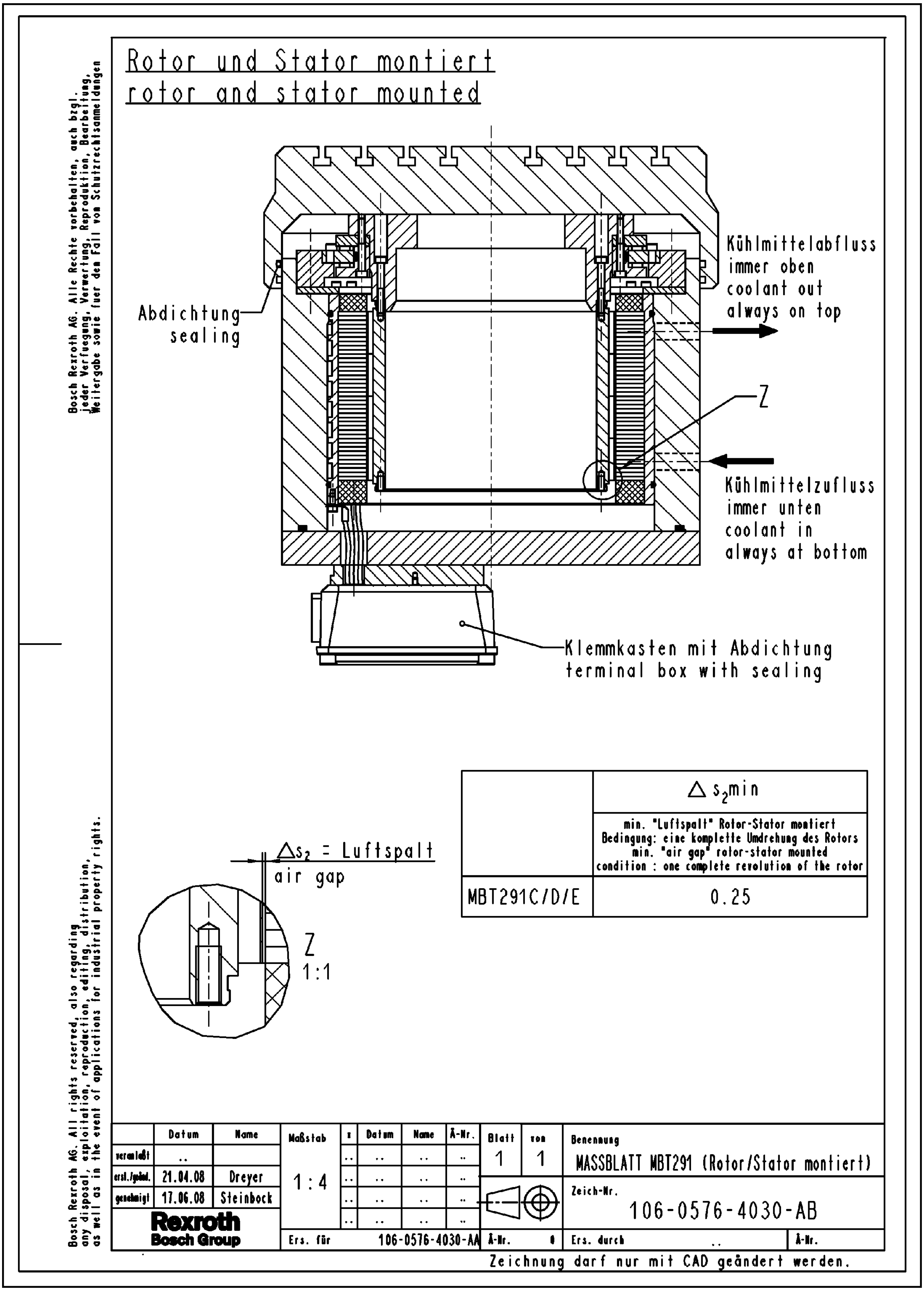
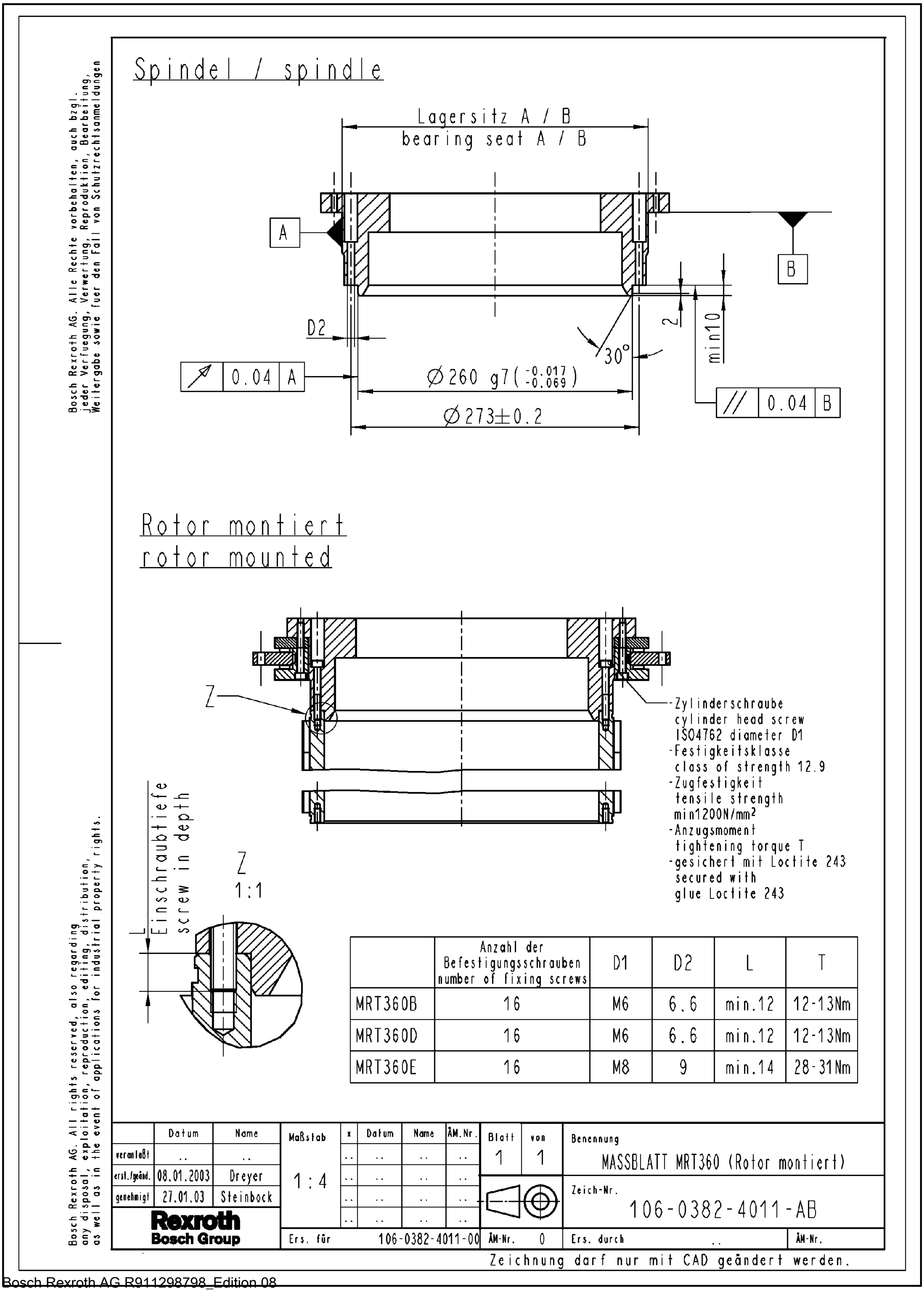


Fig. 12-39: *MBT291 (rotor and stator mounted)*

12.12.10 Mounting example MBT360

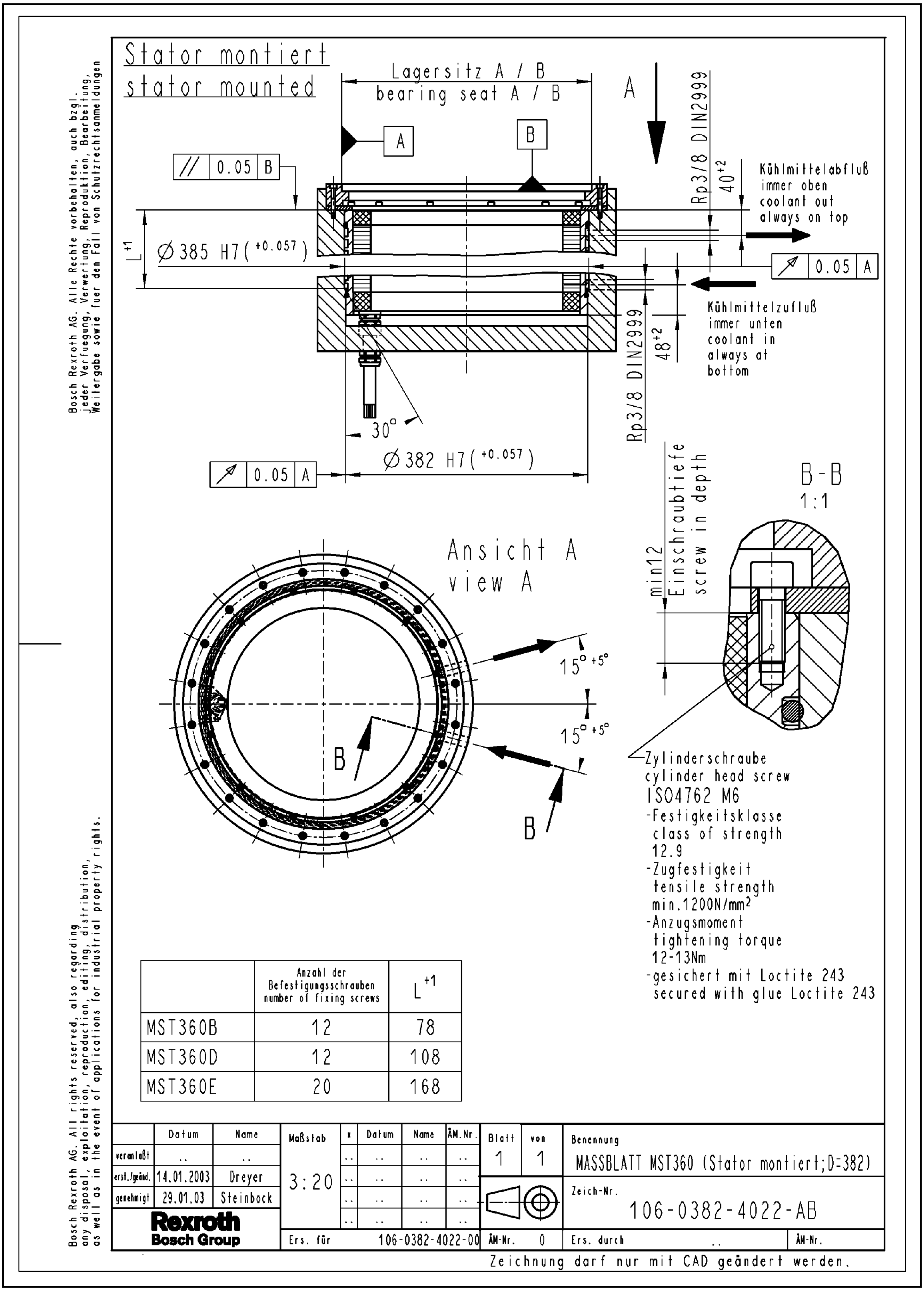
Rotor MRT360, mounted



	Anzahl der Befestigungsschrauben number of fixing screws	D1	D2	L	T
MRT360B	16	M6	6.6	min.12	12-13Nm
MRT360D	16	M6	6.6	min.12	12-13Nm
MRT360E	16	M8	9	min.14	28-31Nm

Fig. 12-42: MRT360, rotor mounted

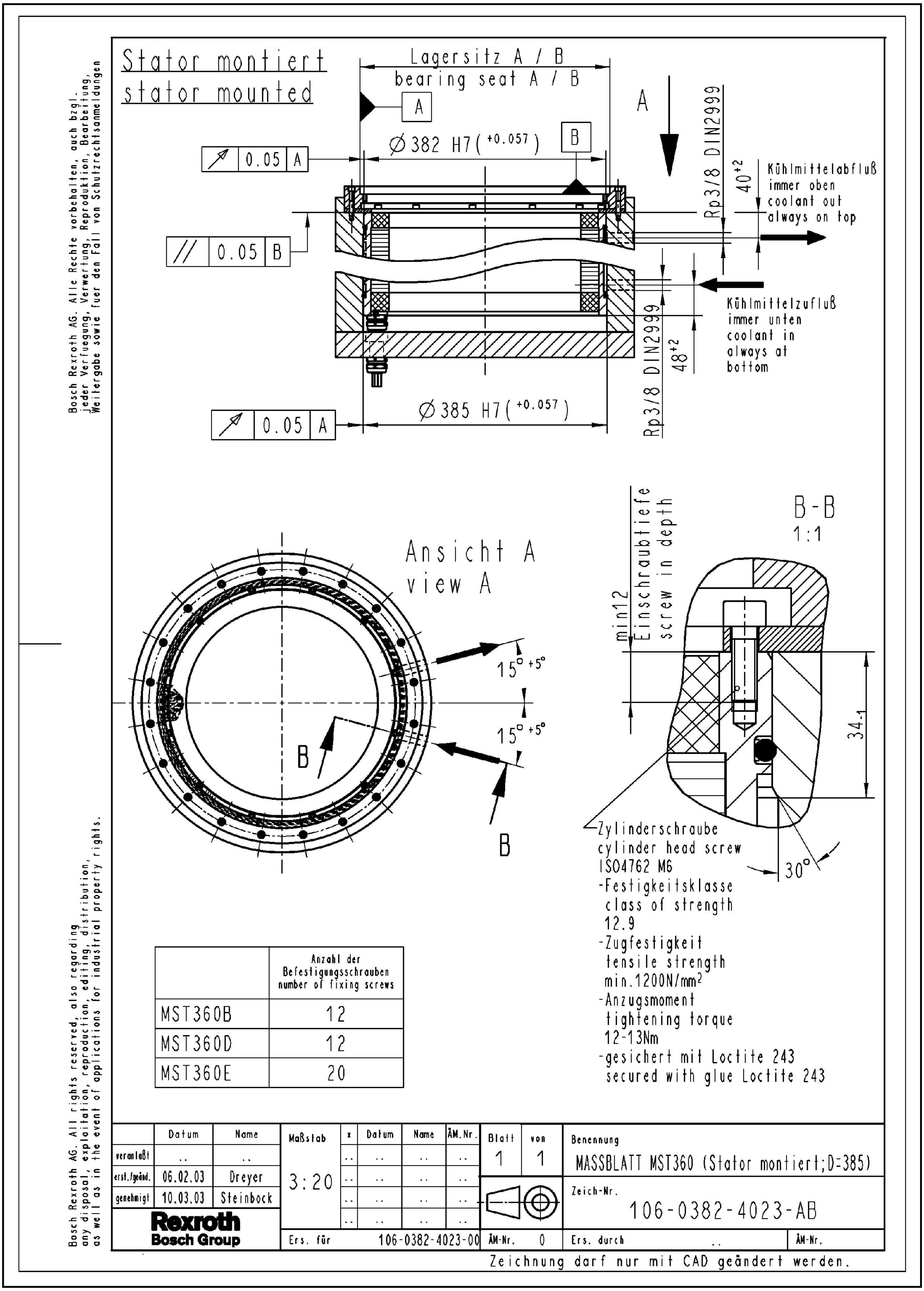
Stator MST360 mounted, electrical connection "SN"



	Anzahl der Befestigungsschrauben number of fixing screws	L+1
MST360B	12	78
MST360D	12	108
MST360E	20	168

Fig. 12-41: MST360 mounted, electrical connection "SN"

Stator MST360 mounted, electrical connection "CN"

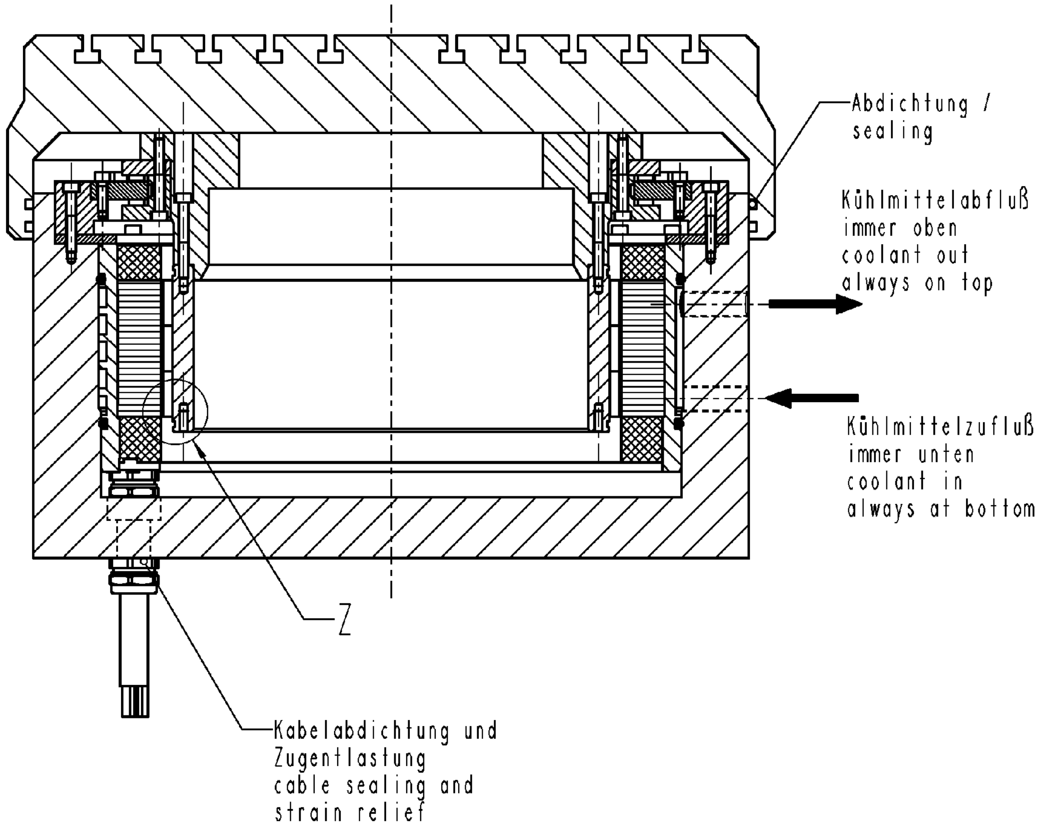


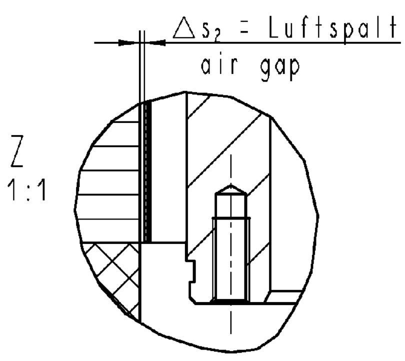
	Anzahl der Befestigungsschrauben number of fixing screws
MST360B	12
MST360D	12
MST360E	20

Fig. 12-42: MST360 mounted, electrical connection "CN"

Rotor and stator, mounted

Rotor und Stator montiert
rotor and stator mounted





	$\Delta s_2 min$ min. "air gap" rotor-stator mounted condition: one complete revolution of the rotor
MBT360B	0.25
MBT360D	
MBT360E	

	Datum	Name	Maßstab	x	Datum	Name	ÄM.Nr.	Blatt	von	Benennung
veranlaßt	..	..	1 : 4	..	..	..	..	1	1	MASSBLATT MBT360 (Rotor,Stator montiert)
erst./geänd.	14.01.03	Dreyer		..	..	..	..			Zeich-Nr. 106-0382-4030-AB
genehmigt	30.01.03	Steinbock		..	..	..	..			
				..	..	..	..			

