rexroth
A Bosch Company

Project Planning Manual

MBT

HighTorque Synchronous Motors



R911298798 Edition 09

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1 Product presentation

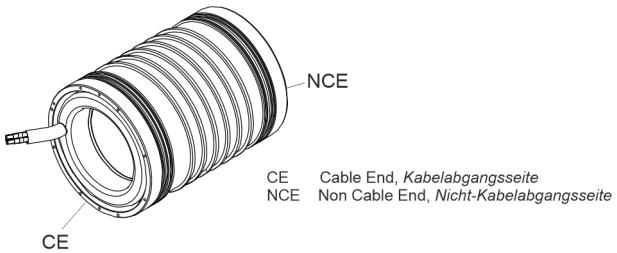
1.1 Fields of application

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: ➦ https://www.boschrexroth.com.

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 NN (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	 Fig. 1: 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 used:

- **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.

The motors exist in two versions, which essentially differ in their electromagnetic design:

- **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".



Fig. 2: MBT components stator and rotor
① Stator version without housing
② Stator version with housing

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 of the performance spectrum:

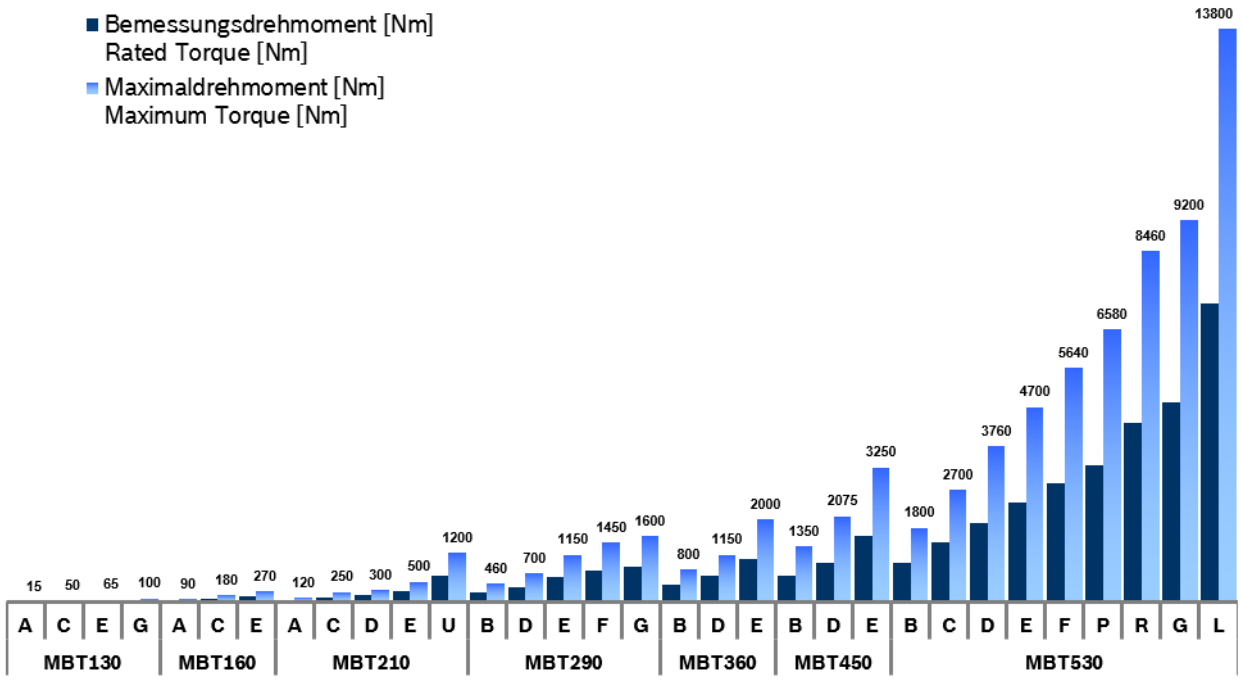


Fig. 3: MBTxx0 Power spectrum

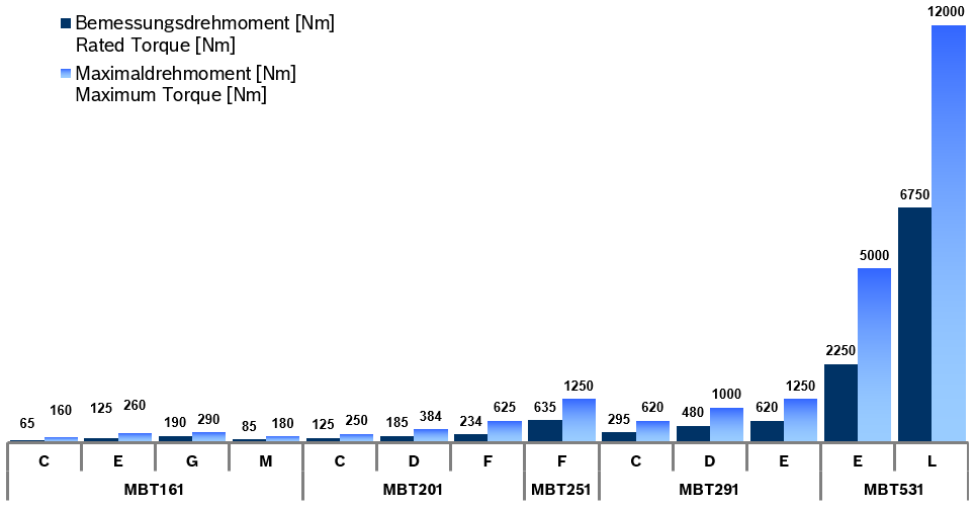


Fig. 4: MBTxx1 Power spectrum

1.5 About this documentation

1.5.1 Editions of this documentation

Table 1: Record of revisions

Edition	Release date	Note
09	05/2024	Revision and update of commissoning notes
08	07/2021	Revision and amendment of new frame sizes and windings
07	12/2018	Revision and amendment, incorporation of MBTxx1 series
06	11/2011	Revision and amendment
...		
01	01/2001	First edition

1.5.2 Document structure

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

Table 2: Chapter structure

<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 on 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="5">for designers and project developers</td></tr>
<tr><td>5</td><td>Dimension 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 techniques</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>
<tr><td>13</td><td>Service & support</td><td colspan="2" rowspan="2">Additional information</td></tr>
<tr><td></td><td>Index</td></tr>
</table>

1.5.3 Presentation of information

Explanation of signal words and the safety alert symbol

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

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

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

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

Table 3: Symbols

Symbol	Meaning
🕮	Reference to supplementary documentation
	This note gives important information, which must be observed.
⇒	Single, independent handling step
1. 2. 3.	Numbered instruction: The numbers show that the action steps must be taken one after the other.
	Warning against dangerous electric voltage.
	Warning against hot surfaces.
	Warning against rotating machine parts.
	Warning against overhead load.
	Warning against crushing hazard.
	Electrostatic sensitive devices.
	Access for persons with cardiac pacemaker forbidden.
	Do not carry along metal parts or clocks.
	Hammer scales are forbidden.

Markup

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

🕮 Reference to supplementary documentation



This note gives important information, which must be observed.

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

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

1.5.4 Further documentation

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

Rexroth provides the complete product documentation in PDF format

in the following ➦ Bosch Rexroth Media Directory.

1.5.5 Standards

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

BEUTH Verlag GmbH

Burggrafenstraße 6

10787 Berlin, Germany

Internet: ➦ https://www.din.de/beuth

1.5.6 Additional components

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

1.5.7 Your feedback

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

Bosch Rexroth AG

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

Buergermeister-Dr.-Nebel-Straße 2

97816 Lohr am Main, Germany

E-Mail: ➦ dokusupport@boschrexroth.de

2 Safety instructions

2.1 Important directions on use

2.1.1 Intended use

Introduction

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

⚠ WARNING	**Personal injury and property damage by using products incorrectly!** Failure to use our products in an unintended way may cause situations resulting in property damage and personal injury.
NOTICE	**Inappropriate use** Bosch Rexroth, as the manufacturer, does not provide any warranty, assume any liability, or pay any damages for damage caused by products not being used as intended. Any risks resulting from the products not being used as intended are the sole responsibility of the user.

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

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

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

Areas of use and application

Typical applications include, for example:

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

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

Standards	
EN 60034-1 EN 60034-1:2010 + Cor.:2010	Rating and performance behavior
EN 60034-5 EN IEC 60034-5:2020	Type of protection
Directives	
2014/35/EU	Low voltage directive

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

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

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

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

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

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

2.1.2 Unintended use

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

Do not use these motors, if

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

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

Trademark right third parties

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

2.2 Qualification of personnel

Any work with or on the described product may only done by qualified or skilled personnel. For the purpose of this manual, qualified personnel means persons who are familiar with transporting, installing, mounting, commissioning and operating the components of the electrical drive and control system and the associated hazards and have an appropriate qualification for their job.

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

2.3 Safety instructions

tbd

2.4 Safety instructions for electric drive and control systems

2.4.1 Basic information

Using and passing on the safety instructions

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

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

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

Requirements for safe use

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

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

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

Hazards due to incorrect use

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

2.4.2 Instructions with regard to specific dangers

Protection against contact with electrical parts and housings

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

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

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

- Only qualified persons are allowed to operate, maintain and/or repair the components of the electric drive and control system.
- Follow the general installation and safety regulations when working on power installations.

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

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

- Prior to switching on and commissioning, ground or connect the electric drive and control system components to the equipment grounding conductor at the grounding points.
- Connect the equipment grounding conductor of the electric drive and control system components permanently to the main power supply at all times. The leakage current is greater than 3.5 mA.
- Establish an equipment grounding connection with a minimum cross section according to the table below. With an outer conductor cross section smaller 10 mm^2 (8 AWG), the alternative connection of two equipment grounding conductors is allowed, each having the same cross section as the outer conductors.

Table 4: Minimum cross section of equipment grounding connection

Cross section of outer conductor	Minimum cross section of equipment grounding conductor Leakage current ≥ 3.5 mA	
	1 equipment grounding conductor	2 equipment grounding conductors
1.5 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)	-

Protective extra-low voltage as protection against electric shock

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

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

Danger to life, risk of injury by electric shock! High electrical voltage due to 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 **Protective Extra Low Voltage - PELV**.

Protection against dangerous movements

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

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

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

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

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

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

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

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

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

Protection against electromagnetic and magnetic fields during operation and mounting

Electromagnetic and magnetic fields!

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

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

Protection against contact with hot parts

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

Protection during handling and mounting

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

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

Battery safety

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

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

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

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

Protection against pressurized systems

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

Risk of injury by improper handling of pressurized lines!

- Do not attempt to disconnect, open or cut pressurized lines (risk of explosion).
- Comply with the respective manufacturer's operating instructions.
- Before 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. Comply with the national regulations of your country.

Explanation of signal words and the safety alert symbol

The safety instructions in the available application documentation contain specific signal words (DANGER, WARNING, CAUTION, NOTICE) and, where required, a safety alert symbol (in accordance with ANSI Z535.6-2023).

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

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

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

2.5 Product- and technology-dependent safety instructions

2.5.1 Protection from electric voltage

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

Before working:

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

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

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

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

2.5.2 Protection from mechanical danger

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

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

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

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

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

2.5.3 Protection against dangerous movements

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

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

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

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

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

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

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

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

To avoid accidents, injury and/or property damage:

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

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

2.5.4 Protection against magnetic and electromagnetic fields

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

Electro magnetic and magnetic fields!

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

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

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

Risk of destruction of sensitive parts! Data loss!

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

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

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

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

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

Behavior in the case of accidents with permanent magnets

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

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

In the case of an accident:

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

2.5.5 Protection during handling and assembly

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

Please observe the safety notes about strong attractive forces of permanent magnets under ➦ Chapter 2.5.4 Protection against magnetic and electromagnetic fields on page 32.

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

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

Observe the following instructions during unpacking and handling.

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

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

Store the original package of the motor components with permanent magnets

Store the original package for later use.

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

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

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

2.5.6 Protection against burns

Risk of burns due to hot motor surfaces!

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

2.5.7 Protection against pressurized systems

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

Risk of injury by improper handling of pressurized lines!

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



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

2.5.8 Electrostatic sensitive devices (ESD)

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

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

Remark

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

3 Technical data

3.1 Definitions

3.1.1 Rated 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 8.7.5 Coolant inlet temperature on page 272.

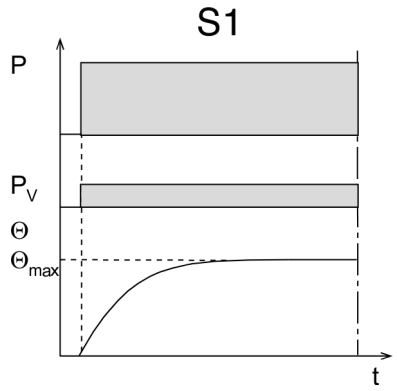


Fig. 5: Operation mode according to DIN EN 60034-1

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

3.1.2 Operating behavior

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

The achievable motor torque depends on the drive controller used (see ➦ Chapter 3.2 IndraSize on page 39). The reference value for the motor characteristic curves is a DC bus voltage of 540 V_{DC}.

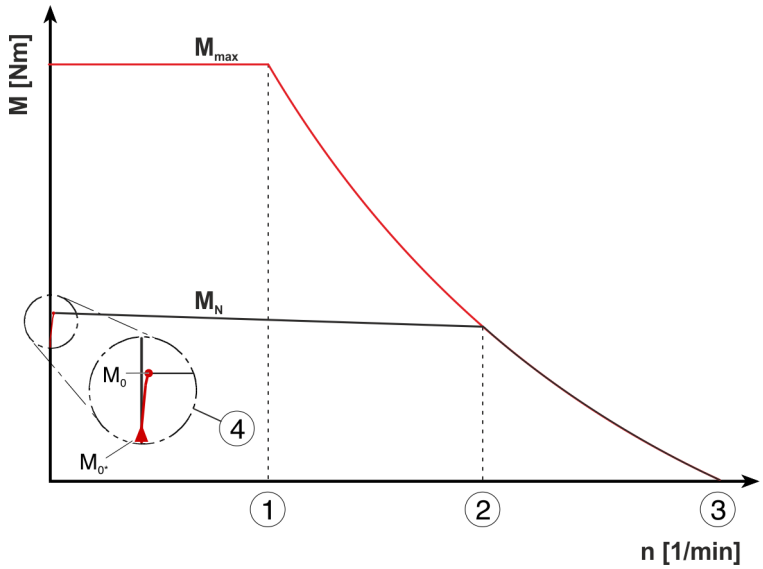


Fig. 6: Example characteristic curve MBT

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. Generally $M_0^* = M_0/\sqrt{2}$
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 ➦ Protection from thermal overload during standstill operation

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.

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

Fig. 7: Conversion example

U_{DCxxx} New DC bus voltage

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. 8: Example conversion to DC bus voltage 750 V

3.1.3 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

Table 5: General technical data for stators MST

Designation	Symbol	Unit	Description
Standstill torque	M_0	Nm	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	Available torque that can be output at the rated speed in operation mode S1 (continuous operation).
Rated power	P_N	kW	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}	Useful speed defined by the manufacturer. Depending on the application, other speeds are possible (see speed-torque characteristic curve).
Maximum torque	M_{max}	Nm	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}	Maximum permissible speed of the motor. Normally restricted by mechanical factors such as centrifugal forces or bearing stress.
Power wire cross-section	A	mm^2	Rated according to DIN VDE 0298-4 and laying type B2 according to DIN IEC 60204-1 with conversion factor for Rexroth cables at 40 °C ambient temperature. The power wire cross section that is specified in the data sheets can vary depending on the selected type of connection - plug or terminal box.
Torque constant	K_{M_N}	Nm/A	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}	Root-mean-square value of the induced motor voltage at a motor temperature of 20 °C and 1 revolution per minute.

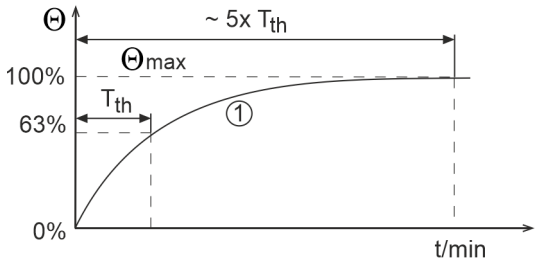
Designation	Symbol	Unit	Description
Thermal time constant	T_{th_nenn}	min	Duration of the temperature rise to 63% of the final temperature of the winding at motor load with permissible S1 continuous torque. The thermal time constant is determined by the cooling type used.  Fig. 9: Thermal time constant ① Chronological course 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_{ab}	nF	Capacitance 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 design and cooling mode refer to ➥ Chapter 3.16.
Power dissipation	P_V	kW	Power loss in operation mode S1 (continuous operation) at nominal velocity v_N.
Coolant inlet temperature	T_{in}	°C	Allowed cooling inlet temperature. The coolant inlet temperature should be maximum 5°C lower than the existing ambient temperature T_{um}. In case of a higher temperature difference, danger of condensation!
Allowed coolant-temperature for P_V	ΔT_{max}	K	Temperature difference between coolant inlet and outlet temperature during operation with liquid cooling (coolant water) and rated power loss P_V.
Required coolant flow for P_V	Q_{min}	l/min	Required coolant flow for compliance with the specified motor torque.
Pressure drop at Q_{min}	Δp	bar	Pressure loss within the internal coolant circuit of the motor Q_{min}.
Volume of coolant duct	V_{cool}	l	Coolant volume of the motor.
Maximum permissible inlet pressure	p_{max}	bar	Maximum permitted inlet pressure of the liquid cooling on the motor with coolant water.

Table 6: General technical data for rotors MRT

Designation	Symbol	Unit	Description
Moment of inertia of rotor	J_{rot}	kgm^2	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.

3.2 IndraSize

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

3.3 General technical data

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.

Table 7: General technical data

Designation	Symbol	Unit	MSTxxx	MRTxxx
Ambient temperature during operation (see also ➦Chapter 8.1 Installation altitude and ambient temperature on page 265)	T_{um}	°C	0 ... +40	
Allowed transport temperature (see also ➦Chapter 10.2.2 Transport instructions on page 302)	T_T	°C	See ➦Chapter 10.2.2 Transport instructions on page 302.	
Allowed storage temperature (see also ➦Chapter 10.2.3 Storage instructions on page 305)	T_L	°C	See ➦Chapter 10.2.3 Storage instructions on page 305.	
Permissible coolant inlet temperature (see also ➦Chapter 8.7.5 Coolant inlet temperature on page 272)	T_{in}	°C	+10 ... +40	
Allowed coolant-temperature for P_V	ΔT_{max}	K	10	
Maximum allowed coolant input pressure	P_{max}	bar	6	
Thermal class according to 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 acc. to DIN EN 60034-5	-	-	IP00	
RoHS conformity			according to directive 2011/65/EU	
E-file number	-	-	E341734	

3.4 Frame size 130

3.4.1 Data sheet MST130

Table 8: MST130A - Technical data

Designation	Symbol	Unit	MST130A	
			-0200-F	-0250-N
Standstill torque [1)]	M_0	Nm	9	5
Continuous current at standstill	I_0	A	6.5	3.9
Rated torque [2)]	M_N	Nm	8.1	4.5
Rated power[3)]	P_N	kW	1.70	1.2
Rated current	I_N	A	6.4	3.5

Designation	Symbol	Unit	MST130A	
			-0200-F	-0250-N
Rated speed [4]	n_N	min-1	2,000	2500
Maximum torque [5]	M_{max}	Nm	15	13.0
Maximum current	I_{max}	A	16	12
Maximum speed (electrical) [6]	n_{max}	min-1	4,000	4,000
Power wire cross-section	A	mm^2	1.0	1.0
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	1.25	1.3
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	0.094	0.085
Thermal time constant	T_{th_nenn}	min	4.1	15
Winding resistance at 20 °C	R_{12}	Ohm	5.5	5.5
Winding inductance	L_{12}	mH	17.5	17.5
Leakage capacitance of the component	C_{ab}	nF	2	2.19
Number of pole pairs	p	-	10	
Details about liquid cooling				
Power dissipation	P_V	kW	0.5	0.11
Required coolant flow for P_V	Q_{min}	l/min	0.7	-
Pressure drop at Q_{min}	Δp	bar	0.1	-
Volume of coolant duct	V_{kuehl}	l	0.04	-
1...8) Tolerance ± 5%				
Latest amendment: 2024-03-18				

Table 9: MST130C - Technical data

Designation	Symbol	Unit	MST130C			
			-0050-F	-0075-N	-0200-F	-0300-N
Standstill torque [1]	M_0	Nm	27	14.6	27	12.5
Continuous current at standstill	I_0	A	6.8	3.9	16.2	8
Rated torque [2]	M_N	Nm	25	13.5	25	6.8
Rated power[3]	P_N	kW	1.31	1.1	5.24	2.136
Rated current	I_N	A	6.1	3.5	15.2	5.3
Rated speed [4]	n_N	min-1	500	750	2,000	3000
Maximum torque [5]	M_{max}	Nm	50	40	40	40
Maximum current	I_{max}	A	12.5	13	38	26.6
Maximum speed (electrical) [6]	n_{max}	min-1	1,500	1,500	3850	3850
Power wire cross-section	A	mm^2	1.0	1.0	1.5	1.0
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	4.3	3.86	1.65	1.283
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	0.285	0.280	0.071	0.103
Thermal time constant	T_{th_nenn}	min	2.5	15	2	47
Winding resistance at 20 °C	R_{12}	Ohm	10.3	10.3	1.68	1.68
Winding inductance	L_{12}	mH	40	41.4	6.8	6.8
Leakage capacitance of the component	C_{ab}	nF	2.7	6.56	2.72	2.72
Number of pole pairs	p	-	10			
Details about liquid cooling						
Power dissipation	P_V	kW	1.4	0.17	1.0	0.17
Required coolant flow for P_V	Q_{min}	l/min	2	-	1.4	-

Designation	Symbol	Unit	MST130C			
			-0050-F	-0075-N	-0200-F	-0300-N
Pressure drop at Q_{min}	Δp	bar	0.1	-	0.1	-
Volume of coolant duct	V_{kuehl}	l	0.09	-	0.09	-
1...8) Tolerance ± 5%						
Latest amendment: 2024-03-18						

Table 10: MST130E/ -G - Technical data

Designation	Symbol	Unit	MST130E		MST130G	
			-0020-F	-0035-N	-0035-N	-0100-F
Standstill torque [1]	M_0	Nm	45	24.3	34	64
Continuous current at standstill	I_0	A	6.7	3.8	5.3	17.7
Rated torque [2]	M_N	Nm	42	22.5	31.5	60
Rated power[3]	P_N	kW	2.0	1.9	1.2	6.3
Rated current	I_N	A	6.3	3.5	4.9	17.5
Rated speed [4]	n_N	min-1	450	800	350	1,000
Maximum torque [5]	M_{max}	Nm	65	65	80	100
Maximum current	I_{max}	A	12	12	18	33.2
Maximum speed (electrical) [6]	n_{max}	min-1	950	950	950	2,700
Power wire cross-section	A	mm^2	1.0	1.0	1.0	2.5
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	5.6	6.6	6.43	3.43
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	1.050	0.340	0.520	0.22
Thermal time constant	T_{th_nenn}	min	2	15	15	5.7
Winding resistance at 20 °C	R_{12}	Ohm	5.9	15.1	17.4	3.3
Winding inductance	L_{12}	mH	65.4	65.4	99.0	14.5
Leakage capacitance of the component	C_{ab}	nF	10.93	10.93	15.31	15.31
Number of pole pairs	p	-	10			
Details about liquid cooling						
Power dissipation	P_V	kW	1.4	0.22	0.29	1.95
Required coolant flow for P_V	Q_{min}	l/min	2.0	-	-	2.8
Pressure drop at Q_{min}	Δp	bar	0.1	-	-	0.2
Volume of coolant duct	V_{kuehl}	l	0.16	-	-	0.25
1...8) Tolerance ± 5%						
Latest amendment: 2024-03-18						

3.4.2 Data sheet MRT130

Table 11: MRT130 - Technical data

Designation	Symbol	Unit	MRT130A	MRT130C	MRT130E	MRT130G
			-__-0060			
Moment of inertia of rotor [1]	J_{Rot}	kg * m^2	0.0008	0.0018	0.0029	0.0039
Rotor mass	m_{rot}	kg	0.64	1.42	2.2	3.0
Maximum speed (mechanical)	$n_{max,mech}$	min-1	4,000			
1) Tolerance ± 5%						
Latest amendment: 2021-07-29						

3.4.3 Motor characteristic curves MST130

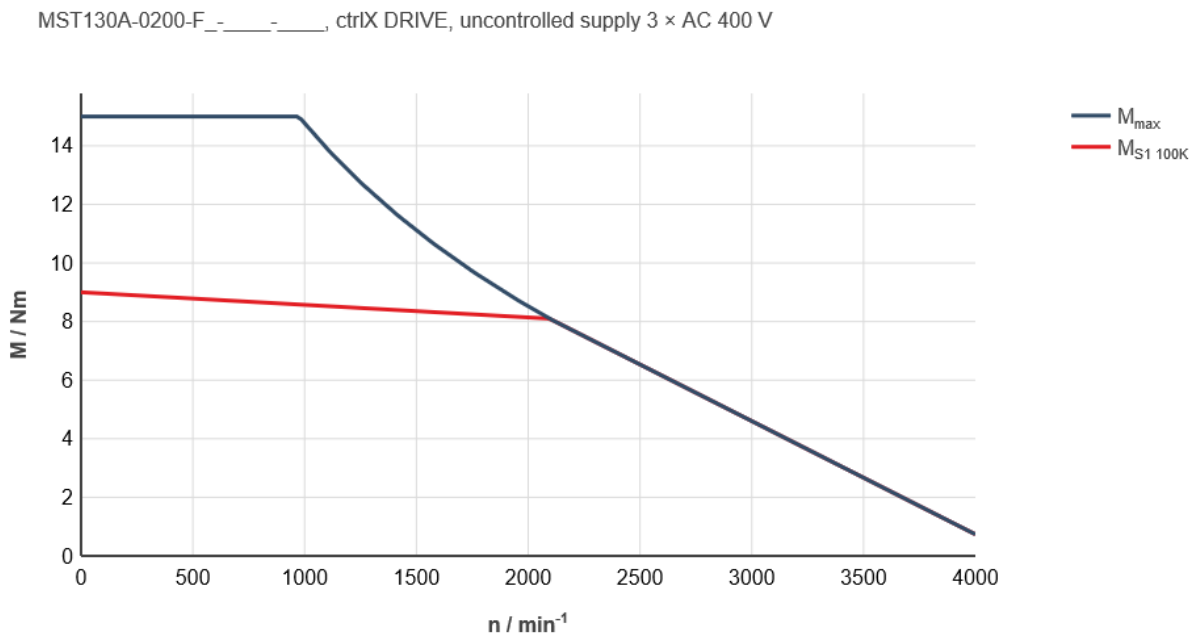


Fig. 10: Motor characteristic curve of MST130A-0200-F... at 540 V_{DC}

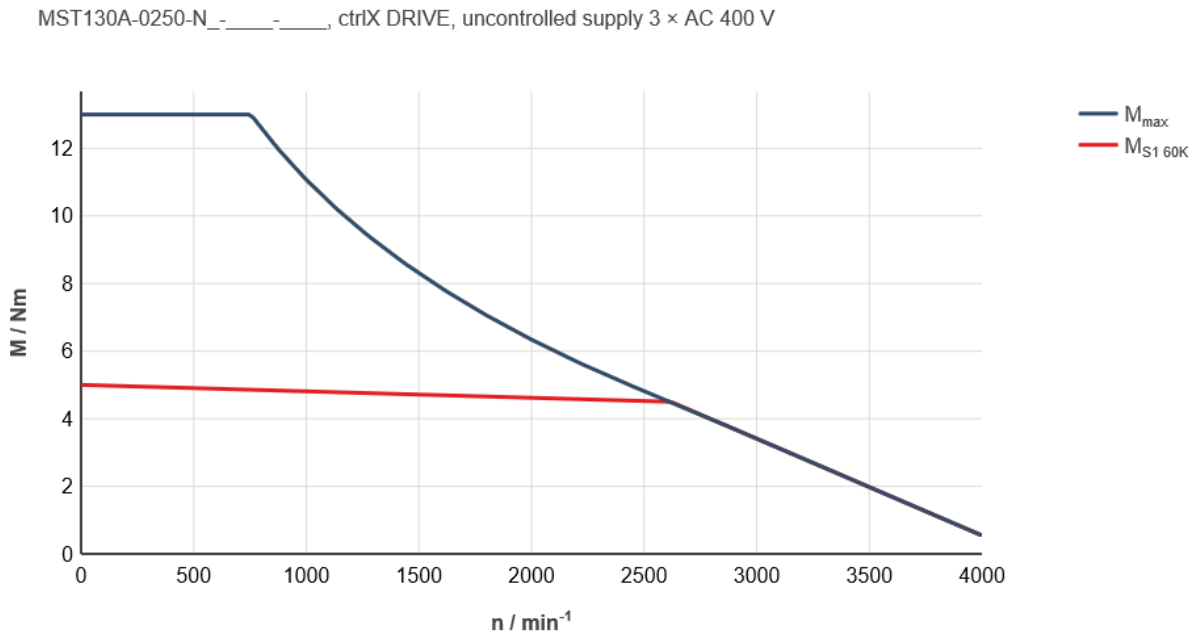


Fig. 11: Motor characteristic curve of MST130A-0250-N... at 540 V_{DC}

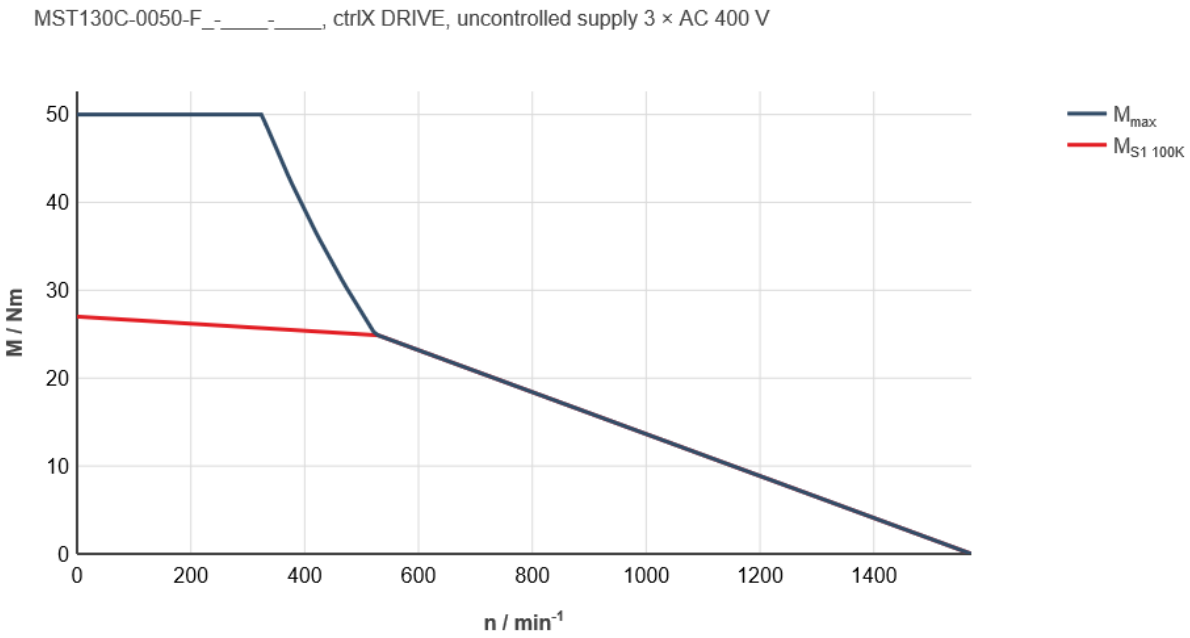


Fig. 12: Motor characteristic curve of MST130C-0050-F... at 540 V_{DC}

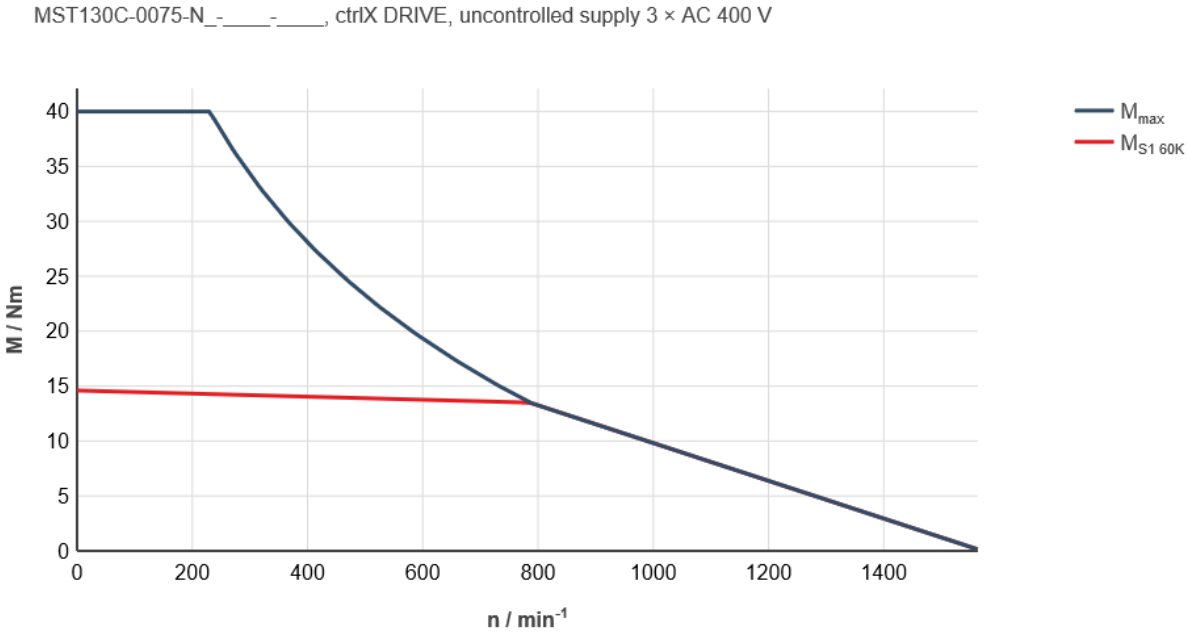


Fig. 13: Motor characteristic curve of MST130C-0075-N... at 540 V_{DC}

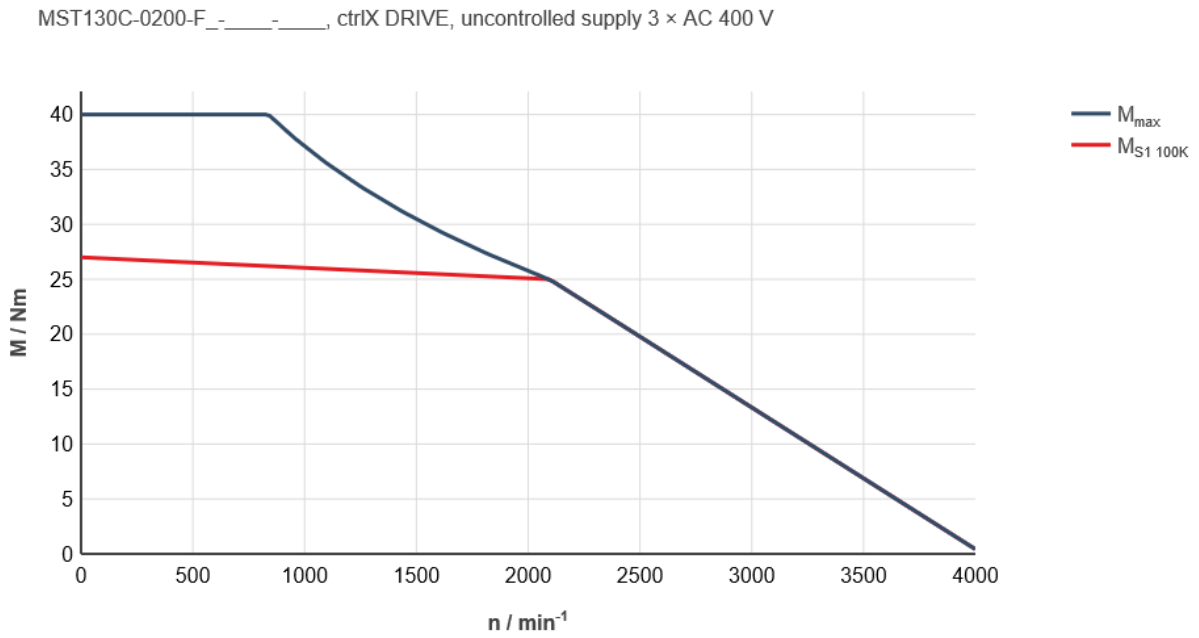


Fig. 14: Motor characteristic curve of MST130C-0200-F... at 540 V_{DC}

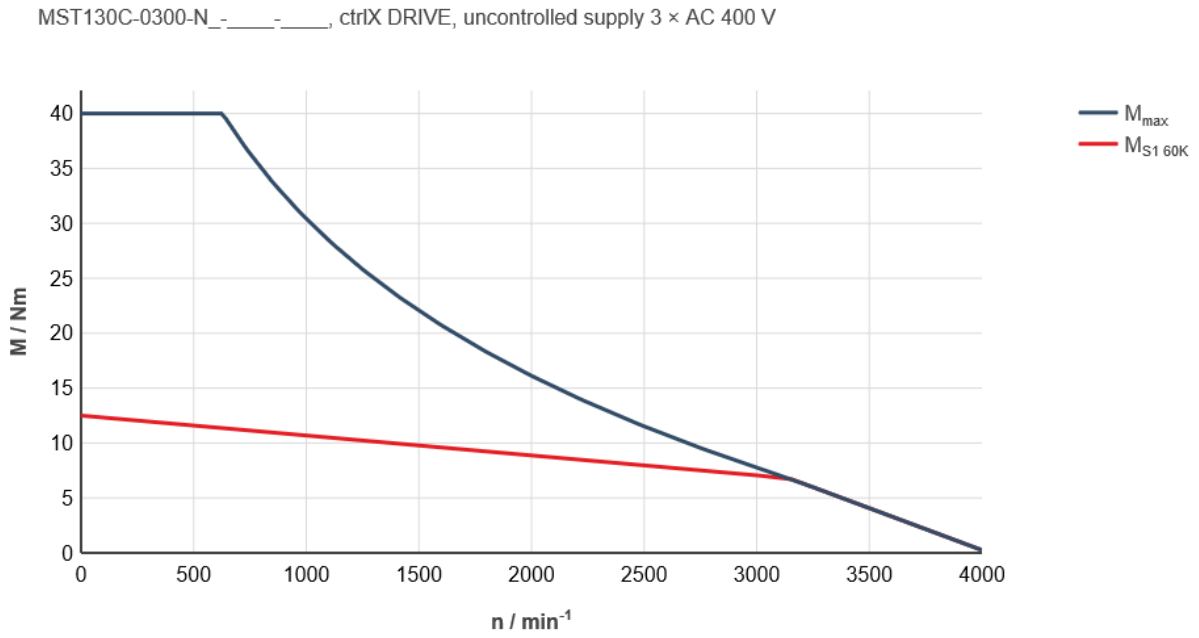


Fig. 15: Motor characteristic curve of MST130C-0300-N... at 540 V_{DC}

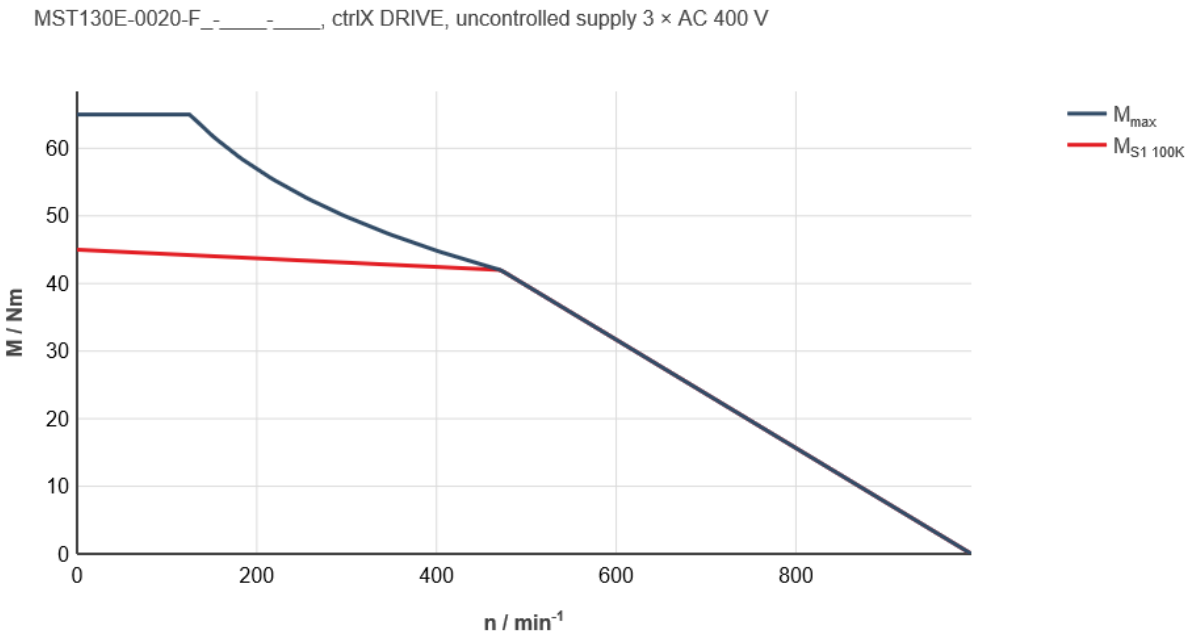


Fig. 16: Motor characteristic curve of MST130E-0020-F... at 540 V_{DC}

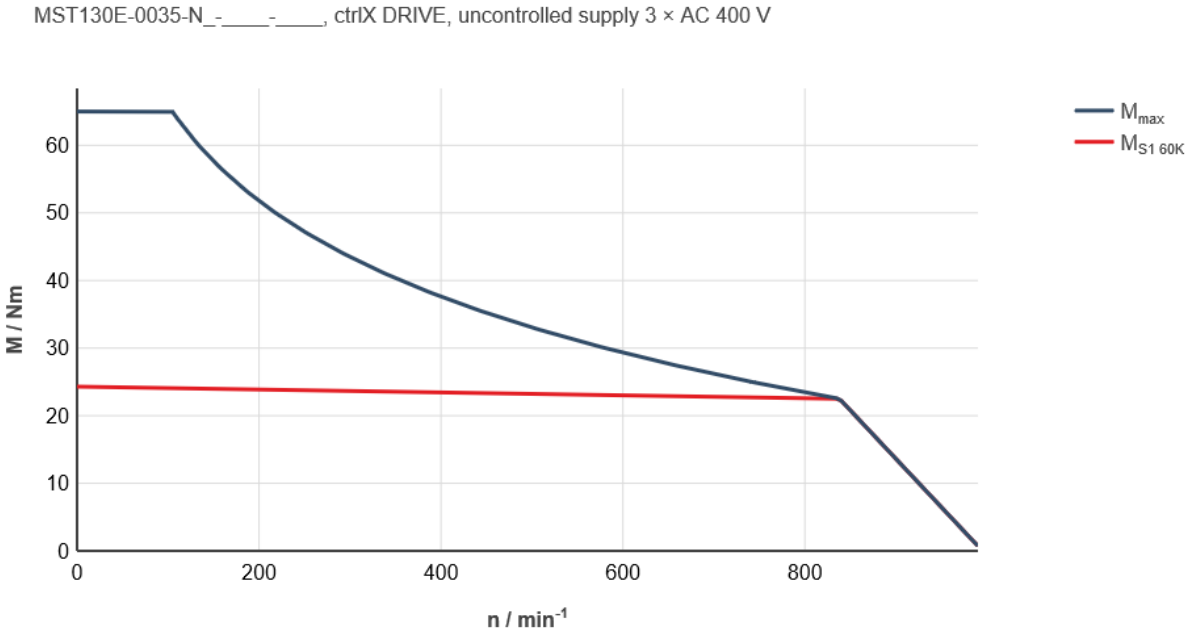


Fig. 17: Motor characteristic curve of MST130E-0035-N... at 540 V_{DC}

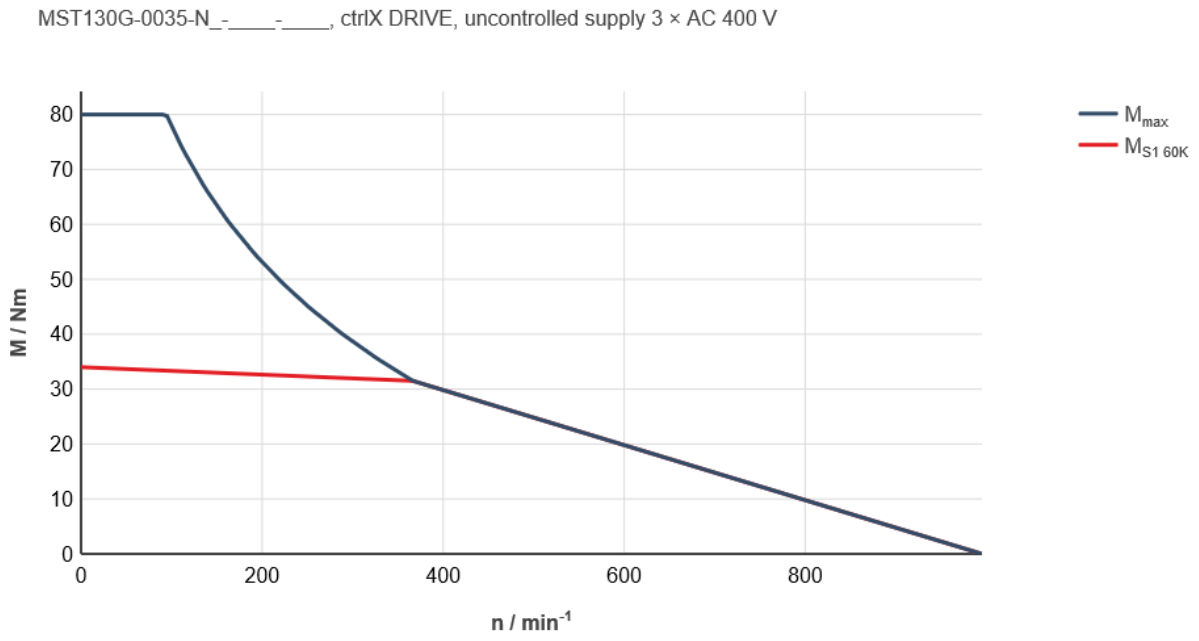


Fig. 18: Motor characteristic curve of MST130G-0035-N... at 540 V_{DC}

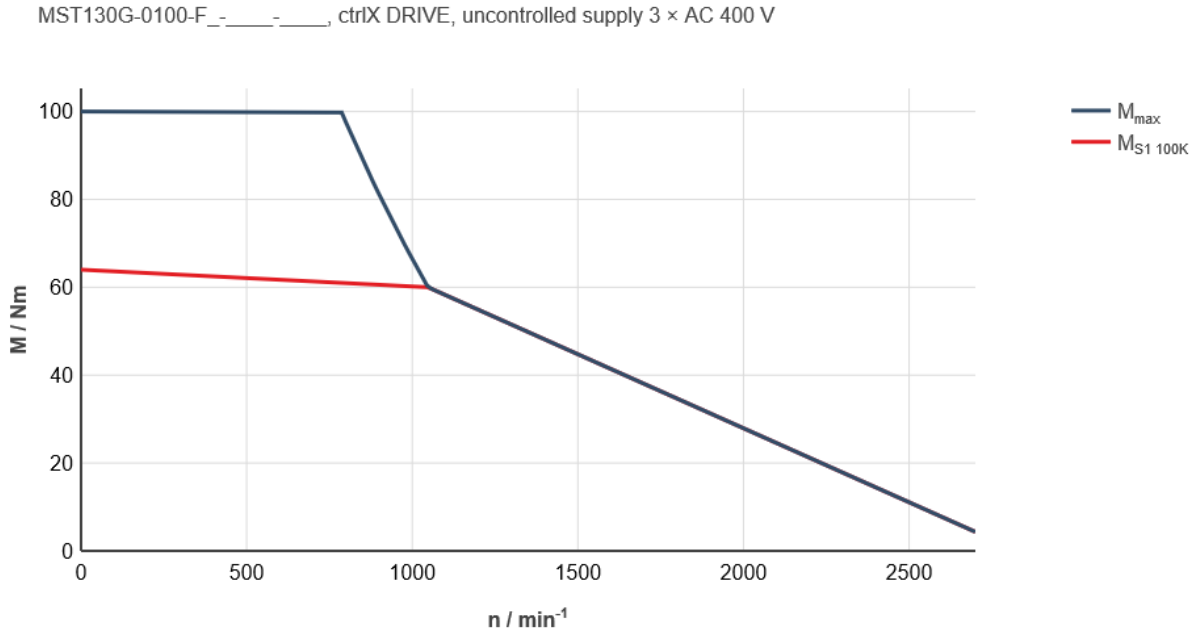


Fig. 19: Motor characteristic curve MST130G-0100-F... at 540 V_{DC}

3.5 Frame size 160

3.5.1 Data sheet MST160

Table 12: MST160 - Technical data

Designation	Symbol	Unit	MST160A	MST160C	MST160E	
			-0050-F	-0050-F	-0027-F	-0050-F
Standstill torque 1)	M_0	Nm	43	95	145	145
Continuous current at standstill	I_0	A	8.2	16.4	11.4	21.4
Rated torque 2)	M_N	Nm	40	80	125	120
Rated power3)	P_N	kW	2.1	5.4	3.3	6.9
Rated current	I_N	A	7.5	14.2	9.8	19.5
Rated speed 4)	n_N	min-1	500	650	250	550
Maximum torque 5)	M_{max}	Nm	90	180	270	270
Maximum current	I_{max}	A	20	40	22.4	60
Maximum speed (electrical) 6)	n_{max}	min-1	1100	1100	450	900
Power wire cross-section	A	mm^2	1.0	1.0	1.0	2.5
Torque constant at 20 °C 7)	K_{M_N}	Nm/A	5.33	5.63	12.75	6.15
Voltage constant at 20 °C 8)	K_{EMK_1}	V/min-1	0.356	0.365	0.893	0.433
Thermal time constant	T_{th_nenn}	min	2	2	7	7
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	4.40	11.66	17.49	17.49
Number of pole pairs	p	-	15			
Details about liquid cooling						
Power dissipation	P_V	kW	1.3	2.4	3.0	3.0
Required coolant flow for P_V	Q_{min}	l/min	1.9	3.5	4.3	4.3
Pressure drop at Q_{min}	Δp	bar	0.1	0.1	0.1	0.1
Volume of coolant duct	V_{kuehl}	l	0.07	0.16	0.26	0.26
1...8) Tolerance ± 5%						
Latest amendment: 2024-03-18						

3.5.2 Data sheet MRT160

Table 13: MRT160 - Technical data

Designation	Symbol	Unit	MRT160A	MRT160C	MRT160E
			-_-0080		
Moment of inertia of rotor 1)	J_{Rot}	kg * m^2	0.0059	0.0108	0.0158
Rotor mass	m_{rot}	kg	2.4	4.4	6.4
Maximum speed (mechanical)	$n_{max,mech}$	min-1	3500		
1) Tolerance ± 5%					
Latest amendment: 2021-07-29					

3.5.3 Motor characteristic curves MST160

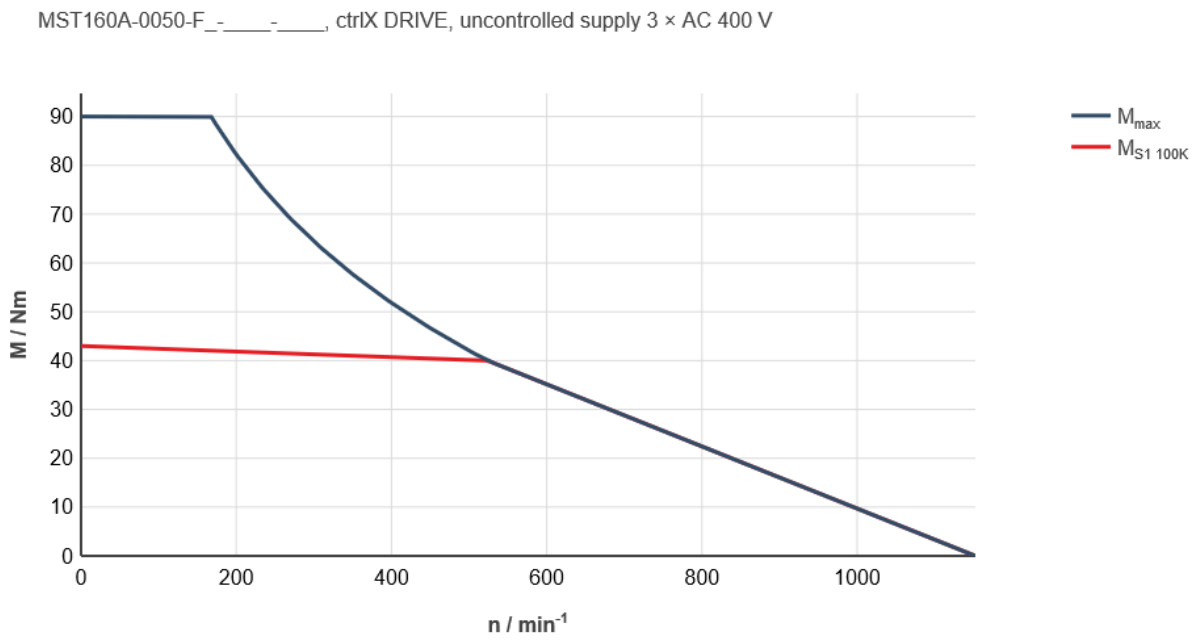


Fig. 20: Motor characteristic curve of MST160A-0050-F... at 540 V_{DC}

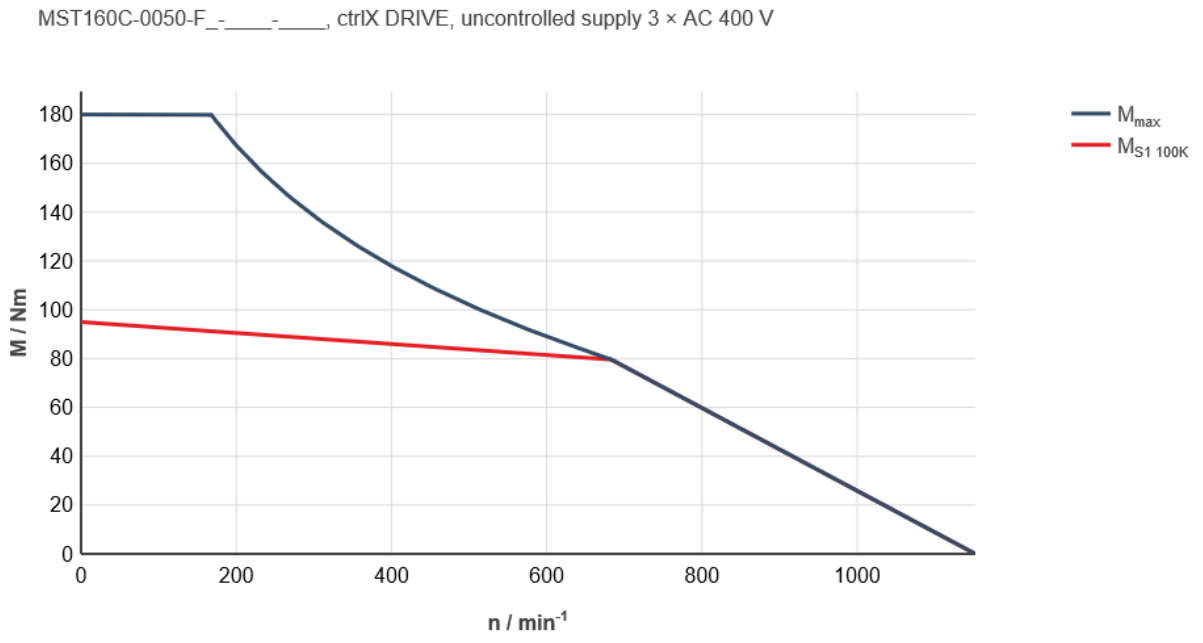


Fig. 21: Motor characteristic curve of MST160C-0050-F... at 540 V_{DC}

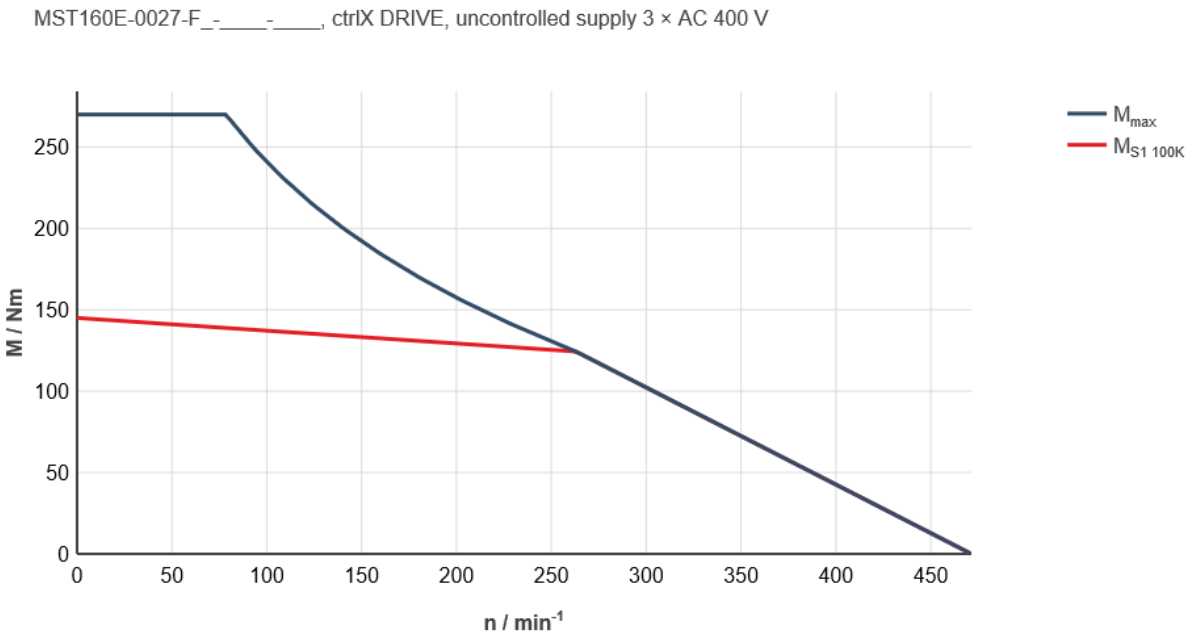


Fig. 22: Motor characteristic curve of MST160E-0027-F... at 540 V_{DC}

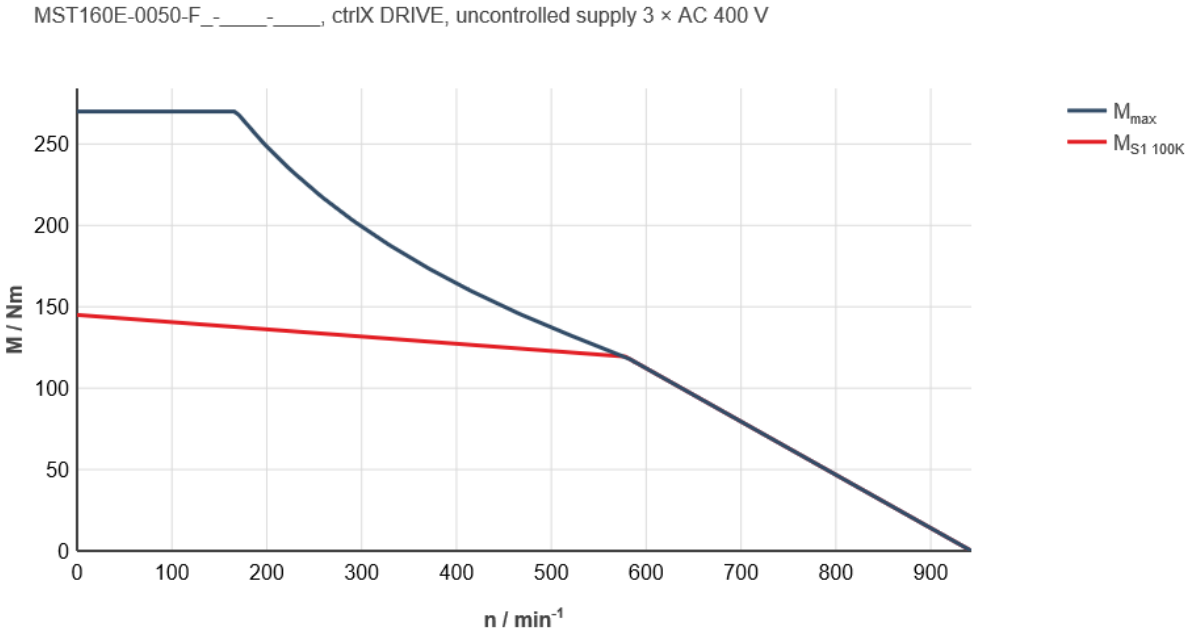


Fig. 23: Motor characteristic curve of MST160E-0050-F... at 540 V_{DC}

3.6 Frame size 161

3.6.1 Data sheet MST161

Table 14: MST161C /-E - Technical data

Designation	Symbol	Unit	MST161C	MST161E	
			-0140-F	-0050-F	-0140-F
Standstill torque 1)	M_0	Nm	65	125	105
Continuous current at standstill	I_0	A	19.2	19.5	35.4
Rated torque 2)	M_N	Nm	52	110	95
Rated power3)	P_N	kW	7.6	7.8	9.95
Rated current	I_N	A	17.4	16.7	32
Rated speed 4)	n_N	min-1	1400	675	1,000
Maximum torque 5)	M_{max}	Nm	160	260	260
Maximum current	I_{max}	A	53	45.8	84
Maximum speed (electrical) 6)	n_{max}	min-1	1900	1050	2,000
Power wire cross-section	A	mm^2	2.5	2.5	6.0
Torque constant at 20 °C 7)	K_{M_N}	Nm/A	3.25	6.01	3.13
Voltage constant at 20 °C 8)	K_{EMK_1}	V/min-1	0.204	0.407	0.207
Thermal time constant	T_{th_nenn}	min	2.0	3.0	3.0
Winding resistance at 20 °C	R_{12}	Ohm	2.0	3.0	0.82
Winding inductance	L_{12}	mH	10.6	18.2	4.8
Leakage capacitance of the component	C_{ab}	nF	5.62	8.34	8.34
Number of pole pairs	p	-	10		
Details about liquid cooling					
Power dissipation	P_V	kW	1.62	2.51	2.51
Required coolant flow for P_V	Q_{min}	l/min	2.3	3.6	3.6
Pressure drop at Q_{min}	Δp	bar	0.1	0.137	0.137
Volume of coolant duct	V_{kuehl}	l	0.140	0.261	0.261
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

Table 15: MST161G /-M - Technical data

Designation	Symbol	Unit	MST161G	MST161M	
			-0100-F	-0040-F	-0055-N
Standstill torque 1)	M_0	Nm	190	85	38
Continuous current at standstill	I_0	A	40	8.8	3.9
Rated torque 2)	M_N	Nm	175	80	30
Rated power3)	P_N	kW	16.5	3.35	1.7
Rated current	I_N	A	35.0	8.0	2.7
Rated speed 4)	n_N	min-1	900	400	550
Maximum torque 5)	M_{max}	Nm	290	180	180
Maximum current	I_{max}	A	58.0	22.0	22.0
Maximum speed (electrical) 6)	n_{max}	min-1	1600	1900	1900
Power wire cross-section	A	mm^2	6.0	1.0	1.0
Torque constant at 20 °C 7)	K_{M_N}	Nm/A	4.75	9.66	9.74
Voltage constant at 20 °C 8)	K_{EMK_1}	V/min-1	0.288	0.571	0.571

Designation	Symbol	Unit	MST161G	MST161M	
			-0100-F	-0040-F	-0055-N
Thermal time constant	T_{th_nenn}	min	4.0	4.1	42.0
Winding resistance at 20 °C	R_{12}	Ohm	1.17	11.0	11.0
Winding inductance	L_{12}	mH	7.5	62.9	62.9
Leakage capacitance of the component	C_{ab}	nF	12.51	5.8	5.8
Number of pole pairs	p	-	10		
Details about liquid cooling					
Power dissipation	P_V	kW	4.34	1.9	0.22
Required coolant flow for P_V	Q_{min}	l/min	6.2	2.8	-
Pressure drop at Q_{min}	Δp	bar	0.2	0.1	-
Volume of coolant duct	V_{kuehl}	l	0.4	0.180	-
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

3.6.2 Data sheet MRT161

Table 16: MRT161 - Technical data

Designation	Symbol	Unit	MRT161C	MRT161E	MRT161G	MRT161M
			-__-0080			
Moment of inertia of rotor [1)]	J_{Rot}	kg * m²	0.0085	0.016	0.0023	0.0108
Rotor mass	m_{rot}	kg	3.3	6.0	8.8	4.2
Maximum speed (mechanical)	$n_{max,mech}$	min-1	2,200			
1) Tolerance ± 5%						
Latest amendment: 2021-07-29						

3.6.3 Motor characteristic curves MST161

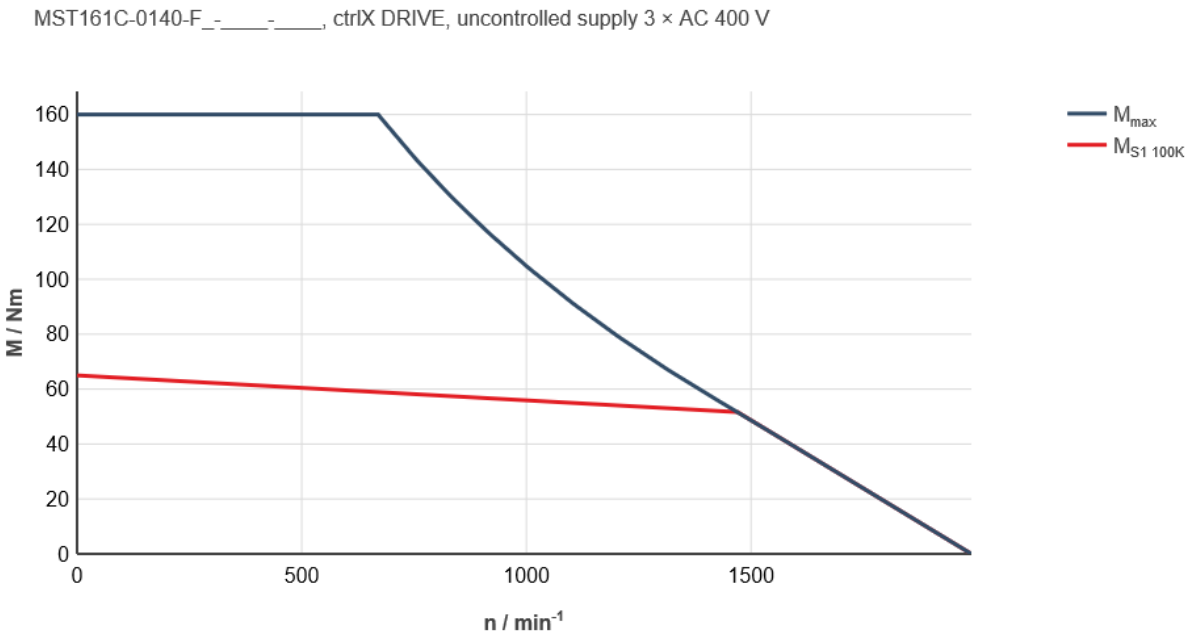


Fig. 24: Motor characteristic curve of MST161C-0140-F... at 540 V_{DC}

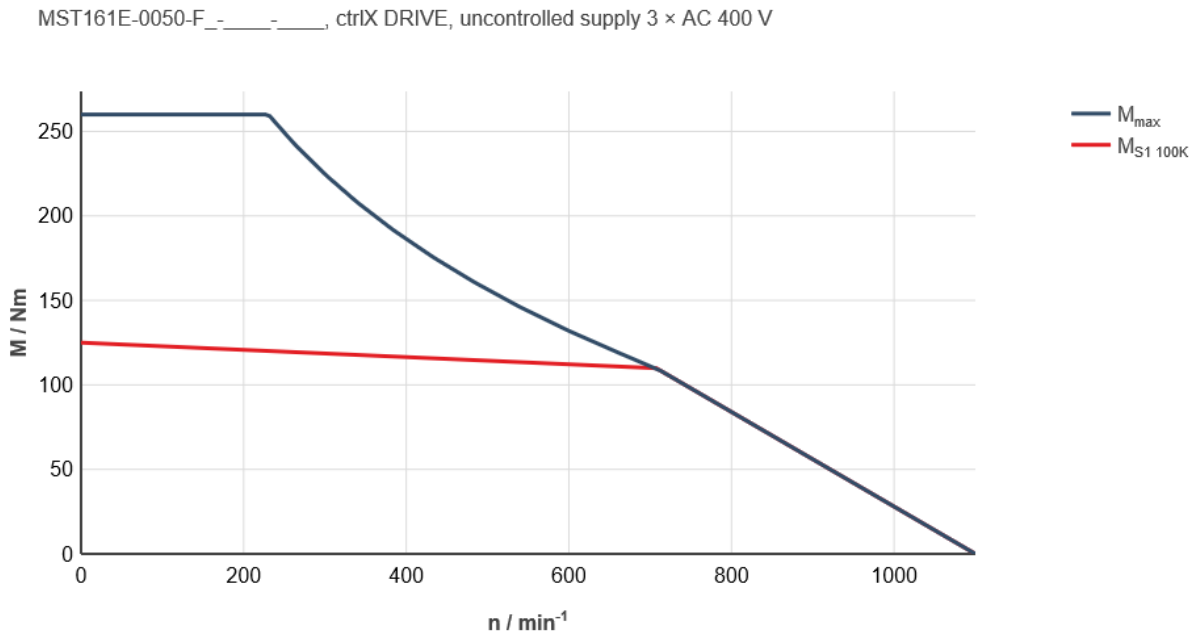


Fig. 25: Motor characteristic curve of MST161E-0050-F... at 540V_{DC}

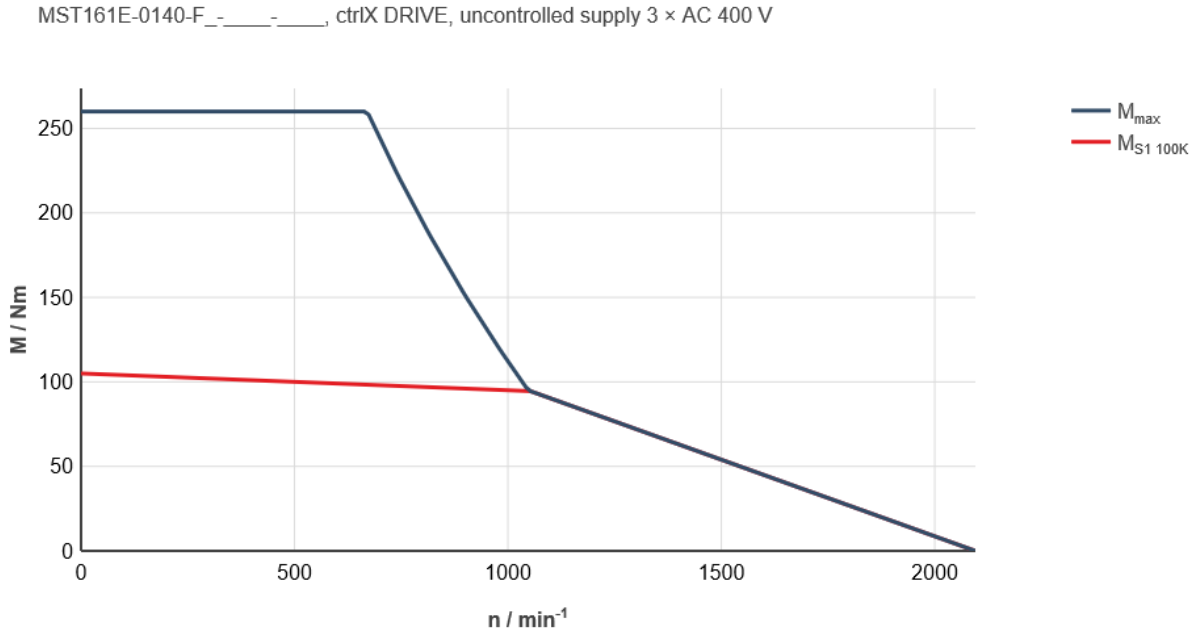


Fig. 26: Motor characteristic curve of MST161E-0140-F... at 540 V_{DC}

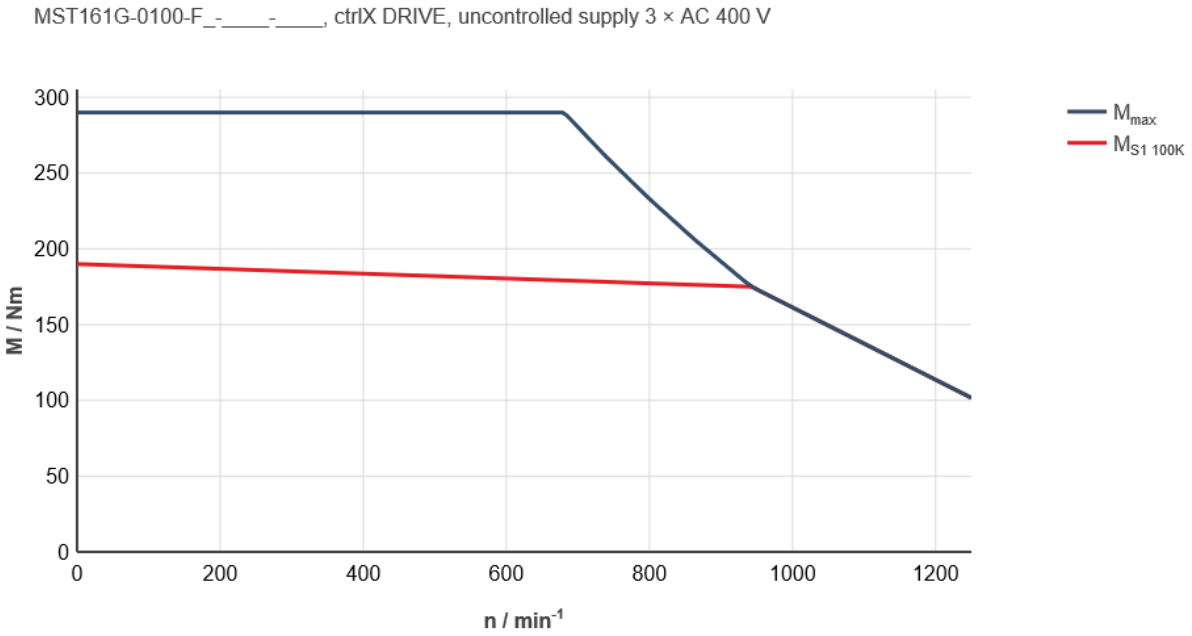


Fig. 27: Motor characteristic curve MST161G-0100-F... at 540 V_{DC}

3.7 Frame size 201

3.7.1 Data sheet MST201

Table 17: MST201C/ -D - Technical data

Designation	Symbol	Unit	MST201C		MST201D	
			-0010-F	-0027-F	-0010-F	-0027-F
Standstill torque 1)	M_0	Nm	125	115	185	175
Continuous current at standstill	I_0	A	6.2	10.3	7.9	14.4
Rated torque 2)	M_N	Nm	105	105	160	140
Rated power3)	P_N	kW	1.319	3.629	2.01	4.838
Rated current	I_N	A	5.2	9.4	6.9	13
Rated speed 4)	n_N	min-1	120	330	120	330
Maximum torque 5)	M_{max}	Nm	250	250	384	350
Maximum current	I_{max}	A	12.4	25.7	17.9	31
Maximum speed (electrical) 6)	n_{max}	min-1	300	540	255	520
Power wire cross-section	A	mm^2	1.0	1.5	1.0	1.0
Torque constant at 20 °C 7)	K_{M_N}	Nm/A	20.19	11.17	24.6	10.769
Voltage constant at 20 °C 8)	K_{EMK_1}	V/min-1	1.02	0.567	1.07	0.78
Thermal time constant	T_{th_nenn}	min	2.5	2.5	2.5	2.5
Winding resistance at 20 °C	R_{12}	Ohm	22.6	7.1	18.3	4.9
Winding inductance	L_{12}	mH	193.0	57.0	168.8	39.7
Leakage capacitance of the component	C_{ab}	nF	5.22	5.22	8.125	7.83
Number of pole pairs	p	-	10			
Details about liquid cooling						
Power dissipation	P_V	kW	1.5	1.5	2.304	2.2304

Designation	Symbol	Unit	MST201C		MST201D	
			-0010-F	-0027-F	-0010-F	-0027-F
Required coolant flow for P_V	Q_{min}	l/min	3.2	3.2	3.2	3.2
Pressure drop at Q_{min}	Δp	bar	0.1	0.1	0.14554	0.14554
Volume of coolant duct	V_{kuehl}	l	0.071	0.071	0.106	0.106
1...8) Tolerance ± 5%						
Latest amendment: 2024-03-18						

Table 18: MST201F - Technical data

Designation	Symbol	Unit	MST201F-0075-F
Standstill torque [1]	M_0	Nm	234
Continuous current at standstill	I_0	A	38.3
Rated torque [2]	M_N	Nm	225
Rated power[3]	P_N	kW	17.67
Rated current	I_N	A	36.8
Rated speed [4]	n_N	min-1	750
Maximum torque [5]	M_{max}	Nm	625
Maximum current	I_{max}	A	123.9
Maximum speed (electrical) [6]	n_{max}	min-1	1050
Power wire cross-section	A	mm^2	6.0
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	6.114
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	0.3726
Thermal time constant	T_{th_nenn}	min	2.5
Winding resistance at 20 °C	R_{12}	Ohm	0.90
Winding inductance	L_{12}	mH	8.0
Leakage capacitance of the component	C_{ab}	nF	13.1
Number of pole pairs	p	-	10
Details about liquid cooling			
Power dissipation	P_V	kW	3.7
Required coolant flow for P_V	Q_{min}	l/min	5.3
Pressure drop at Q_{min}	Δp	bar	0.3
Volume of coolant duct	V_{kuehl}	l	0.19
1...8) Tolerance ± 5%			
Latest amendment: 2024-03-18			

3.7.2 Data sheet MRT201

Table 19: MRT201 - Technical data

Designation	Symbol	Unit	MRT201C	MRT201D	MRT201F
			-__-0110		
Moment of inertia of rotor [1]	J_{Rot}	kg * m^2	0.0203	0.0292	0.0471
Rotor mass	m_{rot}	kg	4.5	6.4	10.3
Maximum speed (mechanical)	$n_{max,mech}$	min-1	1,500		
1) Tolerance ± 5%					
Latest amendment: 2021-07-29					

3.7.3 Motor characteristic curves MST201

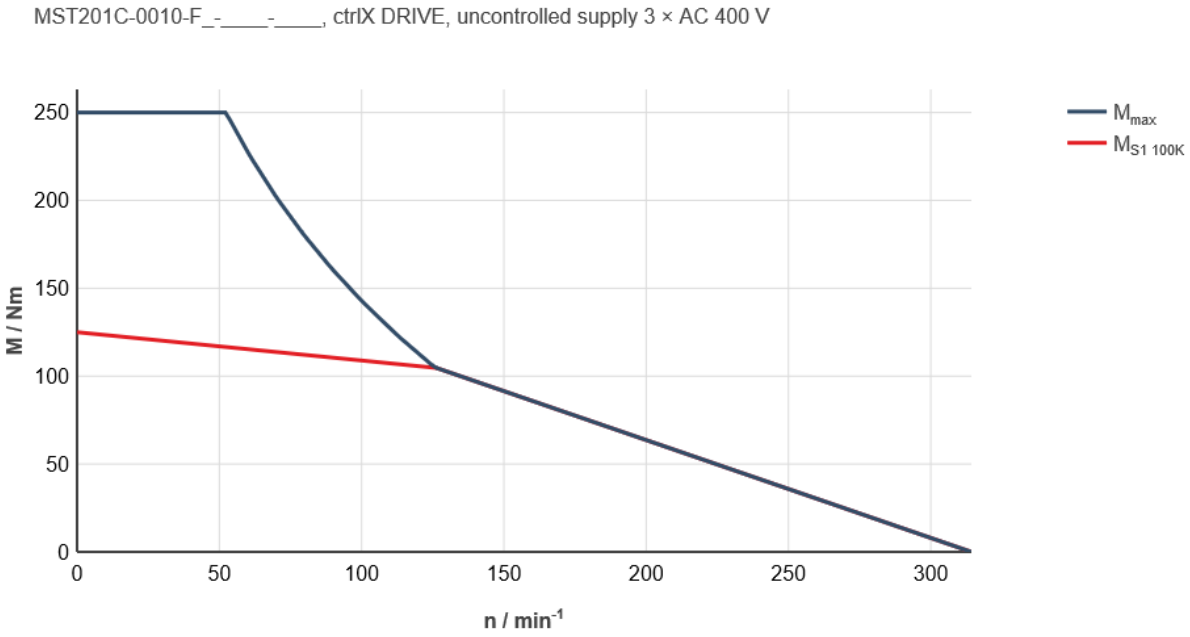


Fig. 28: Motor characteristic curve of MST201C-0010-F... at 540 V_{DC}

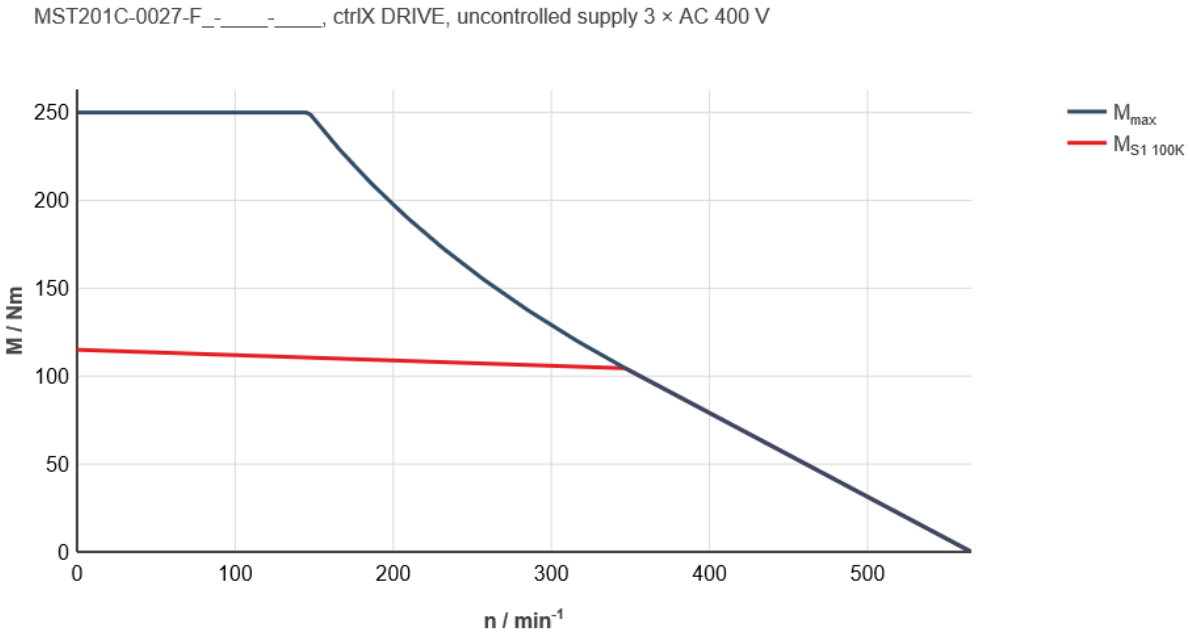


Fig. 29: Motor characteristic curve of MST201C-0027-F... at 540 V_{DC}

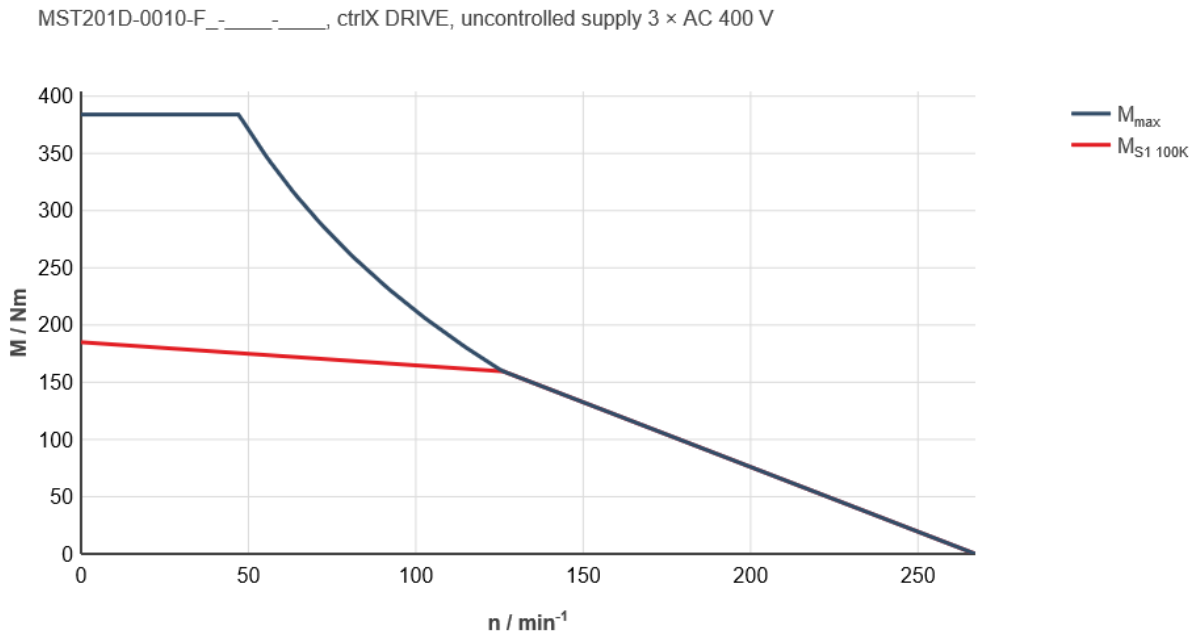


Fig. 30: Motor characteristic curve of MST201D-0010-F... at 540 V_{DC}

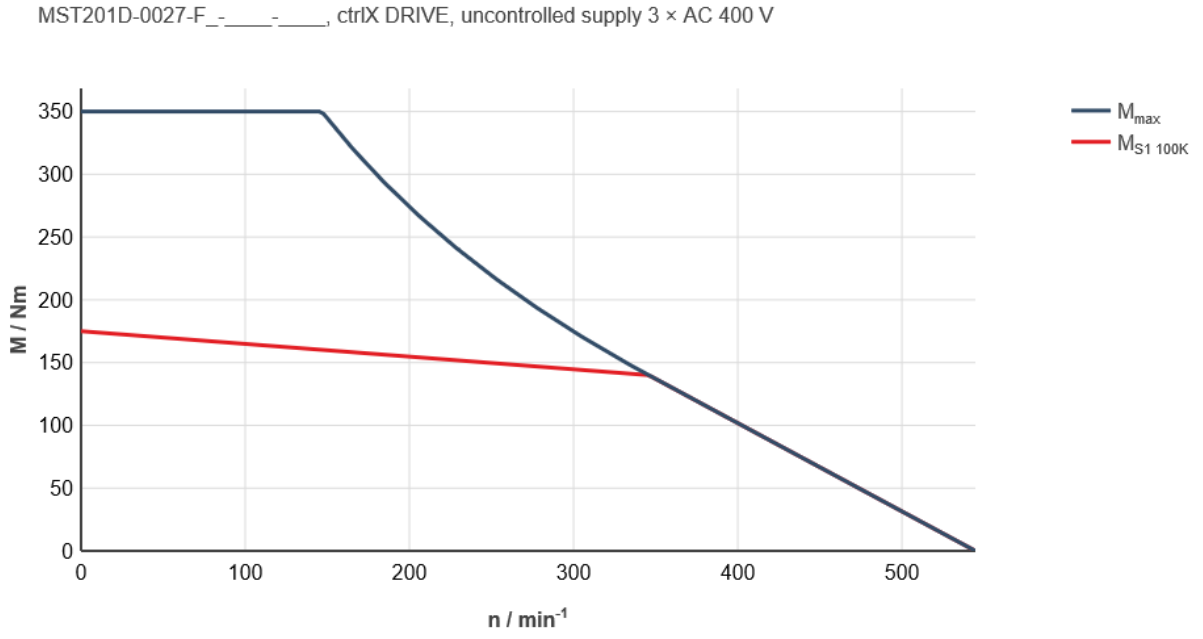


Fig. 31: Motor characteristic curve of MST201D-0027-F... at 540 V_{DC}

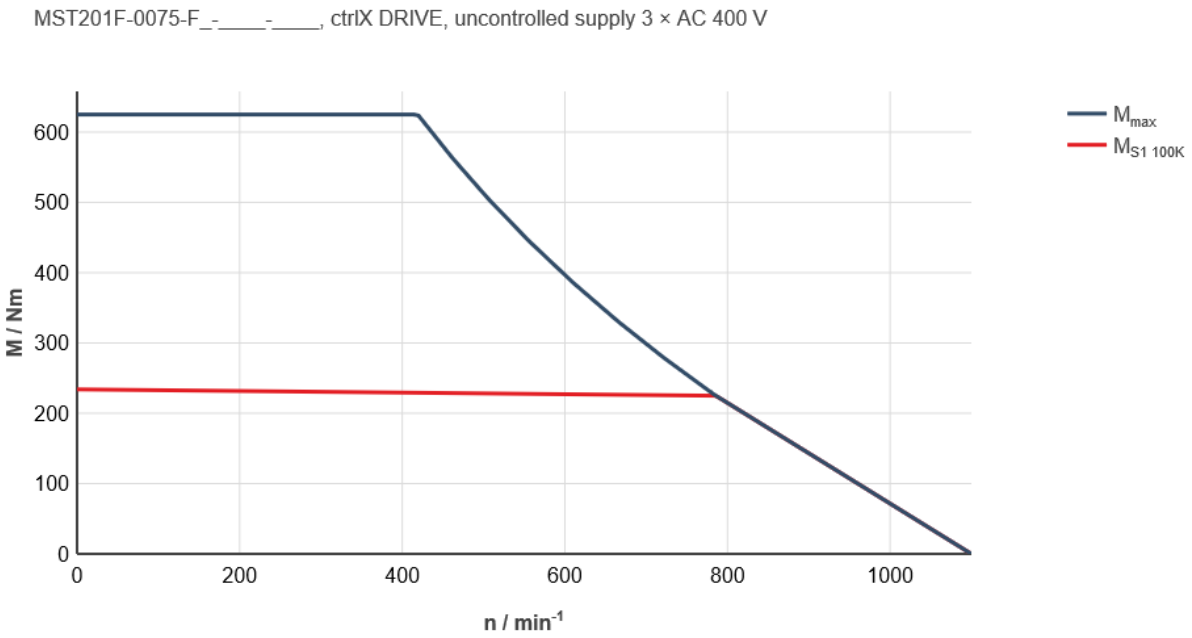


Fig. 32: Motor characteristic curve MST201F-0075-F... at 540 V_{DC}

3.8 Frame size 210

3.8.1 Data sheet MST210

Table 20: MST210A/ -C - Technical data

Designation	Symbol	Unit	MST210A	MST210C	
			-0027-F	-0027-F	-0050-F
Standstill torque [1]	M_0	Nm	55	132	132
Continuous current at standstill	I_0	A	7.7	14.3	27.5
Rated torque [2]	M_N	Nm	50	120	120
Rated power[3]	P_N	kW	2.1	4.1	9.4
Rated current	I_N	A	7	13	25
Rated speed [4]	n_N	min-1	400	330	750
Maximum torque [5]	M_{max}	Nm	120	250	250
Maximum current	I_{max}	A	25	50	100
Maximum speed (electrical) [6]	n_{max}	min-1	720	950	1350
Power wire cross-section	A	mm^2	1.0	1.0	4.0
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	7.71	9.2	4.8
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	0.510	0.620	0.310
Thermal time constant	T_{th_nenn}	min	2.4	3	3
Winding resistance at 20 °C	R_{12}	Ohm	10.9	5.2	1.3
Winding inductance	L_{12}	mH	53.0	30.1	7.5
Leakage capacitance of the component	C_{ab}	nF	4.80	9.51	9.51
Number of pole pairs	p	-	20		
Details about liquid cooling					
Power dissipation	P_V	kW	1.2	2.6	2.8

Designation	Symbol	Unit	MST210A	MST210C	
			-0027-F	-0027-F	-0050-F
Required coolant flow for P_V	Q_{min}	l/min	6	6	6
Pressure drop at Q_{min}	Δp	bar	0.1	0.1	0.1
Volume of coolant duct	V_{kuehl}	l	0.175	0.175	0.175
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

Table 21: MST210D / -E / -U - Technical data

Designation	Symbol	Unit	MST210D	MST210E	MST210U
			-0070-F	-0027-F	-0030-F
Standstill torque [1]	M_0	Nm	165	264	630
Continuous current at standstill	I_0	A	35.2	26.4	51.4
Rated torque [2]	M_N	Nm	150	240	530
Rated power[3]	P_N	kW	11	8.3	17.8
Rated current	I_N	A	32	24	45.7
Rated speed [4]	n_N	min-1	700	330	320
Maximum torque [5]	M_{max}	Nm	300	500	1200
Maximum current	I_{max}	A	72.0	90	165
Maximum speed (electrical) [6]	n_{max}	min-1	1100	600	580
Power wire cross-section	A	mm^2	6.0	4.0	10.0
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	4.7	10	11.62
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	0.310	0.700	0.780
Thermal time constant	T_{th_nenn}	min	3	3	3.9
Winding resistance at 20 °C	R_{12}	Ohm	1.0	2.26	1.56
Winding inductance	L_{12}	mH	6.0	14.1	9.33
Leakage capacitance of the component	C_{ab}	nF	13.32	19.03	24.6
Number of pole pairs	p	-	20		
Details about liquid cooling					
Power dissipation	P_V	kW	3.4	4.0	9.3
Required coolant flow for P_V	Q_{min}	l/min	6	6	8.5
Pressure drop at Q_{min}	Δp	bar	0.1	0.1	1.8
Volume of coolant duct	V_{kuehl}	l	0.21	0.366	0.81
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

3.8.2 Data sheet MRT210

Table 22: MRT210 - Technical data

Designation	Symbol	Unit	MRT210A	MRT210C	MRT210D	MRT210E	MRT210U
			-_-0120				
Moment of inertia of rotor [1]	J_{Rot}	kg * m^2	0.0111	0.0234	0.0317	0.044	0.093
Rotor mass	m_{rot}	kg	2.3	4.8	6.4	8.9	18.8
Maximum speed (mechanical)	$n_{max,mech}$	min-1	2500				

Designation	Symbol	Unit	MRT210A	MRT210C	MRT210D	MRT210E	MRT210U
			-_-0120				
1) Tolerance ± 5%							
Latest amendment: 2021-07-29							