Rexroth Bosch Group

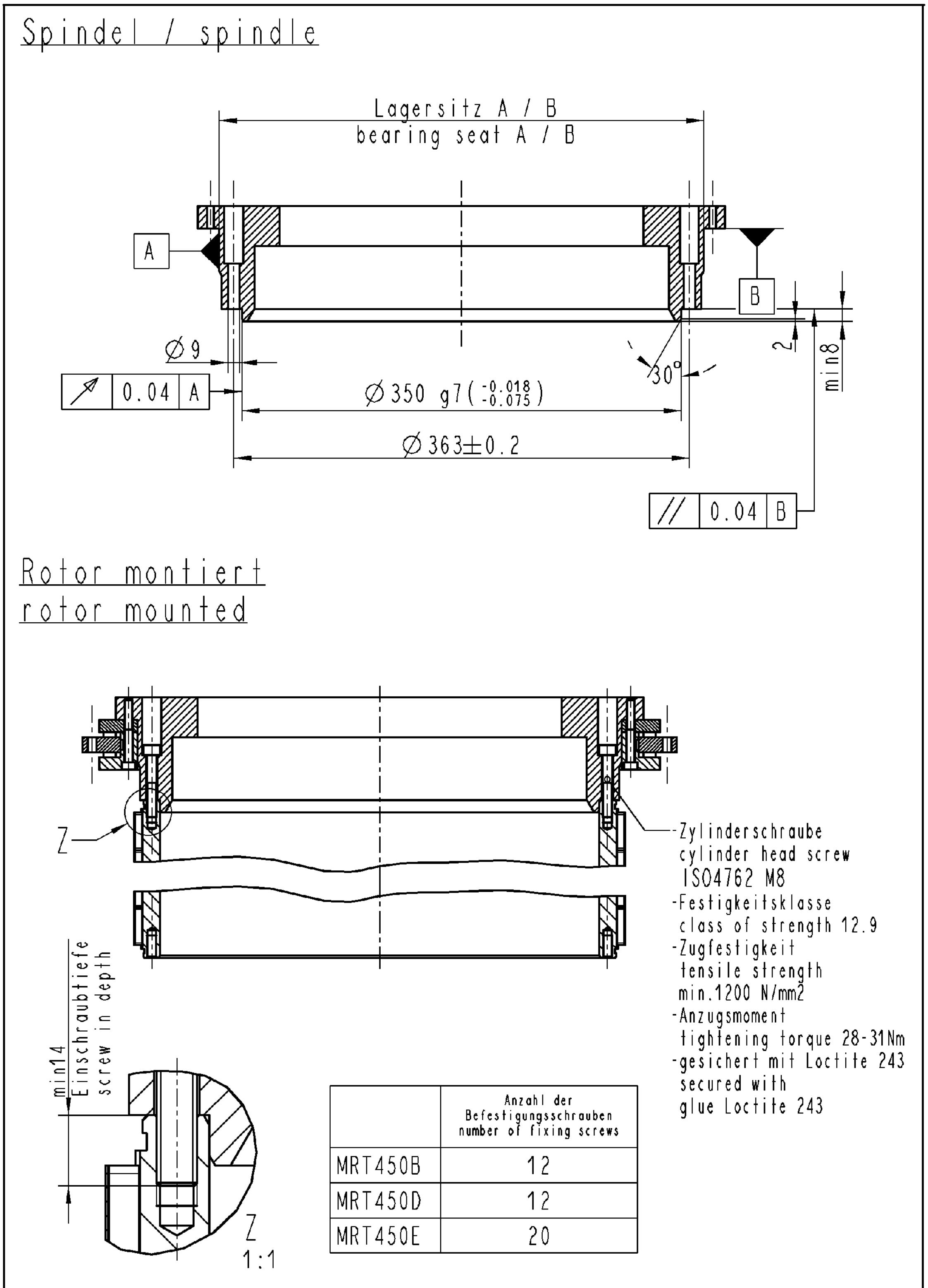
Ers. für 106-0382-4030-00 | ÄM-Nr. 0 | Ers. durch .. | ÄM-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 12-43: Frame size 360, rotor and stator mounted

12.12.11 Mounting example MBT450

Rotor MRT450, mounted

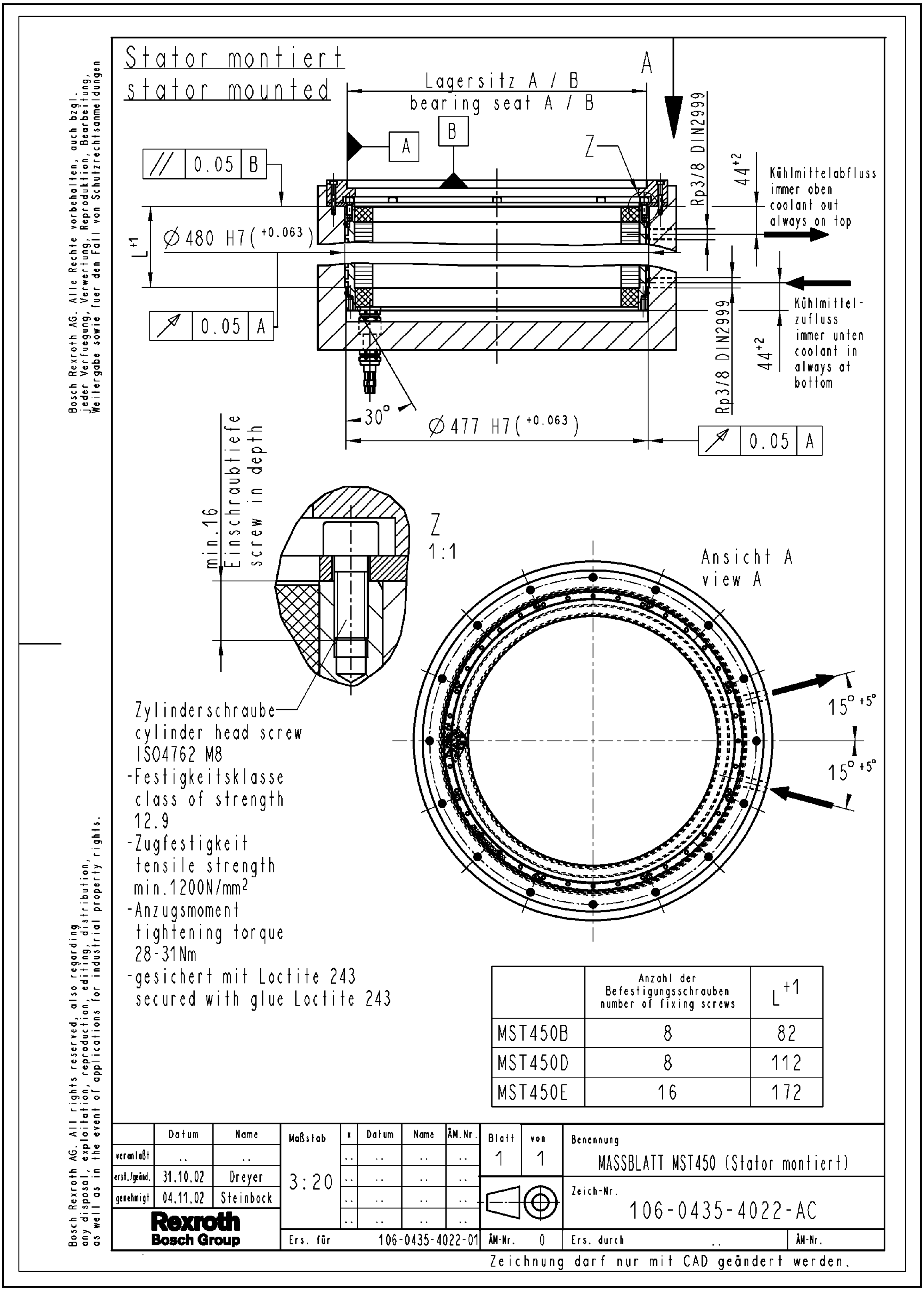


	Anzahl der Befestigungsschrauben number of fixing screws
MRT450B	12
MRT450D	12
MRT450E	20

	Datum	Name	Maßstab	x	Datum	Name	ÄM.Nr.	Blatt	von	Benennung
veranlaßt	..	..	1 : 4	..	..	..	..	1	1	MASSBLATT MRT450 (Rotor montiert)
erst./geänd.	30.10.02	Dreyer		..	..	..	..			Zeich-Nr. 106-0435-4011-AB
genehmigt	30.10.02	Steinbock		..	..	..	..			
Rexroth Bosch Group			Ers. für 106-0435-4011-00					ÄM-Nr. 0		Ers. durch .. ÄM-Nr.

Zeichnung darf nur mit CAD geändert werden.

Stator MST450, mounted



	Anzahl der Befestigungsschrauben number of fixing screws	L^{+1}
MST450B	8	82
MST450D	8	112
MST450E	16	172

Fig. 12-45: Stator MST450, mounted

Rotor and stator, mounted

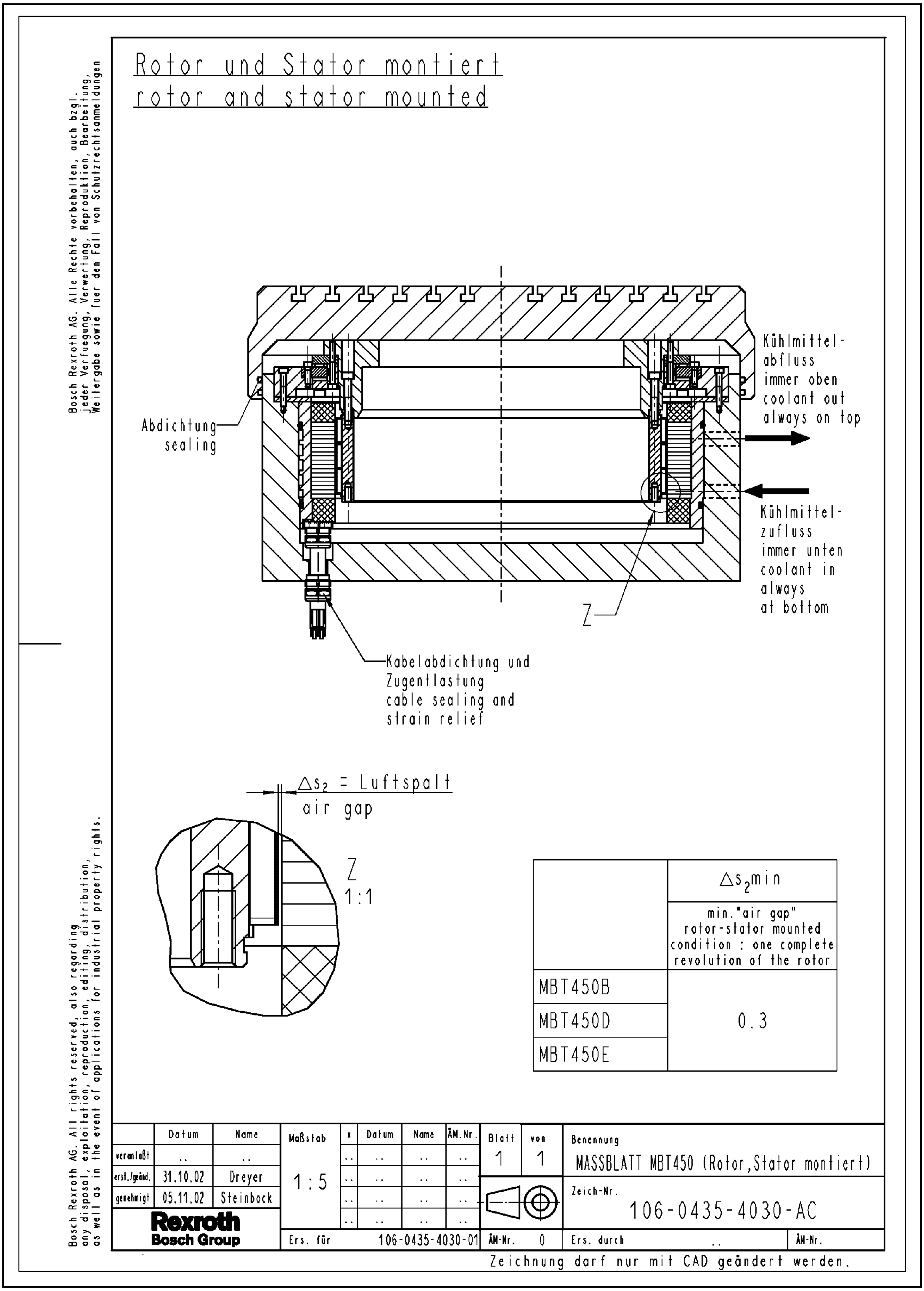


Fig. 12-46: Frame size 450, rotor and stator mounted

12.12.12 Mounting example MBT530

Rotor MRT530B/ -C/ -D/ -E, mounted

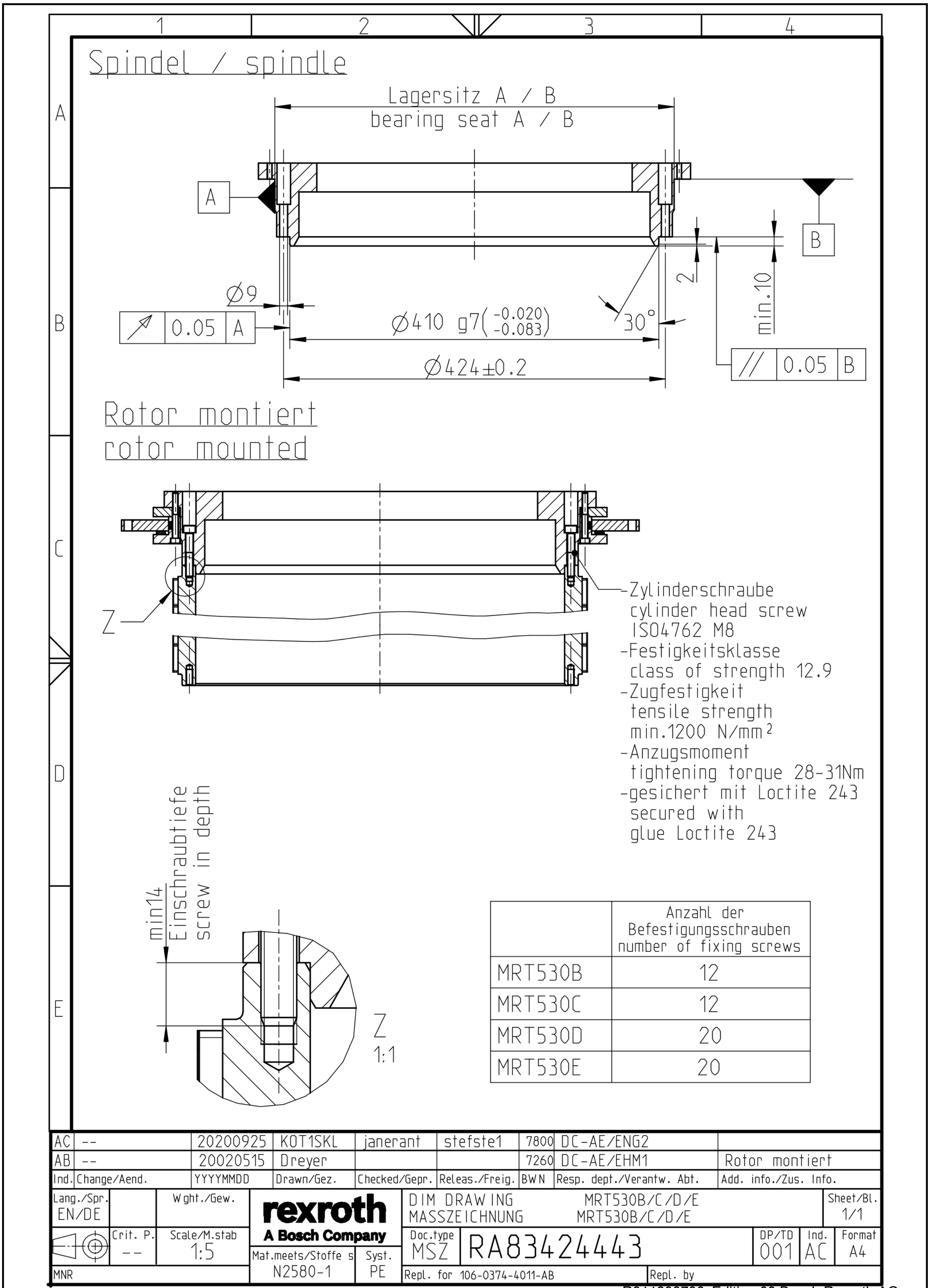


Fig. 12-47: Rotor MRT530B/ -C/ -D/ -E, mounted

Rotor MRT530F/ -G/ -L/ -P/ -R, mounted

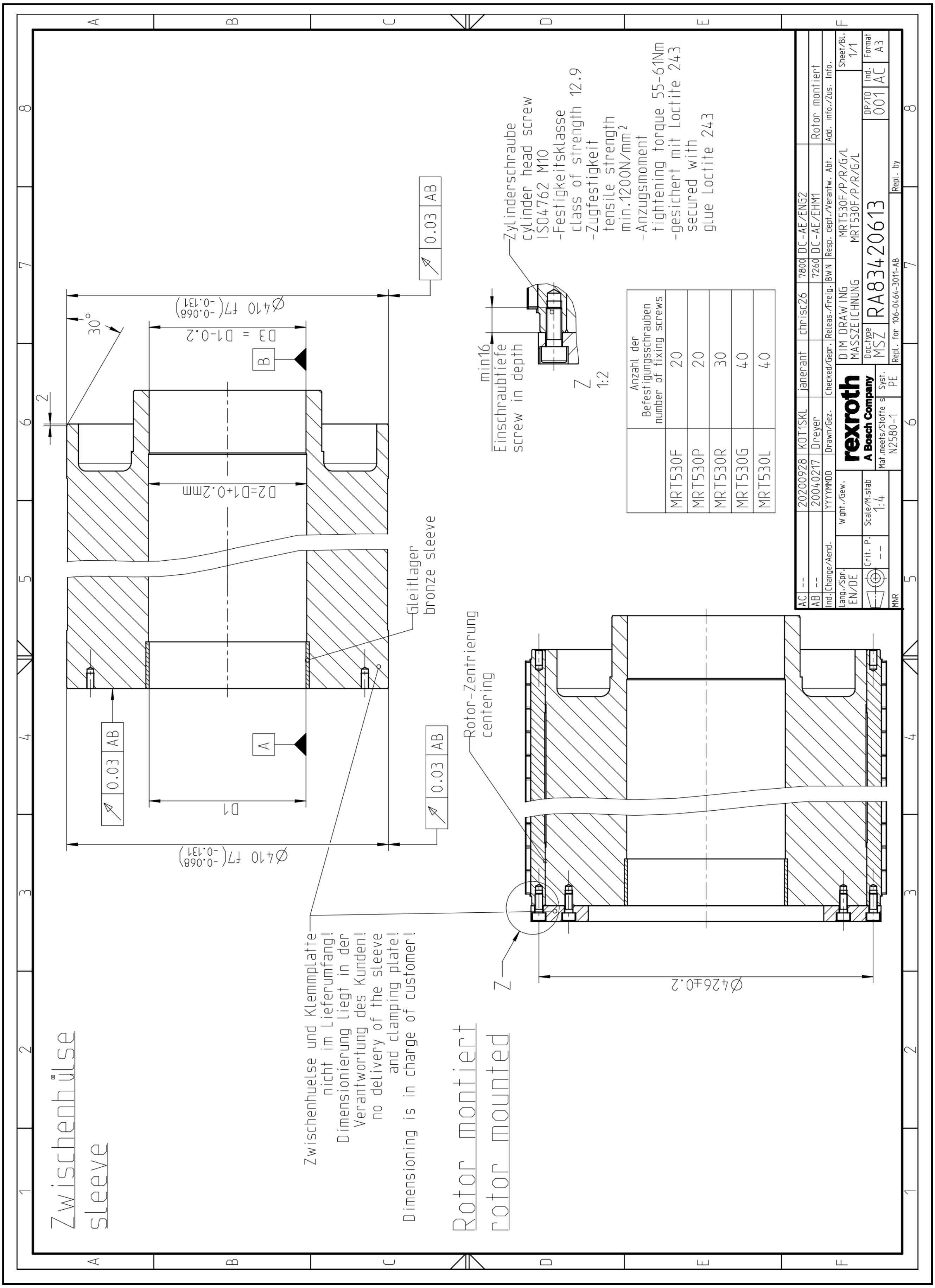
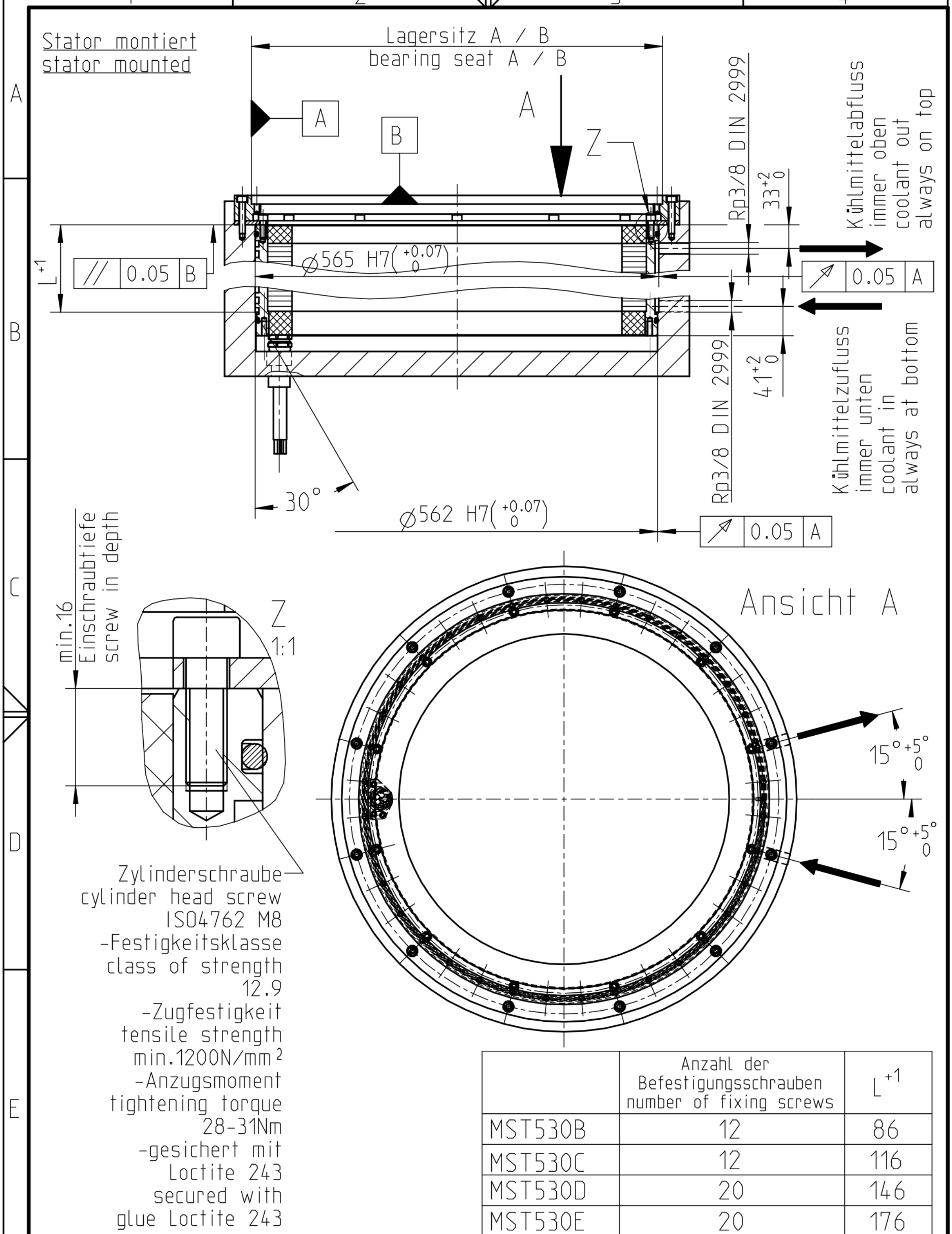


Fig. 12-48: Rotor MRT530F/ -G/ -L/ -P/ -R, mounted

Stator MST530B/ -C/ -D/ -E, electrical connection "SN", mounted



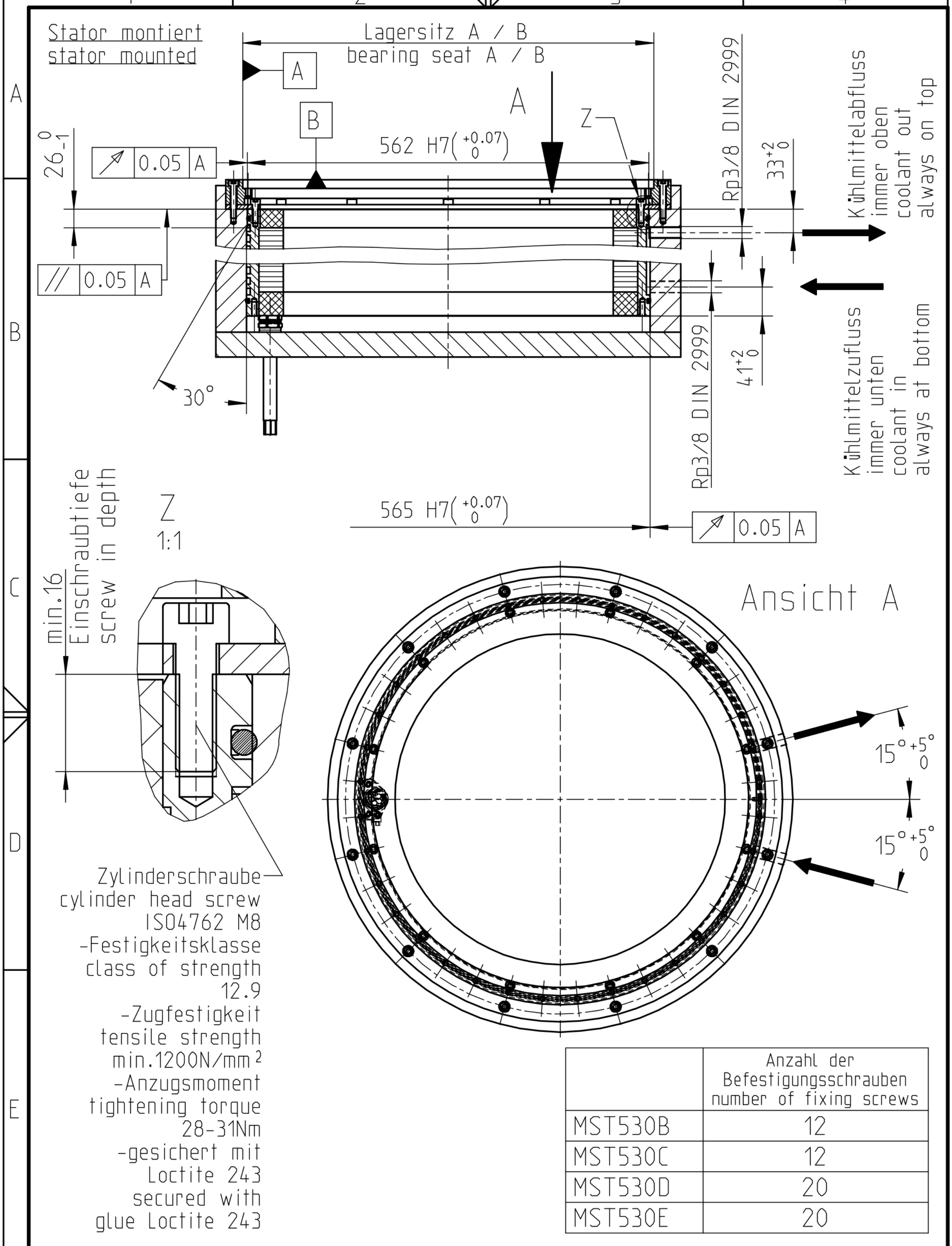
	Anzahl der Befestigungsschrauben number of fixing screws	L^{+1}
MST530B	12	86
MST530C	12	116
MST530D	20	146
MST530E	20	176

Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.
AC	--	20200925	KOT1SKL	janerant	stefste1	7800	DC-AE/ENG2	Stator montiert
AB	--	20020521	Dreyer			7260	DC-AE/EHM1	D=562

Lang./Spr. EN/DE | Wght./Gew. | rexroth A Bosch Company | DIM DRAWING MST530B/C/D/E | MASSZEICHNUNG MST530B/C/D/E | Sheet/Bl. 1/1
Crit. P. -- | Scale/M.stab 7:50 | Mat.meets/Stoffe s N2580-1 | Syst. PE | Doc.type MSZ | RA83424861 | DP/TD 001 | Ind. AC | Format A4
MNR | Repl. for 106-0374-4023-AB | Repl. by

Fig. 12-49: Stator MST530B/ -C/ -D/ -E, electrical connection "SN", mounted

Stator MST530B/ -C/ -D/ -E, electrical connection "CN", mounted



	Anzahl der Befestigungsschrauben number of fixing screws
MST530B	12
MST530C	12
MST530D	20
MST530E	20

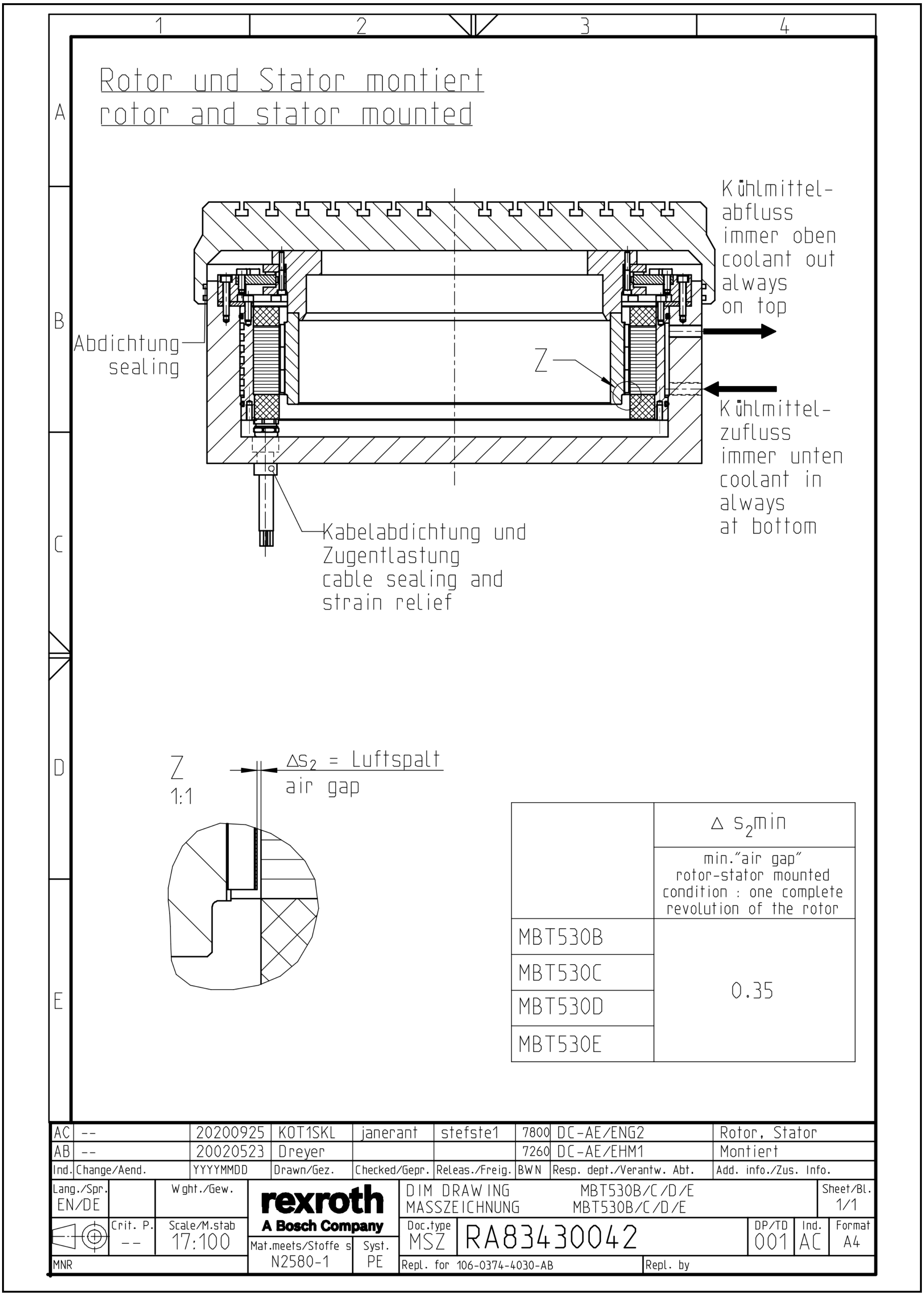
Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.
AA	--	20201001	KOT1SKL	janerant	chrisc26	7800	DC-AE/ENG2	Stator montiert D=565