3.8.3 Motor characteristic curves MST210

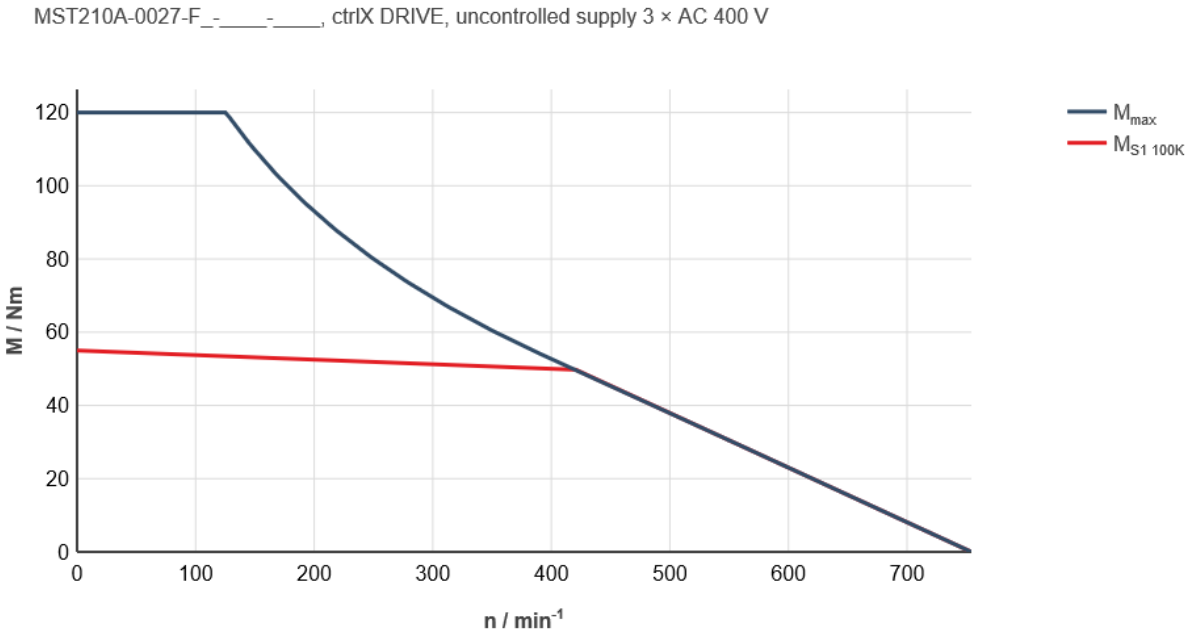


Fig. 33: Motor characteristic curve of MST210A-0027-F... at 540 V_{DC}

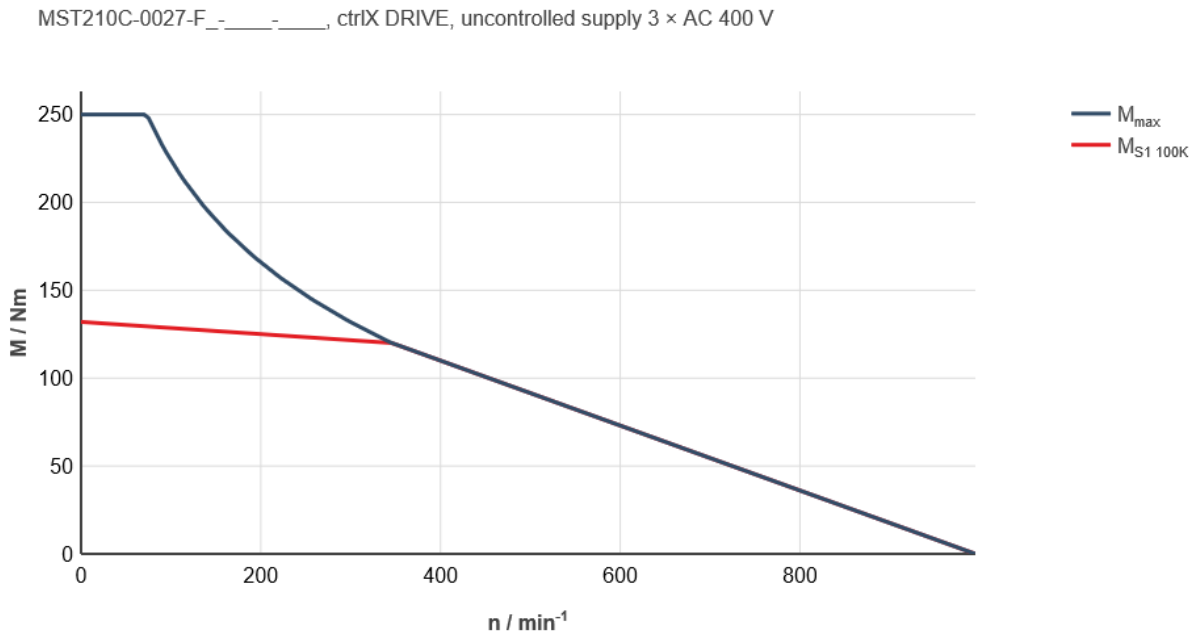


Fig. 34: Motor characteristic curve of MST210C-0027-F... at 540 V_{DC}

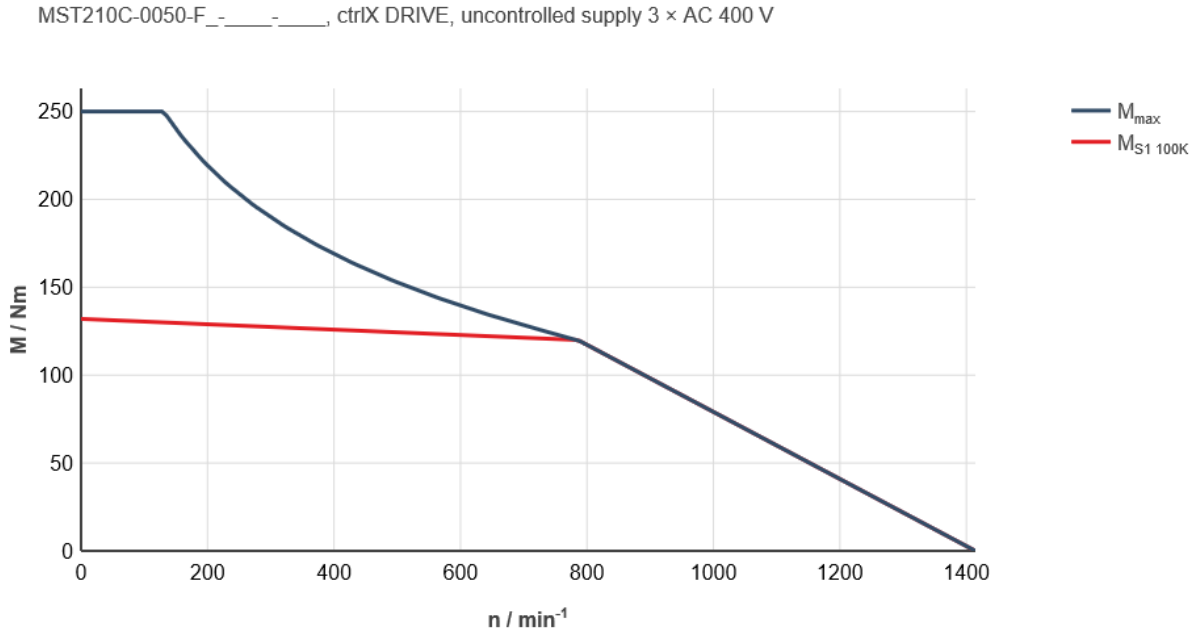


Fig. 35: Motor characteristic curve of MST210C-0050-F... at 540 V_{DC}

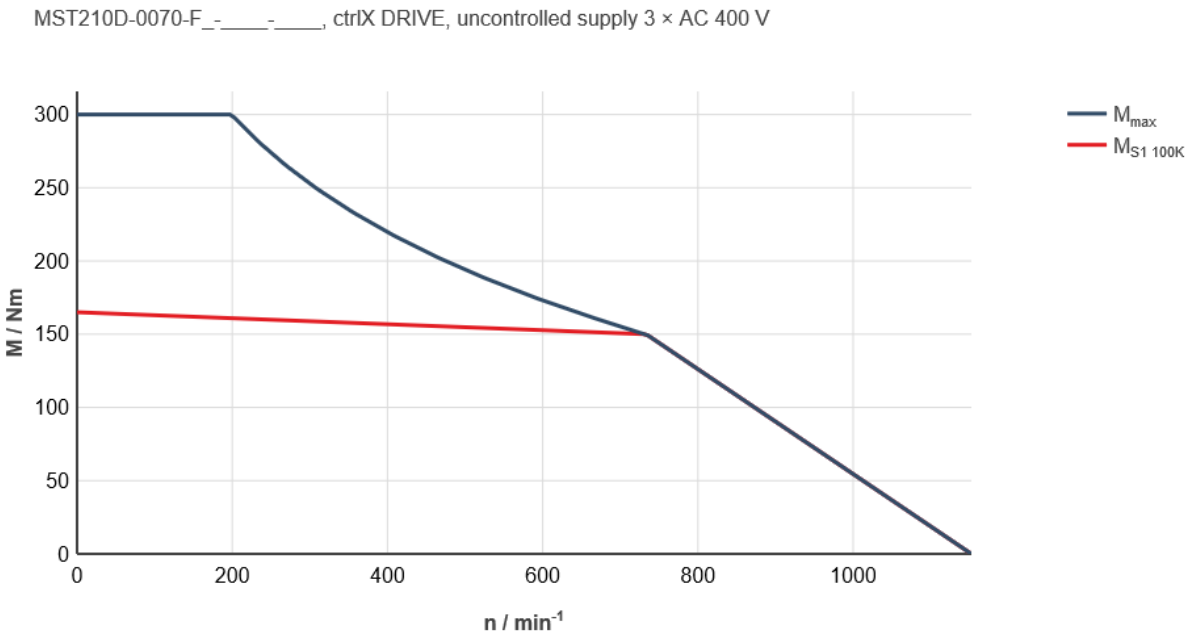


Fig. 36: Motor characteristic curve of MST210D-0070-F... at 540 V_{DC}

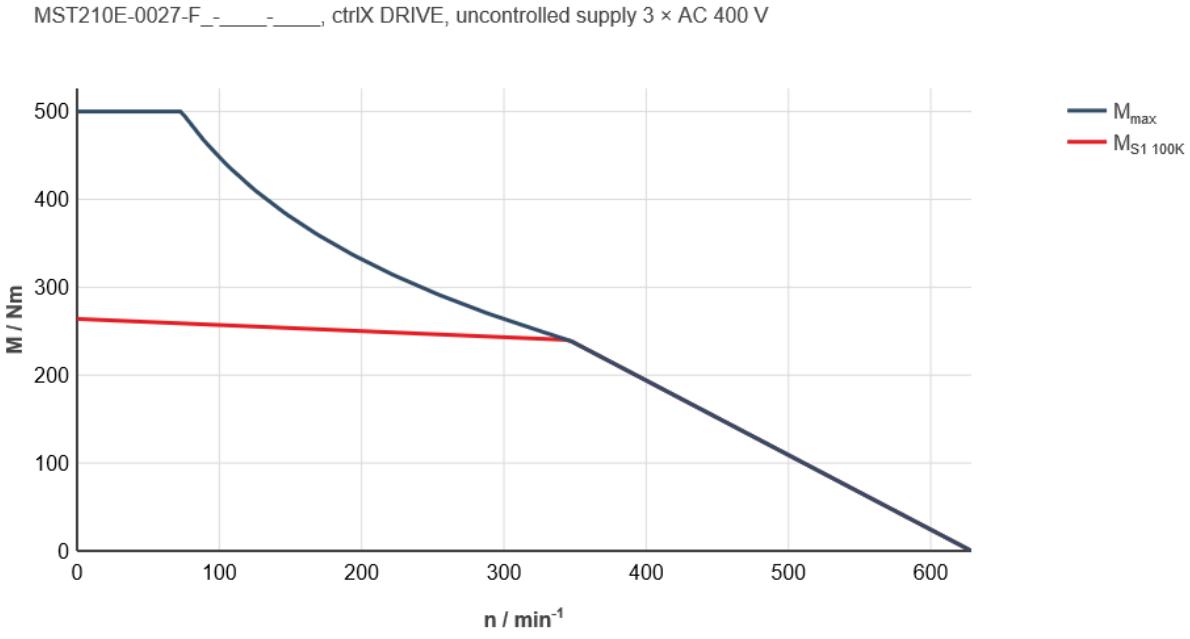


Fig. 37: Motor characteristic curve of MST210E-0027-F... at 540 V_{DC}

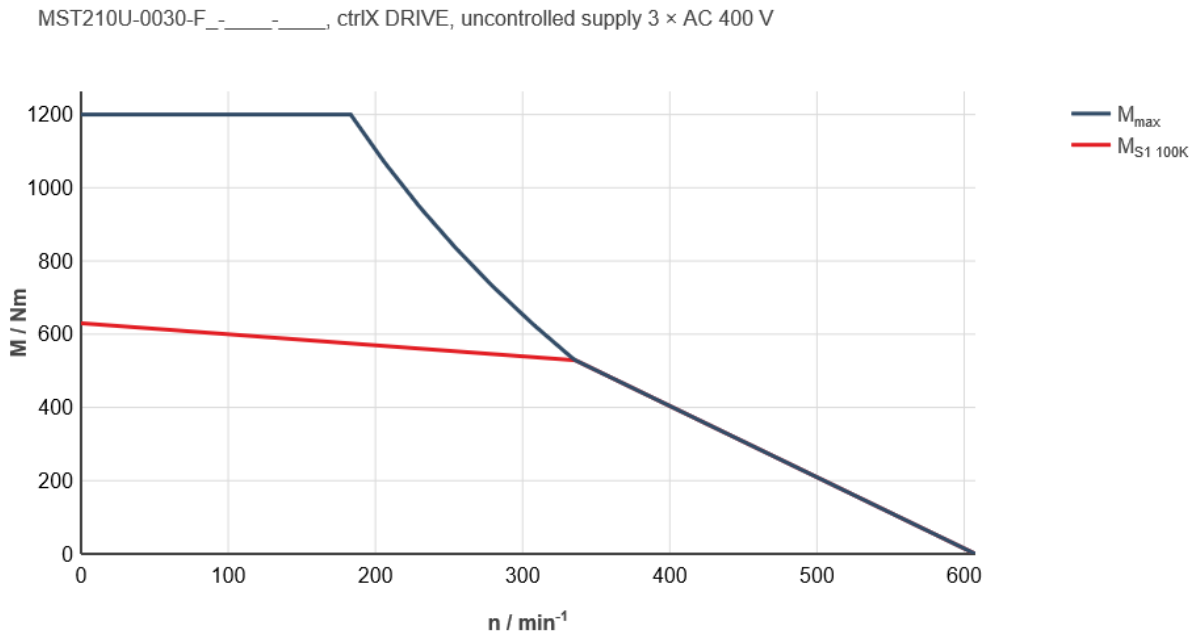


Fig. 38: Motor characteristic curve of MST210U-0030-F... at 540 V_{DC}

3.9 Frame size 251

3.9.1 Data sheet MST251

Table 23: MST251 - Technical data

Designation	Symbol	Unit	MST251F-0040-F
Standstill torque [1]	M_0	Nm	635
Continuous current at standstill	I_0	A	66.9
Rated torque [2]	M_N	Nm	546
Rated power[3]	P_N	kW	22.9
Rated current	I_N	A	59
Rated speed [4]	n_N	min-1	400
Maximum torque [5]	M_{max}	Nm	1,250
Maximum current	I_{max}	A	177
Maximum speed (electrical) [6]	n_{max}	min-1	700
Power wire cross-section	A	mm^2	16.0
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	9.26
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	0.67
Thermal time constant	T_{th_nenn}	min	4
Winding resistance at 20 °C	R_{12}	Ohm	0.63
Winding inductance	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	6.6215
Required coolant flow for P_V	Q_{min}	l/min	9.5

Designation	Symbol	Unit	MST251F-0040-F
Pressure drop at Q_{min}	Δp	bar	1.03
Volume of coolant duct	V_{kuehl}	l	0.484
1...8) Tolerance ± 5%			
Latest amendment: 2024-03-18			

3.9.2 Data sheet MRT251

Table 24: MRT251 - Technical data

Designation	Symbol	Unit	MRT251F-_-0145
Moment of inertia of rotor 1)	J_{Rot}	kg * m²	0.087
Rotor mass	m_{rot}	kg	12.8
Maximum speed (mechanical)	$n_{max,mech}$	min-1	1,500
1) Tolerance ± 5%			
Latest amendment: 2021-07-29			

3.9.3 Motor characteristic curve MST251

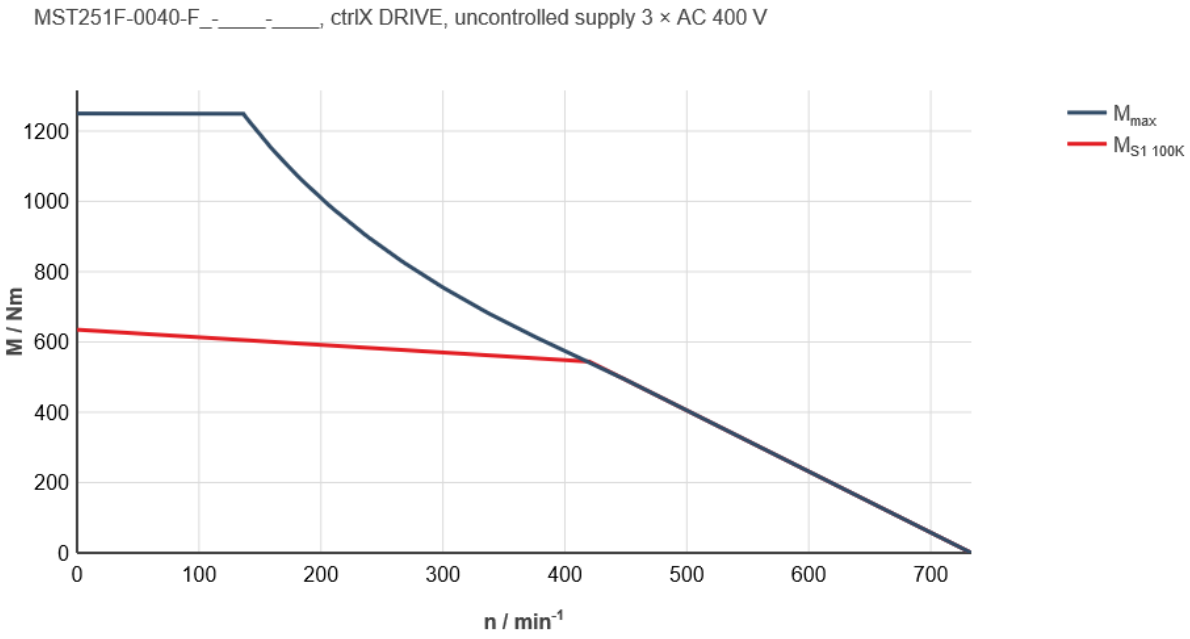


Fig. 39: Motor characteristic curve of MST251F-0040-F... at 540 V_{DC}

3.10 Frame size 290

3.10.1 Data sheet MST290

Table 25: MST290B/ -D - Technical data

Designation	Symbol	Unit	MST290B	MST290D		
			-0018-F	-0002-F	-0004-F	-0018-F
Standstill torque 1)	M_0	Nm	245	365	365	365
Continuous current at standstill	I_0	A	16.5	6.6	11.6	27.1
Rated torque 2)	M_N	Nm	220	350	350	350
Rated power3)	P_N	kW	4.1	0.9	1.65	6.6

Designation	Symbol	Unit	MST290B	MST290D		
			-0018-F	-0002-F	-0004-F	-0018-F
Rated current	I_N	A	14.8	6.3	10.4	26
Rated speed 4)	n_N	min-1	180	25	45	180
Maximum torque 5)	M_{max}	Nm	460	700	700	700
Maximum current	I_{max}	A	60	25	30	100
Maximum speed (electrical) 6)	n_{max}	min-1	340	120	150	400
Power wire cross-section	A	mm^2	1.5	1.0	1.0	4.0
Torque constant at 20 °C 7)	K_{M_N}	Nm/A	14.9	55.5	33.7	13.5
Voltage constant at 20 °C 8)	K_{EMK_1}	V/min-1	1.640	4.670	2.190	0.962
Thermal time constant	T_{th_nenn}	min	3.3	3.3	3.3	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	8.41	15.60	12.62	14.74
Number of pole pairs	p	-	30			
Details about liquid cooling						
Power dissipation	P_V	kW	3	4.2	4.2	4.2
Required coolant flow for P_V	Q_{min}	l/min	5	7	7	7
Pressure drop at Q_{min}	Δp	bar	0.1	0.1	0.1	0.1
Volume of coolant duct	V_{kuehl}	l	0.2	0.31	0.31	0.31
1...8) Tolerance ± 5%						
Latest amendment: 2024-03-18						

Table 26: MST290E/ -F/ -G - Technical data

Designation	Symbol	Unit	MST290E		MST290F	MST290G
			-0004-F	-0018-F	-0020-F	-0020-F
Standstill torque 1)	M_0	Nm	610	610	755	855
Continuous current at standstill	I_0	A	13.3	42.1	41.1	46.1
Rated torque 2)	M_N	Nm	575	563	715	810
Rated power3)	P_N	kW	2.4	14.15	19.8	22.1
Rated current	I_N	A	12.5	34.3	39.9	43.7
Rated speed 4)	n_N	min-1	40	240	265	260
Maximum torque 5)	M_{max}	Nm	1,150	1,150	1450	1600
Maximum current	I_{max}	A	50	125	120	118
Maximum speed (electrical) 6)	n_{max}	min-1	145	415	425	425
Power wire cross-section	A	mm^2	1.0	6.0	10	10
Torque constant at 20 °C 7)	K_{M_N}	Nm/A	46.0	16.4	17.92	18.54
Voltage constant at 20 °C 8)	K_{EMK_1}	V/min-1	3.620	1.037	1.204	1.196
Thermal time constant	T_{th_nenn}	min	3.3	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	21.03	20.00	24.90	28.30
Number of pole pairs	p	-	30			
Details about liquid cooling						
Power dissipation	P_V	kW	5.5	5.5	6.6	7.7
Required coolant flow for P_V	Q_{min}	l/min	9	9	9.6	10.0

Designation	Symbol	Unit	MST290E		MST290F	MST290G
			-0004-F	-0018-F	-0020-F	-0020-F
Pressure drop at Q_{min}	Δp	bar	0.1	0.1	0.1	0.1
Volume of coolant duct	V_{kuehl}	l	0.55	0.55	0.68	0.82
1...8) Tolerance ± 5%						
Latest amendment: 2024-03-18						

3.10.2 Data sheet MRT290

Table 27: MRT290 - Technical data

Designation	Symbol	Unit	MRT290B	MRT290D	MRT290E	MRT290F	MRT290G
			-_-0200				
Moment of inertia of rotor 1)	J_{Rot}	kg * m²	0.077	0.109	0.174	0.206	0.239
Rotor mass	m_{rot}	kg	6.3	8.8	14.0	16.6	19.2
Maximum speed (mechanical)	$n_{max,mech}$	min-1	2,000				
1) Tolerance ± 5%							
Latest amendment: 2021-07-29							

3.10.3 Motor characteristic curves MST290

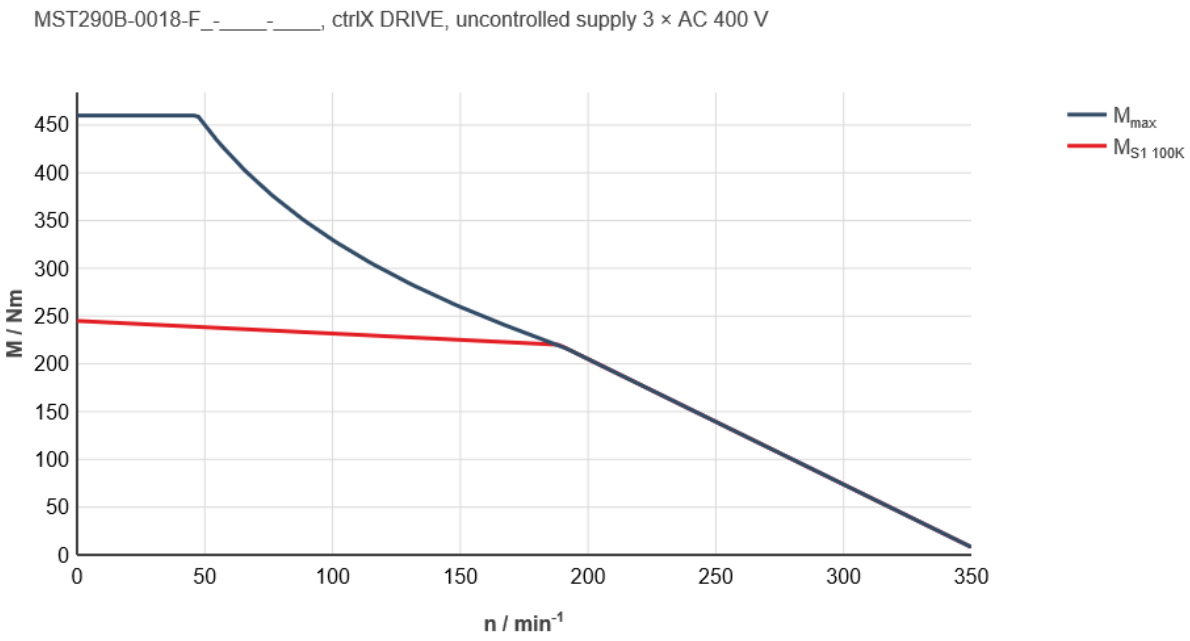


Fig. 40: Motor characteristic curve of MST290B-0018-F... at 540 V_{DC}

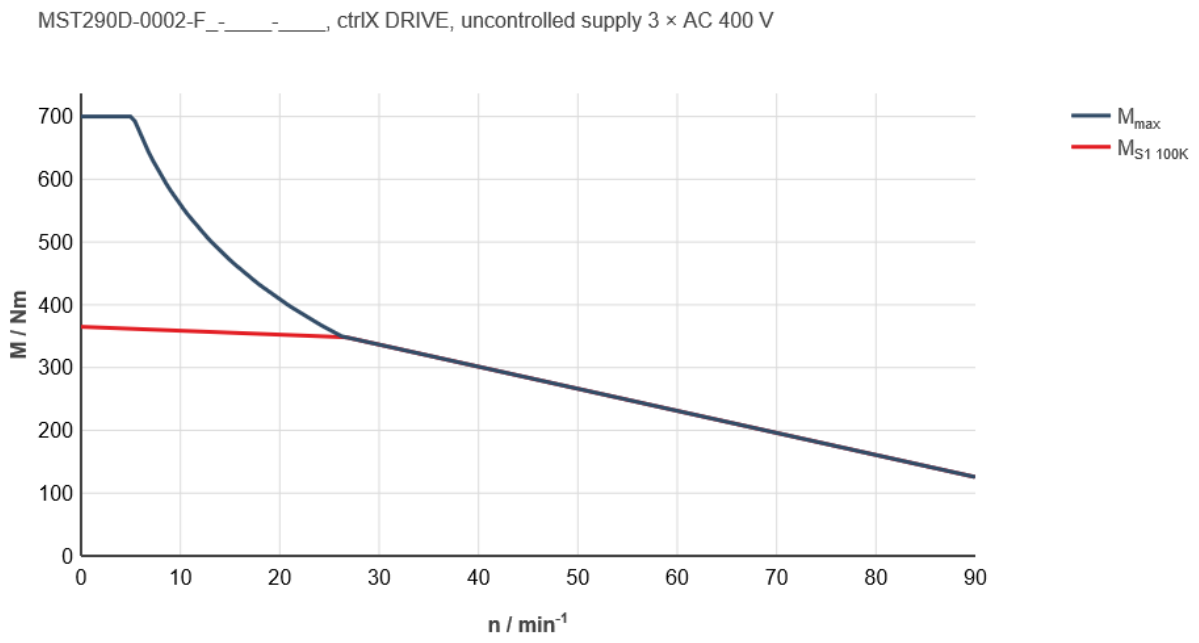


Fig. 41: Motor characteristic curve of MST290D-0002-F... at 540 V_{DC}

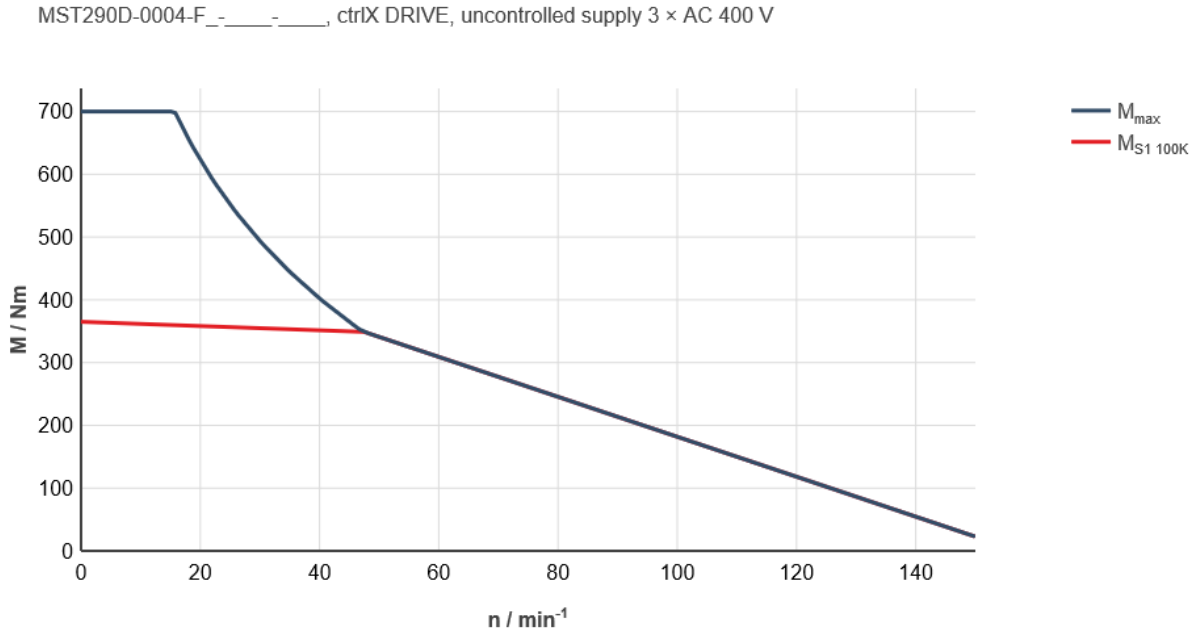


Fig. 42: Motor characteristic curves MST290D-0004-F... at 540 V_{DC}

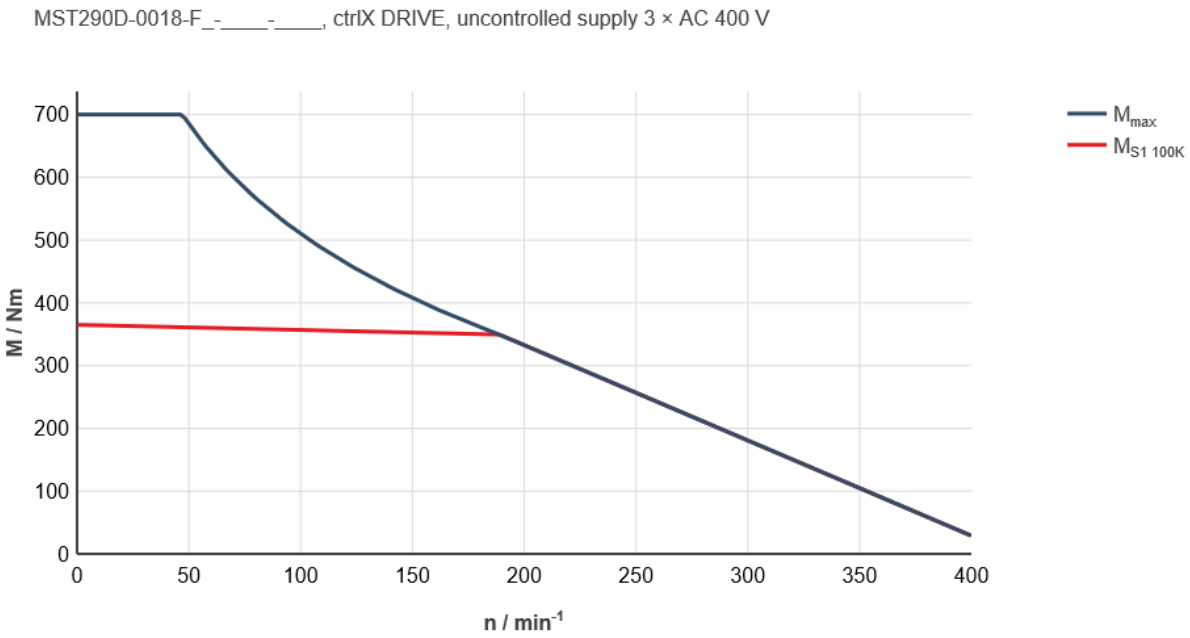


Fig. 43: Motor characteristic curve of MST290D-0018-F... at 540 V_{DC}

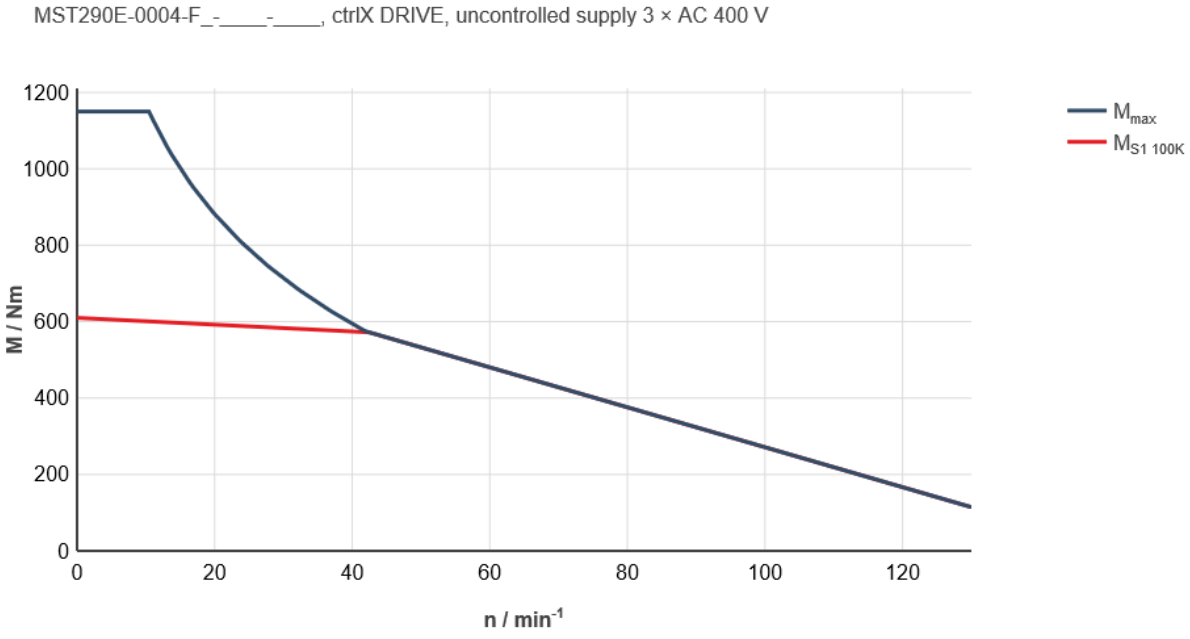


Fig. 44: Motor characteristic curve of MST290E-0004-F... at 540 V_{DC}

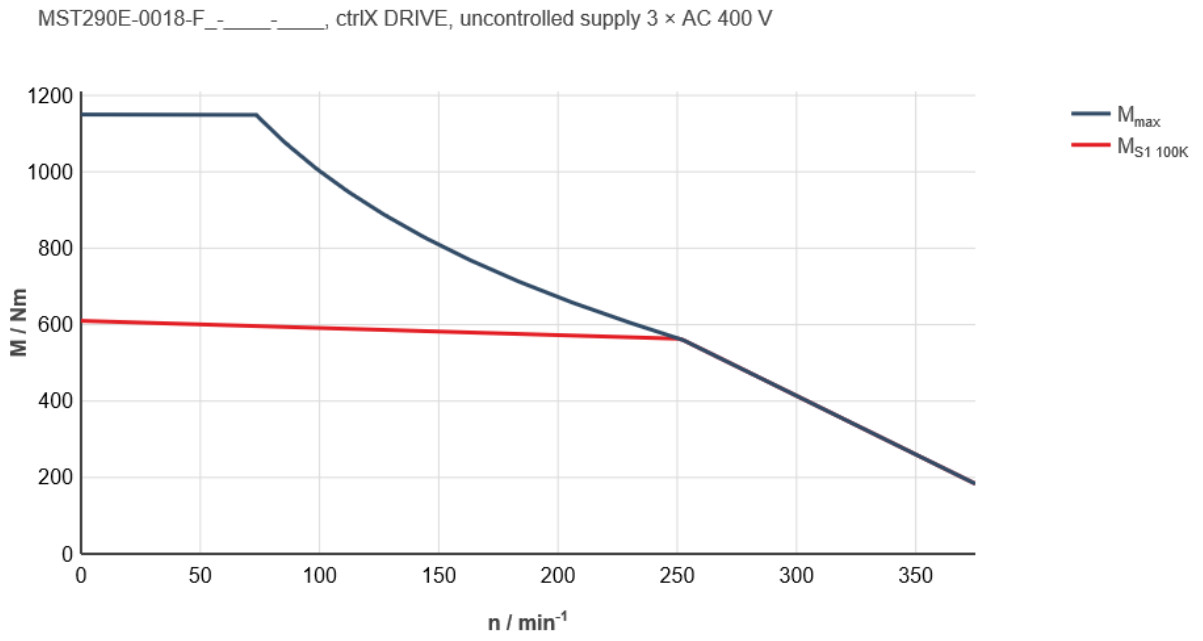


Fig. 45: Motor characteristic curve of MST290E-0018-F... at 540 V_{DC}

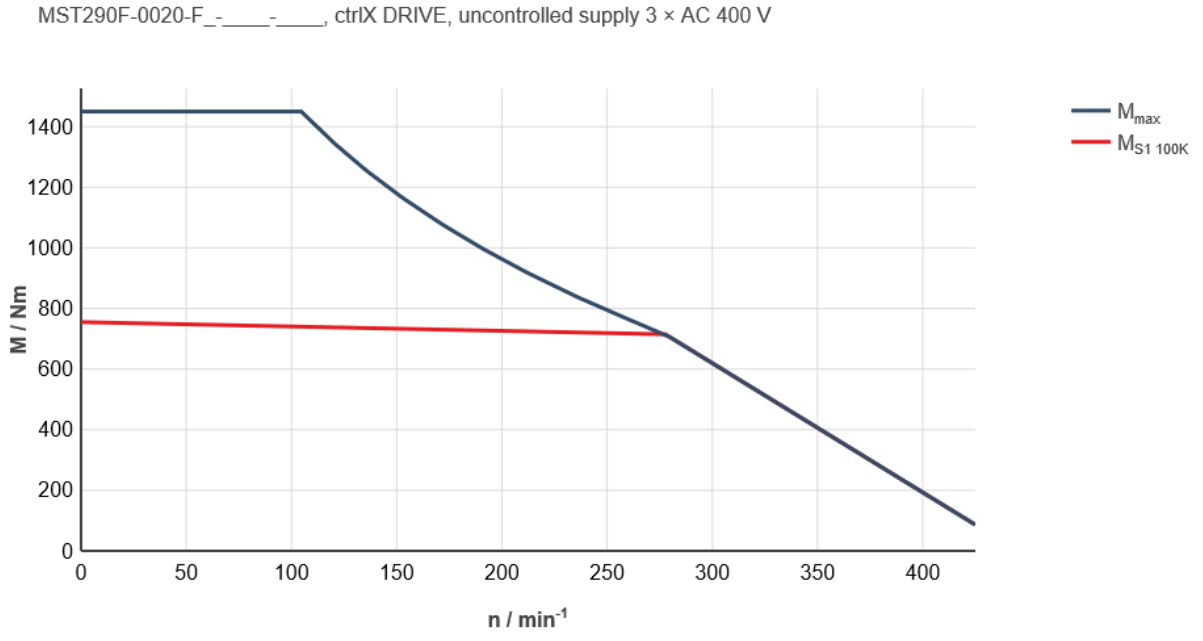


Fig. 46: Motor characteristic curve of MST290F-0020-F... at 540 V_{DC}

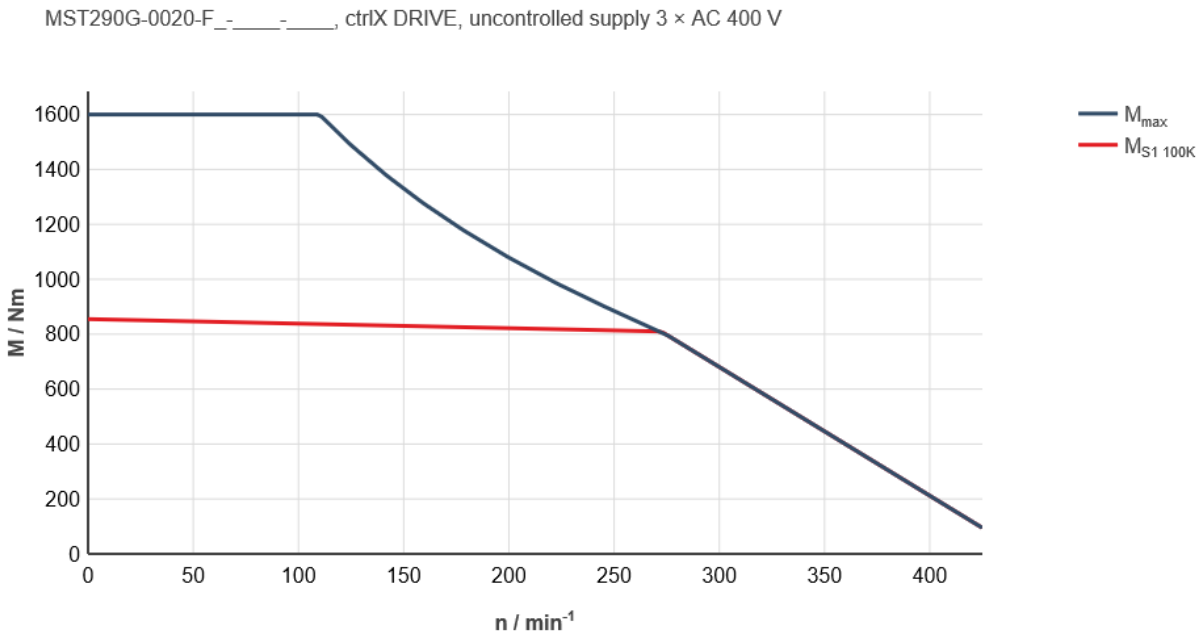


Fig. 47: Motor characteristic curve of MST290G-0020-F... at 540 V_{DC}

3.11 Frame size 291

3.11.1 Data sheet MST291

Table 28: MST291 - Technical data

Designation	Symbol	Unit	MST291C	MST291D	MST291E
			-0018-F	-0010-F	-0010-F
Standstill torque 1)	M_0	Nm	295	480	620
Continuous current at standstill	I_0	A	18.0	19.2	21.8
Rated torque 2)	M_N	Nm	280	440	570
Rated power3)	P_N	kW	6.7	6.5	8.4
Rated current	I_N	A	16.9	16.0	20
Rated speed 4)	n_N	min-1	230	140	140
Maximum torque 5)	M_{max}	Nm	620	1,000	1,250
Maximum current	I_{max}	A	42.2	44	50
Maximum speed (electrical) 6)	n_{max}	min-1	400	250	245
Power wire cross-section	A	mm^2	2.5	2.5	2.5
Torque constant at 20 °C 7)	K_{M_N}	Nm/A	16.568	27.5	28.75
Voltage constant at 20 °C 8)	K_{EMK_1}	V/min-1	1.1	1.632	1.92
Thermal time constant	T_{th_nenn}	min	5	5	5
Winding resistance at 20 °C	R_{12}	Ohm	3.9	5.6	4.4
Winding inductance	L_{12}	mH	34.3	51.0	56.0
Leakage capacitance of the component	C_{ab}	nF	8.25	12.4	16.5
Number of pole pairs	p	-	15		
Details about liquid cooling					
Power dissipation	P_V	kW	2.4	3.6	4.8

Designation	Symbol	Unit	MST291C	MST291D	MST291E
			-0018-F	-0010-F	-0010-F
Required coolant flow for P_V	Q_{min}	l/min	3.5	5.0	6.9
Pressure drop at Q_{min}	Δp	bar	0.39	0.585	0.78
Volume of coolant duct	V_{kuehl}	l	0.132	0.232	0.318
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

3.11.2 Data sheet MRT291

Table 29: MRT291 - Technical data

Designation	Symbol	Unit	MRT291C	MRT291D	MRT291E
				-__-0200	
Moment of inertia of rotor 1)	J_{Rot}	kg * m²	0.091	0.131	0.171
Rotor mass	m_{rot}	kg	7.4	10.6	13.8
Maximum speed (mechanical)	$n_{max,mech}$	min-1	400		
1) Tolerance ± 5%					
Latest amendment: 2021-07-29					

3.11.3 Motor characteristic curves MST291

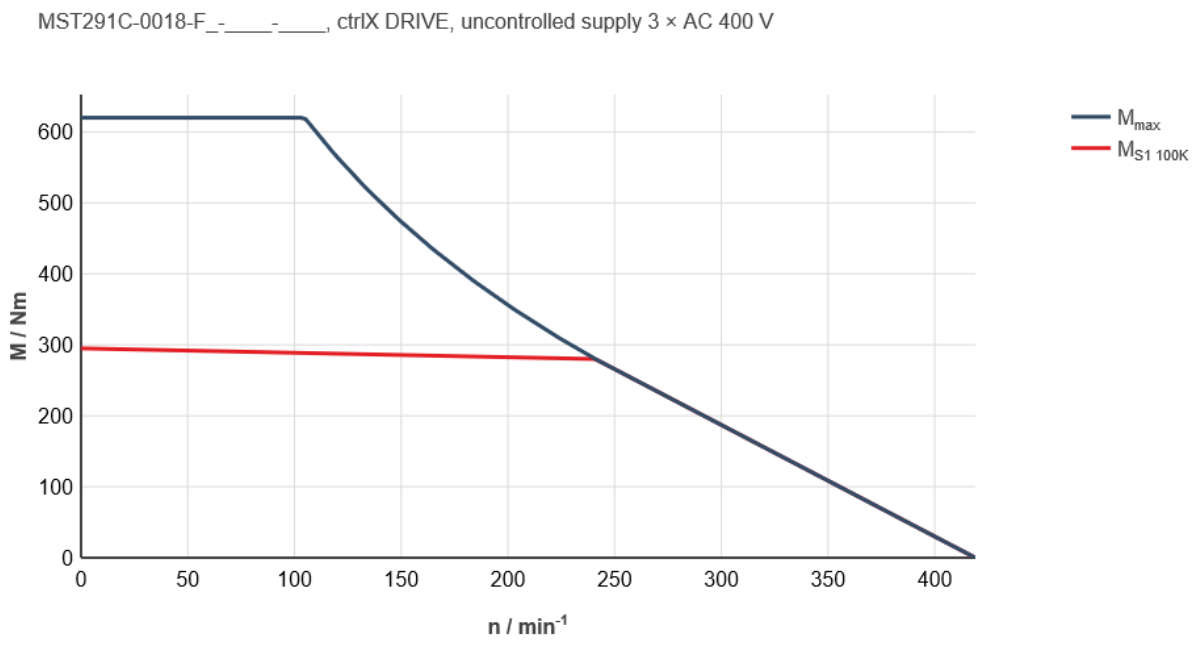


Fig. 48: Motor characteristic curve of MST291C-0018-F... at 540 V_{DC}

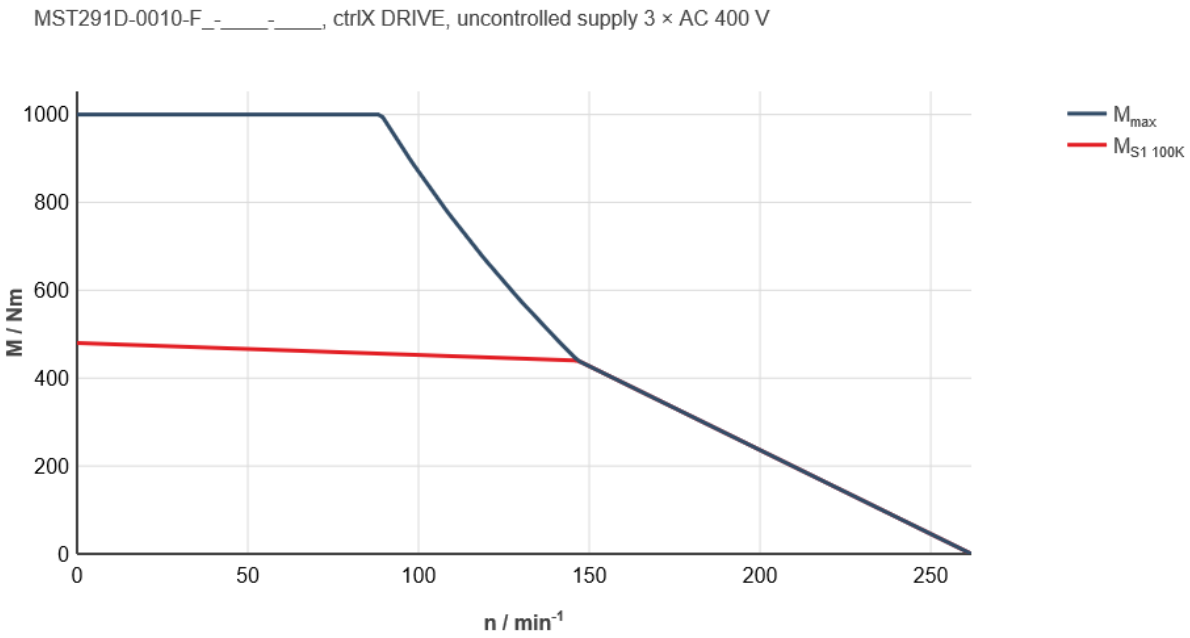


Fig. 49: Motor characteristic curve of MST291D-0010-F... at 540 V_{DC}

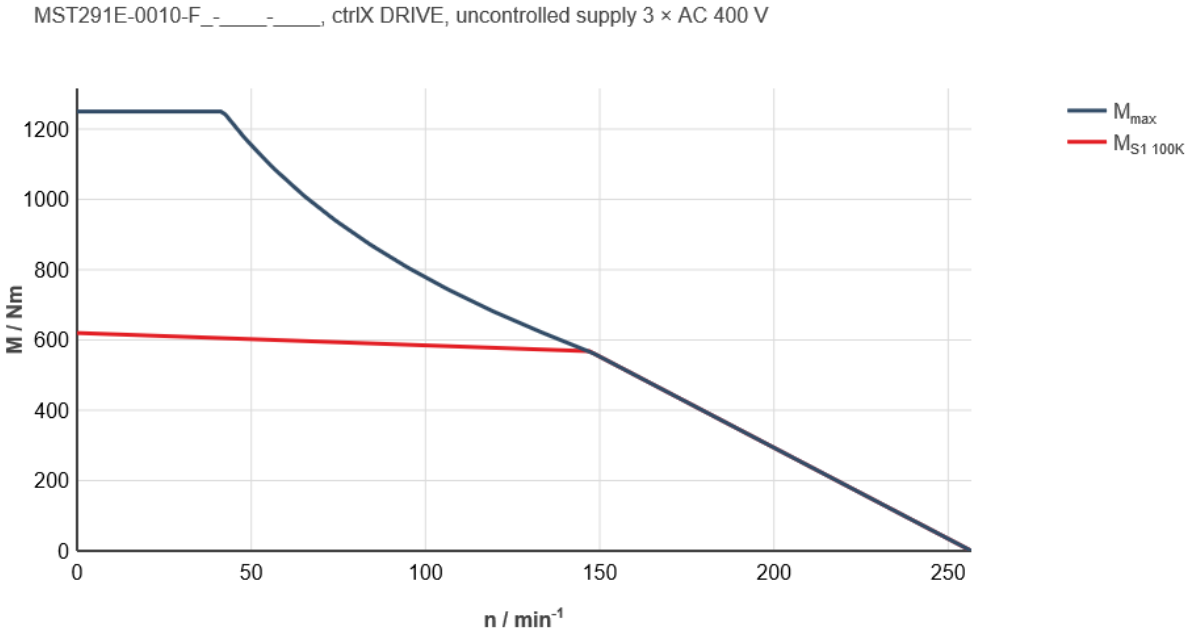


Fig. 50: Motor characteristic curve of MST291E-0010-F... at 540 V_{DC}

3.12 Frame size 360

3.12.1 Data sheet MST360

Table 30: MST360B - Technical data

Designation	Symbol	Unit	MST360B	
			-0006-F	-0018-F
Standstill torque [1]	M_0	Nm	440	440
Continuous current at standstill	I_0	A	9.3	22.6
Rated torque [2]	M_N	Nm	375	375
Rated power[3]	P_N	kW	2.9	7.1
Rated current	I_N	A	8.8	20
Rated speed [4]	n_N	min-1	75	180
Maximum torque [5]	M_{max}	Nm	800	900
Maximum current	I_{max}	A	21.5	70
Maximum speed (electrical) [6]	n_{max}	min-1	150	330
Power wire cross-section	A	mm^2	1.0	2.5
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	47.31	18.8
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	3.148	1.220
Thermal time constant	T_{th_nenn}	min	5	5
Winding resistance at 20 °C	R_{12}	Ohm	14.8	2.43
Winding inductance	L_{12}	mH	105.9	19.2
Leakage capacitance of the component	C_{ab}	nF	9.00	9.00
Number of pole pairs	p	-	25	
Details about liquid cooling				
Power dissipation	P_V	kW	2.7	
Required coolant flow for P_V	Q_{min}	l/min	4.0	
Pressure drop at Q_{min}	Δp	bar	0.1	
Volume of coolant duct	V_{kuehl}	l	0.27	
1...8) Tolerance ± 5%				
Latest amendment: 2024-03-18				

Table 31: MST360D - Technical data

Designation	Symbol	Unit	MST360D		
			-0009-F	-0012-F	-0018-F
Standstill torque [1]	M_0	Nm	640	640	640
Continuous current at standstill	I_0	A	15.5	19.2	34.6
Rated torque [2]	M_N	Nm	525	525	525
Rated power[3]	P_N	kW	4.7	6.3	12.9
Rated current	I_N	A	12.7	15.7	28.3
Rated speed [4]	n_N	min-1	85	115	235
Maximum torque [5]	M_{max}	Nm	1,150	1,150	1,150
Maximum current	I_{max}	A	32.6	39.8	72.0
Maximum speed (electrical) [6]	n_{max}	min-1	155	190	350
Power wire cross-section	A	mm^2	1.0	2.5	4.0
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	41.29	33.33	18.50
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	2.515	2.0435	1.3

Designation	Symbol	Unit	MST360D		
			-0009-F	-0012-F	-0018-F
Thermal time constant	T_{th_nenn}	min	5	5	5
Winding resistance at 20 °C	R_{12}	Ohm	8.16	5.4	1.6
Winding inductance	L_{12}	mH	71.5	46.2	14.4
Leakage capacitance of the component	C_{ab}	nF	13.49	13.49	13.49
Number of pole pairs	p	-	25		
Details about liquid cooling					
Power dissipation	P_V	kW	3.6		
Required coolant flow for P_V	Q_{min}	l/min	6		
Pressure drop at Q_{min}	Δp	bar	0.1		
Volume of coolant duct	V_{kuehl}	l	0.39		
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-18					

Table 32: MST360E - Technical data

Designation	Symbol	Unit	MST360E	
			-0008-F	-0018-F
Standstill torque [1)]	M_0	Nm	1050	1050
Continuous current at standstill	I_0	A	25.2	50.4
Rated torque [2)]	M_N	Nm	875	875
Rated power[3)]	P_N	kW	7.3	16.5
Rated current	I_N	A	21	42
Rated speed [4)]	n_N	min-1	80	180
Maximum torque [5)]	M_{max}	Nm	2,000	1900
Maximum current	I_{max}	A	53	141
Maximum speed (electrical) [6)]	n_{max}	min-1	140	300
Power wire cross-section	A	mm^2	2.5	10.0
Torque constant at 20 °C [7)]	K_{M_N}	Nm/A	41.67	20.8
Voltage constant at 20 °C [8)]	K_{EMK_1}	V/min-1	2.56	1.890
Thermal time constant	T_{th_nenn}	min	5	5
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	20.00	20.00
Number of pole pairs	p	-	25	
Details about liquid cooling				
Power dissipation	P_V	kW	4.0	
Required coolant flow for P_V	Q_{min}	l/min	6	
Pressure drop at Q_{min}	Δp	bar	0.1	
Volume of coolant duct	V_{kuehl}	l	0.69	
1...8) Tolerance ± 5%				
Latest amendment: 2024-03-18				

3.12.2 Data sheet MRT360

Table 33: MRT360 - Technical data

Designation	Symbol	Unit	MRT360B	MRT360D	MRT360E
			-__-0260		
Moment of inertia of rotor 1)	J_{Rot}	kg * m²	0.194	0.275	0.436
Rotor mass	m_{rot}	kg	9.7	13.6	21.5
Maximum speed (mechanical)	$n_{max,mech}$	min-1	1,700	1,700	1,700
1) Tolerance ± 5%					
Latest amendment: 2021-07-29					

3.12.3 Motor characteristic curves MST360

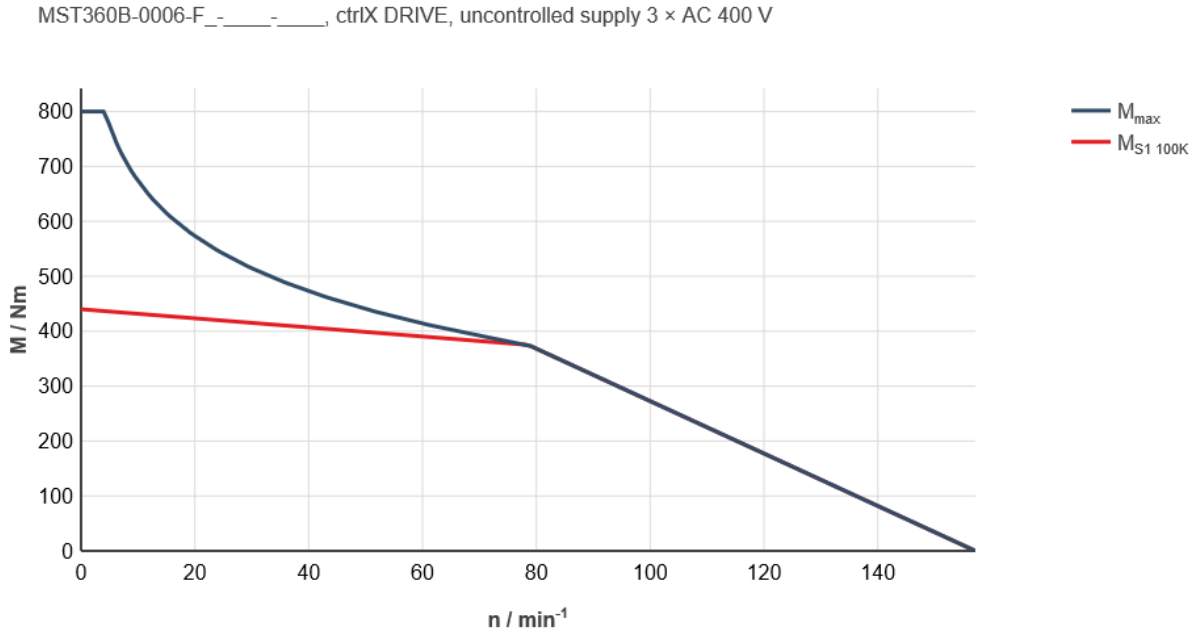


Fig. 51: Motor characteristic curve of MST360B-0006-F... at 540 V_{DC}

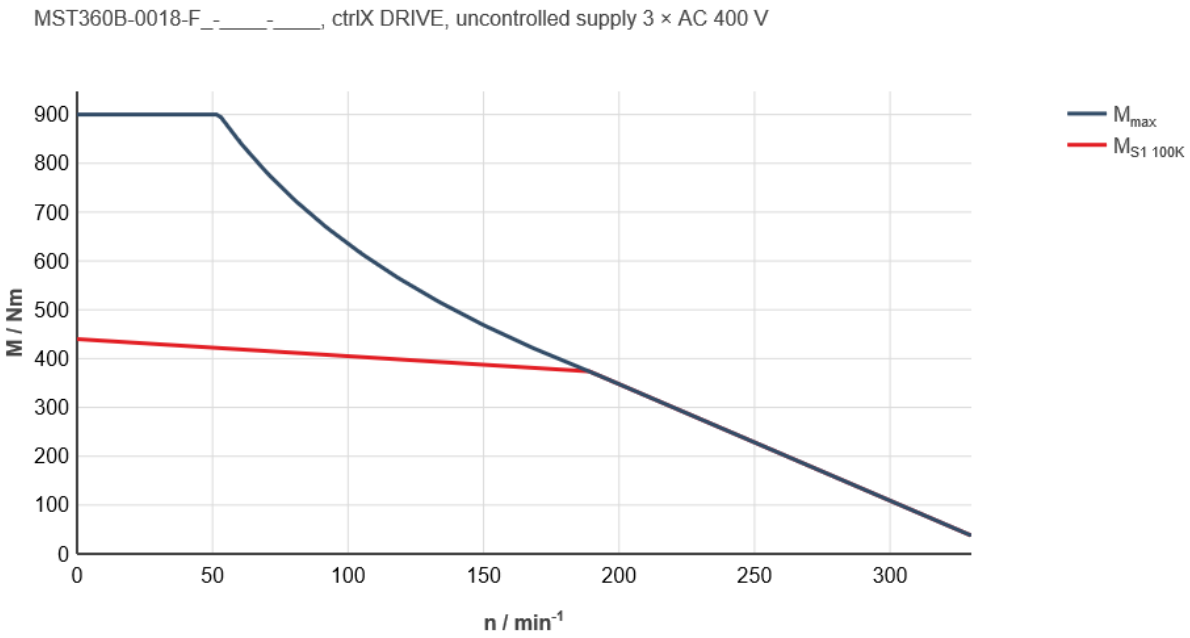


Fig. 52: Motor characteristic curve of MST360B-0018-F... at 540 V_{DC}

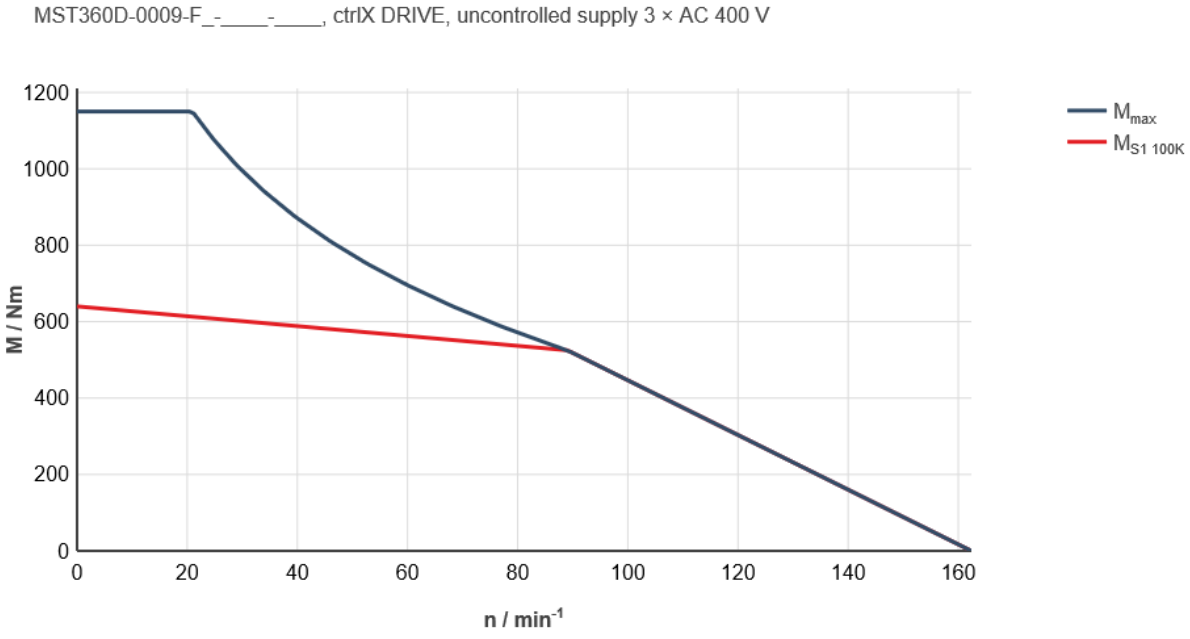


Fig. 53: Motor characteristic curve of MST360D-0009-F... at 540 V_{DC}

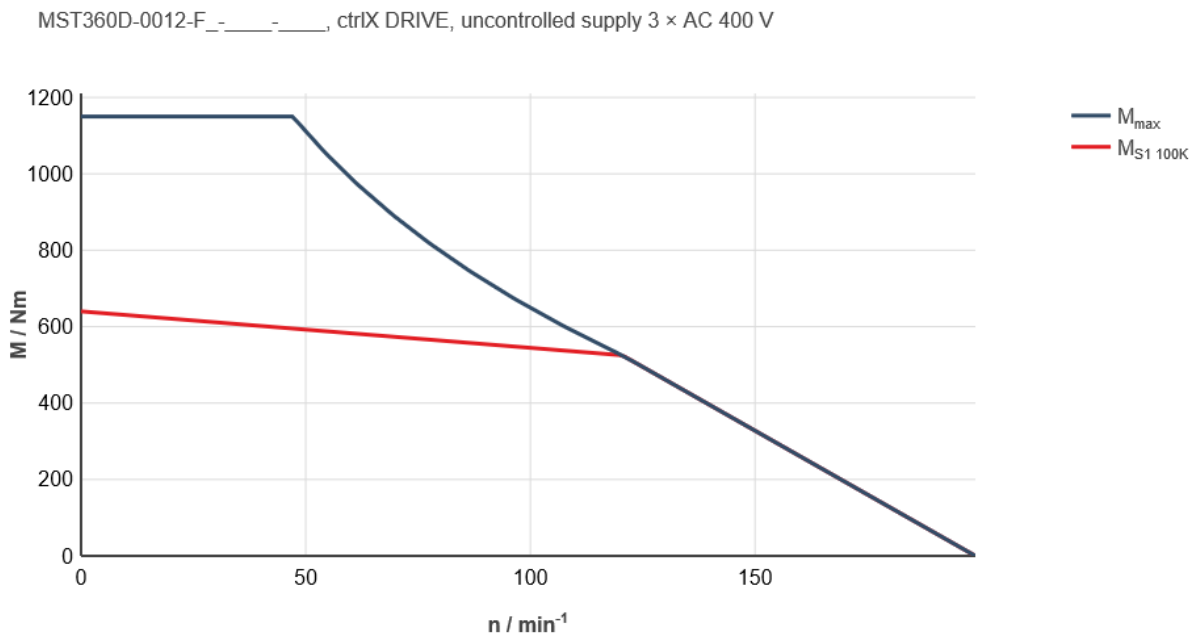


Fig. 54: Motor characteristic curve of MST360D-0012-F... at 540 V_{DC}

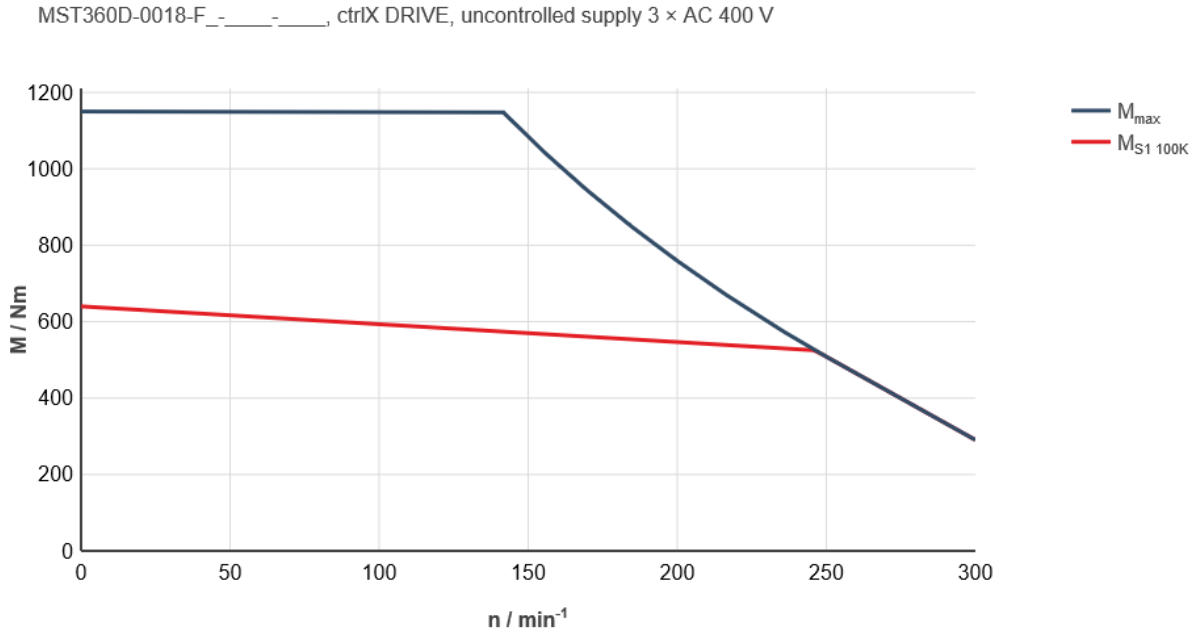


Fig. 55: Motor characteristic curve of MST360D-0018-F... at 540 V_{DC}

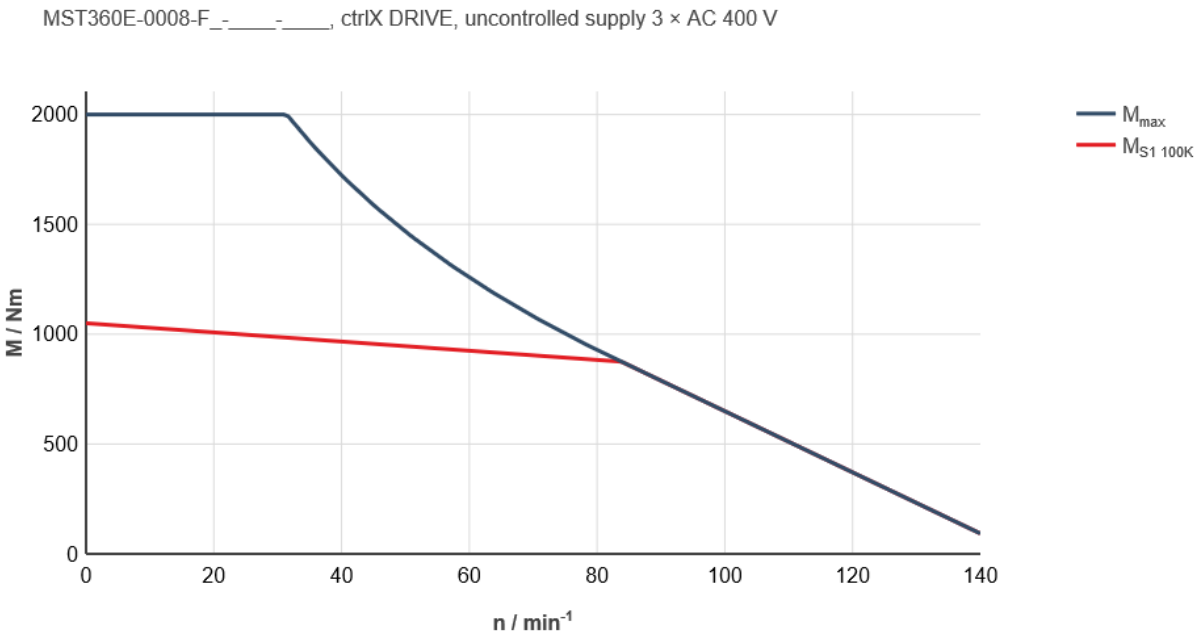


Fig. 56: Motor characteristic curve of MST360E-0008-F... at 540 V_{DC}

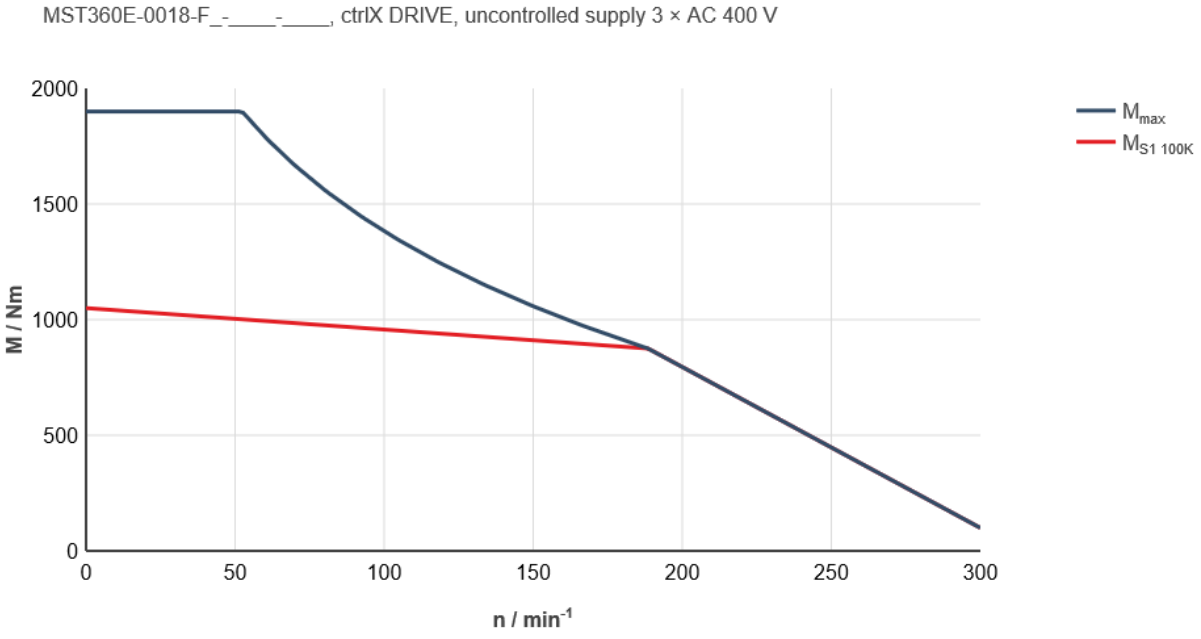


Fig. 57: Motor characteristic curve of MST360E-0018-F... at 540 V_{DC}

3.13 Frame size 450

3.13.1 Data sheet MST450

Table 34: MST450B/ -D - Technical data

Designation	Symbol	Unit	MST450B	MST450D	
			-0012-F	-0006-F	-0012-F
Standstill torque [1]	M_0	Nm	640	965	965
Continuous current at standstill	I_0	A	24.4	21.7	36.7
Rated torque [2]	M_N	Nm	540	810	810
Rated power[3]	P_N	kW	10.5	8.1	16.1
Rated current	I_N	A	20.4	18.1	31.0
Rated speed [4]	n_N	min-1	185	95	190
Maximum torque [5]	M_{max}	Nm	1350	2075	2075
Maximum current	I_{max}	A	65.0	60.0	100.0
Maximum speed (electrical) [6]	n_{max}	min-1	350	350	350
Power wire cross-section	A	mm²	2.5	2.5	6.0
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	26.23	44.47	26.29
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	1.455	2.500	1.455
Thermal time constant	T_{th_nenn}	min	6	6	6
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	14.5
Number of pole pairs	p	-	30		
Details about liquid cooling					
Power dissipation	P_V	kW	3.0	4.0	4.0
Required coolant flow for P_V	Q_{min}	l/min	4.3	5.7	5.7
Pressure drop at Q_{min}	Δp	bar	0.1	0.1	0.1
Volume of coolant duct	V_{kuehl}	l	0.33	0.48	0.48
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-19					

Table 35: MST450E - Technical data

Designation	Symbol	Unit	MST450E			
			-0006-F	-0011-N	-0012-F	-0018-N
Standstill torque [1]	M_0	Nm	1600	625	1600	625
Continuous current at standstill	I_0	A	33.1	14.3	48.6	19.8
Rated torque [2]	M_N	Nm	1400	560	1400	540
Rated power[3]	P_N	kW	12.7	6.5	21.2	10.2
Rated current	I_N	A	27.8	12.8	40.7	17.7
Rated speed [4]	n_N	min-1	90	110	150	180
Maximum torque [5]	M_{max}	Nm	3250	3250	3250	3250
Maximum current	I_{max}	A	85.0	88	125.0	125
Maximum speed (electrical) [6]	n_{max}	min-1	350	135	350	195
Power wire cross-section	A	mm²	6.0	1.0	10.0	2.5
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	48.34	43.8	35.92	30.4
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	2.759	3.860	1.818	1.930

Designation	Symbol	Unit	MST450E			
			-0006-F	-0011-N	-0012-F	-0018-N
Thermal time constant	T_{th_nenn}	min	6	170	6	170
Winding resistance at 20 °C	R_{12}	Ohm	2.6	2.6	1.16	1.16
Winding inductance	L_{12}	mH	21.9	22.1	10.0	10.0
Leakage capacitance of the component	C_{ab}	nF	21.3	24.10	21.3	24.10
Number of pole pairs	p	-	30			
Details about liquid cooling						
Power dissipation	P_V	kW	6.2	1.14	6.2	1.14
Required coolant flow for 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_{kuehl}	l	0.86	-	0.86	-
1...8) Tolerance ± 5%						
Latest amendment: 2024-03-19						

3.13.2 Data sheet MRT450

Table 36: MRT450 - Technical data

Designation	Symbol	Unit	MRT450B	MRT450D	MRT450E
			-__-0350		
Moment of inertia of rotor [1)]	J_{Rot}	kg * m²	0.45	0.64	1.01
Rotor mass	m_{rot}	kg	12.5	17.6	27.8
Maximum speed (mechanical)	$n_{max,mech}$	min-1	1400		
1) Tolerance ± 5%					
Latest amendment: 2021-07-29					

3.13.3 Motor characteristic curves MST450

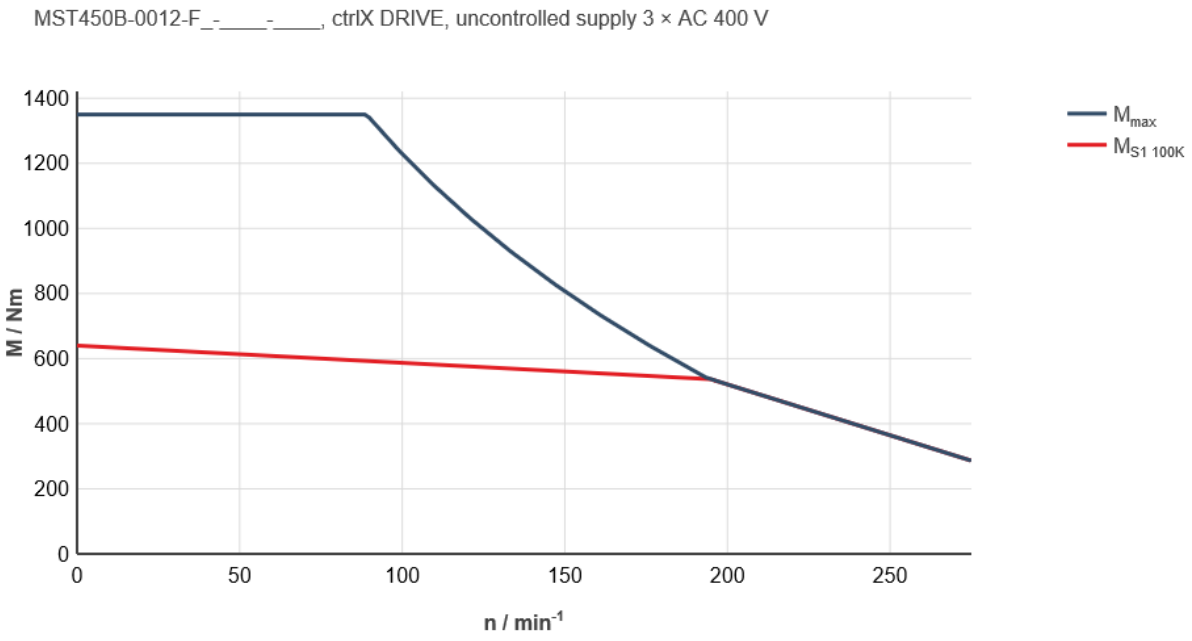


Fig. 58: Motor characteristic curve of MST450B-0012-F... at 540 V_{DC}

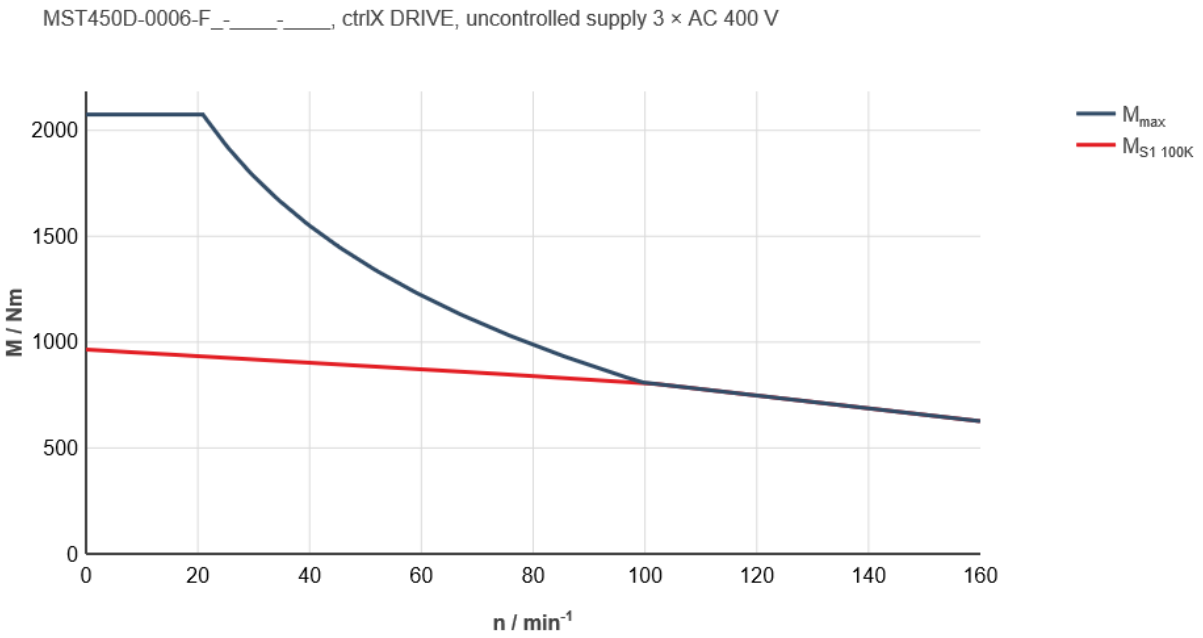


Fig. 59: Motor characteristic curve of MST450D-0006-F... at 540 V_{DC}

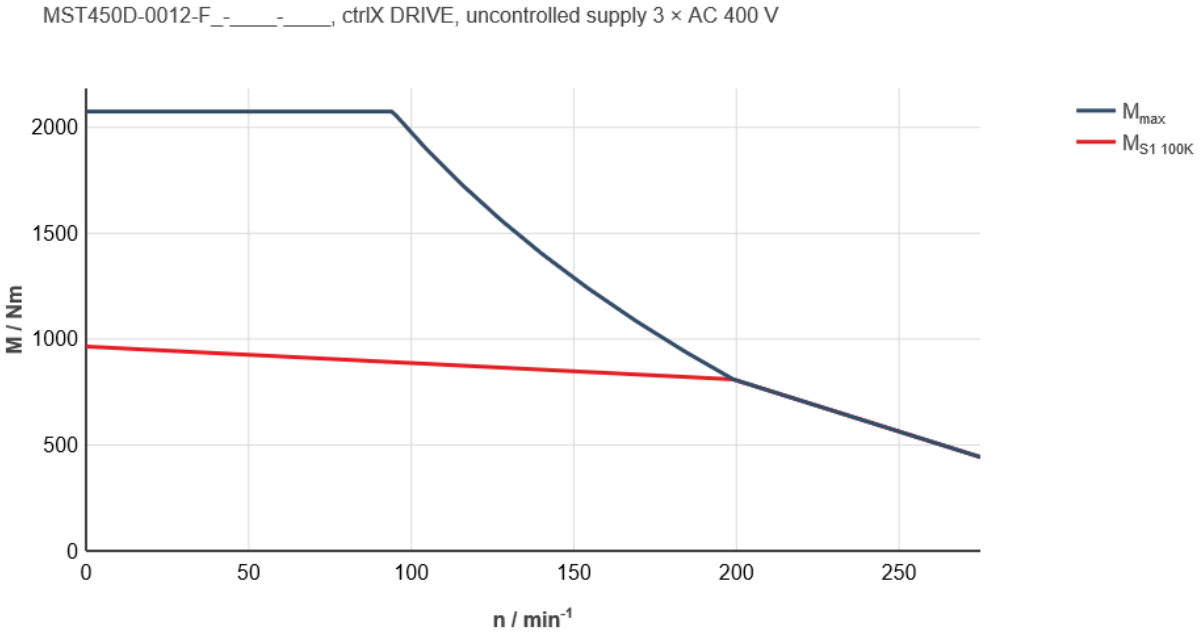


Fig. 60: Motor characteristic curve of MST450D-0012-F... at 540 V_{DC}

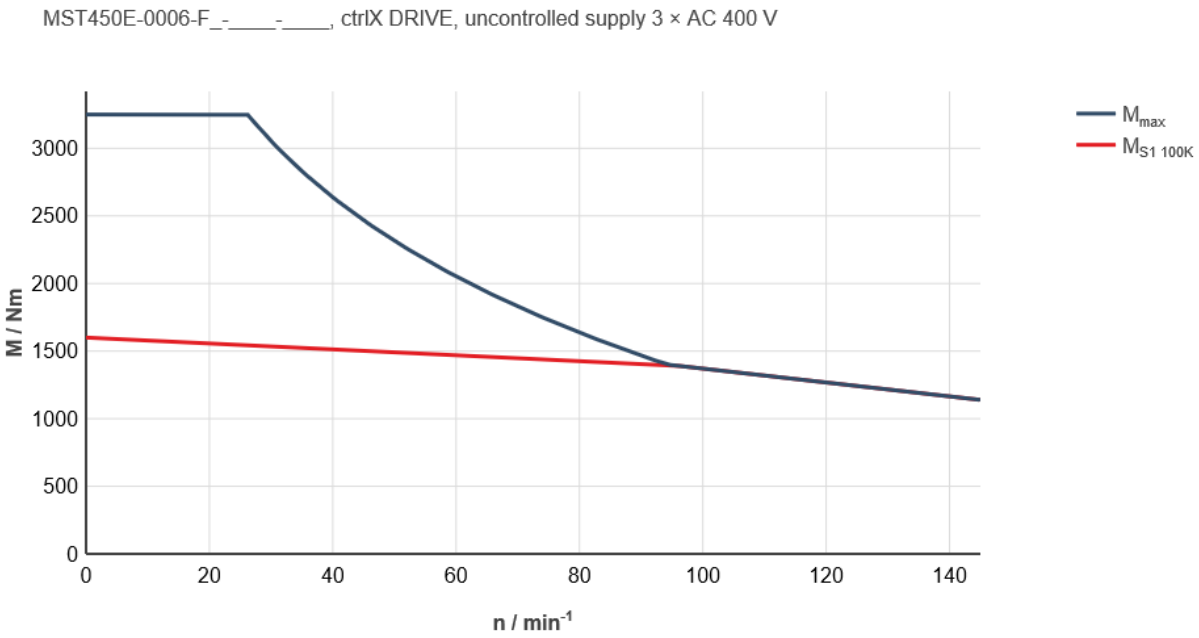


Fig. 61: Motor characteristic curve of MST450E-0006-F... at 540 V_{DC}

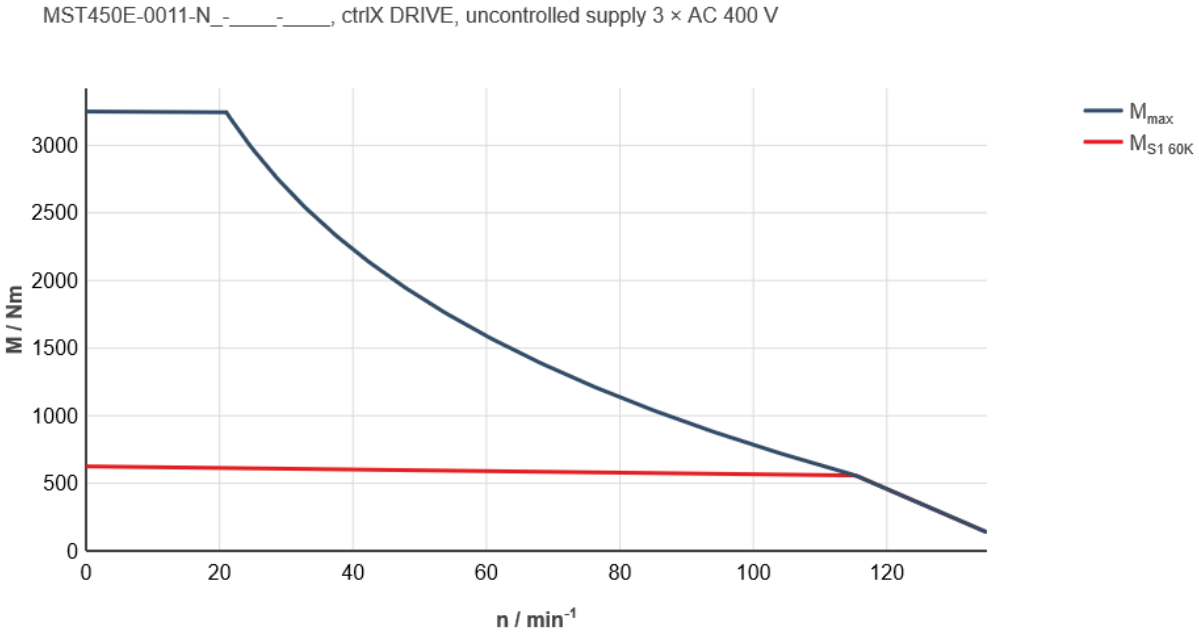


Fig. 62: Motor characteristic curve of MST450E-0011-N... at 540 V_{DC}

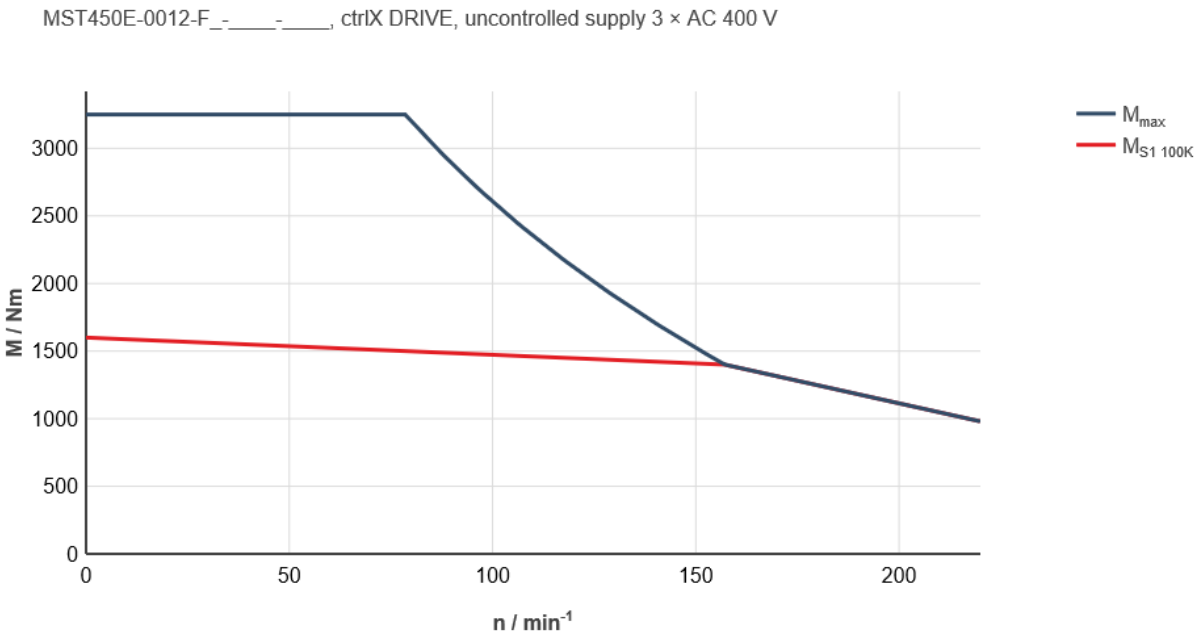


Fig. 63: Motor characteristic curve of MST450E-0012-F... at 540 V_{DC}

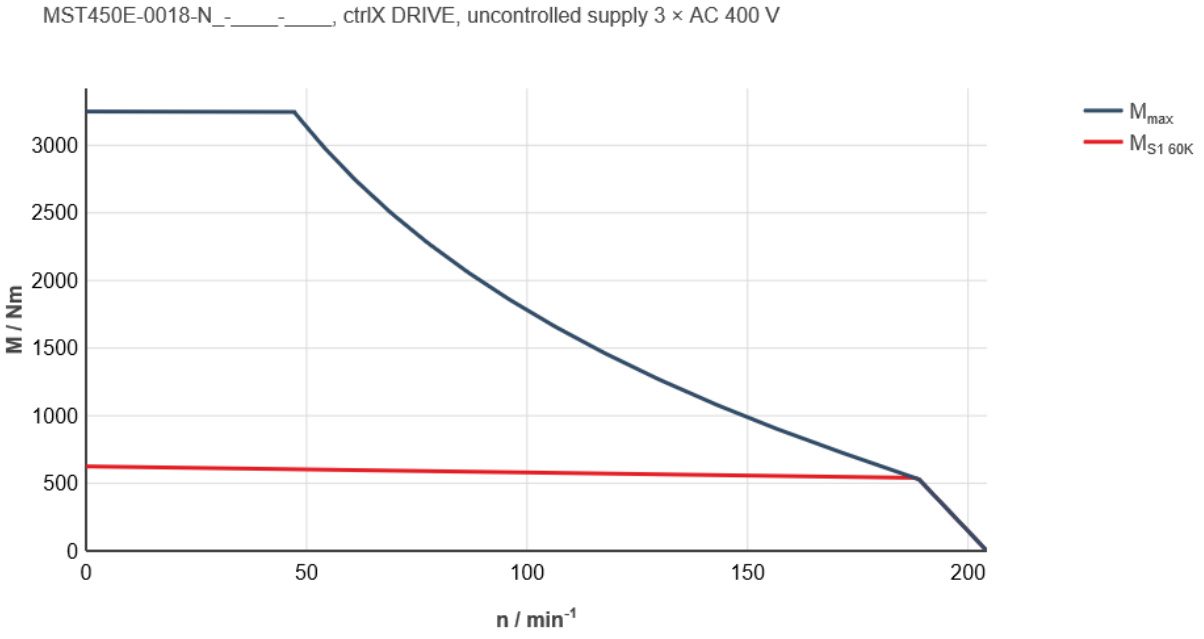


Fig. 64: Motor characteristic curve of MST450E-0018-N... at 540 V_{DC}

3.14 Frame size 530

3.14.1 Data sheet MST530

Table 37: MST530B/ -C - Technical data

Designation	Symbol	Unit	MST530B	MST530C		
			-0010-F	-0010-F	-0010-N	-0014-F
Standstill torque 1)	M_0	Nm	960	1440	600	1440
Continuous current at standstill	I_0	A	34.3	37.4	15.6	43.0
Rated torque 2)	M_N	Nm	800	1200	580	1200
Rated power3)	P_N	kW	8.4	12.6	6.1	15.7
Rated current	I_N	A	28.6	31.2	15.0	35.8
Rated speed 4)	n_N	min-1	100	100	100	125
Maximum torque 5)	M_{max}	Nm	1800	2,700	2,700	2,700
Maximum current	I_{max}	A	71	88	88	100
Maximum speed (electrical) 6)	n_{max}	min-1	200	140	140	175
Power wire cross-section	A	mm^2	4.0	6.0	6.0	6.0
Torque constant at 20 °C 7)	K_{M_N}	Nm/A	28	38.5	38.5	33.52
Voltage constant at 20 °C 8)	K_{EMK_1}	V/min-1	1.890	2.810	2.810	1.486
Thermal time constant	T_{th_nenn}	min	8.3	8.3	15	8.3
Winding resistance at 20 °C	R_{12}	Ohm	1.4	2.0	2.0	1.187
Winding inductance	L_{12}	mH	16.2	24.6	24.6	14.1
Leakage capacitance of the component	C_{ab}	nF	10.14	15.21	15.21	15.21
Number of pole pairs	p	-	35			
Details about liquid cooling						
Power dissipation	P_V	kW	3.3	4.3	1.3	4.8
Required coolant flow for P_V	Q_{min}	l/min	4.8	4.8	-	5.4
Pressure drop at Q_{min}	Δp	bar	0.1	0.1	-	0.1
Volume of coolant duct	V_{kuehl}	l	0.6	0.9	-	0.9
1...8) Tolerance ± 5%						
Latest amendment: 2024-03-19						