Lang./Spr.	EN/DE
Crit. P.	--
Scale/M.stab	7:50
Mat.meets/Stoffe s	N2580-1
Syst.	PE
Title	DIM DRAWING MST530B/C/D/E; MASSZEICHNUNG MST530B/C/D/E
Sheet/Bl.	1/1
Doc.type	MSZ
Number	RA83457209
DP/TD	001
Ind.	AA
Format	A4
Repl. for	106-0374-4022-AB
Repl. by	

rexroth A Bosch Company

Fig. 12-50: Stator MST530B/ -C/ -D/ -E, electrical connection "CN", mounted

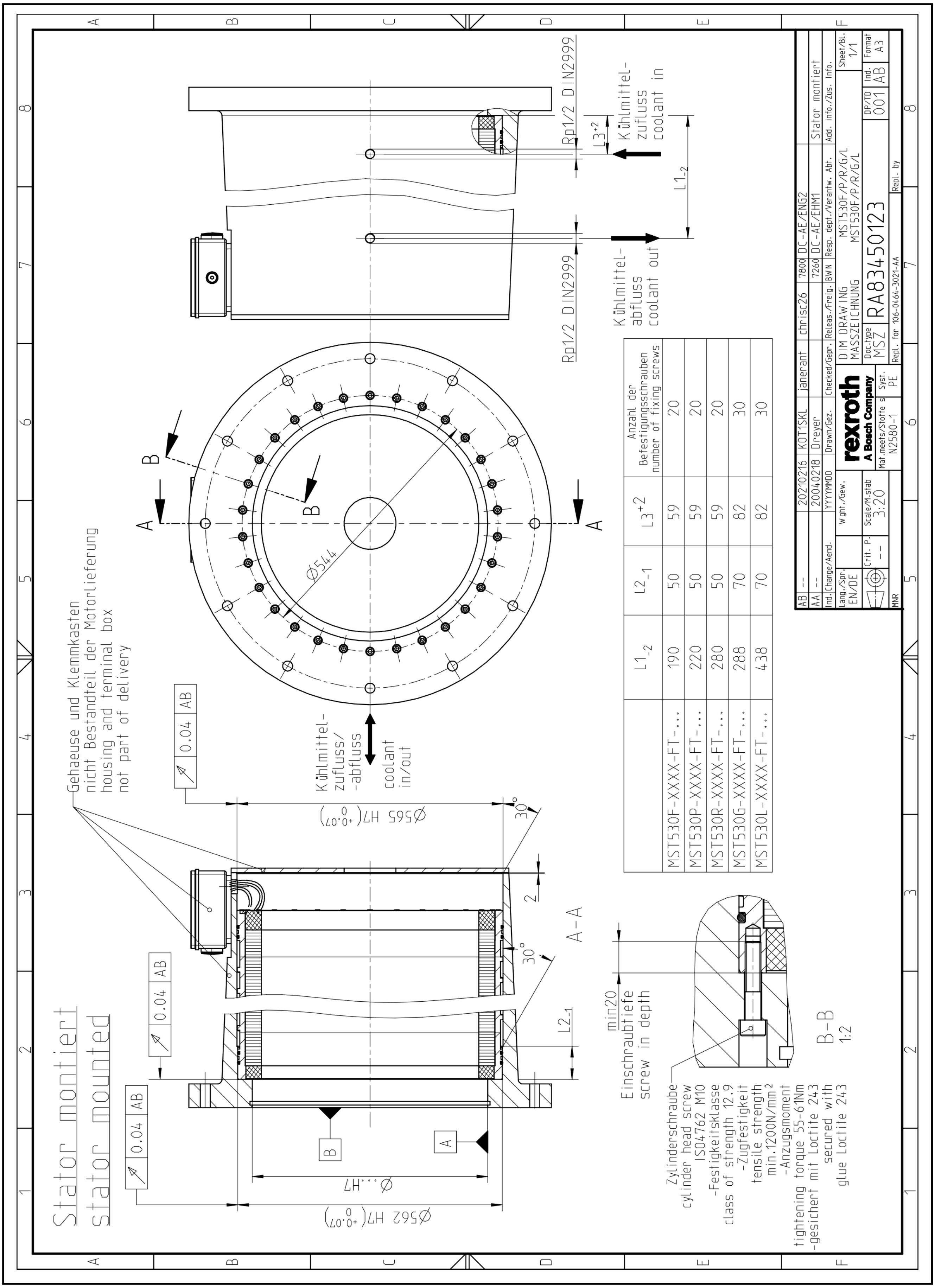
Frame size 530B/ -C/ -D/ -E, rotor and stator mounted



	$\Delta s_2 min$
	min."air gap" rotor-stator mounted condition : one complete revolution of the rotor
MBT530B	0.35
MBT530C	
MBT530D	
MBT530E	

Fig. 12-51: Frame size 530B/ -C/ -D/ -E, rotor and stator mounted

MST530F/ -G/ -L/ -P/ -R, mounting housing



	$L1_{-2}$	$L2_{-1}$	$L3^{+2}$	Anzahl der Befestigungsschrauben number of fixing screws
MST530F-XXXX-FT-...	190	50	59	20
MST530P-XXXX-FT-...	220	50	59	20
MST530R-XXXX-FT-...	280	50	59	20
MST530G-XXXX-FT-...	288	70	82	30
MST530L-XXXX-FT-...	438	70	82	30

Fig. 12-52: MST530F/ -G/ -L/ -P/ -R, mounting housing

Frame size 530F/ -G/ -L/ -P/ -R, mounting with housing

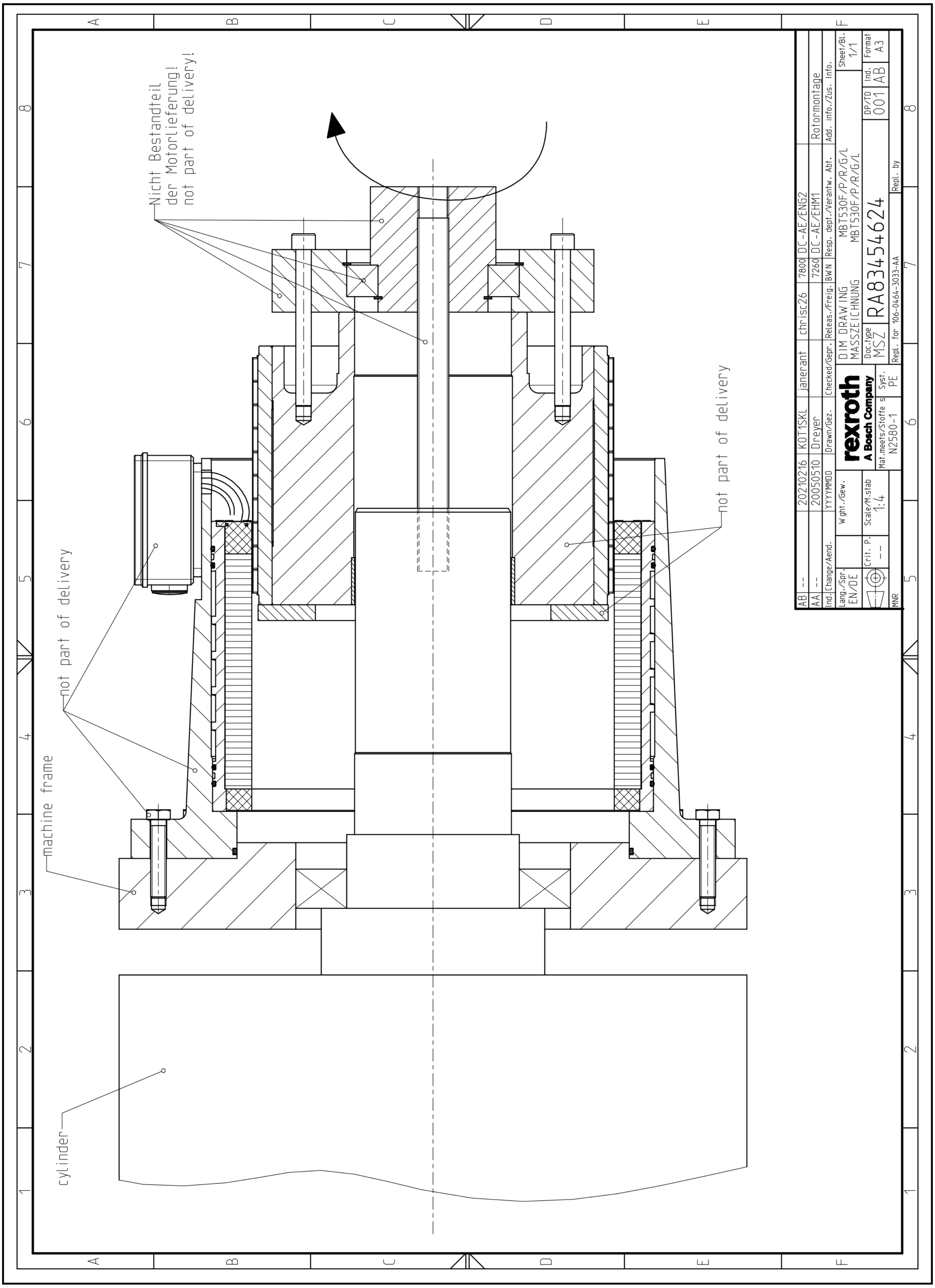


Fig. 12-53: Frame size 530F/ -G/ -L/ -P/ -R, mounting with housing

Frame size 530F/ -G/ -L/ -P/ -R with housing, mounted

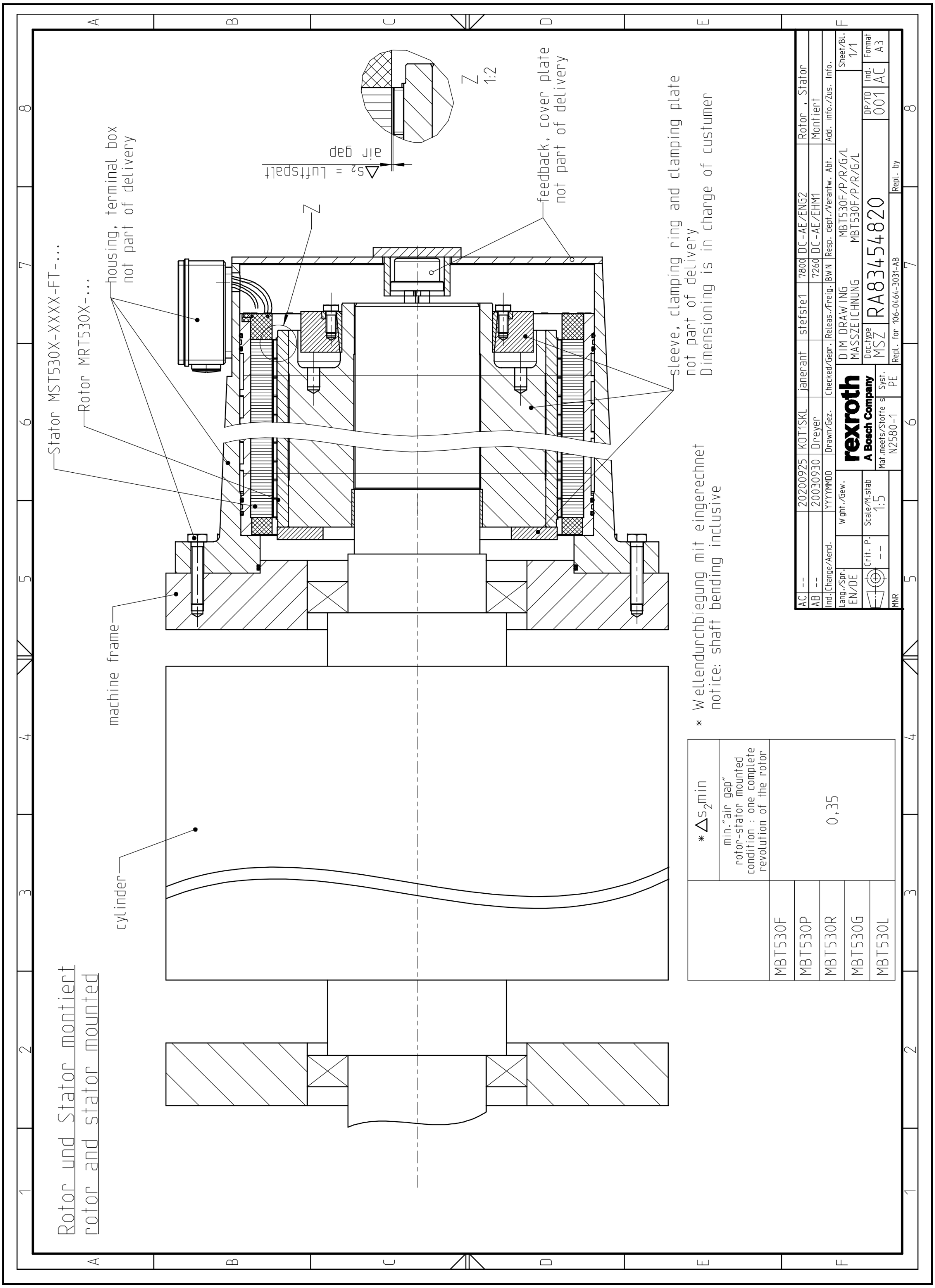


Fig. 12-54: Frame size 530F/ -G/ -L/ -P/ -R with housing, mounted

Dimensioning of shaft and stator for MBT530F/ -G/ -L/ -P/ -R

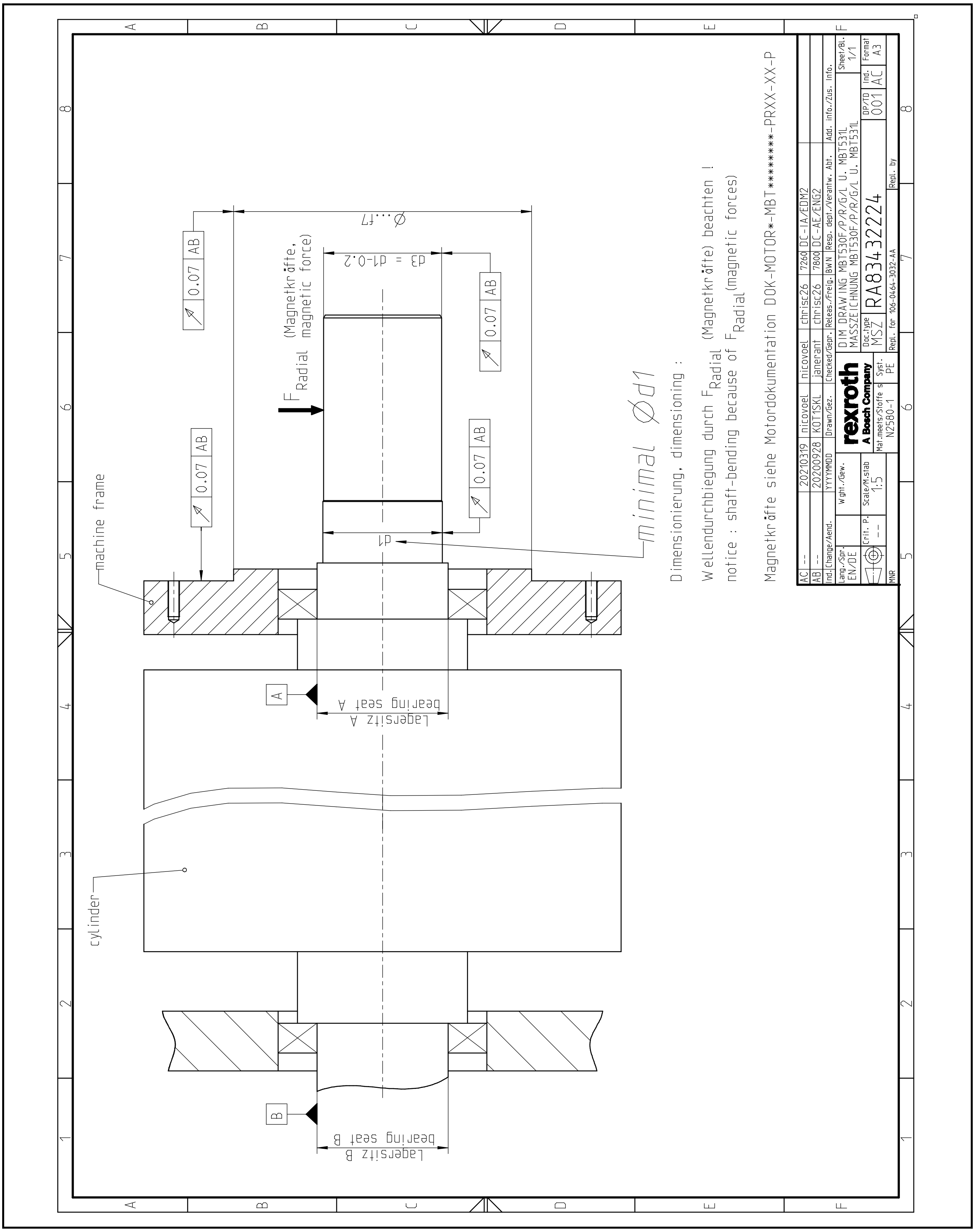


Fig. 12-55: Dimensioning of shaft for MBT530F/ -G/ -L/ -P/ -R

Rotor MST530G, 530L, mounted

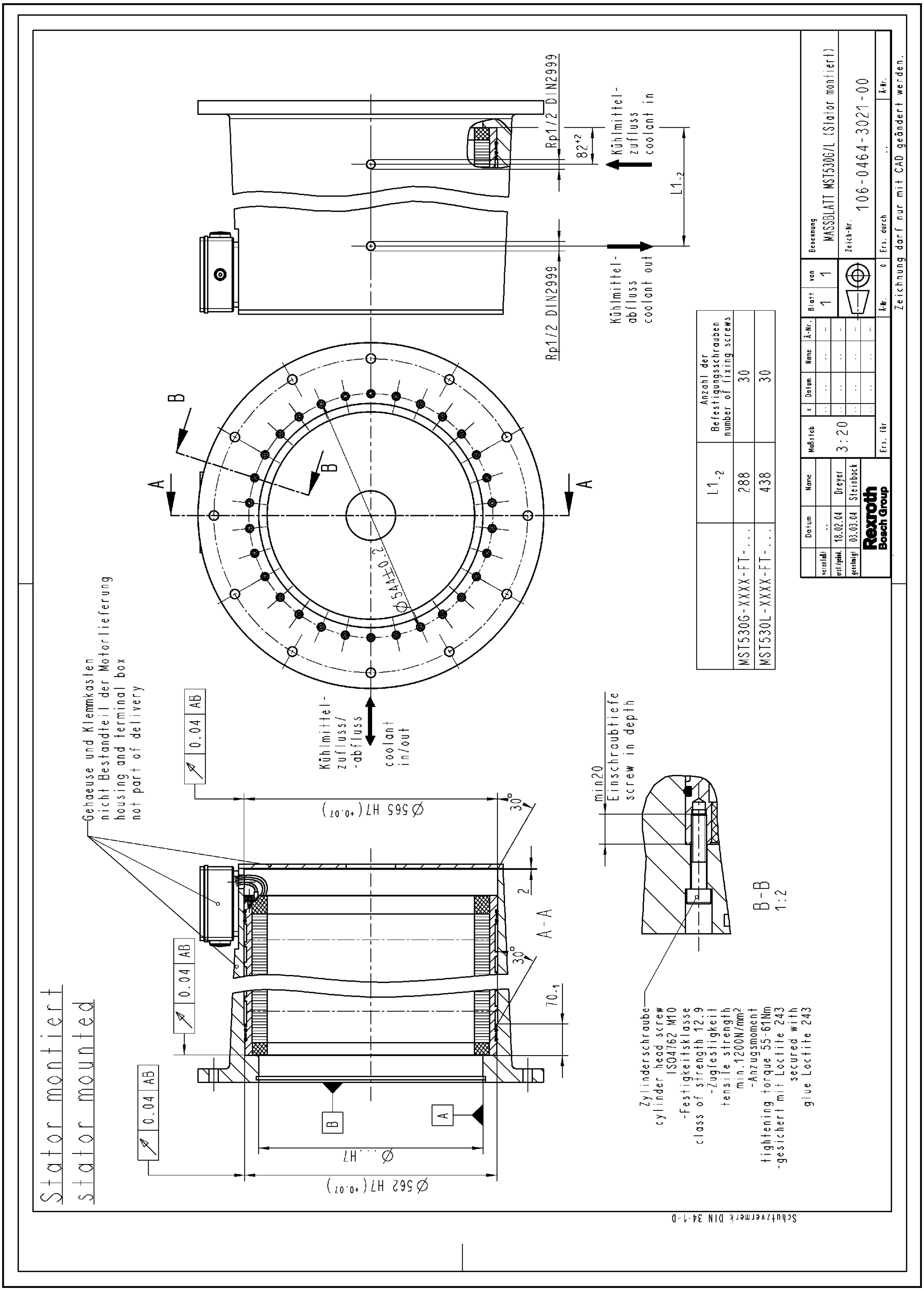


Fig. 12-56: Stator mounted - MST530G, 530L

Example of a assembly aid for MBT530F/ -G/ -L/ -P/ -R

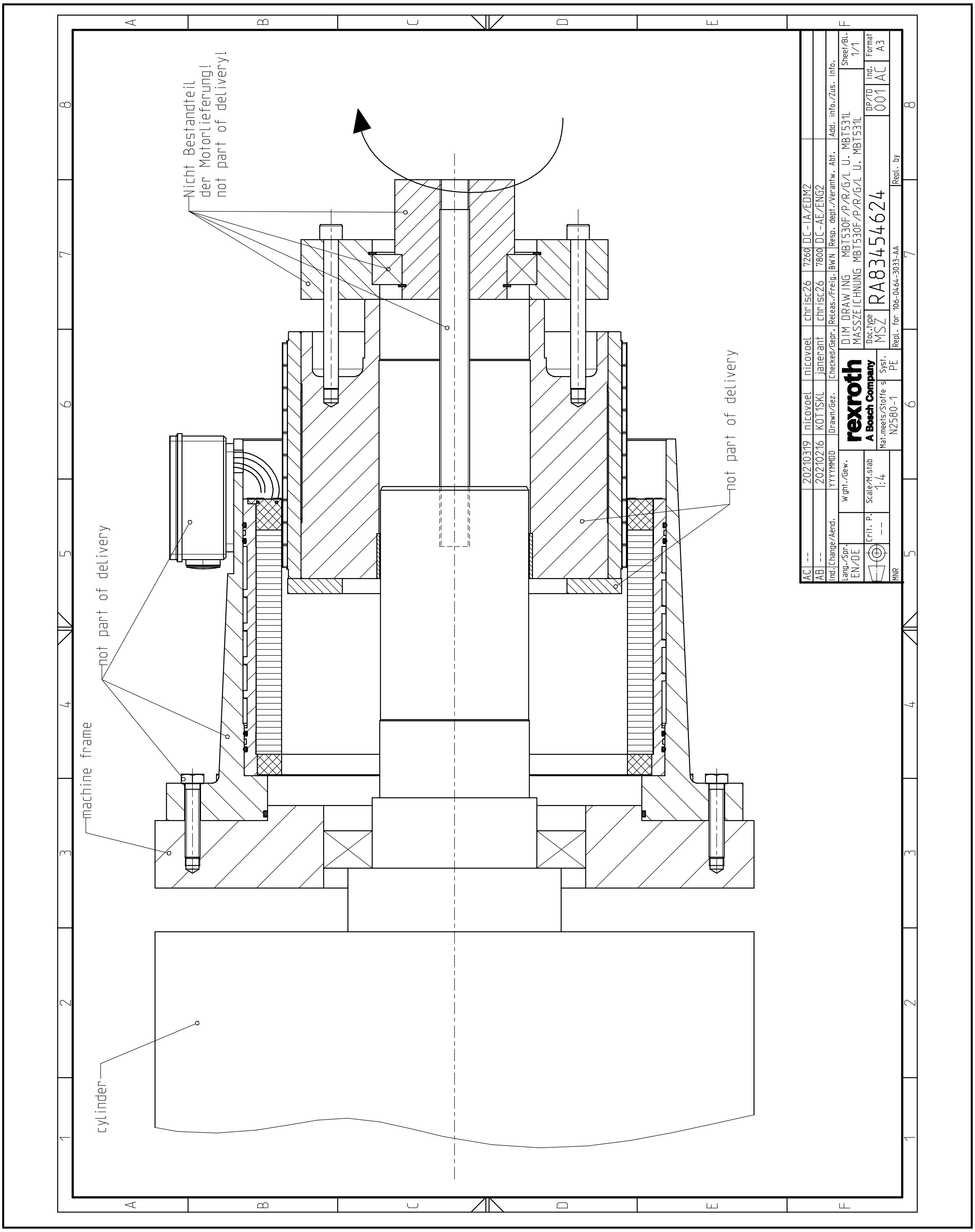


Fig. 12-57: Example of a assembly aid for MBT530F/ -G/ -L/ -P/ -R

Motor MBT530F/ -G/ -L/ -P/ -R, rotor and stator mounted

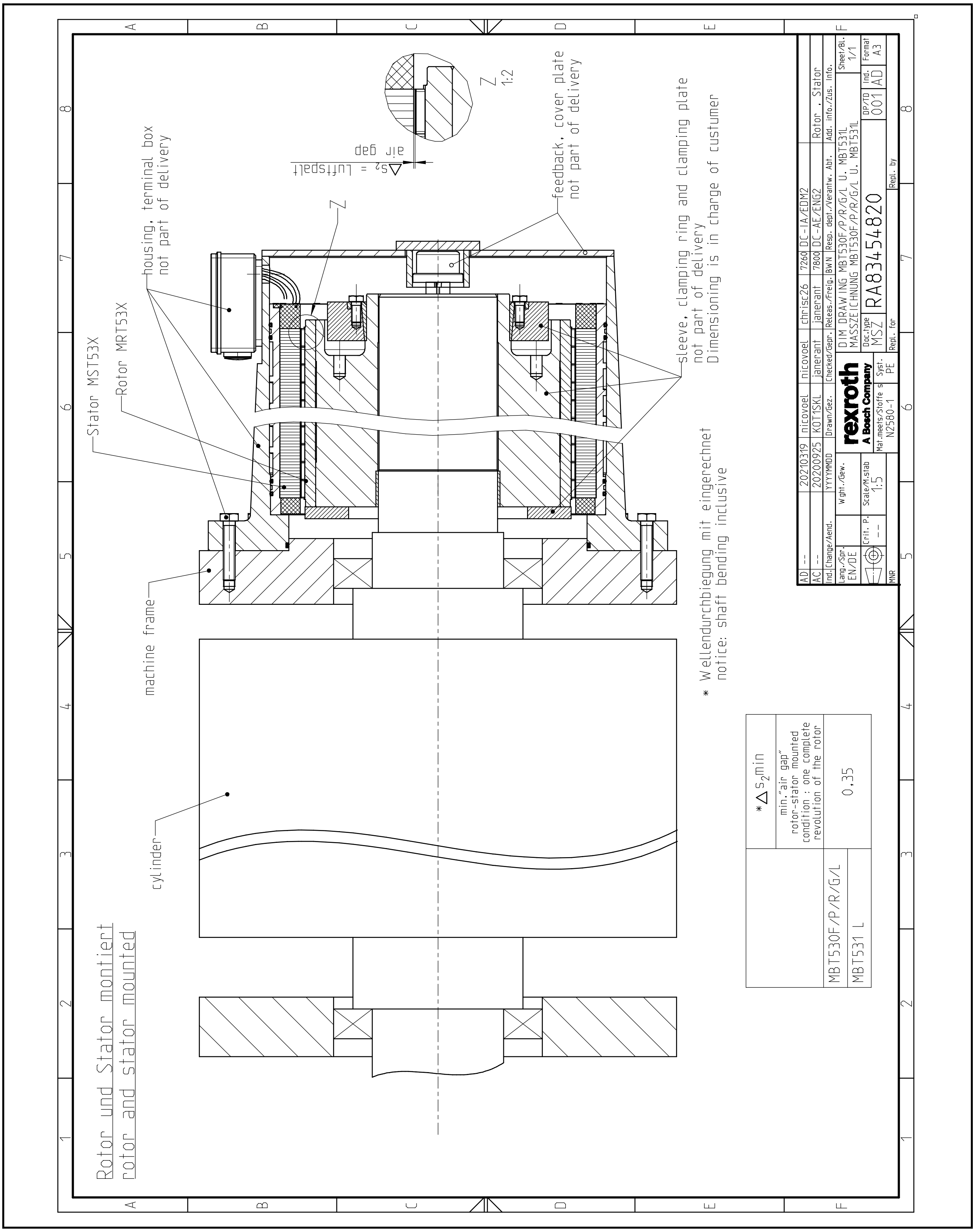


Fig. 12-58: Motor MBT530F/ -G/ -L/ -P/ -R, rotor and stator mounted

12.12.13 Mounting example MBT531

Rotor MRT531E, mounted

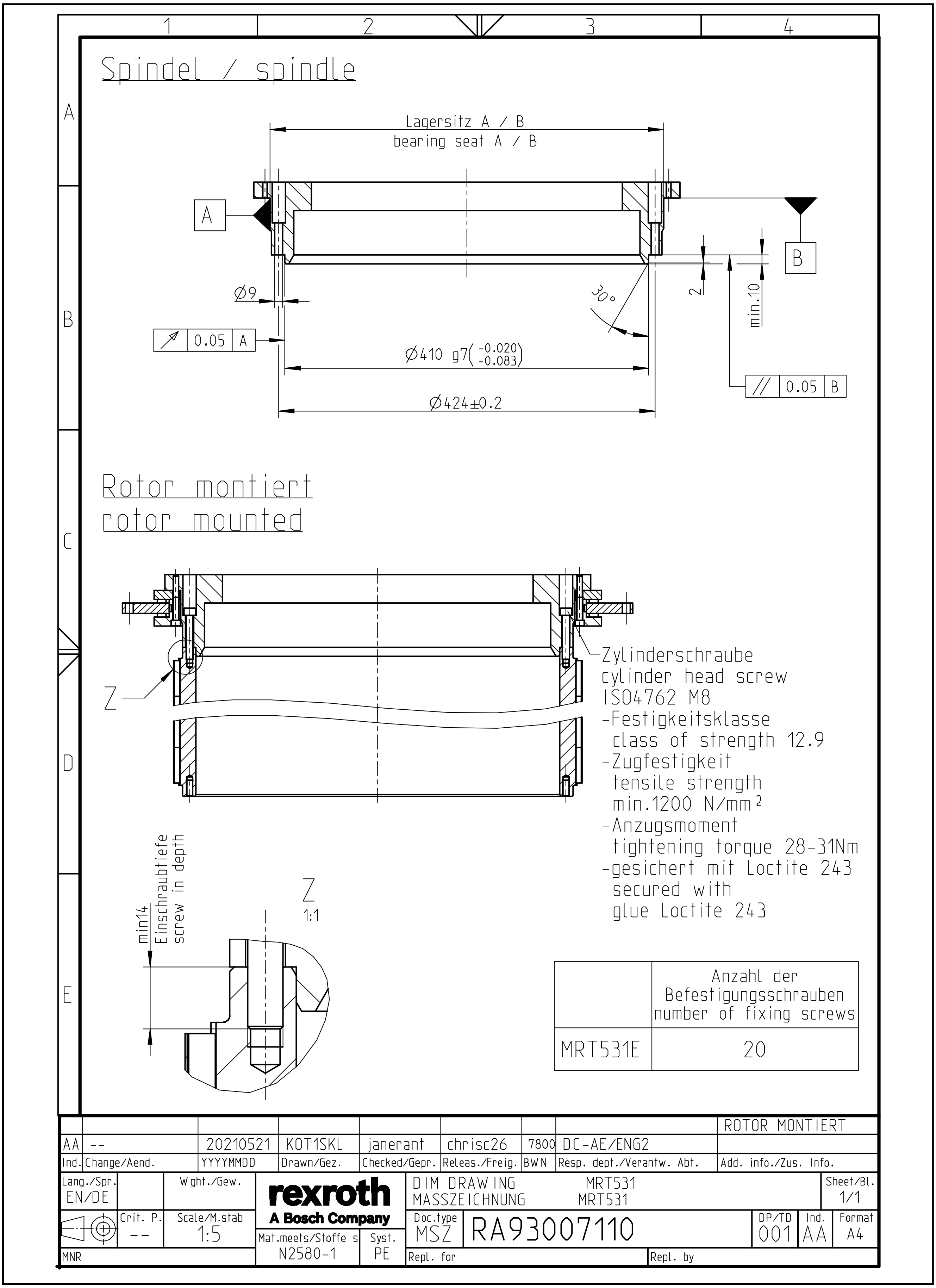


Fig. 12-59: MRT531E (rotor mounted)

Stator MST531E, mounted

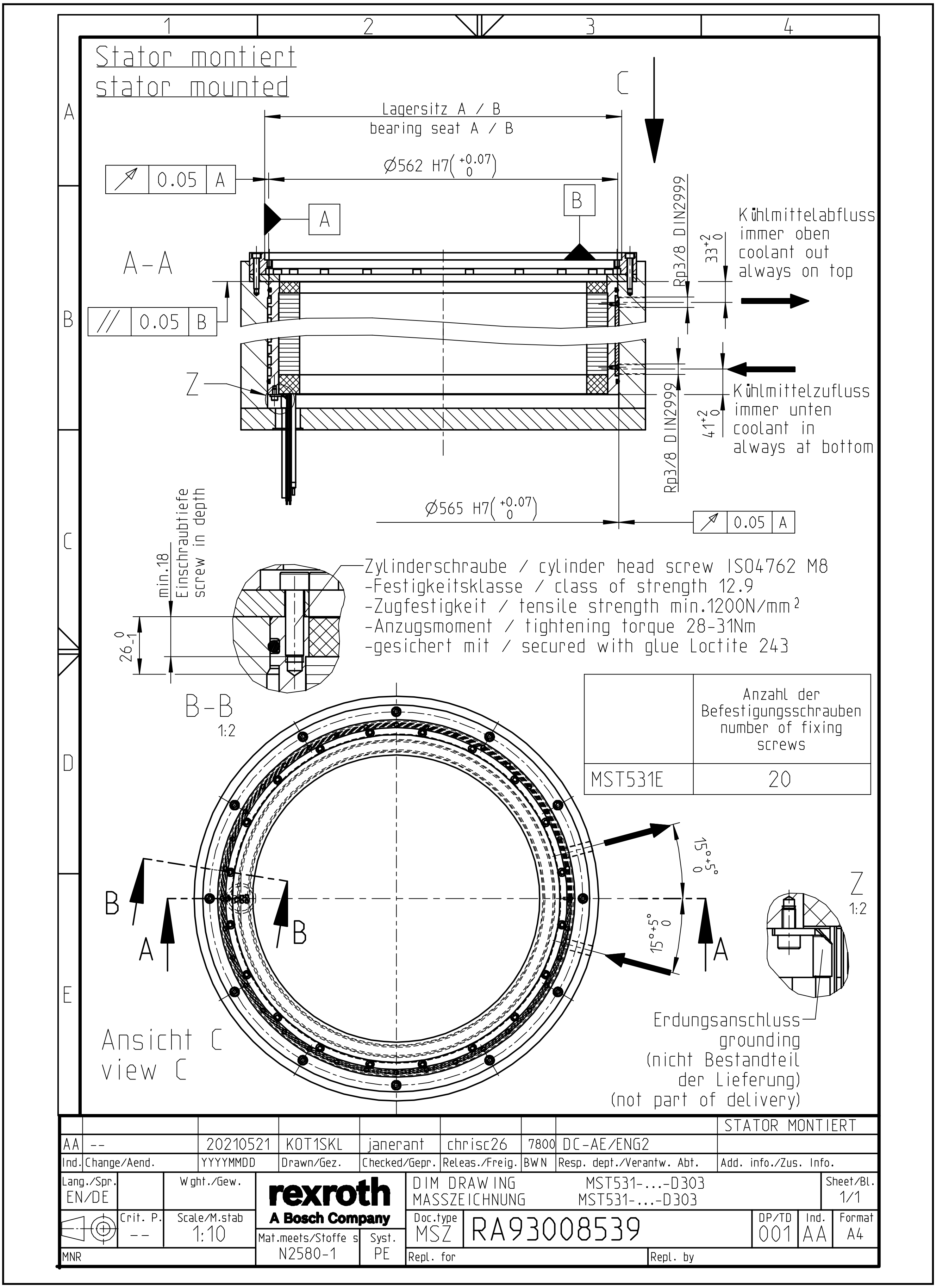


Fig. 12-60: MST531E (stator mounted)