Table 38: MST530D/ -E- Technical data

Designation	Symbol	Unit	MST530D	MST530E
			-0012-F	-0010-F
Standstill torque 1)	M_0	Nm	1920	2400
Continuous current at standstill	I_0	A	53.8	73.1
Rated torque 2)	M_N	Nm	1,680	2,100
Rated power3)	P_N	kW	21.1	19.8
Rated current	I_N	A	47.2	64
Rated speed 4)	n_N	min-1	120	90
Maximum torque 5)	M_{max}	Nm	3760	4700
Maximum current	I_{max}	A	156.4	212
Maximum speed (electrical) 6)	n_{max}	min-1	170	200
Power wire cross-section	A	mm^2	10.0	16.0
Torque constant at 20 °C 7)	K_{M_N}	Nm/A	35.59	32.8
Voltage constant at 20 °C 8)	K_{EMK_1}	V/min-1	2.531	2.090

Designation	Symbol	Unit	MST530D	MST530E
			-0012-F	-0010-F
Thermal time constant	T_{th_nenn}	min	8.3	8.3
Winding resistance at 20 °C	R_{12}	Ohm	1.017	0.59
Winding inductance	L_{12}	mH	11.91	7.5
Leakage capacitance of the component	C_{ab}	nF	18.4	23.00
Number of pole pairs	p	-	35	
Details about liquid cooling				
Power dissipation	P_V	kW	5.4	6.7
Required coolant flow for P_V	Q_{min}	l/min	7.0	9.5
Pressure drop at Q_{min}	Δp	bar	0.15	0.2
Volume of coolant duct	V_{kuehl}	l	1.2	1.5
1...8) Tolerance ± 5%				
Latest amendment: 2024-03-19				

Table 39: MST530F/ -P/ -R - Technical data

Designation	Symbol	Unit	MST530F	MST530P	MST530R
			-0012-F	-0012-F	-0011-F
Standstill torque [1]	M_0	Nm	2880	3300	4320
Continuous current at standstill	I_0	A	82.0	93.9	119.6
Rated torque [2]	M_N	Nm	2520	2940	3780
Rated power[3]	P_N	kW	31.7	36.9	43.5
Rated current	I_N	A	71.3	83.8	104.7
Rated speed [4]	n_N	min-1	120	120	110
Maximum torque [5]	M_{max}	Nm	5640	6580	8460
Maximum current	I_{max}	A	253	284	339
Maximum speed (electrical) [6]	n_{max}	min-1	175	180	175
Power wire cross-section	A	mm^2	16.0	25.0	35.0
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	35.3	35.1	36.1
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	2.4296	3.1285	4.1393
Thermal time constant	T_{th_nenn}	min	8.3	8.3	8.3
Winding resistance at 20 °C	R_{12}	Ohm	0.546	0.485	0.397
Winding inductance	L_{12}	mH	6.45	5.76	5.5
Leakage capacitance of the component	C_{ab}	nF	27.60	32.20	41.40
Number of pole pairs	p	-	35		
Details about liquid cooling					
Power dissipation	P_V	kW	8.1	8.7	11.2
Required coolant flow for P_V	Q_{min}	l/min	11.5	12.5	16.1
Pressure drop at Q_{min}	Δp	bar	0.25	0.3	0.4
Volume of coolant duct	V_{kuehl}	l	1.8	1.65	1.8
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-19					

Table 40: MST530G - Technical data

Designation	Symbol	Unit	MST530G		
			-0006-F	-0007-F	-0010-F
Standstill torque 1)	M_0	Nm	4,800	4,800	4,800
Continuous current at standstill	I_0	A	83.4	90.7	133.5
Rated torque 2)	M_N	Nm	4200	4200	4200
Rated power3)	P_N	kW	26.4	30.8	44
Rated current	I_N	A	73.0	79.4	116.8
Rated speed 4)	n_N	min-1	60	70	100
Maximum torque 5)	M_{max}	Nm	9200	9200	9200
Maximum current	I_{max}	A	240	305	350
Maximum speed (electrical) 6)	n_{max}	min-1	105	115	160
Power wire cross-section	A	mm²	2x10.0	2x16.0	2x25.0
Torque constant at 20 °C 7)	K_{M_N}	Nm/A	55.3	43.8	32.7
Voltage constant at 20 °C 8)	K_{EMK_1}	V/min-1	4.4	3.650	2.7
Thermal time constant	T_{th_nenn}	min	8.3	8.3	8.3
Winding resistance at 20 °C	R_{12}	Ohm	0.833	0.706	0.336
Winding inductance	L_{12}	mH	12.0	8.8	4.5
Leakage capacitance of the component	C_{ab}	nF	50.71	50.71	50.71
Number of pole pairs	p	-	35		
Details about liquid cooling					
Power dissipation	P_V	kW	11.5	11.5	11.5
Required coolant flow for P_V	Q_{min}	l/min	16.5	16.5	16.5
Pressure drop at Q_{min}	Δp	bar	0.45	0.45	0.45
Volume of coolant duct	V_{kuehl}	l	2.0	2.0	2.0
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-19					

Table 41: MST530L - Technical data

Designation	Symbol	Unit	MST530L		
			-0003-F	-0006-F	-0007-F
Standstill torque 1)	M_0	Nm	7200	7200	7200
Continuous current at standstill	I_0	A	66.1	137.1	152
Rated torque 2)	M_N	Nm	6300	6300	6300
Rated power3)	P_N	kW	19.8	39.6	46.2
Rated current	I_N	A	57.8	120	133
Rated speed 4)	n_N	min-1	30	60	70
Maximum torque 5)	M_{max}	Nm	11,000	13,800	13,800
Maximum current	I_{max}	A	120	279	308
Maximum speed (electrical) 6)	n_{max}	min-1	55	110	110
Power wire cross-section	A	mm²	10.0	2x25.0	2x25.0
Torque constant at 20 °C 7)	K_{M_N}	Nm/A	109.0	52.5	47.4
Voltage constant at 20 °C 8)	K_{EMK_1}	V/min-1	6.700	3.350	3.000
Thermal time constant	T_{th_nenn}	min	8.3	8.3	8.3
Winding resistance at 20 °C	R_{12}	Ohm	1.9	0.46	0.52
Winding inductance	L_{12}	mH	25.9	6.4	5.3

Designation	Symbol	Unit	MST530L		
			-0003-F	-0006-F	-0007-F
Leakage capacitance of the component	C_{ab}	nF	76.06	76.06	76.06
Number of pole pairs	p	-	35		
Details about liquid cooling					
Power dissipation	P_V	kW	15.0	15.0	15.0
Required coolant flow for P_V	Q_{min}	l/min	21.5	21.5	21.5
Pressure drop at Q_{min}	Δp	bar	0.7	0.7	0.7
Volume of coolant duct	V_{kuehl}	l	3.2	3.2	3.2
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-19					

3.14.2 Data sheet MRT530

Table 42: Technical data MRT530B, -C, -D, -E, -F

Designation	Symbol	Unit	MRT530B	MRT530C	MRT530D	MRT530E	MRT530F
			-_-0410				
Moment of inertia of rotor [1)]	J_{Rot}	kg * m²	0.98	1.35	1.72	2.09	2.46
Rotor mass	m_{rot}	kg	19.6	26.7	33.8	40.9	48.0
Maximum speed (mechanical)	$n_{max,mech}$	min-1	1100				
1) Tolerance ± 5%							
Latest amendment: 2021-07-29							

Table 43: Technical data MRT530G, -L, -P, -R

Designation	Symbol	Unit	MRT530G	MRT530L	MRT530P	MRT530R
			-_-0410			
Moment of inertia of rotor [1)]	J_{Rot}	kg * m²	3.94	5.78	2.83	3.57
Rotor mass	m_{rot}	kg	76.5	112	55.2	69.4
Maximum speed (mechanical)	$n_{max,mech}$	min-1	1100			
1) Tolerance ± 5%						
Latest amendment: 2021-07-29						

3.14.3 Motor characteristic curves MST530

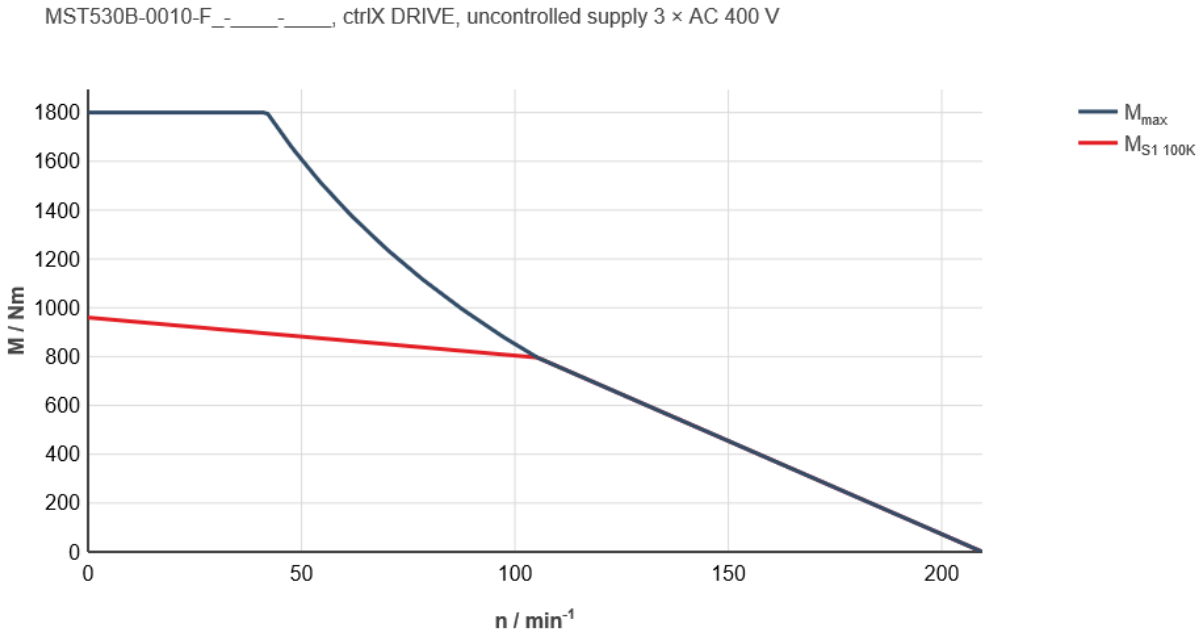


Fig. 65: Motor characteristic curve of MST530B-0010-F... at 540 V_{DC}

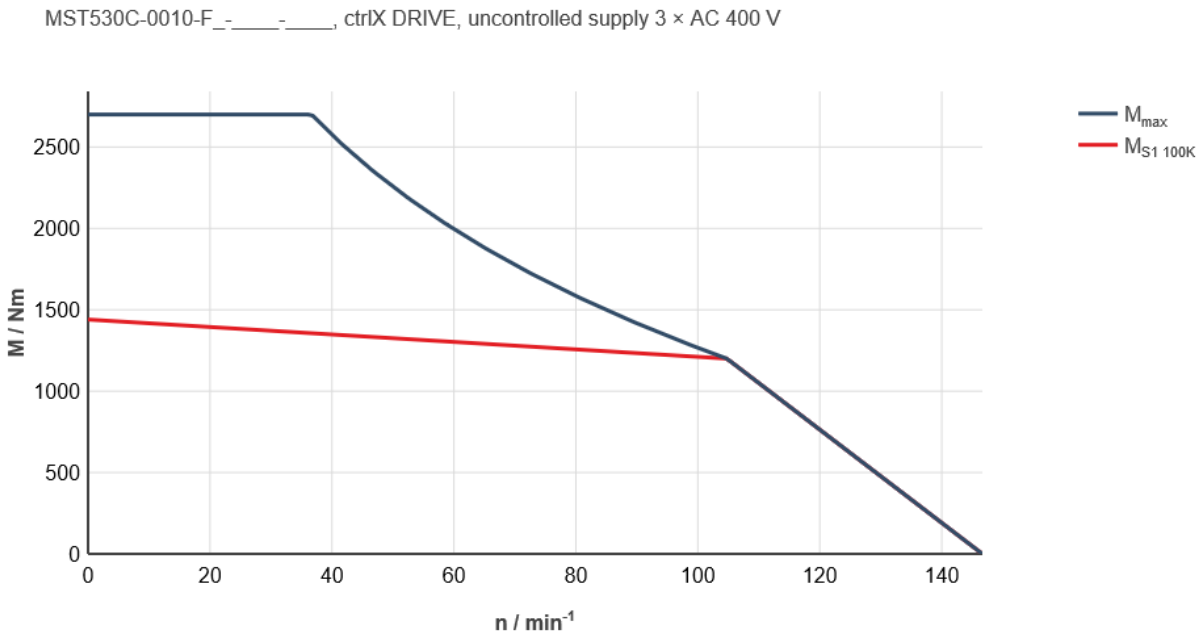


Fig. 66: Motor characteristic curve of MST530C-0010-F... at 540 V_{DC}

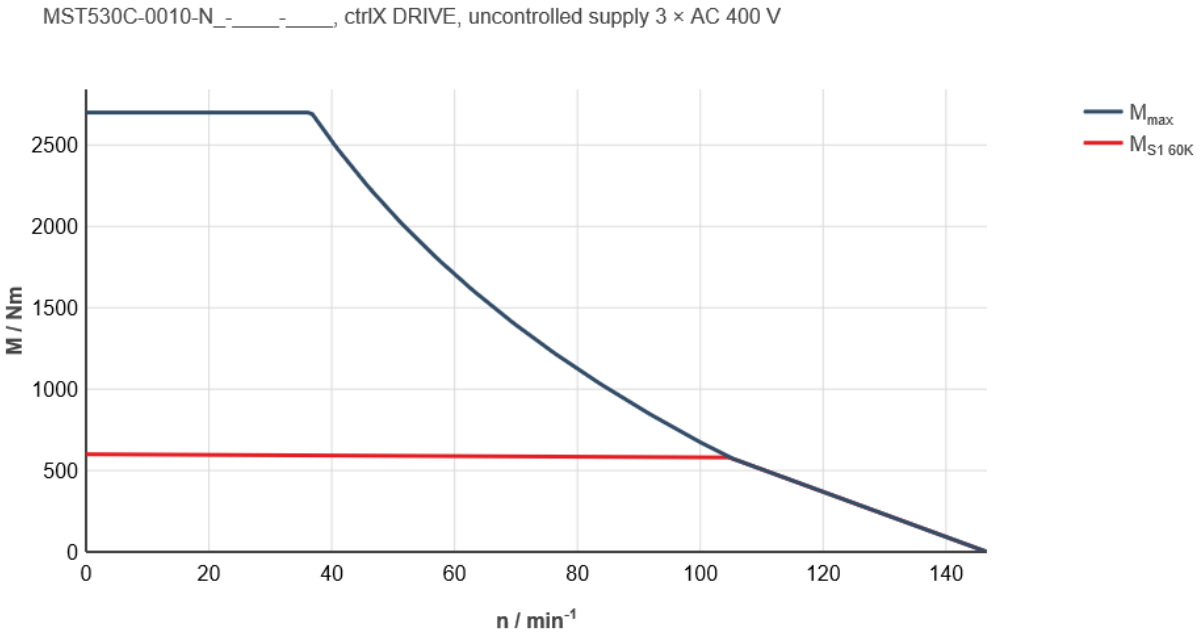


Fig. 67: Motor characteristic curve of MST530C-0010-N... at 540 V_{DC}

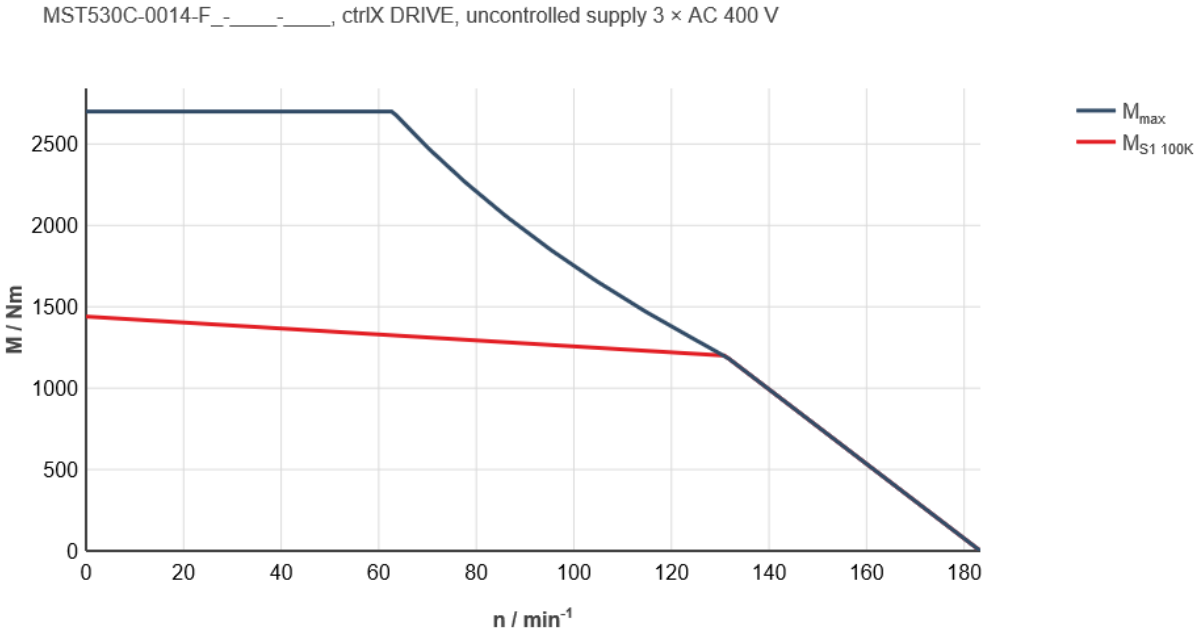


Fig. 68: Motor characteristic curve of MT530C-0014-F... at 540 V_{DC}

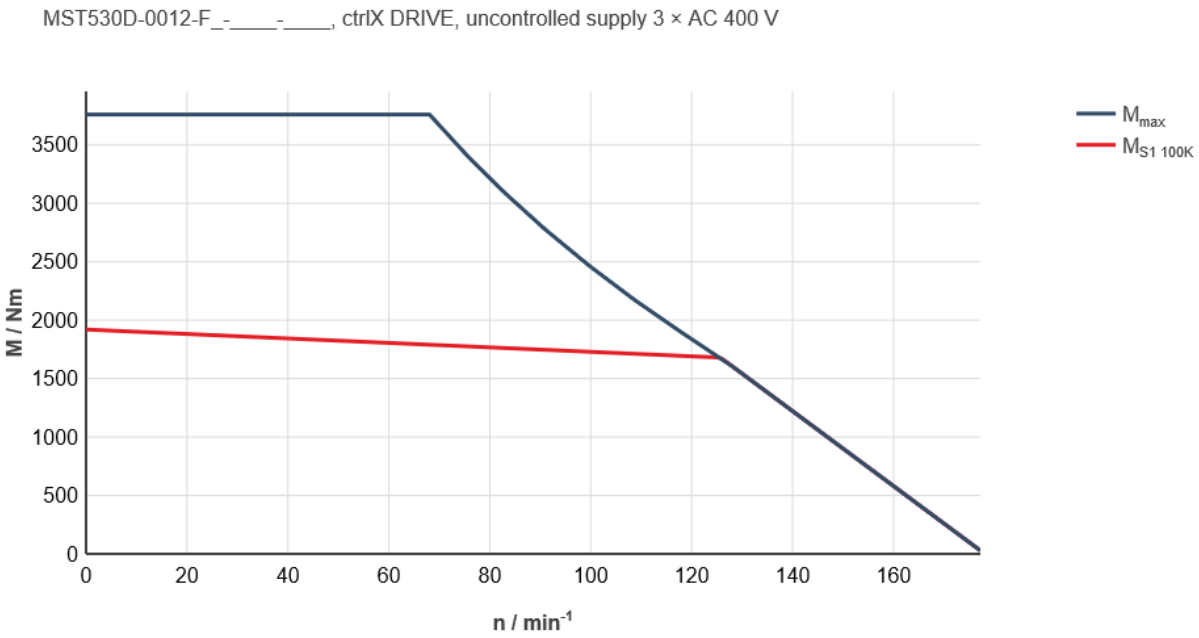


Fig. 69: Motor characteristic curve of MST530D-0012-F... at 540 V_{DC}

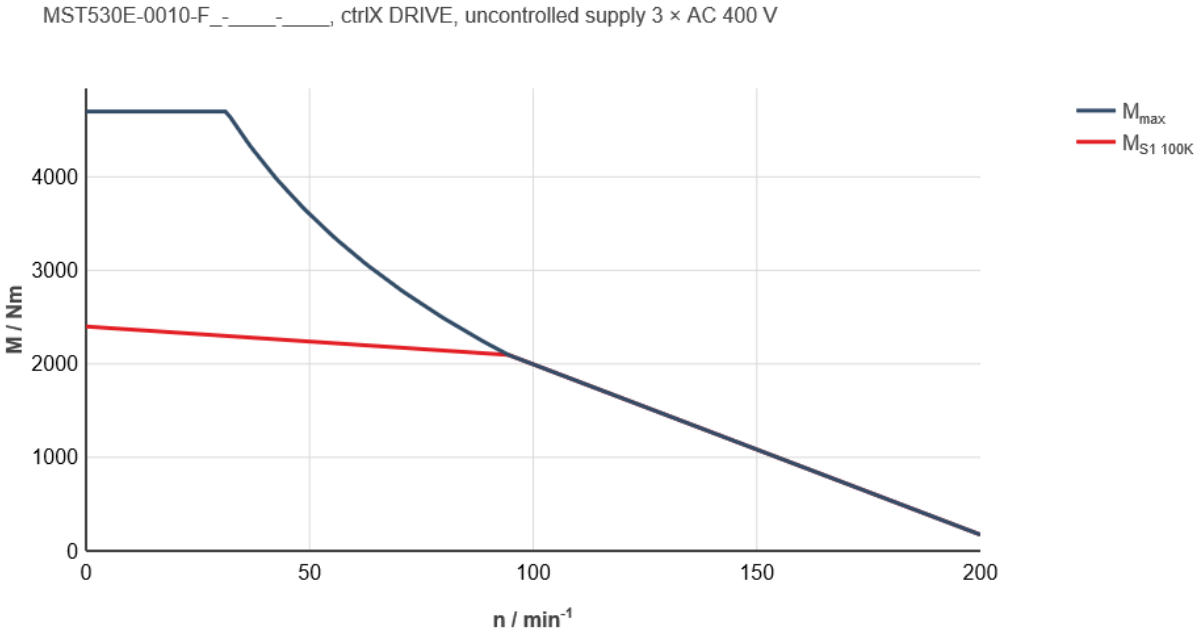


Fig. 70: Motor characteristic curve of MST530E-0010-F... at 540 V_{DC}

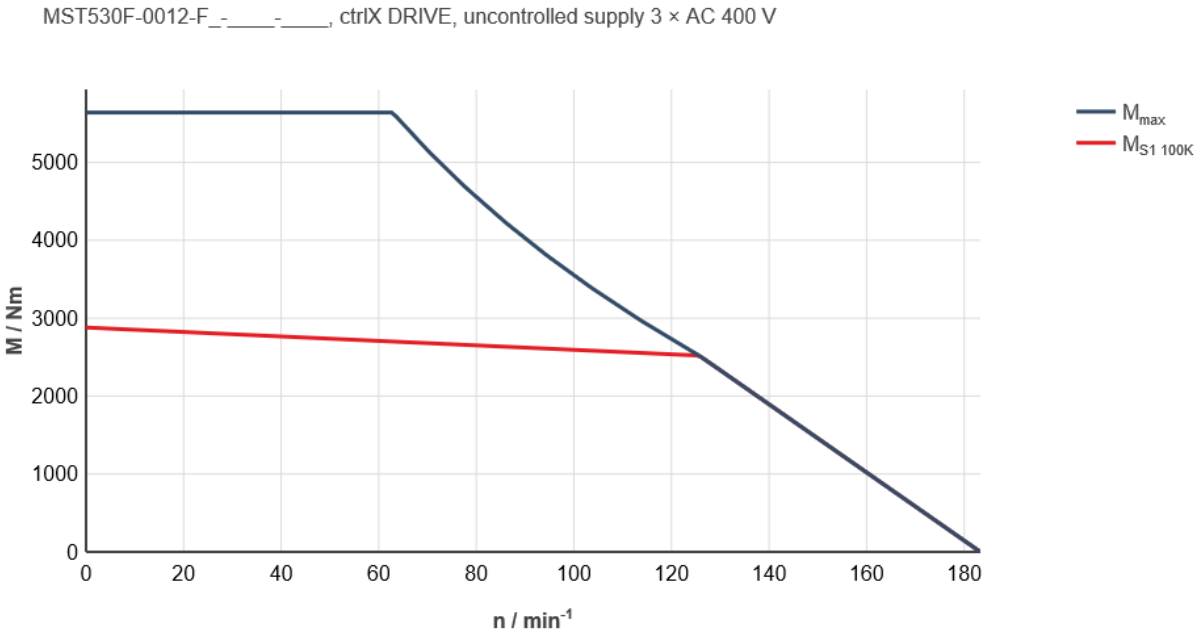


Fig. 71: Motor characteristic curve of MST530F-0012-F... at 540 V_{DC}

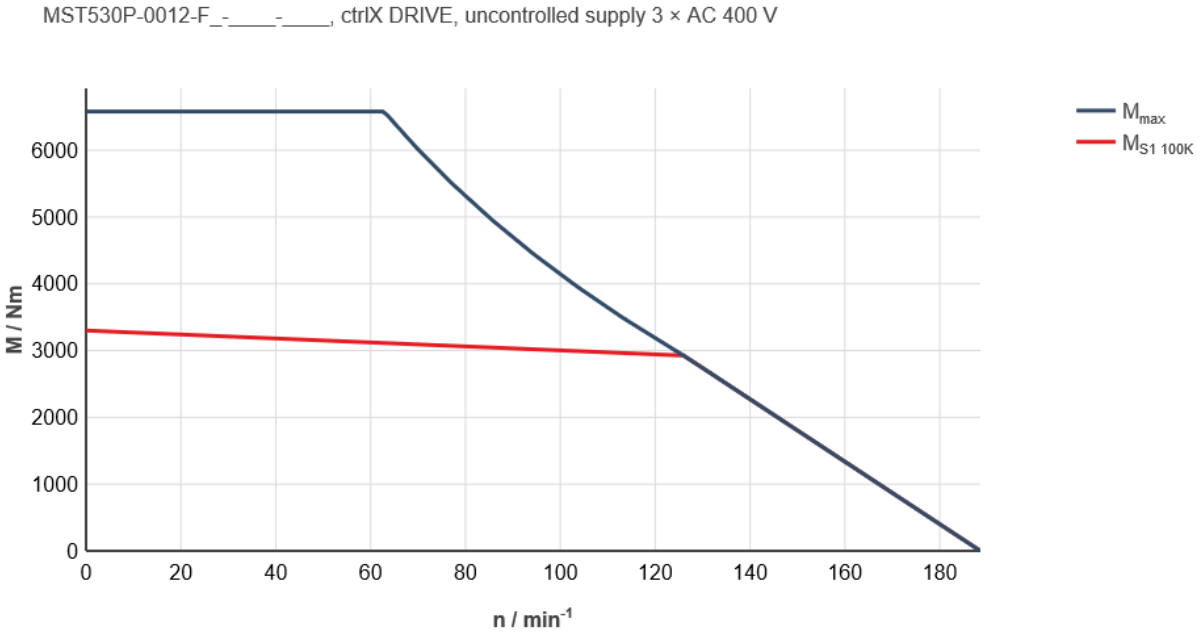


Fig. 72: Motor characteristic curve of MST530P-0012-F... at 540 V_{DC}

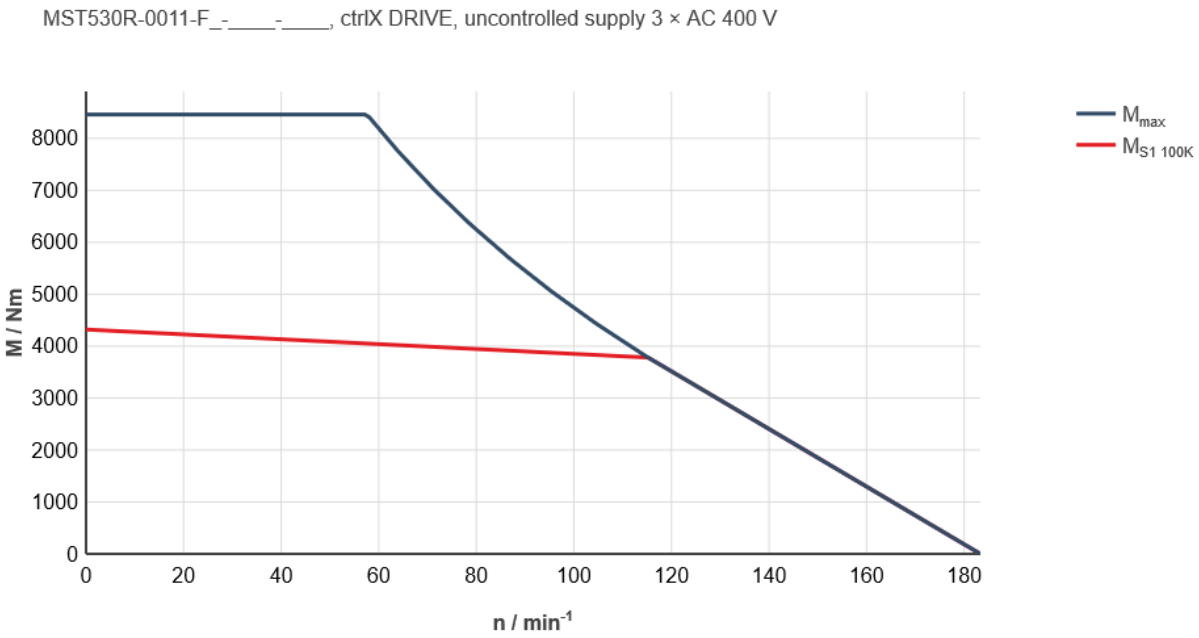


Fig. 73: Motor characteristic curve of MST530R-0011-F... at 540 V_{DC}

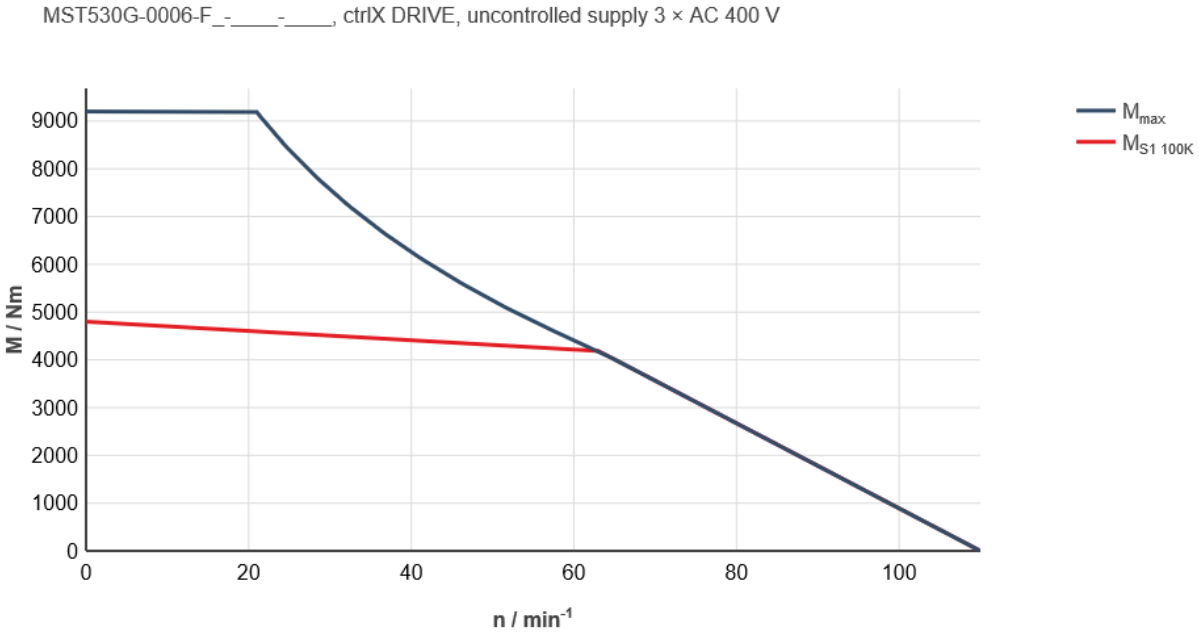


Fig. 74: Motor characteristic curve of MST530G-0006-F... at 540 V_{DC}

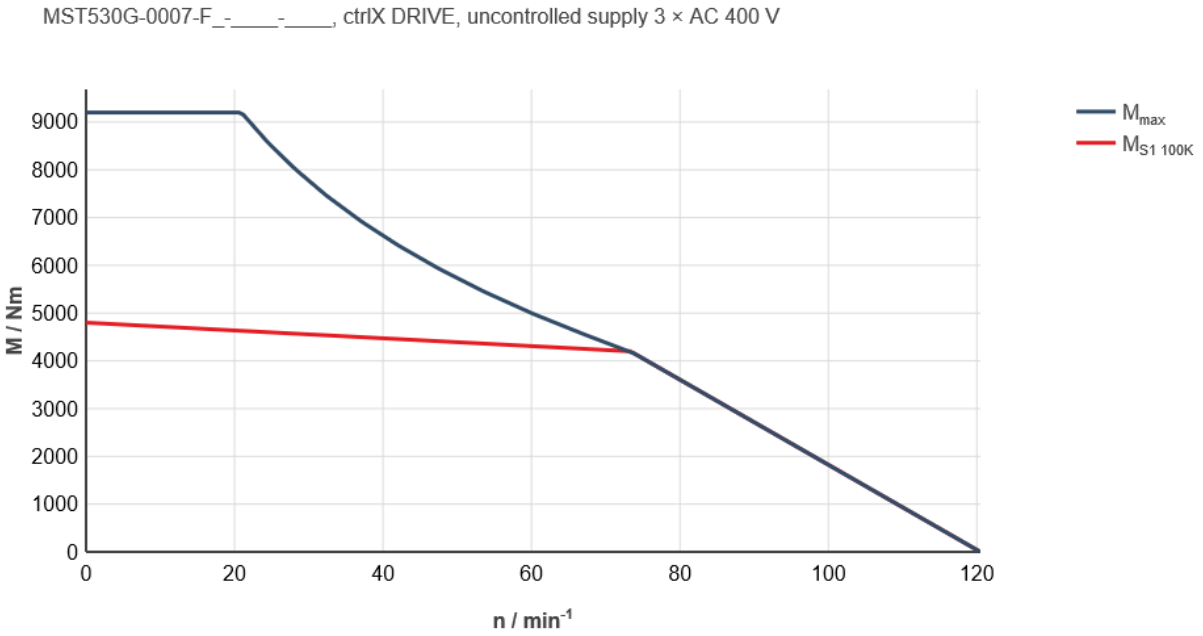


Fig. 75: Motor characteristic curve of MST530G-0007-F... at 540 V_{DC}

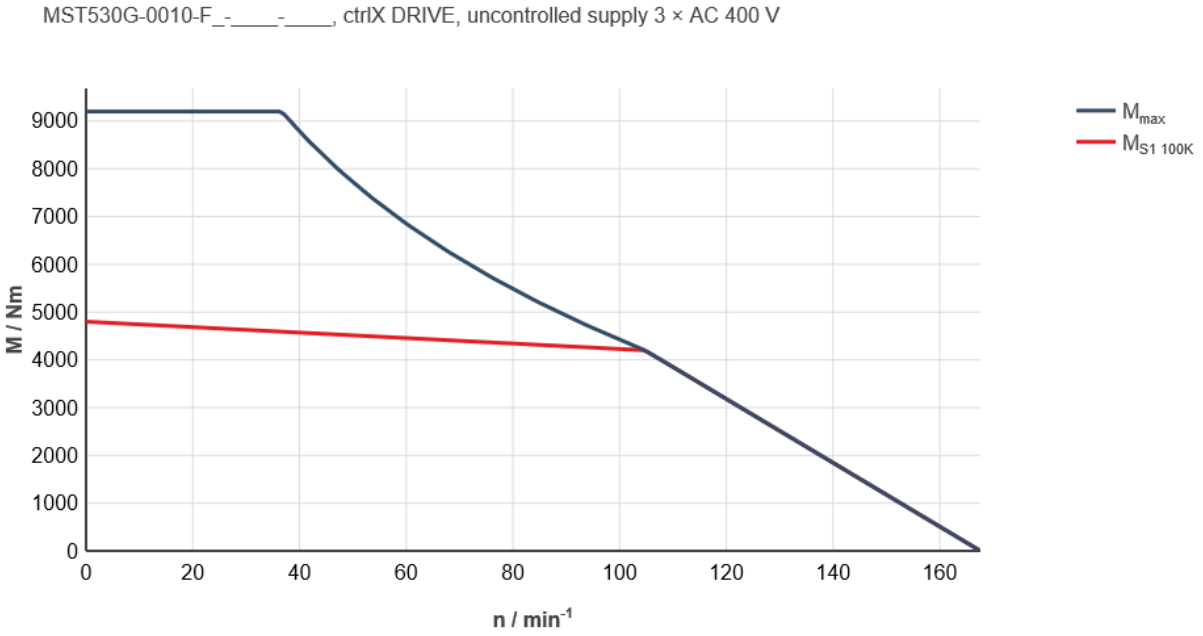


Fig. 76: Motor characteristic curve of MST530G-0010-F... at 540 V_{DC}

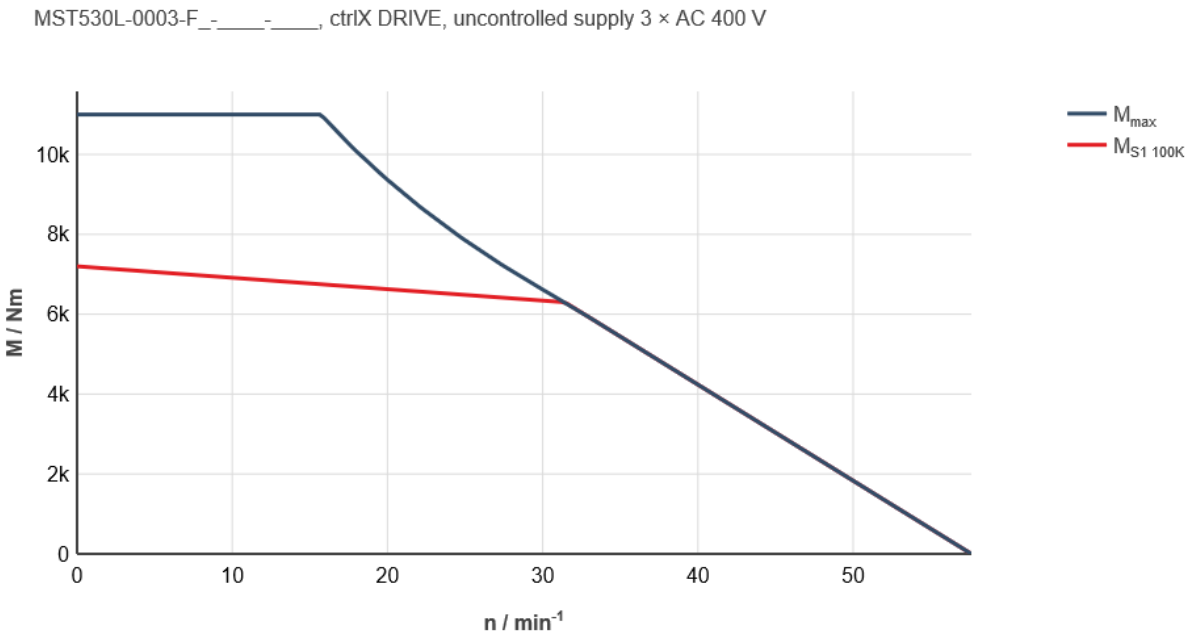


Fig. 77: Motor characteristic curve of MST530L-0003-F... at 540 V_{DC}

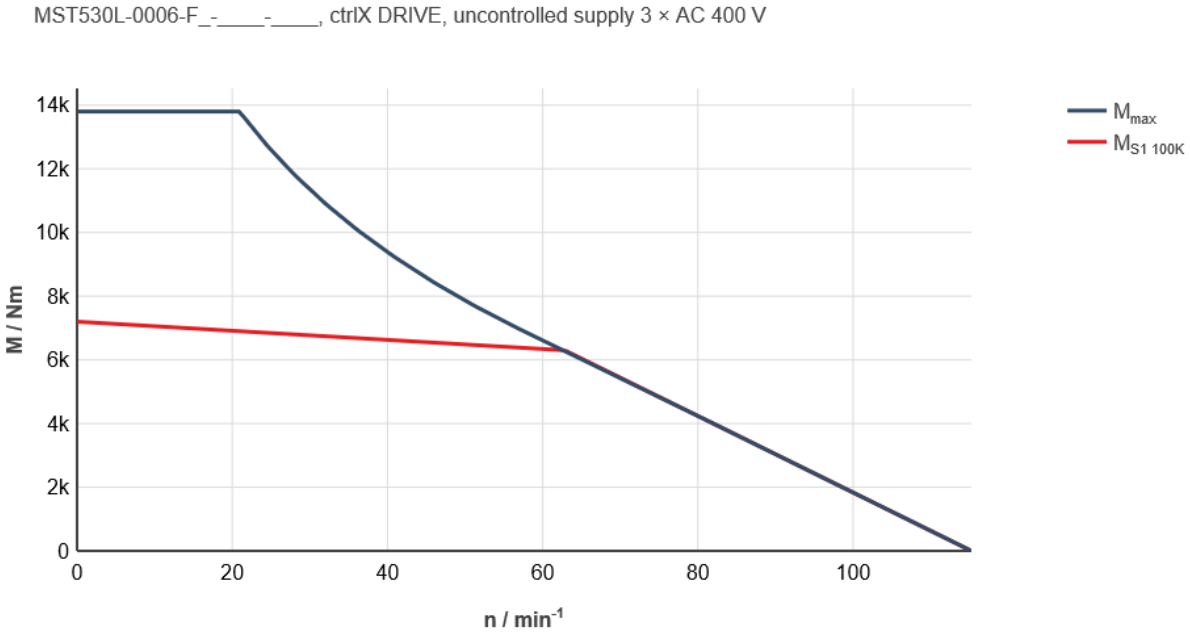


Fig. 78: Motor characteristic curve of MST530L-0006-F... at 540 V_{DC}

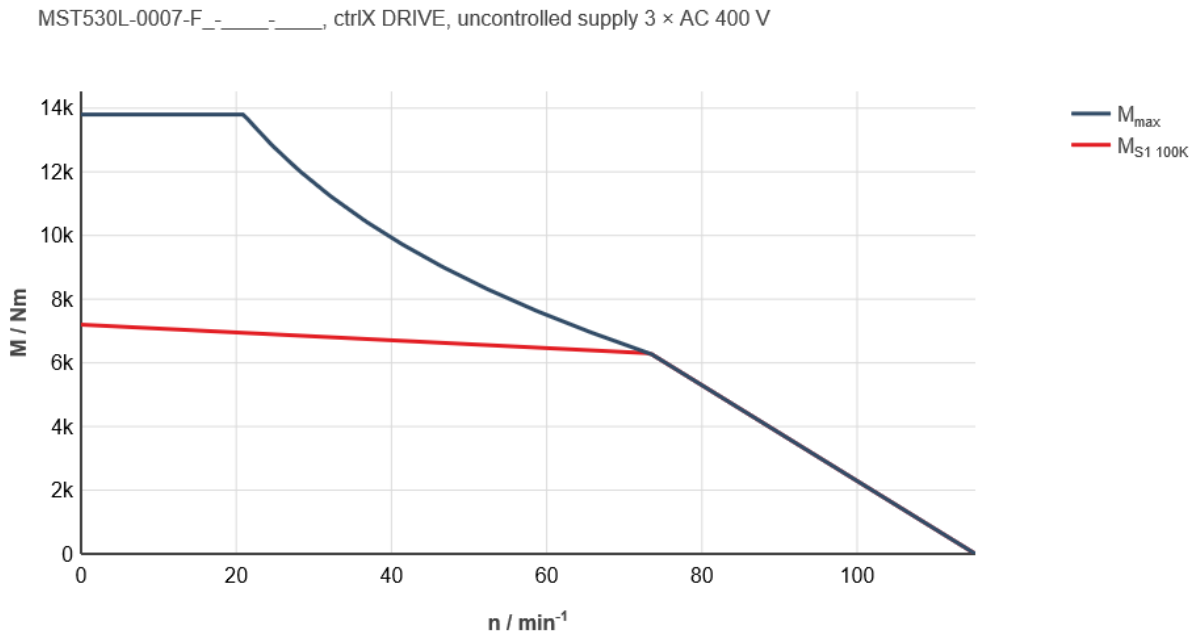


Fig. 79: Motor characteristic curve of MST530L-0007-F... at 540 V_{DC}

3.15 Frame size 531

3.15.1 Data sheet MST531

Table 44: MST531 - Technical data

Designation	Symbol	Unit	MST531E		MST531L
			-0006-F	-0018-F	-0009-F
Standstill torque [1]	M_0	Nm	2,250	2,250	6,750
Continuous current at standstill	I_0	A	38.2	95.6	132.3
Rated torque [2]	M_N	Nm	2150	1800	5000
Rated power[3]	P_N	kW	13.5	33.93	47.1
Rated current	I_N	A	36.5	76.5	98
Rated speed [4]	n_N	min-1	60	180	90
Maximum torque [5]	M_{max}	Nm	5000	5000	12,000
Maximum current	I_{max}	A	95	210	240
Maximum speed (electrical) [6]	n_{max}	min-1	95	230	110
Power wire cross-section	A	mm^2	6.0	2x10.0	35
Torque constant at 20 °C [7]	K_{M_N}	Nm/A	58.90410959	23.594	51
Voltage constant at 20 °C [8]	K_{EMK_1}	V/min-1	4.2	1.74	3.08
Thermal time constant	T_{th_nenn}	min	7	6	6.0
Winding resistance at 20 °C	R_{12}	Ohm	2.43	0.45	0.53
Winding inductance	L_{12}	mH	37.5	6.6	8
Leakage capacitance of the component	C_{ab}	nF	30.2	30.7	81.13
Number of pole pairs	p	-	25		
Details about liquid cooling					
Power dissipation	P_V	kW	6.97	8.0852	11.5

Designation	Symbol	Unit	MST531E		MST531L
			-0006-F	-0018-F	-0009-F
Required coolant flow for P_V	Q_{min}	l/min	10	11.6	16.5
Pressure drop at Q_{min}	Δp	bar	0.94	0.506288	0.2
Volume of coolant duct	V_{kuehl}	l	1.084	1.084	3.4
1...8) Tolerance ± 5%					
Latest amendment: 2024-03-19					

3.15.2 Data sheet MRT531

Table 45: Technical data MRT531

Designation	Symbol	Unit	MRT531E-__-0410	MRT531L-__-0410
Moment of inertia of rotor [1)]	J_{Rot}	kg * m²	2.22	6.15
Rotor mass	m_{rot}	kg	44.1	122
Maximum speed (mechanical)	$n_{max,mech}$	min-1	300	300
1) Tolerance ± 5%				
Latest amendment: 2021-07-29				

3.15.3 Motor characteristic curves MST531

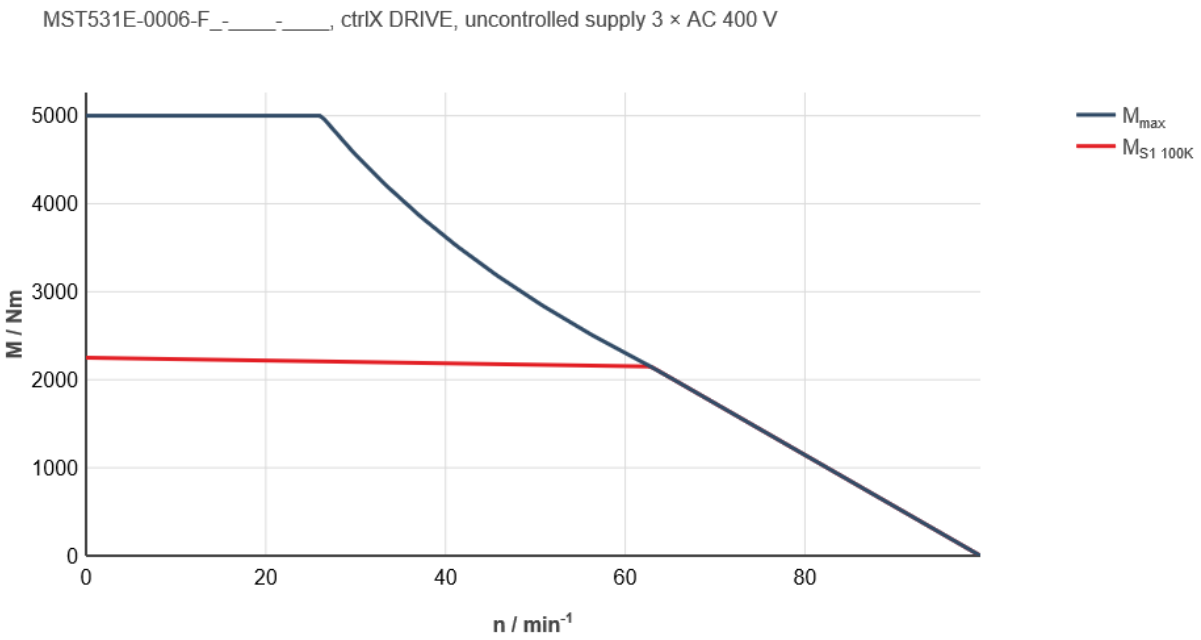


Fig. 80: Motor characteristic curve of MST531E-0006-F... at 540 V_{DC}

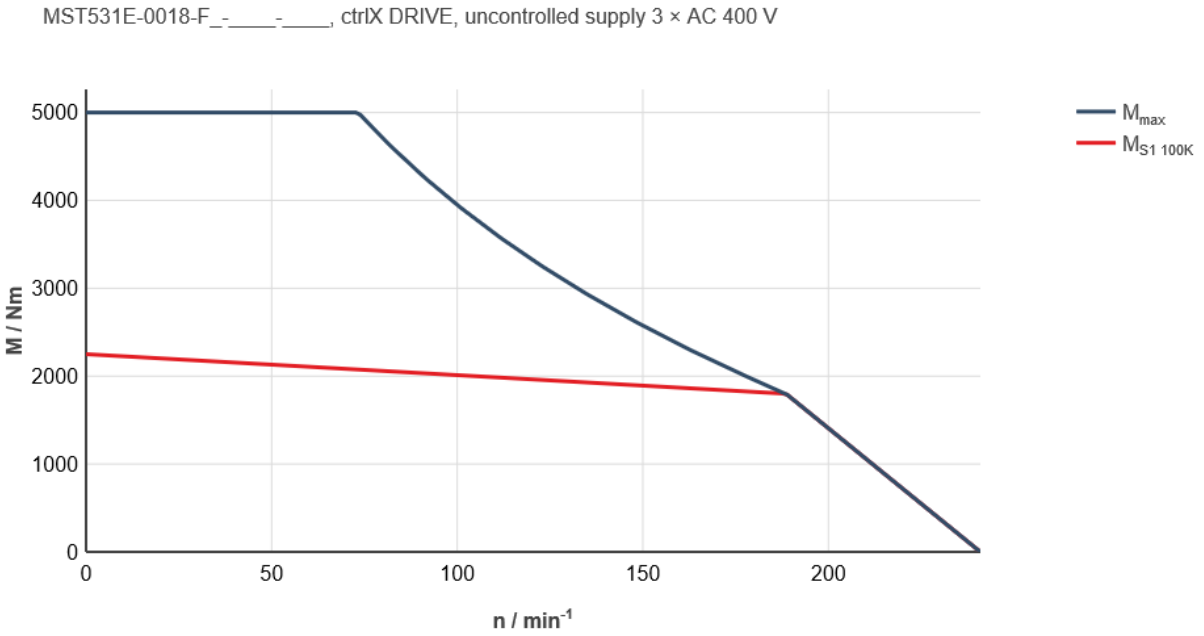


Fig. 81: Motor characteristic curve of MST531E-0018-F... at 540 V_{DC}

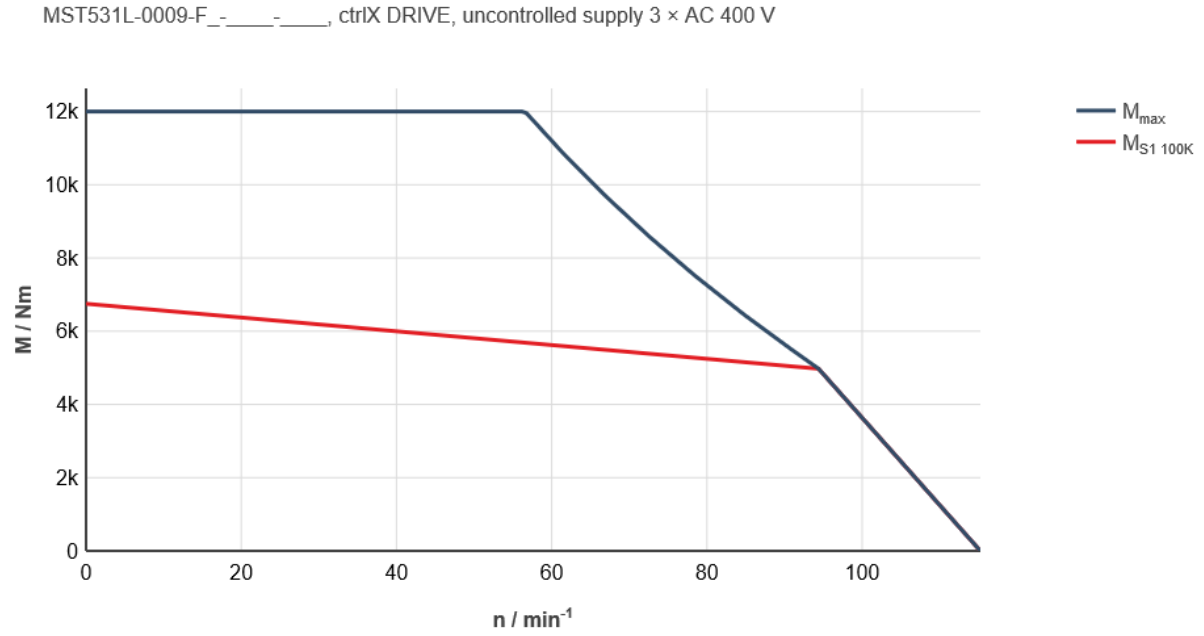


Fig. 82: Motor characteristic curve of MST531L-0009-F... at 540 V_{DC}

3.16 Mass of different stator designs

MST stators are available with different cooling modes and design or encapsulations. Please also refer to the detailed type code. The available options of the masses are given in the following.

Table 46: Masses of different stator designs

Frame size MST	Mass [kg]			
	Casing			
	T	S	(H)	[A]
130A	2.4	3.6	-	-
130C	5.1	5.9	-	-
130E	7.7	8.3	-	-
130G	10.2	10.6	-	-
160A	5.6	-	-	-
160C	9.6	-	-	-
160E	13.9	-	-	-
161C	6.6	-	-	-
161E	12.8	-	-	-
161G	14.4	-	-	-
161M	8.0	-	-	8.0
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	-
290F	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	-
450D	38.7	-	72.5	-
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	87.7	-	134.0	-
530G	144.0	-	204.0	-
530L	205.0	-	280.0	-
530P	100.9	-	151.0	-

Frame size MST	Mass [kg]			
	Casing			
	T	S	(H)	[A]
530R	127.4	-	184.0	-
531E	53.0	-	-	-
531L	158.0	-	-	-

4 Dimensional sheets

4.1 General

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)

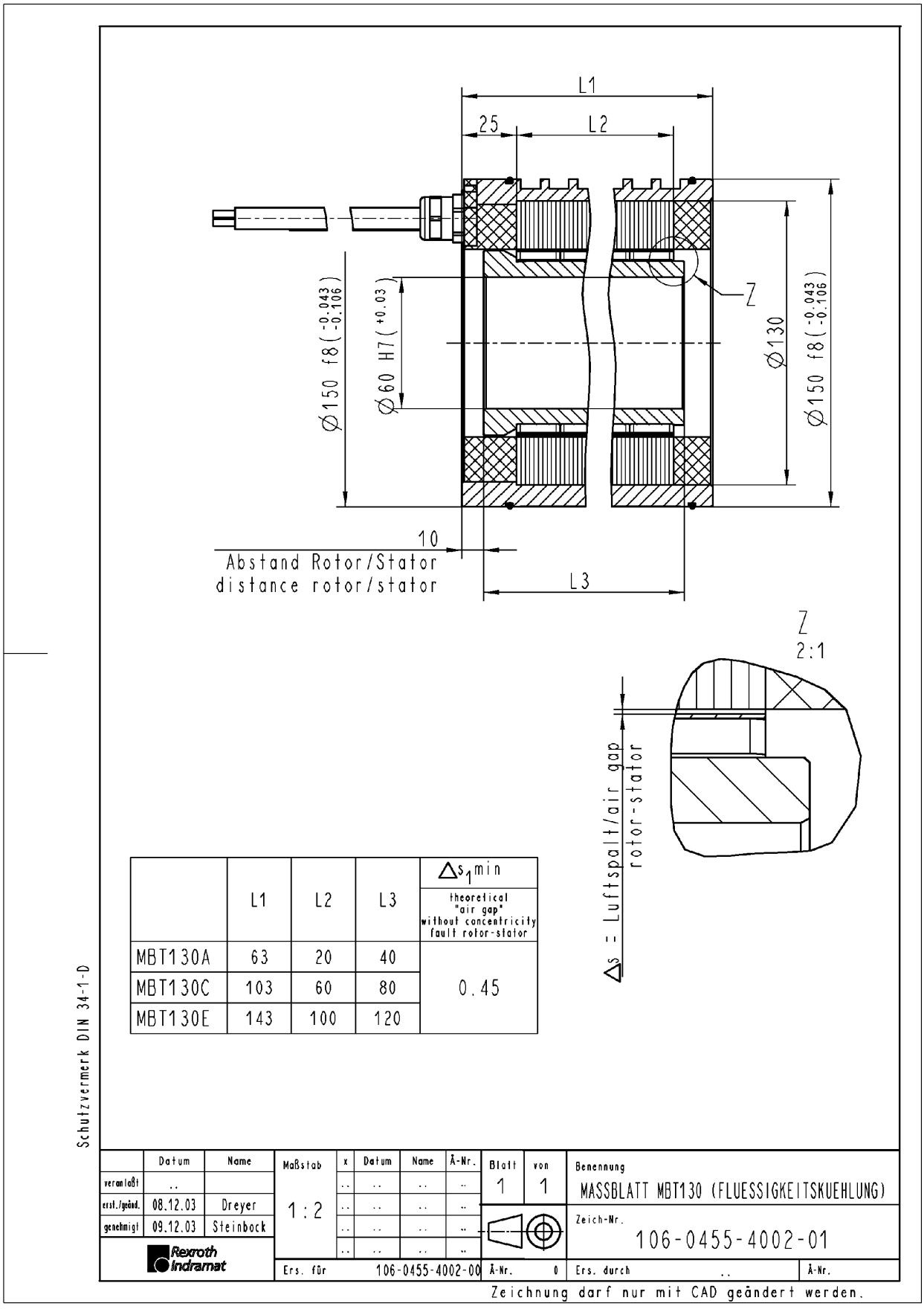
Form and position tolerances: DIN EN ISO 1101



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4.2 Dimension sheets 130

4.2.1 MBT130A/ -C/ -E with liquid cooling, “NNNN” design



	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT130A	63	20	40	0.45
MBT130C	103	60	80	
MBT130E	143	100	120	

Fig. 83: MBT130A/ -C/ -E with liquid cooling, “NNNN” design

4.2.2 MBT130G with liquid cooling, “D303” design

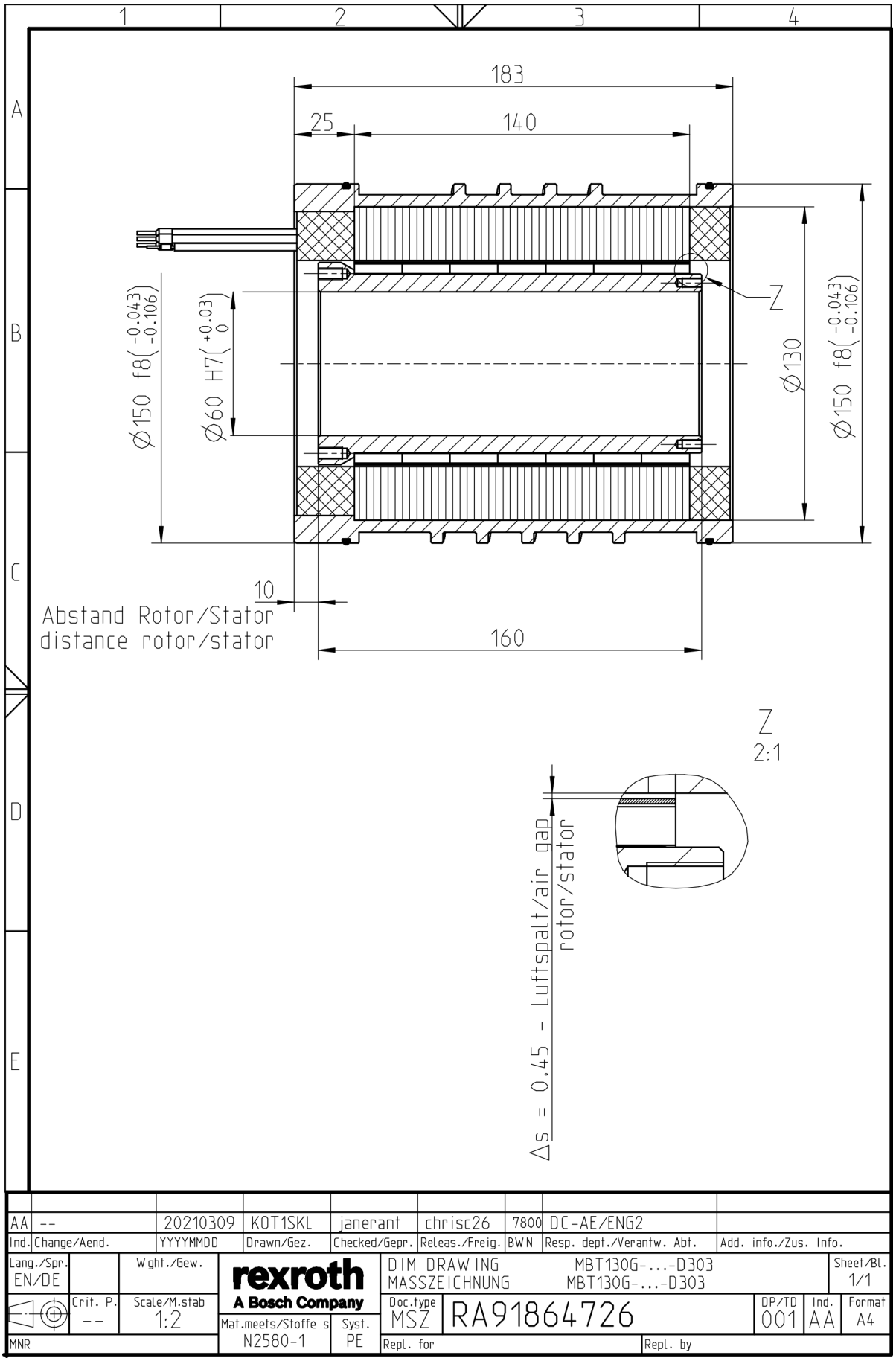
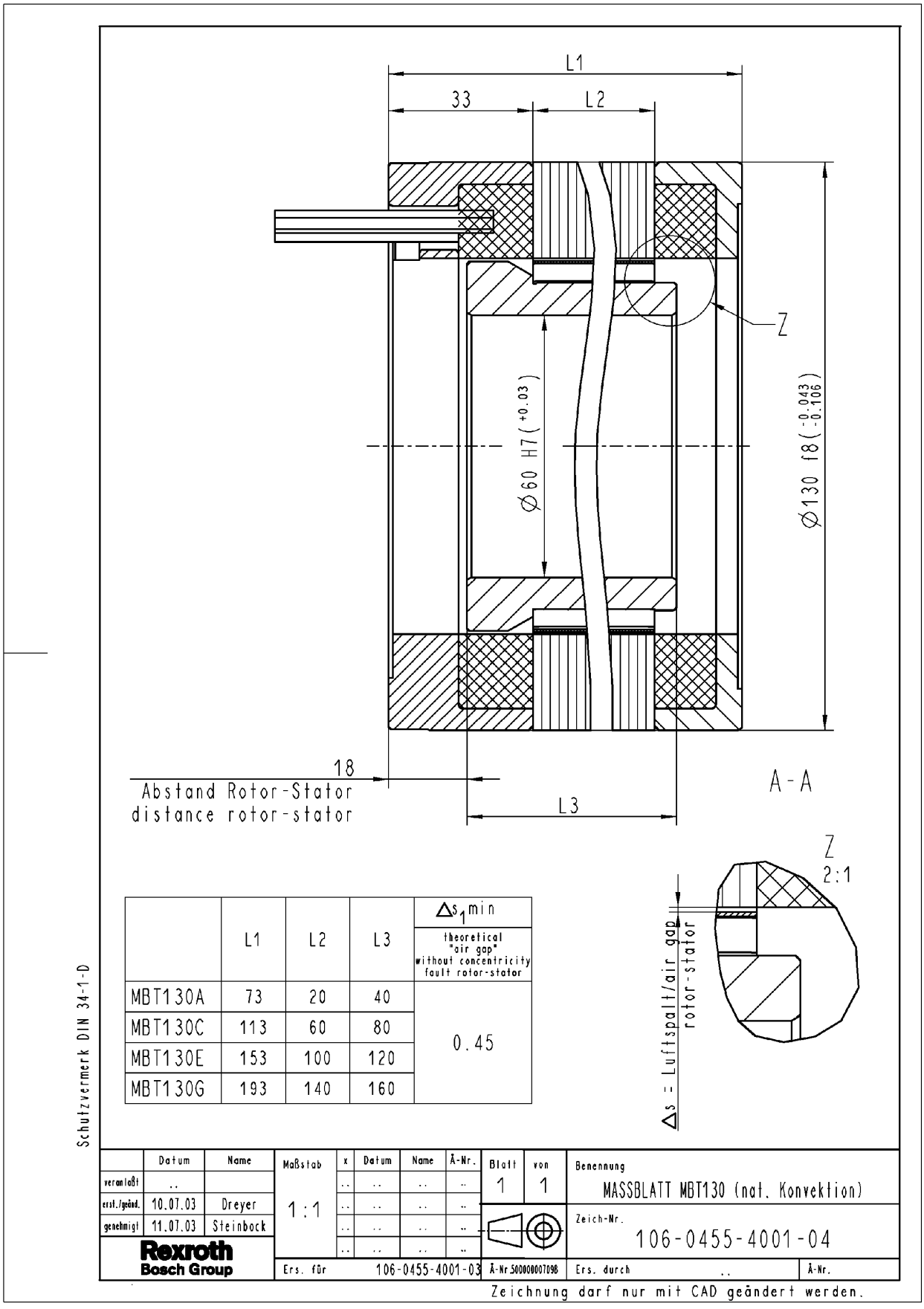


Fig. 84: MBT130G with liquid cooling, “D303” design

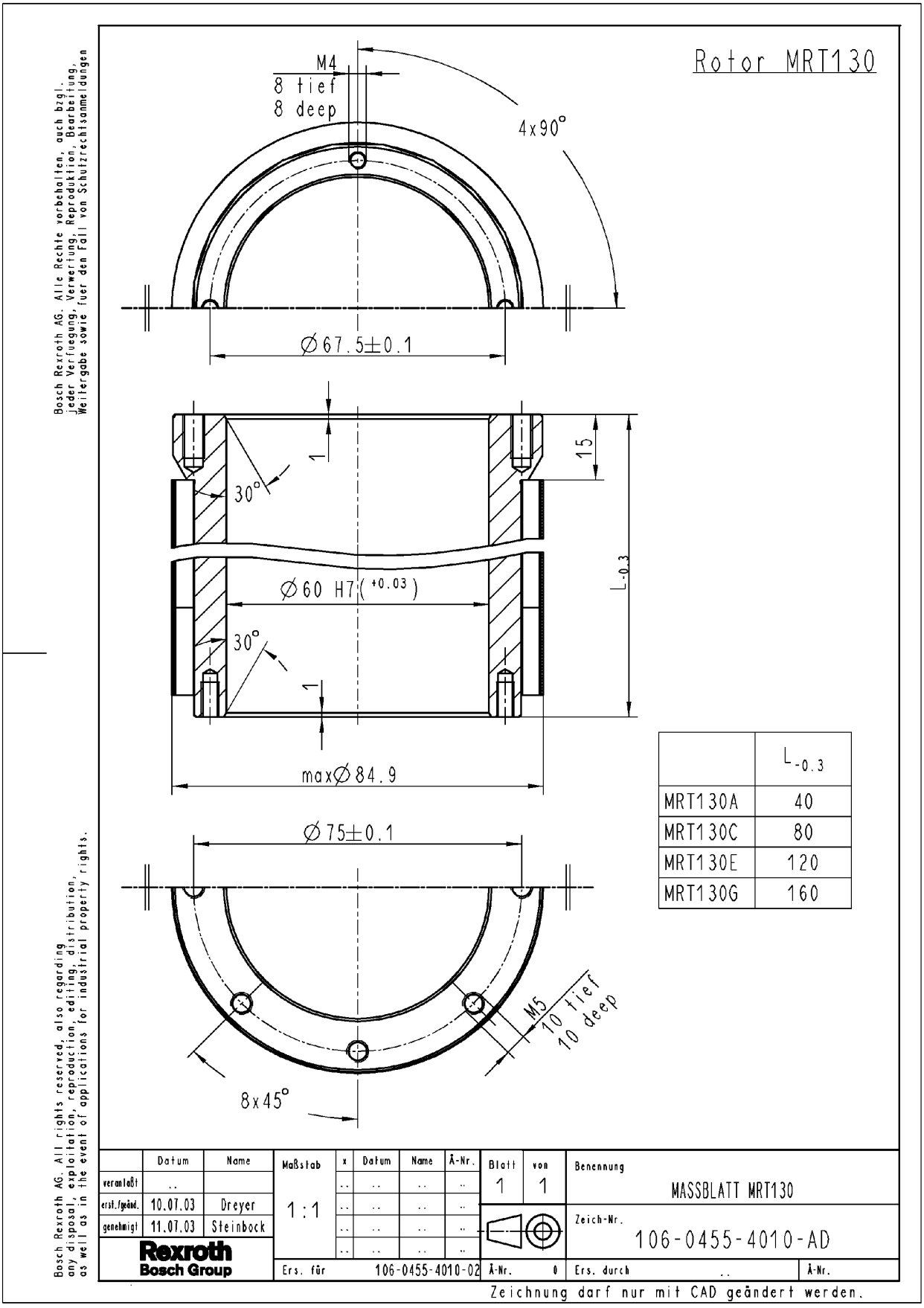
4.2.3 MBT130 with self-cooling



	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. 85: MBT130 with self-cooling

4.2.4 Rotor MRT130



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

Fig. 86: Rotor MRT130

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

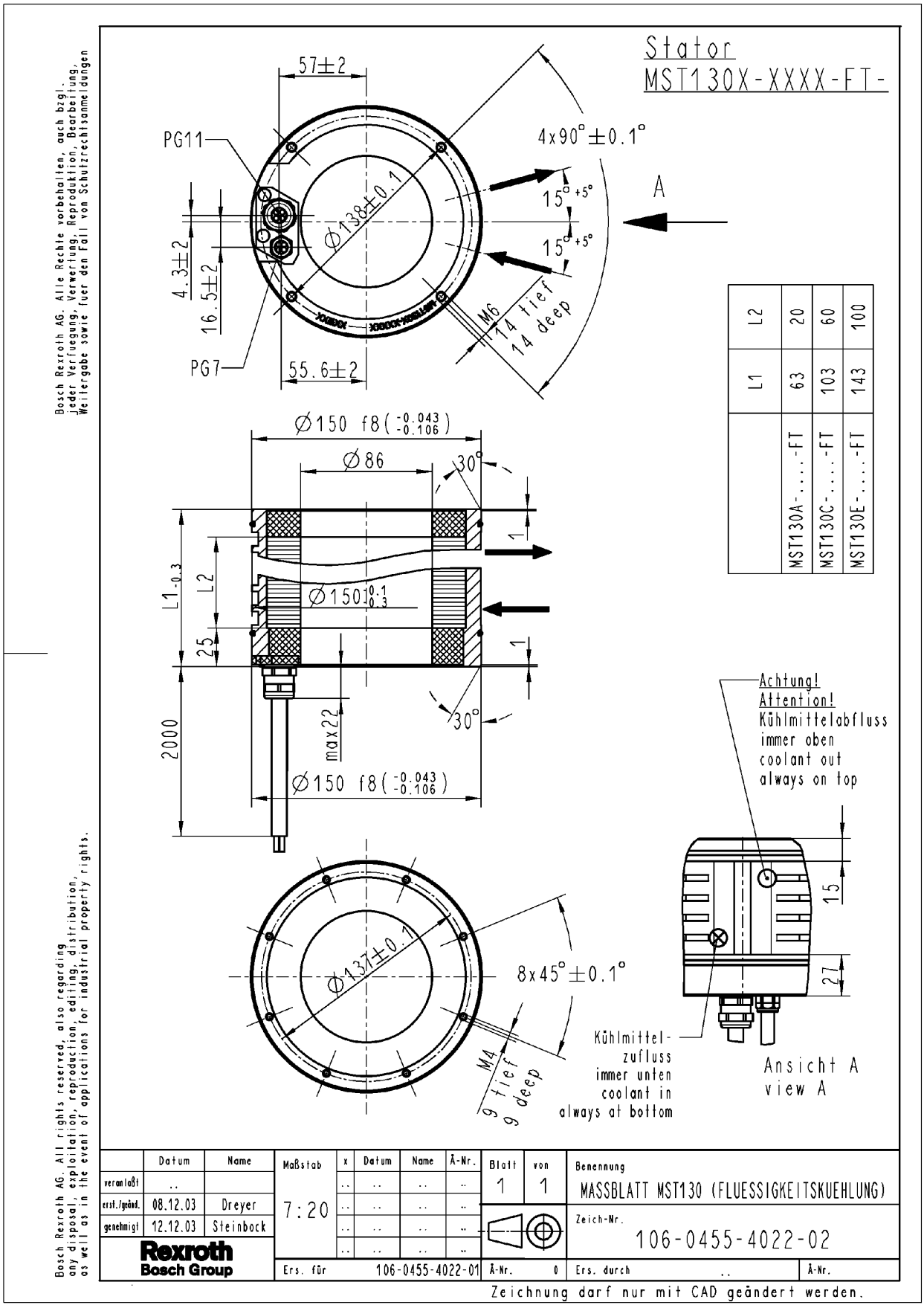


Fig. 87: MST130A/ -C/ -E, liquid cooled, "NNNN" design

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

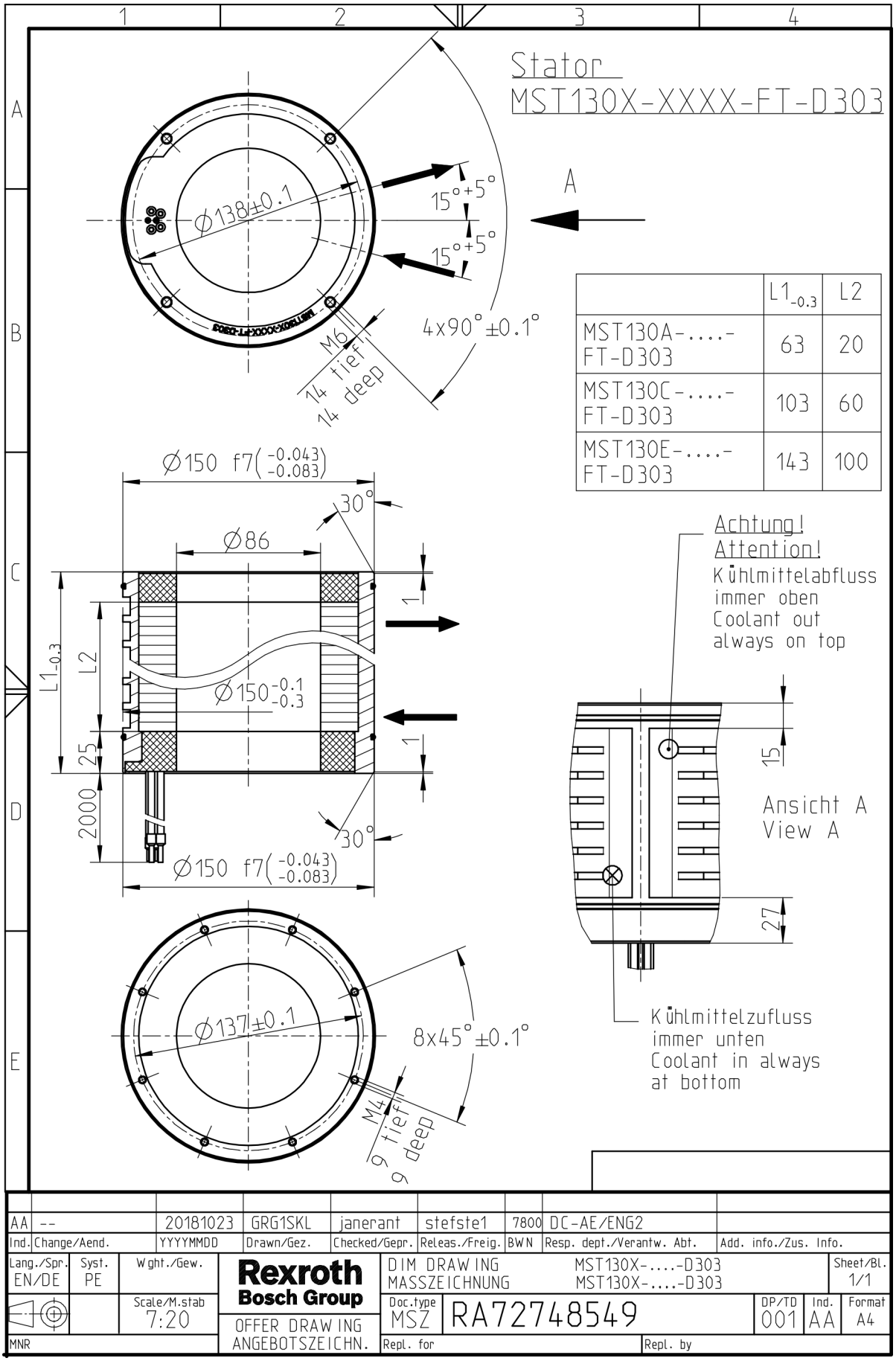


Fig. 88: MST130A, -C, -E, liquid cooled, "D303" design

4.2.7 Stator MST130G, liquid cooled, "D303" design

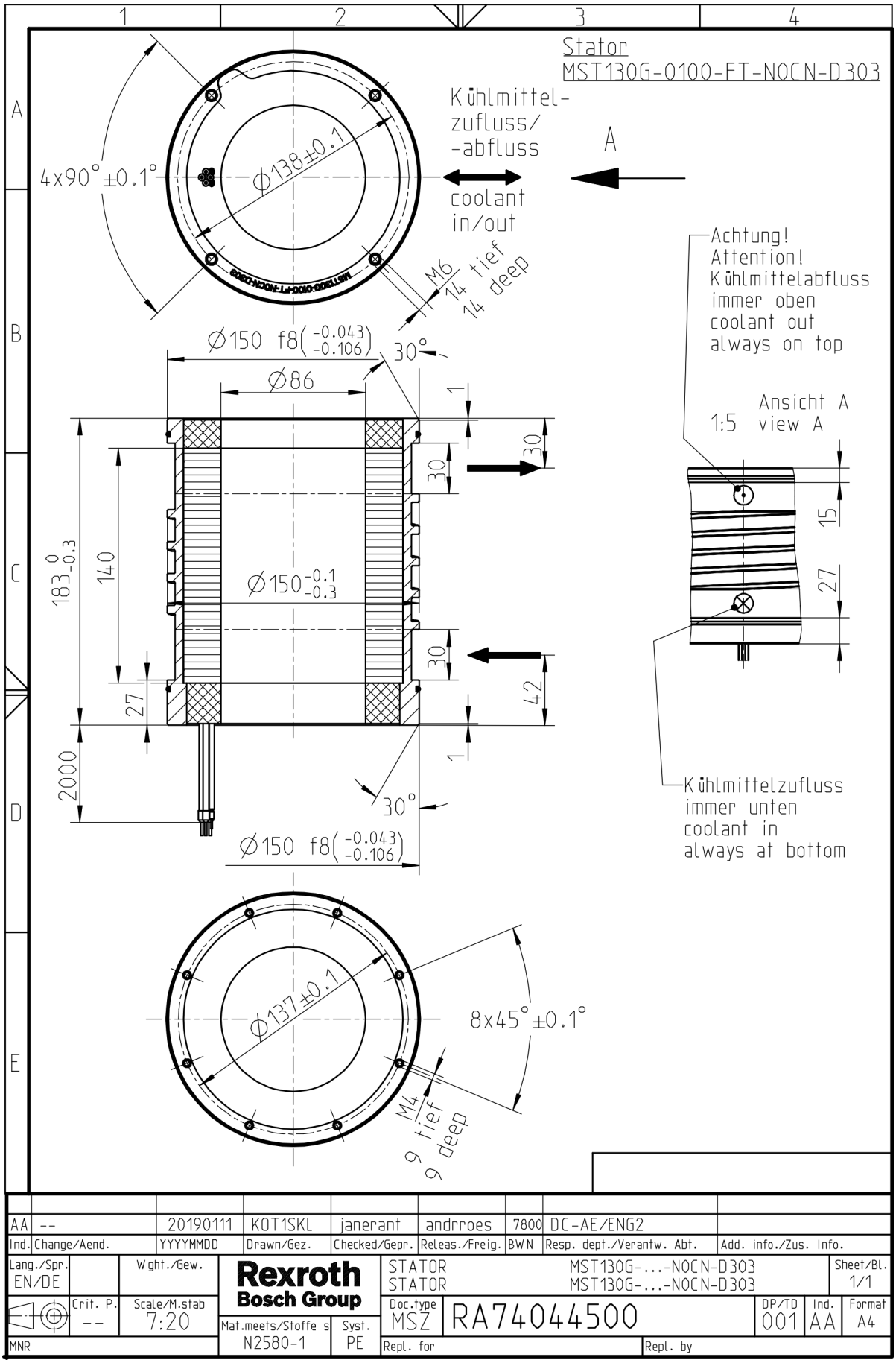
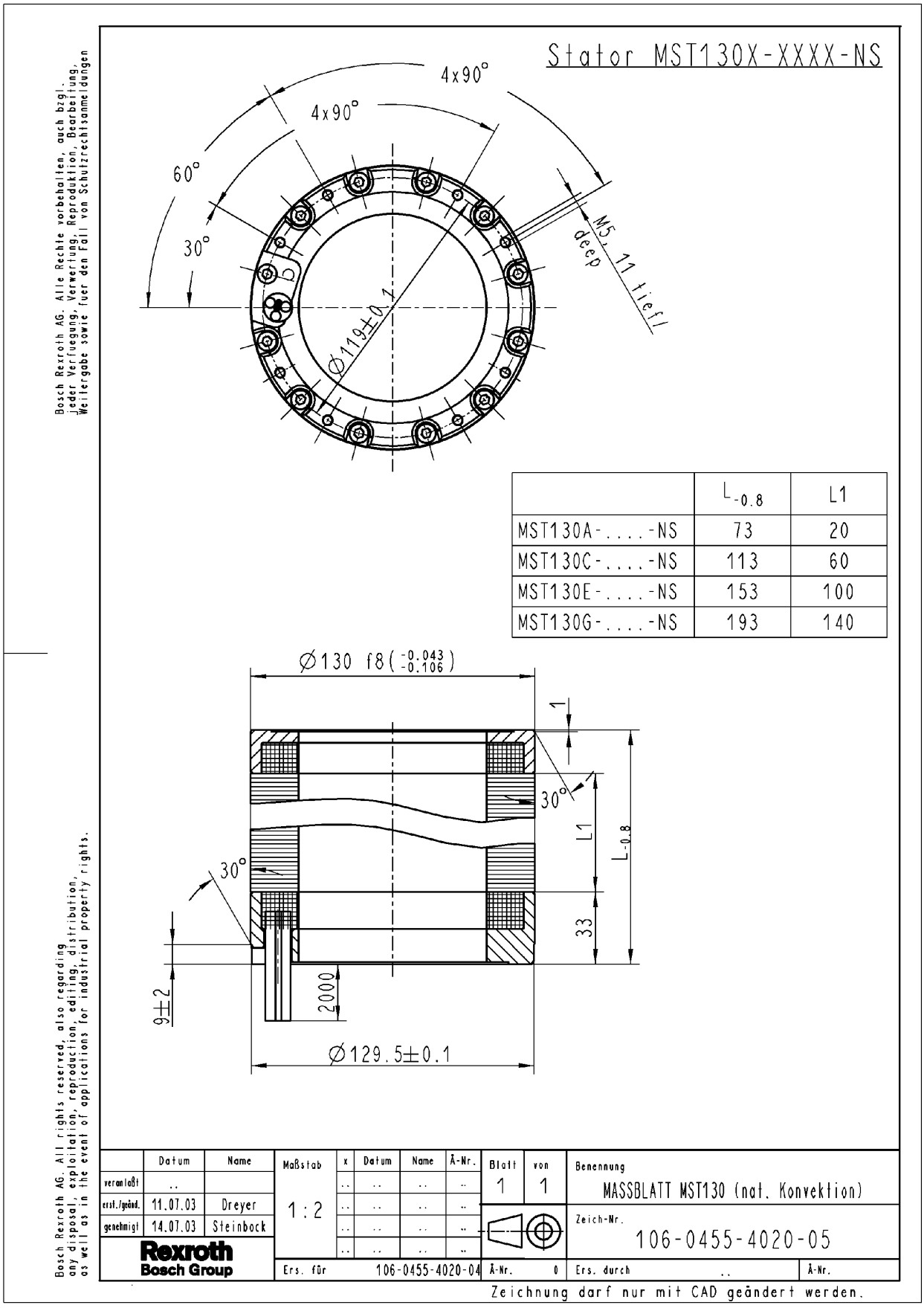


Fig. 89: MST130G, liquid cooled, "D303" design

4.2.8 Stator MST130, self-cooling, design "D303"

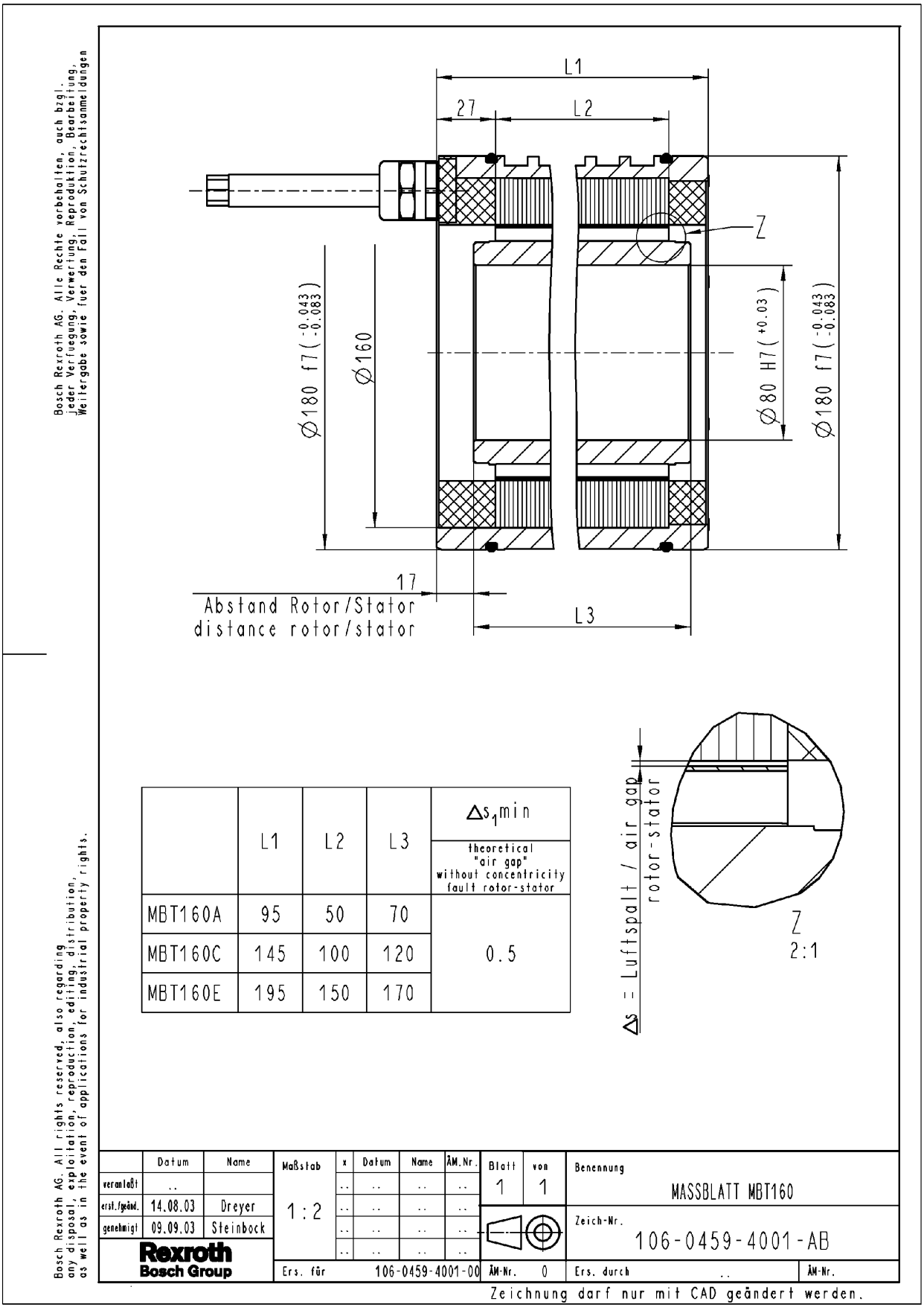


	$L_{-0.8}$	L1
MST130A-....-NS	73	20
MST130C-....-NS	113	60
MST130E-....-NS	153	100
MST130G-....-NS	193	140

Fig. 90: MST130, Self-cooling, design “D303”

4.3 Dimension sheets 160

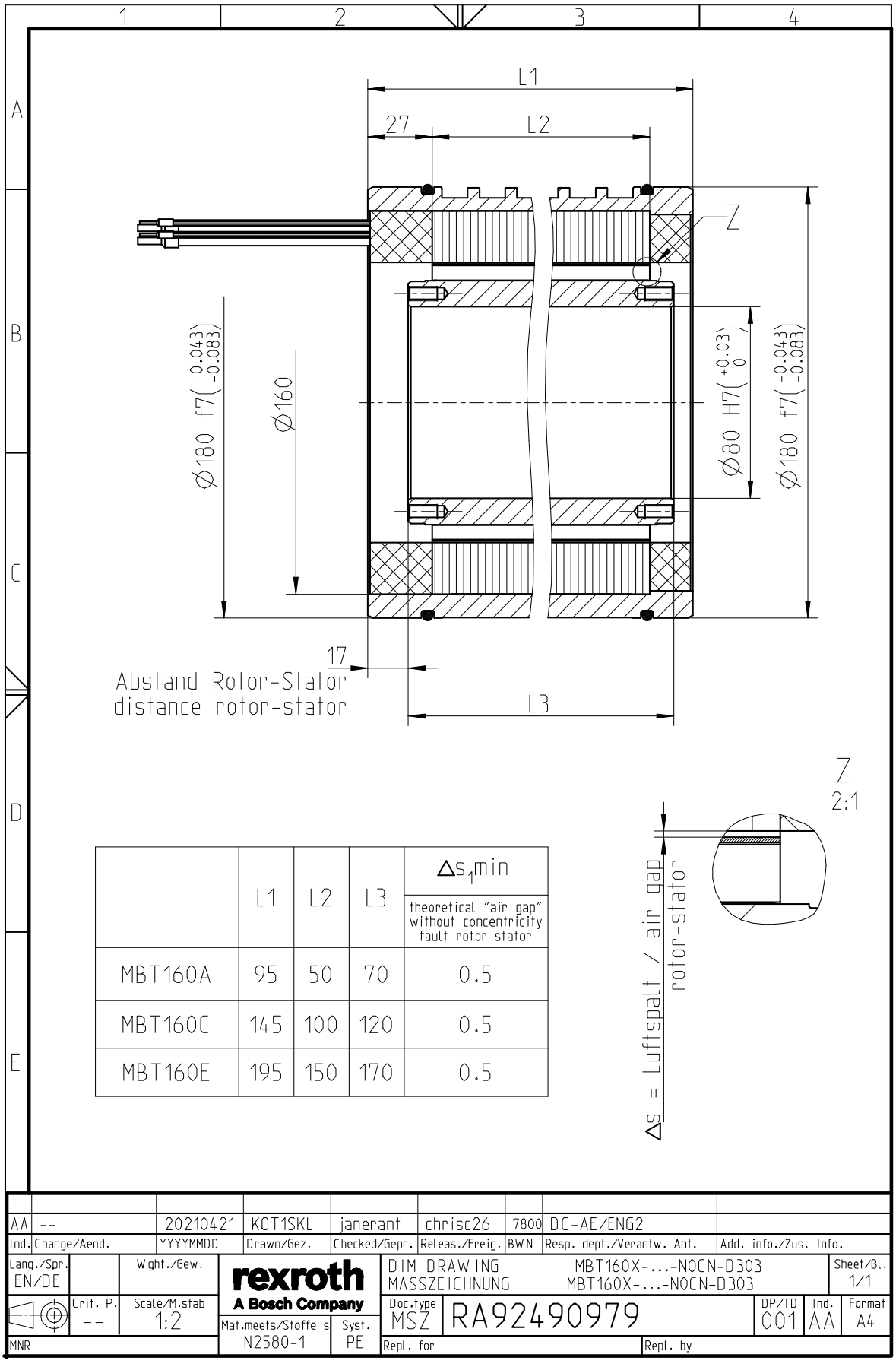
4.3.1 MBT160 with liquid cooling, “NNNN” design