Motor MBT531E, rotor and stator, mounted

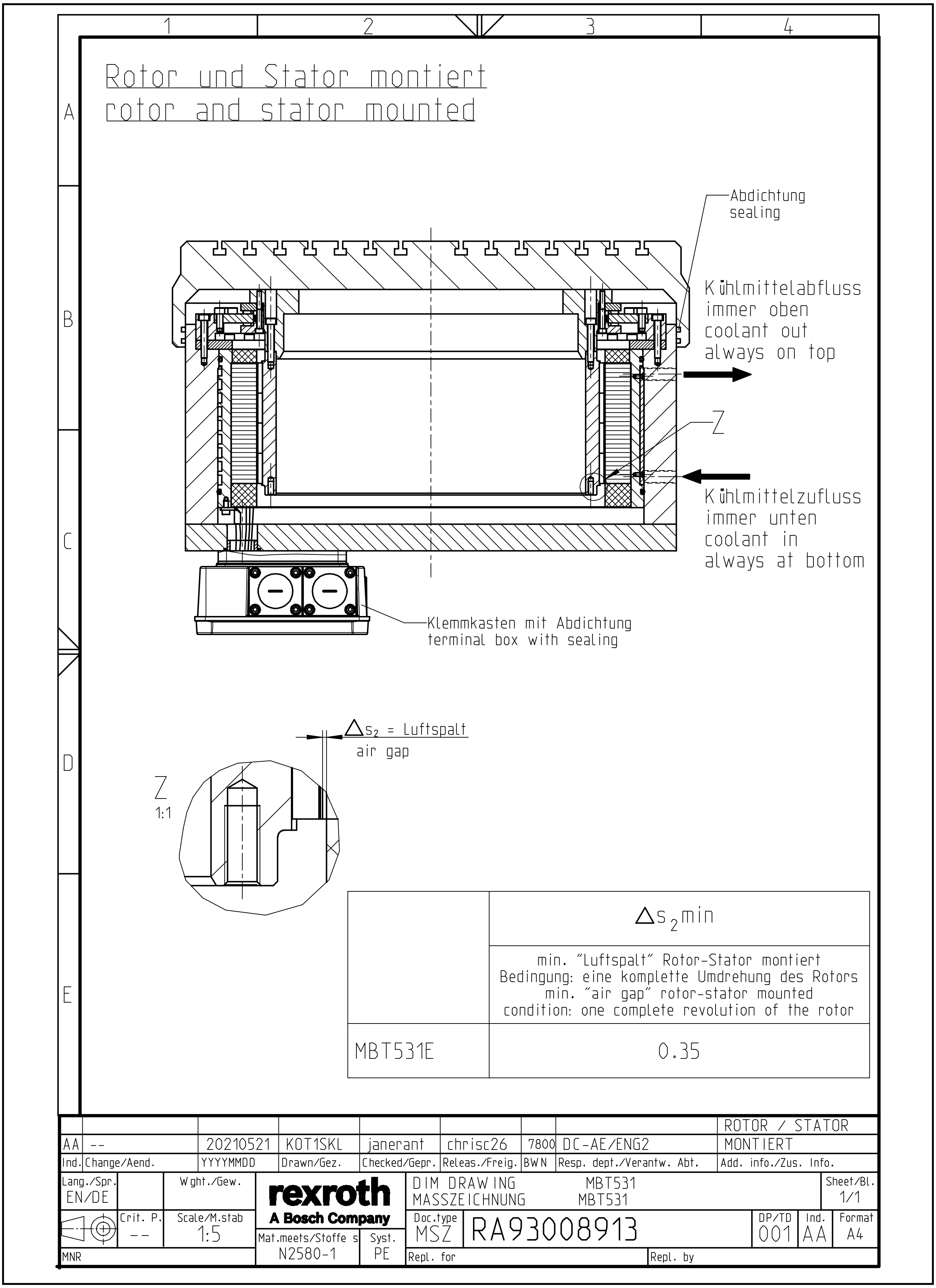


Fig. 12-61: MBT531E (rotor and stator mounted)

Dimensionsing of shaft for rotor MRT531L

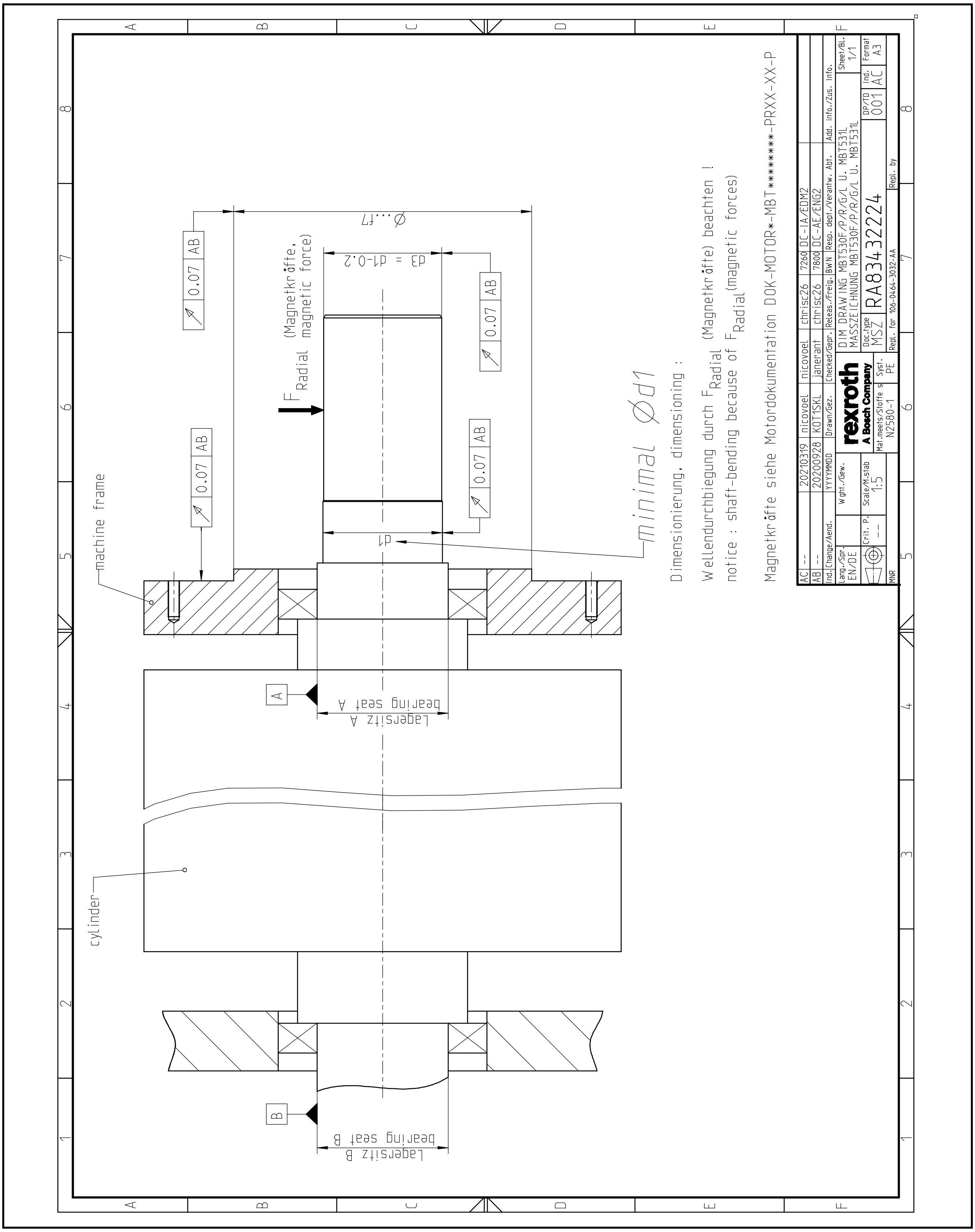


Fig. 12-62: Dimensionsing of shaft for rotor MRT531L

Rotor mounted - MRT531L

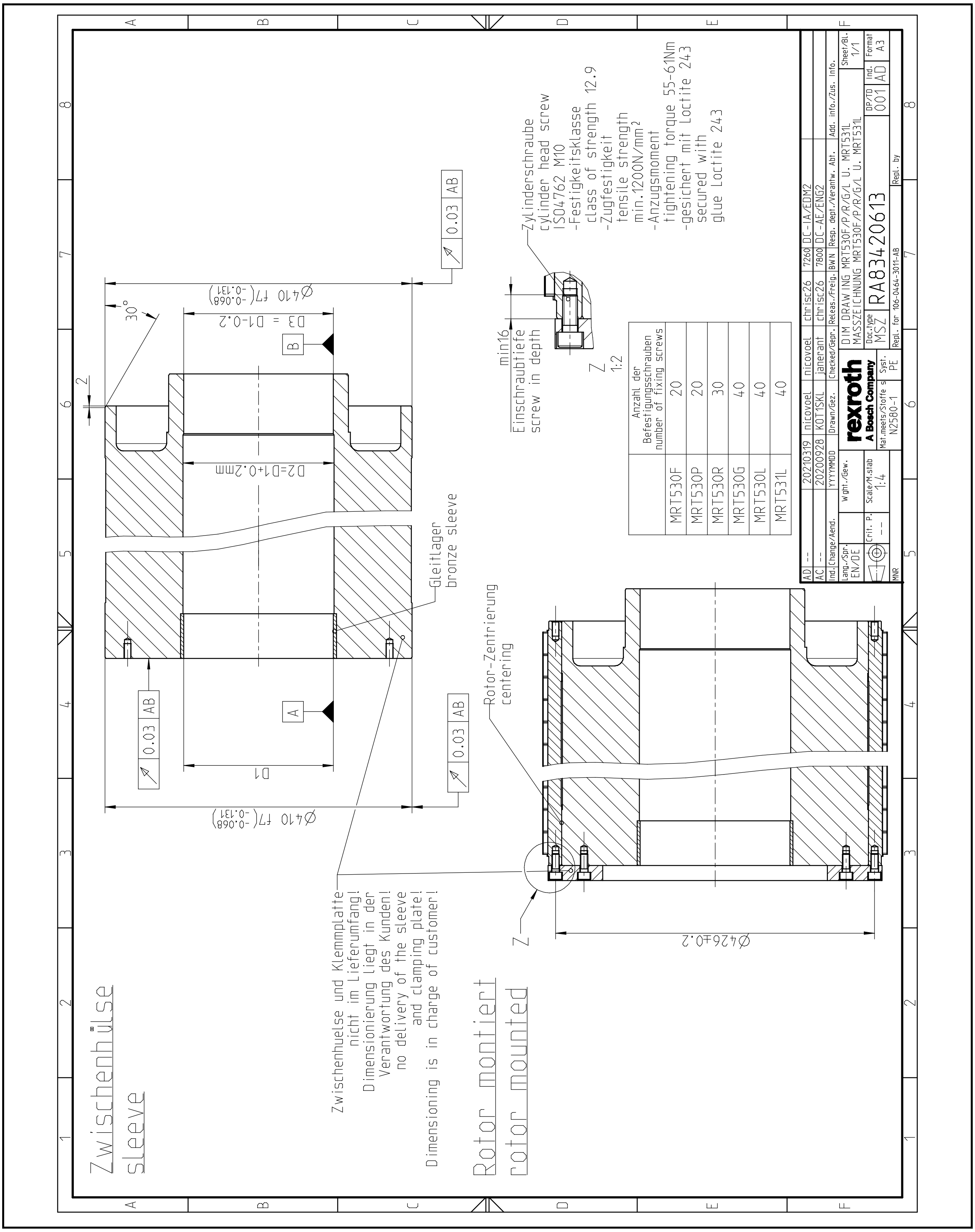


Fig. 12-63: MRT531L, rotor mounted

Stator mounted into housing - MST531L

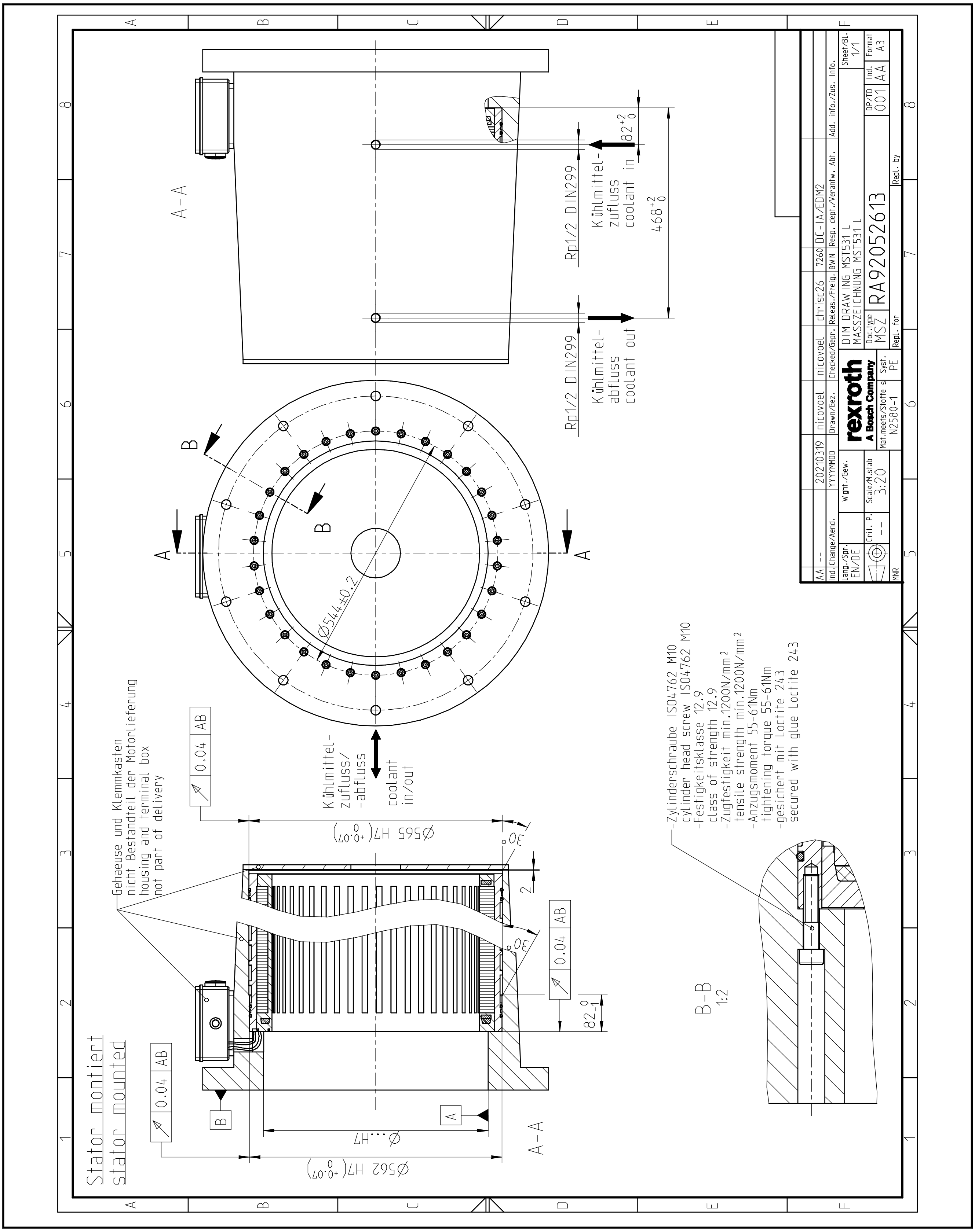


Fig. 12-64: MST531L, stator mounted into housing

Example of an assembly aid for MBT531L

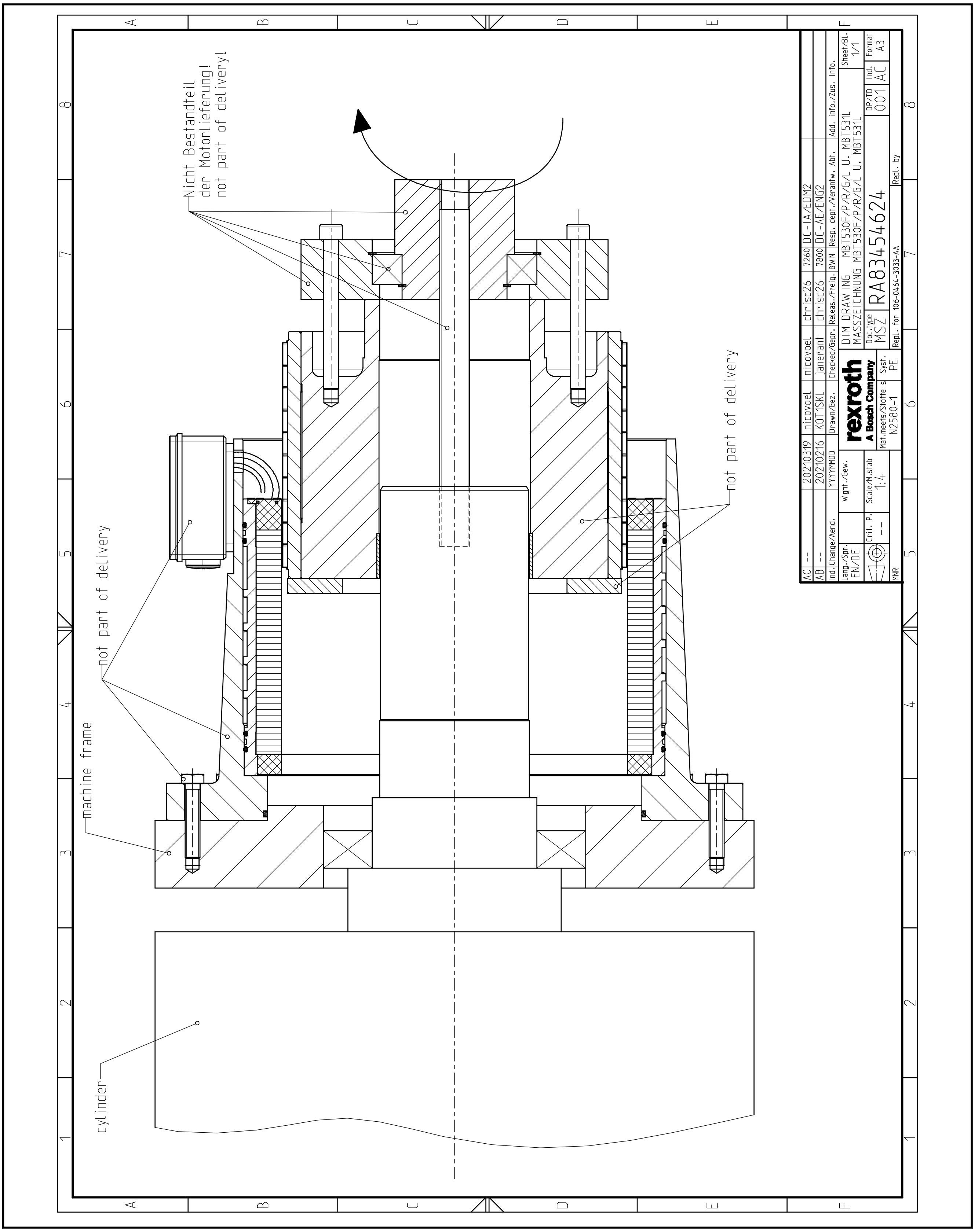


Fig. 12-65: Assembly aid MBT531L

Motor MBT531L, rotor and stator, mounted

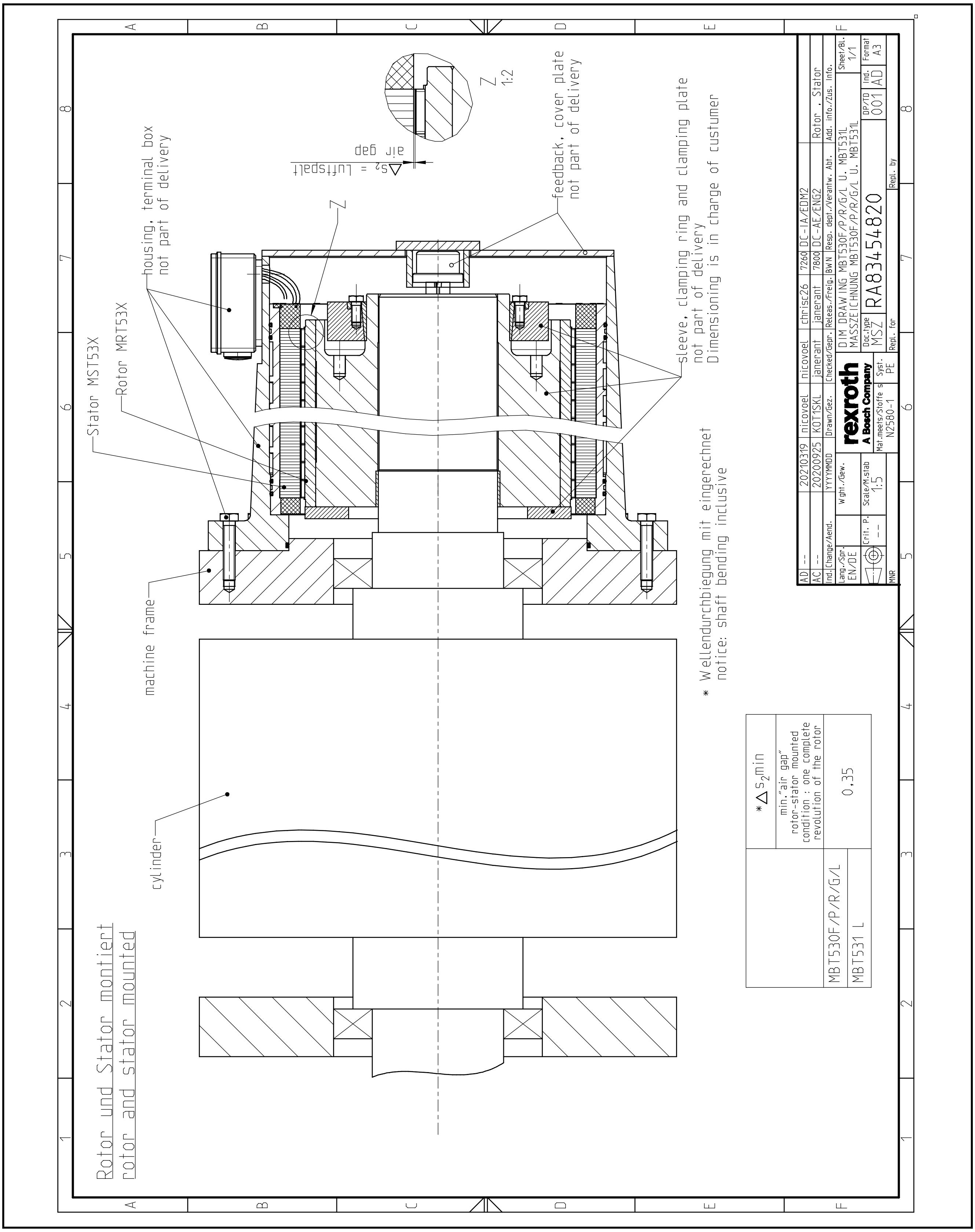


Fig. 12-66: MBT531L, mounted

13 Commissioning, operation and maintenance

13.1 Instructions on commissioning

General information

⚠ CAUTION **Property damage caused by errors when controlling motors and moving parts! Unclear operating states and product data!**

⇒ Do not commission the motors if connections, operating states or product data are unclear or faulty.

⇒ Do not commission the motors if safety devices and monitoring units of the plant are damaged or not in operation.

⇒ Damaged products must not be operated.

⇒ Contact Bosch Rexroth for additional information or support during commissioning

The following commissioning instructions refer to the motors as part of a drive system with controller and control unit.

Preparation

1. Make sure you have the documentations of all used products ready.
2. Record all measures taken in the commissioning log.
3. Check the products for damage.
4. Check all mechanical and electrical connections.
5. When setting up and programming the machine, ensure proper allocation of the directions of rotation of the motor and the encoder.
6. Activate the safety and monitoring equipment of the system.

Procedure

Once all requirements are met, proceed as follows:

1. Activate the external cooling system to supply the motor and check it for proper operation. The motor cooling circuit has to be completely filled with coolant. Comply with the manufacturer's instructions.
2. Commission the drive system according to the instructions of the corresponding product documentation. The corresponding information is provided in the functional descriptions of the drive controllers.
3. Record all measures taken in the commissioning log.

☞ For commissioning of the controllers and control systems, additional steps may be required. The check for proper functioning and performance of the systems is not included in motor commissioning; instead, it is carried out within the scope of commissioning the entire machine. Comply with the information and instructions of the machine manufacturer.

13.2 Commissioning

The following points have to be noted when commissioning MBT motors in particular:

Parameters

MBT motors are kit motors whose single components are - completed by an encoder system - directly installed into the machine by the manufacturer. 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 commissioning program from Rexroth provides all Rexroth motor parameters.

Encoder polarity

The encoder polarity has to be set before the commutation is adjusted, taking the direction of rotation of the rotor into account.

Also see chapter 13.6 "Determining the polarity of the encoder system" on page 389 and fig. 13-2 "Direction of rotation of the rotor, as viewed from the cable output side at the stator (MST)" on page 390.

Commutation adjustment

At MBT 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 requires the following documents:

- Rexroth IndraDrive Firmware for Drive Controllers, Functional Description, DOK-INDRV*-MP*-02VRS**-FK□□-□□-P
- Rexroth IndraDrive Drive Controllers, Parameter Description, DOK-INDRV*-GEN-**VRS**-PA□□-□□-P
- Rexroth IndraDrive Troubleshooting Guide, DOK-INDRV*-GEN-**VRS**-WA□□-□□-P

13.3 General requirements

13.3.1 General information

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

13.3.2 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

⚠ WARNING **Danger to life, heavy injury or damage by failure or malfunction of mechanical or electrical components!**

⇒ Failures or malfunctions of mechanical or electrical components have to be removed before commissioning according to the previously mentioned information.

13.3.3 Tools

DriveTop commissioning software The motors can be commissioned either directly via an NC terminal or via special commissioning software. The DriveTop commissioning software allows menu-driven, custom-designed and motor-specific parameterization and optimization.

PC DriveTop requires a commercial Windows PC.

Commissioning via NC Commissioning via the NC control unit requires access to all drive parameters and functionalities.

Oscilloscope An oscilloscope is required for drive optimization. This oscilloscope serves to display the signals which can be output via the adjustable analog outputs of the drive controller. Displayable signals are, e.g., command and feedback values of velocity, position or current, lag errors, DC bus power.

Multimeter Troubleshooting and component checks can be facilitated by a multimeter allowing the measurement of voltage, current and resistance values.

13.4 General commissioning procedure

In the following flow diagram, the commissioning sequence is explained. The individual items are explained in more detail in the chapters following thereafter.

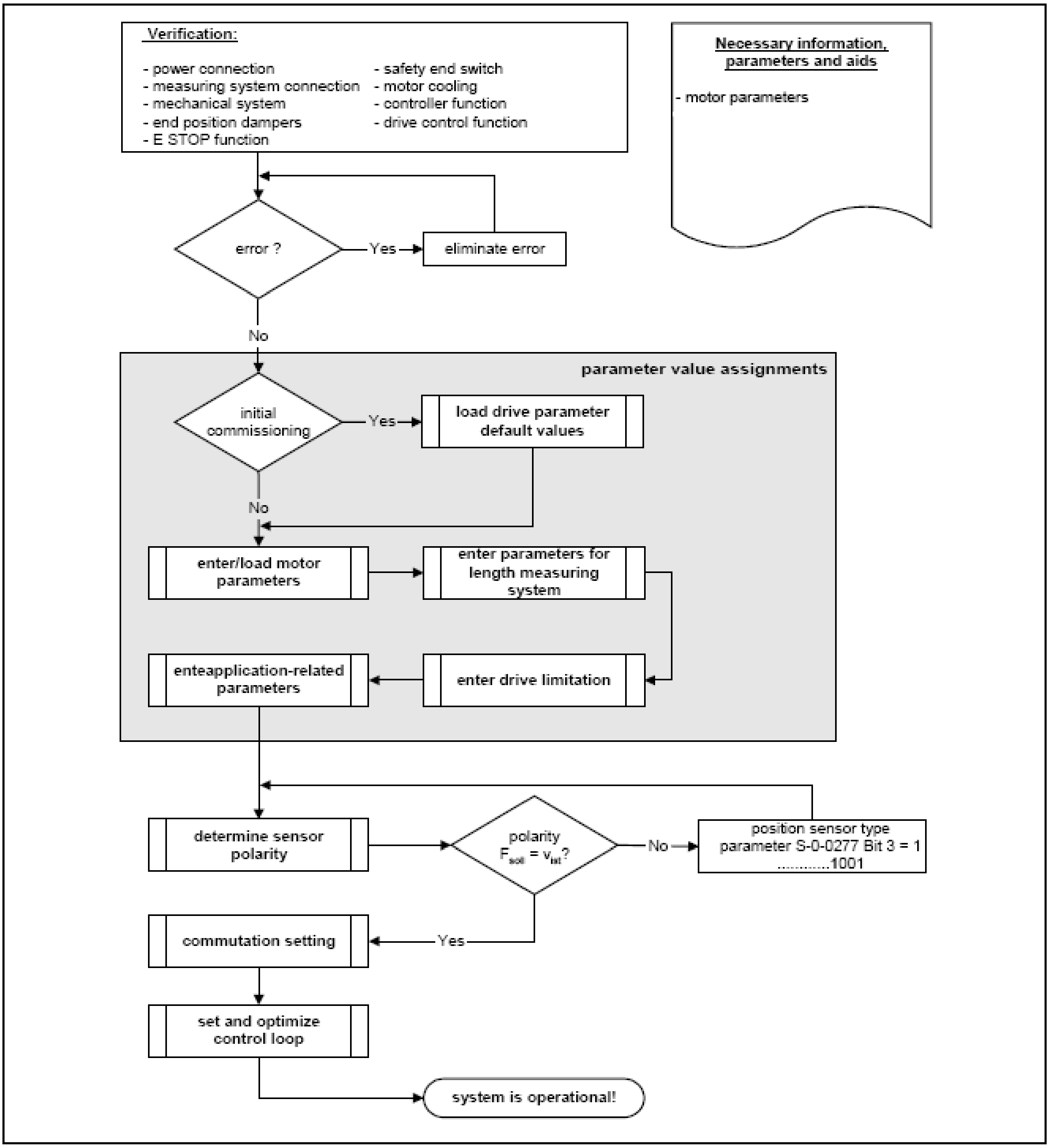


Fig. 13-1: General commissioning procedure for synchronous torque motors

13.5 Parameterization

13.5.1 General information

DriveTop allows entering or editing certain parameters and executing commands during commissioning by means of menu-driven dialogs and list representations or, optionally, via the control terminal.

13.5.2 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:

☞
- Use DriveTop to load all motor parameters.

If the DriveTop commissioning software is not available, you have to

- enter the individual parameters manually via the controller. A list of the corresponding motor parameters is available from your sales partner.

Motor parameters

SercosID	Motor parameter
P-0-0004	Velocity loop smoothing time constant
P-0-0018	Number of pole pairs/pole pair distance
P-0-0045	Control word of current controller
P-0-0051	Torque/force constant
P-0-0512	Temperature sensor
P-0-0533	Voltage loop proportional gain
P-0-0534	Voltage loop integral action time
P-0-0535	Motor voltage at no load
P-0-0536	Maximum motor voltage
P-0-4005	Flux-generating current, limit value
P-0-4014	Type of construction of motor
P-0-4016	Direct-axis inductance of motor
P-0-4017	Quadrature-axis inductance of motor
P-0-4034	Thermal time constant of winding
P-0-4035	Thermal time constant of motor
P-0-4036	Rated motor speed

SercosID	Motor parameter
P-0-4037	Thermal short-time overload of winding
P-0-4048	Motor winding resistance
S-0-0100	Velocity loop proportional gain
S-0-0101	Velocity loop integral action time
S-0-0106	Current loop proportional gain 1
S-0-0107	Current loop integral action time 1
S-0-0109	Motor peak current
S-0-0111	Motor current at standstill
S-0-0113	Maximum motor speed
S-0-0201	Motor warning temperature
S-0-0204	Motor shutdown temperature

Tab. 13-1: MBT motor parameters

13.5.3 Entering encoder system parameters

Encoder type

The type of the encoder system has to be defined by means of parameter P-0-0074.

Encoder type	P-0-0074
Incremental encoder, e.g. Lenord&Bauer geared encoder	2
Absolute encoder, e.g. Rexroth GDS/GDM02.1	1

Tab. 13-2: Defining the encoder type

Signal period

In encoder systems for MBT motors, **sinusoidal signals** are generated and evaluated. The sine signal period has to be entered in parameter S-0-0116, Resolution of feedback 1.

Necessary details are provided by the encoder manufacturer.

13.5.4 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 more details refer to the IndraDrive functional description, DOK-INDRV*-MP*-02VRS**-FK□□-□□-P.

13.6 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 identical.

⚠ 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:

Parameter	Description	Value
S-0-0085	Torque/force polarity parameter	0000000000000000
S-0-0043	Velocity polarity parameter	0000000000000000
S-0-0055	Position polarity	0000000000000000

Tab. 13-3: Table of polarity parameters

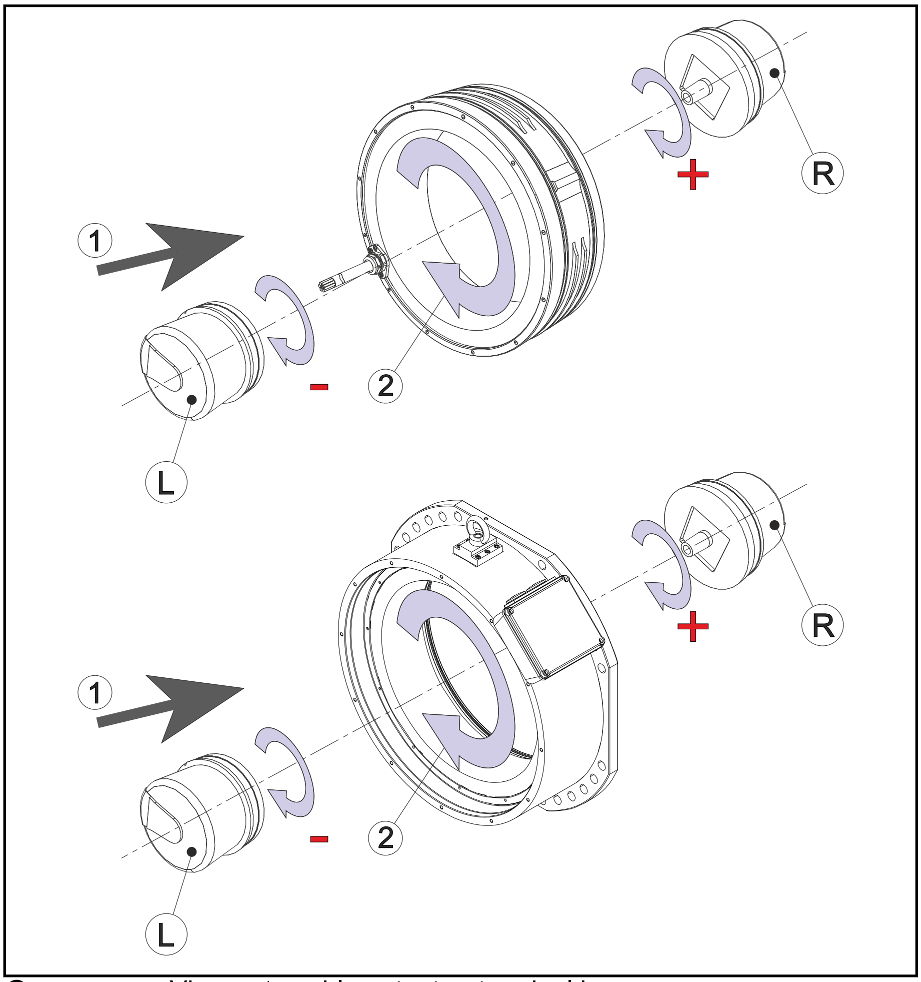
The encoder polarity is set by means of parameter **S-0-0277, Position feedback 1 type (bit 3)**; see fig. 13-2 "Direction of rotation of the rotor, as viewed from the cable output side at the stator (MST)" on page 390 and tab. 13-4 "Parameter S-0-0277" on page 390.