	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT160A	95	50	70	0.5
MBT160C	145	100	120	
MBT160E	195	150	170	

Fig. 91: MBT160 with liquid cooling, “NNNN” design

4.3.2 MBT160 with liquid cooling, “D303” design



	L1	L2	L3	Δs_1 min 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

AA	--	20210421	KOT1SKL	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	MBT160X-...-NOCN-D303 MBT160X-...-NOCN-D303			Sheet/Bl. 1/1
Crit. P. --	Scale/M.stab 1:2		Doc.type MSZ	RA92490979	DP/TD 001	Ind. AA	Format A4
MNR		Mat.meets/Stoffe s N2580-1	Syst. PE	Repl. for	Repl. by		

Fig. 92: MBT160 with liquid cooling, “D303” design

4.3.3 Rotor MRT160

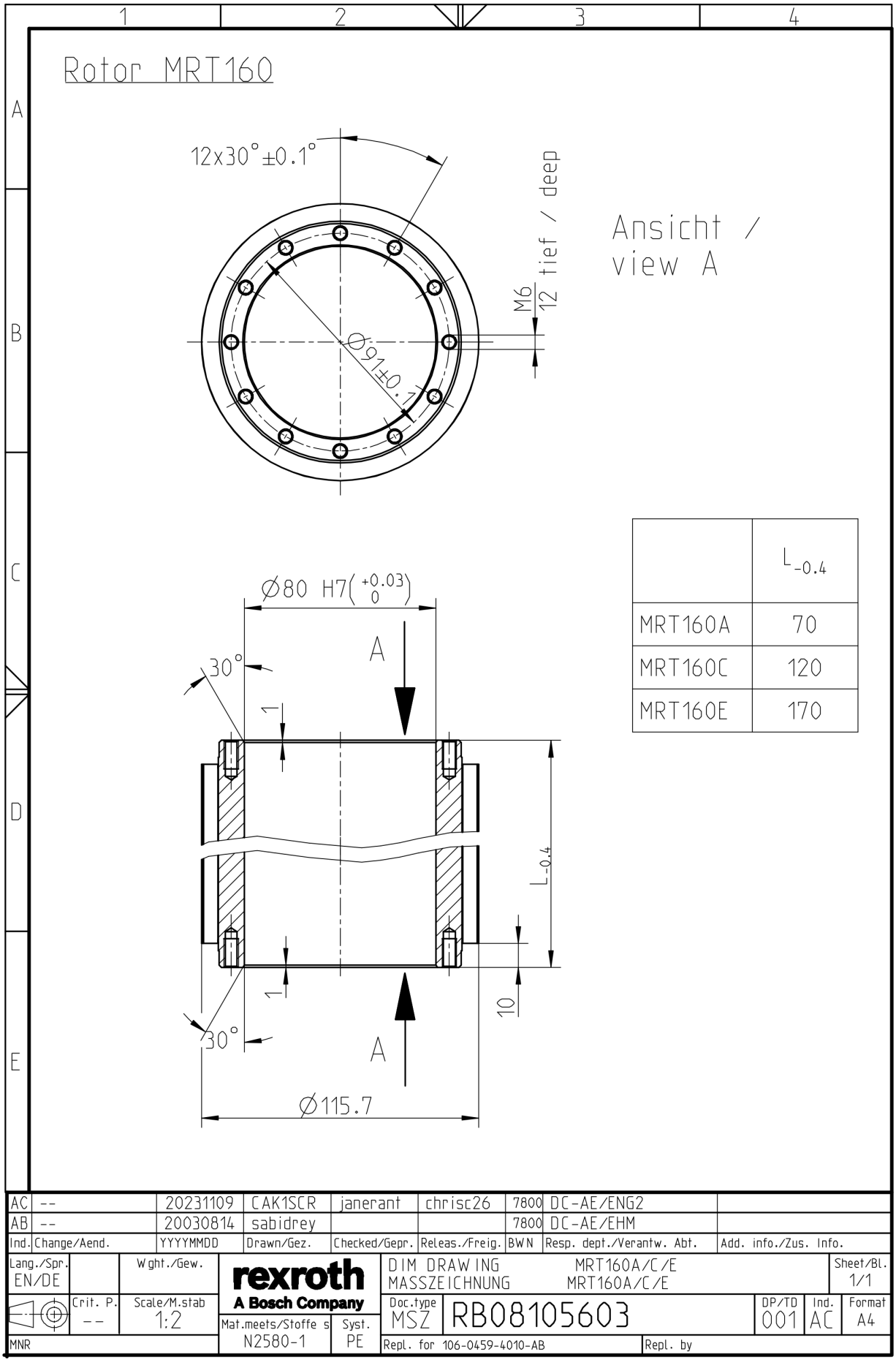


Fig. 93: Rotor MRT160

4.3.4 Stator MST160 in "NNNN" design

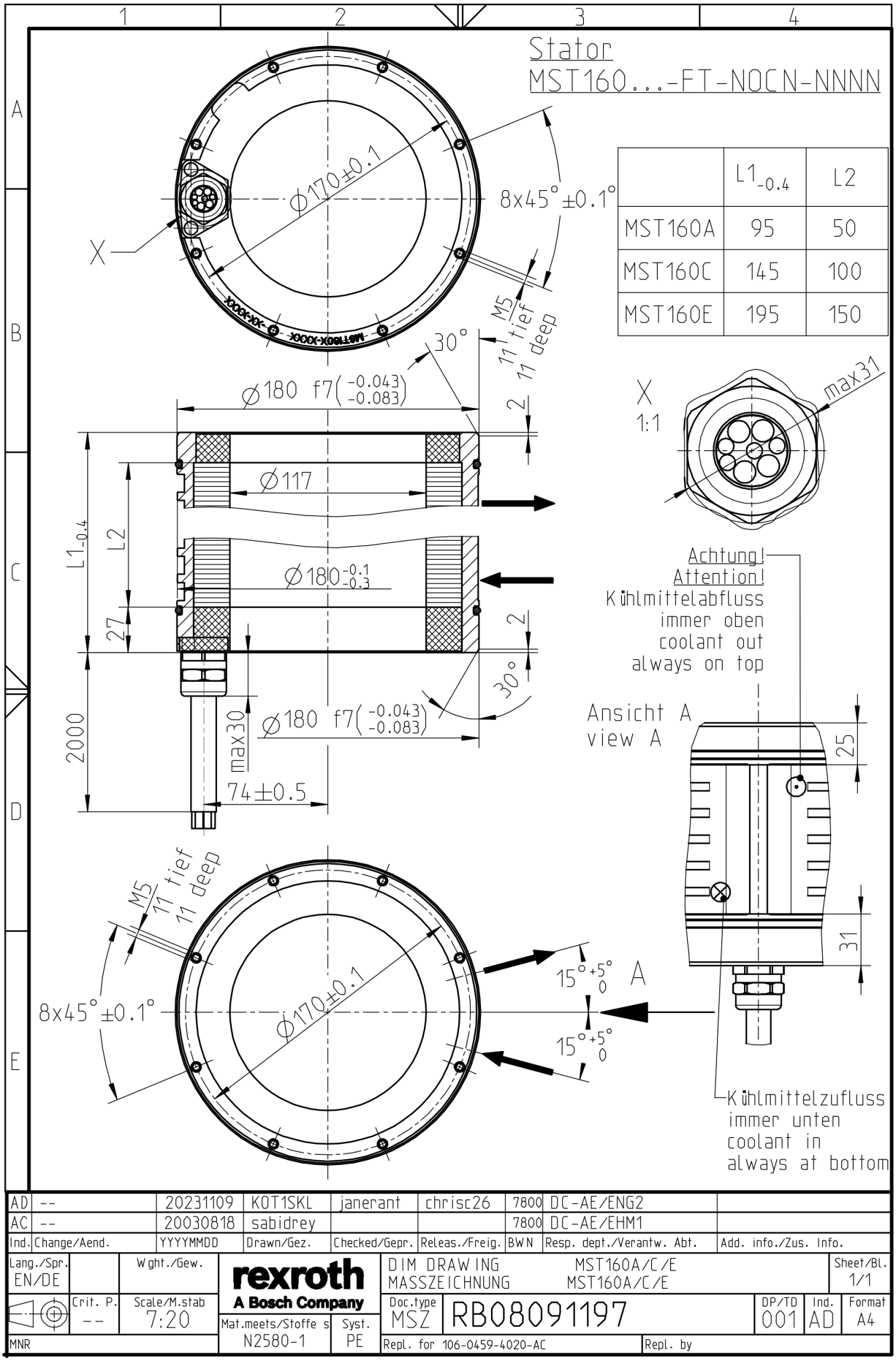


Fig. 94: Stator MST160

4.3.5 Stator MST160 in "D303" design

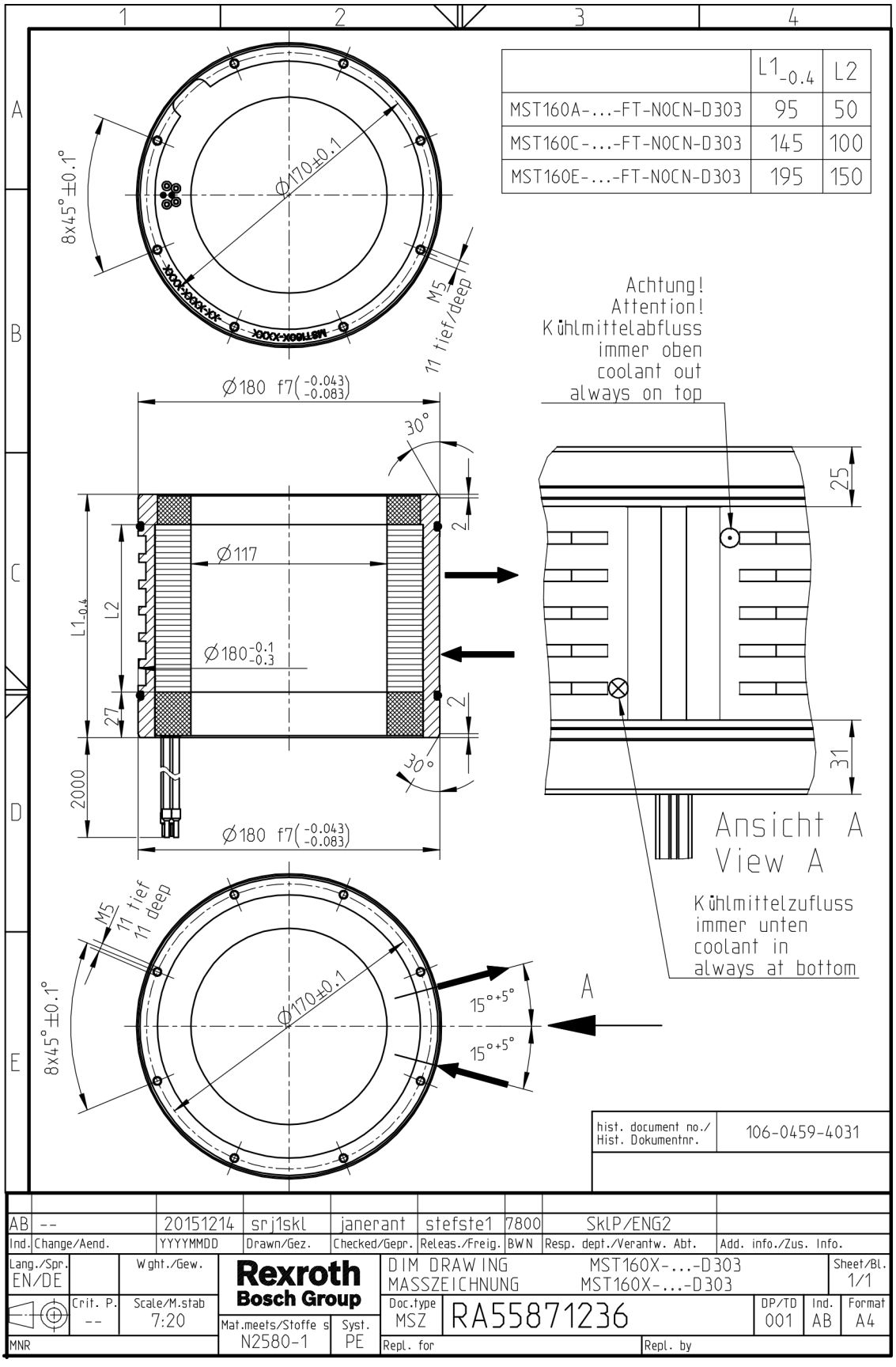
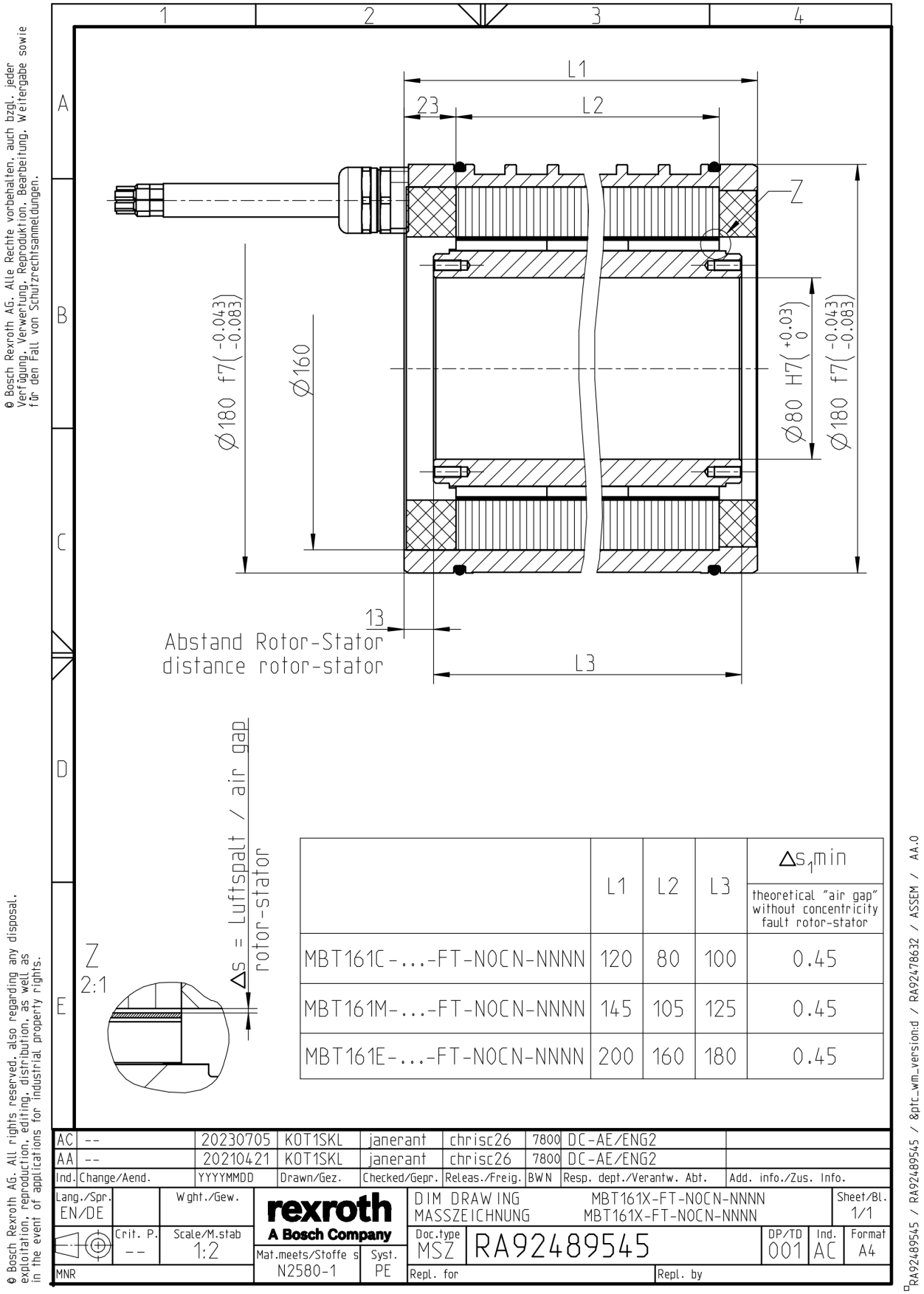


Fig. 95: MST160-....-D303

4.4 Dimension sheets 161

4.4.1 MBT161C/ -E / -M with liquid cooling, design "NNNN"



	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT161C-...-FT-NOCN-NNNN	120	80	100	0.45
MBT161M-...-FT-NOCN-NNNN	145	105	125	0.45
MBT161E-...-FT-NOCN-NNNN	200	160	180	0.45

Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.
AC	--	20230705	KOT1SKL	janerant	chrisc26	7800	DC-AE/ENG2	
AA	--	20210421	KOT1SKL	janerant	chrisc26	7800	DC-AE/ENG2	

Lang./Spr.: EN/DE | Wght./Gew. | Crit. P.: -- | Scale/M.stab: 1:2 | Mat.meets/Stoffe s: N2580-1 | Syst.: PE | MNR

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DIM DRAWING / MASSZEICHNUNG: MBT161X-FT-NOCN-NNNN / MBT161X-FT-NOCN-NNNN | Sheet/Bl.: 1/1

Doc.type: MSZ | RA92489545 | DP/TD: 001 | Ind.: AC | Format: A4

Repl. for | Repl. by

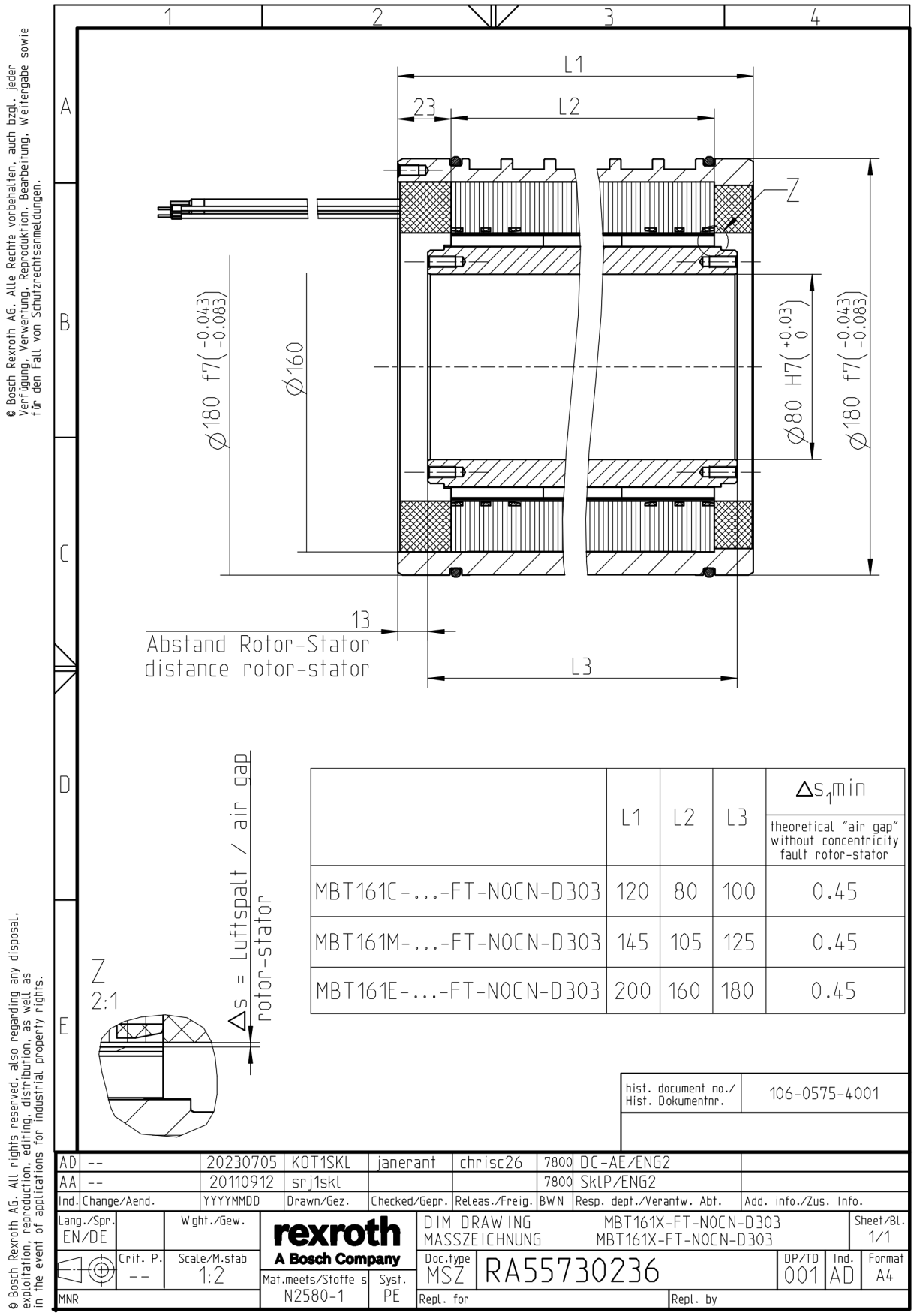
RA92489545 / RA92489545 / &ptc_wm_version:d / RA92478632 / ASSEM / AA.0

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Fig. 96: MBT161C/ -E / -M with liquid cooling, design "NNNN"

4.4.2 MBT161C/ -E / -M with liquid cooling, design "D303"



	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT161C-...-FT-NOCN-D303	120	80	100	0.45
MBT161M-...-FT-NOCN-D303	145	105	125	0.45
MBT161E-...-FT-NOCN-D303	200	160	180	0.45

AD	--	20230705	KOT1SKL	janerant	chrisc26	7800	DC-AE/ENG2	
AA	--	20110912	srj1skl			7800	SklP/ENG2	
Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.

hist. document no./ Hist. Dokumentnr.: 106-0575-4001

Lang./Spr.: EN/DE | Wght./Gew. | Crit. P.: -- | Scale/M.stab: 1:2 | Mat.meets/Stoffe s: N2580-1 | Syst.: PE | MNR

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DIM DRAWING MASSZEICHNUNG: MBT161X-FT-NOCN-D303 / MBT161X-FT-NOCN-D303

Sheet/Bl.: 1/1 | Doc.type: MSZ | RA55730236 | DP/TD: 001 | Ind.: AD | Format: A4

Repl. for | Repl. by

RA55730236 / DB275010 / AD.1 / DB275009 / ASSEM / Bosch-DC

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Fig. 97: MBT161C/ -E / -M with liquid cooling, design "D303"

4.4.3 MBT161G with liquid cooling, design "D303"

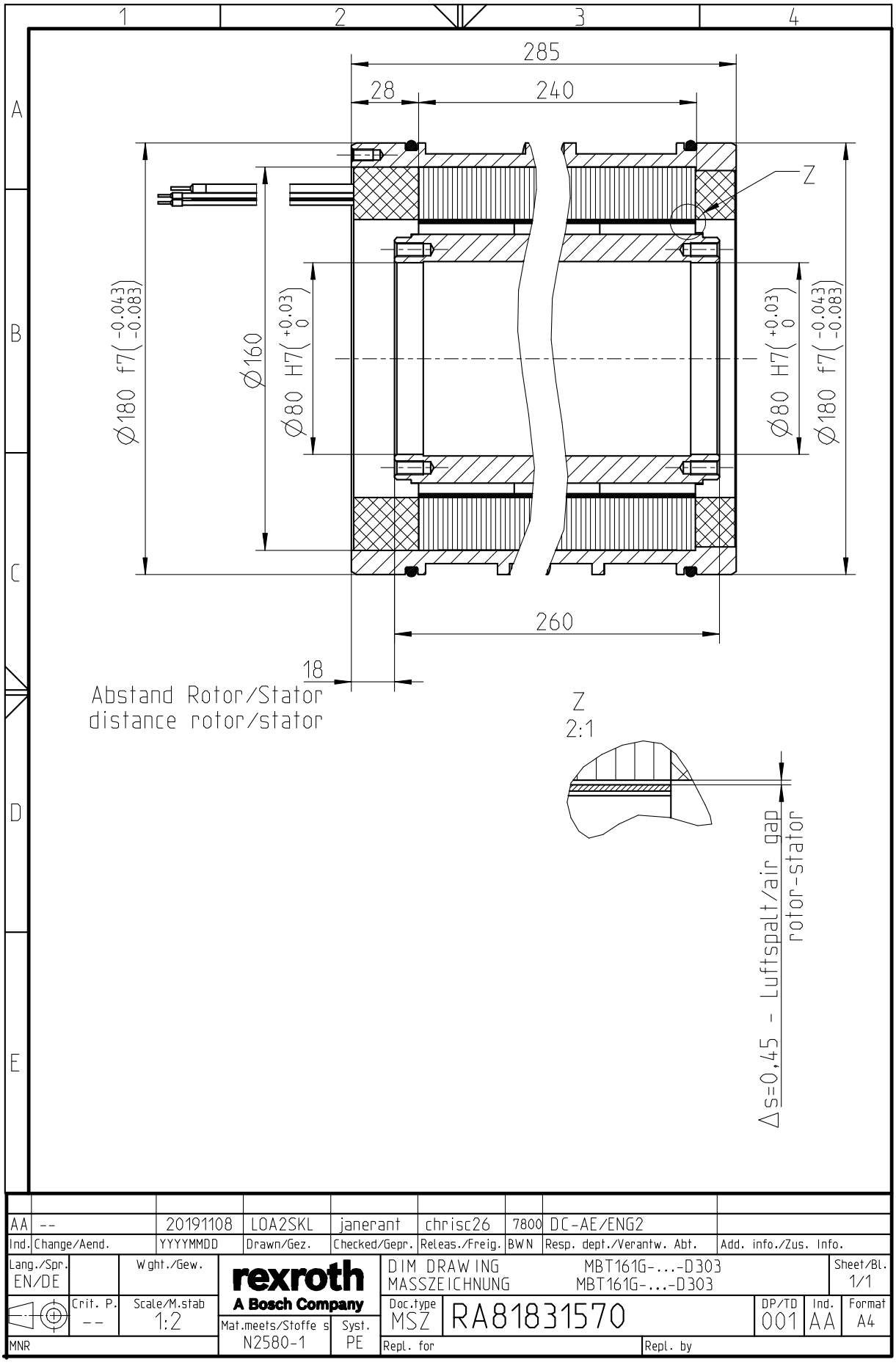
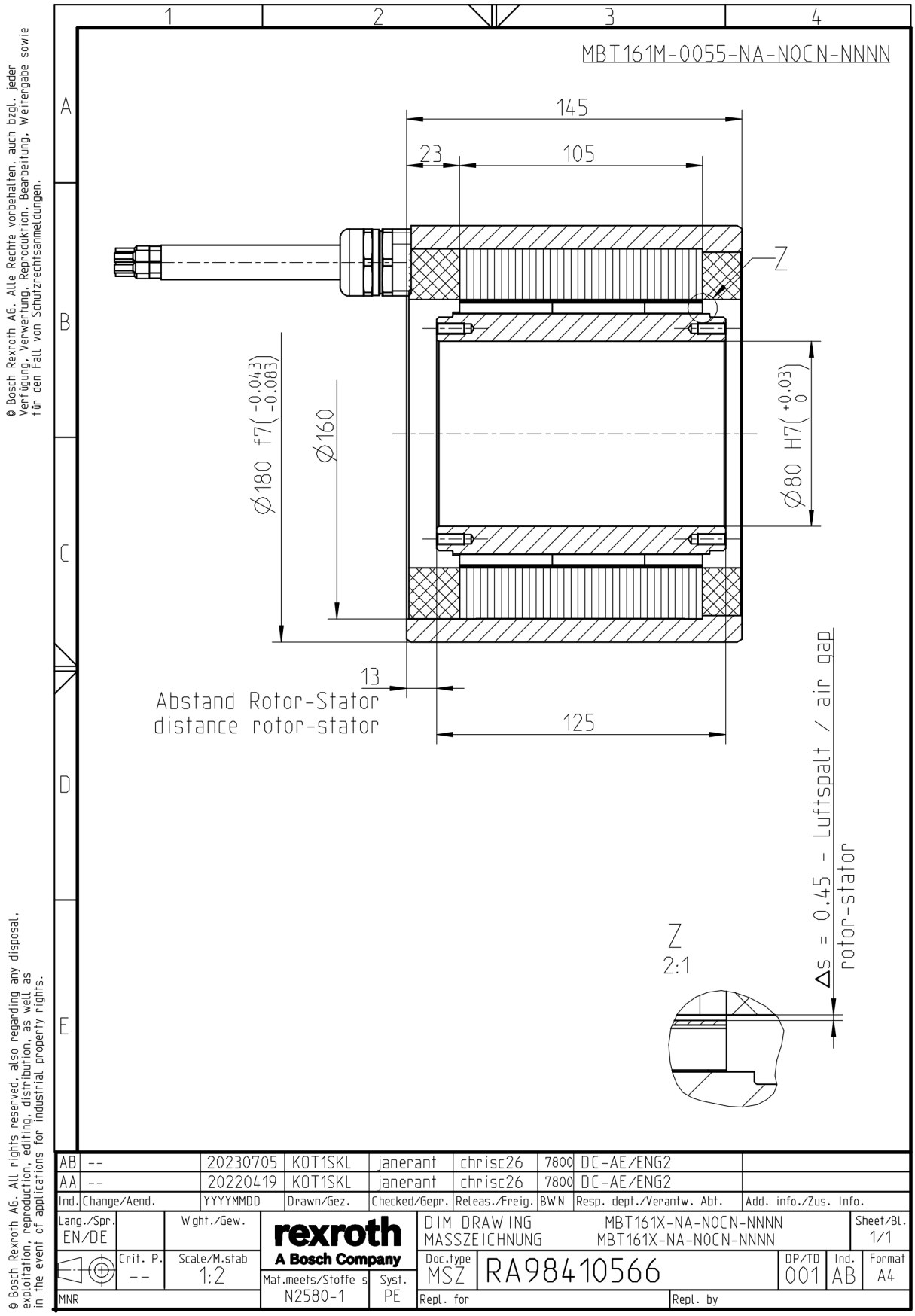


Fig. 98: MBT161G-...-D303 with liquid cooling

4.4.4 MBT161M with self-cooling, design "NNNN"



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Fig. 99: MBT161M with self-cooling, design "NNNN"

4.4.5 MBT161M with self-cooling, design "D303"

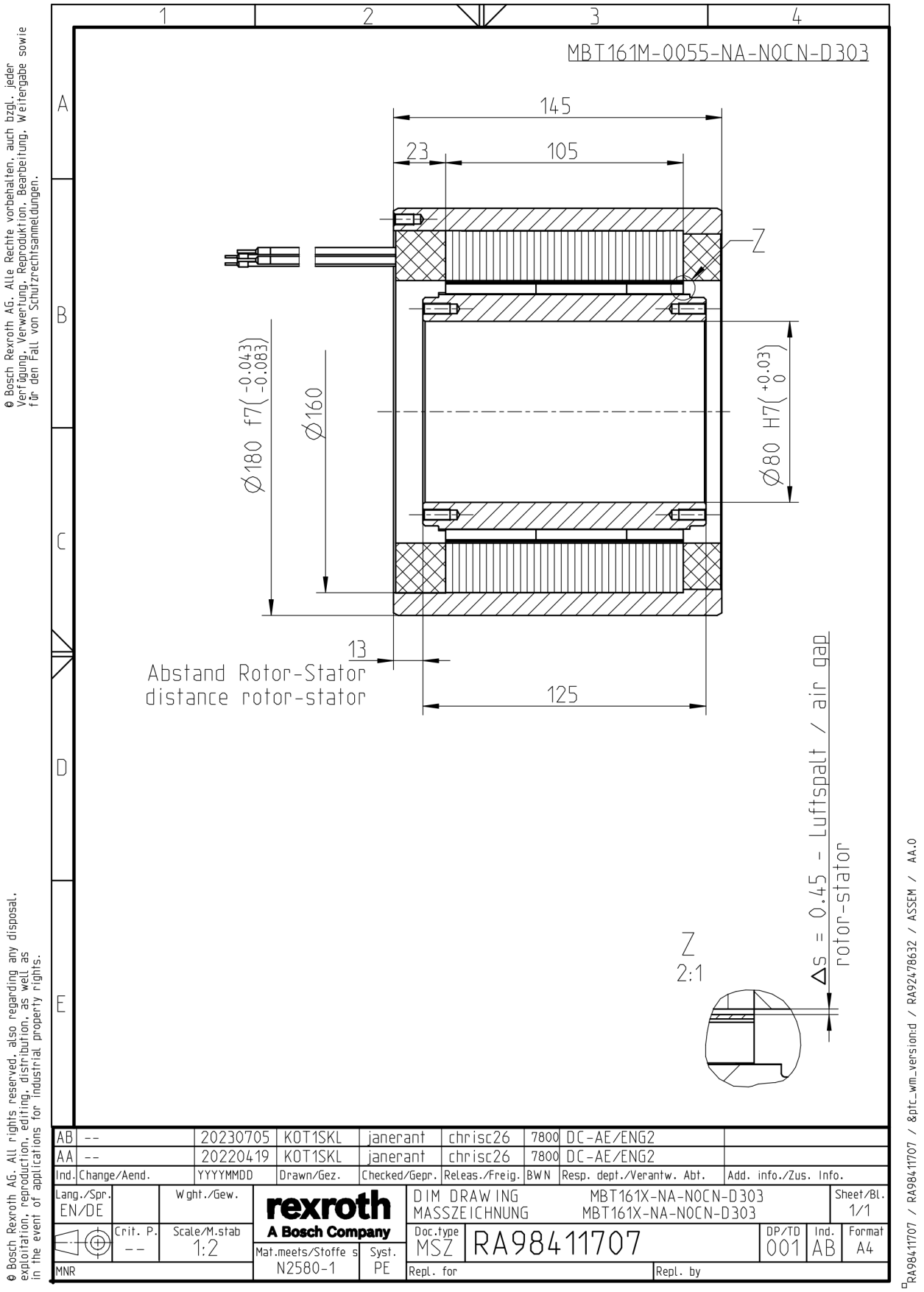


Fig. 100: MBT161M with self-cooling, design "D303"

4.4.6 Rotor MRT161C/ -E -M

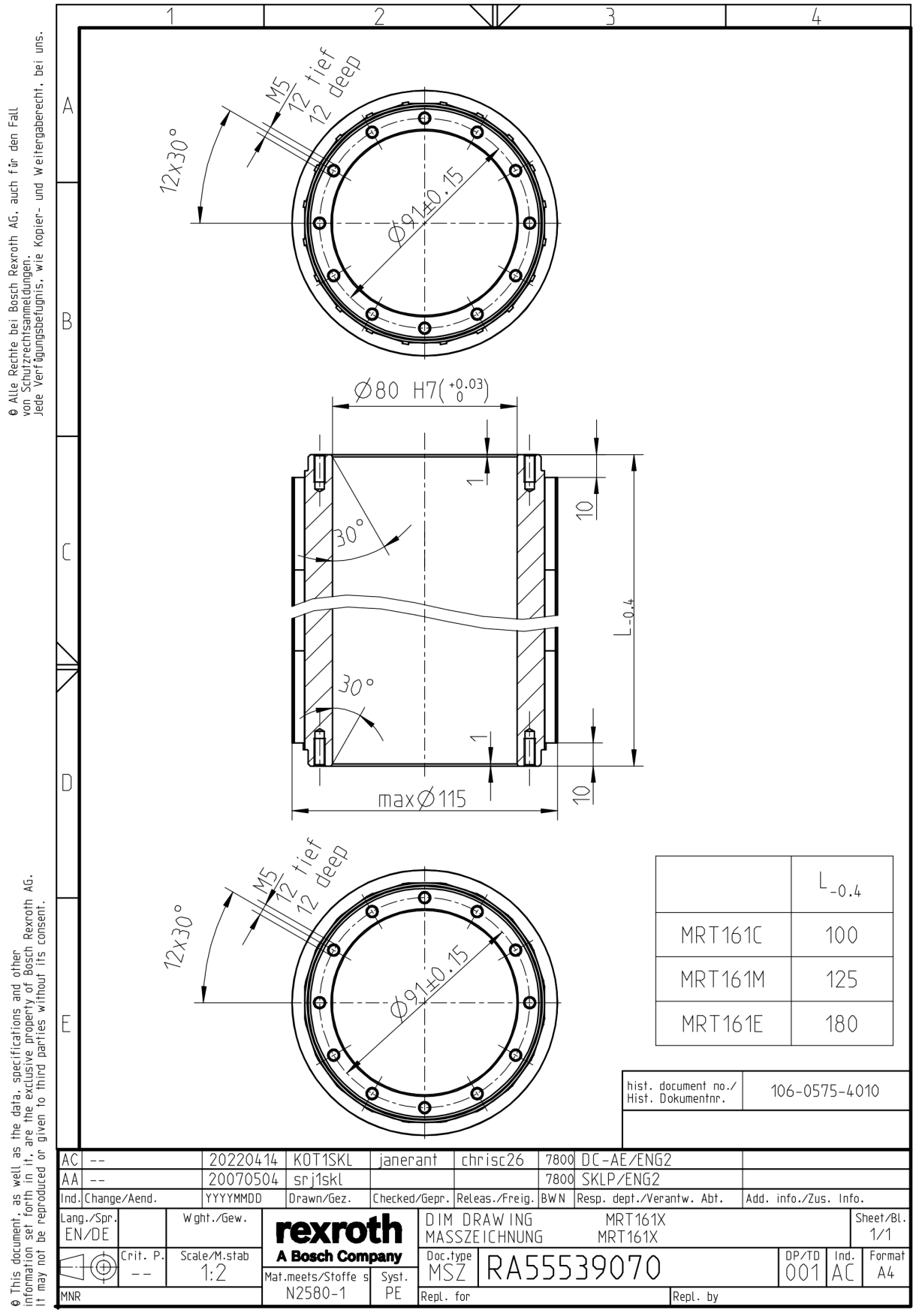


Fig. 101: MRT161C/ -E / -M

4.4.7 Rotor MRT161G

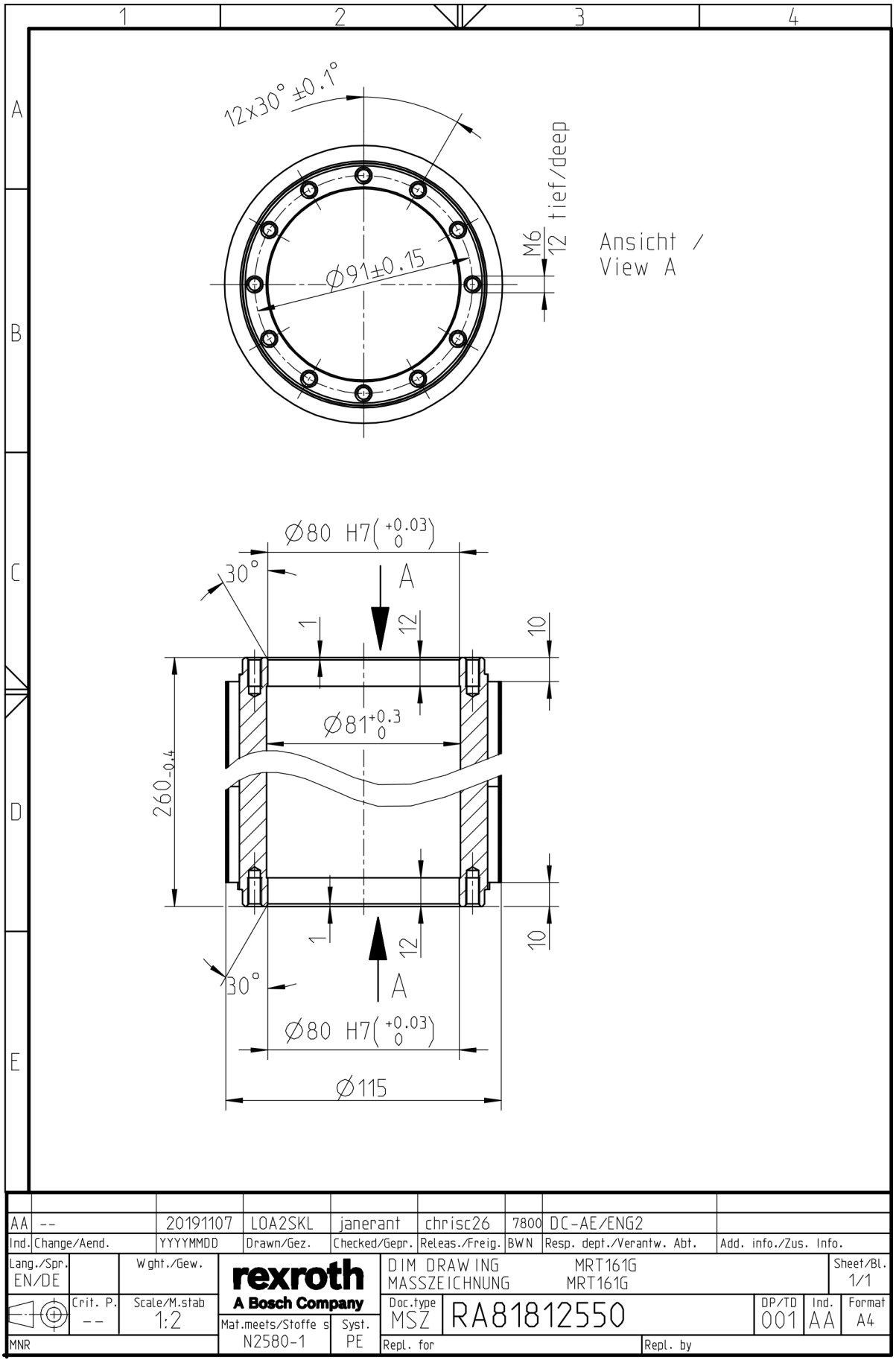


Fig. 102: MRT161G

4.4.8 Stator MST161_-...-NNNN with liquid cooling

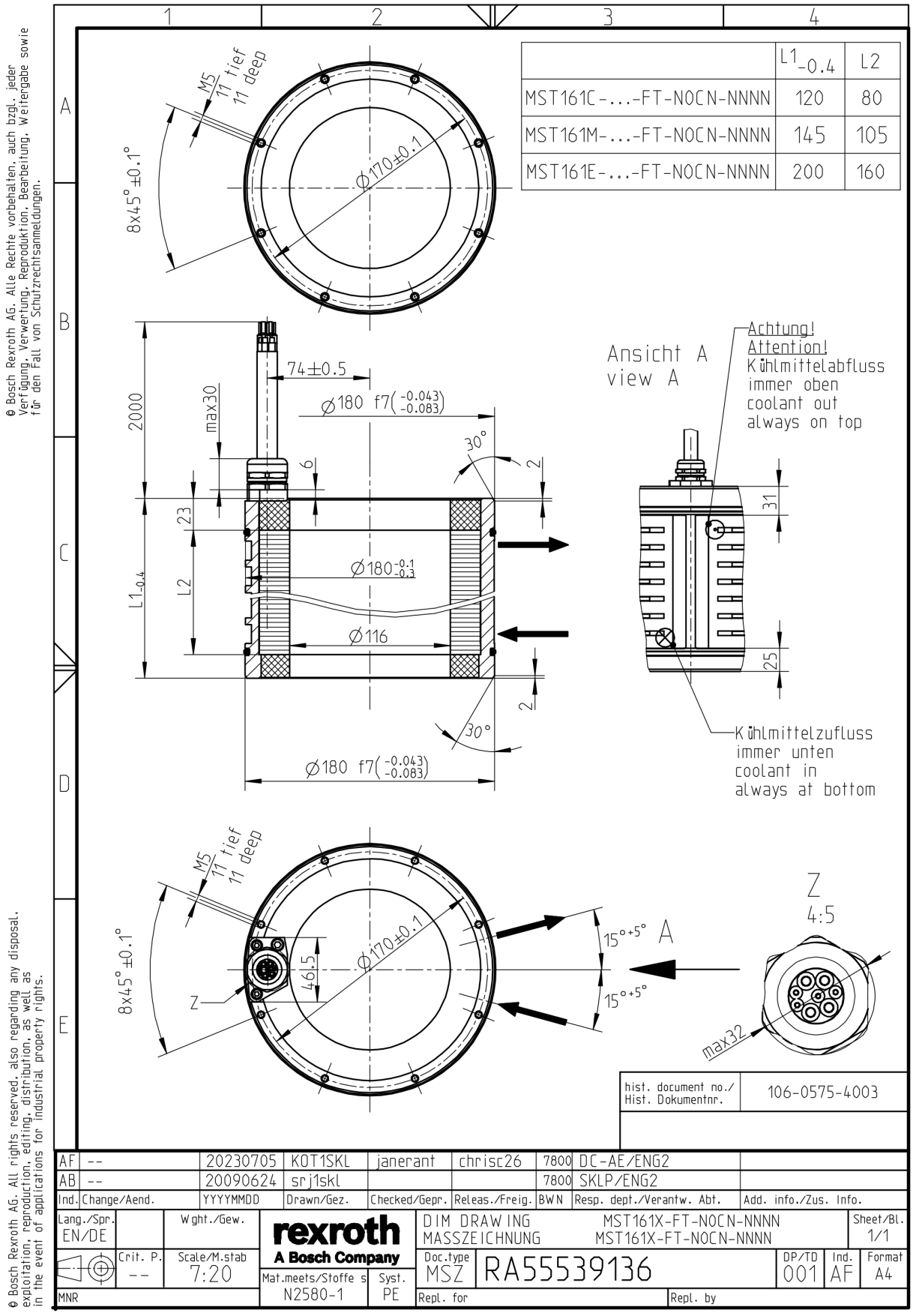
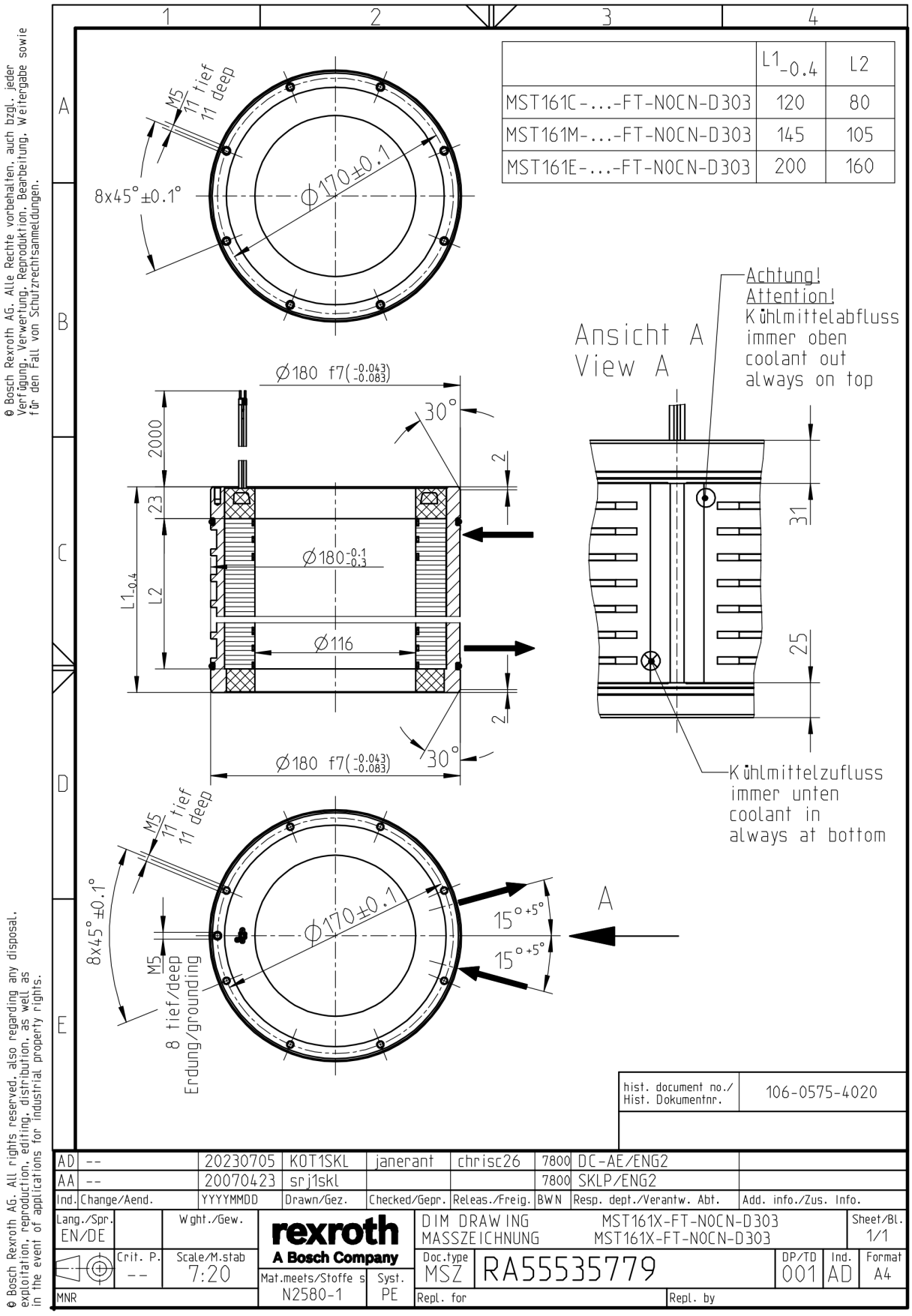


Fig. 103: MST161...-NNNN with liquid cooling

4.4.9 Stator MST161C/ -E- / -M...-D303 with liquid cooling



	L1 -0.4	L2
MST161C-...-FT-NOCN-D303	120	80
MST161M-...-FT-NOCN-D303	145	105
MST161E-...-FT-NOCN-D303	200	160

Fig. 104: MST161C/ -E / -M -...-D303 with liquid cooling

4.4.10 Stator MST161G-...-D303 with liquid cooling

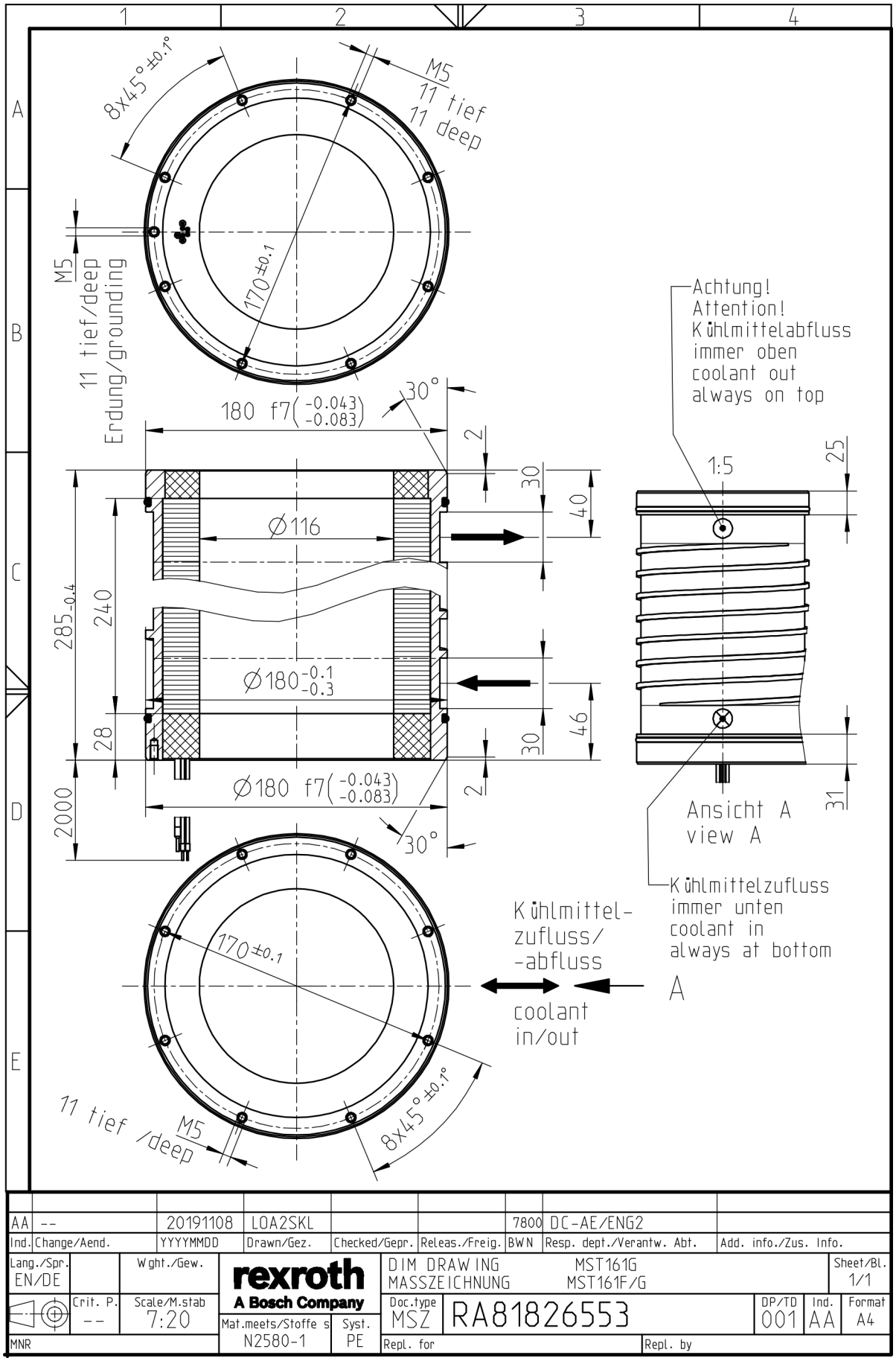


Fig. 105: MST161G-...-D303 with liquid cooling

4.4.11 Stator MST161M-...-NNNN with self-cooling

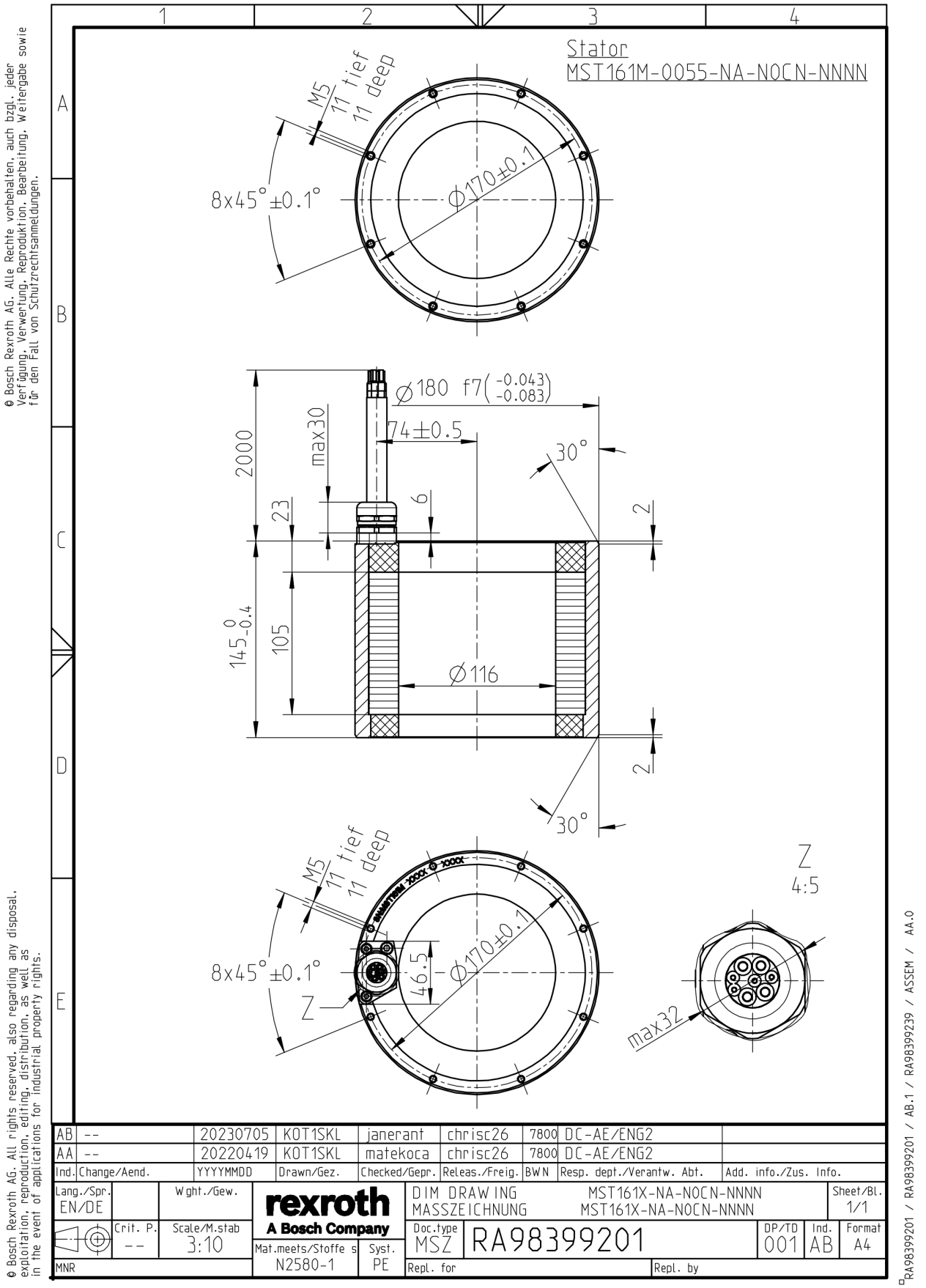


Fig. 106: Stator MST161M-...-NNNN with self-cooling

4.4.12 Stator MST161M-...-D303 with self-cooling

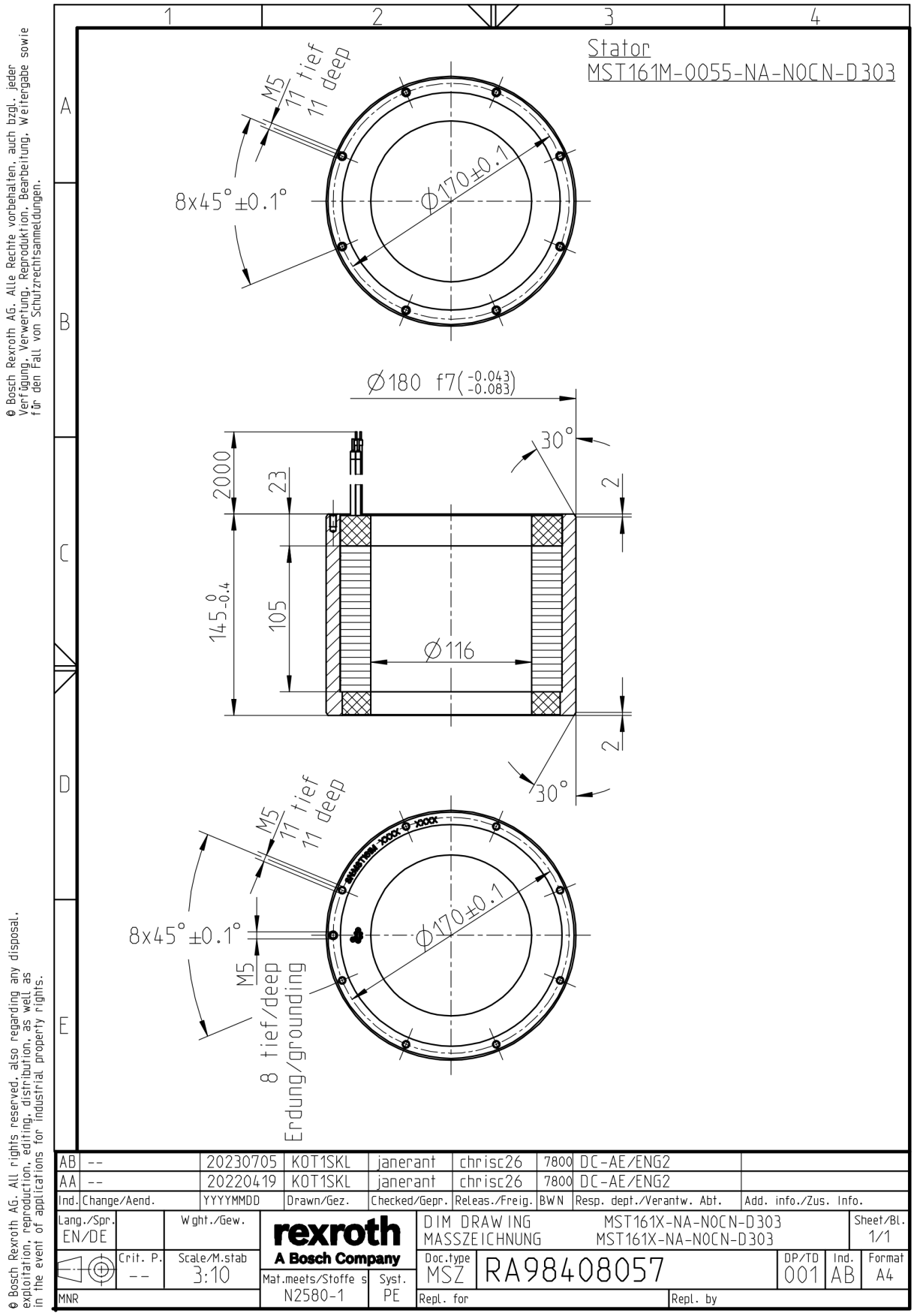
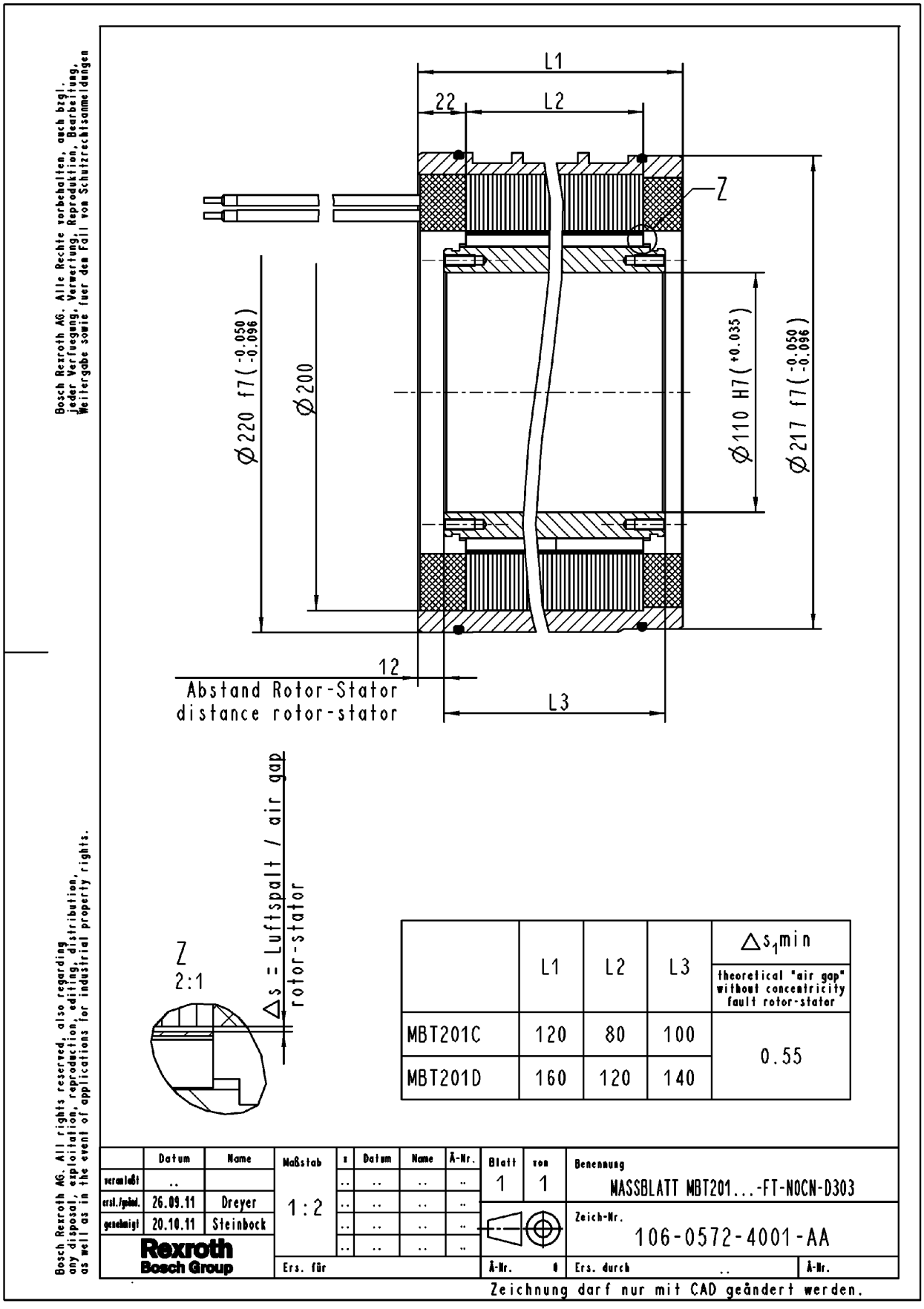


Fig. 107: Stator MST161M-...-D303 with self-cooling

4.5 Dimension sheets 201

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



	L1	L2	L3	△s1min theoretical "air gap" without concentricity fault rotor-stator
MBT201C	120	80	100	0.55
MBT201D	160	120	140	

Fig. 108: MBT201C/ -D, electrical connection "-_CN-D303"

4.5.2 MBT201F, electrical connection "-_CN-NNNN"

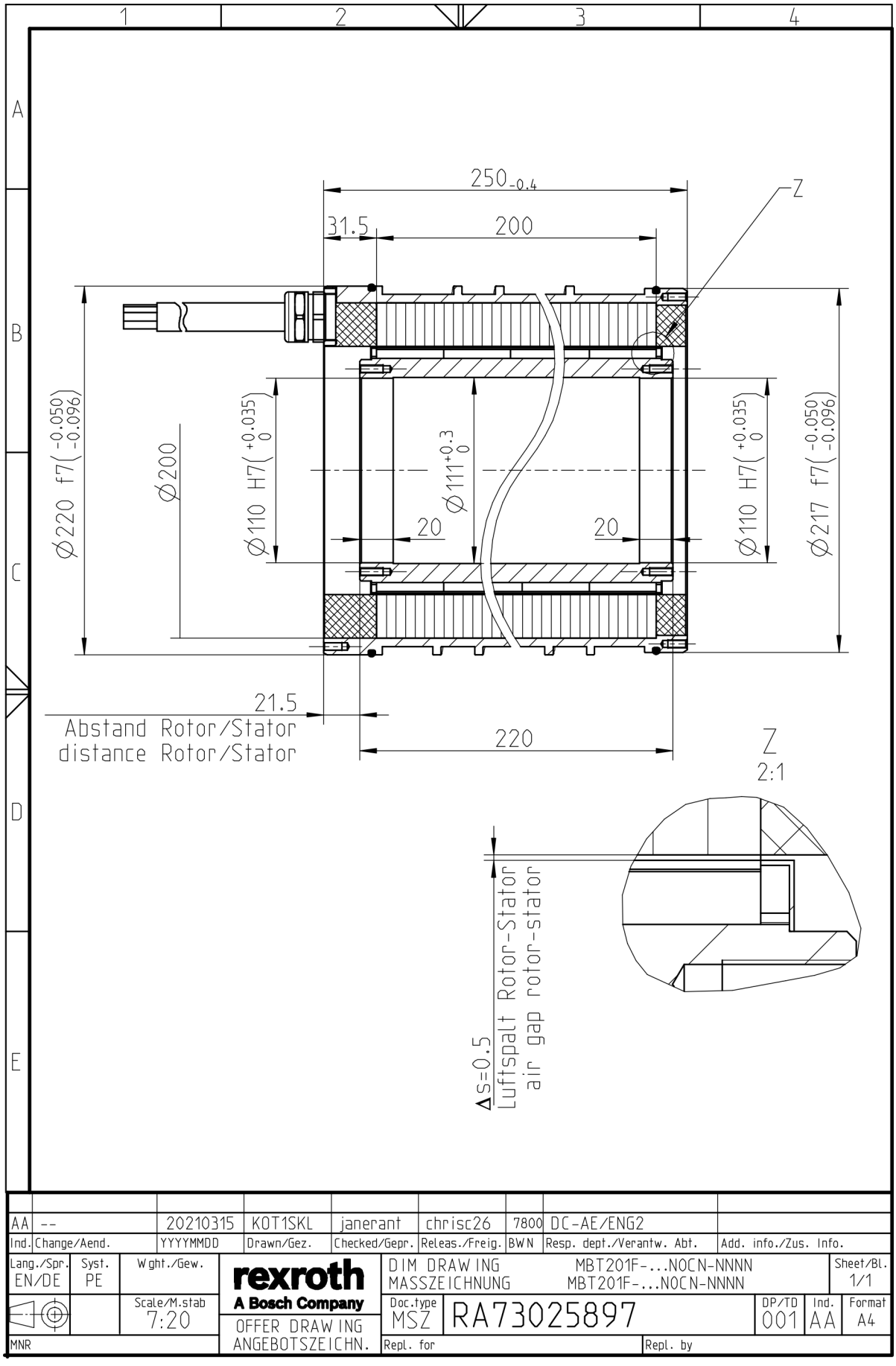
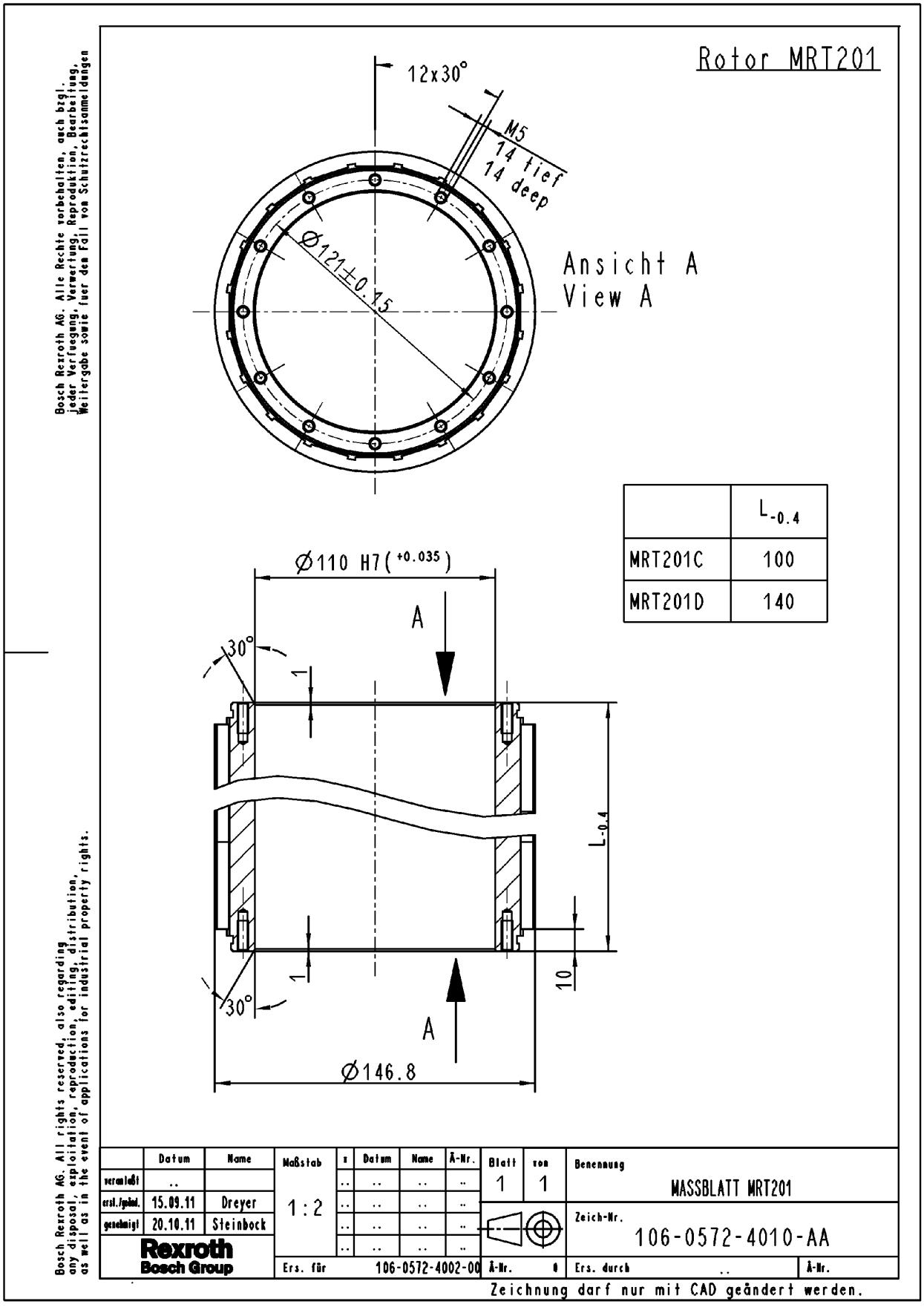


Fig. 109: MBT201F, electrical connection "-_CN-NNNN"

4.5.3 MRT201C/ -D



	L-0.4
MRT201C	100
MRT201D	140

Fig. 110: MRT201C/ -D

4.5.4 MRT201F

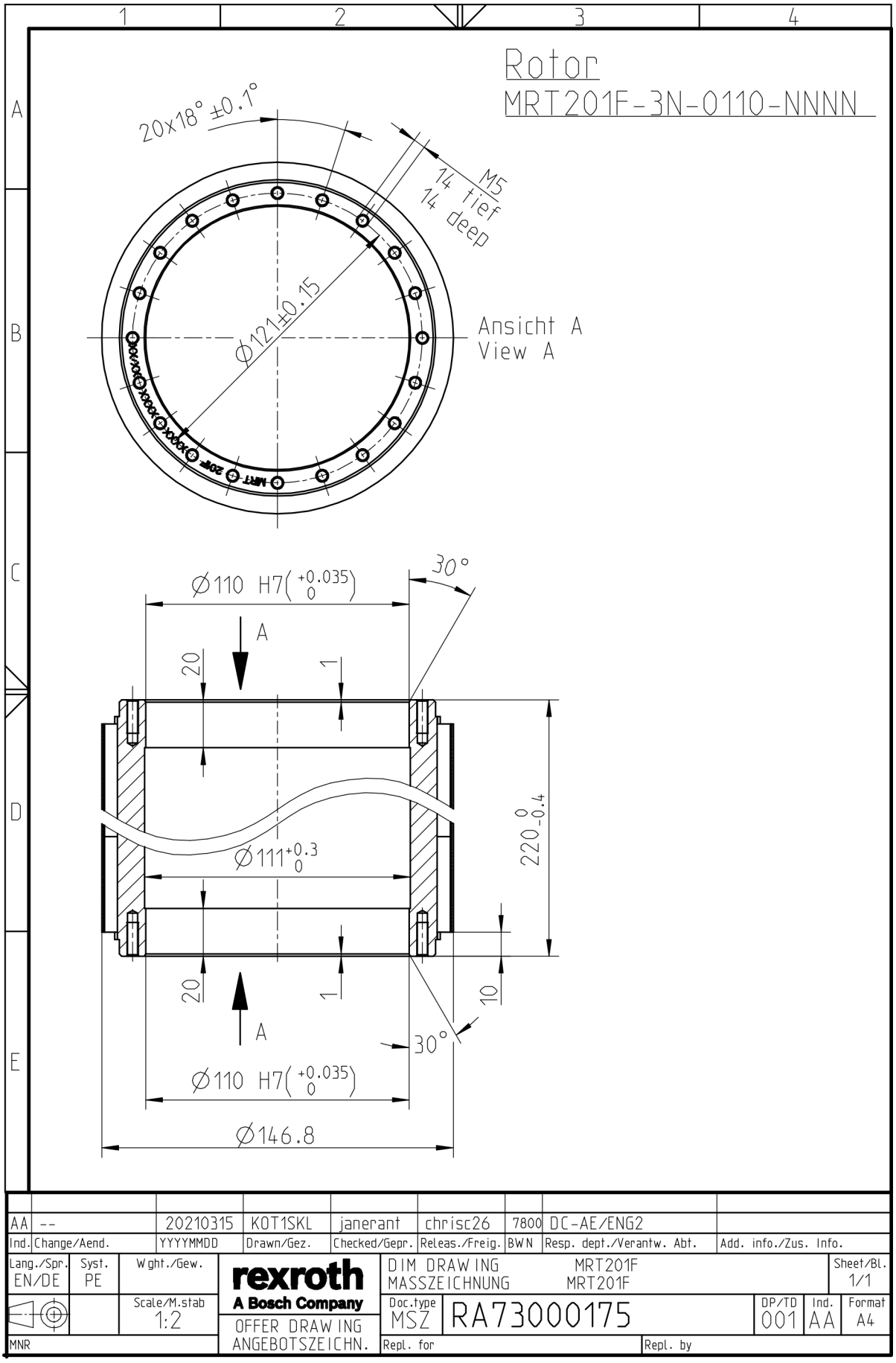


Fig. 111: MRT201F

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

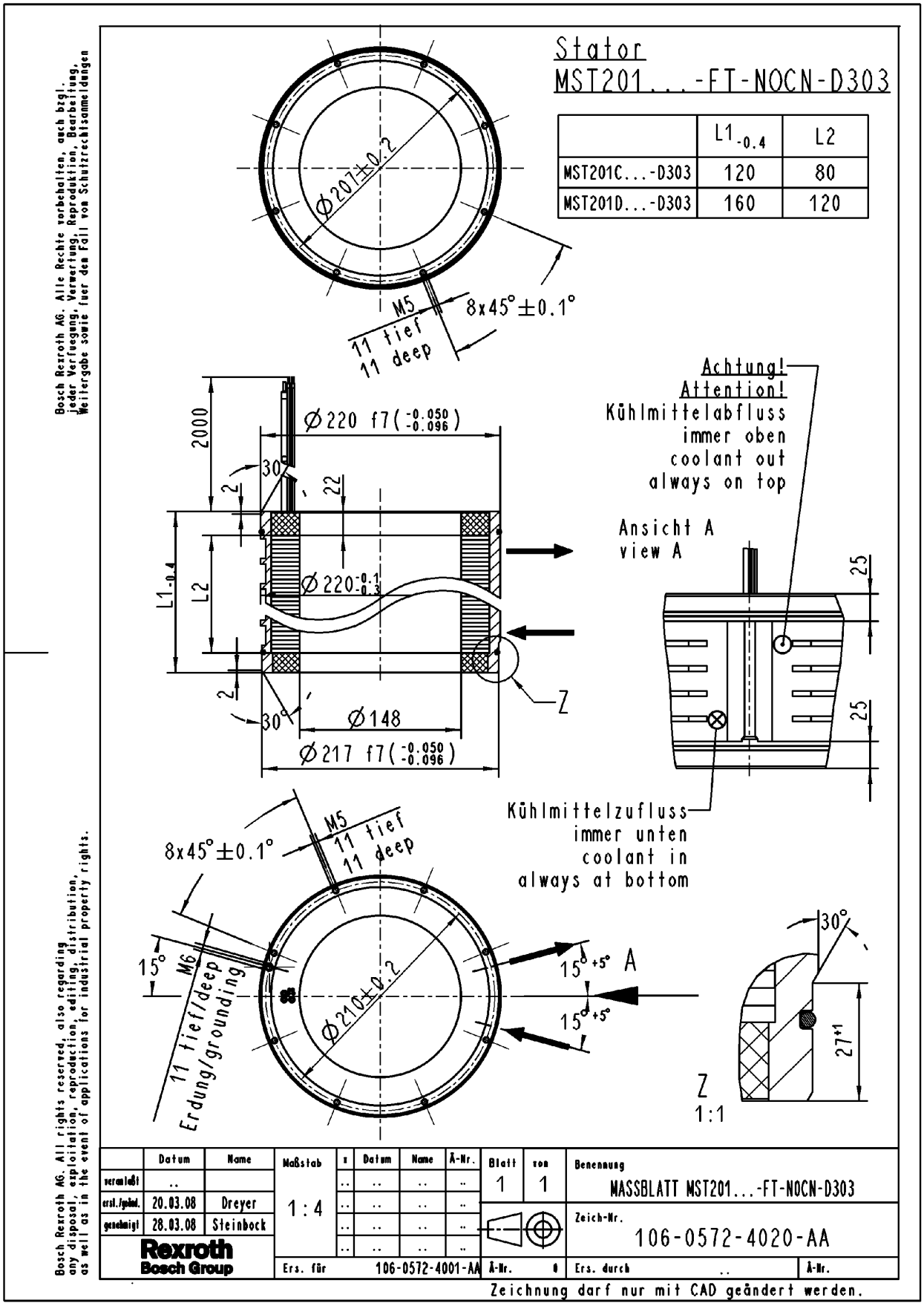


Fig. 112: MST201C/ -D, electrical connection "-_CN-D303"

4.5.6 MST201F, electrical connection "-_CN-NNNN"

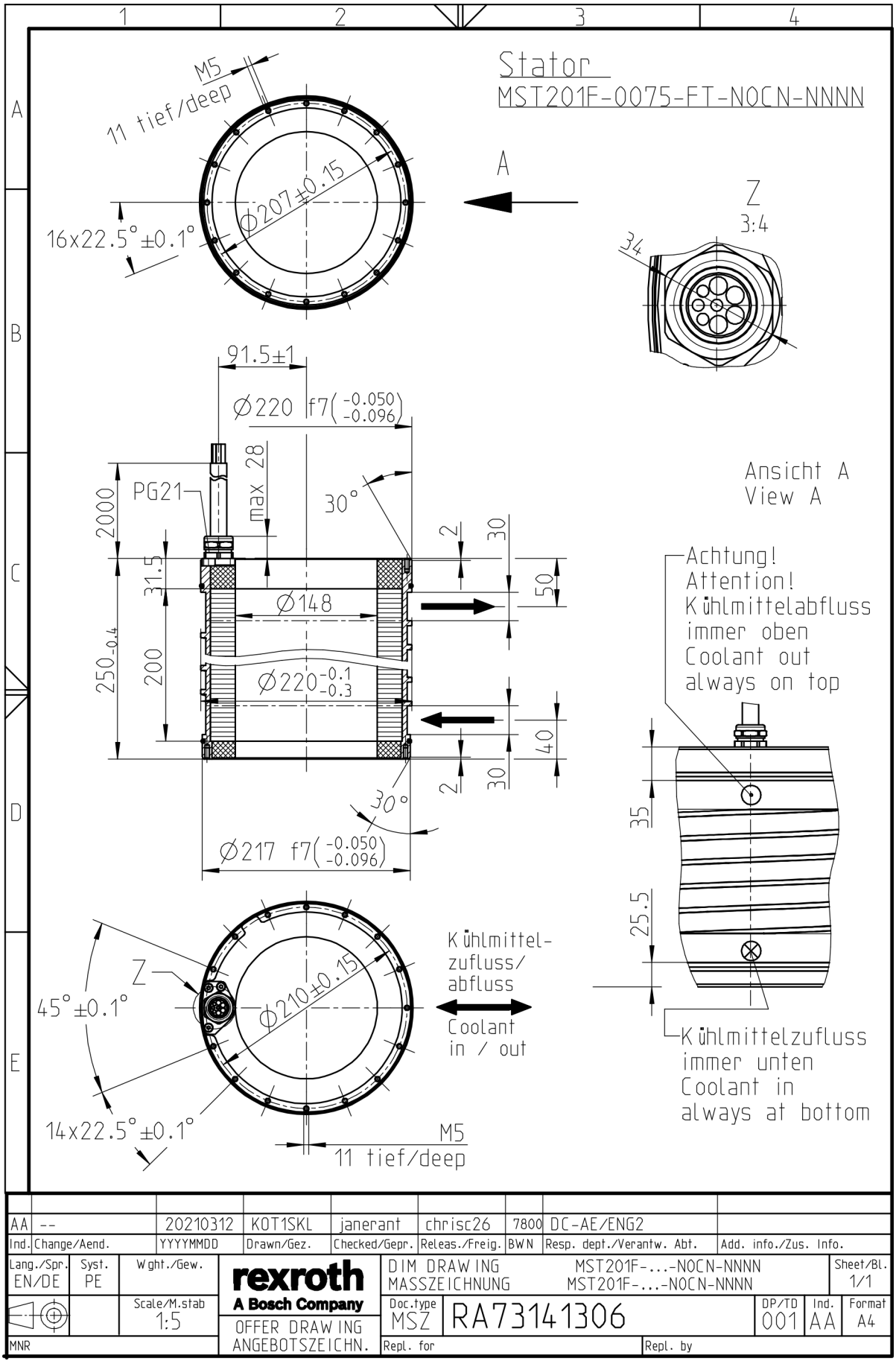
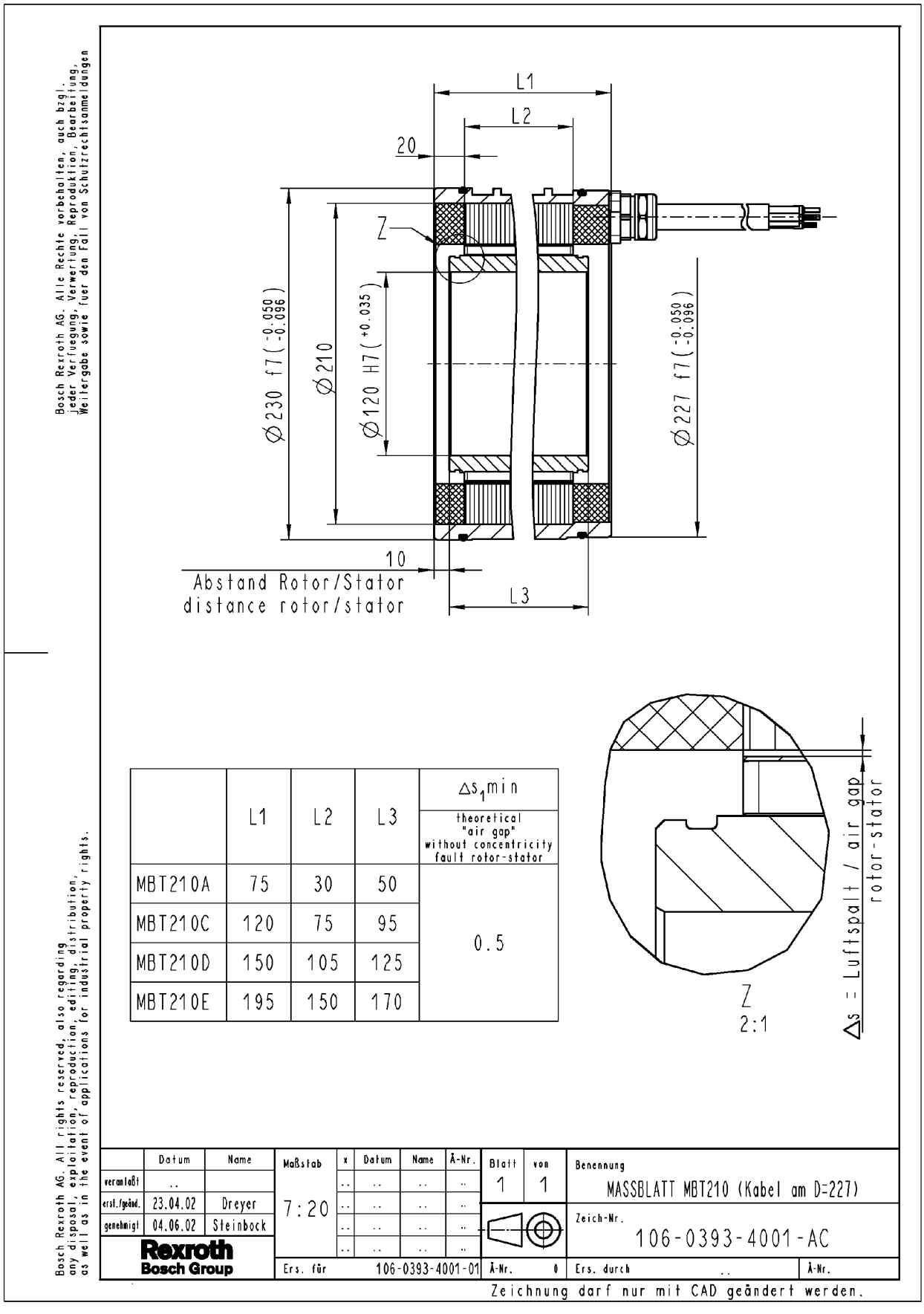


Fig. 113: MST201F, electrical connection "-_CN-NNNN"

4.6 Dimension sheets 210

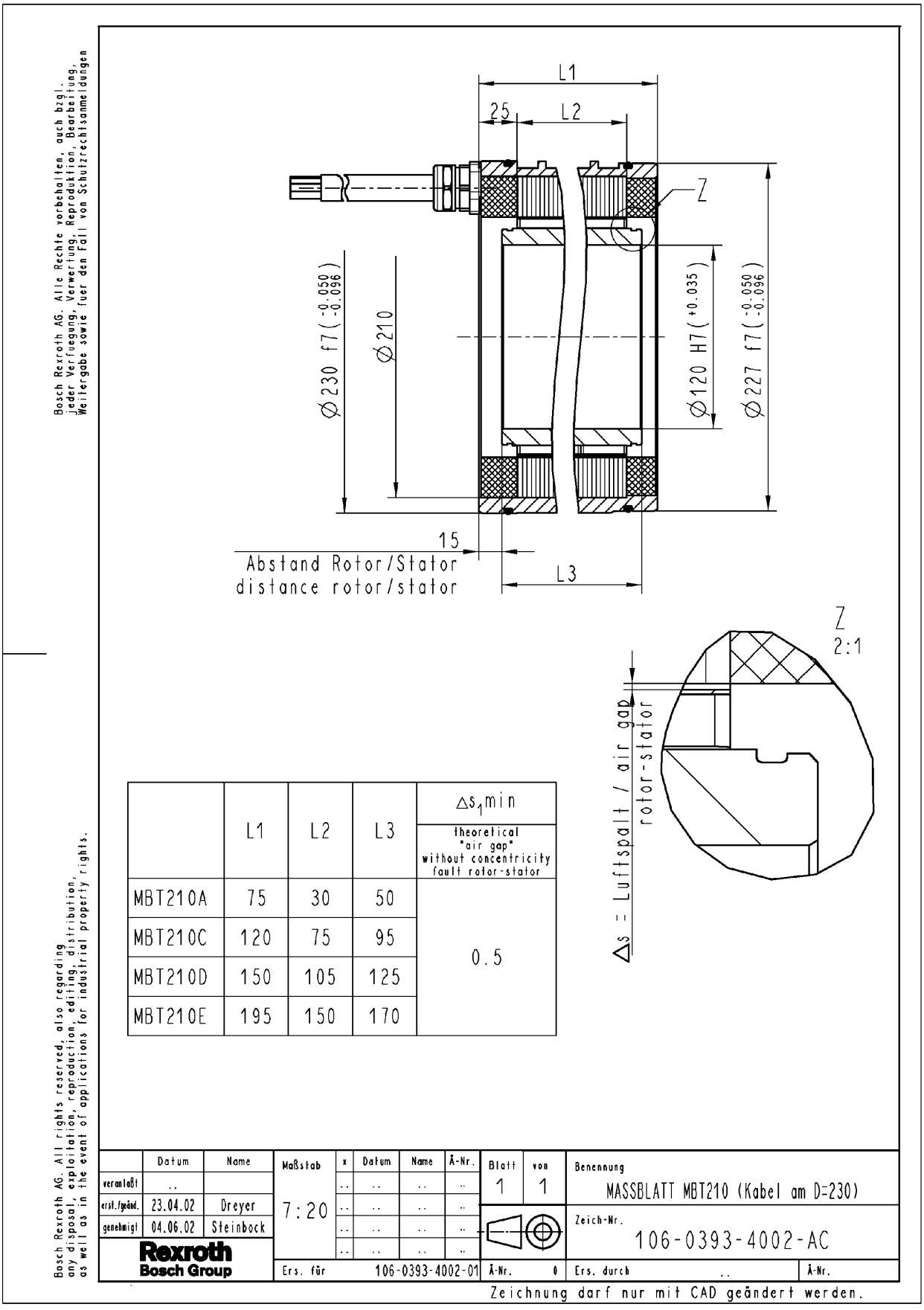
4.6.1 MBT210A/ -C/ -D/ -E with electrical connection “_SN-NNNN"



	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	

Fig. 114: MST210A/ -C/ -D/ -E, electrical connection "_SN-NNNN"

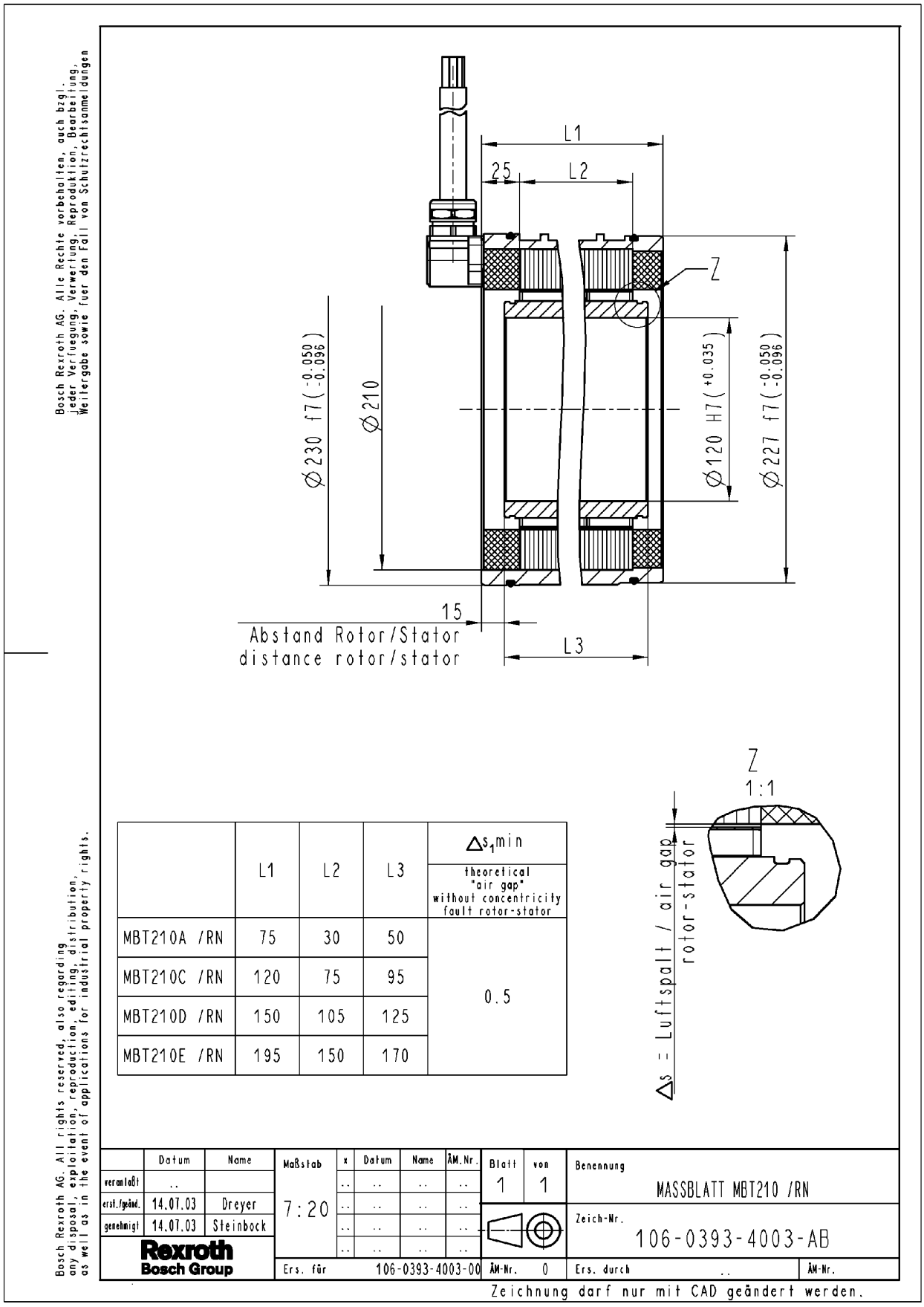
4.6.2 MBT210A/ -C/ -D/ -E with electrical connection "_CN-NNNN"



	L1	L2	L3	Δs_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	

Fig. 115: MST210A/ -C/ -D/ -E, electrical connection "_CN-NNNN"

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



	L1	L2	L3	$\Delta s_1 min$ 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	

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	Datum	Name
veranlaßt	..	
erst.fgeänd.	14.07.03	Dreyer
genehmigt	14.07.03	Steinbock

Rexroth Bosch Group

Maßstab 7:20 | x | Datum | Name | ÄM.Nr.