Direction of rotation of the motor

The direction of rotation of the motor or the rotor of MBT 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.



①	View onto cable output or terminal box
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)
L	S-0-0277 bit 3 set to "1" if the encoder is rotating to the right; S-0-0277 bit 3 set to "0" if the encoder is rotating to the left
R	S-0-0277 bit 3 set to "0" if the encoder is rotating to the right; S-0-0277 bit 3 set to "1" if the encoder is rotating to the left

Fig. 13-2: Direction of rotation of the rotor, as viewed from the cable output side at the stator (MST)

☞ 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.

If this is not the case, the encoder polarity has to be adjusted via parameter S-0-0277 bit 3.

Parameter	Description	Position of bit 3
S-0-0277	Position feedback type 1	000000000000>**0**<000

Tab. 13-4: Parameter S-0-0277

Bit 3 if the encoder	Design	
	L	R
is rotating to the right (positive)	1	0
is rotating to the left (positive)	0	1

Tab. 13-5: Parameter S-0-0277 bit 3

13.7 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 angle 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 8 "Connection technique" on page 237.

Adjustment procedure

Different commutation adjustment procedures have been implemented in the firmware. They are selected via parameter P-0-0522. The following figure shows an overview of the interrelation among the encoder system used and the method to be applied.

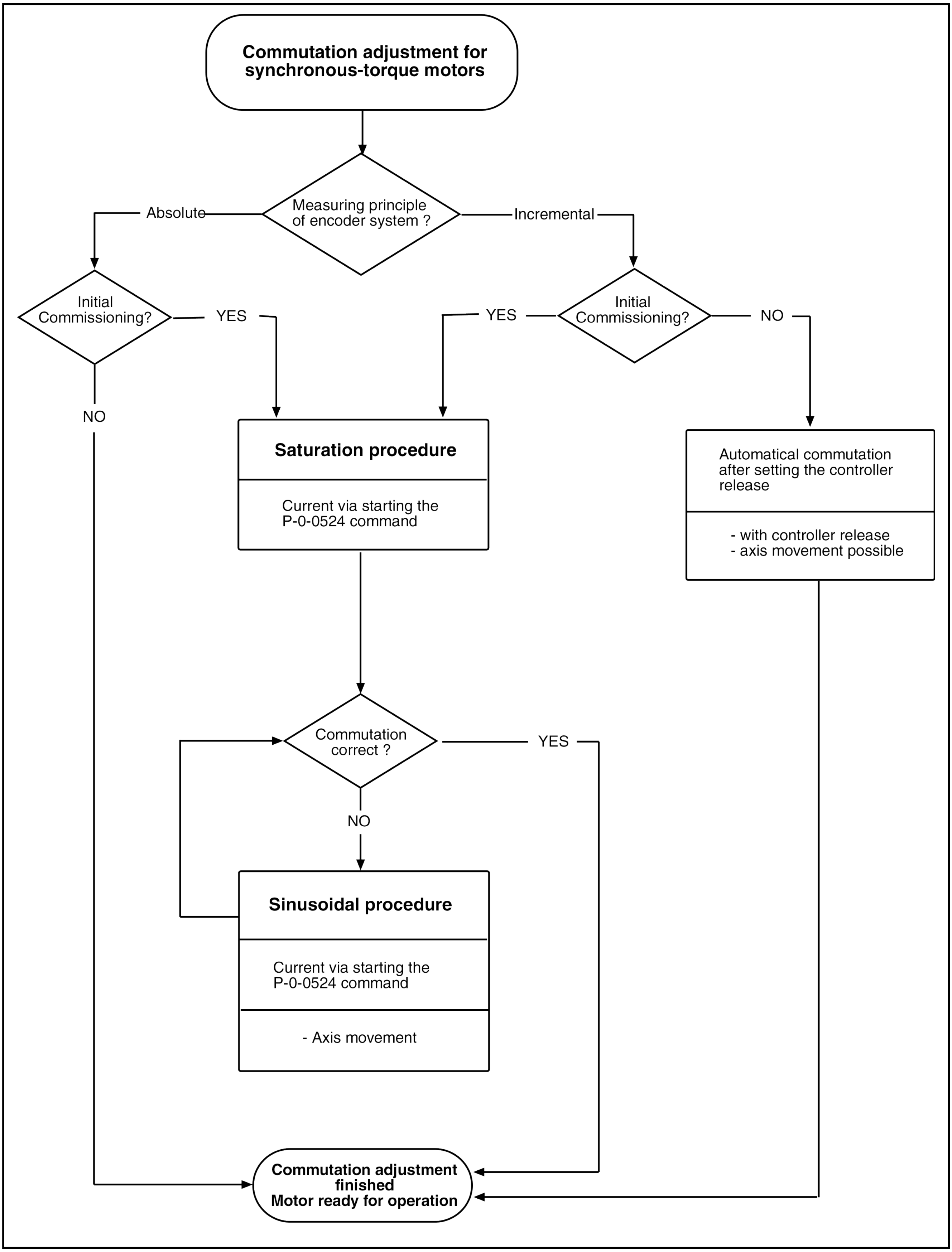


Fig. 13-3: Procedure for commutation adjustment for synchronous torque motors

A detailed description of the different methods is given in the firmware description for Rexroth IndraDrive controllers DOK-INDRV*-MP*-02VRS**-FK□□-□□-P.

13.8 Setting and optimizing the control loop

13.8.1 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.

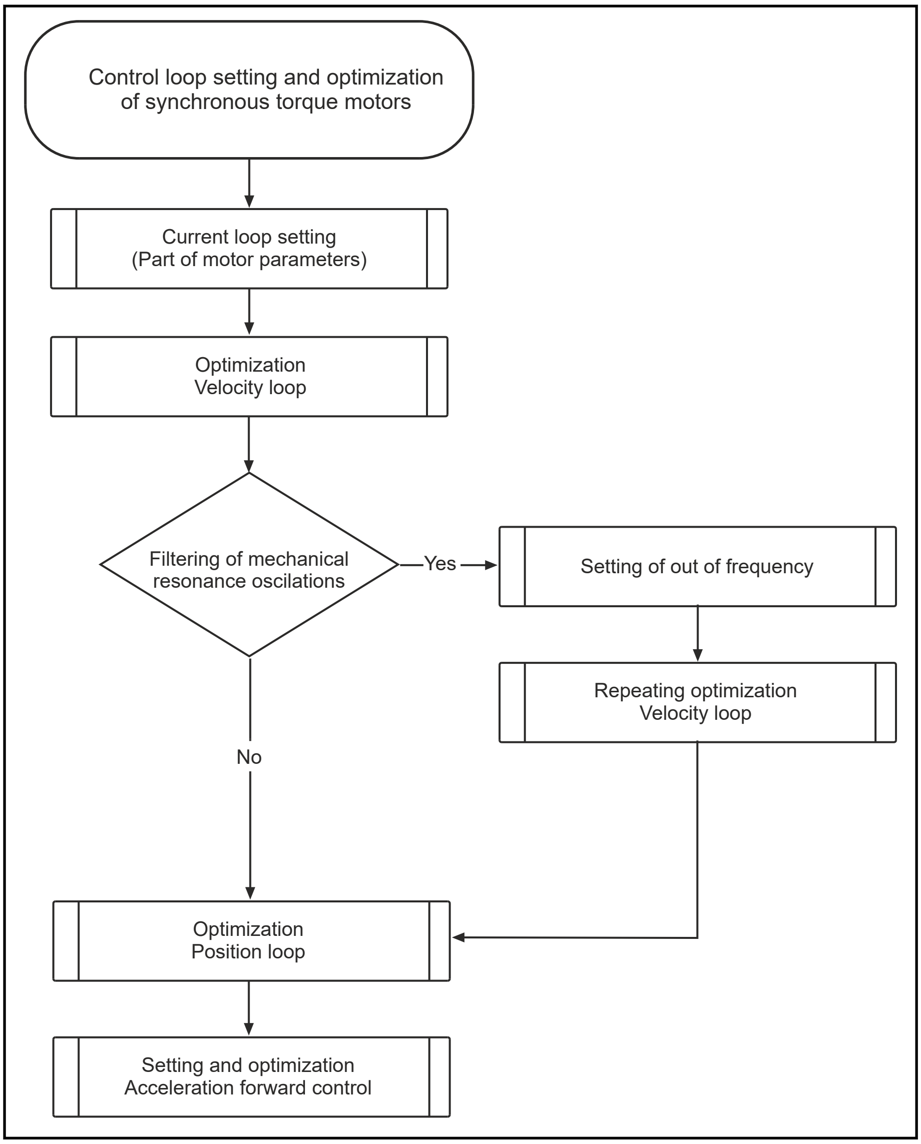


Fig. 13-4: Setting and optimizing the control loop of synchronous torque motors

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!

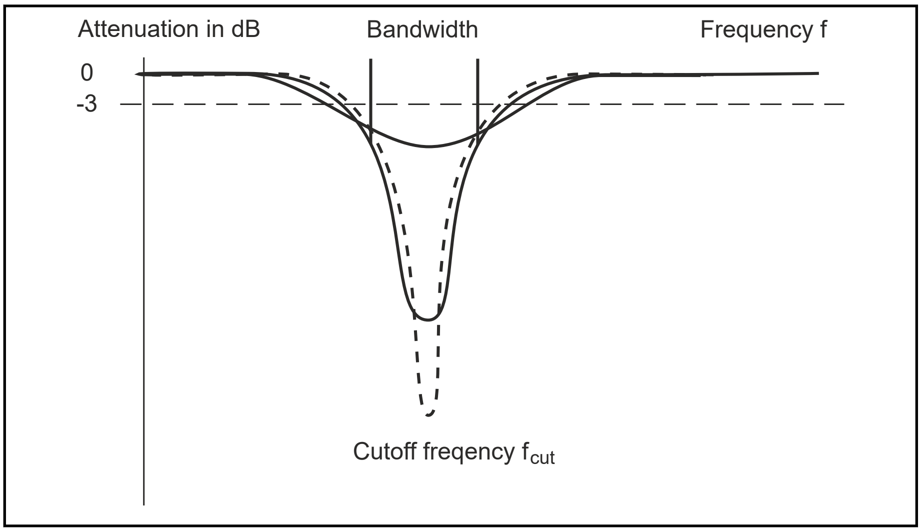


Fig. 13-5: Amplitude response of the rejection filter in relation to the bandwidth, qualitative

13.9 Deactivation

In case of malfunctions, maintenance measures or to deactivate the motors, proceed as follows:

1. Comply with the instructions in the machine documentation.
2. Use the machine-side control commands 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. Document all executed measures in the commissioning report and the machine maintenance plan.

13.10 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.

1. Comply with the instructions in the machine documentation.
2. Comply with the safety instructions and carry out all steps as described above in section "Deactivation".
3. Before disassembling the motor and the supply lines, secure them against dropping or movements. Subsequently, disconnect the mechanical connections.
4. Empty the coolant ducts of the motor and dismount the motor from the machine. Store the motor appropriately.
5. Document all executed measures in the commissioning report and the machine maintenance plan.

☞ Information on stators with encapulation “T”:

When connecting the cables at the spindle housing, it has to be ensured that Ensure that the separator between inlet and outlet at the cooling jacket is also removed from the machine after disassembling the stator (see chapt.Mechanical assembly).

13.11 Maintenance

13.11.1 General information

Synchronous motors of the MBT 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.

13.11.2 Measures

⚠ DANGER **Risk of injury due to moving elements! Risk of injury due to hot surfaces!**

⇒ Do not carry out any maintenance work while the machine is running

⇒ Secure the machine against start-up and unauthorized operation during maintenance work

⇒ Do not work on hot surfaces

Bosch Rexroth recommends the following maintenance measures based on the machine manufacturer's maintenance plan:

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.

Tab. 13-6: Maintenance measures

13.11.3 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. Observe the safety instructions.
- Protect open supply lines and connections against ingress of dirt.

13.12 Electrical check of motor components

Electrical defects at stators are 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 wired and guides

Resistance and inductance

The measured values of resistance and inductance can be compared to the values specified in chapter 4 "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.

13.13 Troubleshooting

13.13.1 General information

⚠ DANGER **Risk of injury due to moving elements! Risk of injury due to hot surfaces!**

⇒ Do not carry out any maintenance work 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

⇒ Secure the machine against start-up and unauthorized operation during maintenance work

⇒ 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.

⇒ Handle all magnetic components with care.

⇒ 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. Comply with the instructions in the corresponding documentation.

The sections below describe examples of some fault states along with possible causes. This list is not exhaustive.

13.13.2 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 or an increase in motor temperature Risk of damage!

⇒ Wait until the motor temperature has dropped under +40 °C before the restart

Possible causes

1. Failure or malfunction in the cooling system.
2. The original machining cycle has been changed.
3. The original motor parameters have been changed.
4. Motor bearings are worn or defective.

Measures for

1. Check the cooling system. Clean or rinse the cooling circuit as required. Contact the machine manufacturer in the case of a cooling system failure.
2. Check the sizing of the drive for changed requirements. Stop operation in case of overload. Risk of damage!
3. Restore the original parameters. Check the sizing of the drive if requirements have been changed.
4. Contact the machine manufacturer.

13.13.3 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

1. Wiring error or cable break in sensor cable.
2. Diagnostic system defective.
3. Failure of the winding temperature sensor (PTC).

Measures for

1. Check the wiring and connection of the temperature sensor according to the interconnection diagram.
2. Check the diagnostic system at the controller or the control unit.
3. 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 9.8 "Motor temperature monitoring" on page 277.

13.13.4 Motor or machine generate vibrations

State
Audible or tactile vibrations occur on the motor or on the machine.

Possible causes
1. Driven machine elements are insufficiently coupled or damaged.
2. Motor bearings are worn or defective. Available bearing lifetime or grease lifetime has elapsed.
3. Motor mount has loosened.
4. Drive system is instable from a control point of view.

Countermeasures
1. Contact the machine manufacturer.
2. Contact the machine manufacturer.
3. Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
4. Check the parameterization of the drive system (motor and encoder data). Comply with the instructions in the controller documentations.

13.13.5 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
1. Wiring of encoder cable is incorrect or defective. Pin assignment (encoder signals) in cable or plug may be interchanged.
2. Insufficient shielding of encoder cable against interference signals.
3. Incorrect parameterization of encoder data in controller.
4. Motor-machine element connection has loosened.
5. Encoder defective.

Countermeasures
1. Check wiring according to interconnection diagram of machine and check cables for damage.
2. Check shielding; if necessary, increase effective contact surfaces of shielding.
3. Correct the parameterization. Observe the commissioning log.
4. Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
5. The encoder has to be replaced. Contact the machine manufacturer.

13.14 Operation with third-party controllers

Rate of rise of voltage

The 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.

☞ The final stages of IndraDrive converters keep this limits.

14 Environmental protection and disposal

14.1 Environmental protection

Production processes

The products are manufactured in energy- and resource-optimized production processes which allow re-using and recycling the resulting waste. We regularly try to replace pollutant-loaded raw materials and supplies by more environment-friendly alternatives.

No release of hazardous substances

Our products do not contain any hazardous substances which may be released in case of appropriate use. Normally, our products will not have any negative influences on the environment.

Significant components

Significant components of our products are:

Electronic devices
- Steel
- Aluminum
- Copper
- Plastics
- Electronic components

Motors
- Steel / Stainless steel
- Aluminum
- Copper
- Brass
- Magnetic materials
- Elektronic components

14.2 Disposal

Return of products

Our products can be returned to us for disposal free of charge. However, this requires that the products be free from oil, grease or other dirt.

Furthermore, the products returned for disposal may not contain any undue foreign material or foreign components.

Deliver the products "free domicile" to the following address:

Bosch Rexroth AG
Electric Drives and Controls
Buergermeister-Dr.-Nebel-Straße 2
97816 Lohr am Main, Germany

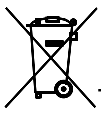
Packaging

Packaging materials consist of cardboard, wood and polystyrene They can be recycled anywhere without any problem.

For ecological reasons, please refrain from returning the empty packages to us.

Batteries and accumulators

Batteries and accumulators can be labeled with this symbol.



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 validity of the EU Directive 2006/66/EC, the particularly 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.

After use, the batteries or accumulators contained in Rexroth products must be properly disposed of according to the country-specific collection systems.

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.

Plastic parts of the products may contain flame retardants. These plastic parts are labeled according to EN ISO 1043. They have to be recycled separately or disposed of according to the applicable legal provisions.

15 Service and support

Our worldwide service network provides an optimized and efficient support. Our experts offer you advice and assistance should you have any queries. 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
E-mail:	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)

Index

Notes

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