Ers. für 106-0393-4003-00 | ÄM-Nr. 0

Blatt 1 von 1

Benennung: MASSBLATT MBT210 /RN

Zeich-Nr.: 106-0393-4003-AB

Ers. durch .. | ÄM-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 116: MST210A/ -C/ -D/ -E, electrical connection ”_RN-NNNN”

4.6.4 MBT210U with electrical connection "_CN-D303"

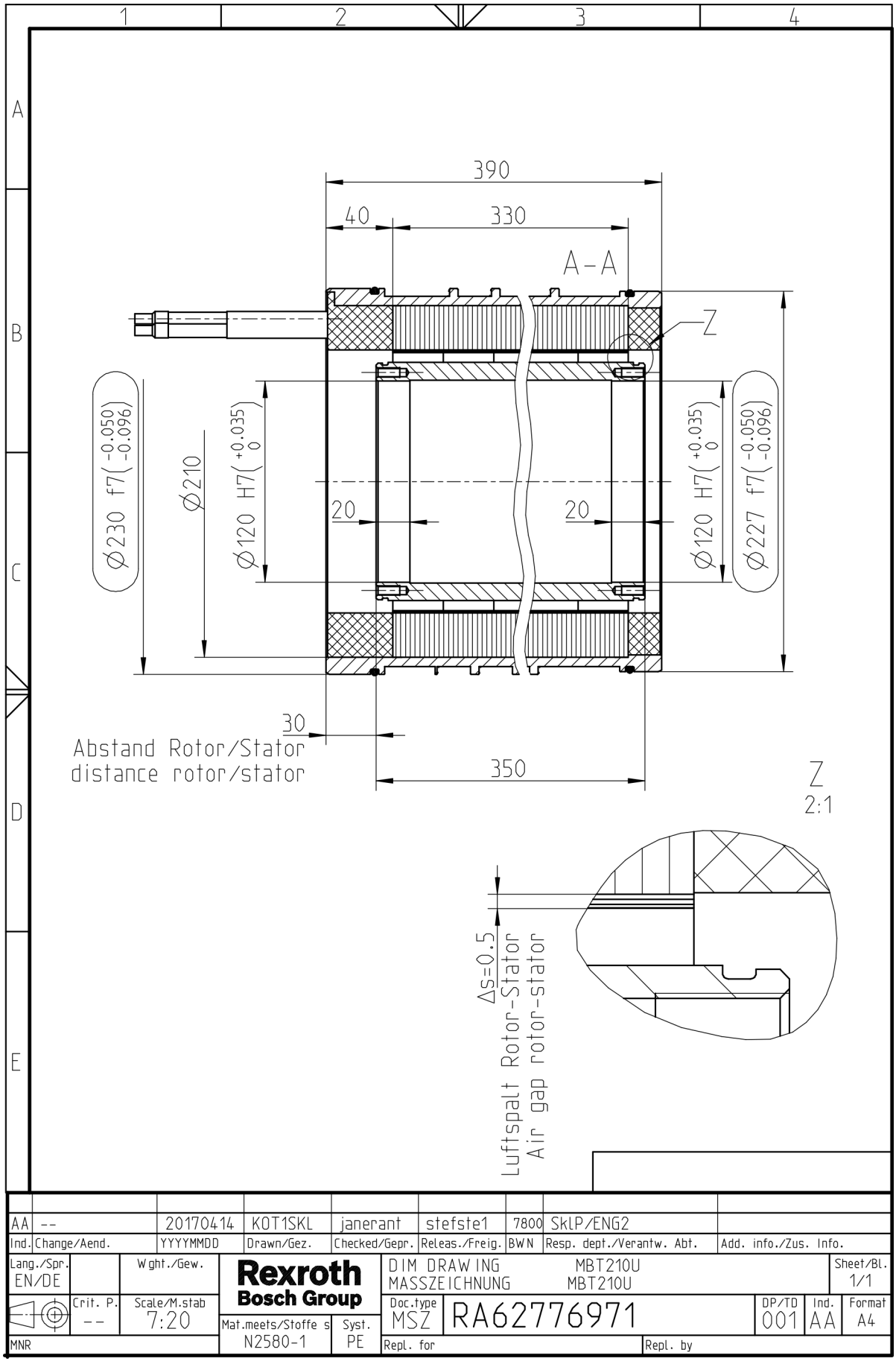


Fig. 117: MST210U, electrical connection "_CN-D303"

4.6.5 Rotor MRT210A/ -C/ -D/ -E

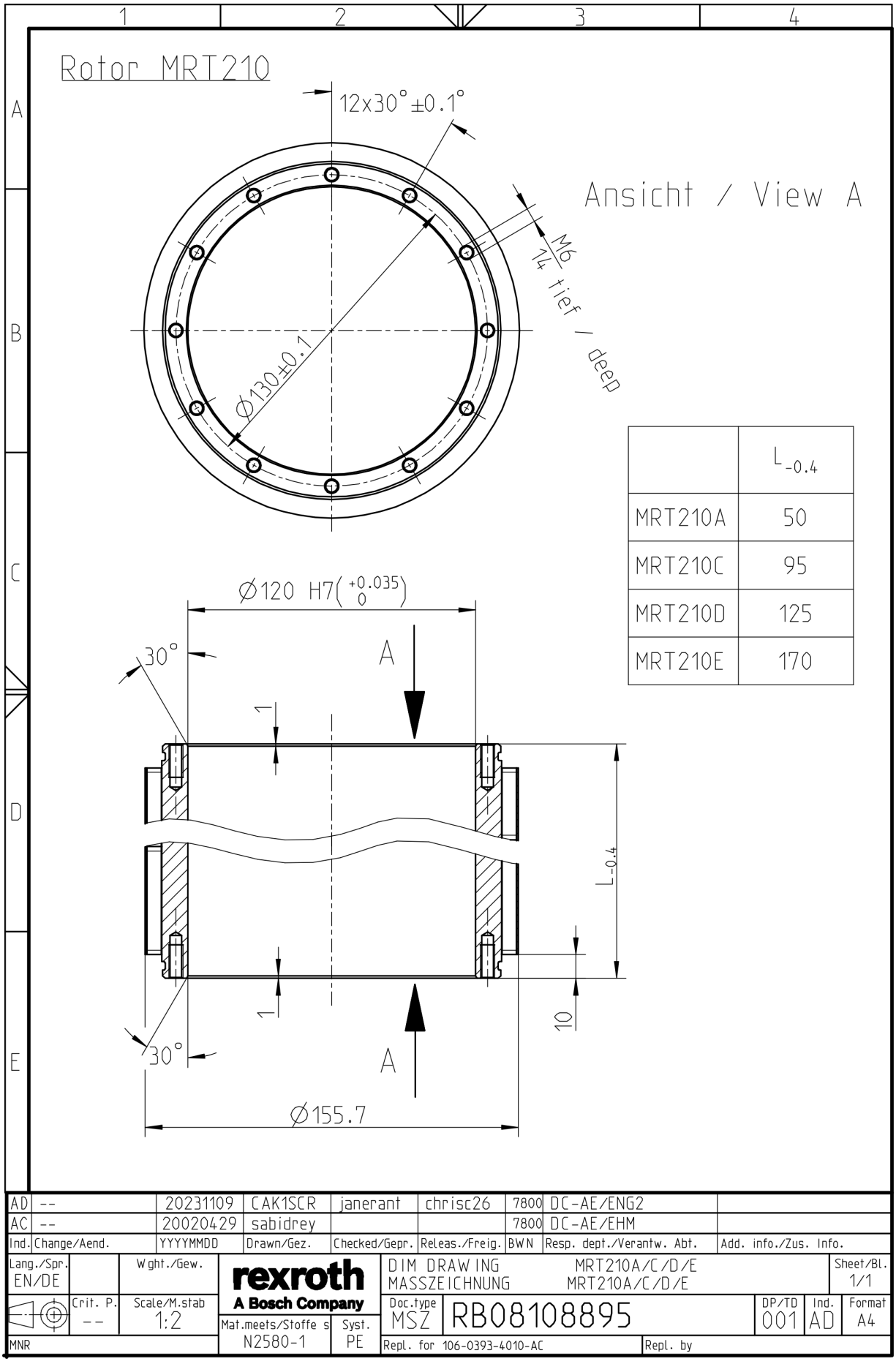


Fig. 118: MRT210A/ -C/ -D/ -E

4.6.6 Rotor MRT210U

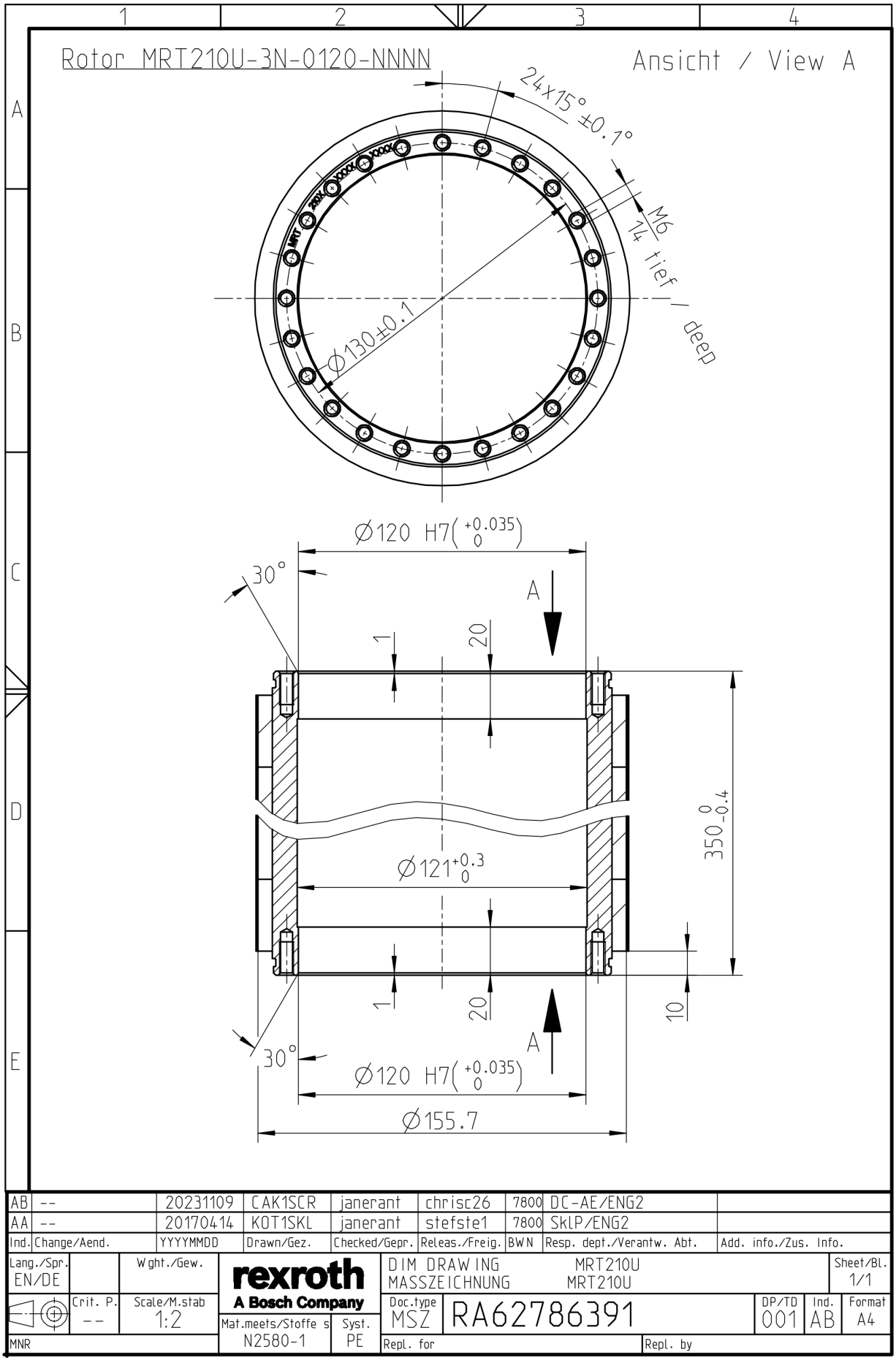


Fig. 119: MRT210U

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

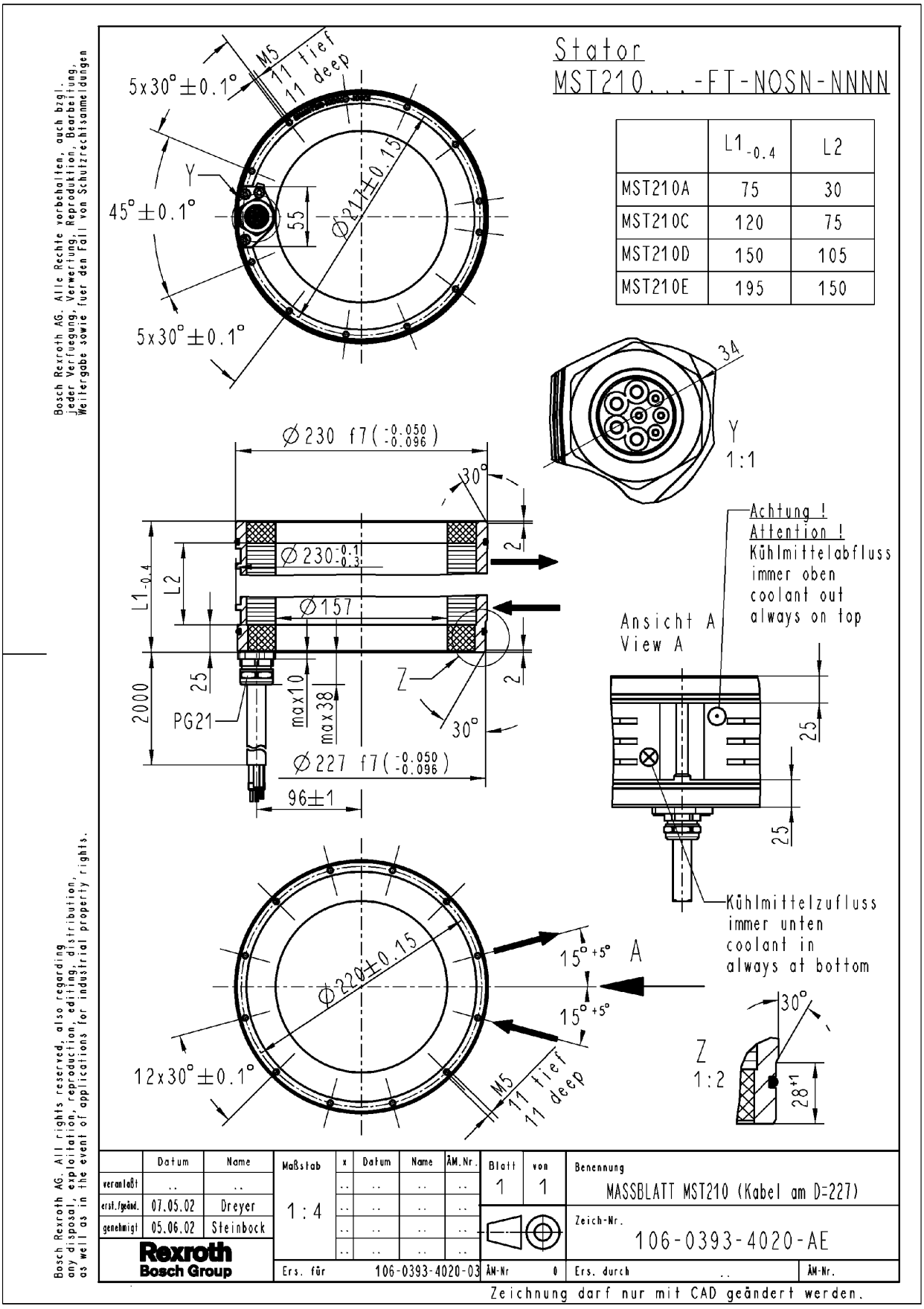


Fig. 120: MST210A/ -C/ -D/ -E, electrical connection "_SN-NNNN"

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

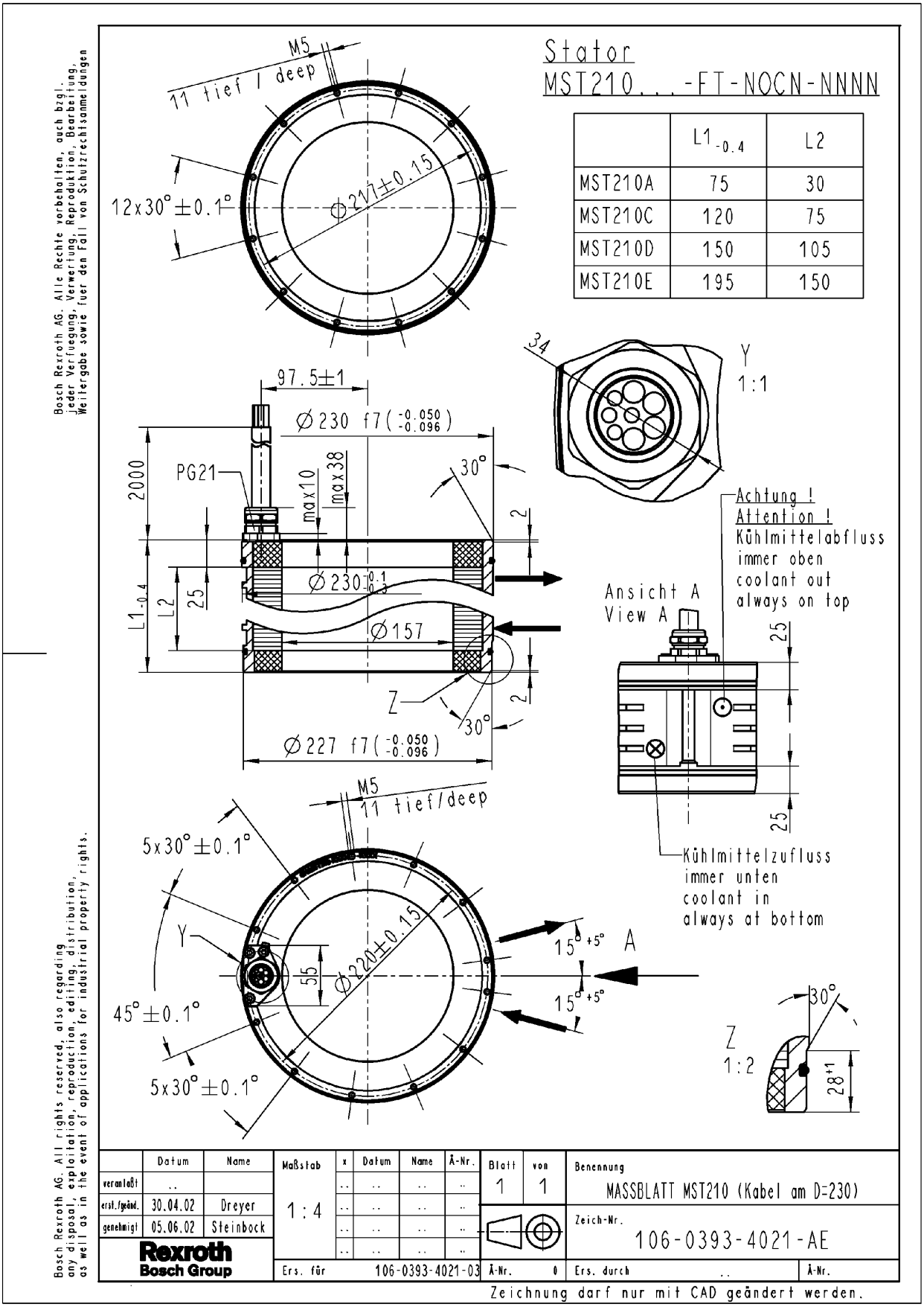


Fig. 121: MST210A/ -C/ -D/ -E, electrical connection "_CN-NNNN"

4.6.9 Stator MST210A/ -D/ -E, electrical connection "_CN-D301"

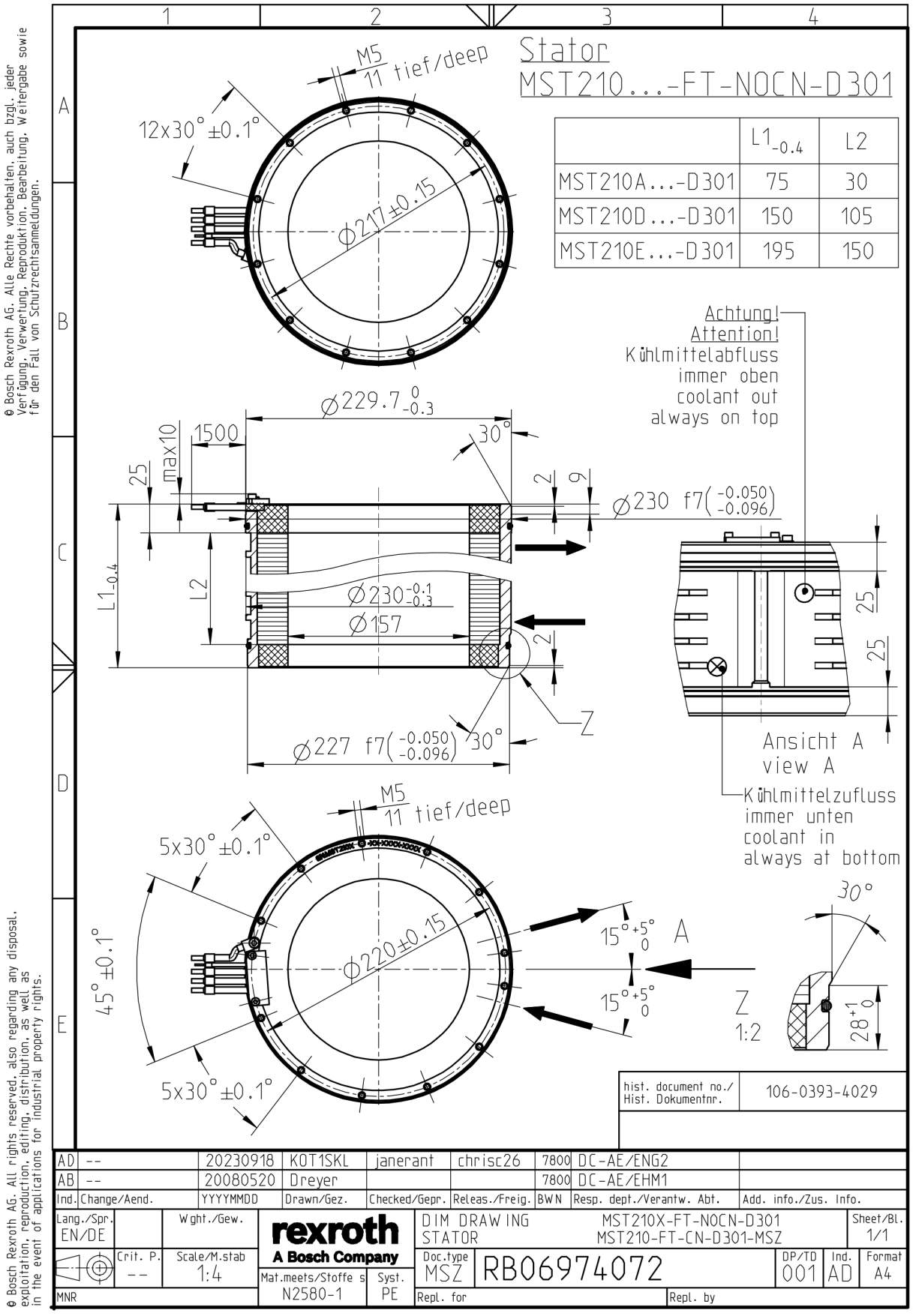
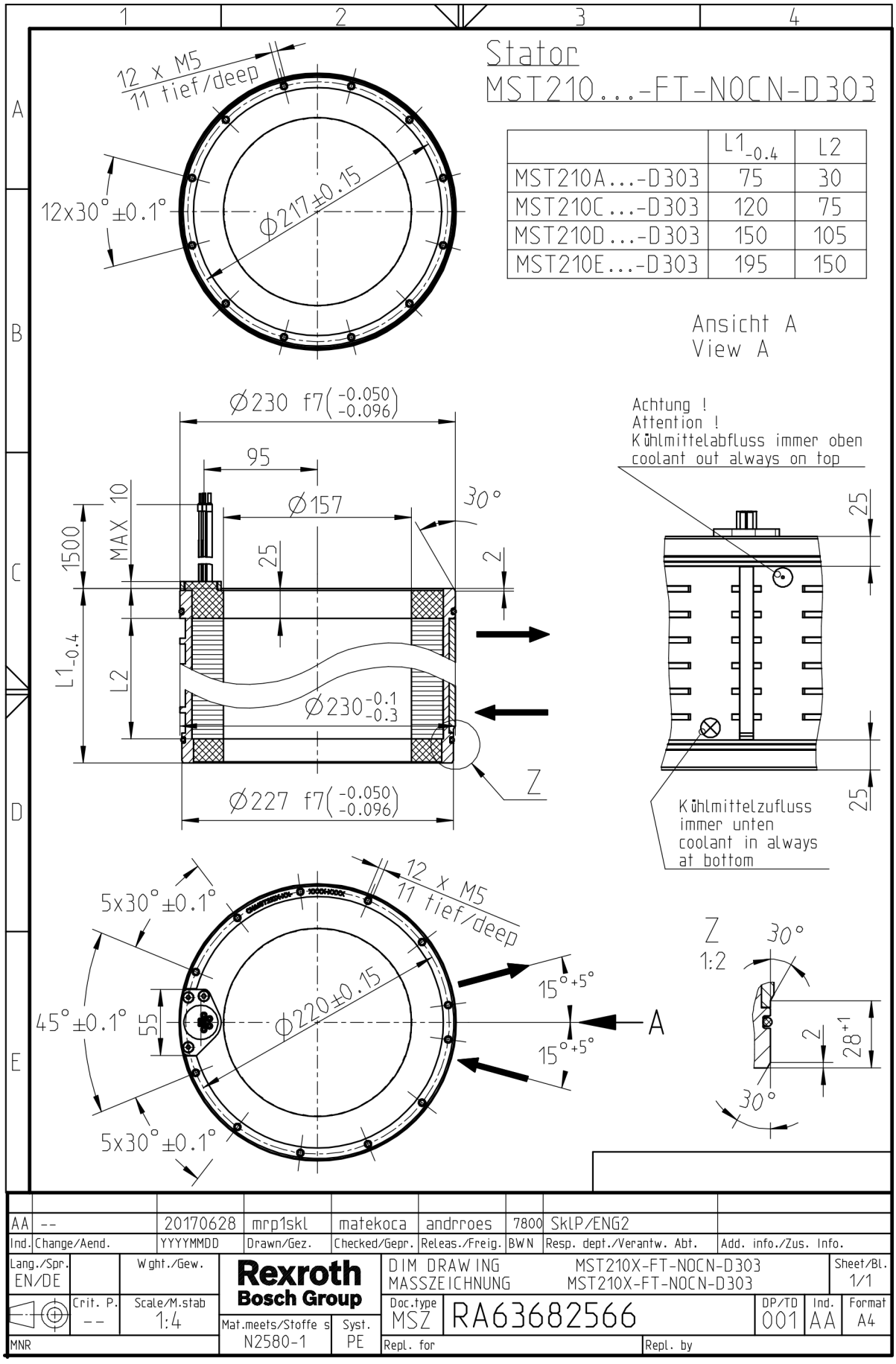


Fig. 122: Stator MST210A/ -D/ -E, electrical connection "_CN-D301"

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



	$L1_{-0.4}$	L2
MST210A...-D303	75	30
MST210C...-D303	120	75
MST210D...-D303	150	105
MST210E...-D303	195	150

Fig. 123: Stator MST210A/ -C/ -D/ -E, electrical connection "_CN-D303"

4.6.11 Stator MST210U, electrical connection "_CN-D303"

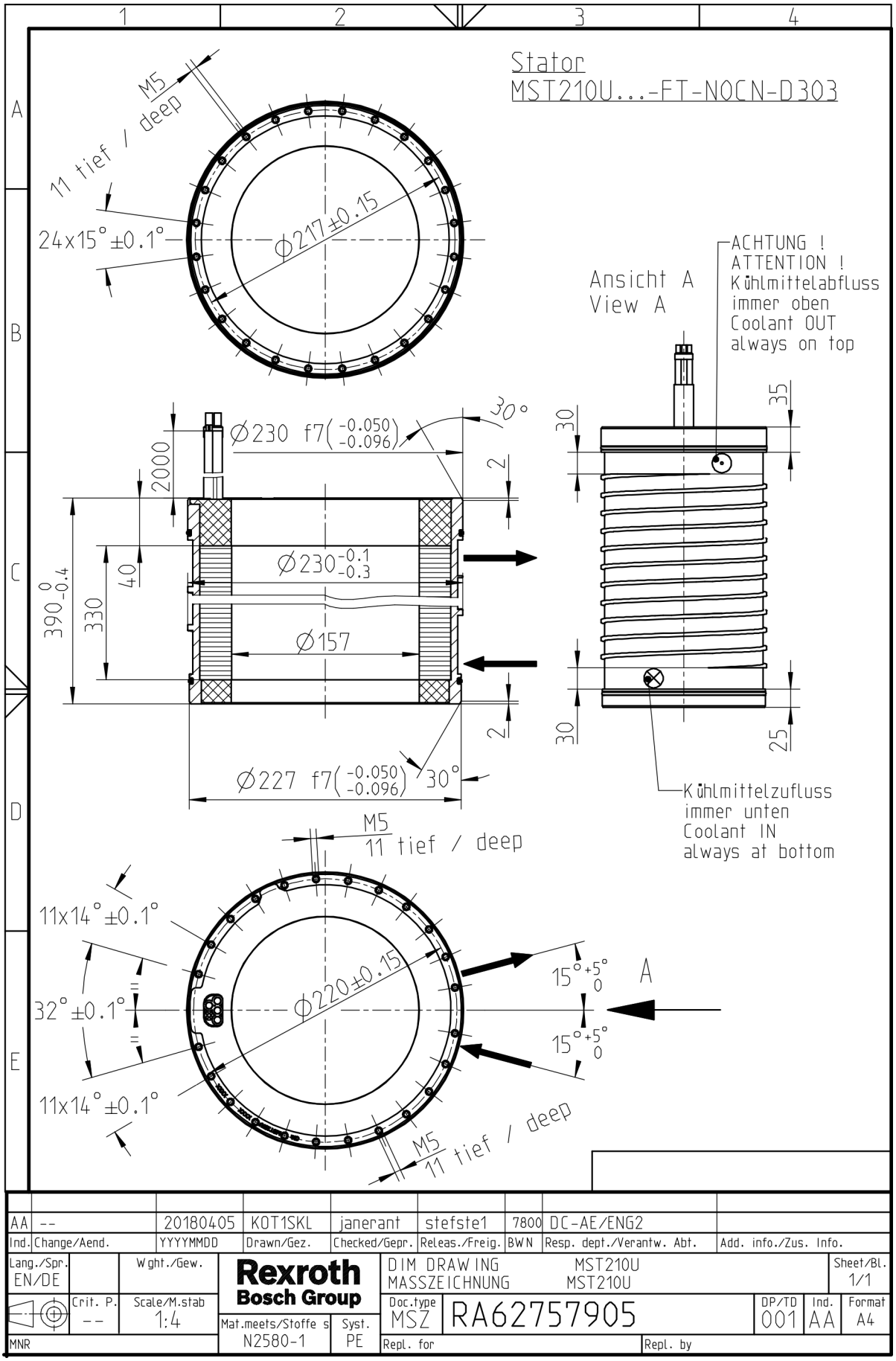
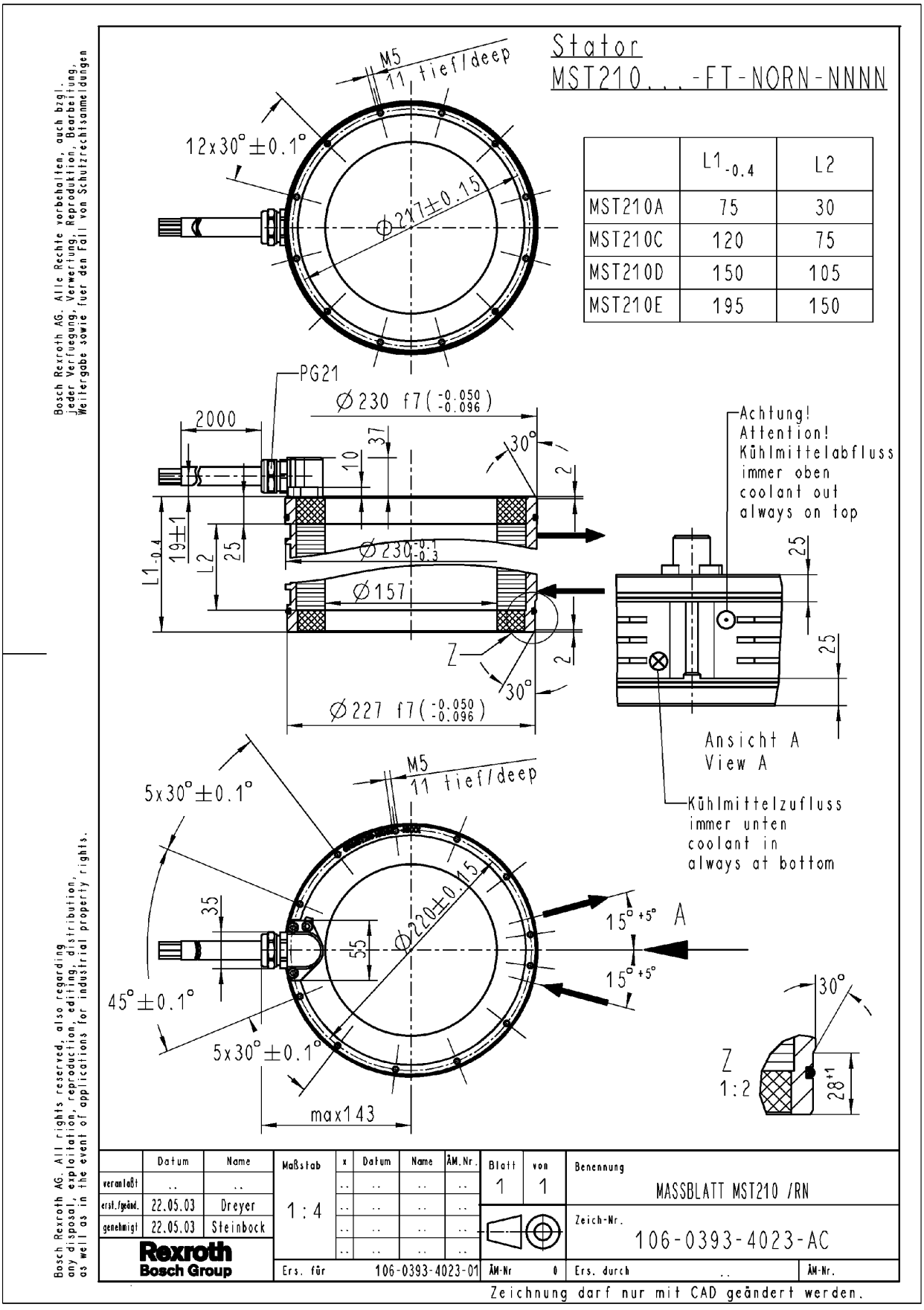


Fig. 124: Stator MST210U, electrical connection "_CN-D303"

4.6.12 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. 125: MST210A/ -C/ -D/ -E, electrical connection "_RN-NNNN"

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

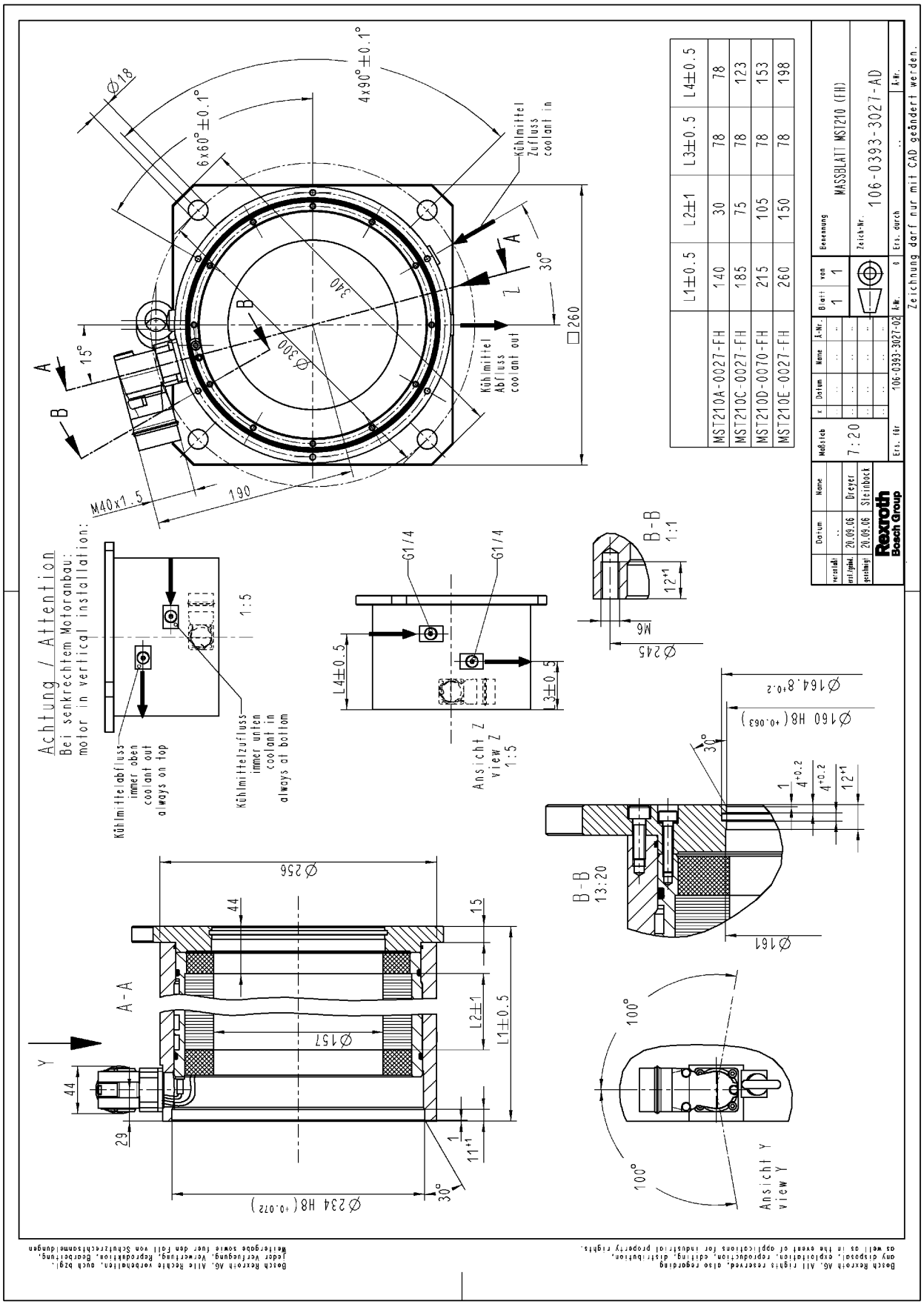
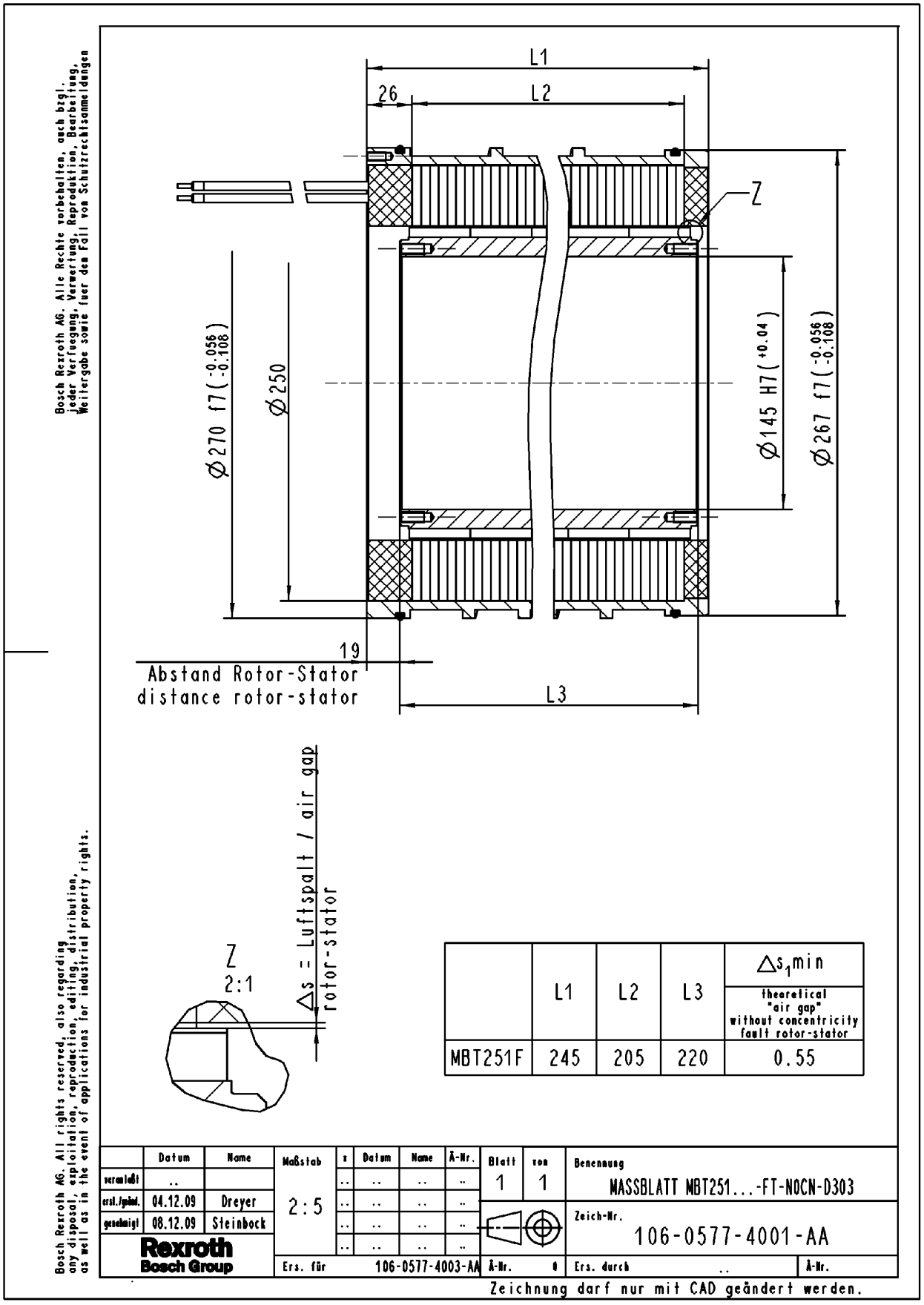


Fig. 126: MST210A/ -C/ -D/ -E with housing ("FH" design)

4.7 Frame size 251

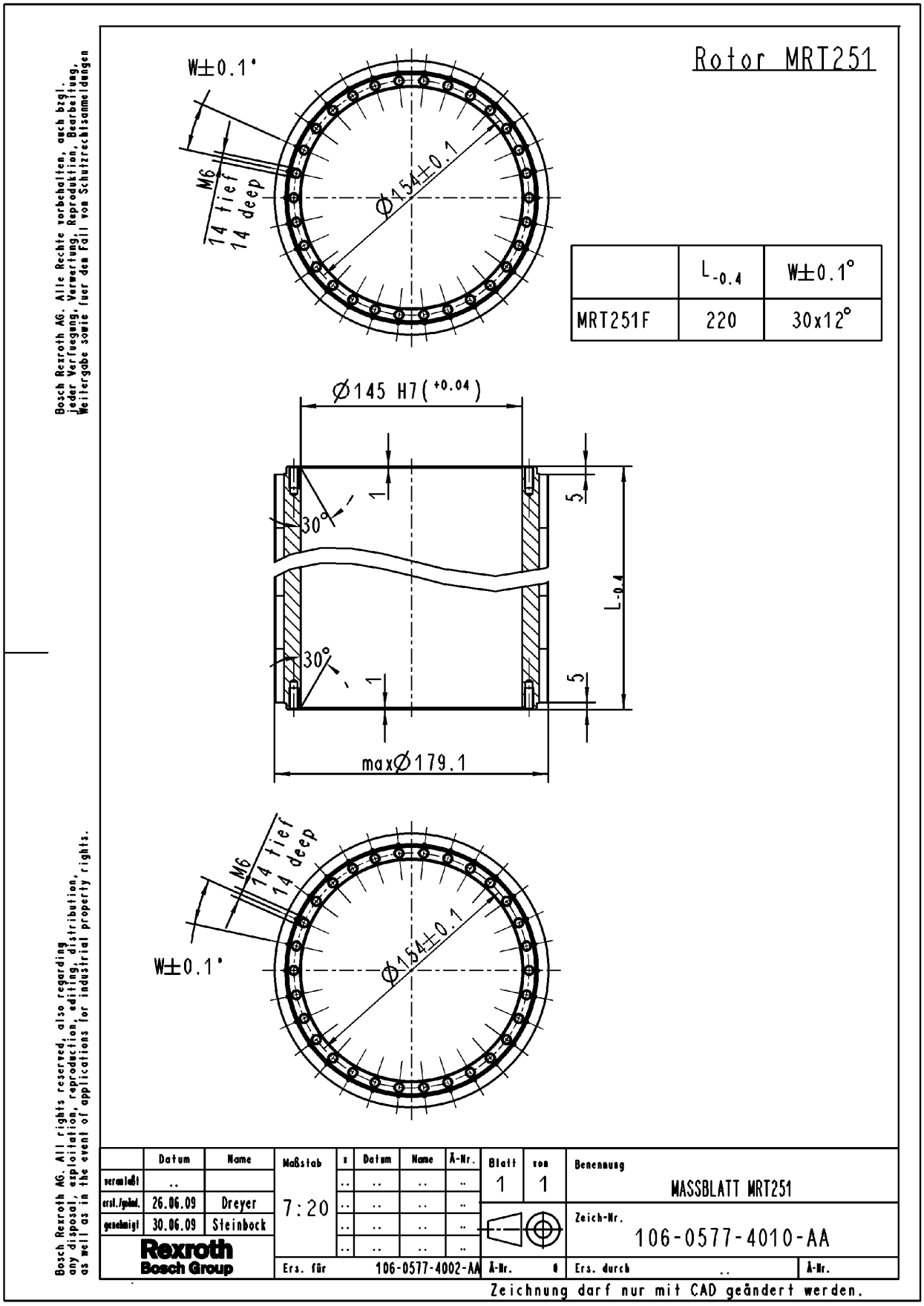
4.7.1 Motor MBT251



	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT251F	245	205	220	0.55

Fig. 127: MBT251

4.7.2 Rotor MRT251



	$L_{-0.4}$	W±0.1°
MRT251F	220	30x12°

	Datum	Name
veranlaßt	..	
erst./gepüf.	26.06.09	Dreyer
genehmigt	30.06.09	Steinbock

Rexroth Bosch Group

Maßstab 7:20

x	Datum	Name	Ä-Nr.
..	..	..	..
..	..	..	..
..	..	..	..
..	..	..	..

Ers. für 106-0577-4002-AA

Blatt 1 von 1

Benennung MASSBLATT MRT251

Zeich-Nr. 106-0577-4010-AA

Ä-Nr. 0 Ers. durch .. Ä-Nr.

Fig. 128: MRT251

4.7.3 Stator MST251

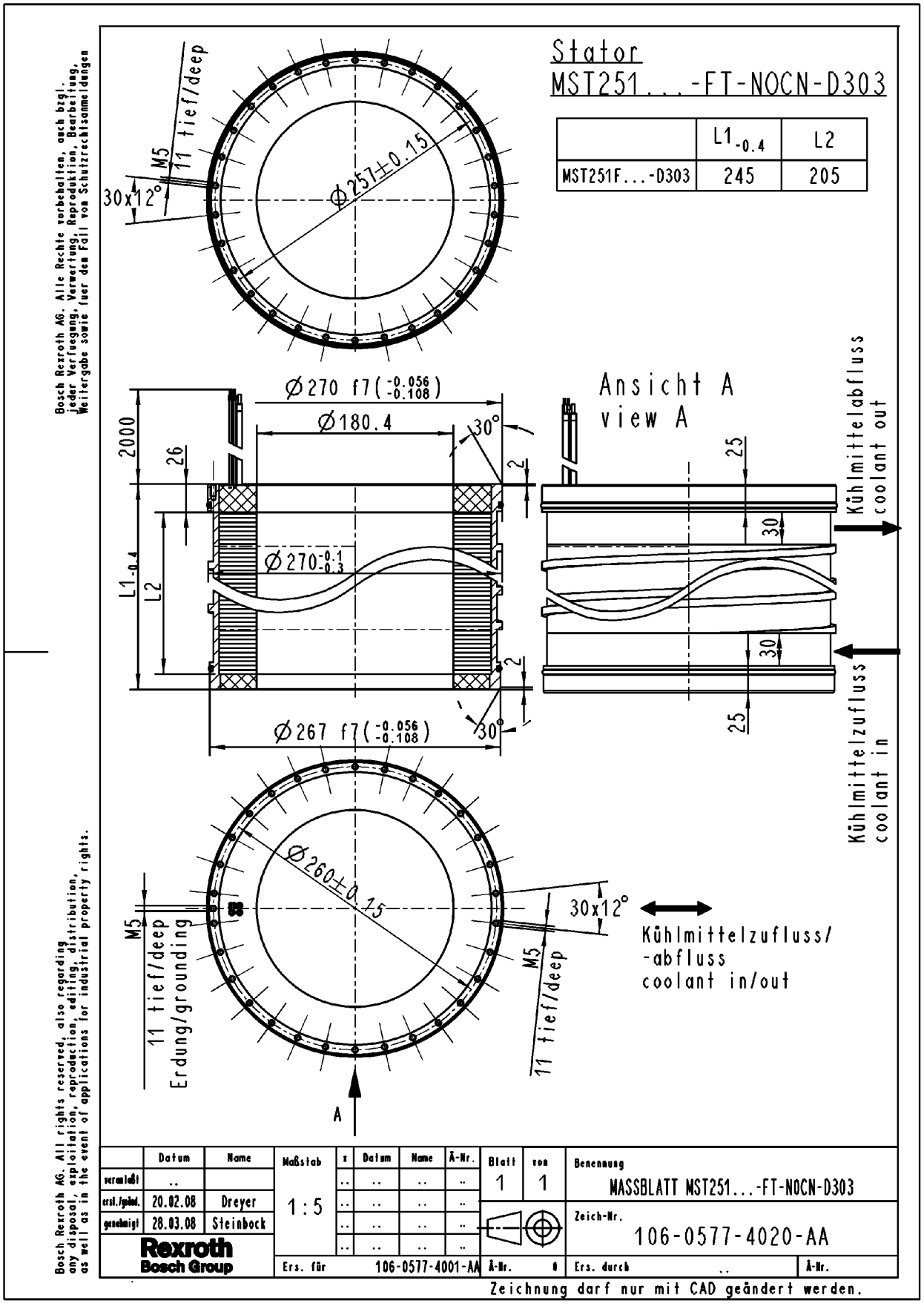
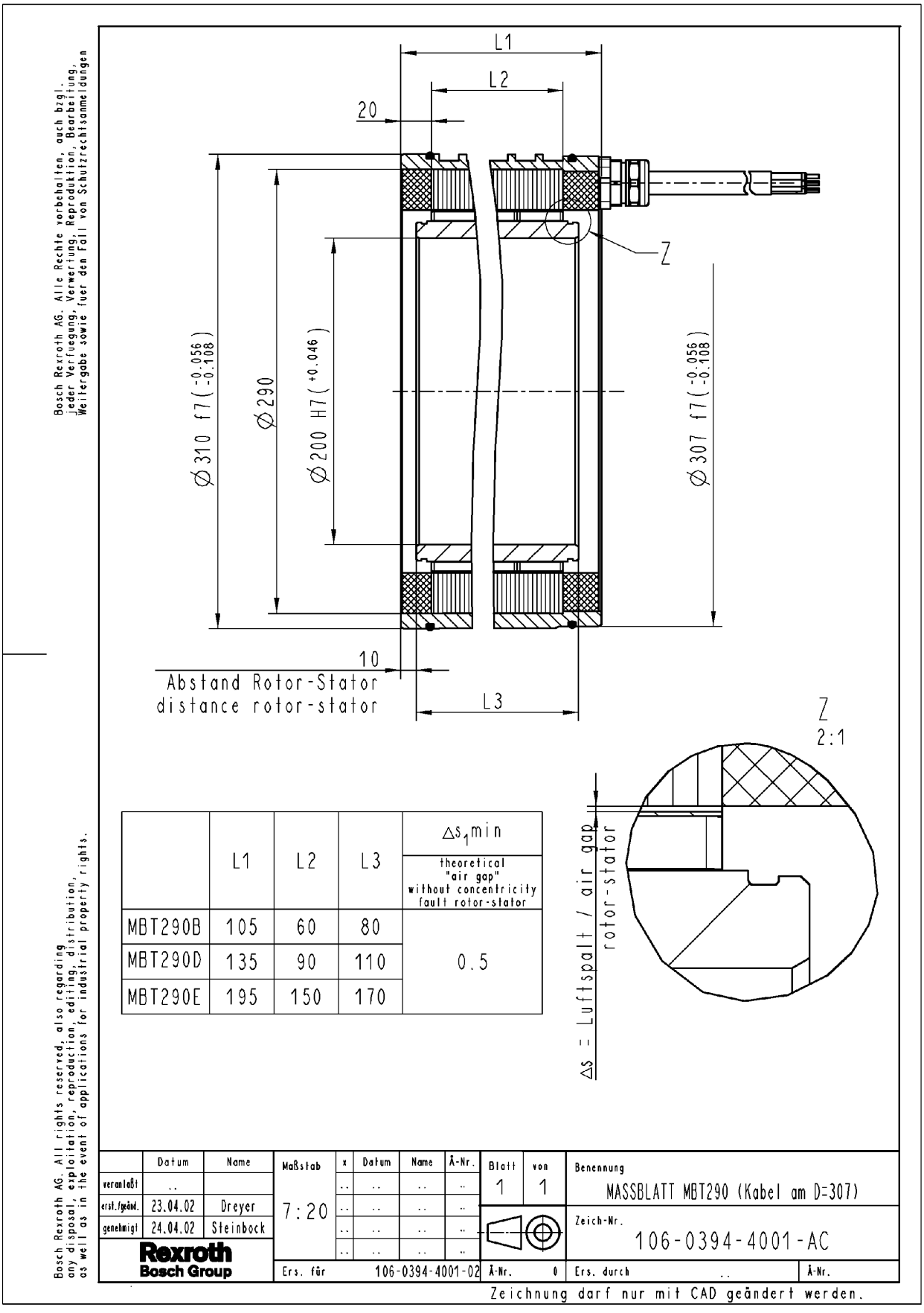


Fig. 129: MST251

4.8 Dimension sheets 290

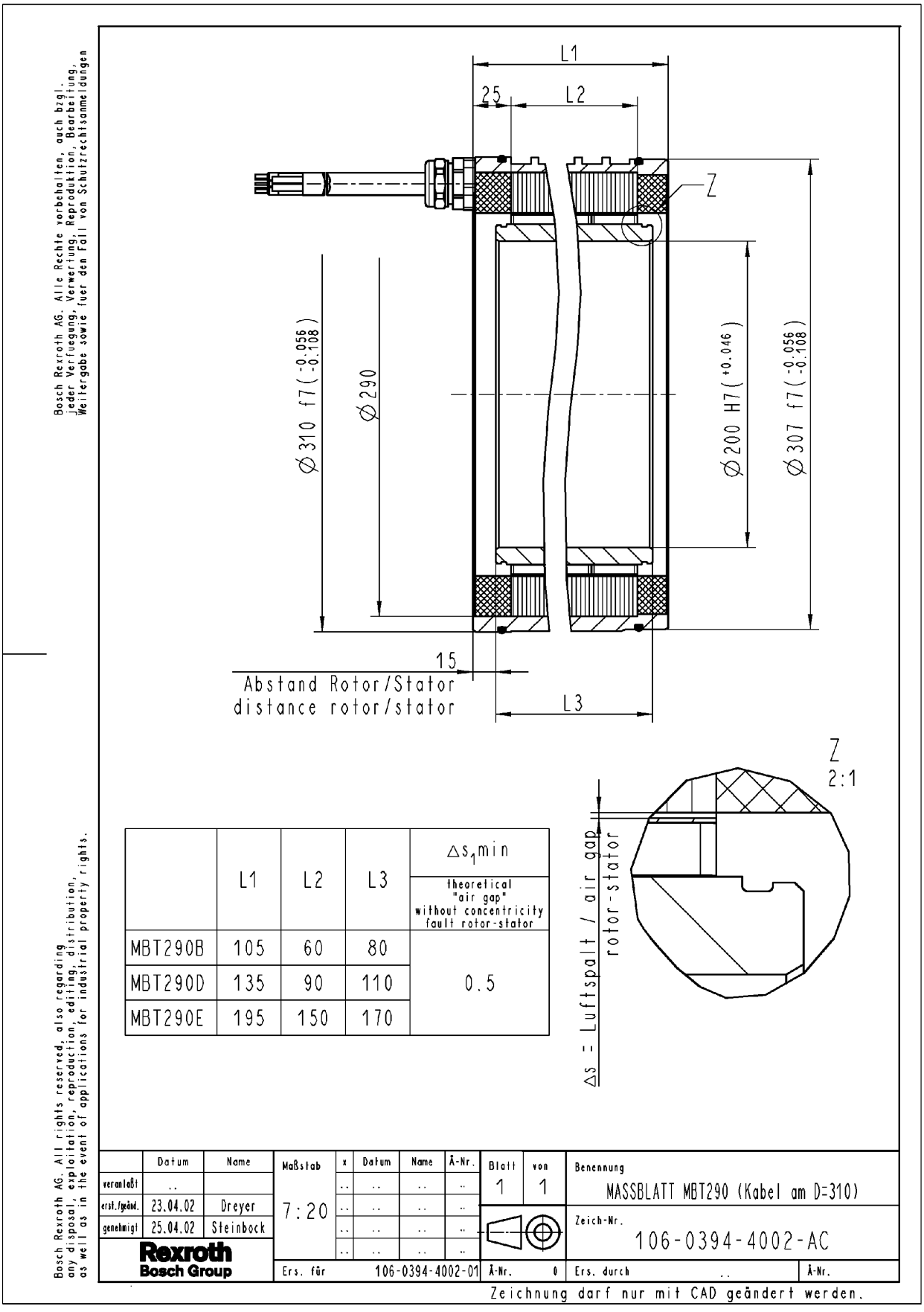
4.8.1 MBT290B/ -D/ -E with electrical connection "_SN-NNNN"



	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT290B	105	60	80	0.5
MBT290D	135	90	110	
MBT290E	195	150	170	

Fig. 130: MBT290B/ -D/ -E, electrical connection "_SN-NNNN"

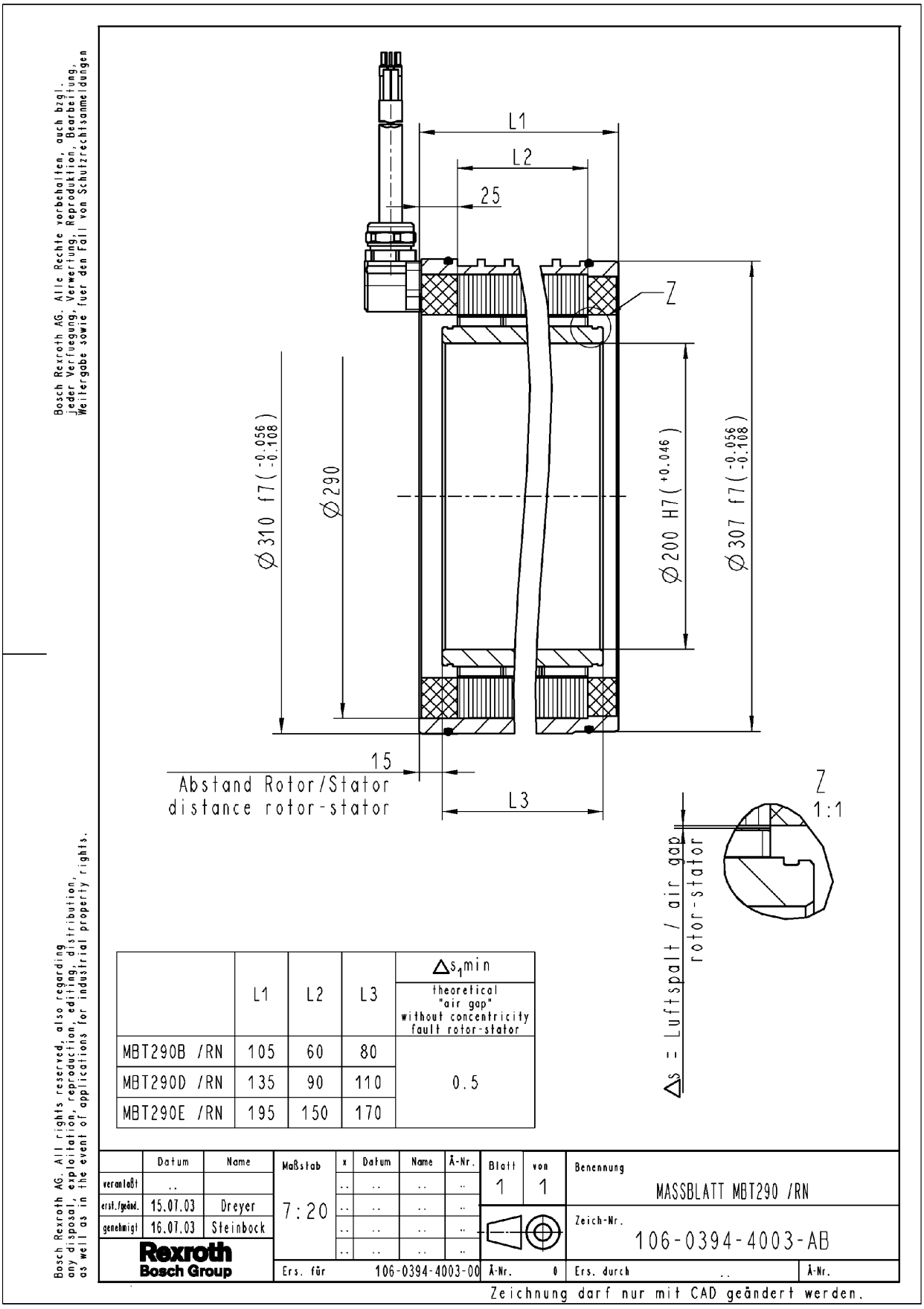
4.8.2 MBT290B/ -D/ -E with electrical connection "_CN-NNNN"



	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT290B	105	60	80	0.5
MBT290D	135	90	110	
MBT290E	195	150	170	

Fig. 131: MBT290B/ -D/ -E with electrical connection "_CN-NNNN"

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



	L1	L2	L3	$\Delta s_1 min$ 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	

	Datum	Name
veranlaßt	..	
erst./geänd.	15.07.03	Dreyer
genehmigt	16.07.03	Steinbock

Rexroth Bosch Group

Maßstab 7:20 | x | Datum | Name | Ä-Nr.

Ers. für 106-0394-4003-00 | Ä-Nr. 0

Blatt 1 von 1

Benennung: MASSBLATT MBT290 /RN

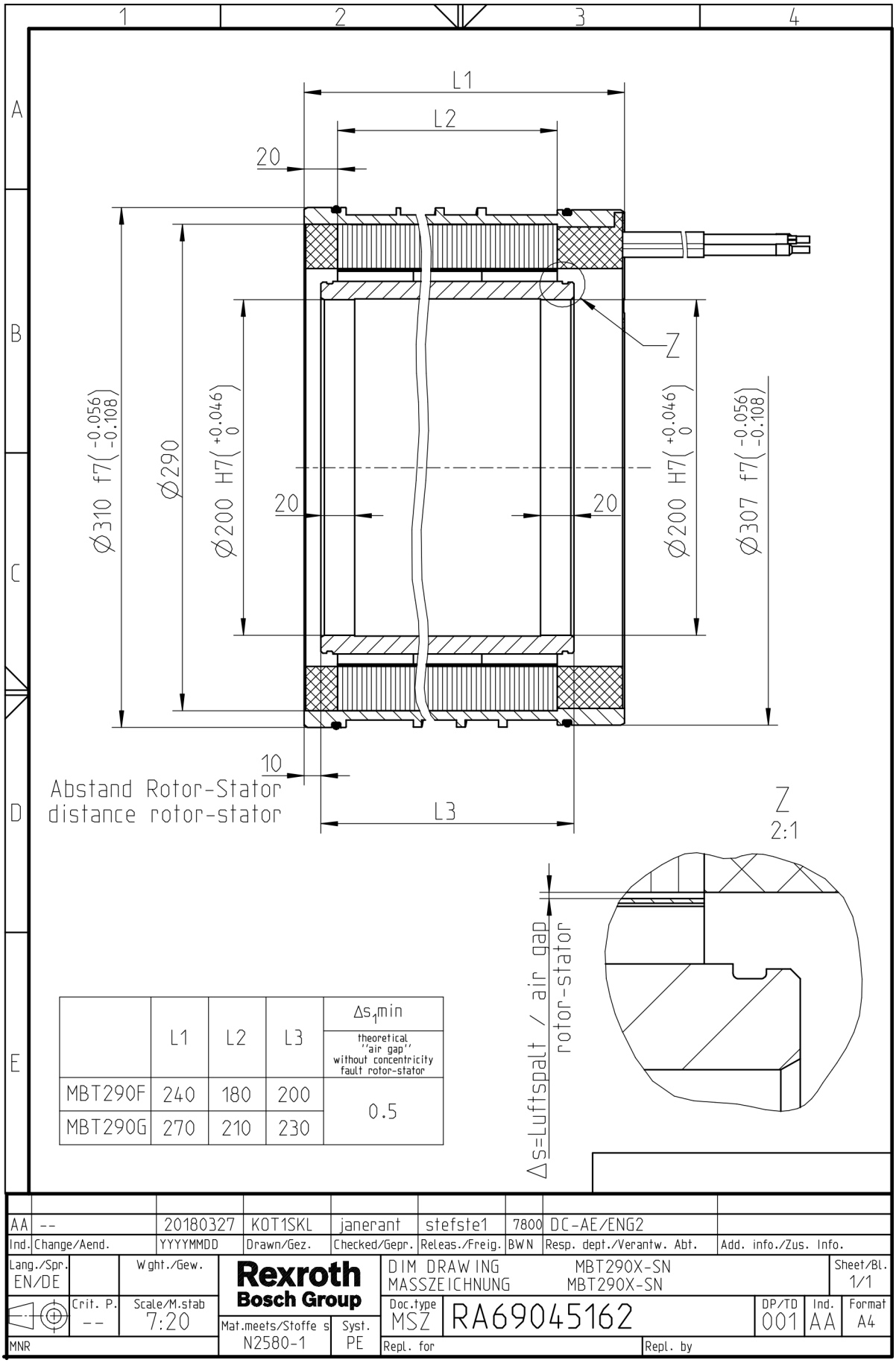
Zeich-Nr.: 106-0394-4003-AB

Ers. durch .. | Ä-Nr.

Zeichnung darf nur mit CAD geändert werden.

Fig. 132: MBT290B/ -D/ -E with electrical connection "_RN-NNNN"

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



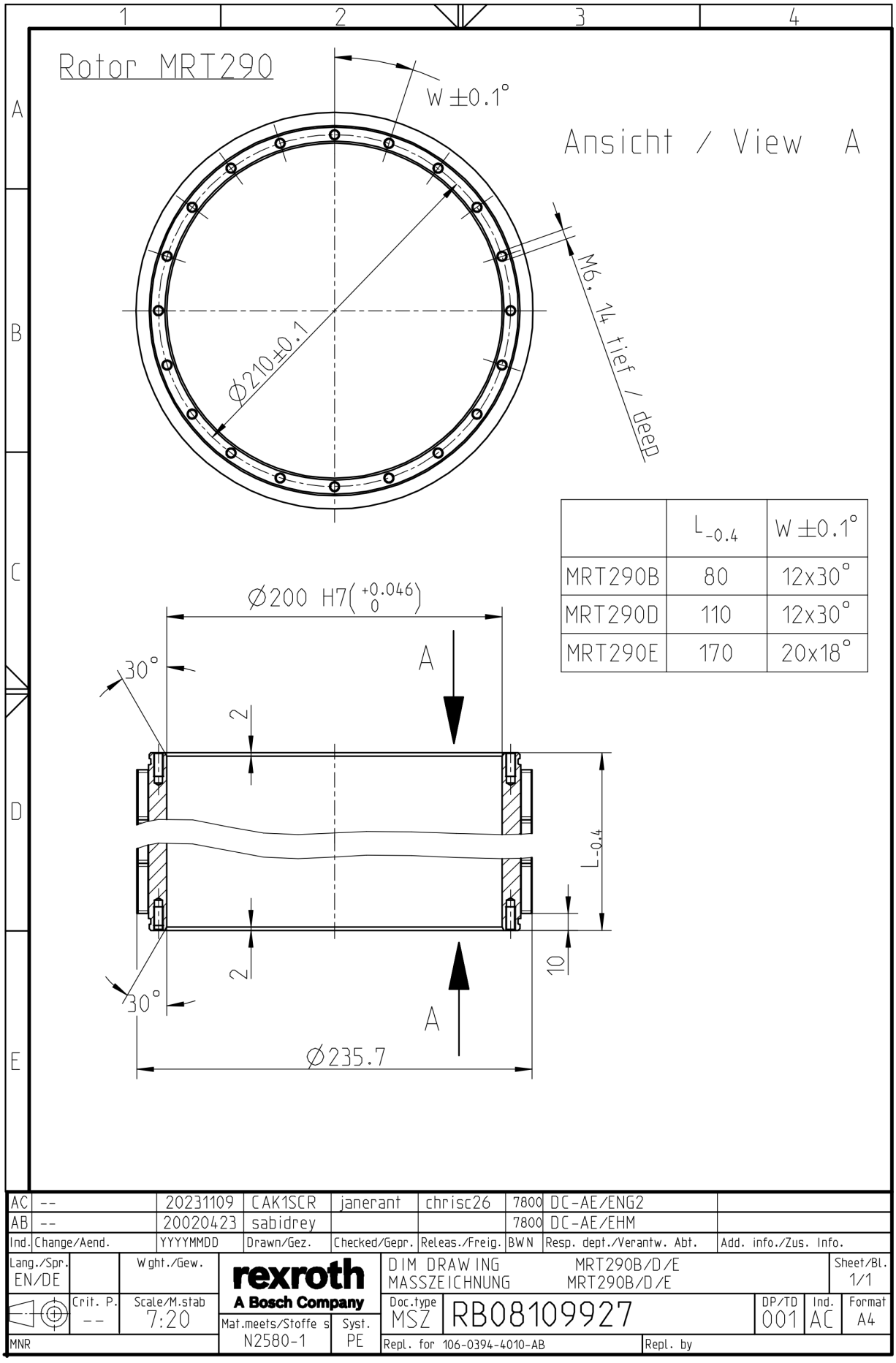
	L1	L2	L3	Δs_1 min theoretical "air gap" without concentricity fault rotor-stator
MBT290F	240	180	200	0.5
MBT290G	270	210	230	

AA	--	20180327	KOT1SKL	janerant	stefste1	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 Bosch Group	DIM DRAWING MASSZEICHNUNG	MBT290X-SN MBT290X-SN			Sheet/Bl. 1/1
Crit. P. --	Scale/M.stab 7:20	Mat.meets/Stoffe s N2580-1	Syst. PE	Doc.type MSZ	RA69045162	DP/TD 001	Ind. AA / Format A4
MNR				Repl. for		Repl. by	

Fig. 133: MBT290F/ -G with electrical connection "_SN-D303"

4.8.5 Rotor MRT290B/ -D/ -E



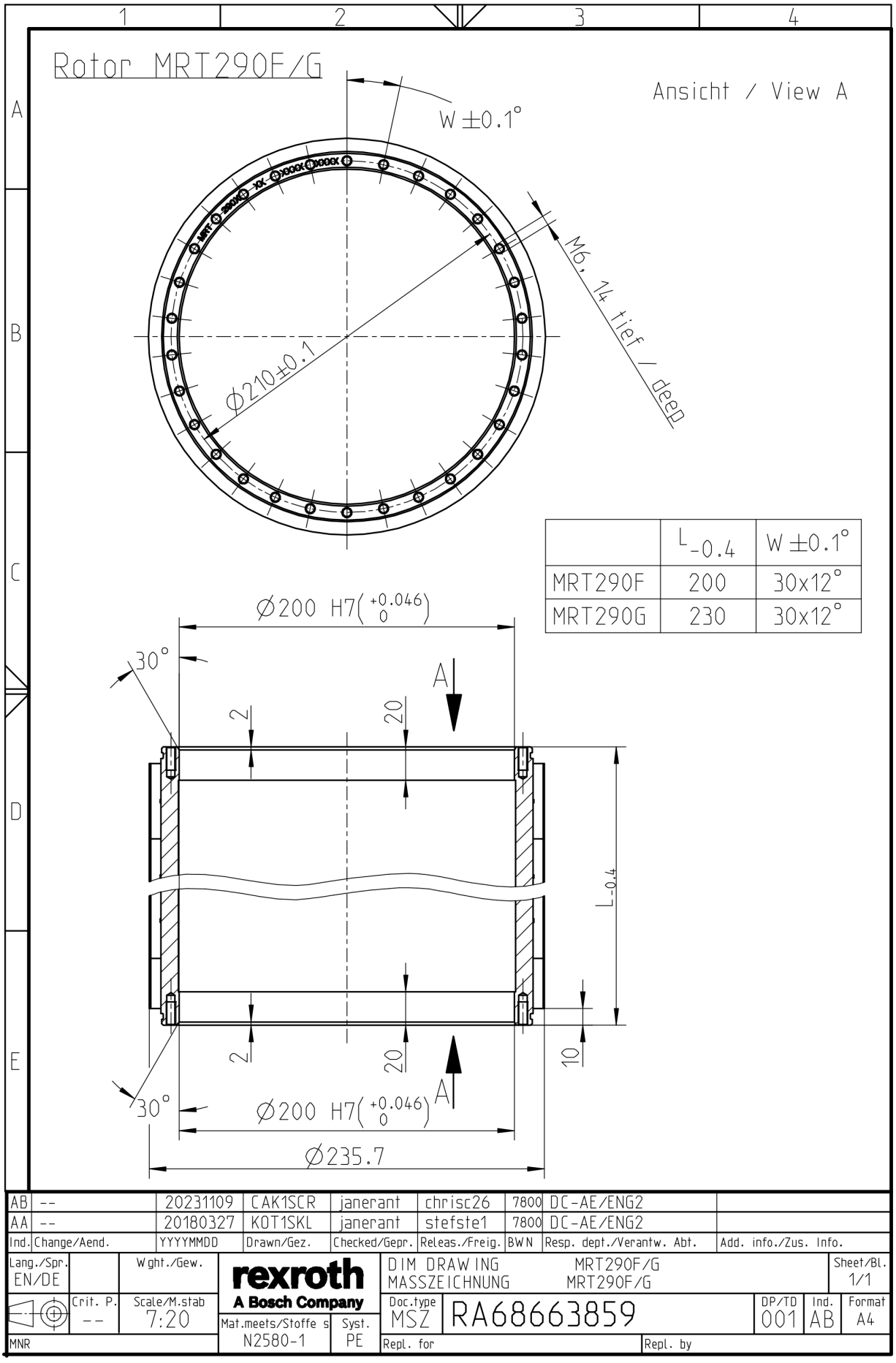
	$L_{-0.4}$	W ±0.1°
MRT290B	80	12x30°
MRT290D	110	12x30°
MRT290E	170	20x18°

AC	--	20231109	CAK1SCR	janerant	chrisc26	7800	DC-AE/ENG2	
AB	--	20020423	sabidrey			7800	DC-AE/EHM	
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 MRT290B/D/E MRT290B/D/E				Sheet/Bl. 1/1
Crit. P. --	Scale/M.stab 7:20		Doc.type MSZ	RB08109927	DP/TD 001	Ind. AC	Format A4
MNR		Mat.meets/Stoffe s N2580-1	Syst. PE	Repl. for 106-0394-4010-AB		Repl. by	

Fig. 134: Rotor MRT290B/ -D/ -E

4.8.6 Rotor MRT290F/ -G



	L -0.4	W ±0.1°
MRT290F	200	30x12°
MRT290G	230	30x12°

AB	--	20231109	CAK1SCR	janerant	chrisc26	7800	DC-AE/ENG2	
AA	--	20180327	KOT1SKL	janerant	stefste1	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	MRT290F/G MRT290F/G		Sheet/Bl. 1/1
	Crit. P. --	Scale/M.stab 7:20		Doc.type MSZ	RA68663859	DP/TD 001 / Ind. AB	Format A4
MNR			Mat.meets/Stoffe s N2580-1	Syst. PE	Repl. for	Repl. by	

Fig. 135: Rotor MRT290F/ -G

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

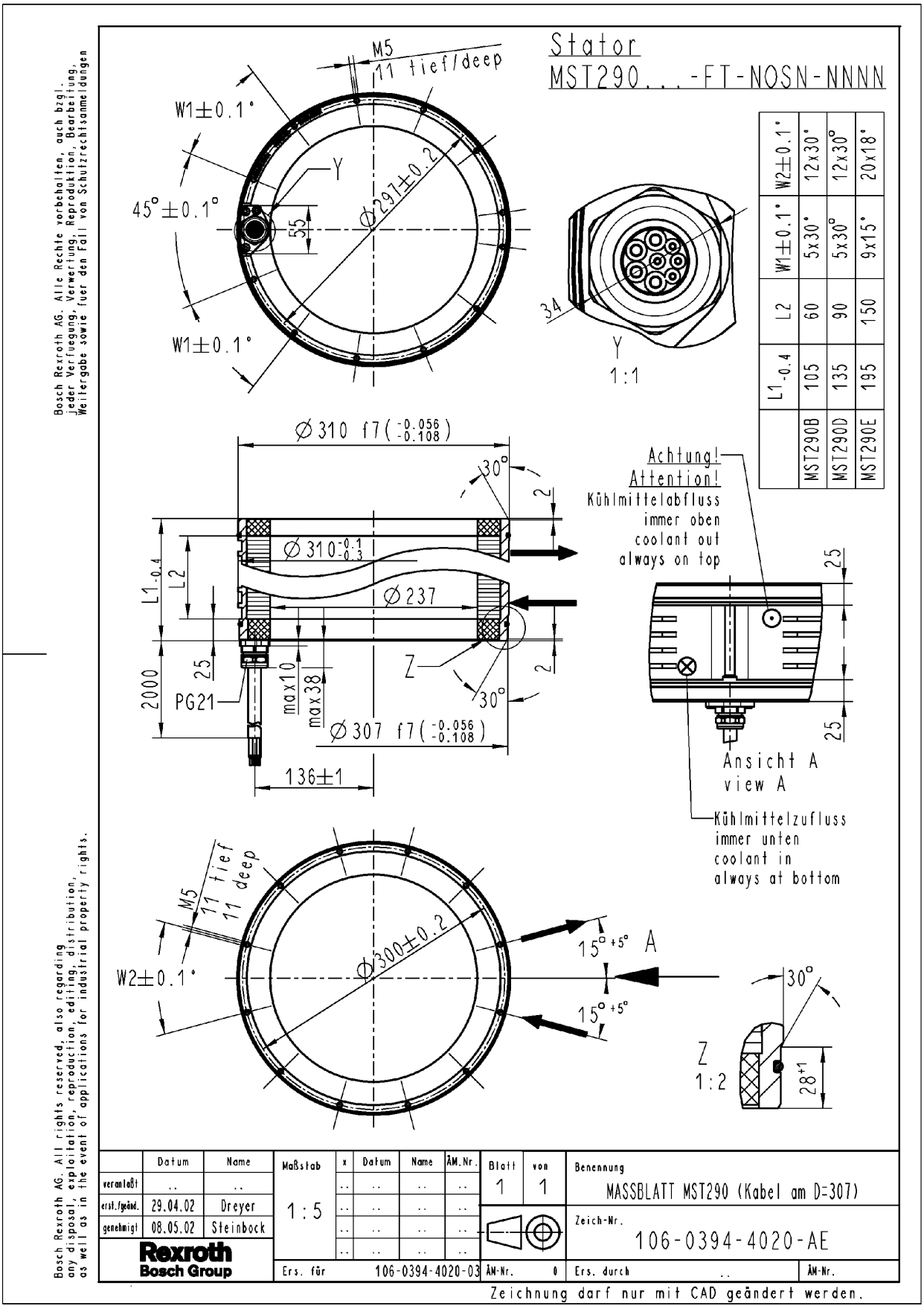


Fig. 136: MST290B/ -D/ -E, electrical connection "_SN-NNNN"

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

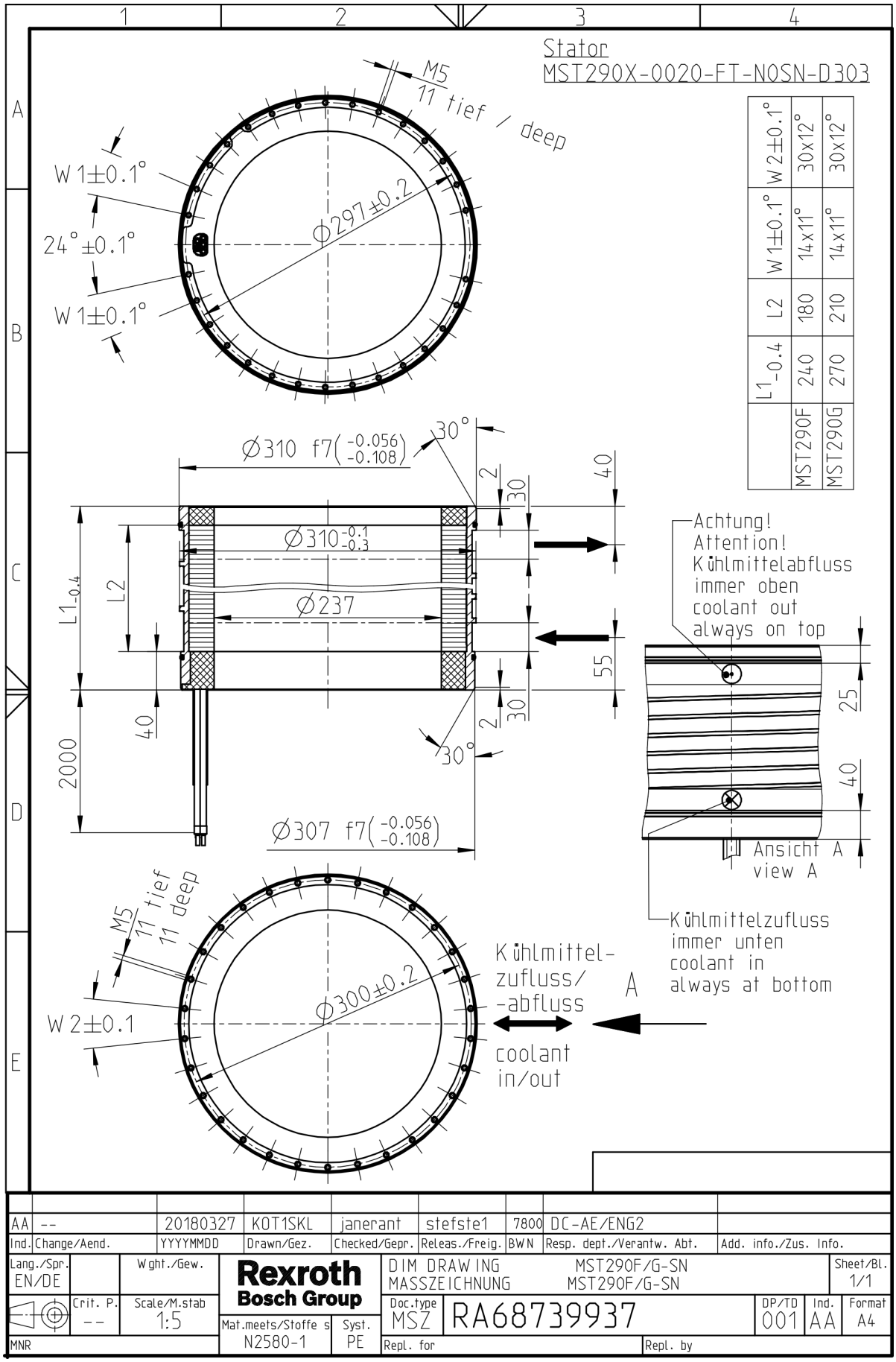


Fig. 137: MST290F/ -G, electrical connection "_SN-D303"

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

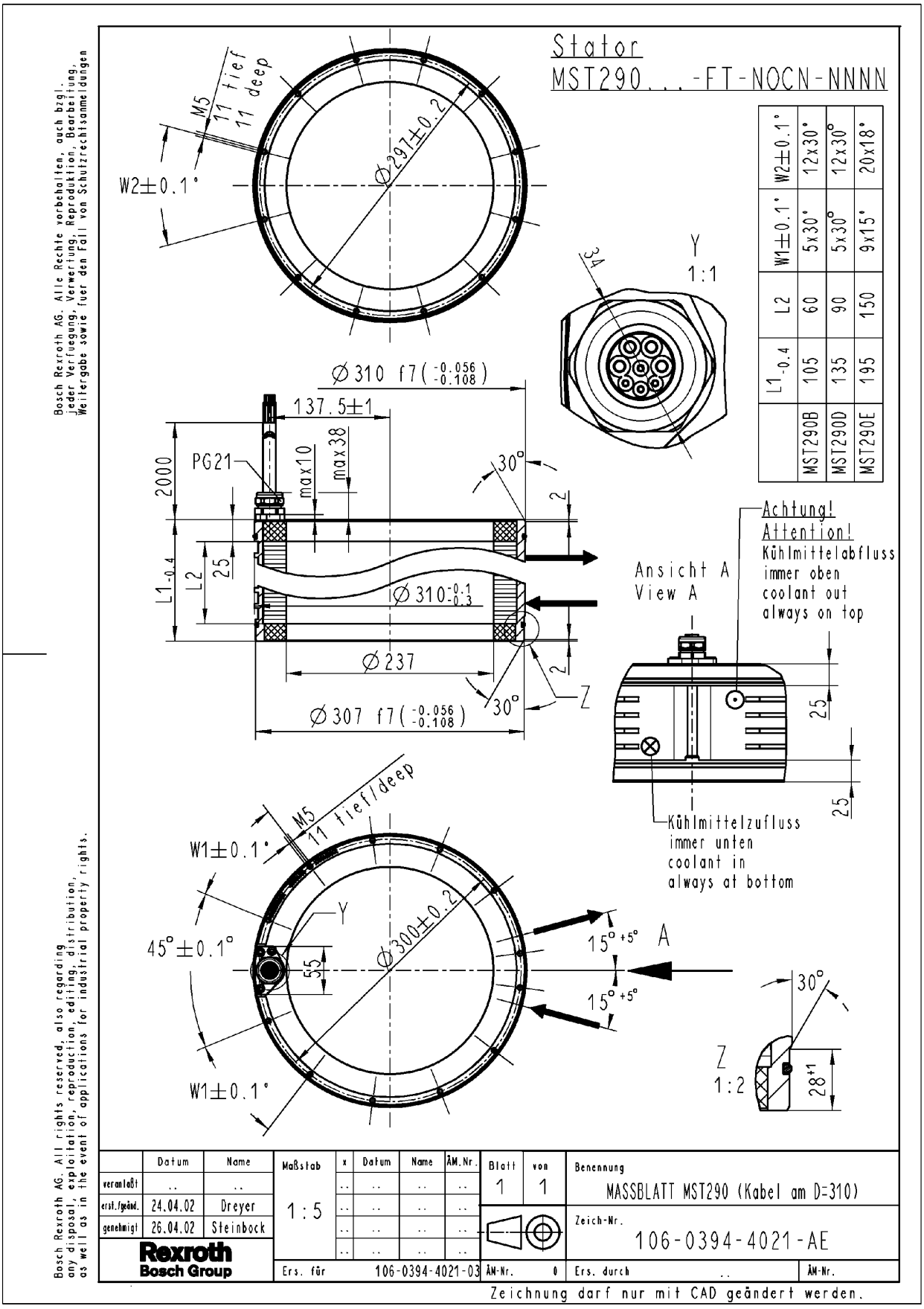


Fig. 138: MST290B/ -D/ -E, electrical connection "_CN-NNNN"

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

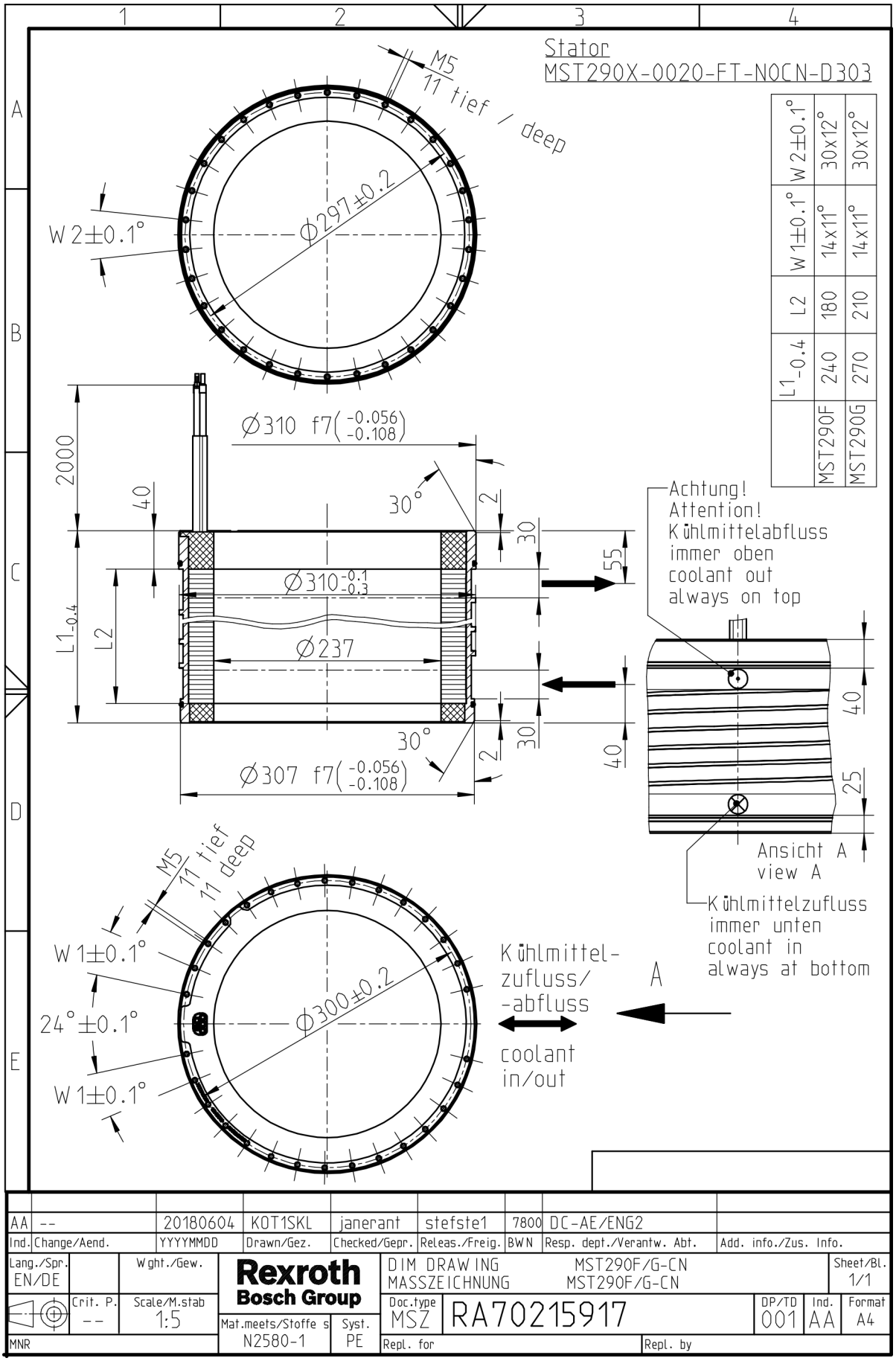


Fig. 139: MST290F/ -G, electrical connection "_CN-D303"

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

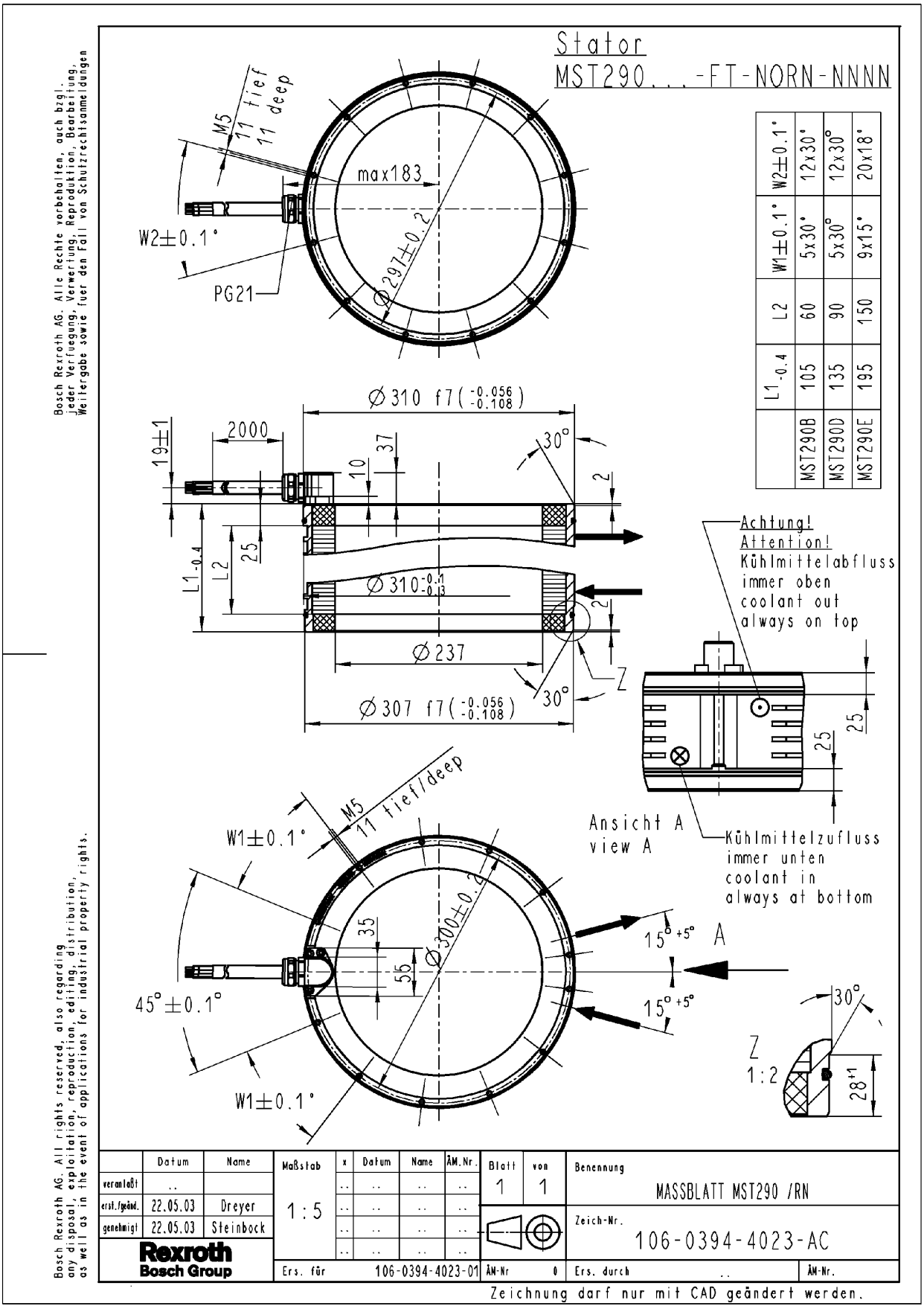


Fig. 140: MST290B/ -D/ -E, electrical connection "_RN-NNNN"

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

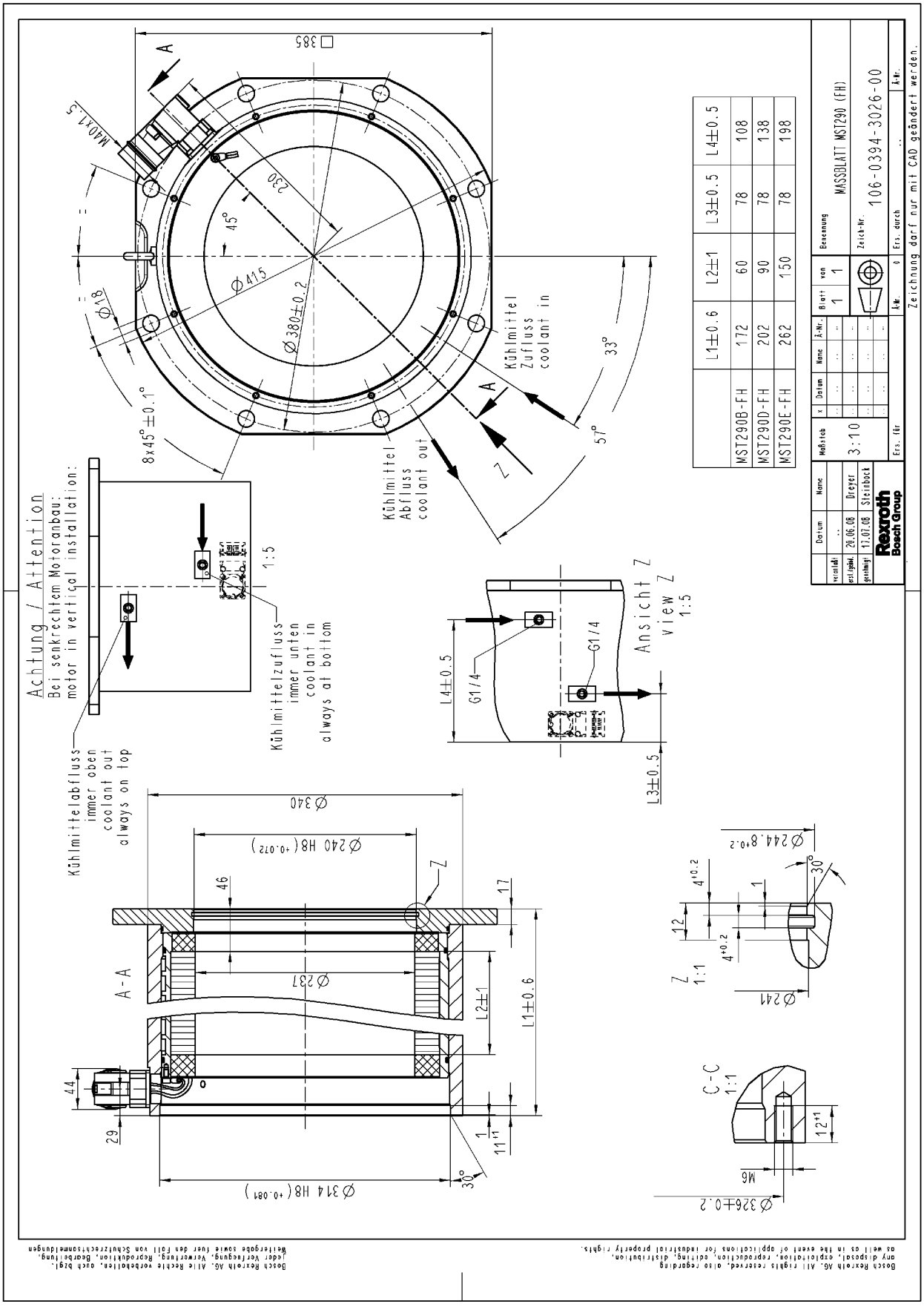
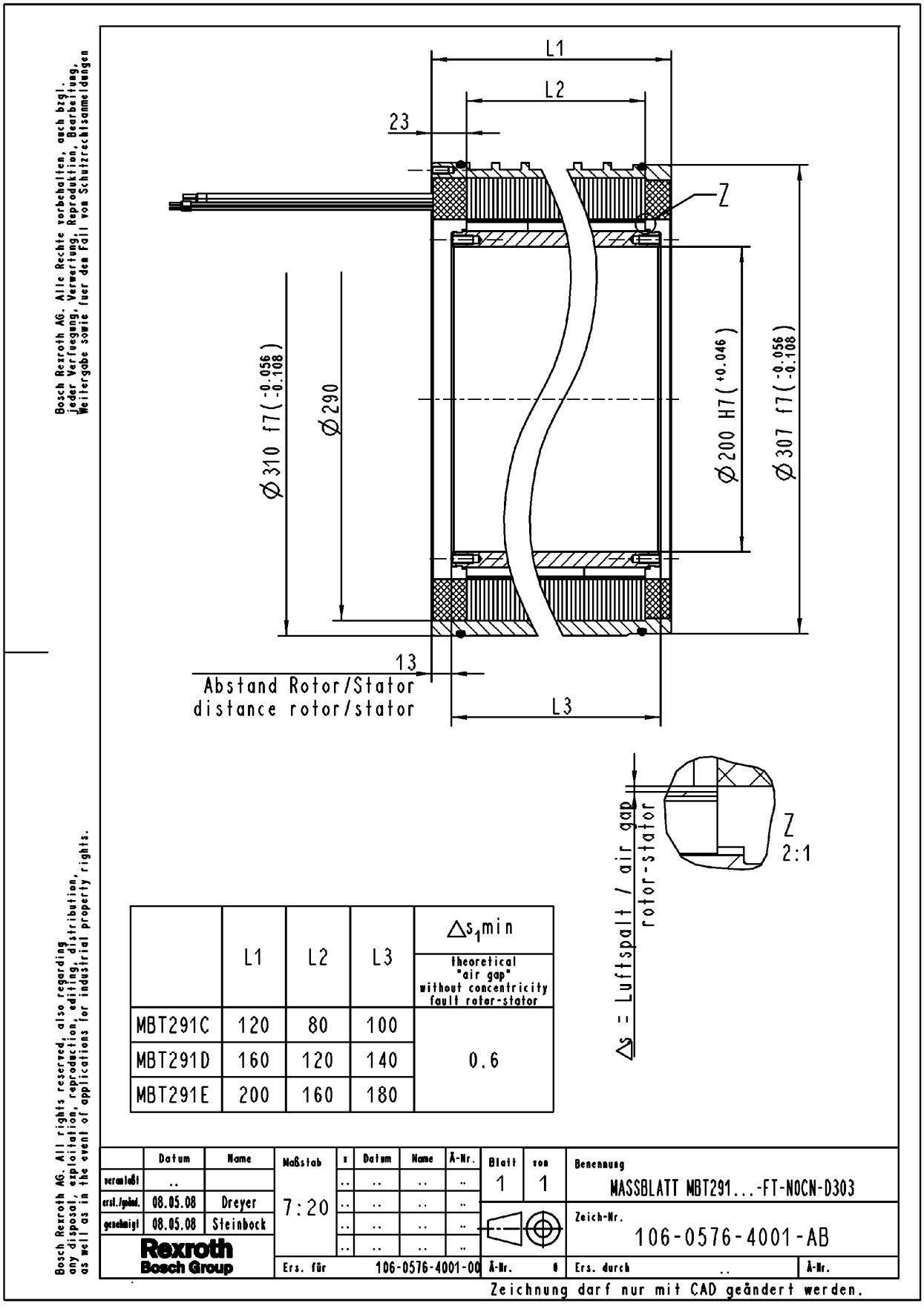


Fig. 141: MST290B/ -D/ -E with housing ("FH" design)

4.9 Dimension sheets 291

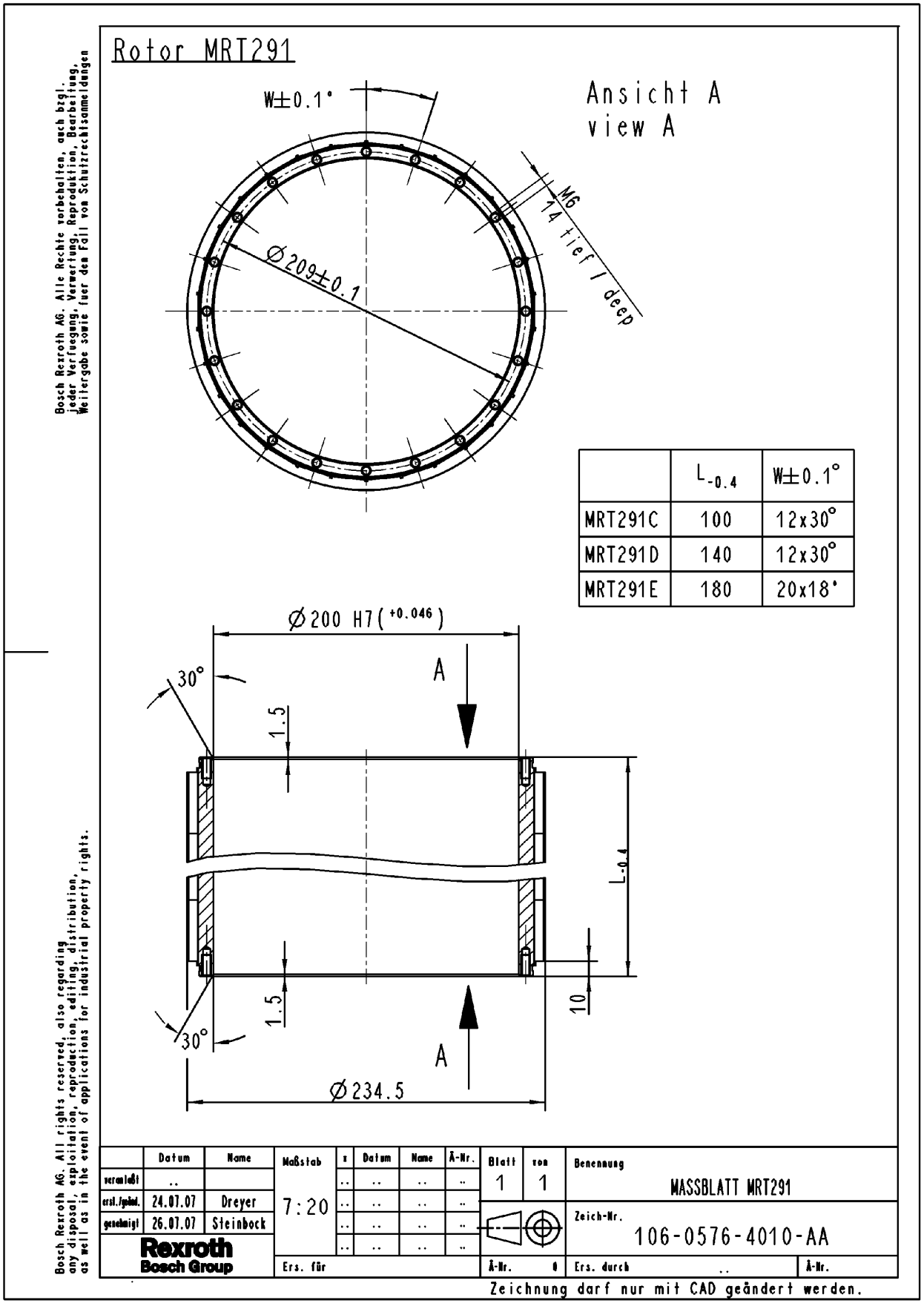
4.9.1 Motor MBT291



	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT291C	120	80	100	0.6
MBT291D	160	120	140	
MBT291E	200	160	180	

Fig. 142: MBT291

4.9.2 Rotor MRT291



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

Fig. 143: MRT291

4.9.3 Stator MST291

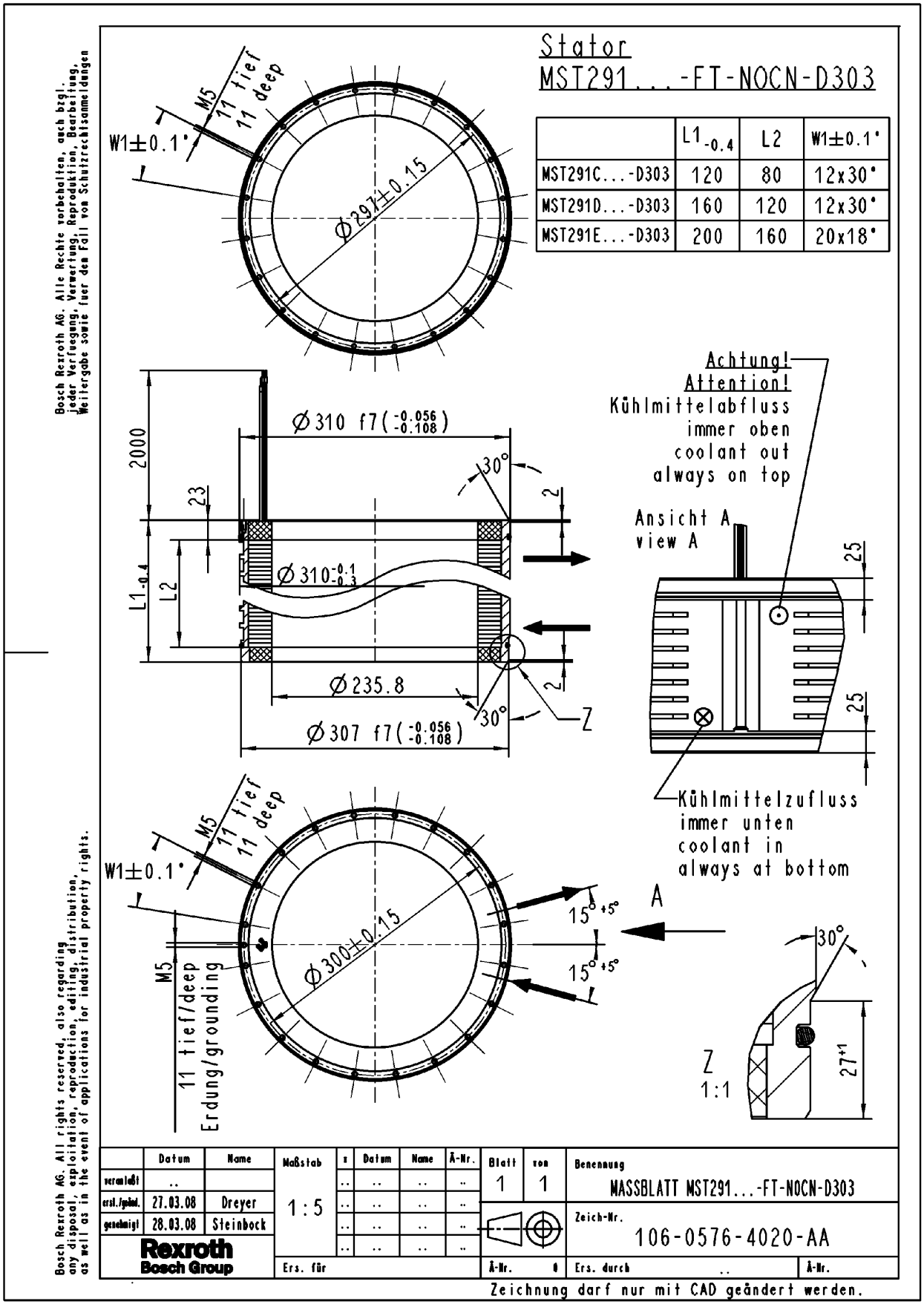
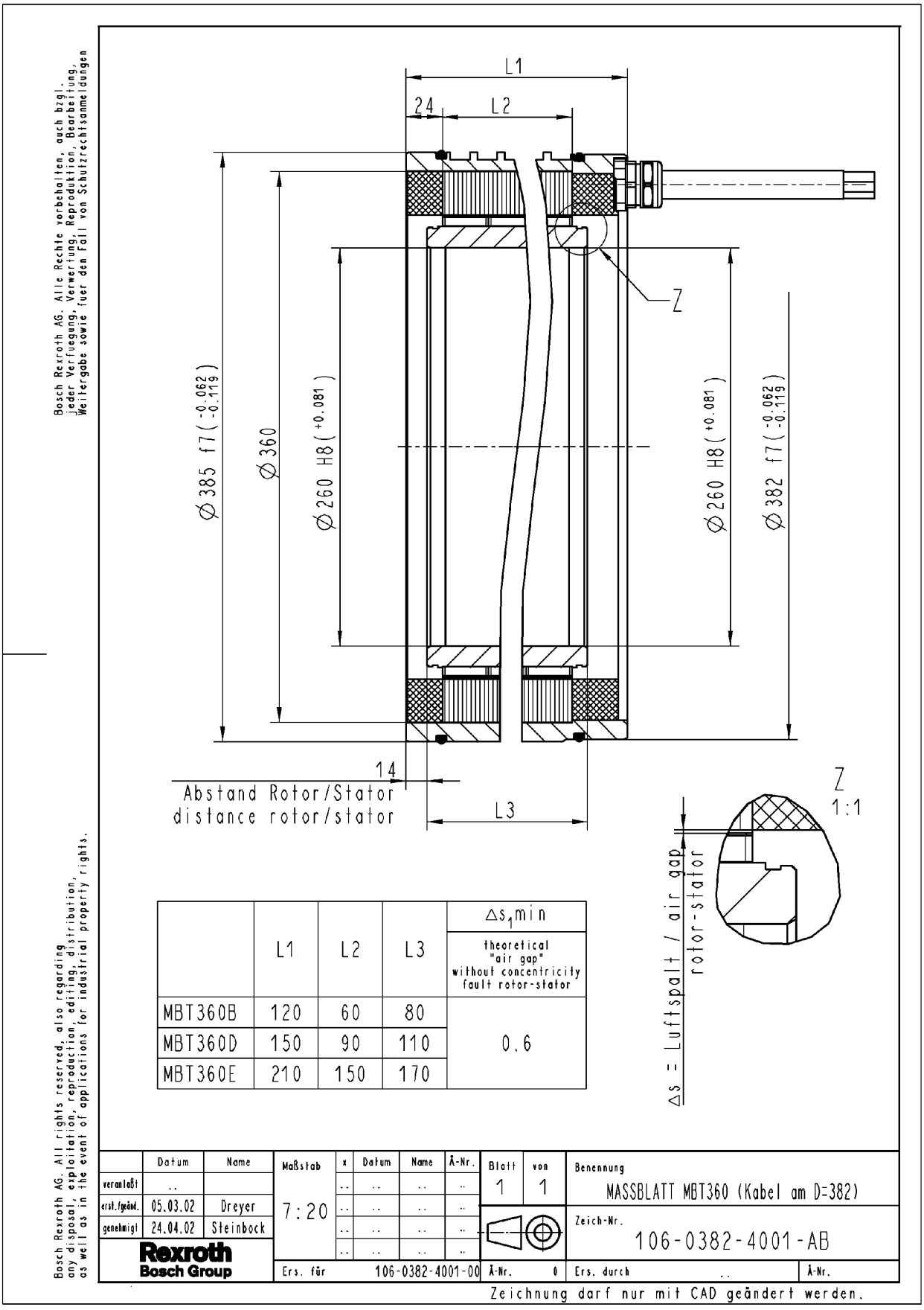


Fig. 144: MST291

4.10 Dimension sheets 360

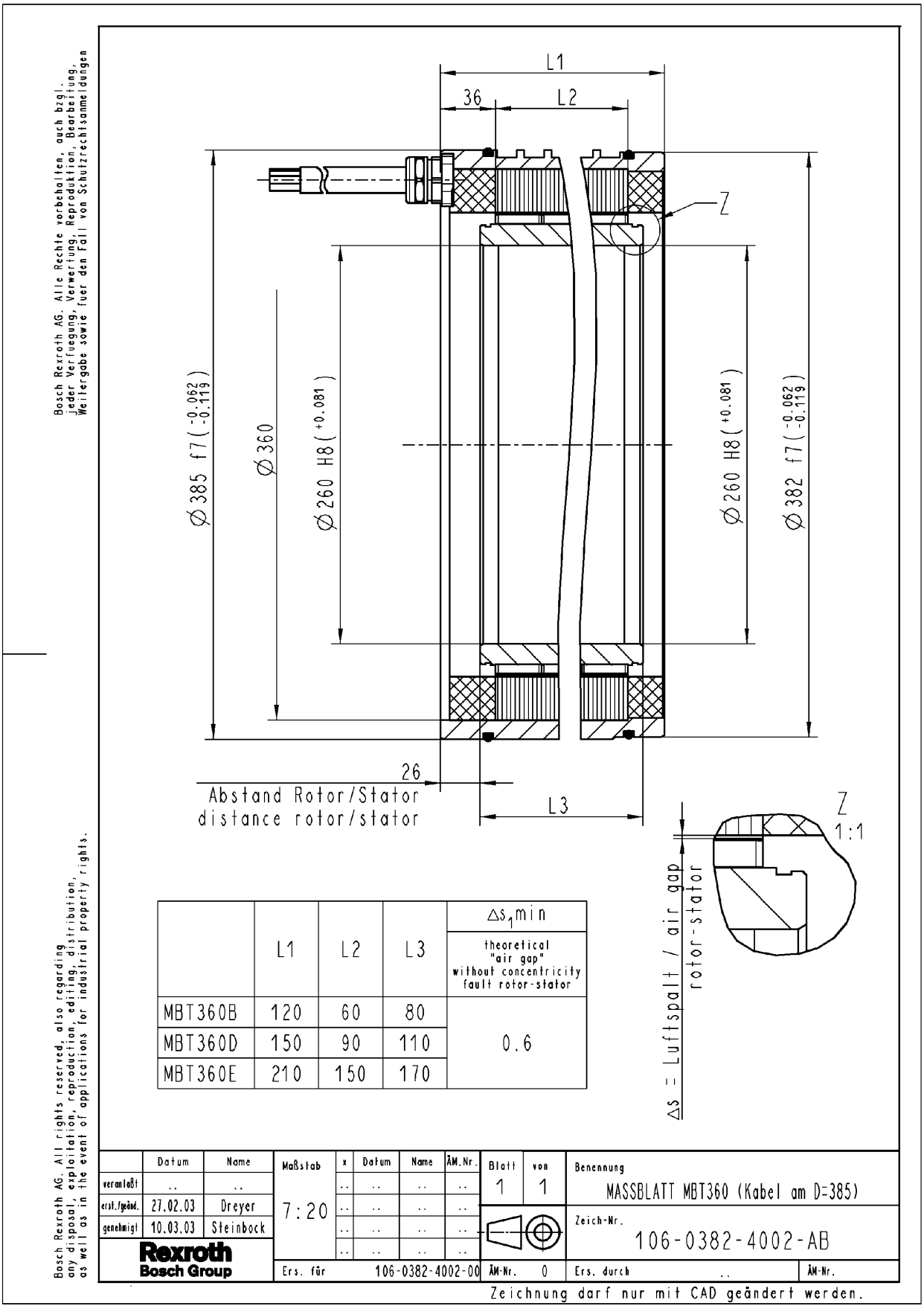
4.10.1 MBT360 with electrical connection "_SN-NNNN"



	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT360B	120	60	80	0.6
MBT360D	150	90	110	
MBT360E	210	150	170	

Fig. 145: MST360, electrical connection "_SN-NNNN"

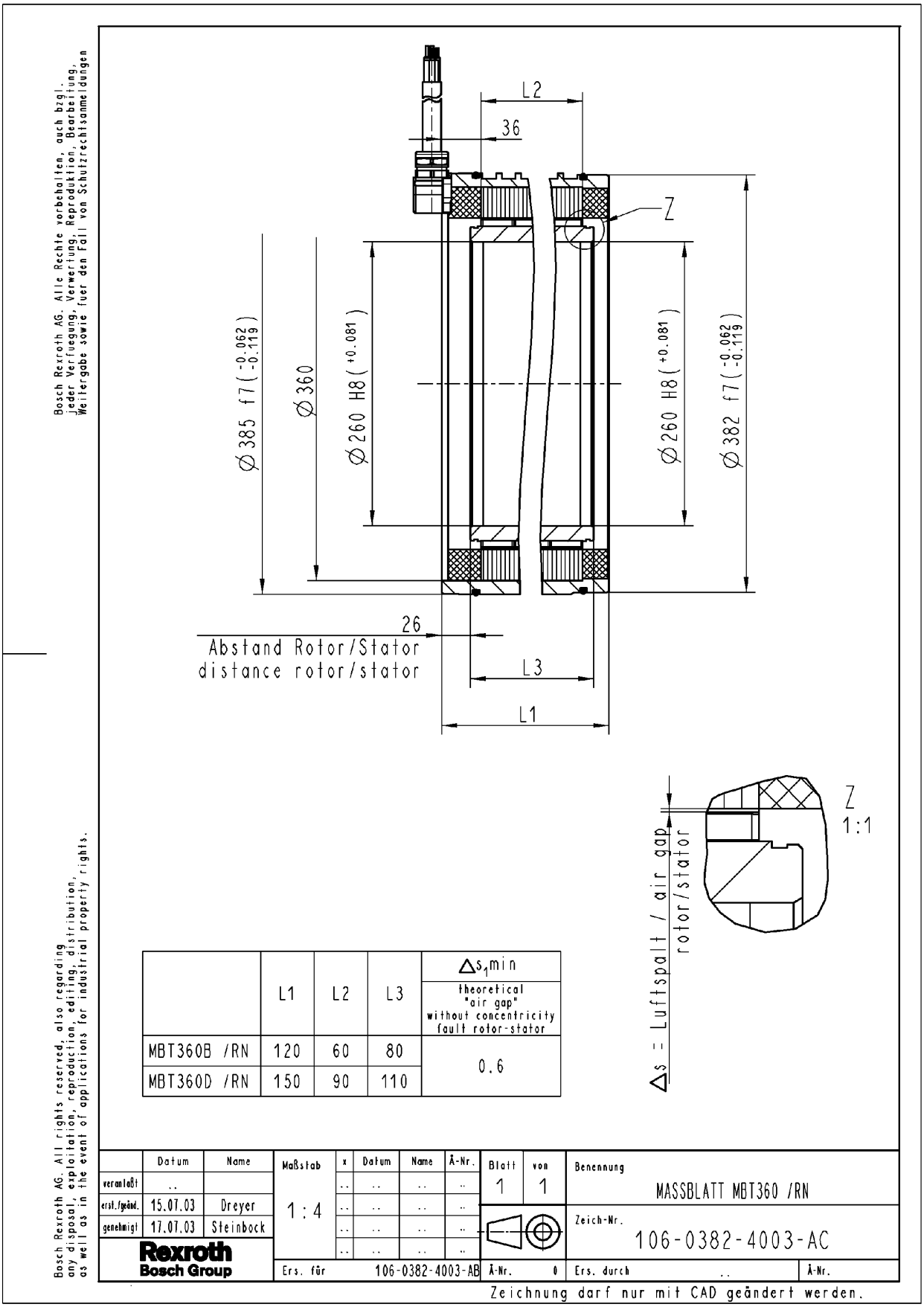
4.10.2 MBT360 with electrical connection "_CN-NNNN"



	L1	L2	L3	Δs_1 min theoretical "air gap" without concentricity fault rotor-stator
MBT360B	120	60	80	0.6
MBT360D	150	90	110	
MBT360E	210	150	170	

Fig. 146: MST360, electrical connection "_CN-NNNN"

4.10.3 MBT360 with electrical connection "_RN-NNNN"



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

	Datum	Name
veranlaßt	..	
erst./geänd.	15.07.03	Dreyer
genehmigt	17.07.03	Steinbock

Maßstab 1 : 4

x	Datum	Name	Ä-Nr.
..	..	..	..
..	..	..	..
..	..	..	..
..	..	..	..

Blatt 1 von 1

Benennung: MASSBLATT MBT360 /RN

Zeich-Nr.: 106-0382-4003-AC

Ers. für 106-0382-4003-AB Ä-Nr. 0 Ers. durch .. Ä-Nr.

Rexroth Bosch Group

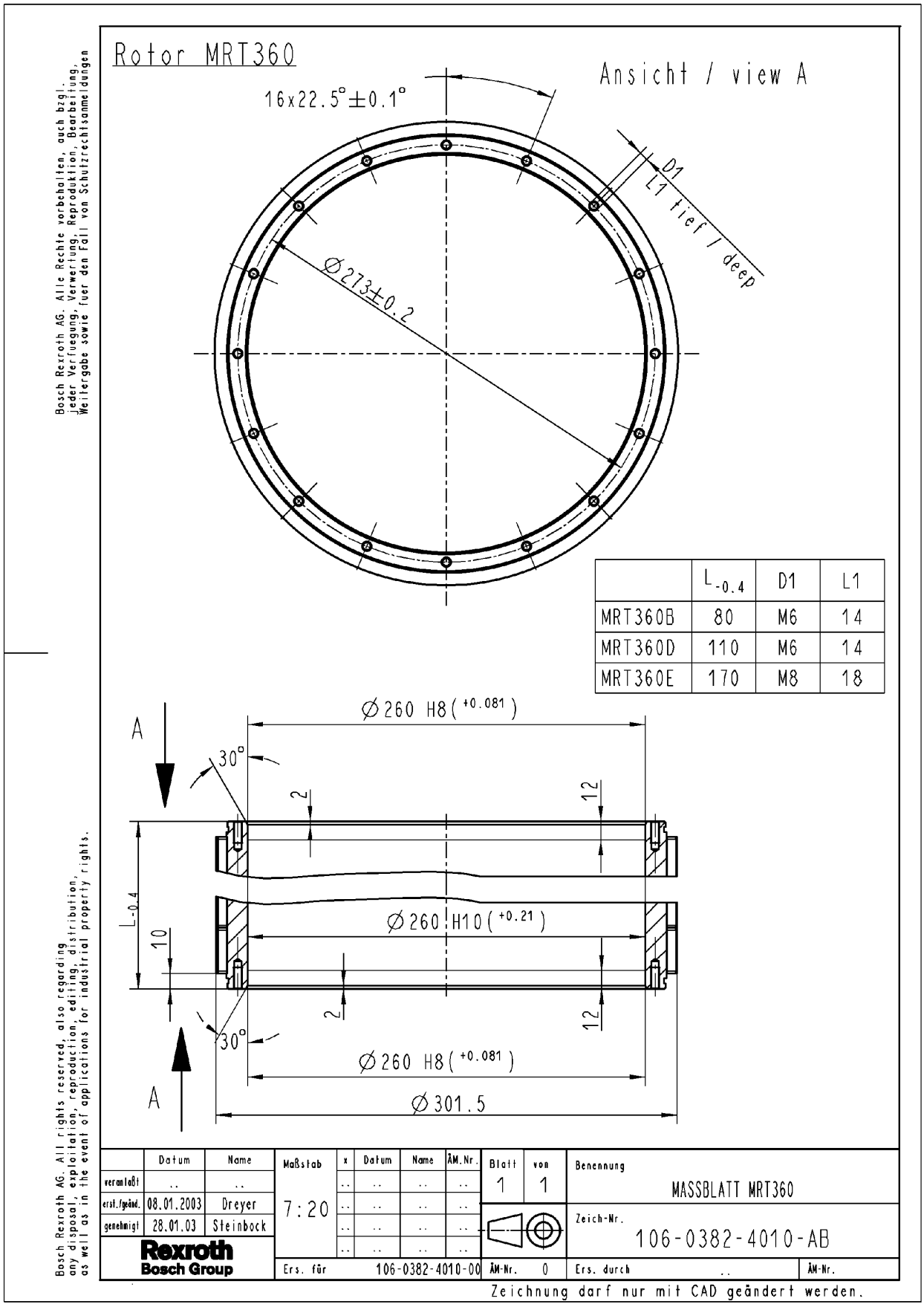
Zeichnung darf nur mit CAD geändert werden.

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Fig. 147: MST360, electrical connection "_RN-NNNN"

4.10.4 Rotor MRT360



	L -0.4	D1	L1
MRT360B	80	M6	14
MRT360D	110	M6	14
MRT360E	170	M8	18

Fig. 148: Rotor MRT360

4.10.5 Stator MST360, electrical connection "_SN-NNNN"

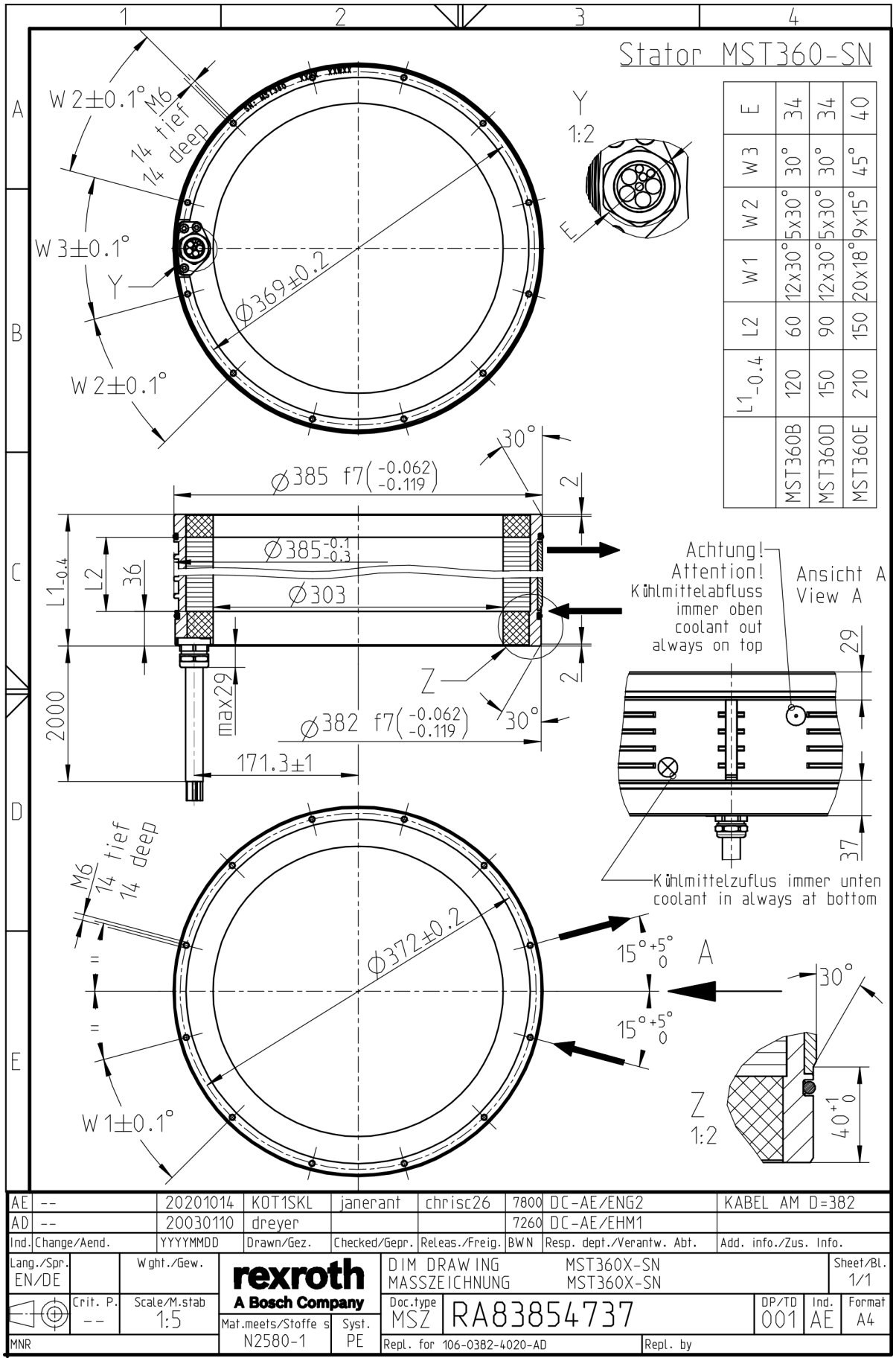


Fig. 149: Stator MST360, electrical connection "_SN-NNNN"

4.10.6 Stator MST360, electrical connection "_CN-NNNN"

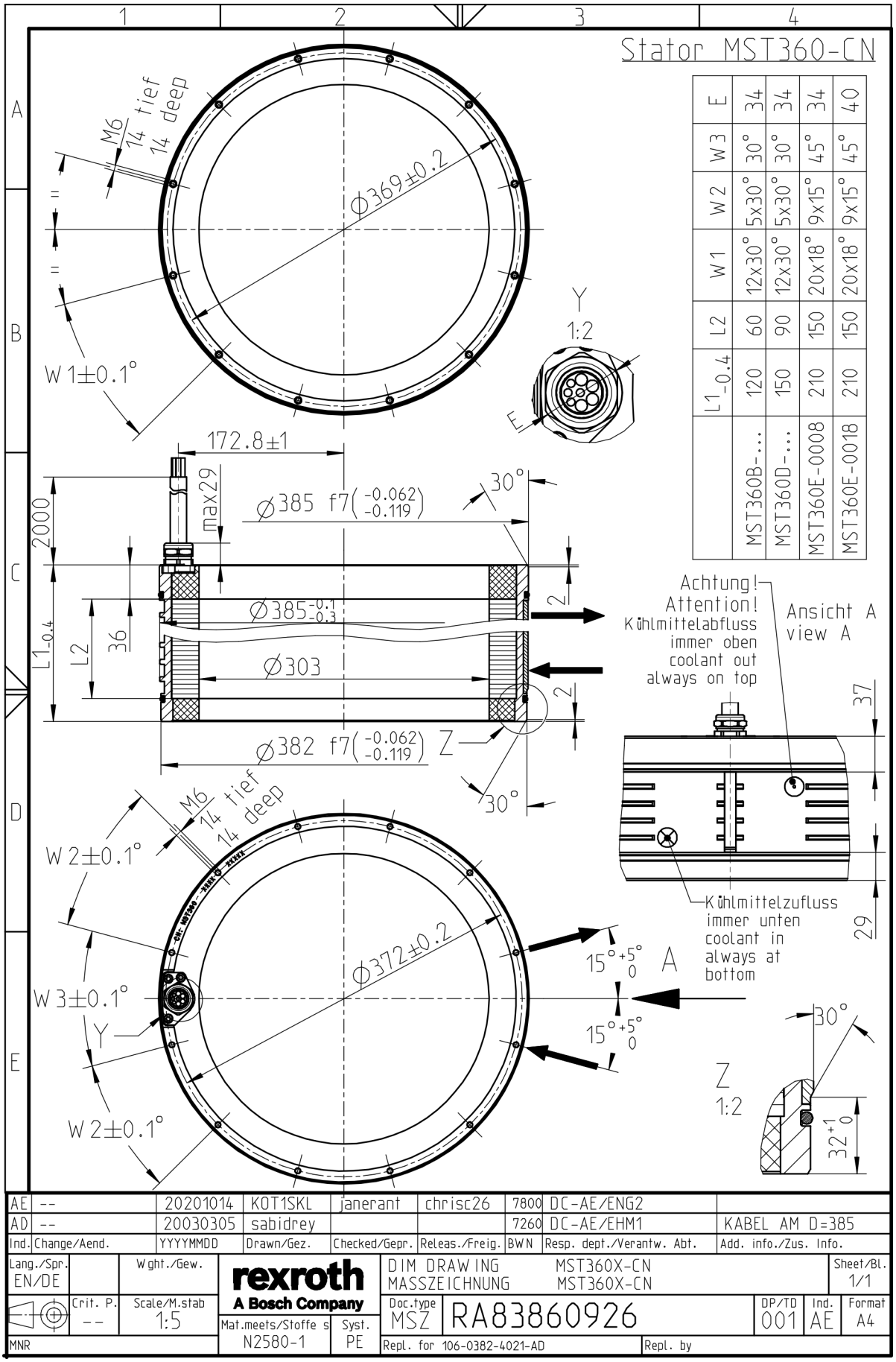


Fig. 150: Stator MST360, electrical connection "_CN-NNNN"

4.10.7 Stator MST360, electrical connection "_CN-D303"

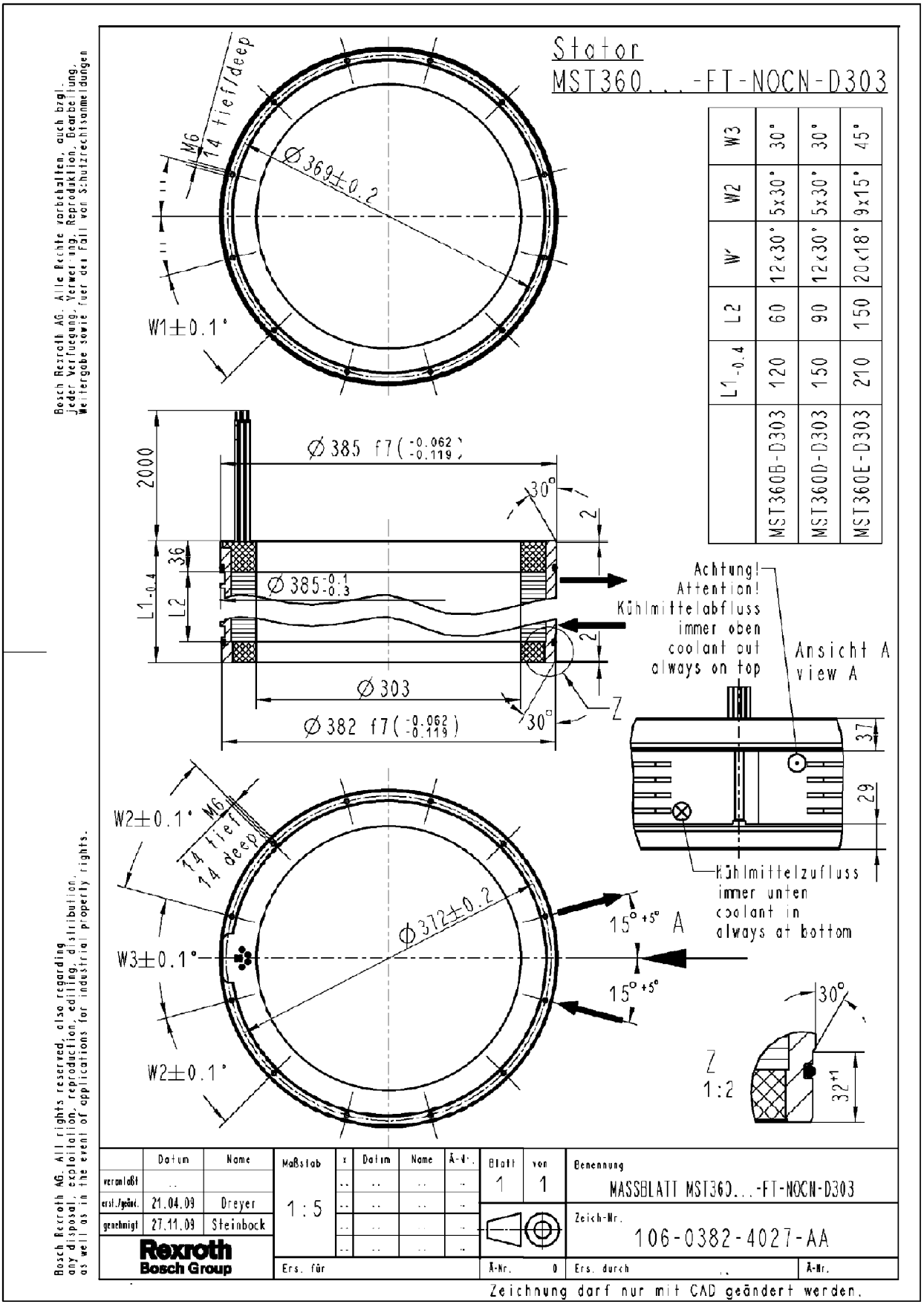


Fig. 151: Stator MST360, electrical connection "-_CN-D303"

4.10.8 Stator MST360, electrical connection "_RN-NNNN"

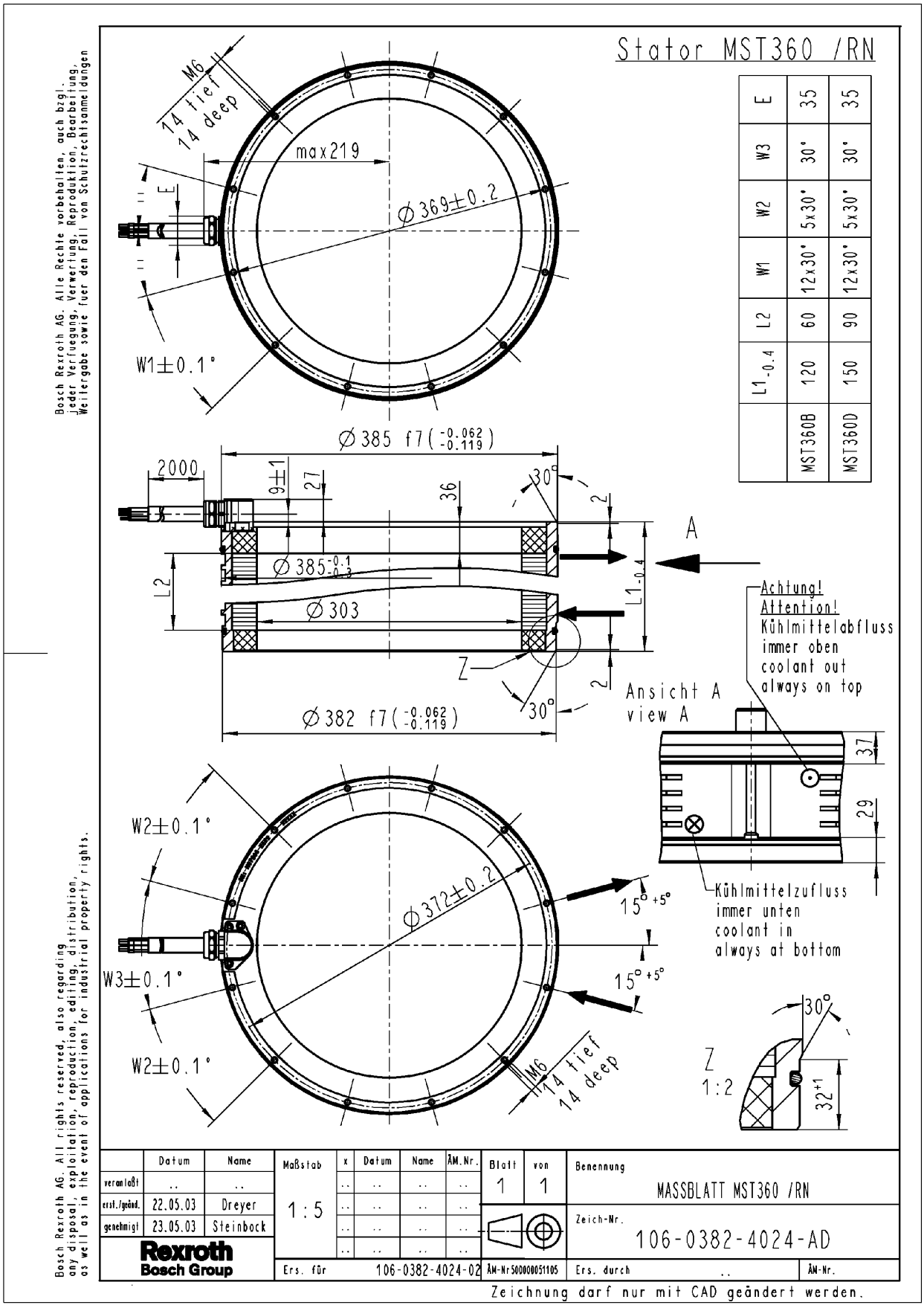


Fig. 152: MST360, electrical connection "_RN-NNNN"

4.10.9 MST360 with housing (design "FH")

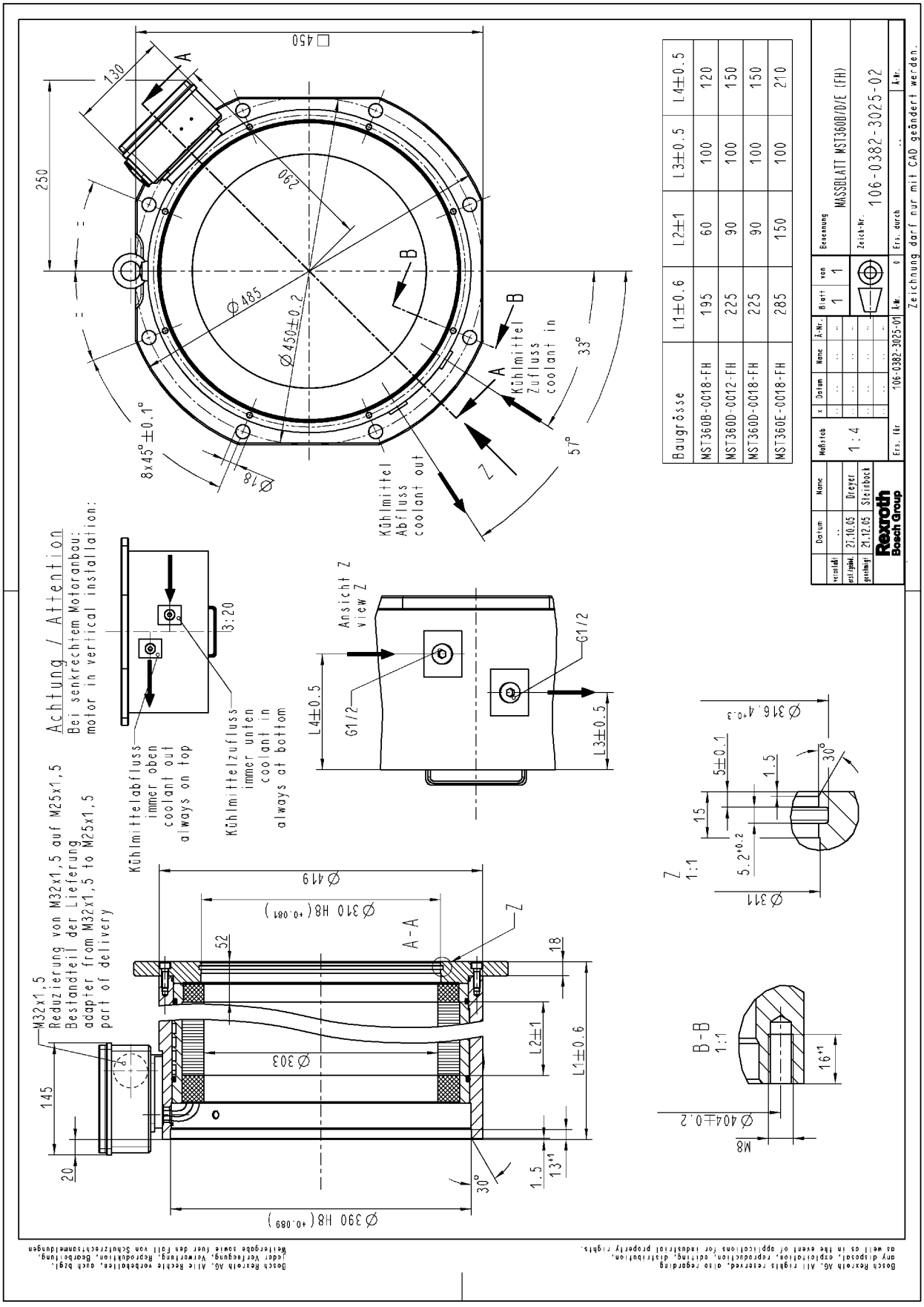
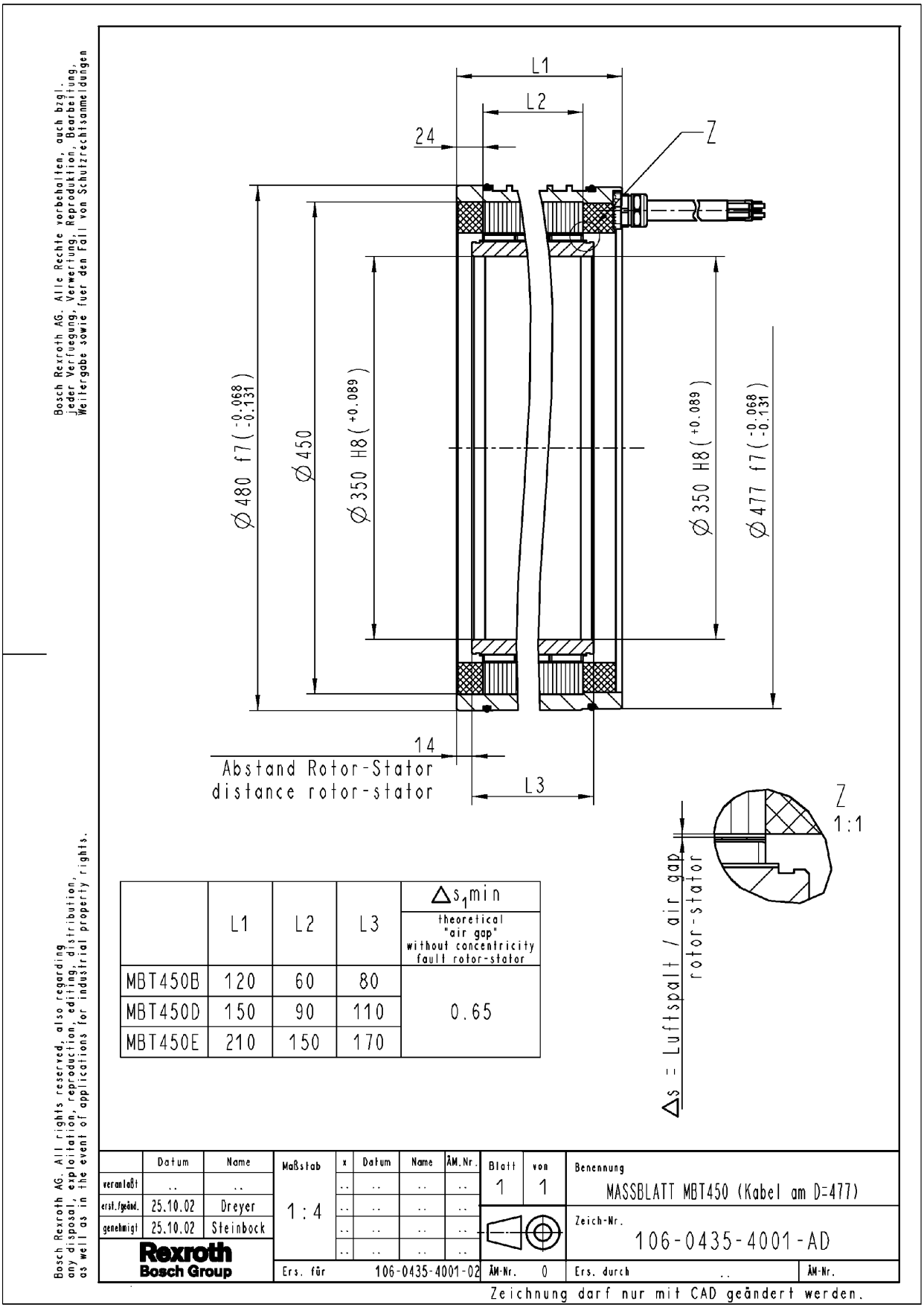


Fig. 153: MST360 with housing (design "FH")

4.11 Dimension sheets 450

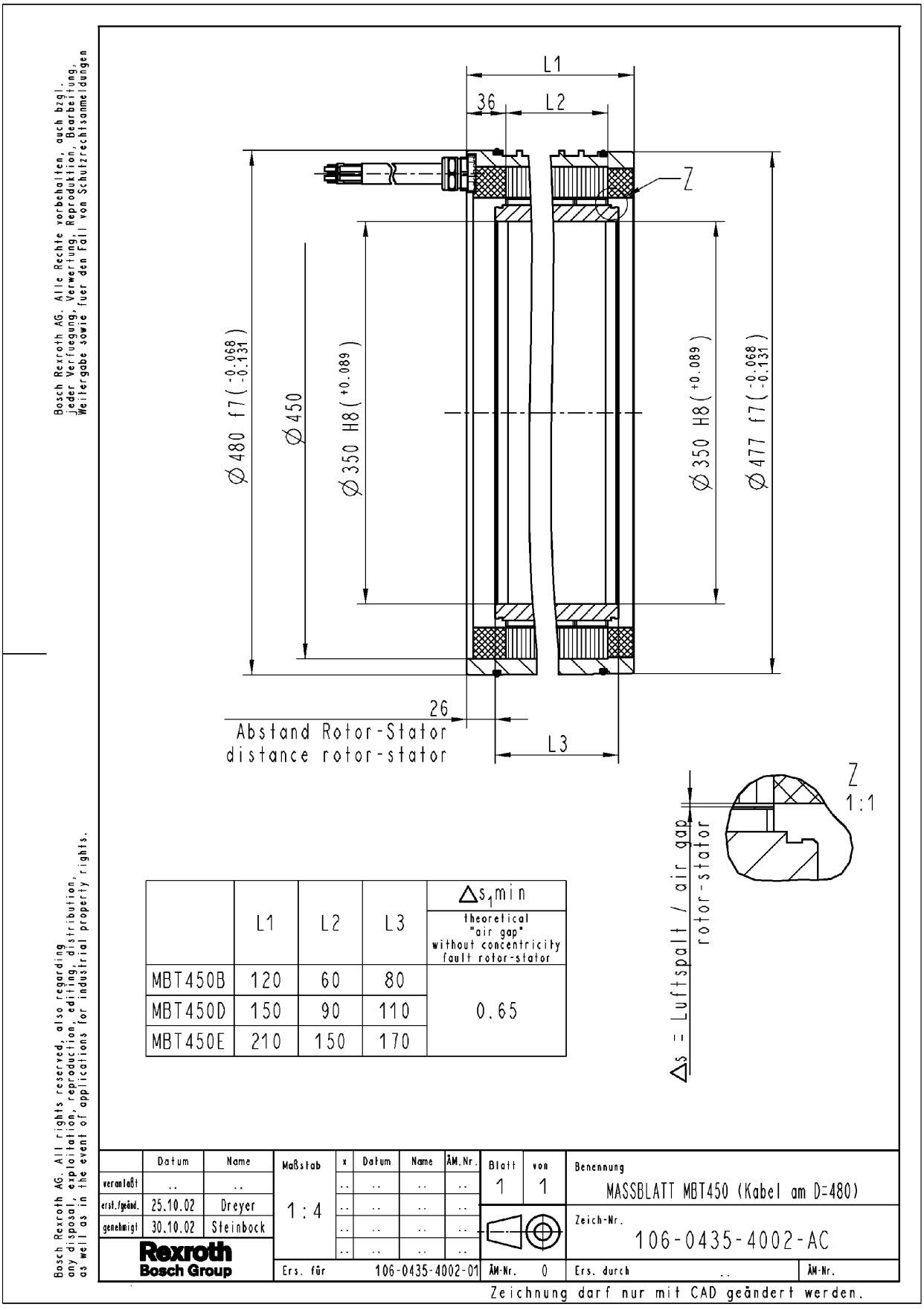
4.11.1 MBT450 with electrical connection "_SN-NNNN"



	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. 154: MBT450, electrical connection "_SN-NNNN"

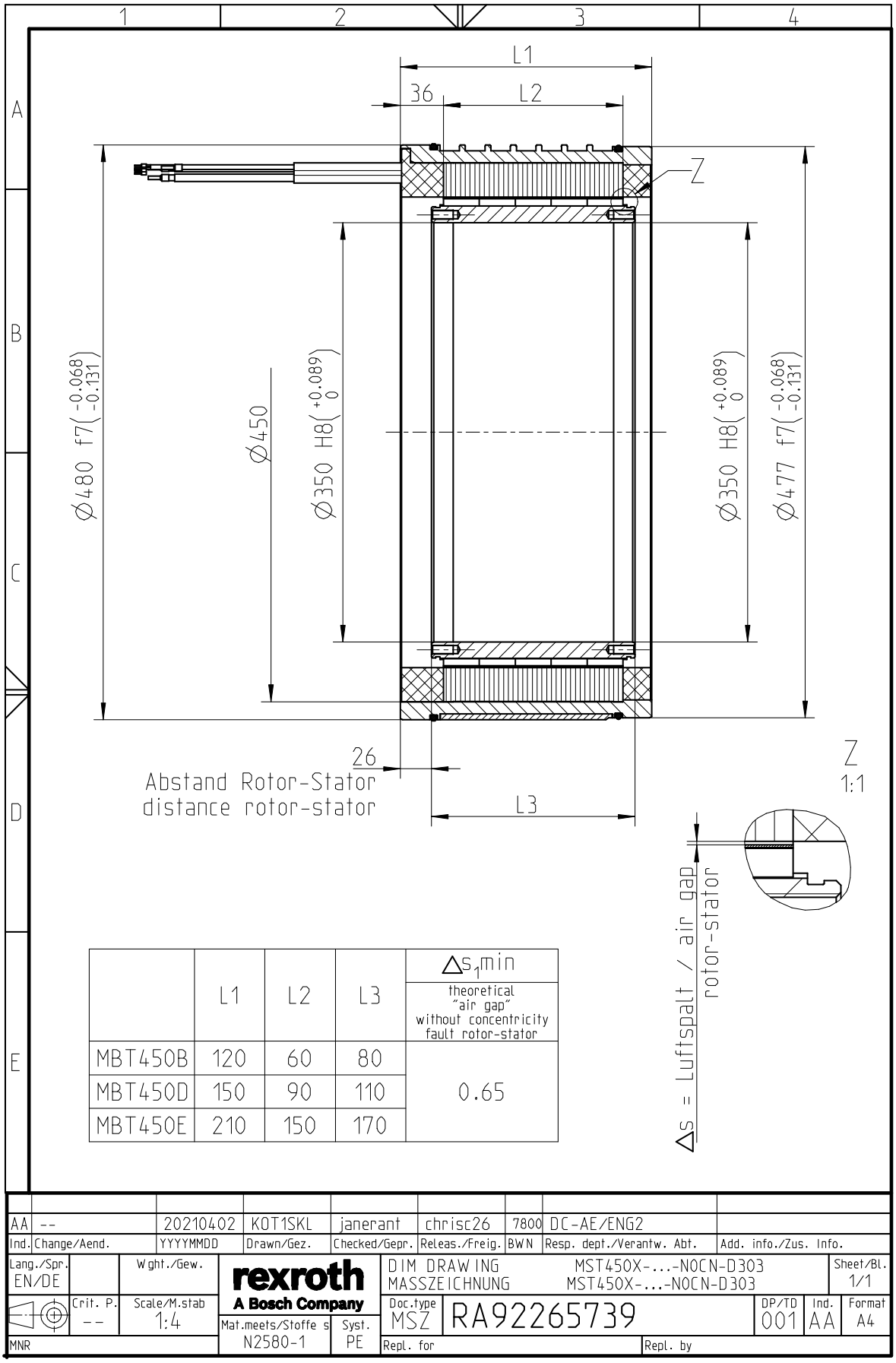
4.11.2 MBT450 with electrical connection "_CN-NNNN"



	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. 155: MBT450, electrical connection "_CN-NNNN"

4.11.3 MBT450, electrical connection "_CN-D303"



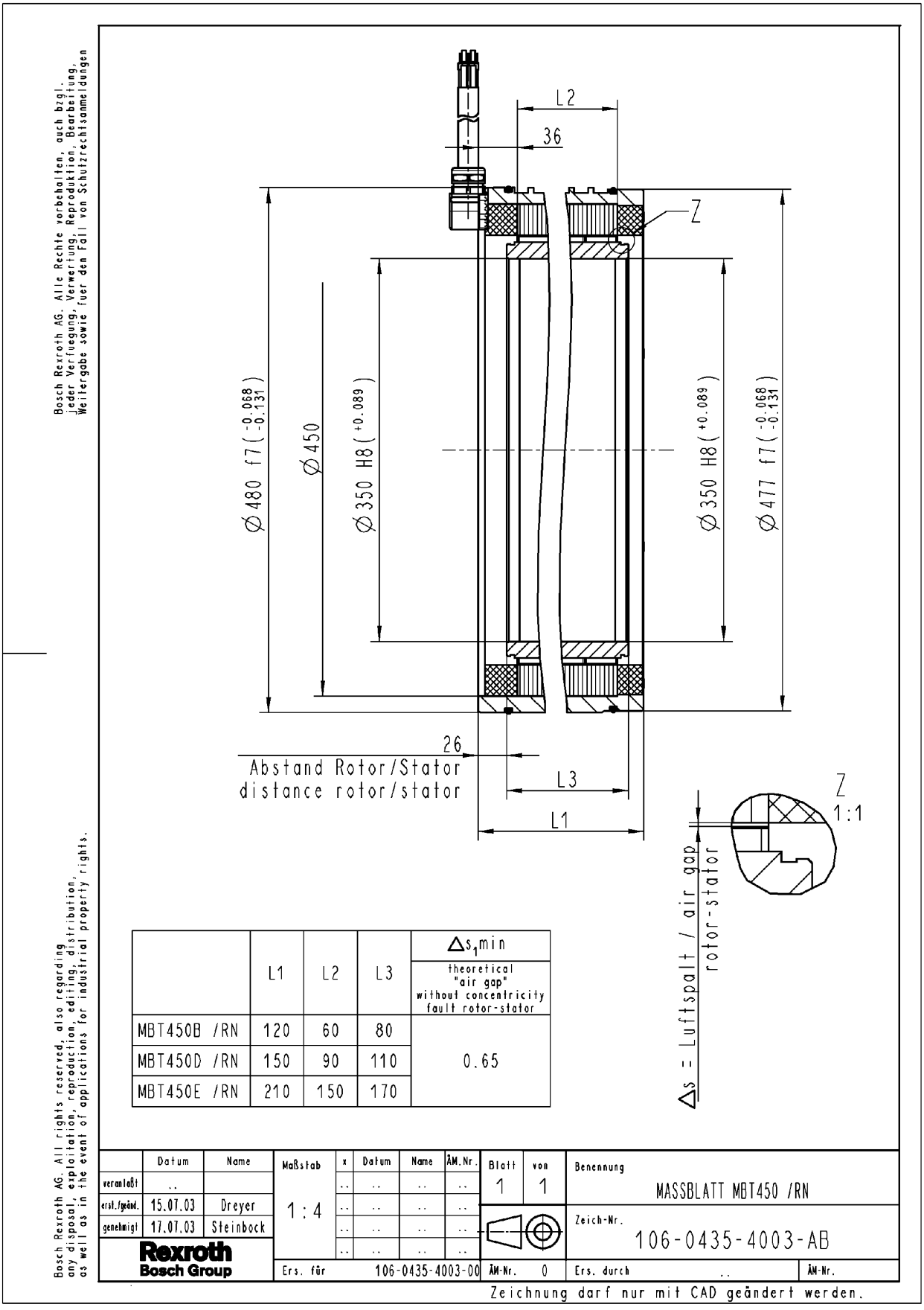
	L1	L2	L3	Δs_1 min theoretical "air gap" without concentricity fault rotor-stator
MBT450B	120	60	80	0.65
MBT450D	150	90	110	
MBT450E	210	150	170	

AA	--	20210402	KOT1SKL	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	MST450X-...-NOCN-D303 MST450X-...-NOCN-D303		Sheet/Bl. 1/1
	Crit. P. --	Scale/M.stab 1:4	Mat.meets/Stoffe s N2580-1	Syst. PE	Doc.type MSZ	RA92265739	DP/TD 001	Ind. AA	Format A4
MNR					Repl. for		Repl. by		

Fig. 156: MBT450, electrical connection "_CN-D303"

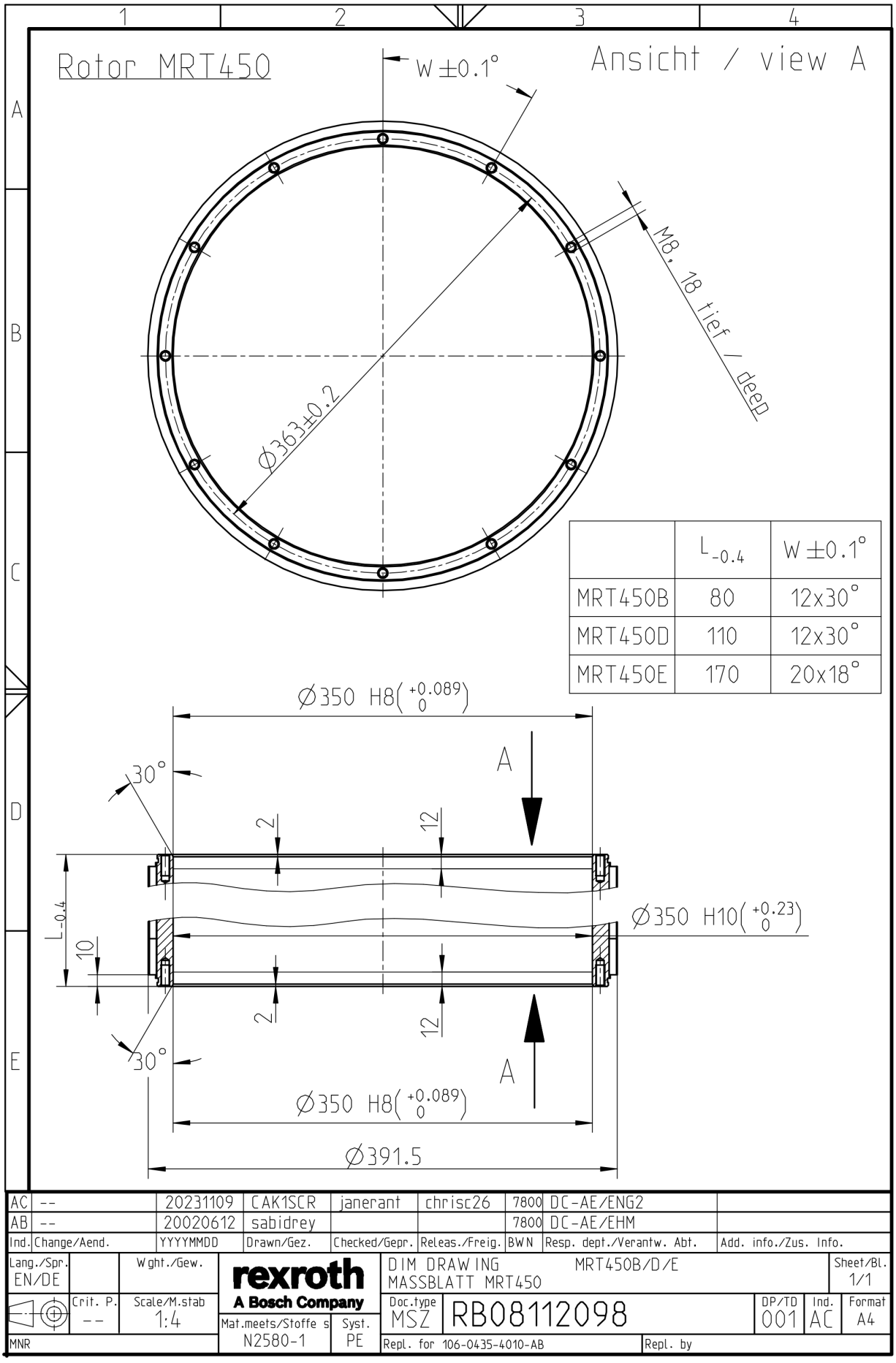
4.11.4 MBT450 with electrical connection "_RN-NNNN"



	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	

Fig. 157: MBT450, electrical connection "_RN-NNNN"

4.11.5 Rotor MRT450



	$L_{-0.4}$	W ±0.1°
MRT450B	80	12x30°
MRT450D	110	12x30°
MRT450E	170	20x18°

AC	--	20231109	CAK1SCR	janerant	chrisc26	7800	DC-AE/ENG2	
AB	--	20020612	sabidrey			7800	DC-AE/EHM	
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 MASSBLATT MRT450	MRT450B/D/E			Sheet/Bl. 1/1
	Crit. P. --	Scale/M.stab 1:4		Doc.type MSZ	RB08112098	DP/TD 001	Ind. AC	Format A4
MNR			Mat.meets/Stoffe s N2580-1	Syst. PE	Repl. for 106-0435-4010-AB		Repl. by	

Fig. 158: MRT450

4.11.6 Stator MST450, electrical connection "_SN-NNNN"

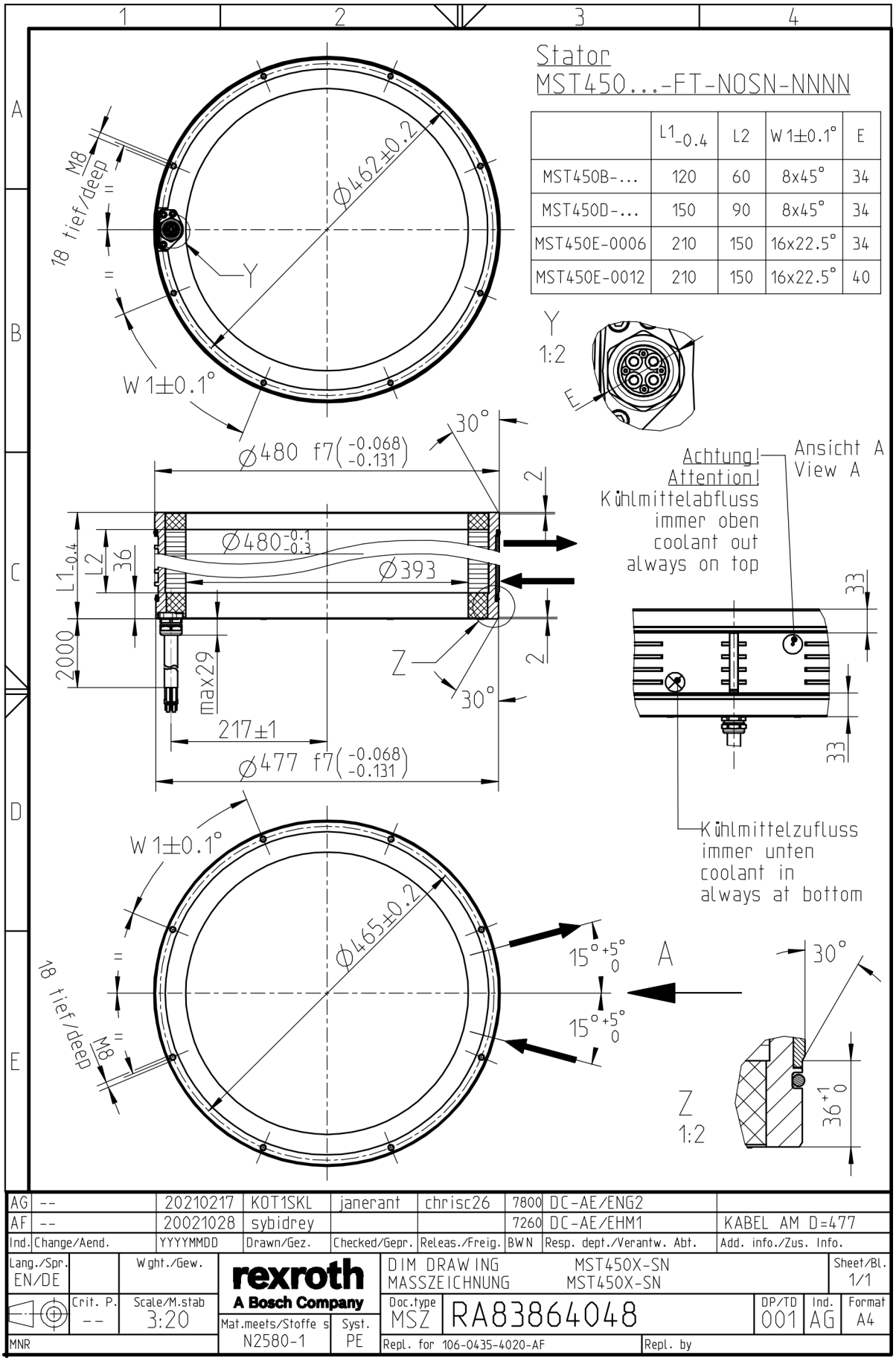
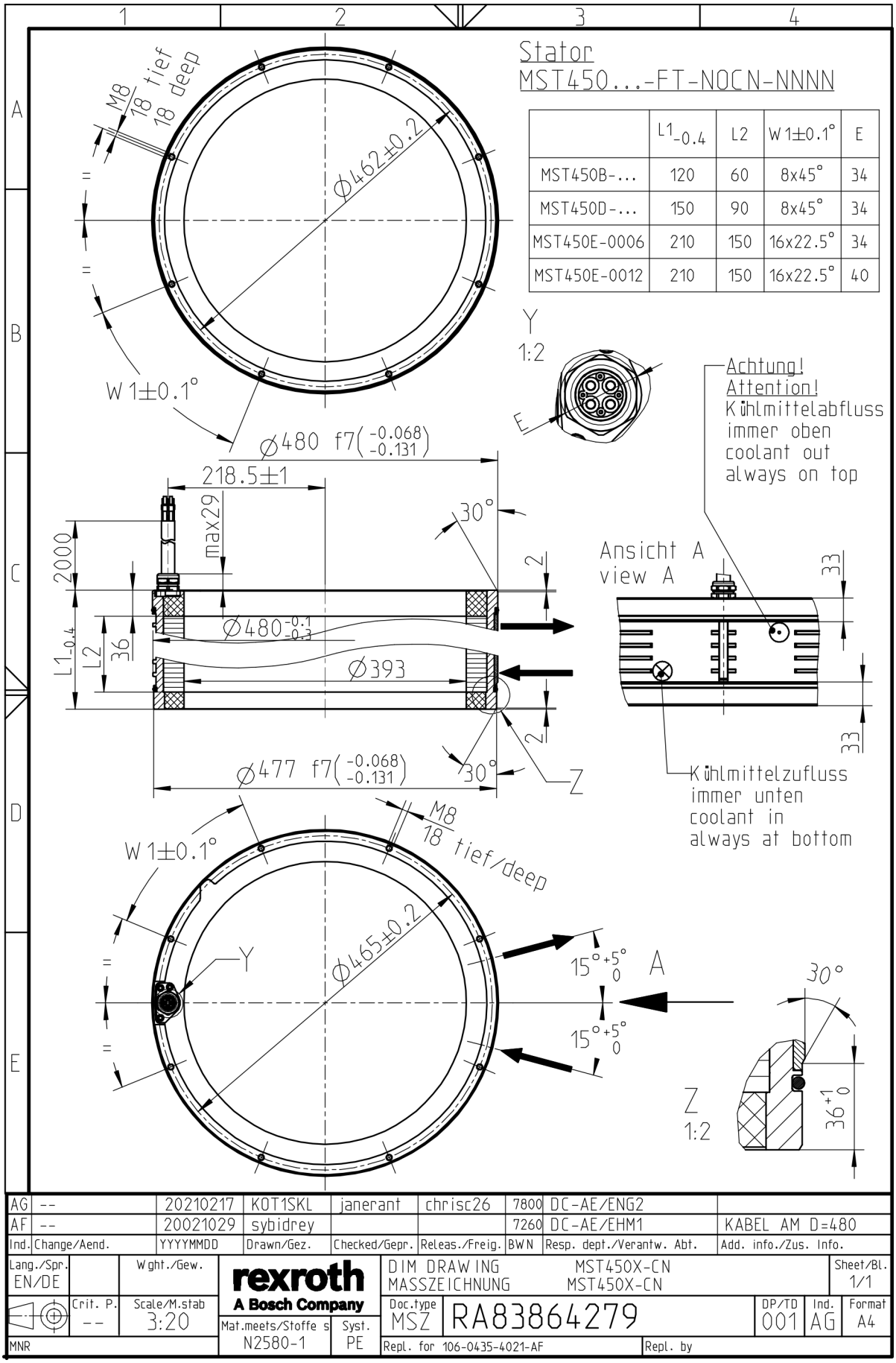


Fig. 159: MST450, electrical connection "_SN-NNNN"

4.11.7 Stator MST450, electrical connection "_CN-NNNN"



	L1 -0.4	L2	W 1±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

AG	--	20210217	KOT1SKL	janerant	chrisc26	7800	DC-AE/ENG2	
AF	--	20021029	sybidrey			7260	DC-AE/EHM1	KABEL AM D=480
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 MST450X-CN				Sheet/Bl. 1/1
Crit. P. --	Scale/M.stab 3:20	Mat.meets/Stoffe s N2580-1	Syst. PE	Doc.type MSZ	RA83864279	DP/TD 001	Ind. AG / Format A4
MNR				Repl. for 106-0435-4021-AF		Repl. by	

Fig. 160: MST450, electrical connection "_CN-NNNN"

4.11.8 Stator MST450, electrical connection "_RN-NNNN"

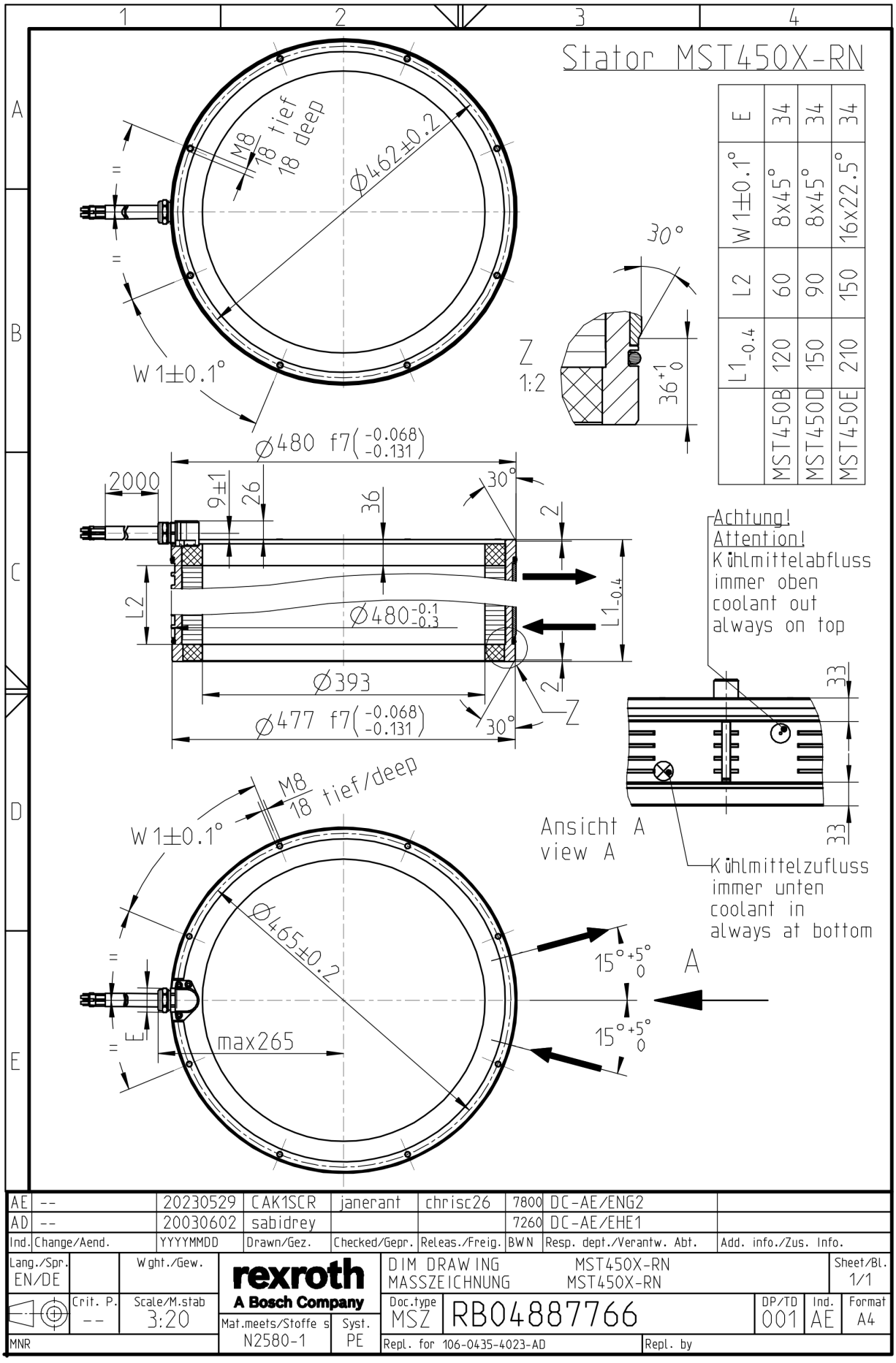
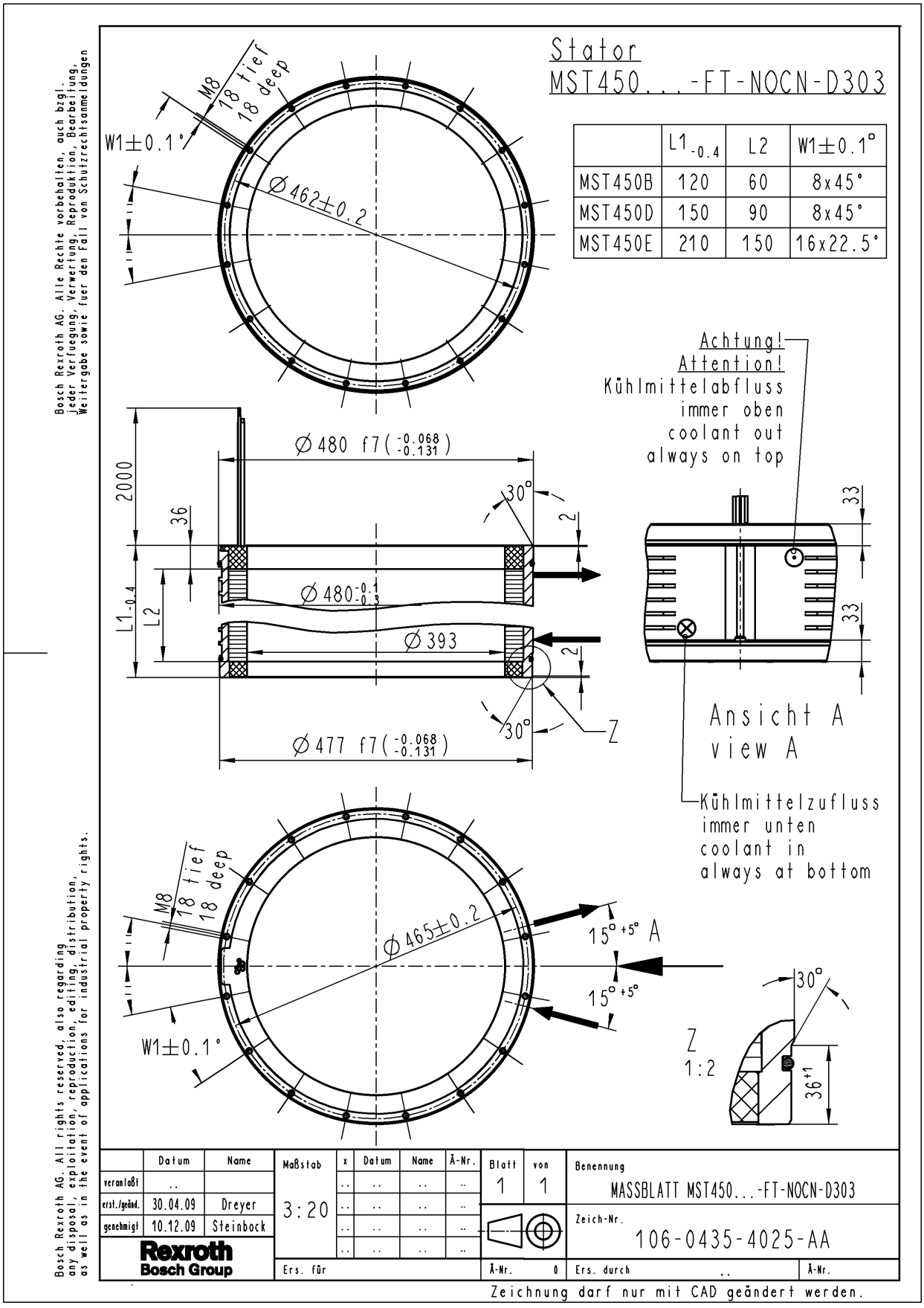


Fig. 161: MST450, electrical connection "_RN-NNNN"

4.11.9 Stator MST450, electrical connection "_CN-D303"



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

Fig. 162: MST450, electrical connection "_CN-D303"

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

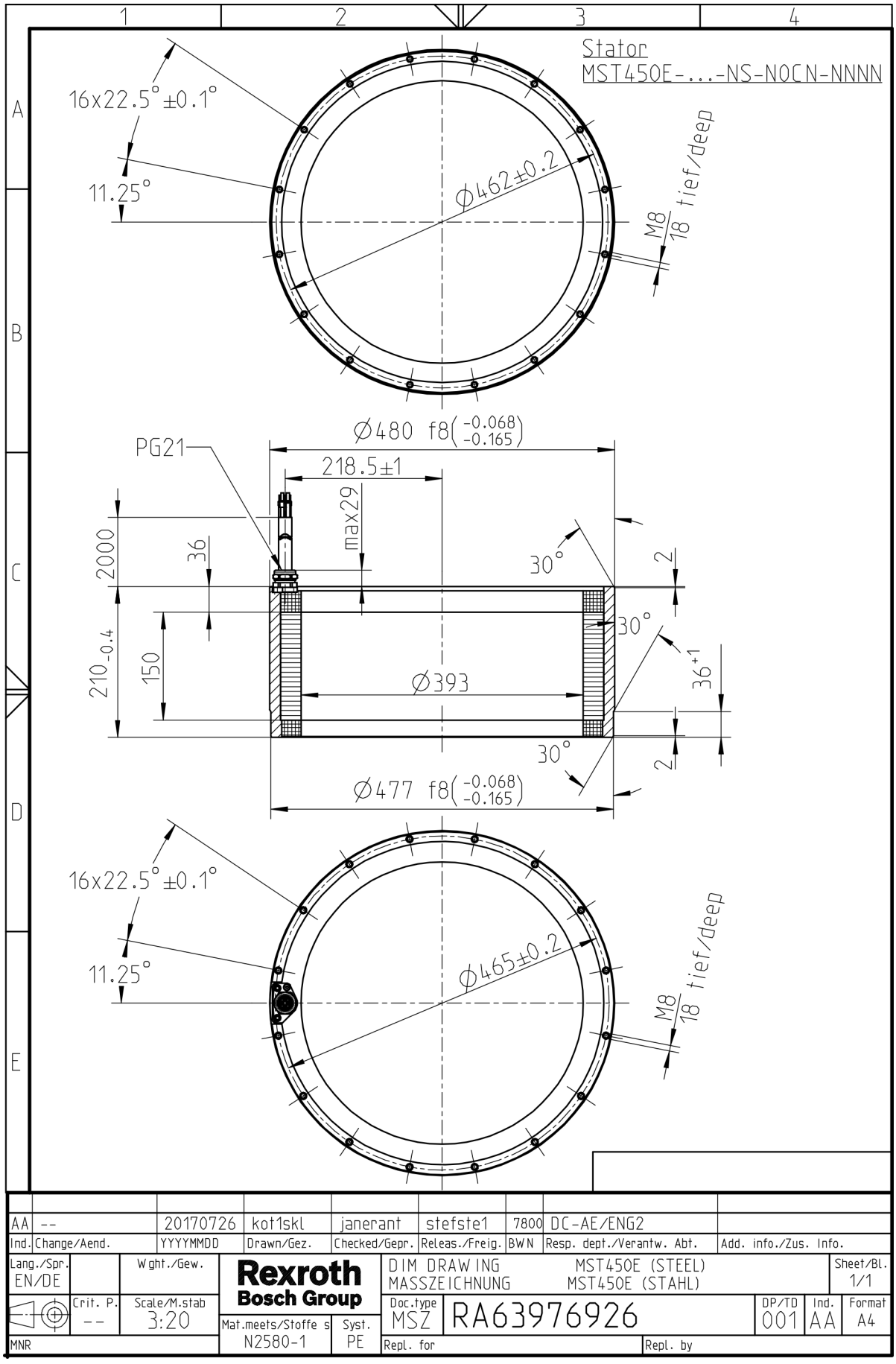
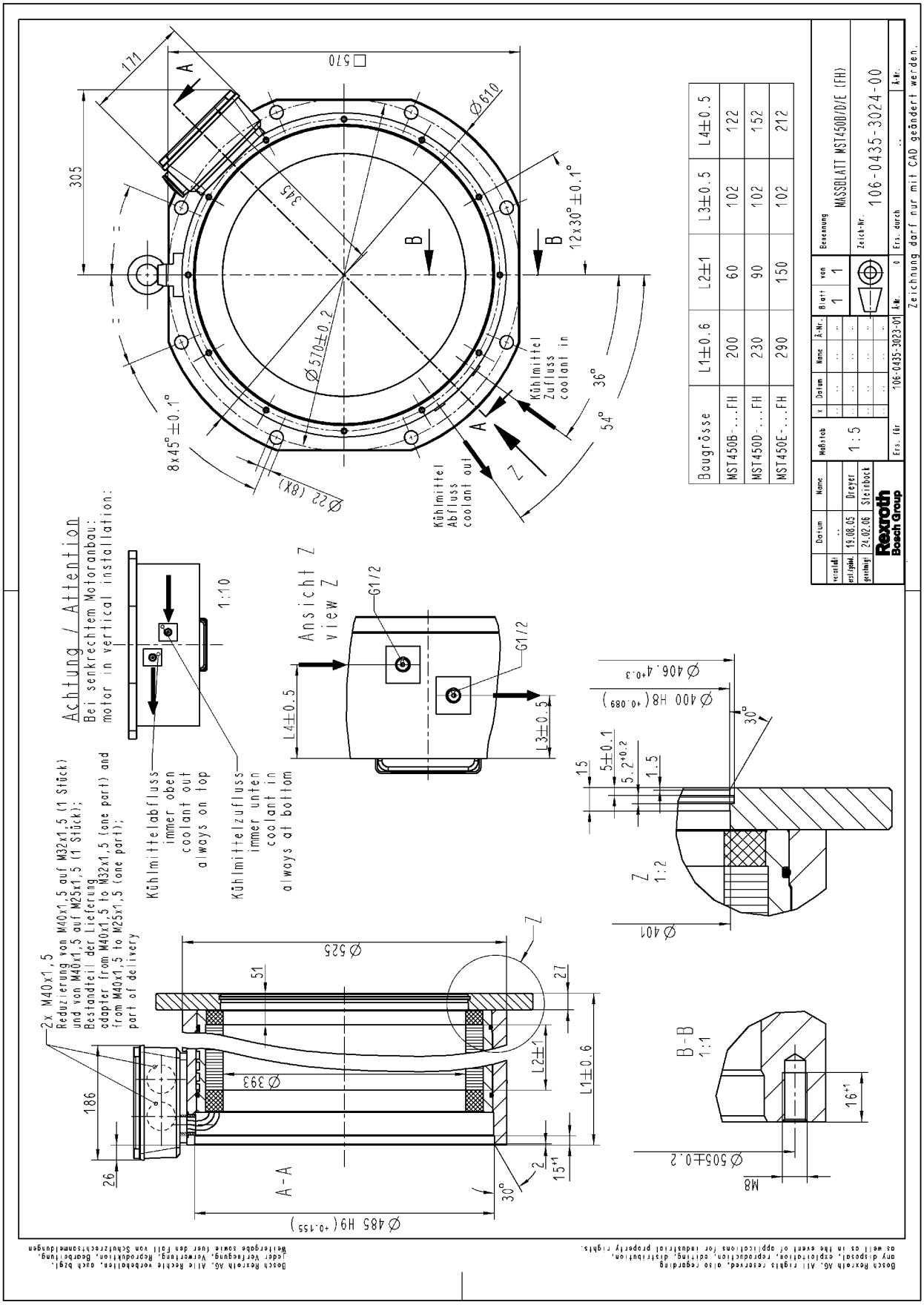


Fig. 163: Stator MST450E, natural convection

4.11.11 Stator MST450 with housing (design "FH")

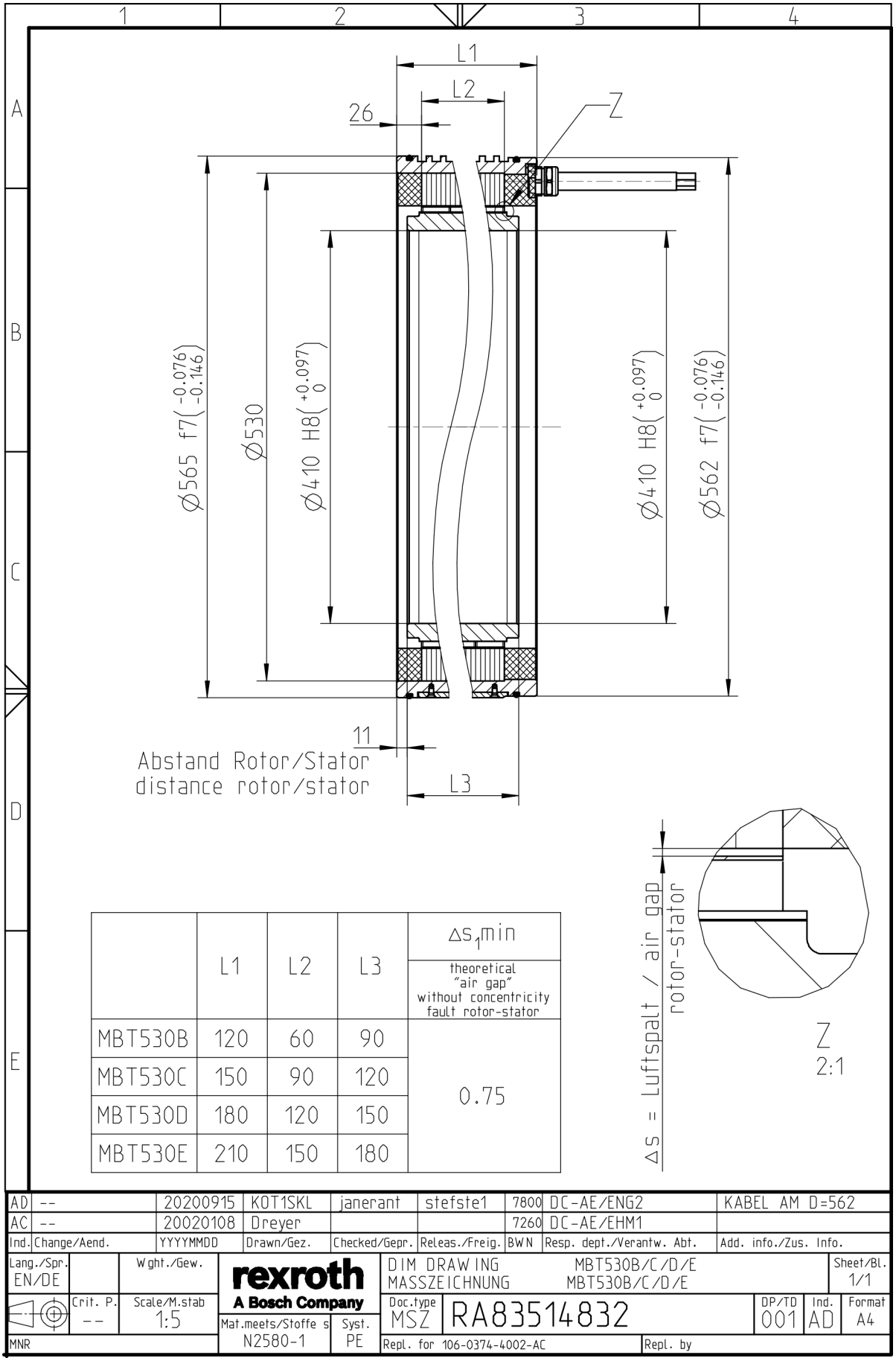


Baugrösse	L1±0.6	L2±1	L3±0.5	L4±0.5
MST450B-...FH	200	60	102	122
MST450D-...FH	230	90	102	152
MST450E-...FH	290	150	102	212

Fig. 164: MST450 with housing (design "FH")

4.12 Dimension sheets 530

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



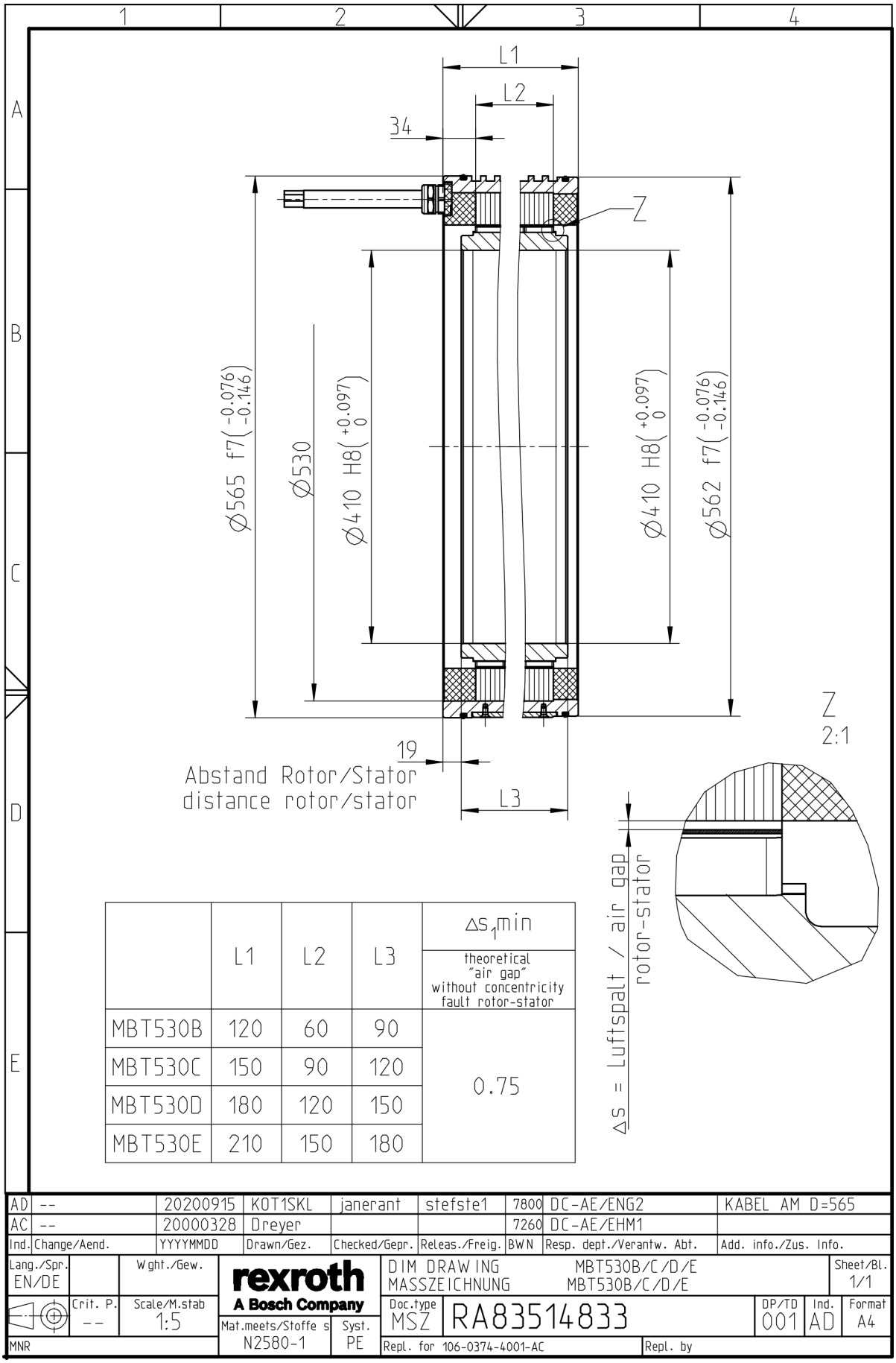
	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT530B	120	60	90	0.75
MBT530C	150	90	120	
MBT530D	180	120	150	
MBT530E	210	150	180	

AD	--	20200915	KOT1SKL	janerant	stefste1	7800	DC-AE/ENG2	KABEL AM D=562
AC	--	20020108	Dreyer			7260	DC-AE/EHM1	
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	MBT530B/C/D/E 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	RA83514832	DP/TD 001 Ind. AD	Format A4
MNR				Repl. for 106-0374-4002-AC		Repl. by	

Fig. 165: MBT530B/ -C/ -D/ -E with electrical connection "_SN-NNNN"

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



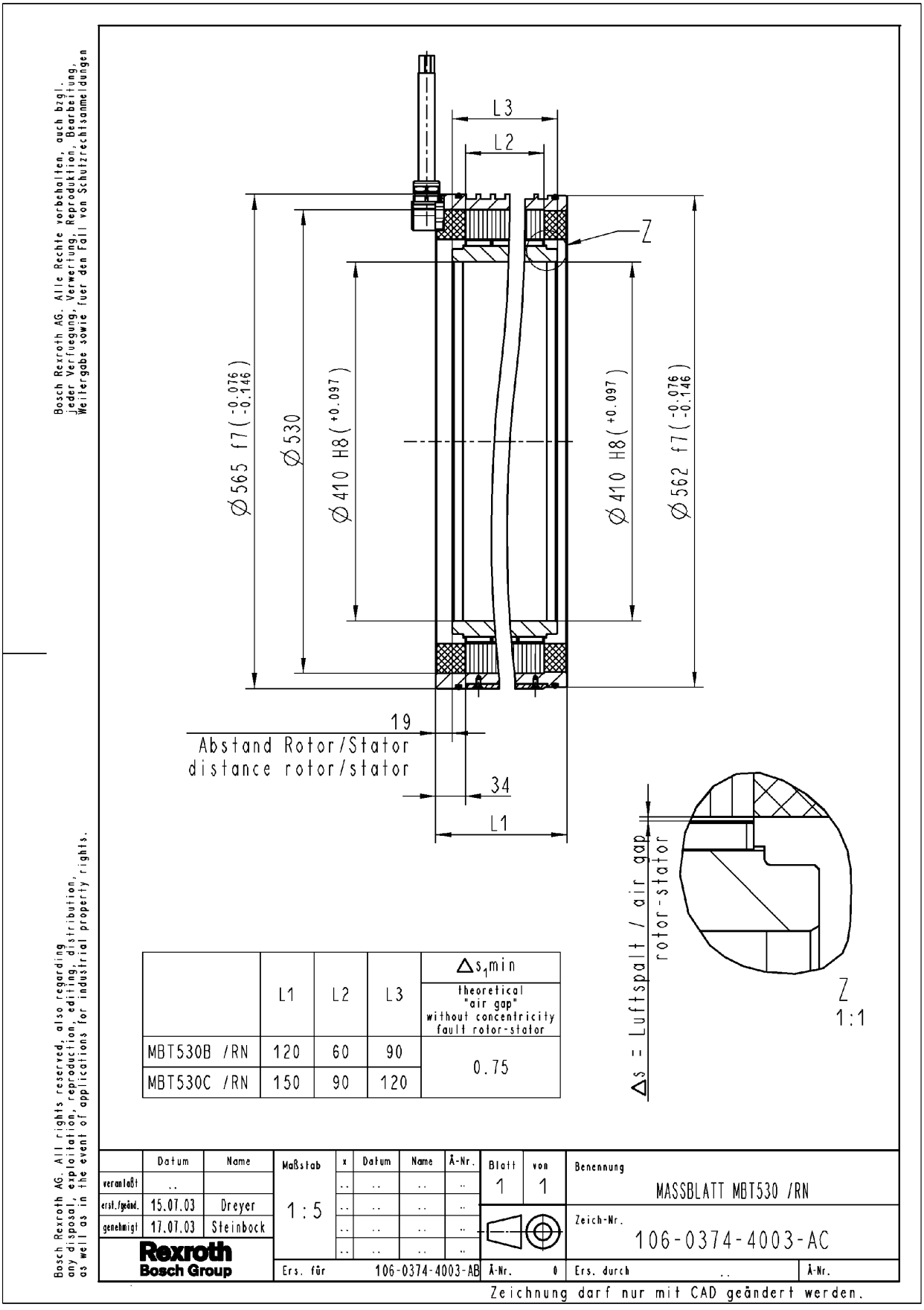
	L1	L2	L3	Δs1min theoretical "air gap" without concentricity fault rotor-stator
MBT530B	120	60	90	0.75
MBT530C	150	90	120	
MBT530D	180	120	150	
MBT530E	210	150	180	

AD	--	20200915	KOT1SKL	janerant	stefste1	7800	DC-AE/ENG2	KABEL AM D=565
AC	--	20000328	Dreyer			7260	DC-AE/EHM1	
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	MBT530B/C/D/E MBT530B/C/D/E			Sheet/Bl. 1/1
Crit. P. --	Scale/M.stab 1:5		Doc.type MSZ	RA83514833	DP/TD 001	Ind. AD	Format A4
MNR		Mat.meets/Stoffe s N2580-1	Syst. PE	Repl. for 106-0374-4001-AC	Repl. by		

Fig. 166: MBT530B/ -C/ -D/ -E with electrical connection "_CN-NNNN"

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



	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT530B /RN	120	60	90	0.75
MBT530C /RN	150	90	120	

Fig. 167: MST530B/ -C, electrical connection "_RN-NNNN"

4.12.4 MBT530F with electrical connection "_CN-NNNN"

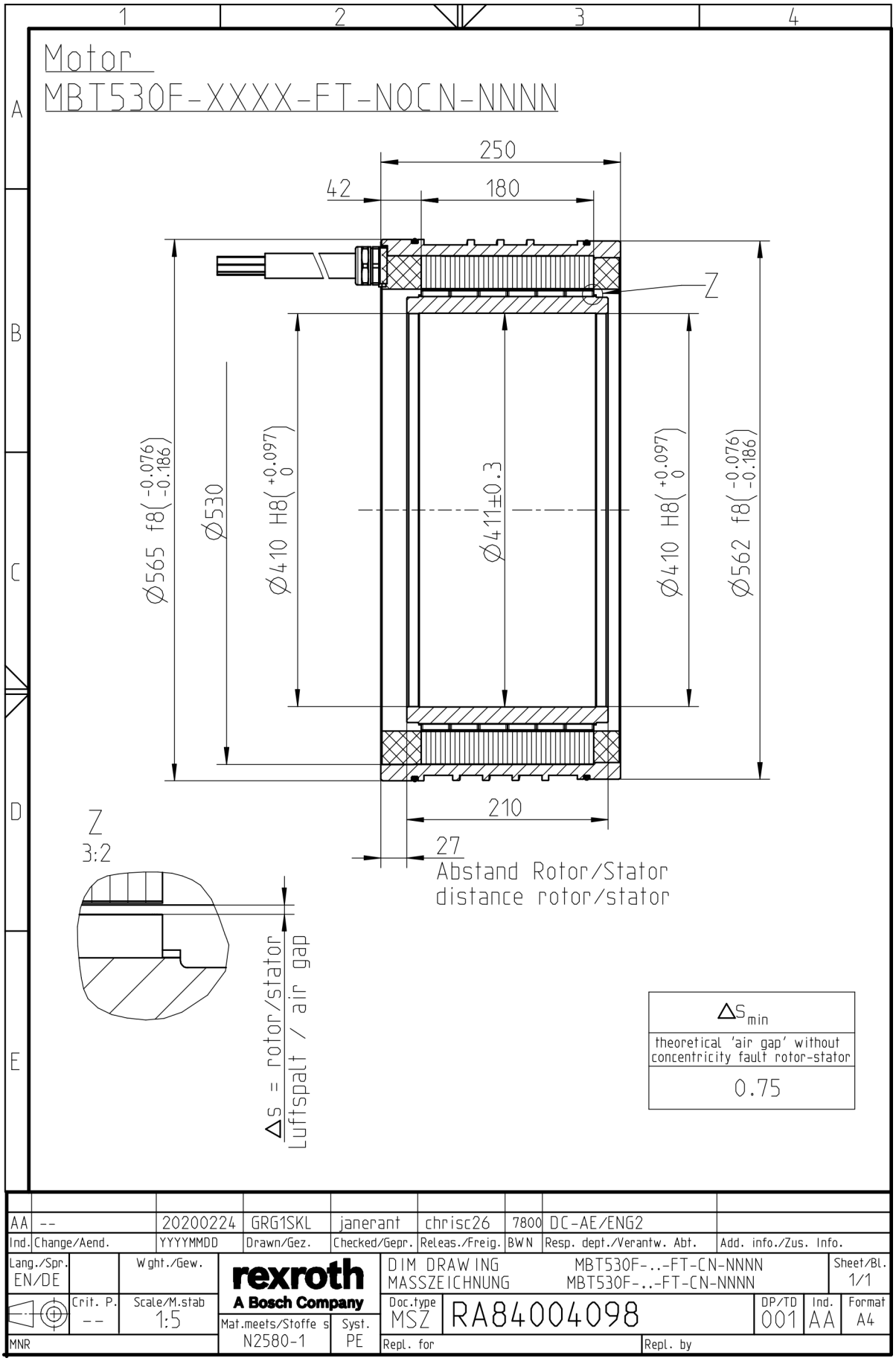


Fig. 168: MBT530F with electrical connection "_CN-NNNN"

4.12.5 MBT530F with electrical connection "_SN-D303"

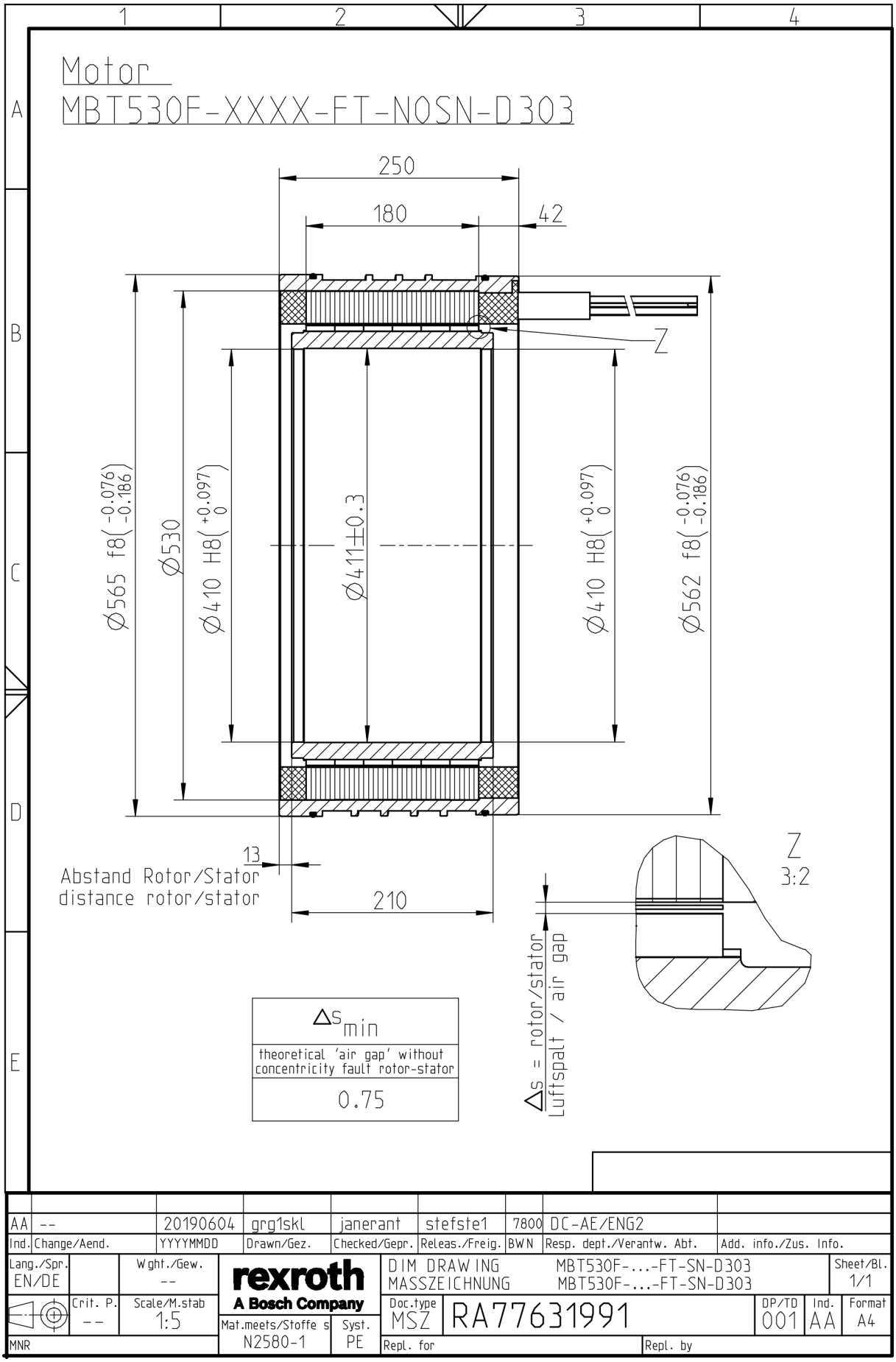


Fig. 169: MBT530F with electrical connection "_SN-D303"

4.12.6 MBT530F with electrical connection "_CN-D303"

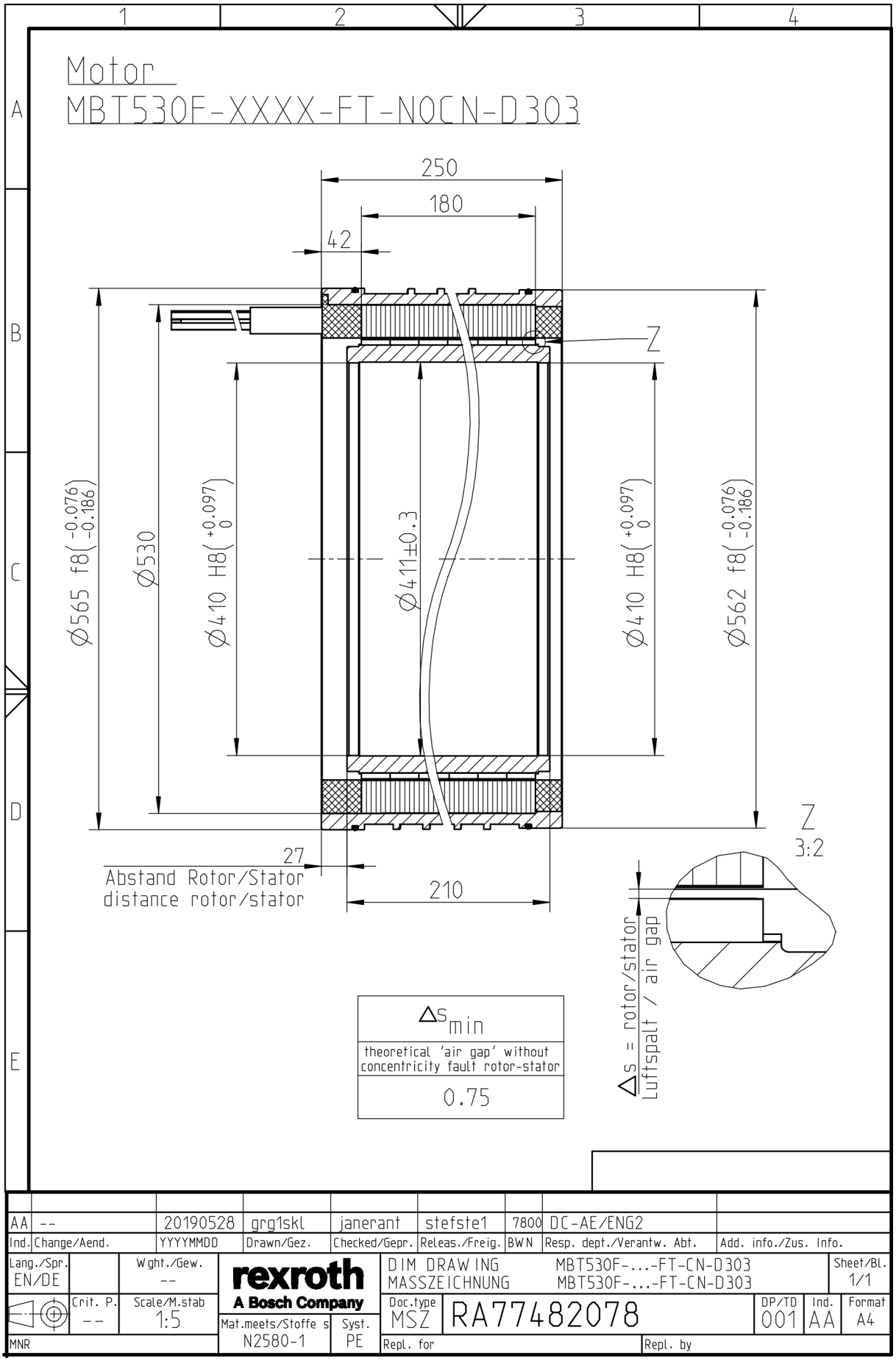
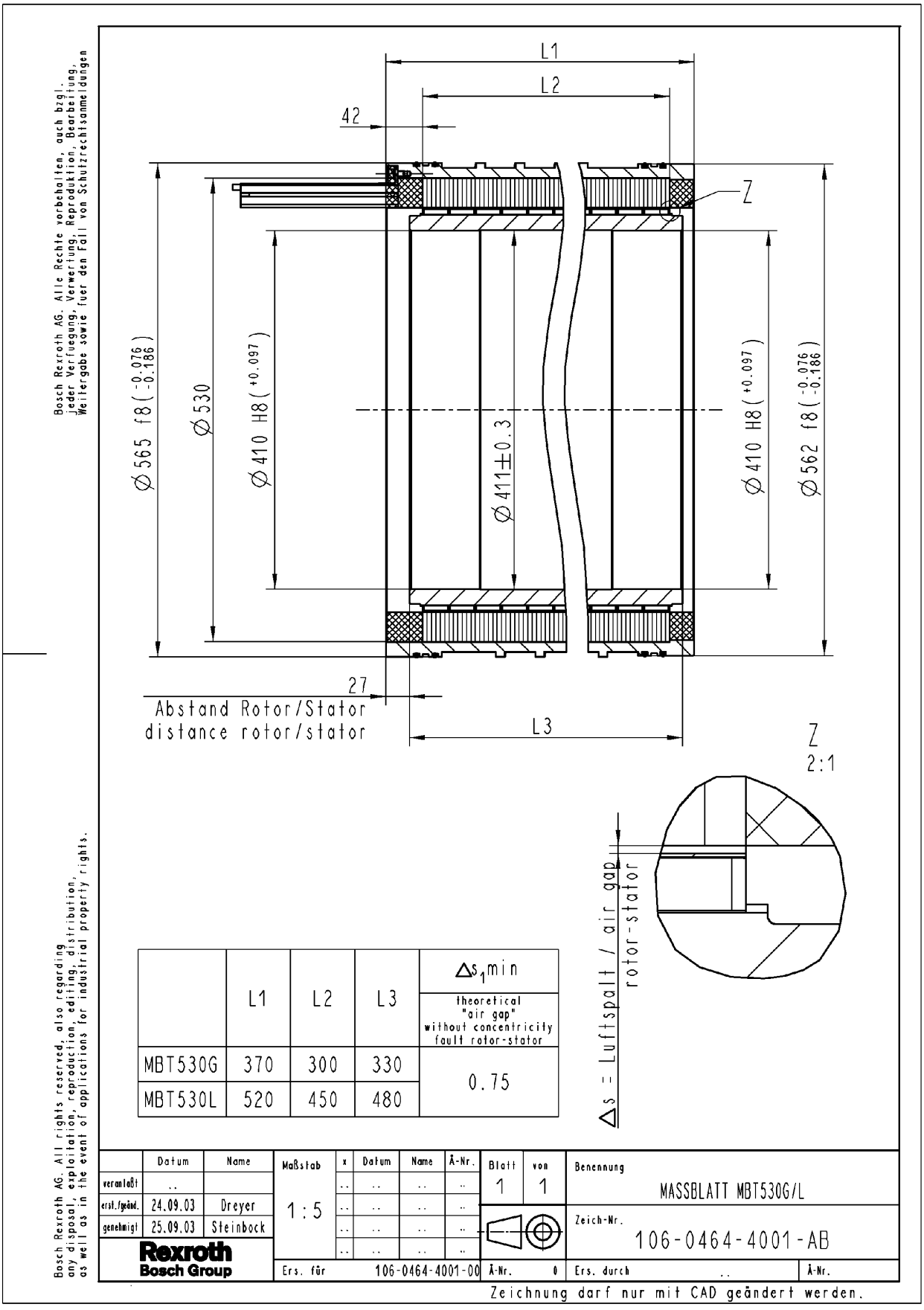


Fig. 170: MBT530F with electrical connection "_CN-D303"

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



	L1	L2	L3	Δs_1 min theoretical "air gap" without concentricity fault rotor-stator
MBT530G	370	300	330	0.75
MBT530L	520	450	480	

	Datum	Name
veranlaßt	..	
erst./geänd.	24.09.03	Dreyer
genehmigt	25.09.03	Steinbock

Maßstab 1 : 5

Ersatz für 106-0464-4001-00

Blatt 1 von 1

Benennung: MASSBLATT MBT530G/L

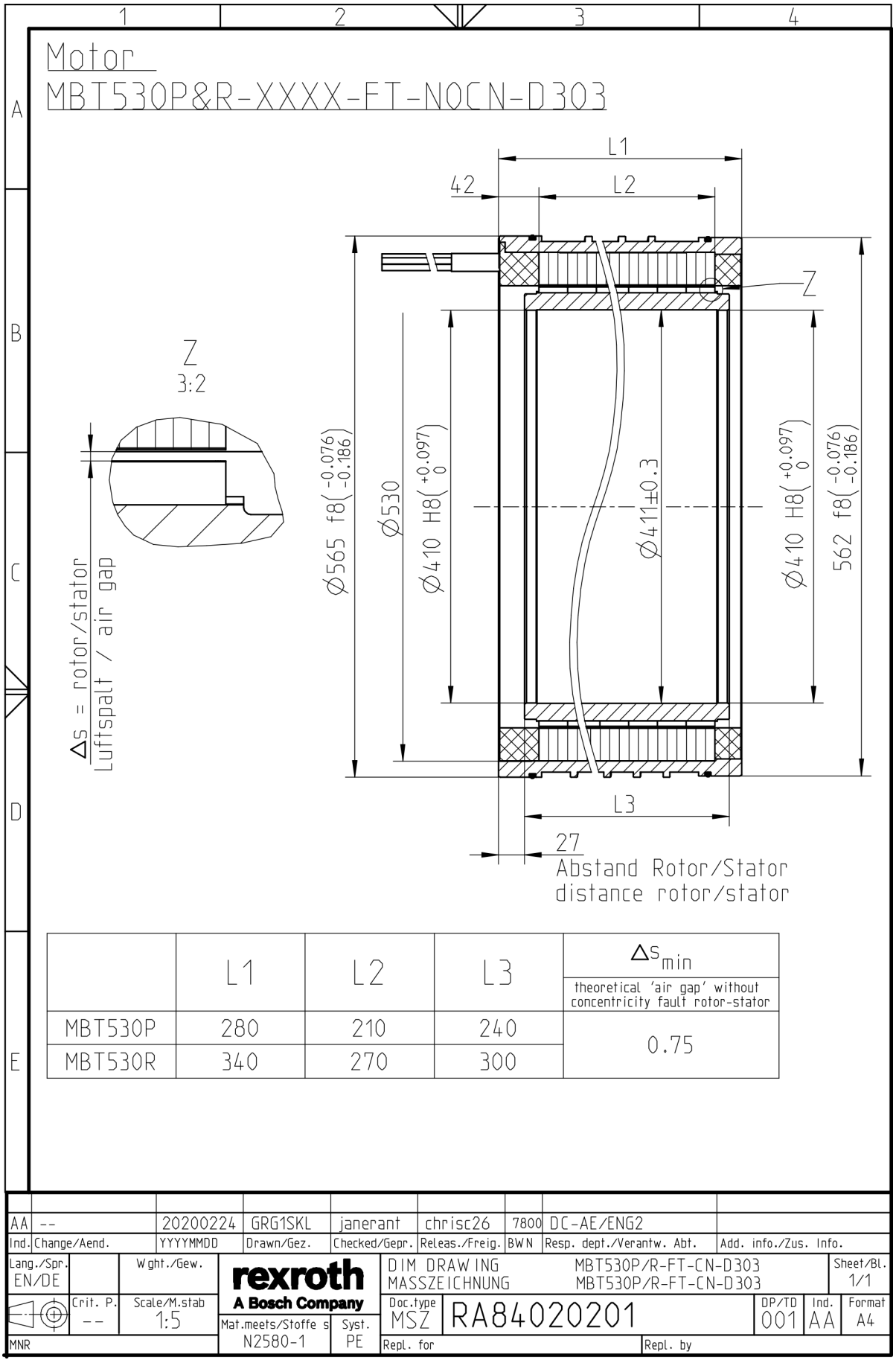
Zeich-Nr.: 106-0464-4001-AB

Ä-Nr. 0 | Ers. durch .. | Ä-Nr.

Rexroth Bosch Group

Fig. 171: MBT530G/ -L with electrical connection "_CN-D303"

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



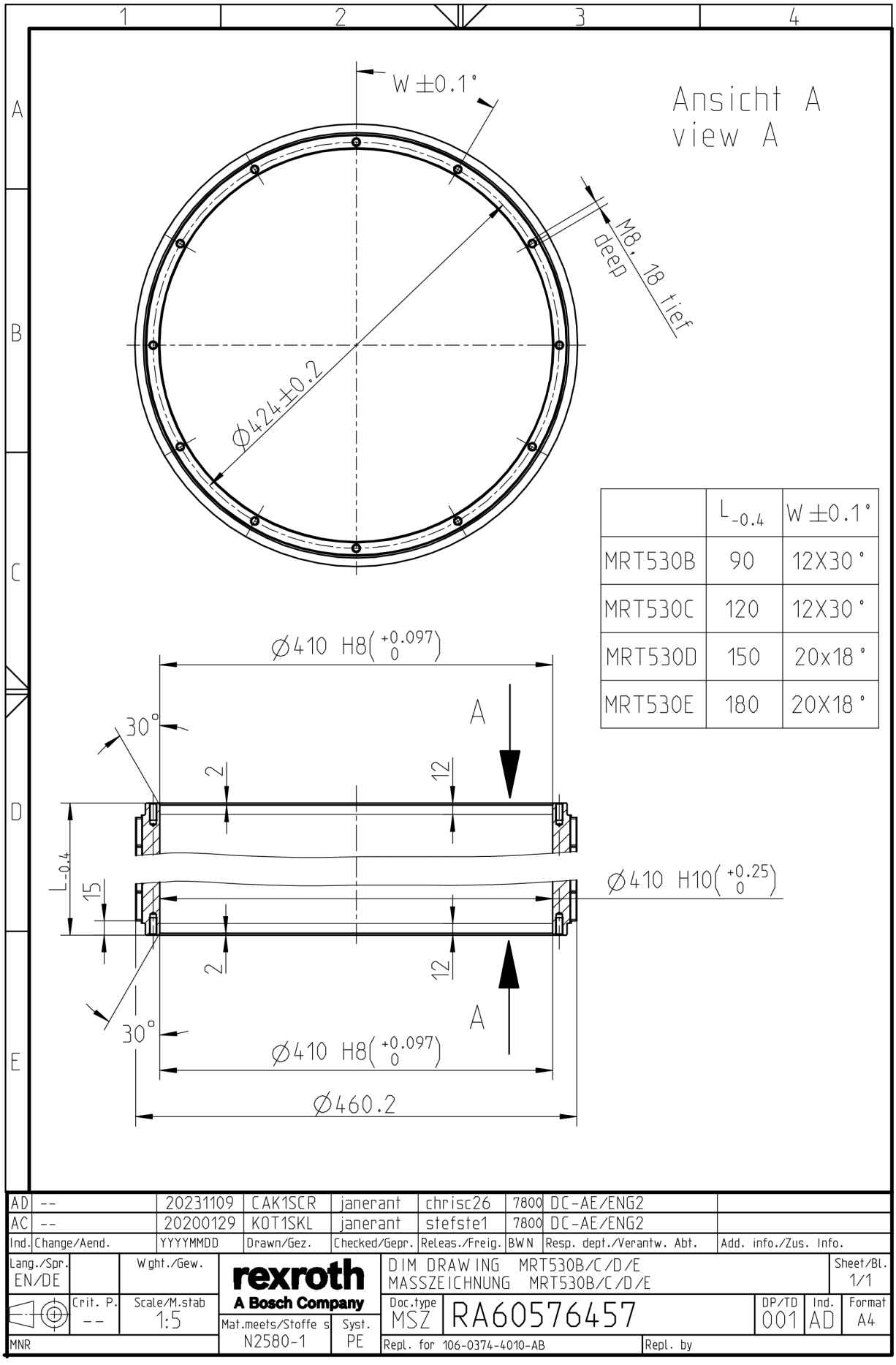
	L1	L2	L3	Δs_{min} theoretical 'air gap' without concentricity fault rotor-stator
MBT530P	280	210	240	0.75
MBT530R	340	270	300	

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
MNR		Mat.meets/Stoffe s N2580-1	Syst. PE	Repl. for		Repl. by	

Fig. 172: MBT530P/ -R with electrical connection "_CN-D303"

4.12.9 Rotor MRT530B/ -C/ -D/ -E



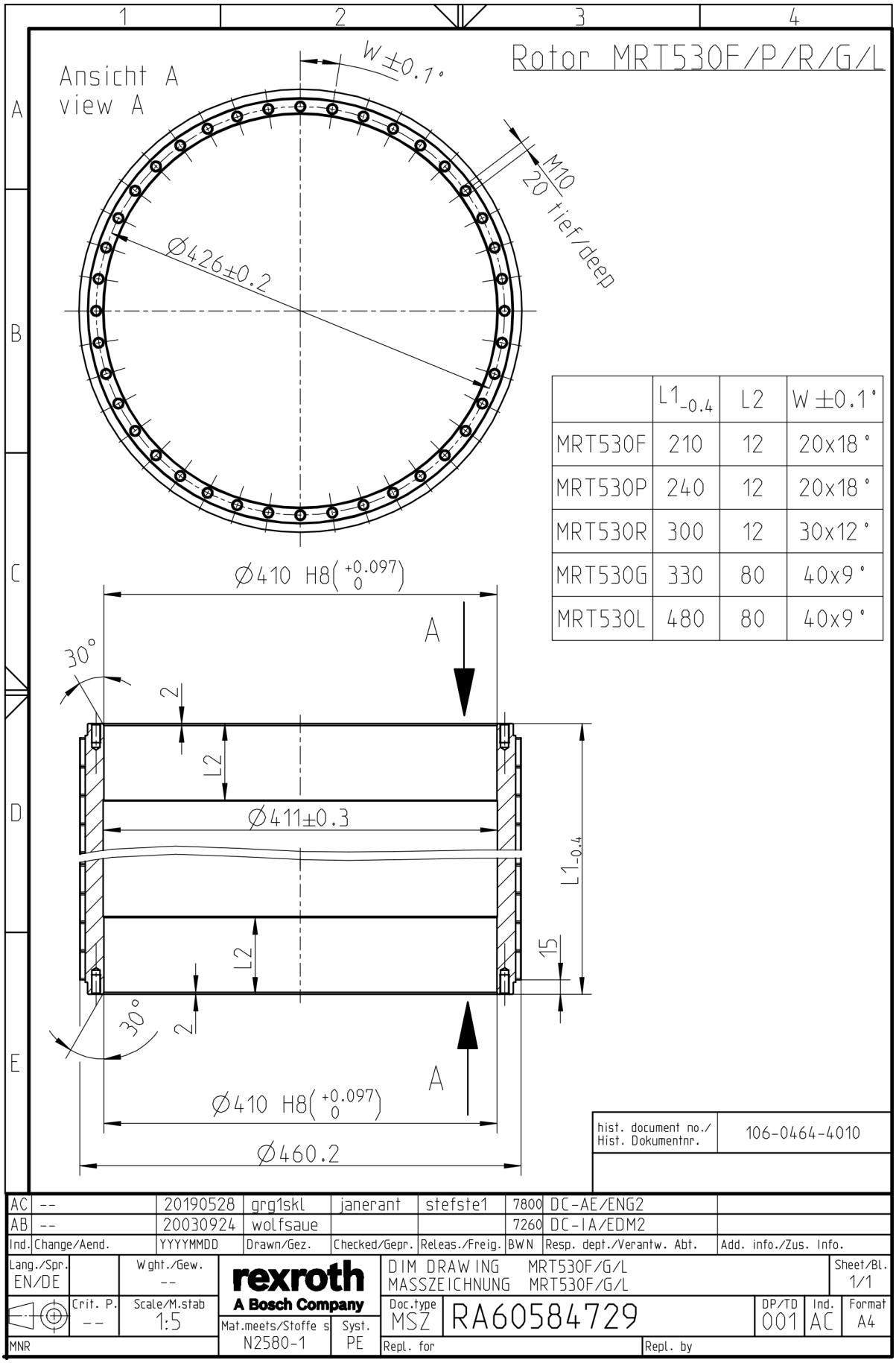
	$L_{-0.4}$	W ±0.1°
MRT530B	90	12X30°
MRT530C	120	12X30°
MRT530D	150	20x18°
MRT530E	180	20X18°

AD	--	20231109	CAK1SCR	janerant	chrisc26	7800	DC-AE/ENG2	
AC	--	20200129	KOT1SKL	janerant	stefste1	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 MRT530B/C/D/E MASSZEICHNUNG MRT530B/C/D/E				Sheet/Bl. 1/1
Crit. P. --	Scale/M.stab 1:5		Doc.type MSZ	RA60576457	DP/TD 001	Ind. AD	Format A4
MNR		Mat.meets/Stoffe s N2580-1	Syst. PE	Repl. for 106-0374-4010-AB		Repl. by	

Fig. 173: MRT530B/ -C/ -D/ -E

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

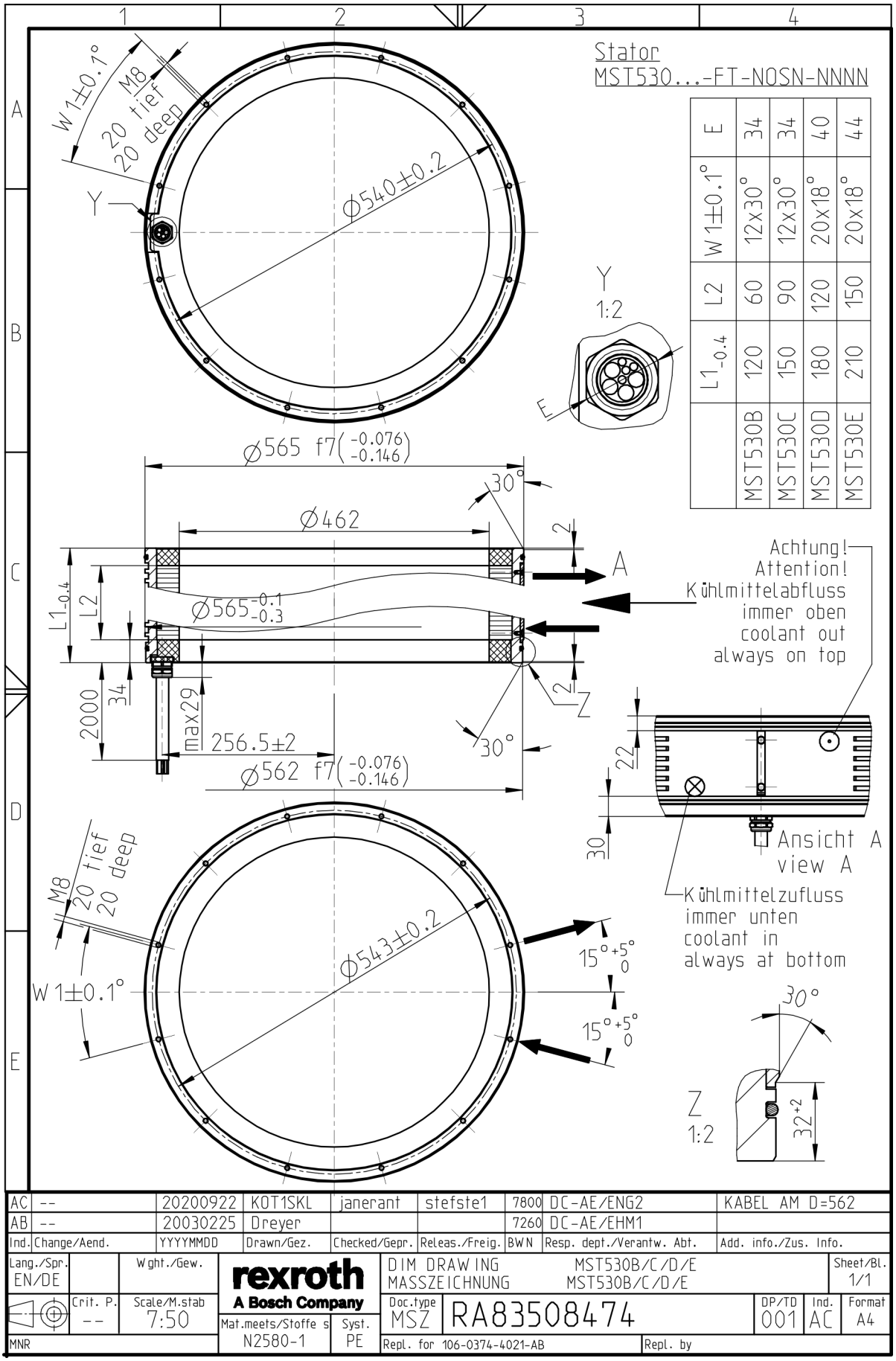


	L1 -0.4	L2	W ±0.1°
MRT530F	210	12	20x18 °
MRT530P	240	12	20x18 °
MRT530R	300	12	30x12 °
MRT530G	330	80	40x9 °
MRT530L	480	80	40x9 °

Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.
AC	--	20190528	grg1skl	janerant	stefste1	7800	DC-AE/ENG2	
AB	--	20030924	wolfsaue			7260	DC-IA/EDM2	

Fig. 174: MRT530F/ -P/ -R/ -G/ -L

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



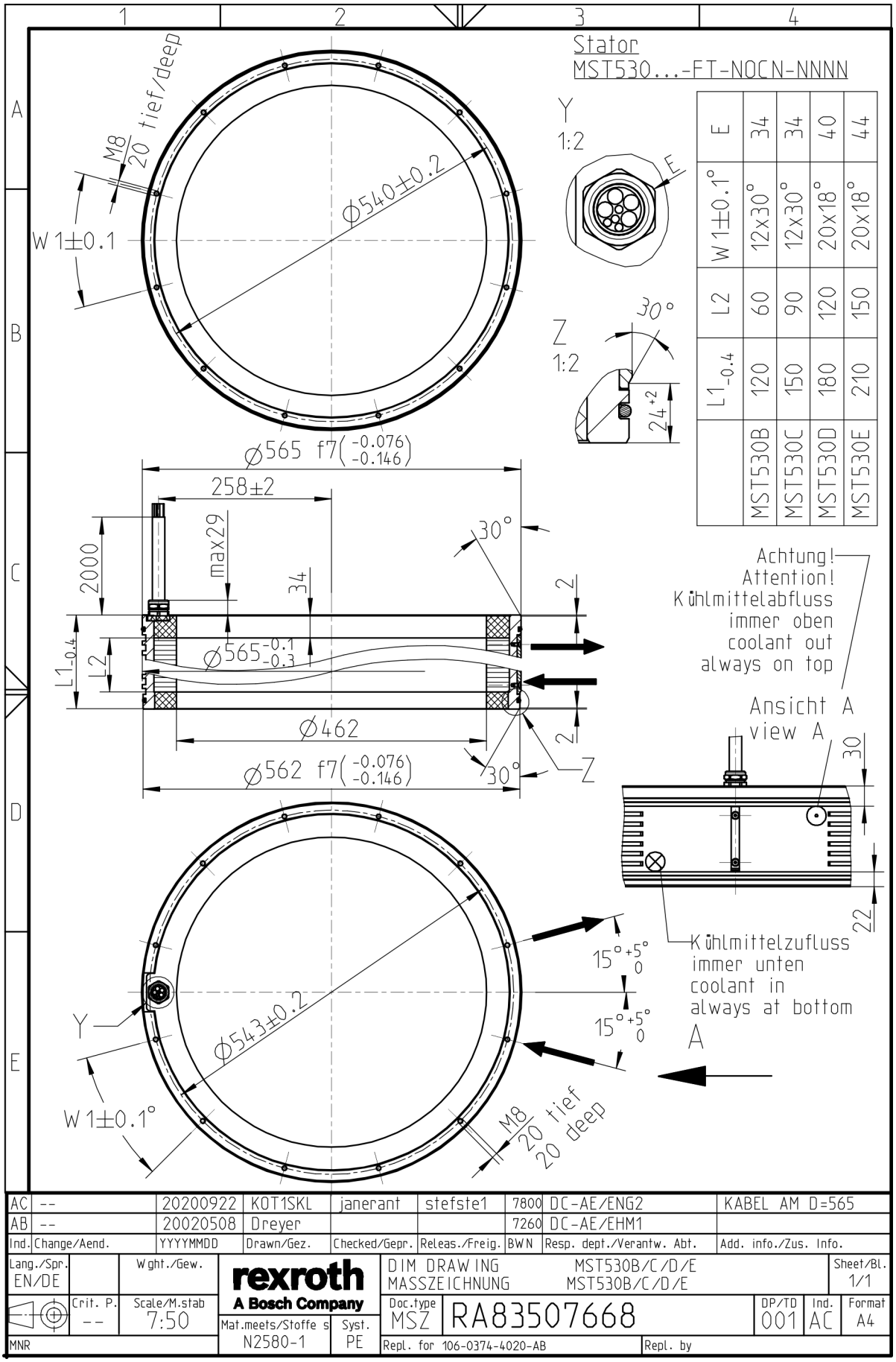
	E	W 1±0.1°	L2	L1-0.4	
MST530B	34	12x30°	60	120	
MST530C	34	12x30°	90	150	
MST530D	40	20x18°	120	180	
MST530E	44	20x18°	150	210	

AC	--	20200922	KOT1SKL	janerant	stefste1	7800	DC-AE/ENG2	KABEL AM D=562
AB	--	20030225	Dreyer			7260	DC-AE/EHM1	
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	MST530B/C/D/E MST530B/C/D/E			Sheet/Bl. 1/1
Crit. P. --	Scale/M.stab 7:50		Doc.type MSZ	RA83508474	DP/TD 001	Ind. AC	Format A4
MNR		Mat.meets/Stoffe s N2580-1	Syst. PE	Repl. for 106-0374-4021-AB		Repl. by	

Fig. 175: MST530B/ -C/ -D/ -E, electrical connection "_SN-NNNN"

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



	E	W 1±0.1°	L2	L1-0.4	
MST530B	34	12x30°	60	120	
MST530C	34	12x30°	90	150	
MST530D	40	20x18°	120	180	
MST530E	44	20x18°	150	210	

AC	--	20200922	KOT1SKL	janerant	stefste1	7800	DC-AE/ENG2	KABEL AM D=565
AB	--	20020508	Dreyer			7260	DC-AE/EHM1	
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	MST530B/C/D/E 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	RA83507668	DP/TD 001 / Ind. AC	Format A4
MNR				Repl. for 106-0374-4020-AB		Repl. by	

Fig. 176: MST530B/ -C/ -D/ -E, electrical connection "_CN-NNNN"

4.12.13 Stator MST530F, electrical connection "_SN-NNNN"

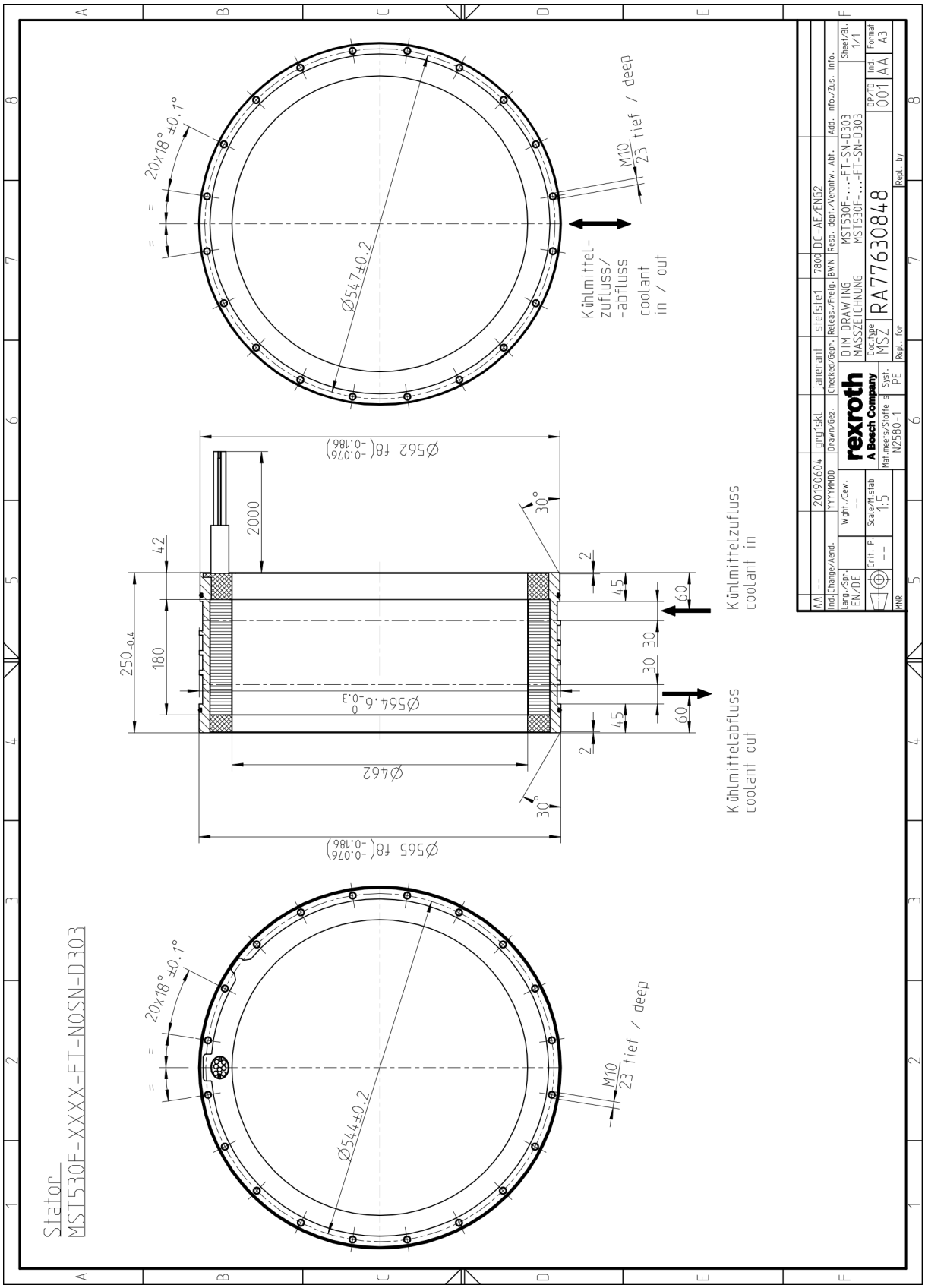


Fig. 177: MST530F, electrical connection "_SN-NNNN"

4.12.14 Stator MST530F, electrical connection "_CN-NNNN"

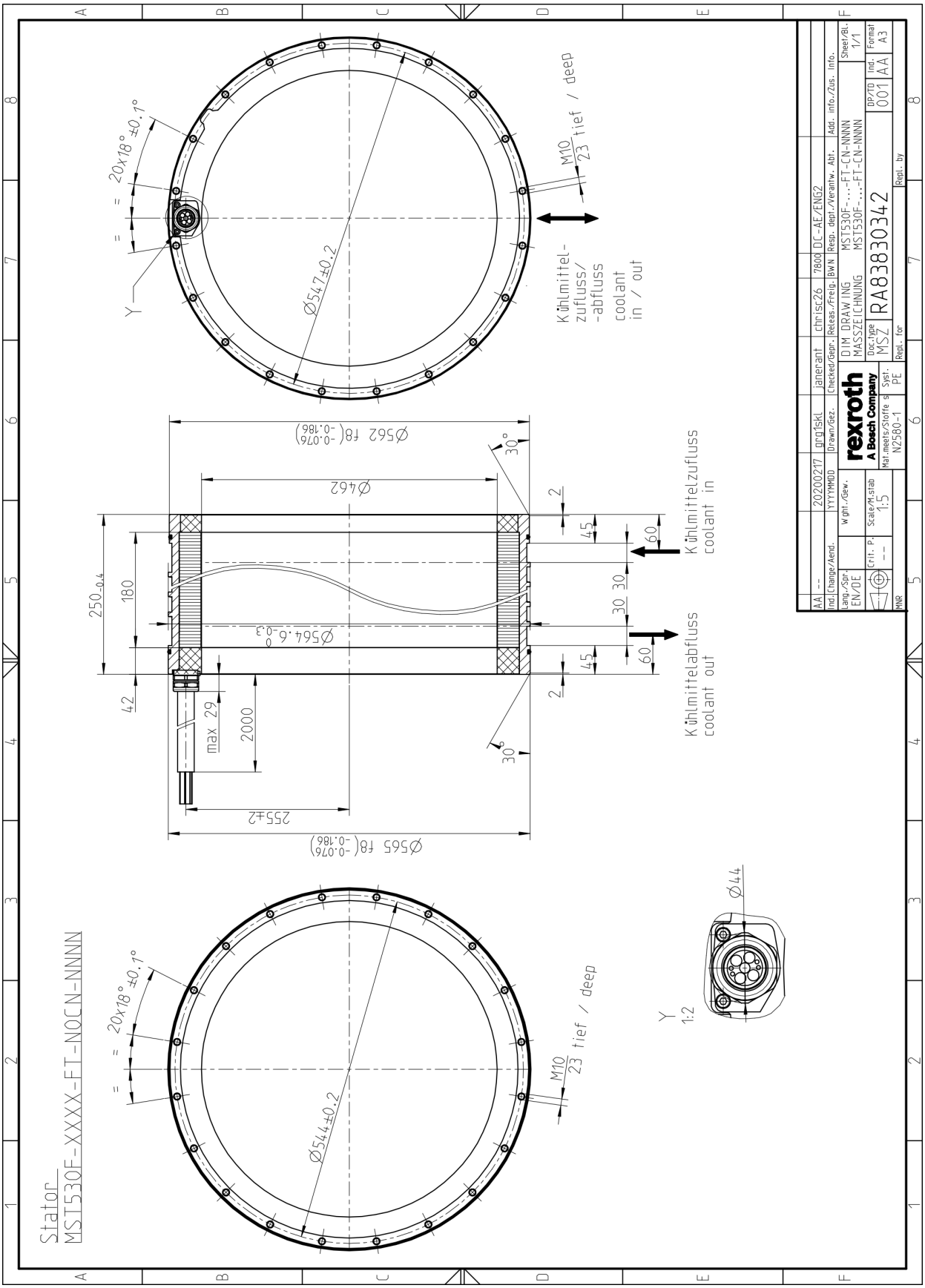


Fig. 178: MST530F, electrical connection "_CN-NNNN"

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

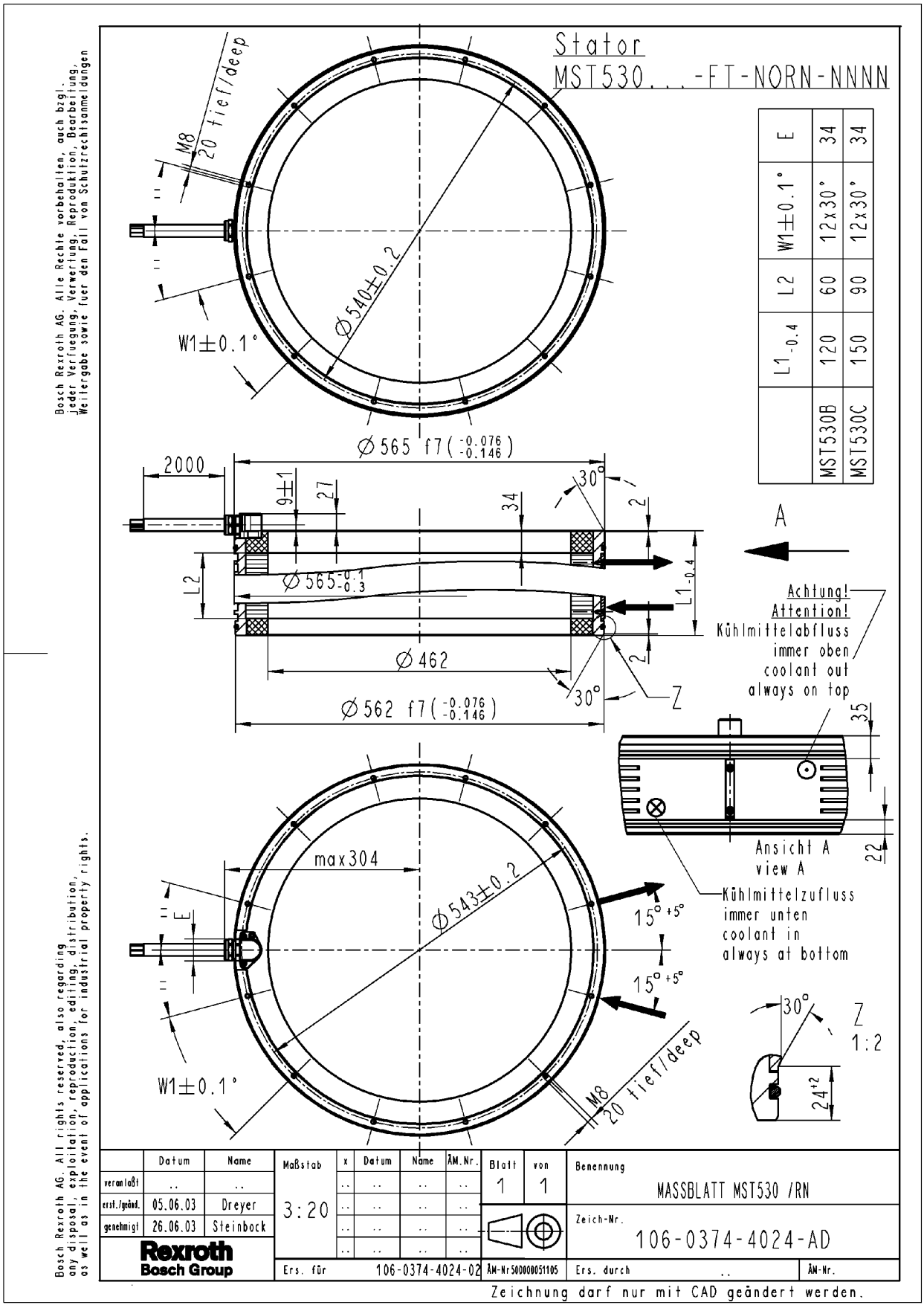
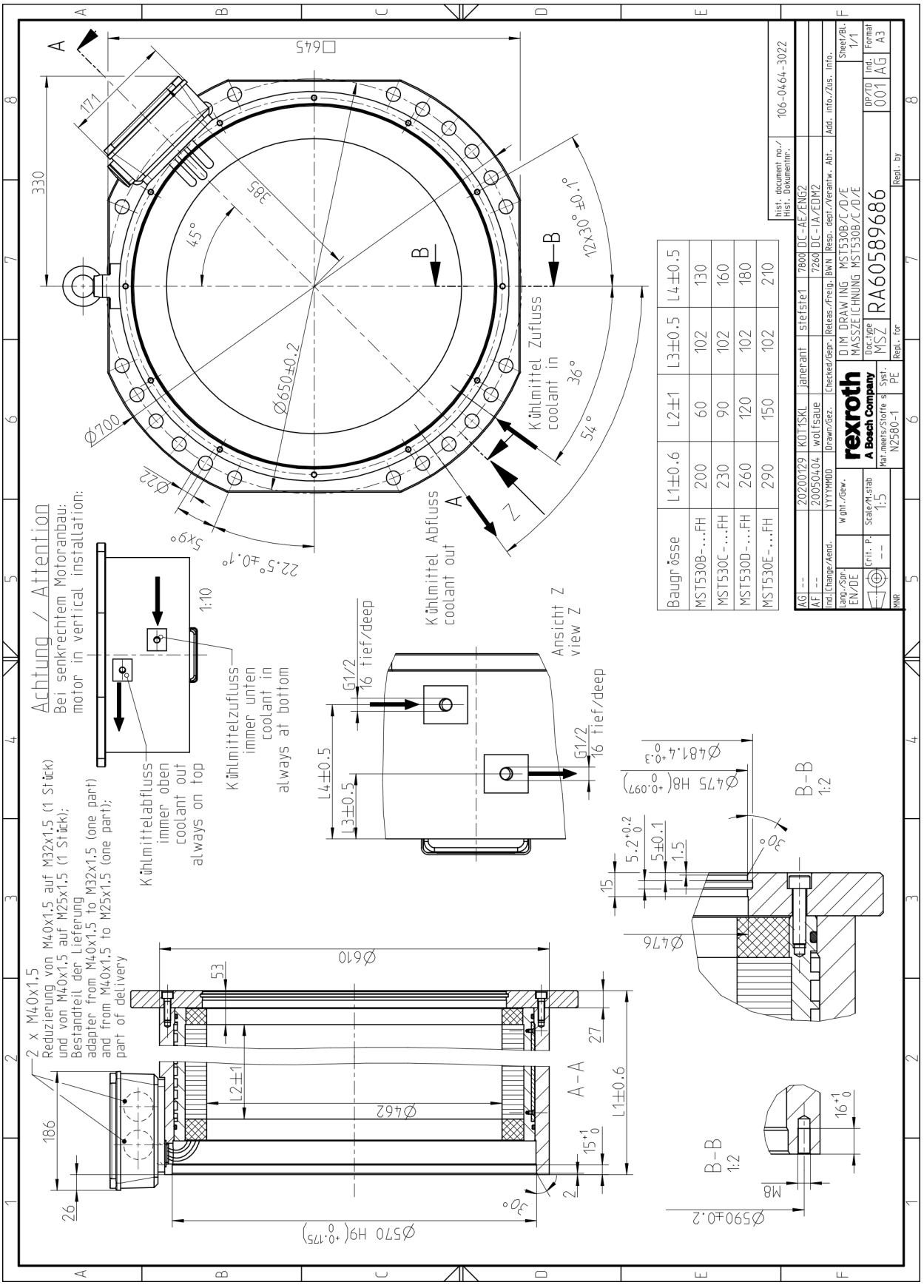


Fig. 179: MST530B/ -C, electrical connection "_RN-NNNN"

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



Baugrösse	L1±0.6	L2±1	L3±0.5	L4±0.5
MST530B-...FH	200	60	102	130
MST530C-...FH	230	90	102	160
MST530D-...FH	260	120	102	180
MST530E-...FH	290	150	102	210

Fig. 180: MST530B/ -C/ -D/ -E, design "-FH-_KR-NNNN"

4.12.17 Stator MST530C in cooling mode ”NS”

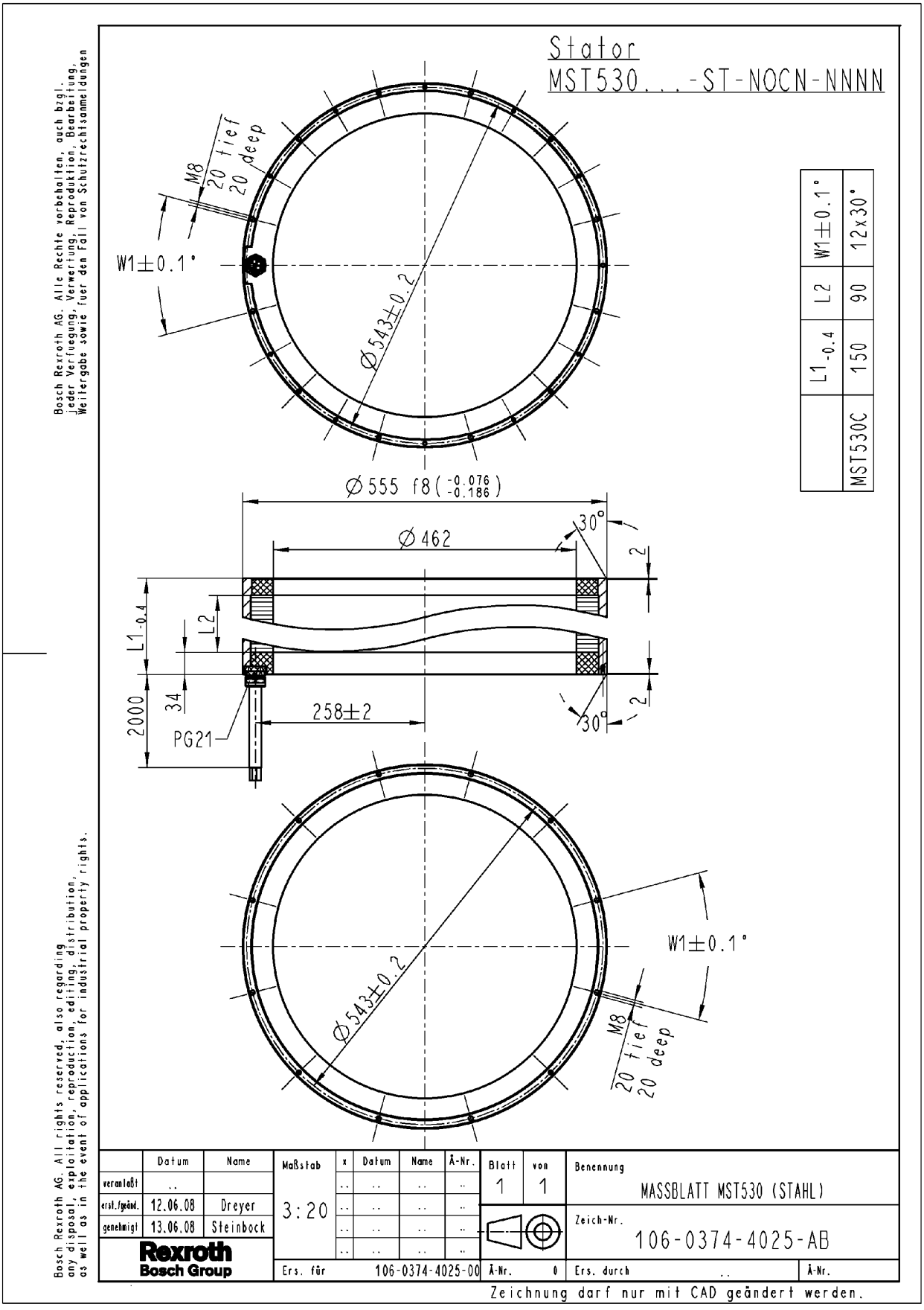


Fig. 181: MST530C in cooling mode ”NS”

4.12.18 Stator MST530F, electrical connection "_CN-D303"

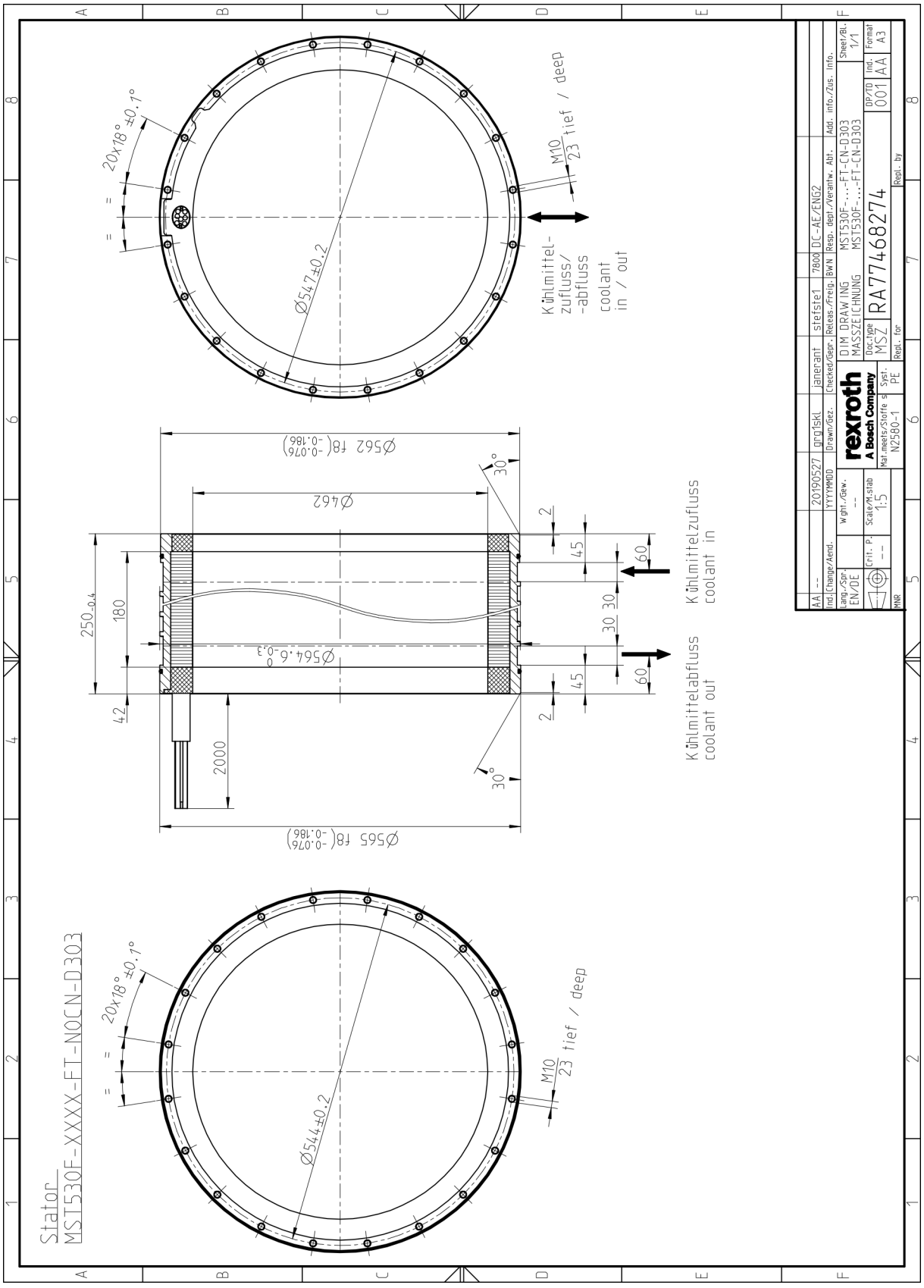


Fig. 182: MST530F, electrical connection "_CN-D303"

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

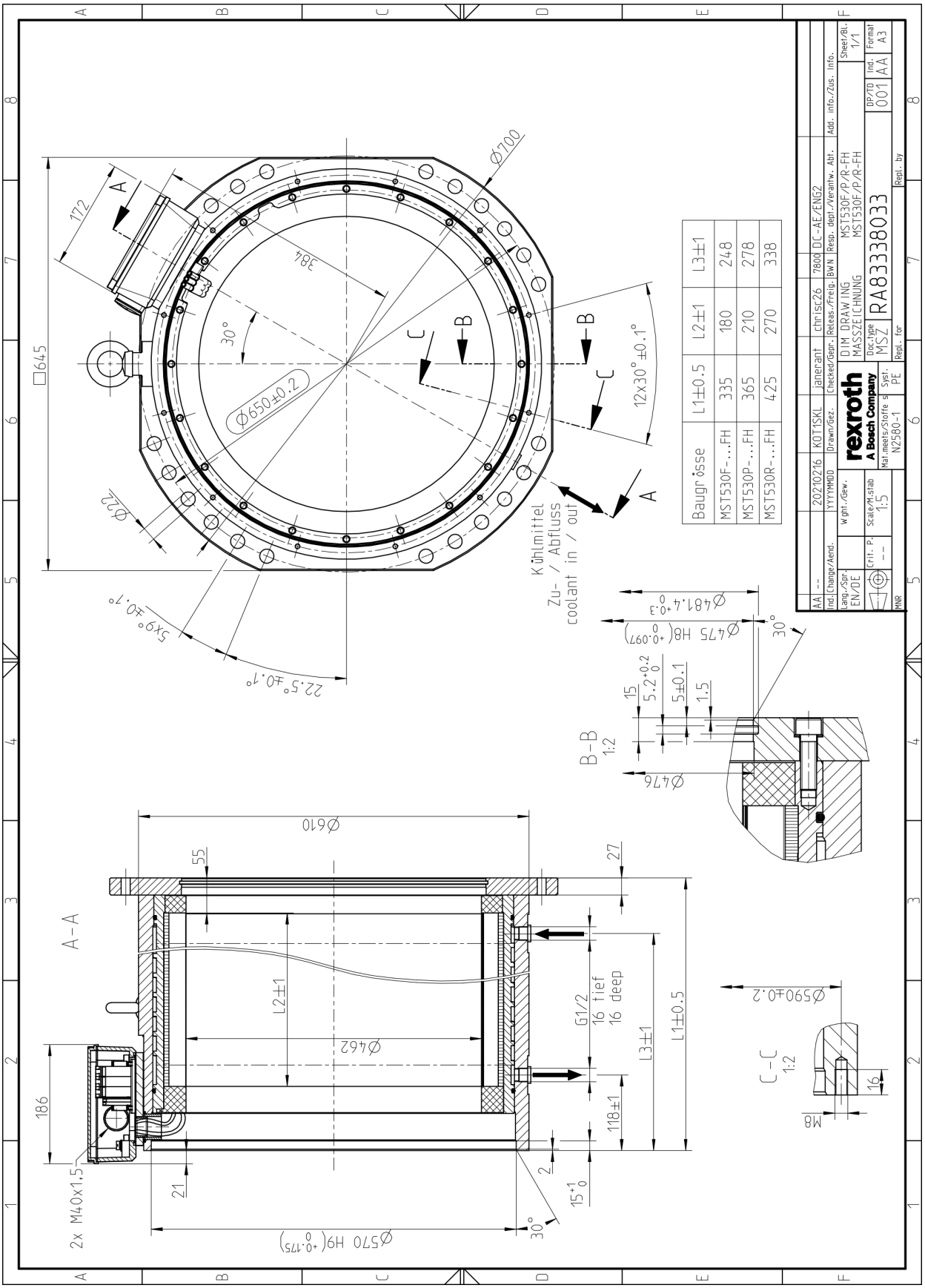
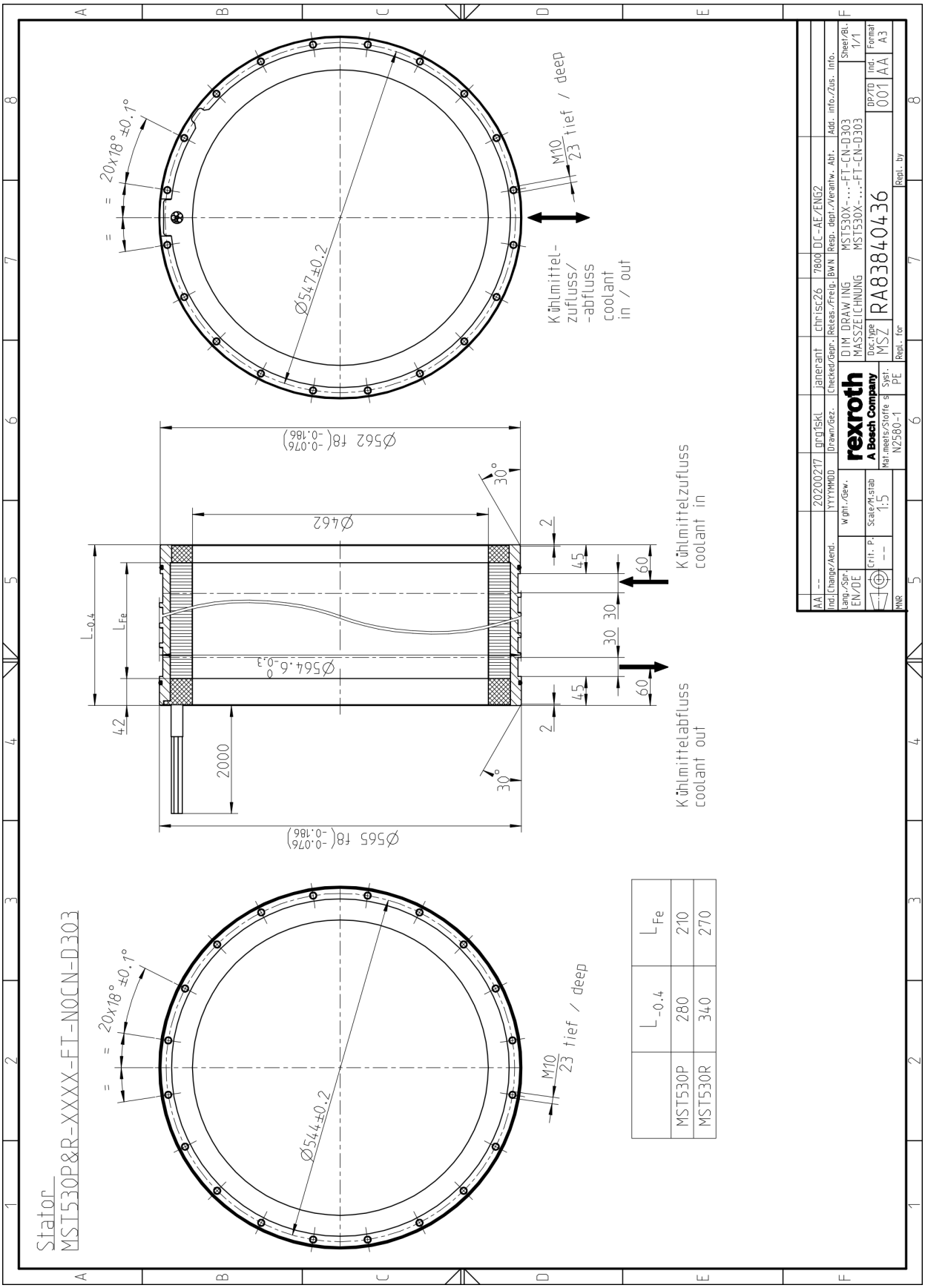


Fig. 183: MST530F/ -P/ -R, electrical connection "-_KR-NNNN"

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



	$L_{-0.4}$	L_{Fe}
MST530P	280	210
MST530R	340	270

Fig. 184: MST530P/ -R, electrical connection "_CN-D303"

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

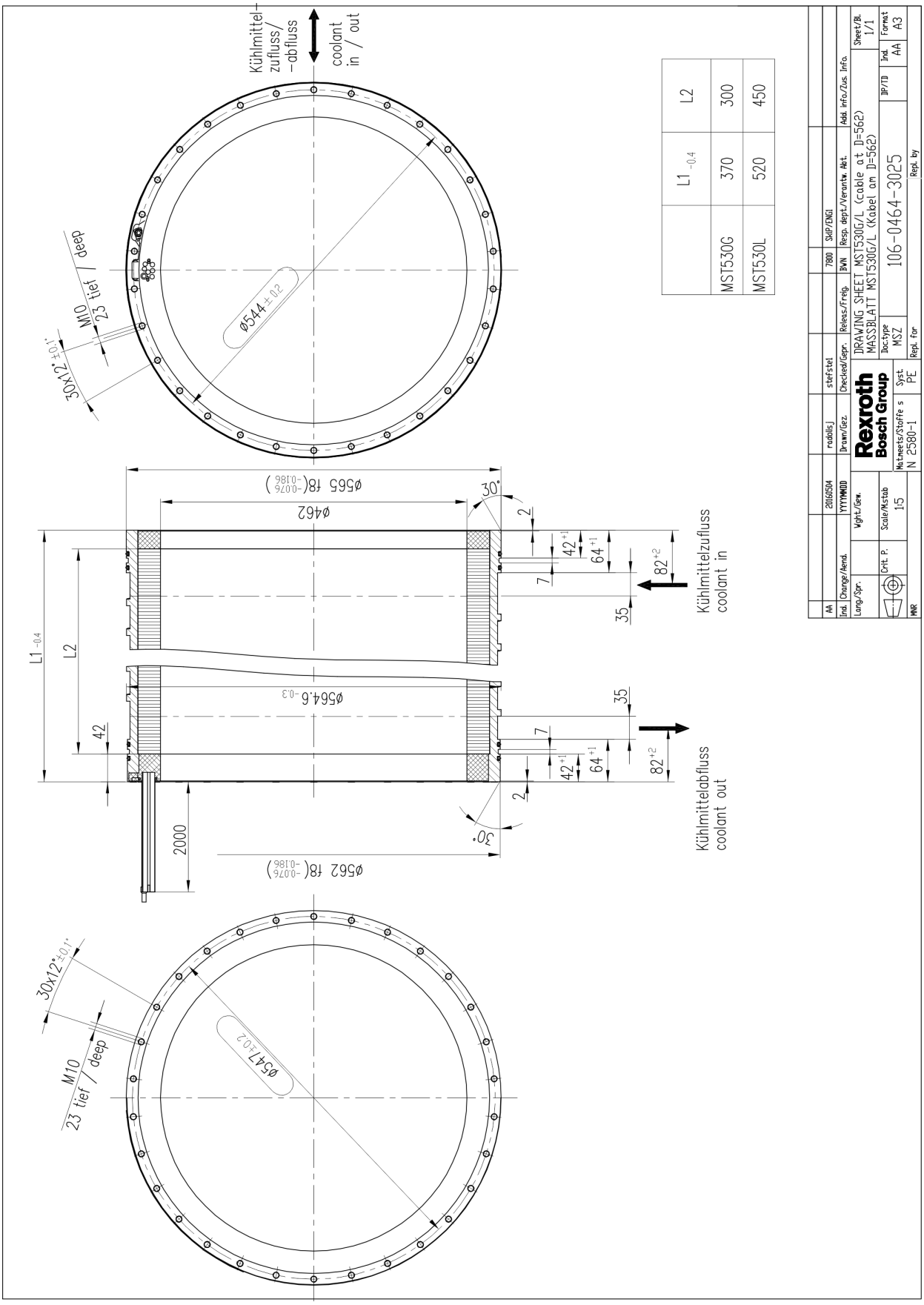


Fig. 185: MST530G/ -L, electrical connection "_SN-D303"

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

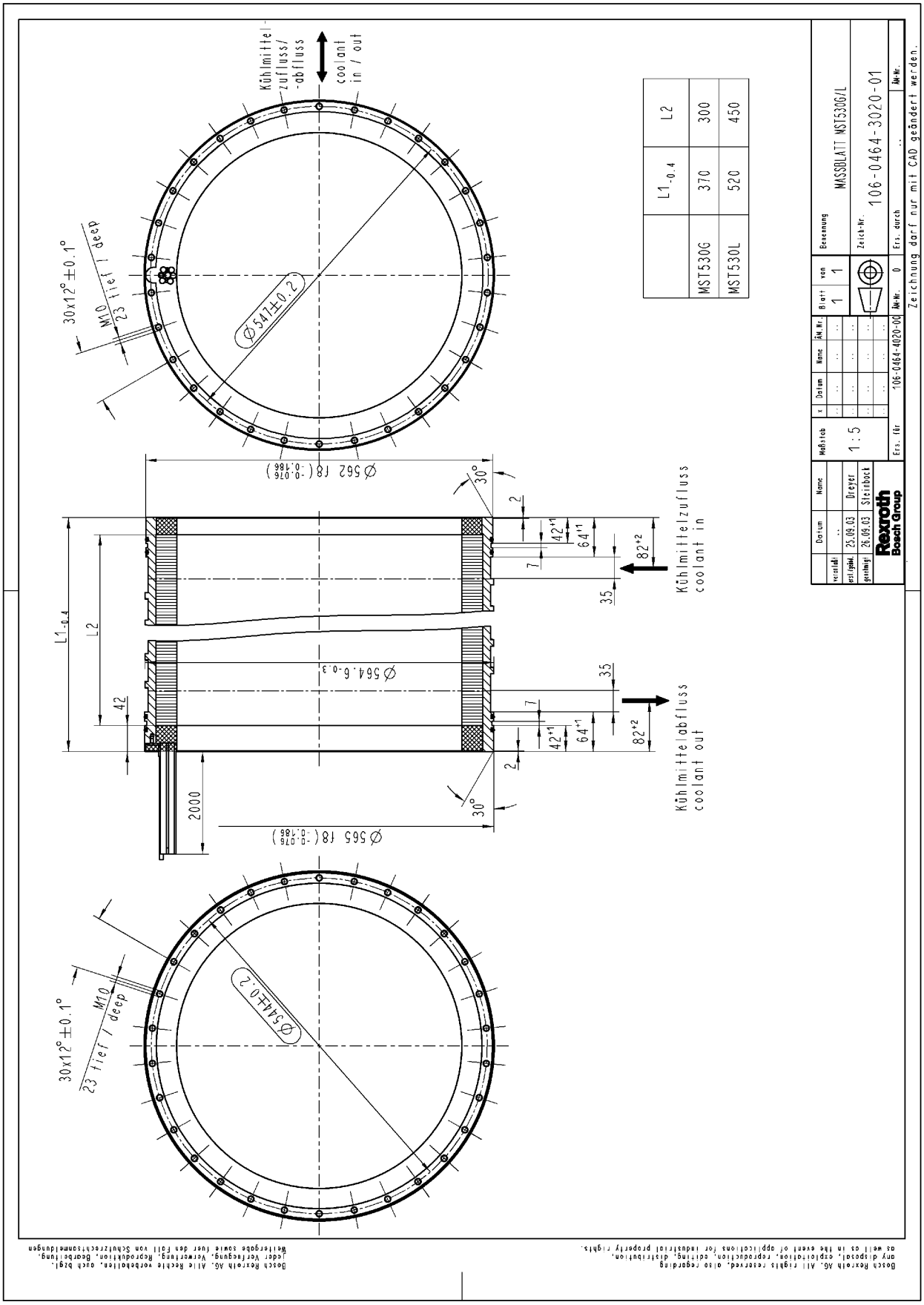


Fig. 186: MST530G/ -L, electrical connection "_CN-D303"

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

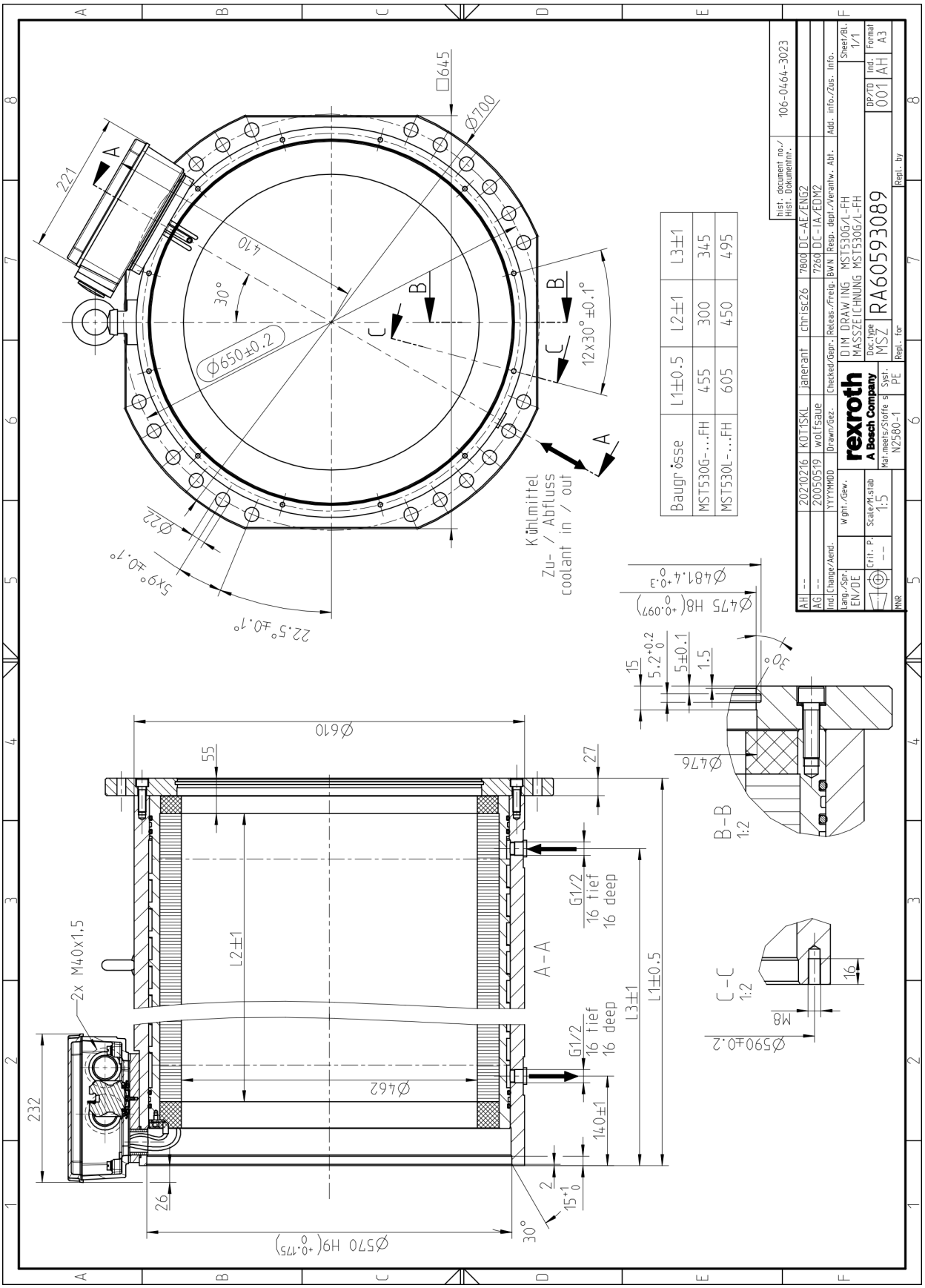
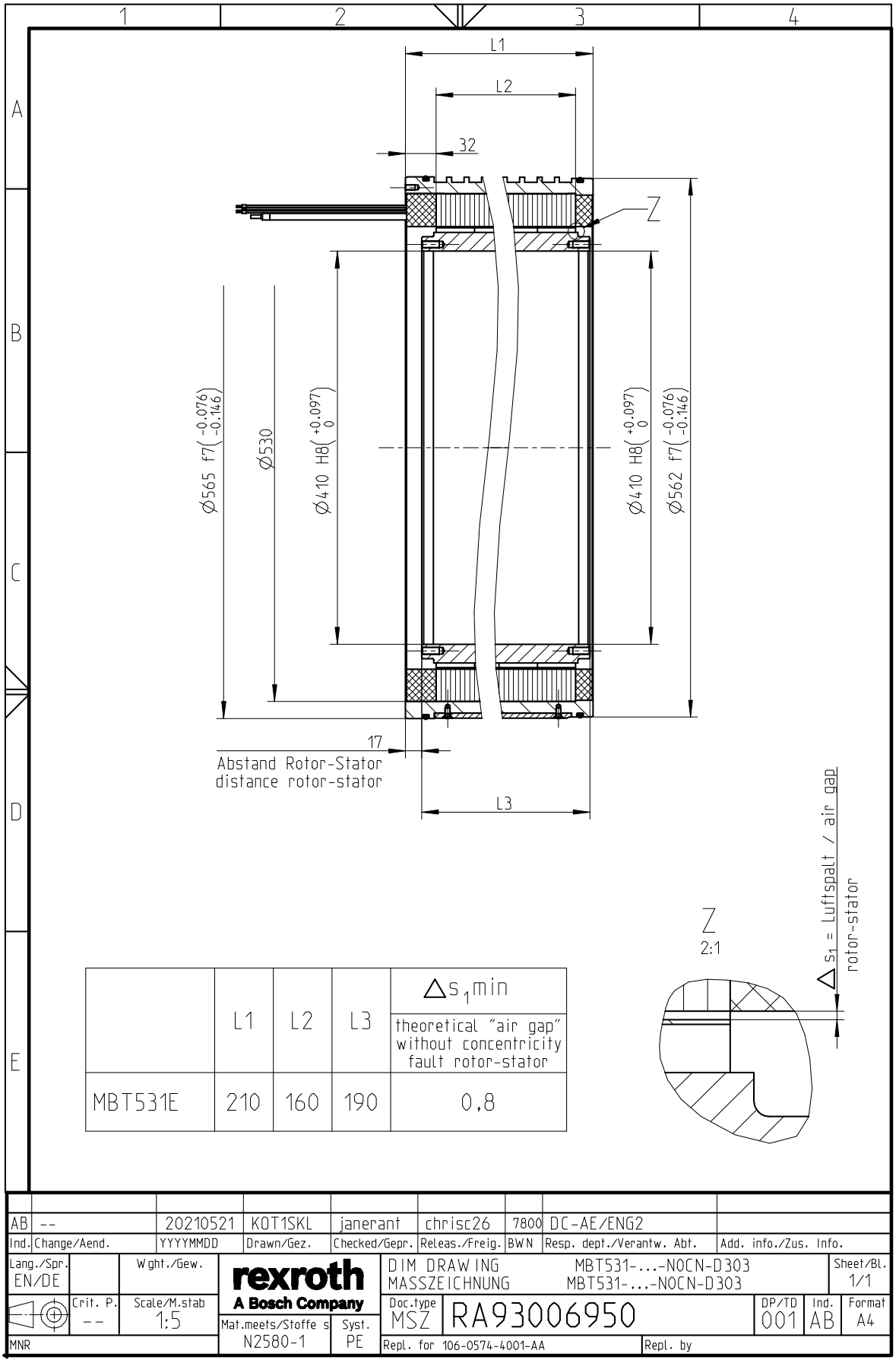


Fig. 187: MST530G/ -L with housing (design "FH")

4.13 Dimension sheets 531

4.13.1 MBT531E with electrical connection "-_CN-D303"



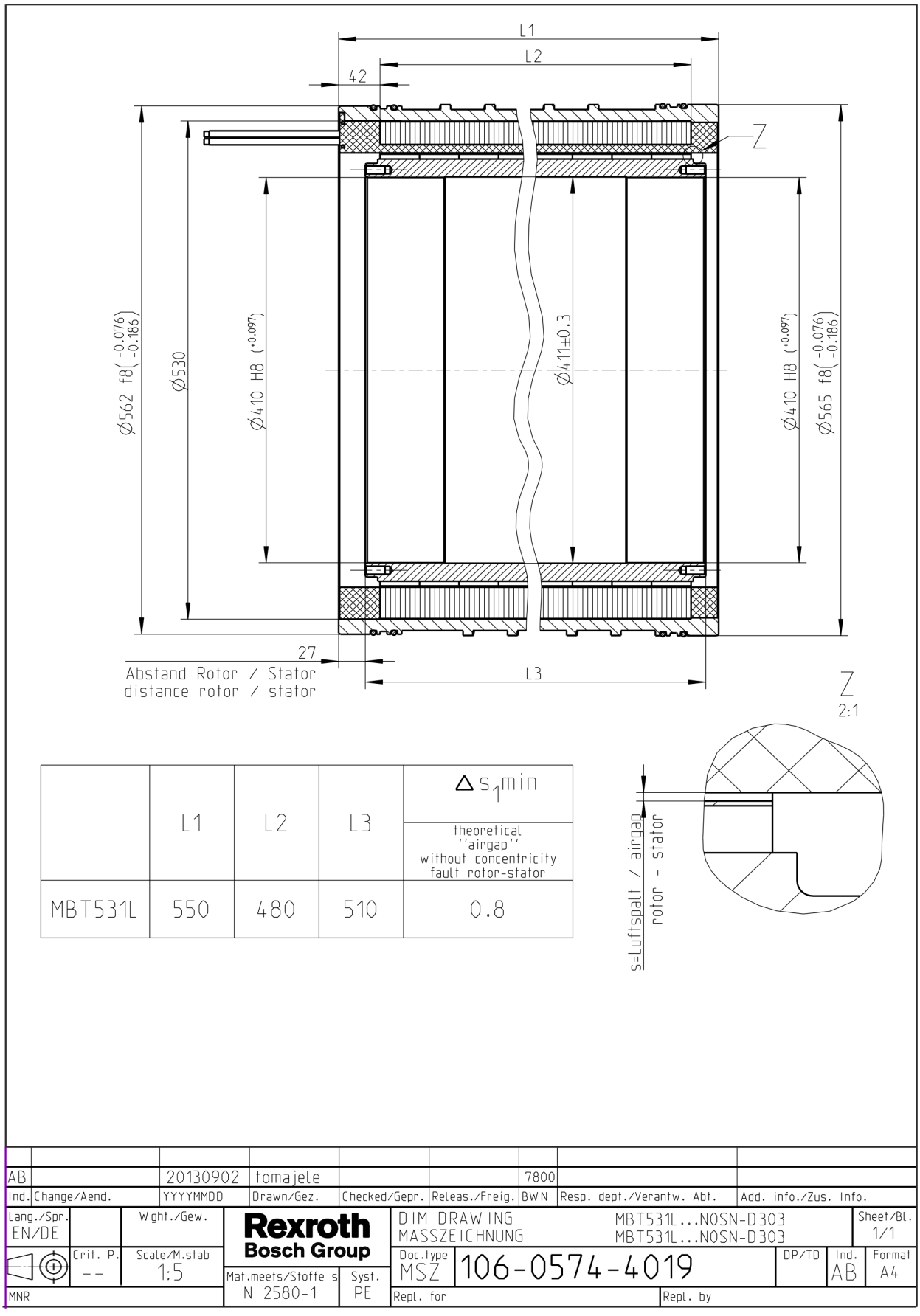
	L1	L2	L3	Δs1min theoretical "air gap" without concentricity fault rotor-stator
MBT531E	210	160	190	0,8

AB	--	20210521	KOT1SKL	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	MBT531-...-NOCN-D303 MBT531-...-NOCN-D303			Sheet/Bl. 1/1
Crit. P. --	Scale/M.stab 1:5	Mat.meets/Stoffe s N2580-1	Syst. PE	Doc.type MSZ	RA93006950	DP/TD 001 / Ind. AB	Format A4
MNR				Repl. for 106-0574-4001-AA		Repl. by	

Fig. 188: MBT531E with electrical connection "-_CN-D303"

4.13.2 MBT531L with electrical connection "-_SN-D303"



	L1	L2	L3	$\Delta s_1 min$ theoretical "airgap" without concentricity fault rotor-stator
MBT531L	550	480	510	0.8

AB		20130902	tomajele			7800			
Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.	
Lang./Spr. EN/DE		Wght./Gew.	Rexroth Bosch Group	DIM DRAWING MASSZEICHNUNG	MBT531L...NOSN-D303 MBT531L...NOSN-D303				Sheet/Bl. 1/1
	Crit. P. --	Scale/M.stab 1:5	Mat.meets/Stoffe s N 2580-1	Syst. PE	Doc.type MSZ	106-0574-4019		DP/TD	Ind. AB / Format A4
MNR					Repl. for		Repl. by		

Fig. 189: MBT531L with electrical connection "-_SN-D303"

4.13.3 Rotor MRT531E

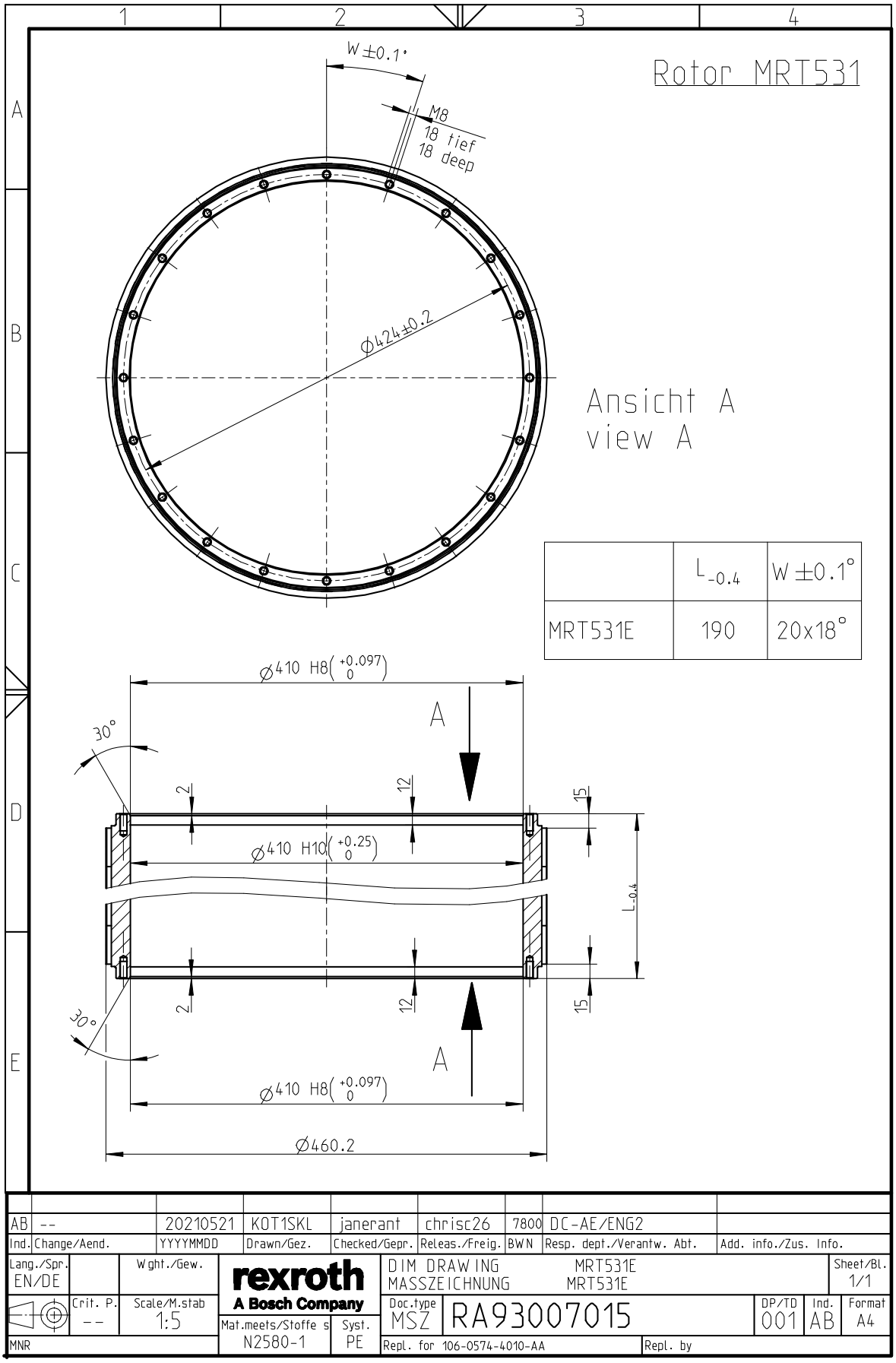


Fig. 190: MRT531E

4.13.4 Rotor MRT531L

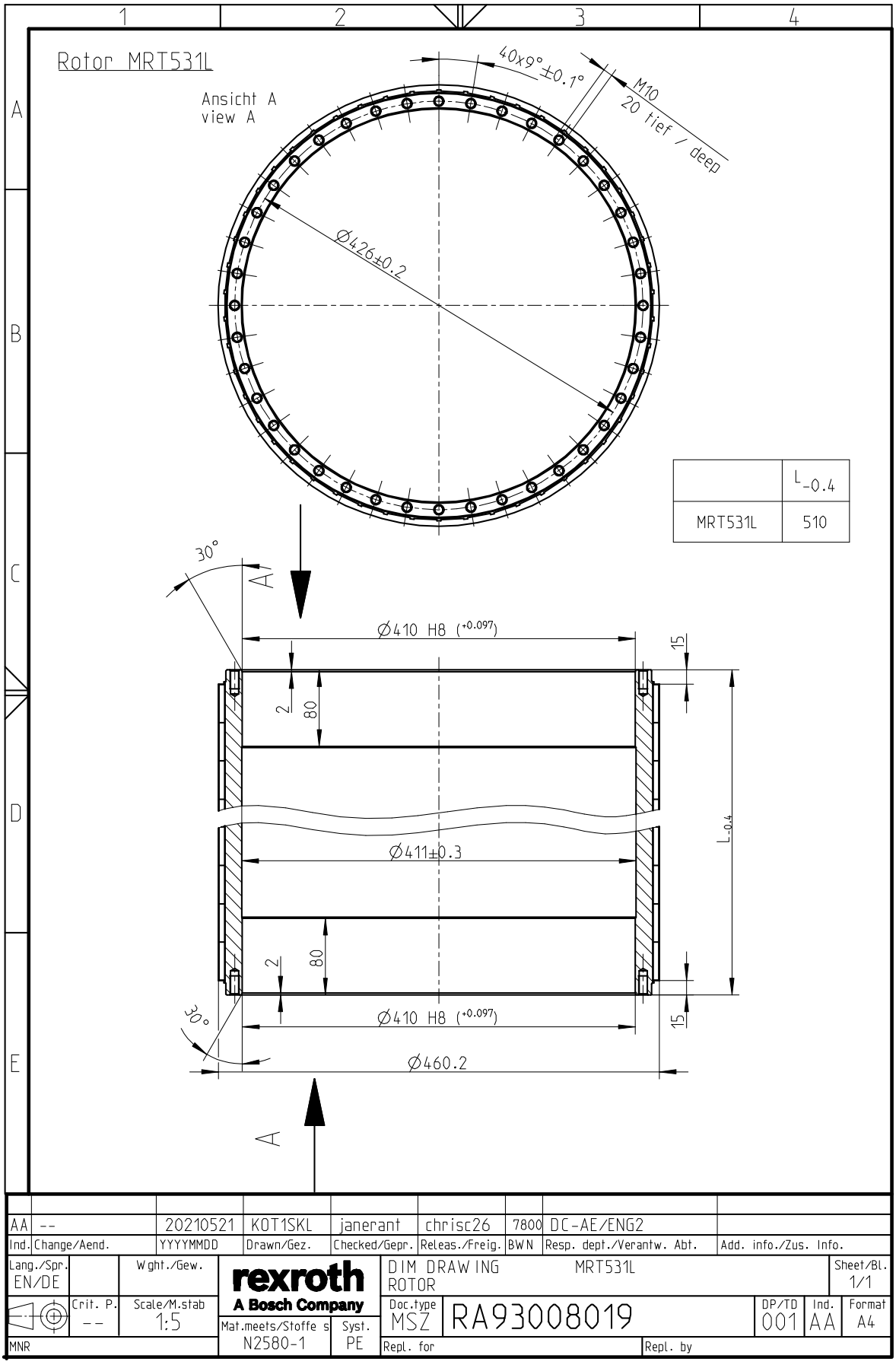


Fig. 191: MRT531L

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

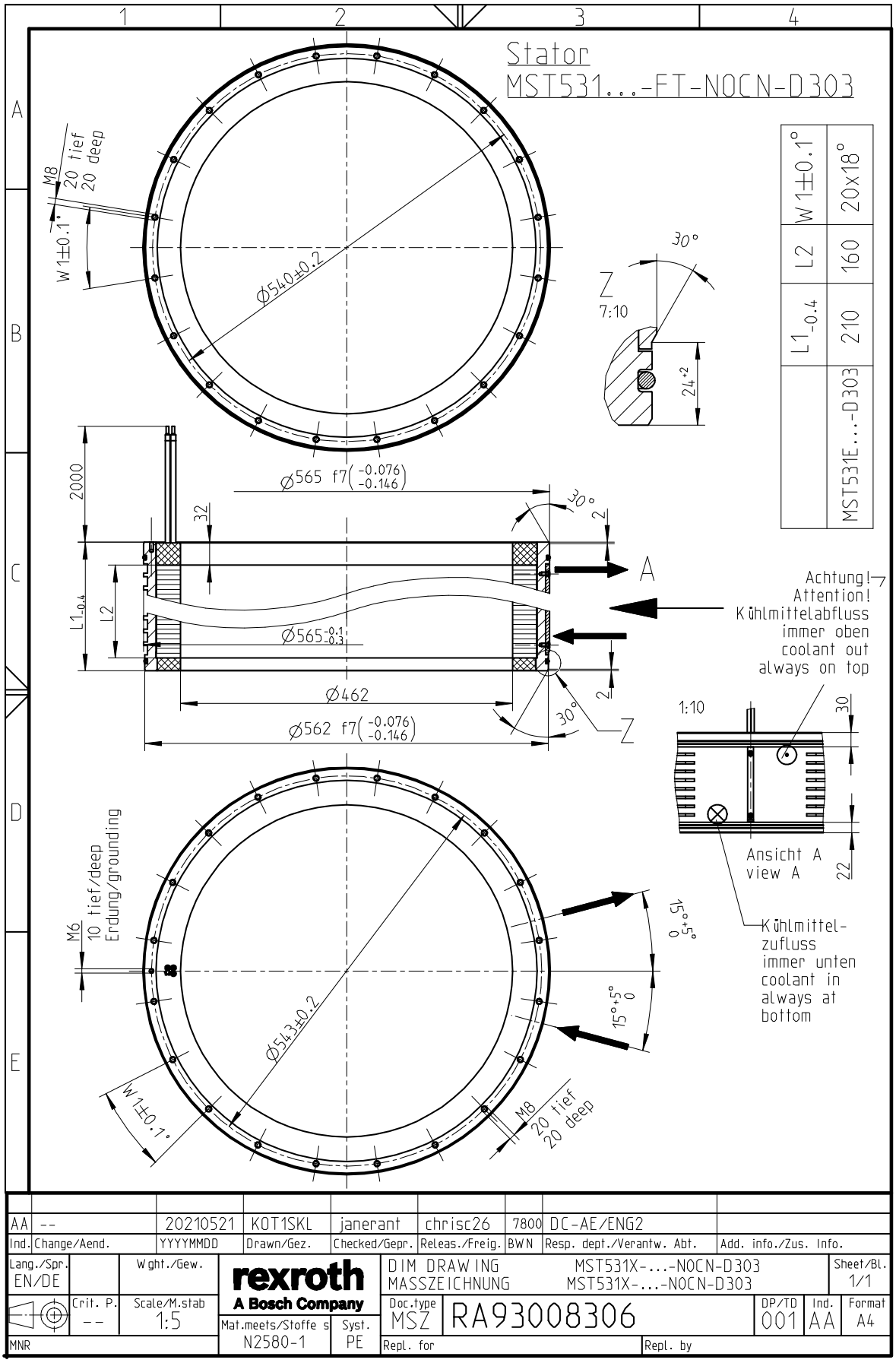


Fig. 192: MST531E, electrical connection "-_CN-D303"

4.13.6 MST531L, electrical connection "-_SN-D303"

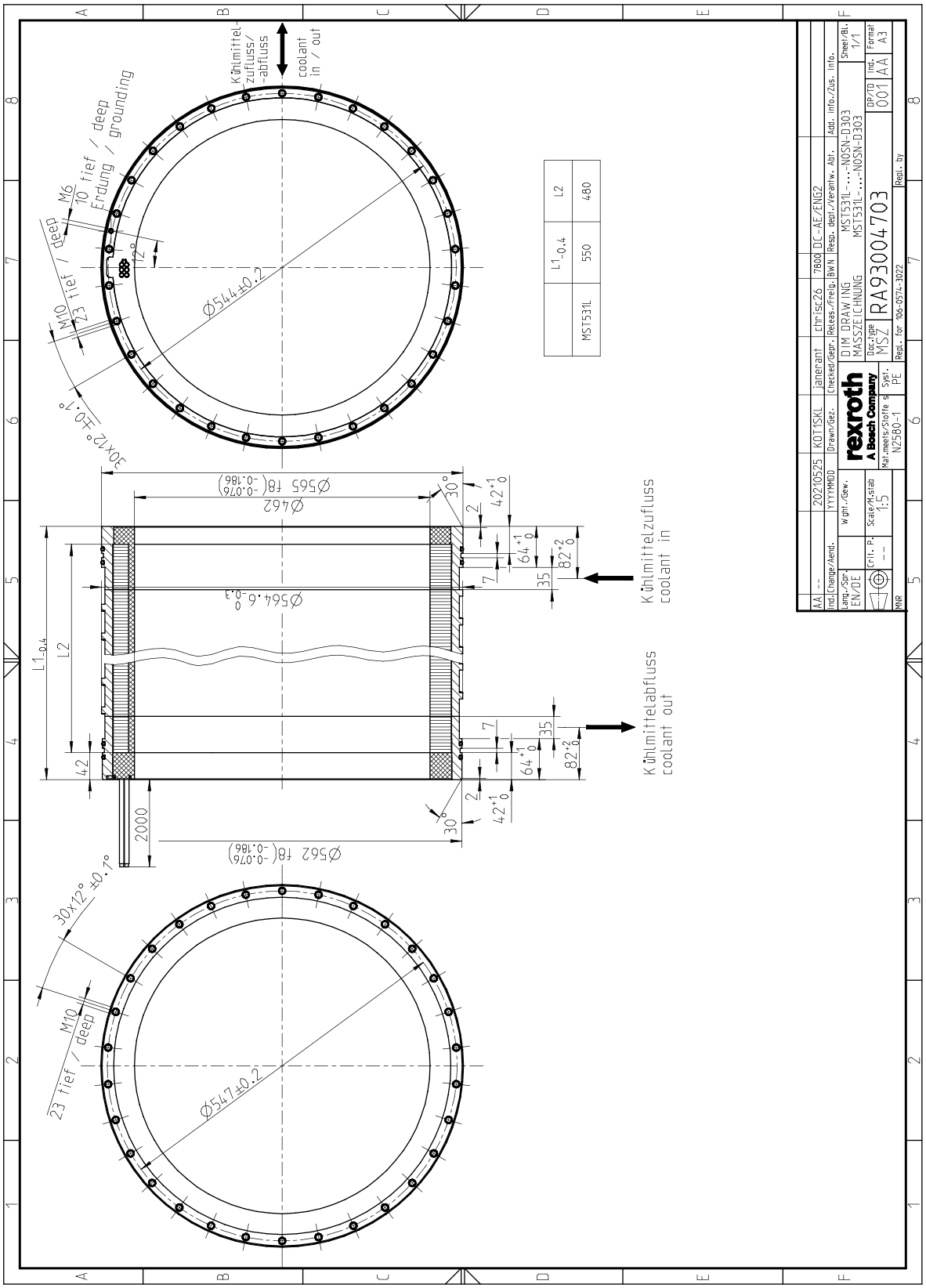


Fig. 193: MST531L, electrical connection "-_SN-D303"

5 Identification

5.1 Identification of motor components

5.1.1 Type codes

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

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 type codes for a specific size can be found in the following chapters.

5.1.2 Type plate

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

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

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

Attach type plate

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

5.2 Identification Stator MST

5.2.1 Type codes

General

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

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.

Type code 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 mode

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

Table 47: MST - Cooling types

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 8.8 Operation without liquid cooling on page 280.
N	Self-cooling	Only applicable to MST130 / 450 / 530.

Design / Enclosure

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

Table 48: MST encapsulation

Option	Design	Detail
S	Standard encapsulation	This option is available for MST130 (only in connection with cooling type “self-cooling"). In case of standard encapulation, the stator package is installed in the machine housing without cooling jacket.
T	Thermal encapsulation	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 cooling jacket for liquid cooling, which is enclosed by a aluminum housing.
A	Aluminum cooling jacket for self-cooling	This option is available for MST161 (only in connection with cooling type “self-cooling").

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 8.12.1 Motor encoder on page 285.

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 connected via a terminal box. Frame sizes 210 and 290 feature a rotary connector.

For more information, please refer to ➦ Chapter 7.3.2 Stators with housing and device connector on page 257.

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

Table 49: MST - Electrical connection

Option	Description
CN	Frame size 130...161: Connection cables axial (same outer diameter on both sides) Frame size 201 ... 531: Connection cables axial 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).

Other designs

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

Table 50: MST - Other designs

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	

Notes

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

5.2.2 Type plate stator MST

Two type plates with the exact type designation and technical data are enclosed for each stator. The UL-label of the stator is only visible at the type plate (main type plate).

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

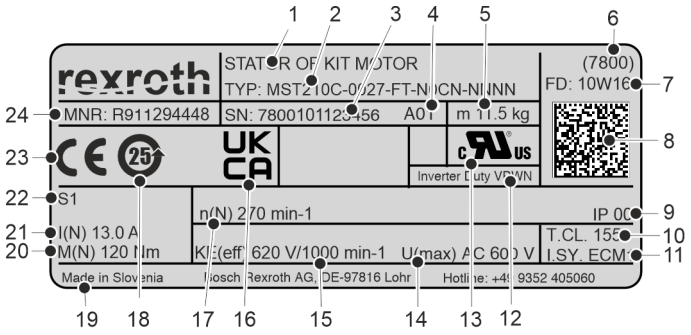


Fig. 194: Example type plate MST

1 Type of machine
2 Type designation
3 Serial number
4 Revision state
5 Mass in kg
6 Manufacturing plant
7 Date of manufacture
8 Rexroth barcode
9 Degree of protection by housing
10 Thermal temperature class
11 Insulation system
12 Inverter Duty VPWM
13 UL label
14 Maximum input voltage
15 R.m.s. voltage constant
16 UK Conformity Assessed (UKCA)
17 Rated velocity in mode S1
18 China-RoHs 2 label
19 Designation of origin
20 Rated torque in mode S1
21 Rated current in operation mode S1
22 Operation mode S1
23 CE mark of conformity
24 Material number

5.3 Identification MRT rotor

5.3.1 Type code MRT rotor

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**

Table 51: MRT - Other designs

Option	Description
NNNN	Standard version

Notes

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

5.3.2 Type plate rotor MRT

Two type plates with the exact type designation and technical data are enclosed for each rotor. The UL-label is only visible on the type plate (main type plate).

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

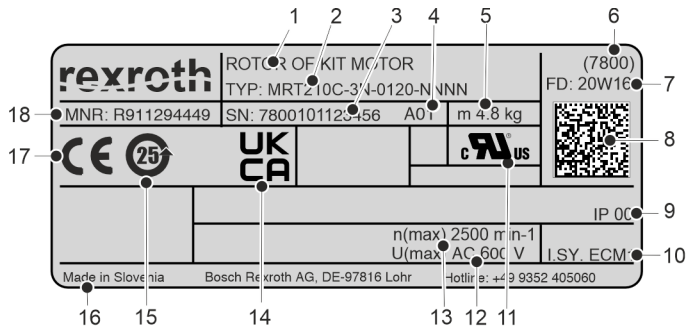


Fig. 195: Example of type plate MRT

1 Type of machine
2 Type designation
3 Serial number
4 Revision state
5 Mass in kg
6 Manufacturing plant

7 Date of manufacture
8 Rexroth barcode
9 Degree of protection by housing
10 Insulation system
11 UL label
12 Maximum input voltage
13 Highest allowed velocity (mechanical)
14 UK Conformity Assessed (UKCA)
15 China-RoHs 2 label
16 Designation of origin
17 CE mark of conformity
18 Material number

5.4 Type code MBT130

5.4.1 Stator MST130

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Example:	M	S	T	1	3	0	C	-	0	0	5	0	-	F	T	-	N	0	C	N	-	N	N	N	N																

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

DCCS-40013-130_TCO_N_EN_2021-05-03

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. 196: Type code of stator MST130

5.4.2 Rotor MRT130

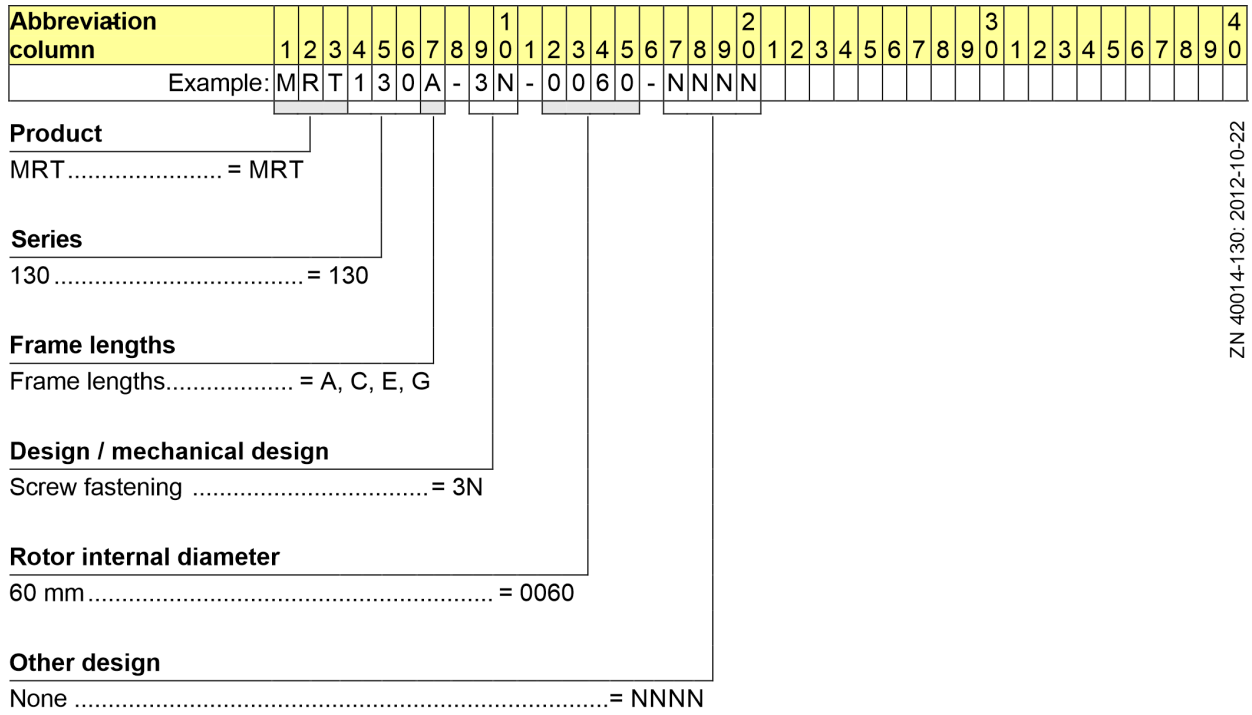


Fig. 197: Type code of rotor MRT130

5.5 Type code MBT160

5.5.1 Stator MST160

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	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. 198: Type code of MST160

5.5.2 Rotor MRT160

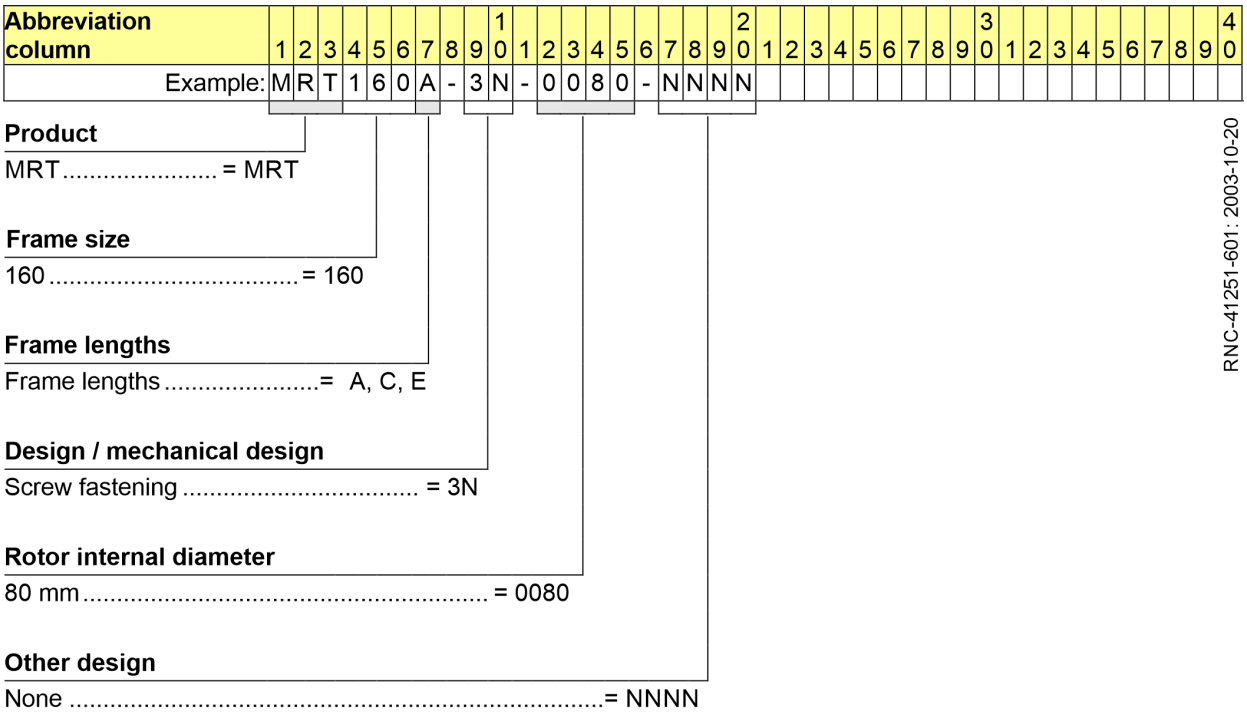


Fig. 199: Type code of rotor MRT160

5.6 Type code MBT161

5.6.1 Stator MST161

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Example:	M	S	T	1	6	1	E	-	0	0	5	0	-	F	T	-	N	0	C	N	-	D	3	0	3																

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

02 **Size**
161 .....= 161

03 **Length**
Length ..... = C, E, G, M

04 **Winding**
MST161C .....= 0140
MST161E .....= 0050, 0140
MST161G .....= 0100
MST161M .....= 0040, 0055

05 **Cooling mode**
Water cooling ..... = F
Self cooling ..... = N

06 **Encapsulation**
Open aluminium cooling jacket ..... = T
Aluminium housing ..... = A

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

08 **Electrical connention**
Axial (same outer diameter) ..... = CN

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

DCCS-40013-161_TCO_N_EN_2022-05-12

Note:
Available standard options:

Length	Winding	Cooling mode	Encap-sulation	Electrical connection	Other design	
				CN	NNNN	D303
C	0140	F	T	+	+	+
E	0050	F	T	+	+	+
E	0140	F	T	+	-	+
G	0100	F	T	+	-	+
M	0040	F	T	+	+	+
M	0055	N	A	+	+	+

+	available
-	not available

Fig. 200: Type code of stator MST161

5.6.2 Rotor MRT161

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Example:	M	R	T	1	6	1	E	-	3	N	-	0	0	8	0	-	N	N	N	N																						

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

02 **Size**
161 .....= 161

03 **Length**
Length ..... = C, E, G, M

04 **Mounting style / mech. design**
Fixing per screws ..... = 3N

05 **Inside diameter of rotor**
80 mm ..... = 0080

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

DCCS-40014-161_TCO_N_EN_2022-05-12

Fig. 201: Type code of rotor MRT161

5.7 Type code MBT201

5.7.1 Stator MST201

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
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. 202: Type code MST201

5.7.2 Rotor MRT201

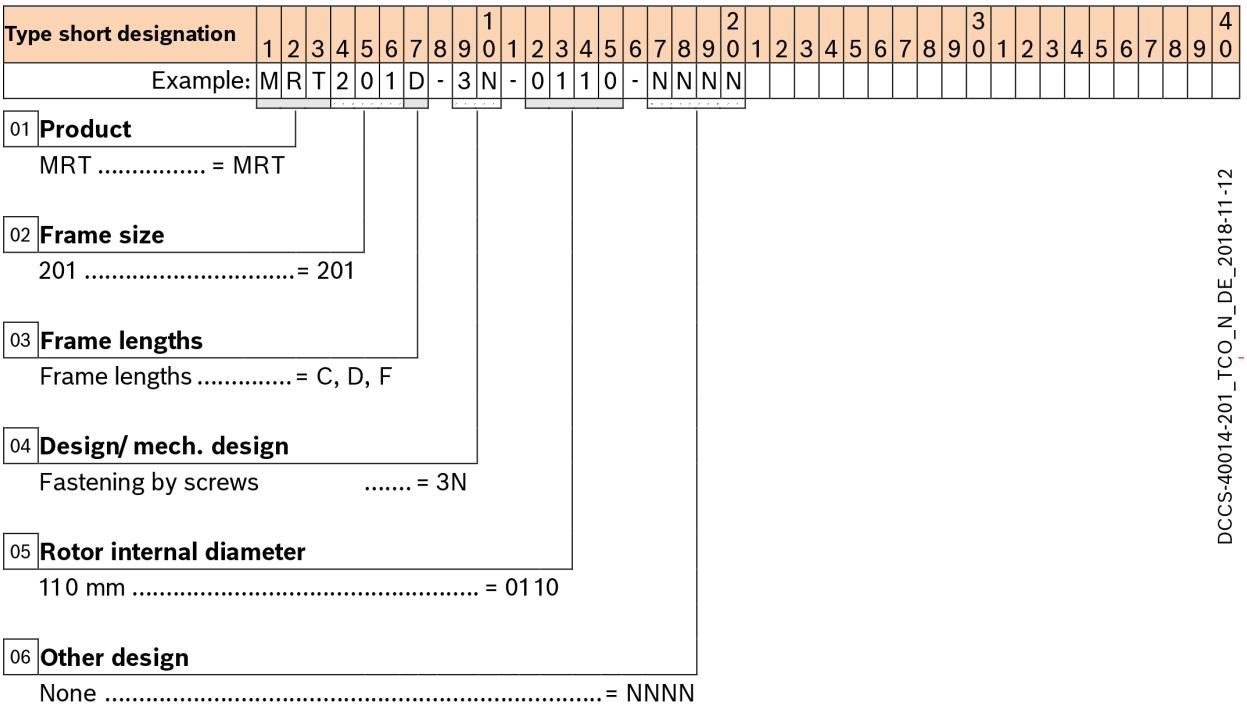
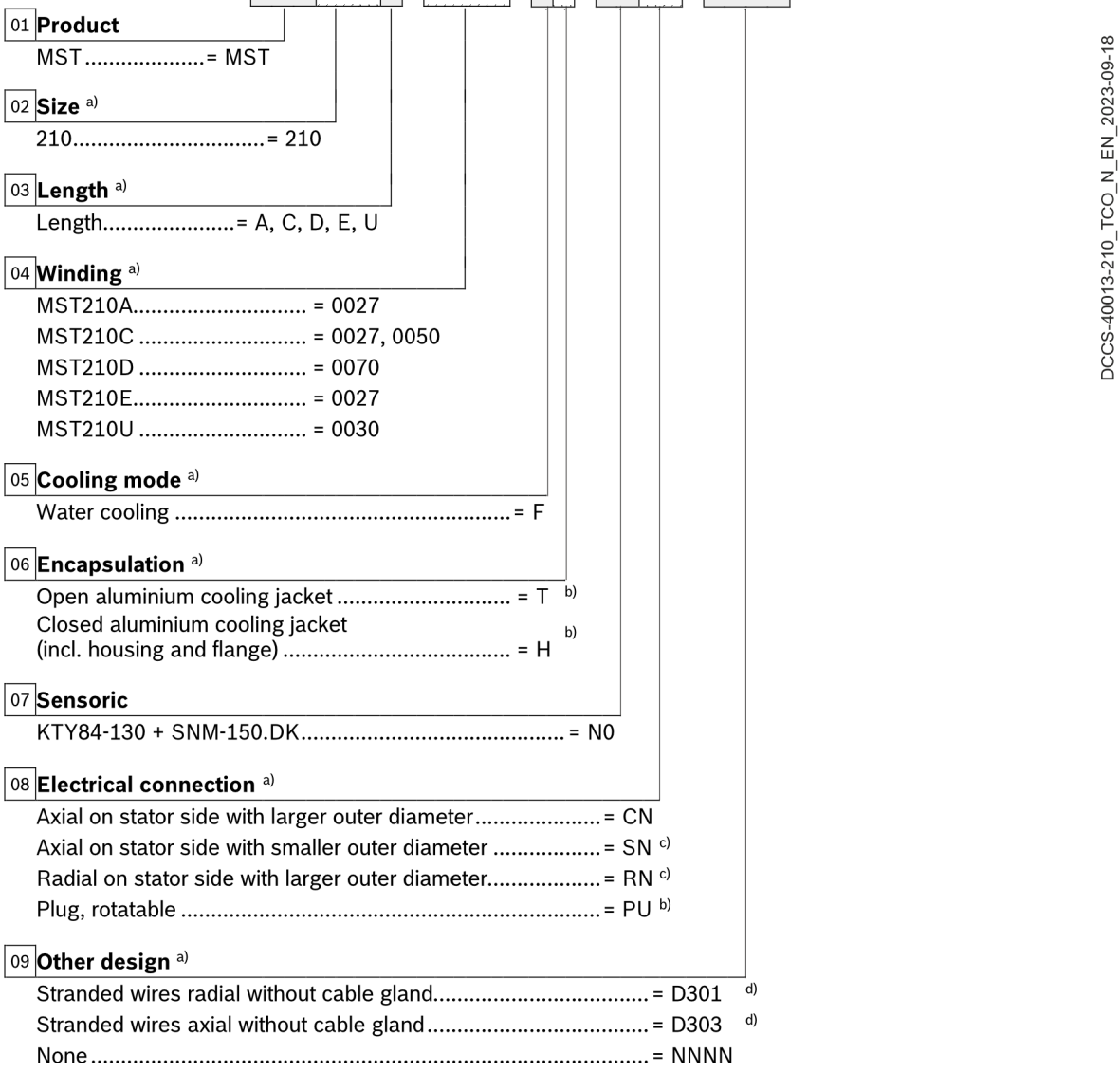


Fig. 203: Type code of rotor MRT201

5.8 Type code MBT210

5.8.1 Stator MST210

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Example:	M	S	T	2	1	0	C	-	0	0	5	0	-	F	T	-	N	0	C	N	-	N	N	N	N																



DCCS-40013-210_TCO_N_EN_2023-09-18

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

Fig. 204: Type code of stator MST210

5.8.2 Rotor MRT210

Type short designation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	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. 205: Type code of rotor MRT210

5.9 Type code MBT251

5.9.1 Stator MST251

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	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. 206: Type code of stator MST251

5.9.2 Rotor MRT251

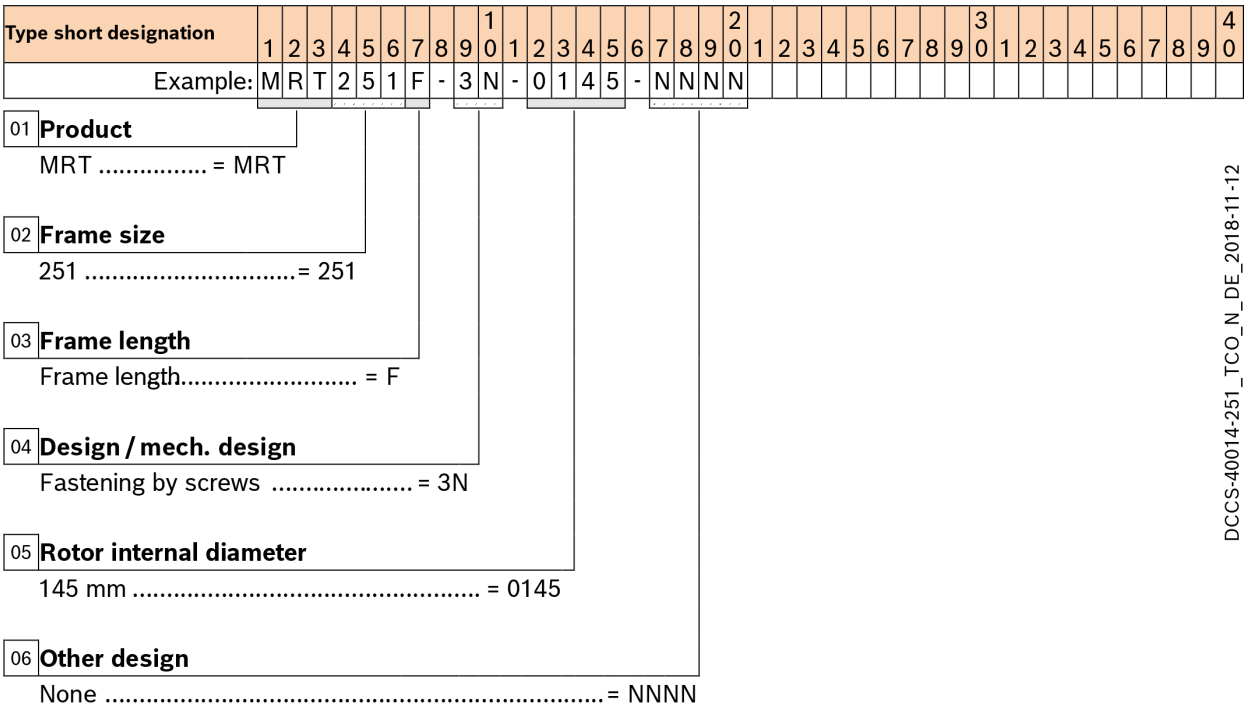
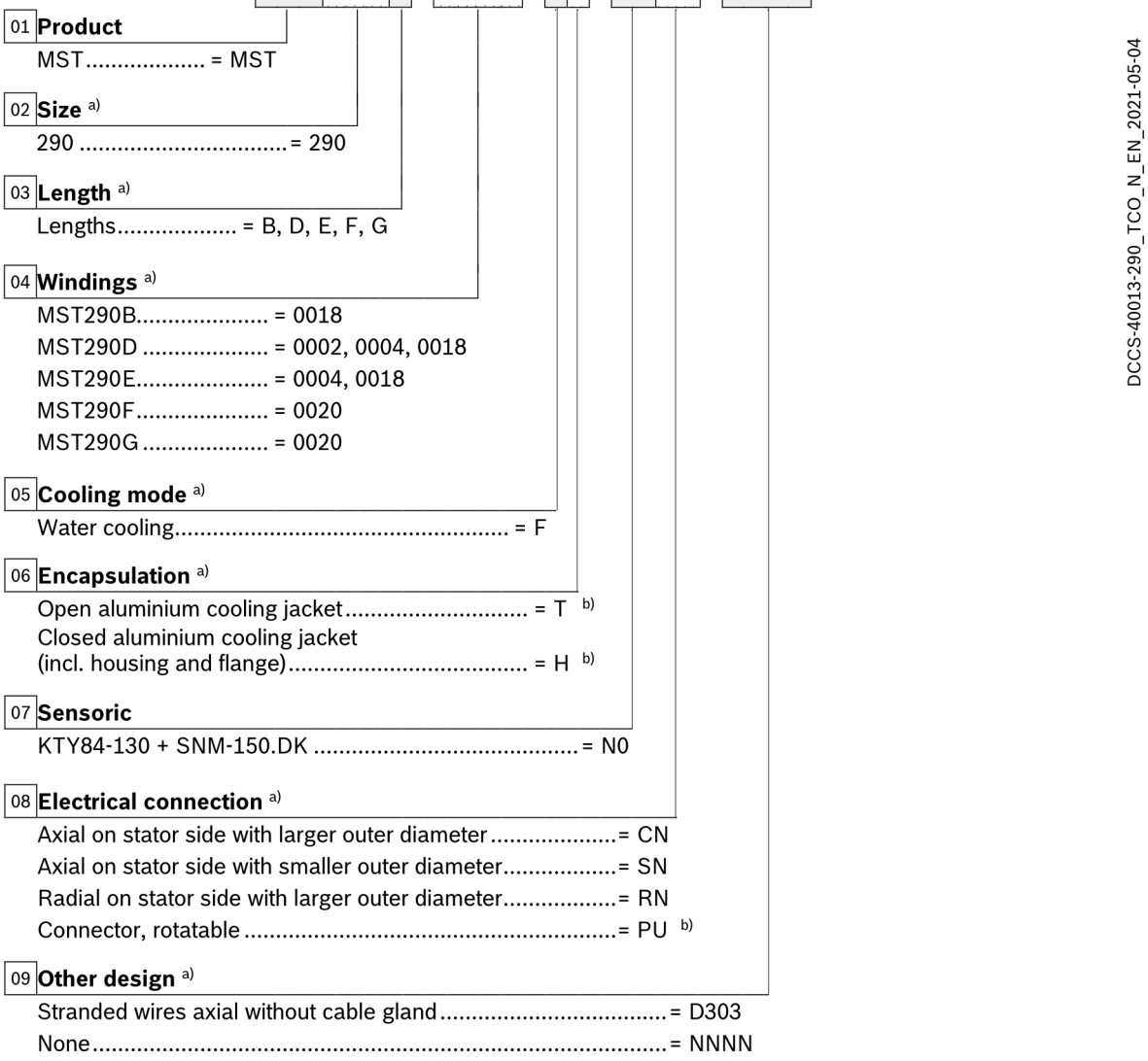


Fig. 207: Type code of rotor MRT251

5.10 Type code MBT290

5.10.1 Stator MST290

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Example:	M	S	T	2	9	0	E	-	0	0	1	8	-	F	T	-	N	0	S	N	-	N	N	N	N																



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. 208: Type code of stator MST290

5.10.2 Rotor MRT290

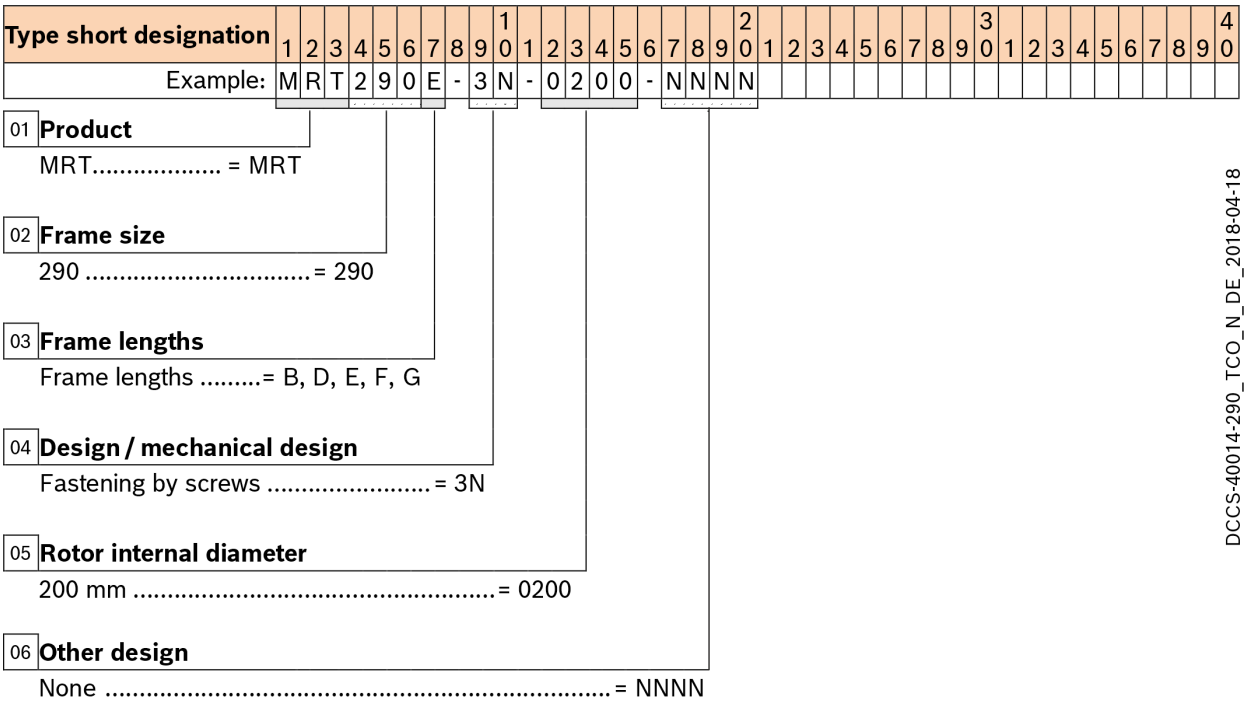


Fig. 209: Type code of rotor MRT290

5.11 Type code MBT291

5.11.1 Stator MST291

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	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

DCCS-40013-291_TCO_N_EN_2021-05-04

Hinweis:
a) Available standard options:

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

+	available
-	not available

Fig. 210: Type code of stator MST291

5.11.2 Rotor MRT291

Type short designation:	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	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. 211: Type code of rotor MRT291

5.12 Type code MBT360

5.12.1 Stator MST360

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Example:	M	S	T	3	6	0	B	-	0	0	1	8	-	F	T	-	N	0	C	N	-	N	N	N	N																

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

DCCS-40013-360_TCO_N_EN_2021-04-29

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. 212: Type code of stator MST360

5.12.2 Rotor MRT360

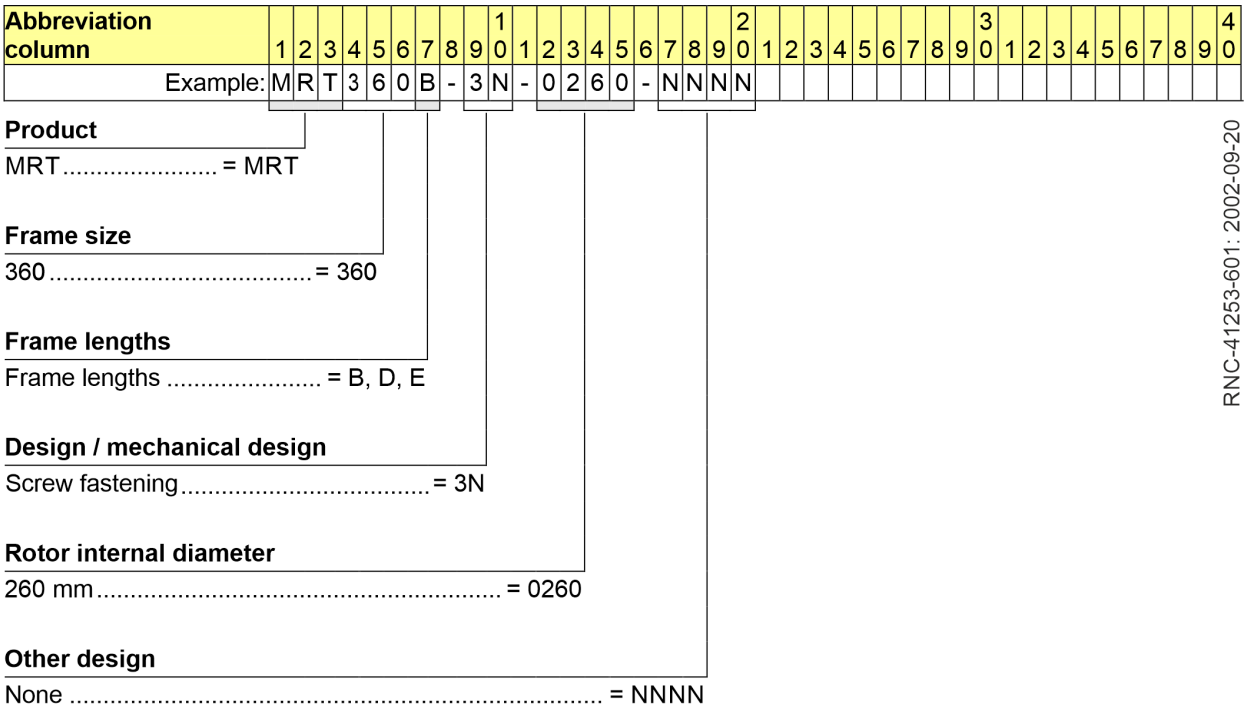


Fig. 213: Type code of rotor MRT360

5.13 Type code MBT450

5.13.1 Stator MST450

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Example:	M	S	T	4	5	0	E	-	0	0	1	2	-	F	T	-	N	0	C	N	-	N	N	N	N																

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)

DCCS-40013-450_TCO_N_EN_2021-04-20

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. 214: Type code of stator MST450

5.13.2 Rotor MRT450

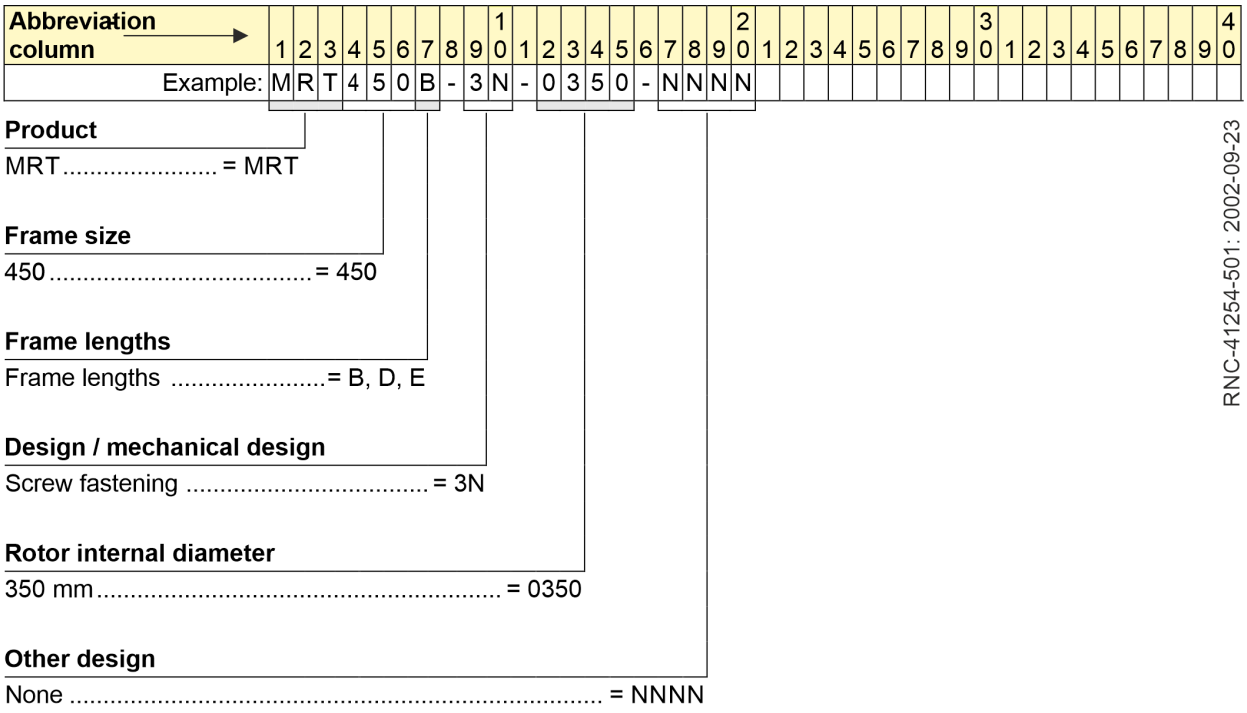


Fig. 215: Type code of rotor MRT450

5.14 Type code MBT530

5.14.1 Stator MST530

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	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. 216: 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	+	+	+	+	+	-
	C	0010	F	T, H	+	+	+	+	+	-
	C	0014	F	T, H	+	+	+	+	+	-
	D	0012	F	T, H	+	-	+	+	+	-
	E	0010	F	T, H	+	-	+	+	+	-
	F	0012	F	T, H	+	-	-	+	+	-
	P	0012	F	T, H	+[e]	-	-	+[d]	+	+
	R	0011	F	T, H	+[e]	-	-	+[d]	+	+
	G	0006	F	T, H	+[e]	-	+[d]	+[d]	+	+
	G	0007	F	T, H	+[e]	-	-	+[d]	+	+
	G	0010	F	T, H	+[e]	-	-	+[d]	+	+
	L	0003	F	T, H	+[e]	-	-	+[d]	+	+
	L	0006	F	T, H	+[e]	-	-	+[d]	+	+
	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. 217: Type code of stator MST530 (page 2/2)

5.14.2 Rotor MRT530

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	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. 218: Type code of rotor MRT530

5.15 Type code MBT531

5.15.1 Stator MST531

Type short description	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	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. 219: Type code of stator MST531

5.15.2 Rotor MRT531

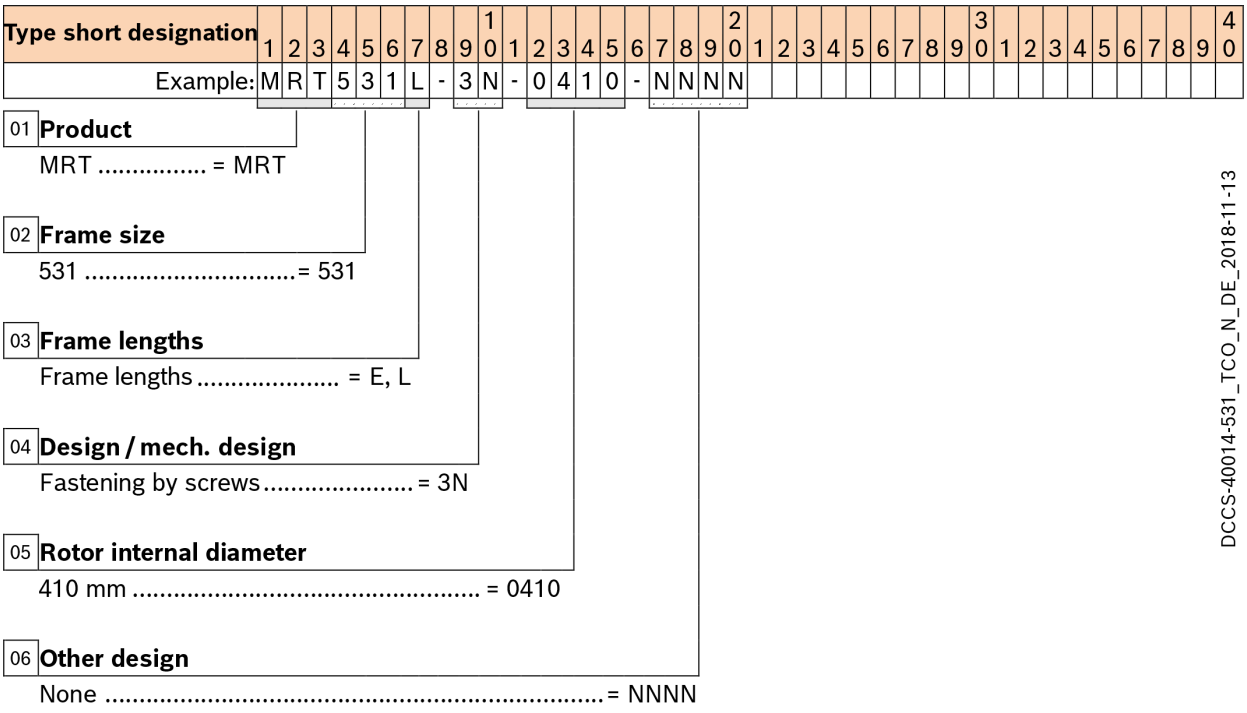


Fig. 220: Type code of rotor MRT531

6 Accessories

6.1 O-rings for stators

The scope of delivery contains 2 o-rings. These are dimensioned to suit the respective stator in order to seal the cooling channels in the machine-side housing. Particular attention must be paid to this:➥ Chapter 11.10 Mounting examples on page 324

O-rings should always be in perfect condition and should therefore not be used more than once. If o-rings are needed after assembly, order them at Bosch Rexroth customer service (see➥ Chapter Service and support). The O-rings suitable for the respective stator are listed in the following table ➥ Tab. 52.

Table 52: O-rings for MST stators

Stator	O-ring	
	(Amount)	Material number
MST130.-....-FT-...	2	R911306474
MST160		R911306476
MST161		R911306476
MST201		R911245301
MST210A/ -C/ -D/ -E		R911306477
MST210R		R911306478
MST251		R996556274
MST290		R911306479
MST291C, -E, -D		R911306479
MST291F		R913084405
MST291Z		R913042601

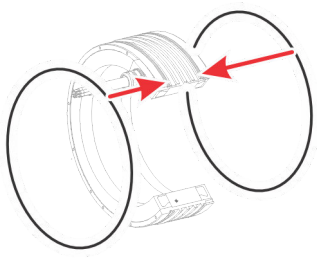


Fig. 221: O-rings stator

Stator	O-ring	
	(Amount)	Material number
MST360		R911306480
MST450		R911306482
MST530M-....-FT-...		R913079281
MST530.-....-FT...		R911306481
MST531		R911306481

6.2 Mounting ring

6.2.1 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.

6.2.2 Schematic design

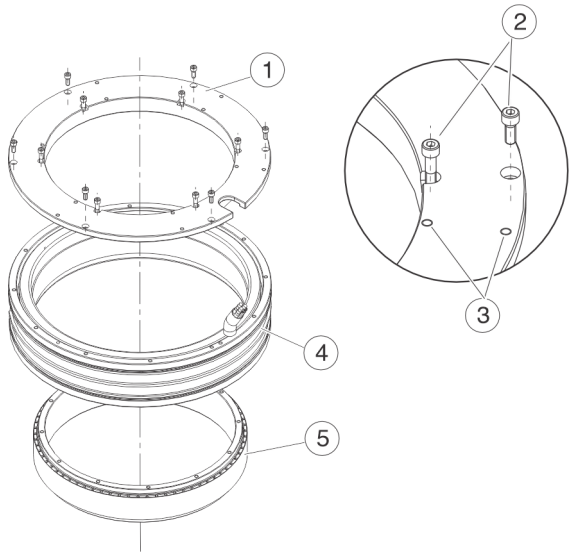


Fig. 222: Mounting rings for MST/MRT
① Mounting ring
② Fastening screw of the mounting ring
③ Borings for ring screws for transport (refer to the transport information in ➦Chapter 10.2.2).
④ MST Stator

④ Rotor MRT

6.2.3 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 pre-mounted ex works. Without this information, the mounting rings are delivered unassembled.

Frame size 530 with encapulation “H” as well as frame sizes 530G an 530L cannot be delivered with a mounting ring!

Table 53: Order designations mounting rings, premounted

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

6.2.4 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

- Contact the Rexroth branch which arranged your delivery and inquire about an RGA number (Returned Goods Authorization).
- Completely fill out the data on the back of the accompanying document.
- 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.
- 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.

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

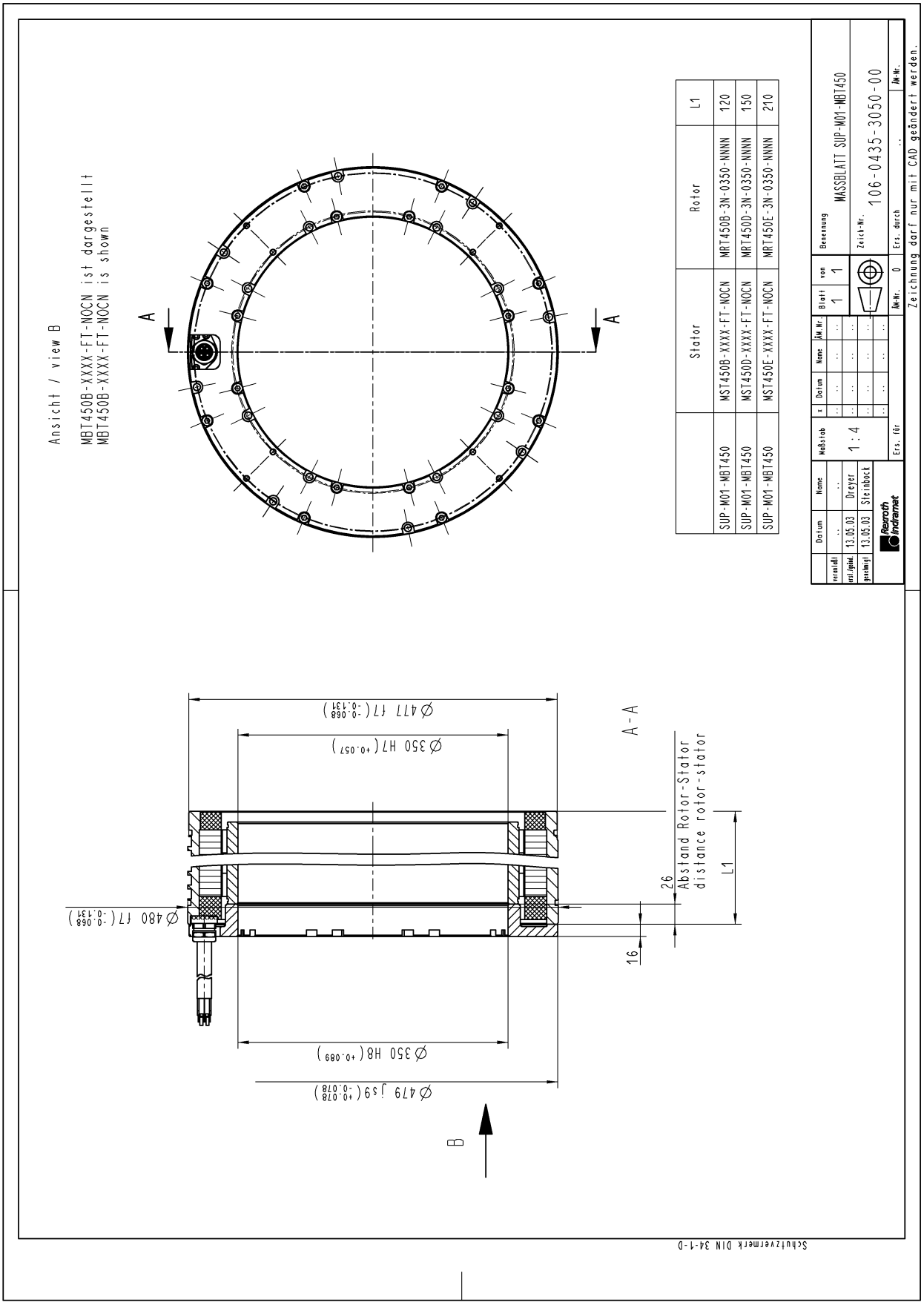


Fig. 223: Dimension sheet of mounting ring in SUP-M01-MBT450

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

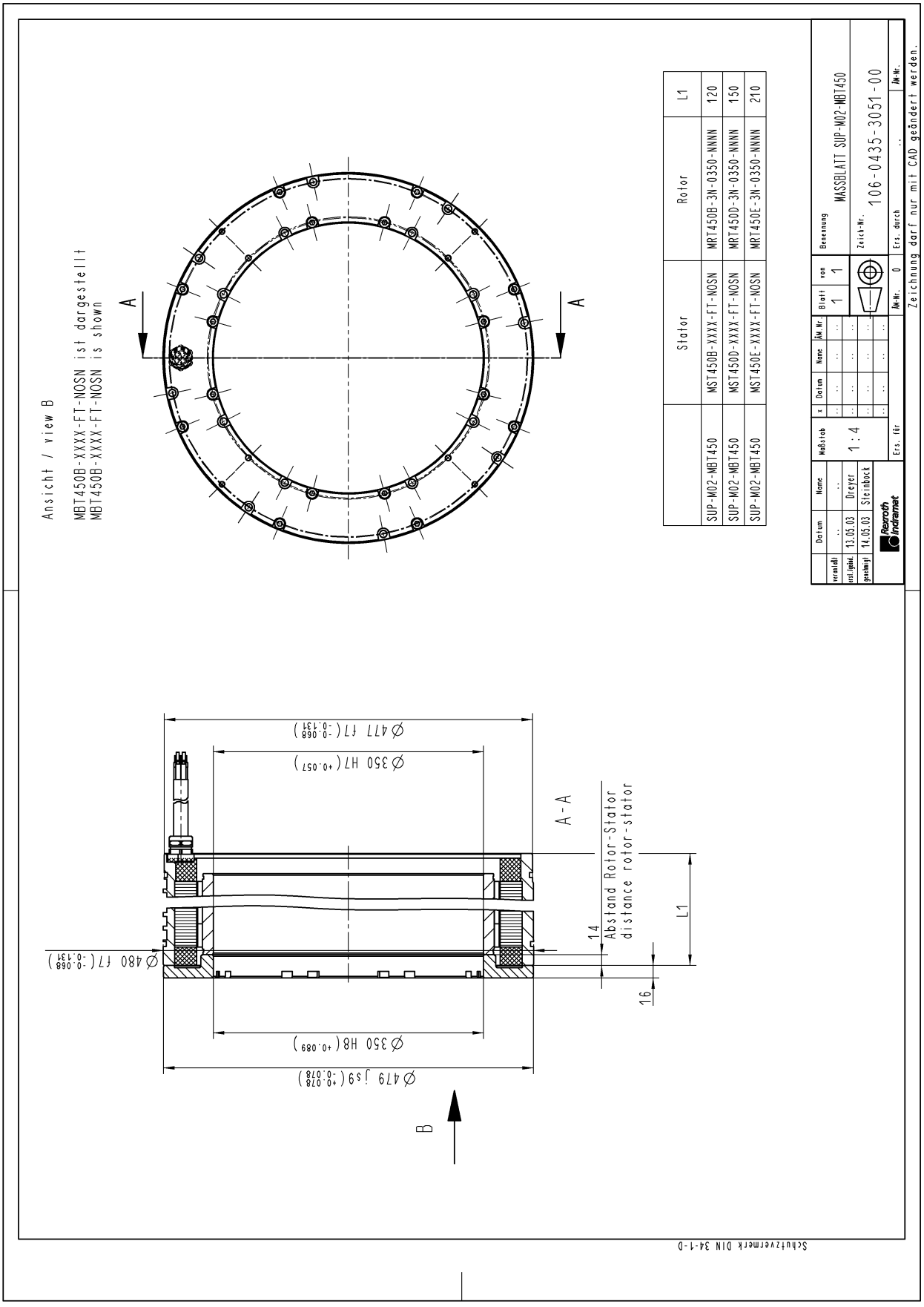


Fig. 224: Dimension sheet of mounting ring in SUP-M02-MBT450

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

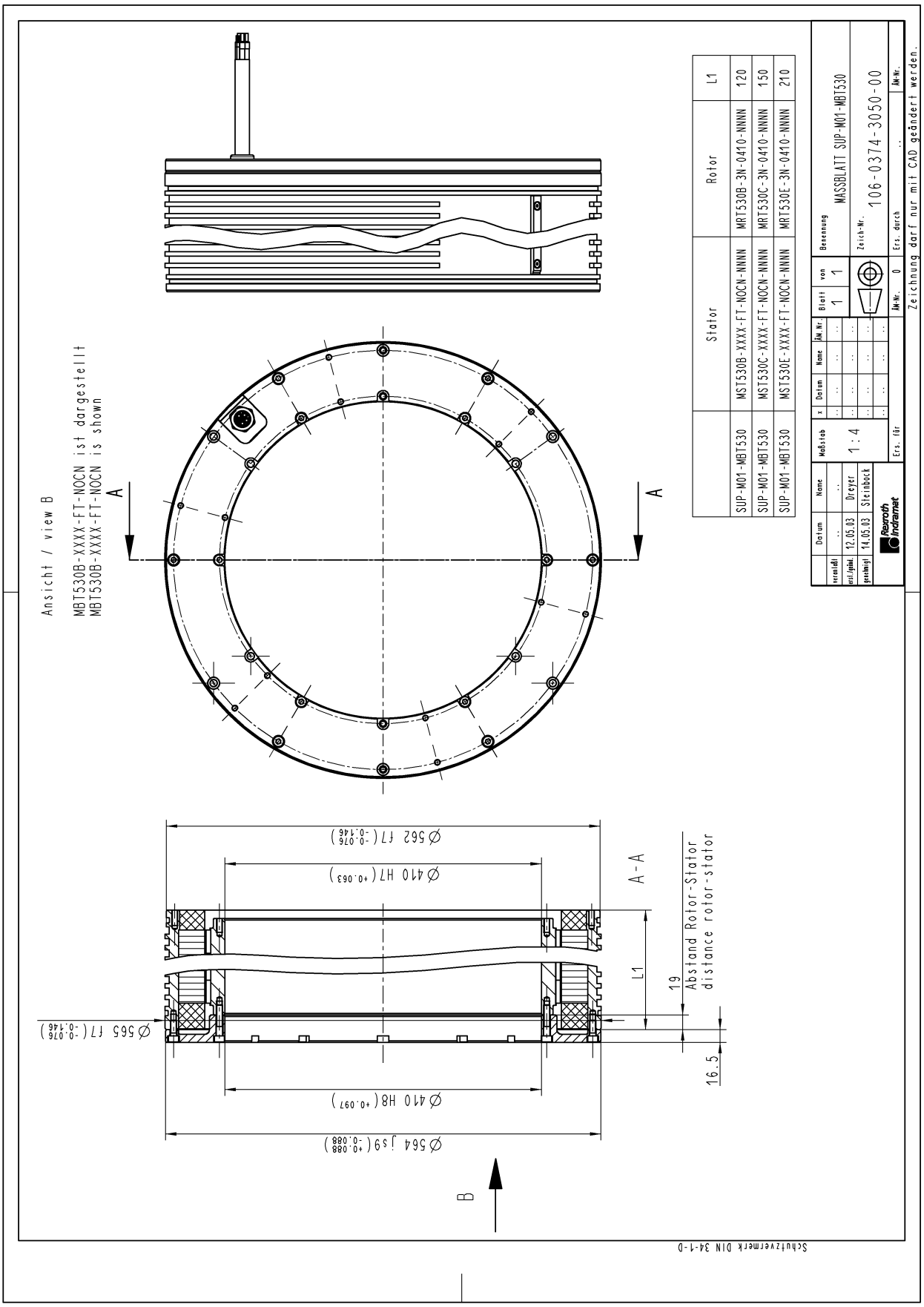


Fig. 225: Dimension sheet of mounting ring in SUP-M01-MBT530

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

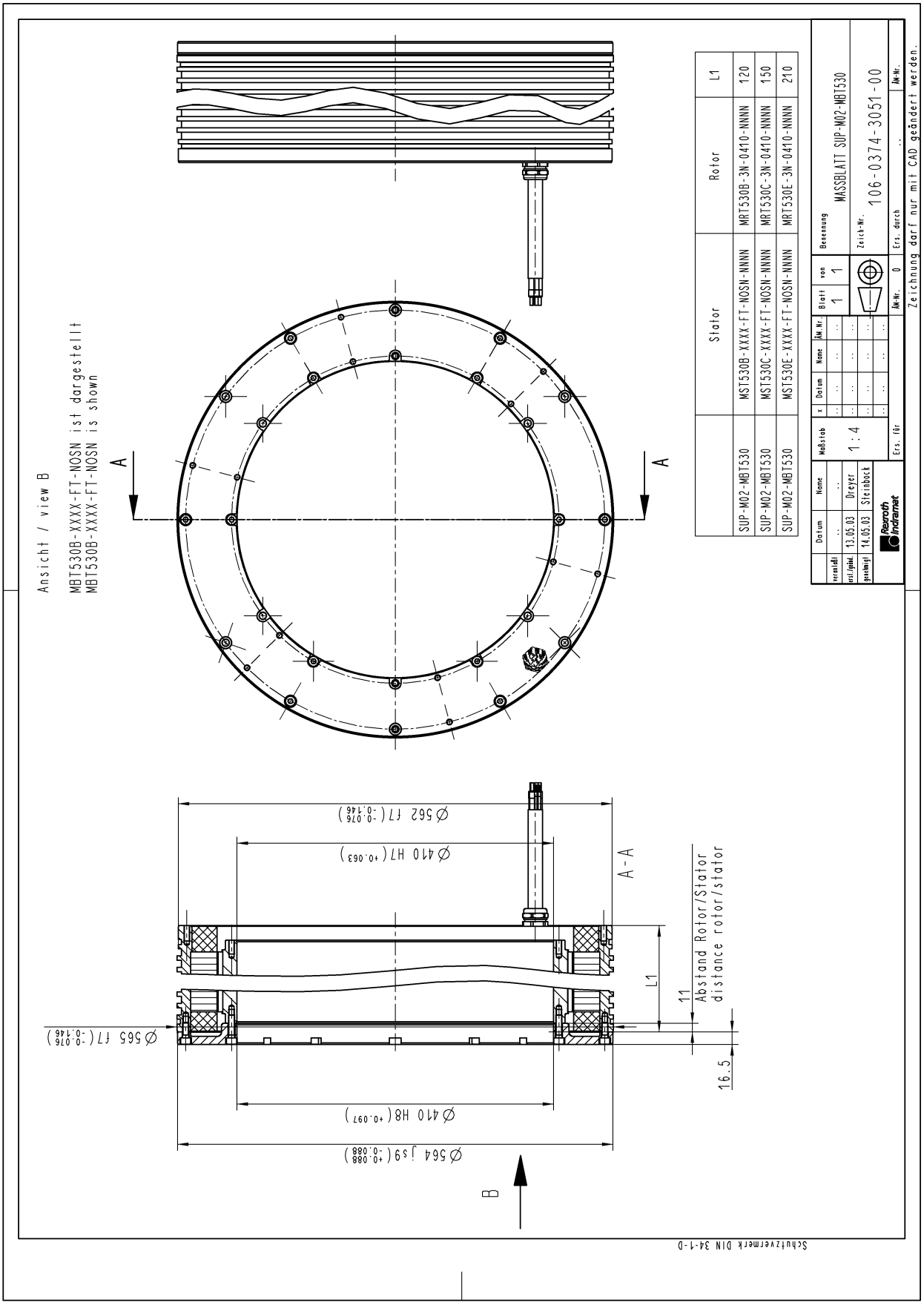


Fig. 226: Dimension sheet of mounting ring in SUP-M02-MBT530

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

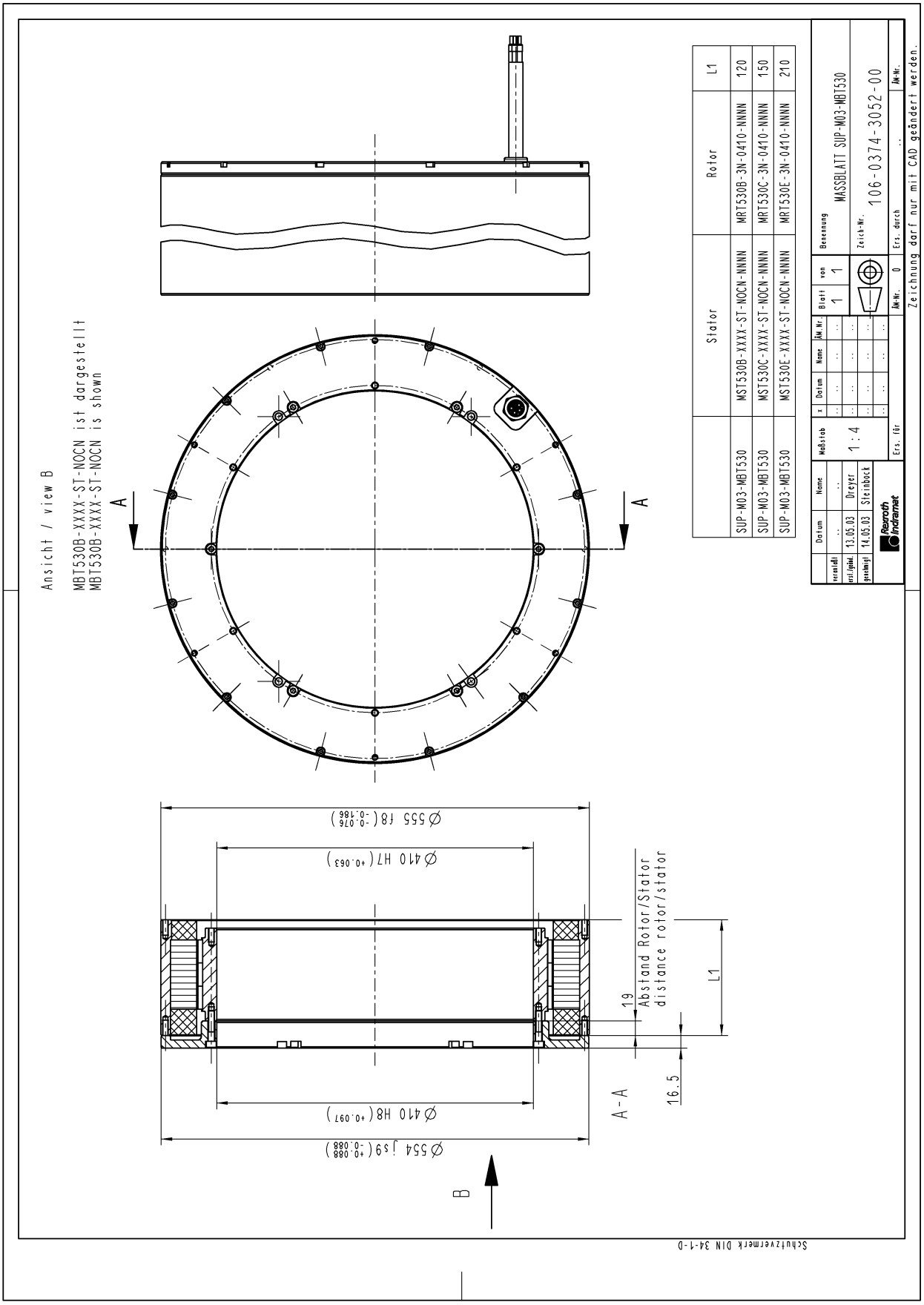


Fig. 227: Dimension sheet of mounting ring in SUP-M03-MBT530

7 Connection technique

7.1 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.

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

Additional information...

- To **select** power and encoder cables for MBT motors in the documentation “Rexroth Connection Cables ...”, (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).

7.2 Power connection of stators with connection cable

7.2.1 General

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.

7.2.2 Connecting the stators

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

- Stators with a 2 m long connection cable with wire end ferrules (other design "NNNN")
- 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”.
  Flexible, single-stranded wires are used up to a cross section of 6 mm².
  High-flexible, single-stranded wires within a fiberglass hose are used from a cross section of 10 mm².

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. However, the customer may also take other protective measures, depending on the installation situation.

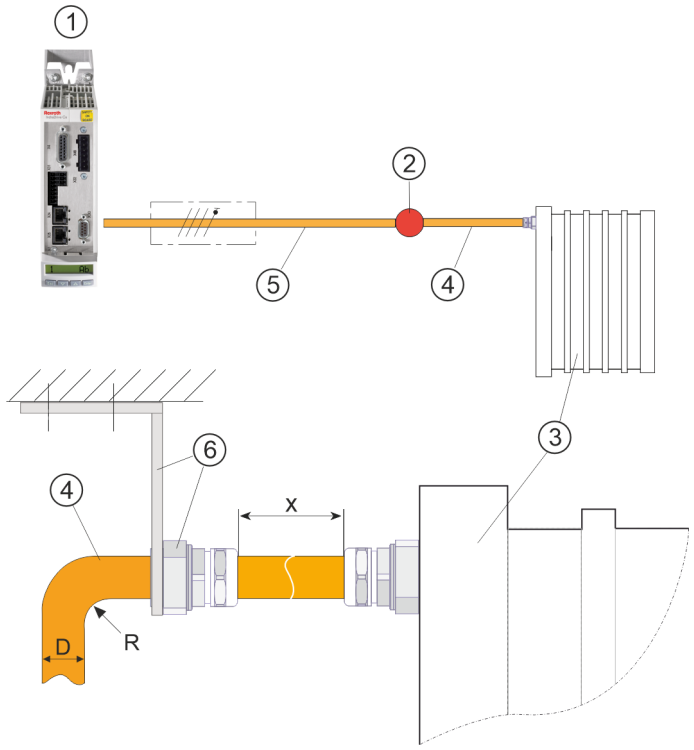


Fig. 228: Cable gland with strain relief
① Drive controller
② Junction
③ MST Stator
④ Connection cables
⑤ Power cable
⑥ Strain relief of cable gland at stator
x Minimum distance 10 mm
D Diameter of connection cable
R Bending radius

Table 54: Bending radius

Cable type	Smallest permissible bending radius R* [mm]
REL (INK...)	5 x D
Wires	3 x D
* for fixed installation	

For stators with stranded 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. 55 .

Table 55: Cross section sensor wires at stator design "D30_"

Temperature sensor	Cross section connection wires	ØD [mm]
SNM.150.DK	0.5 mm²	< = 1.0
KTY84-130	AWG24	< = 1.0

Cable glands at stators with connection cables

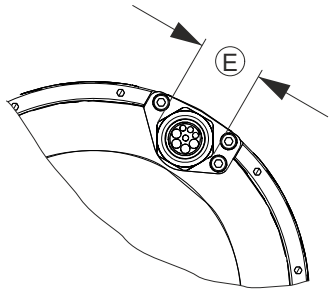


Fig. 229: Cable gland at the stator
Ⓔ Dimension "E", screw connection size see➦ Tab. 56

Connection cables at the stator

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.

Table 56: Connection cables at the stator

Stator	Connection mode[1)]	Cross section [mm²]		Ø D [mm] [3)]	Dimension "E" [mm][5)]	Minimum cross section Continuative power cable [mm²]
		Power[2)]	Sensors			
MST130A-0200-F... -D303	Wires	AWG[4)] 16	see ➦ Tab. 55	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						
MST130G-0100-F...-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	16	
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	Wires	AWG 14	see	3.5 ±0.2	/	1.0

Stator	Connection mode[1]	Cross section [mm²]		Ø D [mm] [3]	Dimension "E" [mm][5]	Minimum cross section Continuative power cable [mm²]
		Power[2]	Sensors			
MST160C-0050-F... -D303			➦ Tab. 55			
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						
MST161M-0040-F...-NNNN						
MST161M-0055-N...-NNNN						
MST161C-0140-F...-D303	Wires	AWG 14	see ➦ Tab. 55	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	Wires	AWG 16	see ➦ Tab. 55	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	34	6.0
MST210A-0027-F... -D30x	Wires	AWG 14	see ➦ Tab. 55	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	34	4.0
MST210E-0027-F... -NNNN						
MST210D-0070-F... -NNNN	REL0109 (INK0604)	6.0		18.5 ±1		6.0
MST251F-0040-F...-D303	Wires	16.0	see ➦ Tab. 55	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	34	4.0
MST290E-0004-F... -NNNN						1.0
MST290E-0018-F... -NNNN	REL0109 (INK0604)	6.0		18.5 ±1		6.0
MST290F-0020-F...-D303	Wires	AWG 8	see ➦ Tab. 55	6.4 ±0.2	/	10.0
MST290G-0020-F...-D303						
MST291C-0018-F...-D303	Wires	AWG 12	see ➦ Tab. 55	4.0 ±0.2	/	2.5
MST291D-0010-F...-D303						
MST291E-0010-F...-D303						
MST360B-0006-F... -NNNN	REL0107 (INK0602)	2.5	1.0	14.8 ±1	34	1.0

Stator	Connection mode[1]	Cross section [mm²]		Ø D [mm] [3]	Dimension "E" [mm][5]	Minimum cross section Continuative power cable [mm²]
		Power[2]	Sensors			
MST360B-0018-F... -NNNN	REL0108 (INK0603)	4.0	2 x 1.0 2 x 1.5	17.0 ±0.5	34	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	34	2.5
MST360D-0018-F... -NNNN						4.0
MST360E-0008-F... -NNNN	REL0107 (INK0602)	2.5	1.0	14.8 ±1	40	2.5
MST360E-0018-F... -NNNN	REL0110 (INK0605)	10.0	1.0	22.2 ±1	40	10.0
MST360B-0006-F... -D303	Wires	AWG 14	see ➦ Tab. 55	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	34	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	34	2.5
MST450B-0012-F... -D303	Wires	AWG 12	see ➦ Tab. 55	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	34	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						

Stator	Connection mode[1]	Cross section [mm²]		Ø D [mm] [3]	Dimension "E" [mm][5]	Minimum cross section Continuative power cable [mm²]
		Power[2]	Sensors			
MST530G-0006-F... -D303	Wires	2 x 16.0	see ➦ Tab. 55	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	Wires	AWG 8	see ➦ Tab. 55	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. 230.

2) Sizing according to DIN VDE 0298-4. The required power wire cross-sections are applicable to laying type B2 (single installation). 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.

5) Dimension "E" (see Fig. 229) defines the maximum diameter of screw connections or union nuts (see dimensional drawings).

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

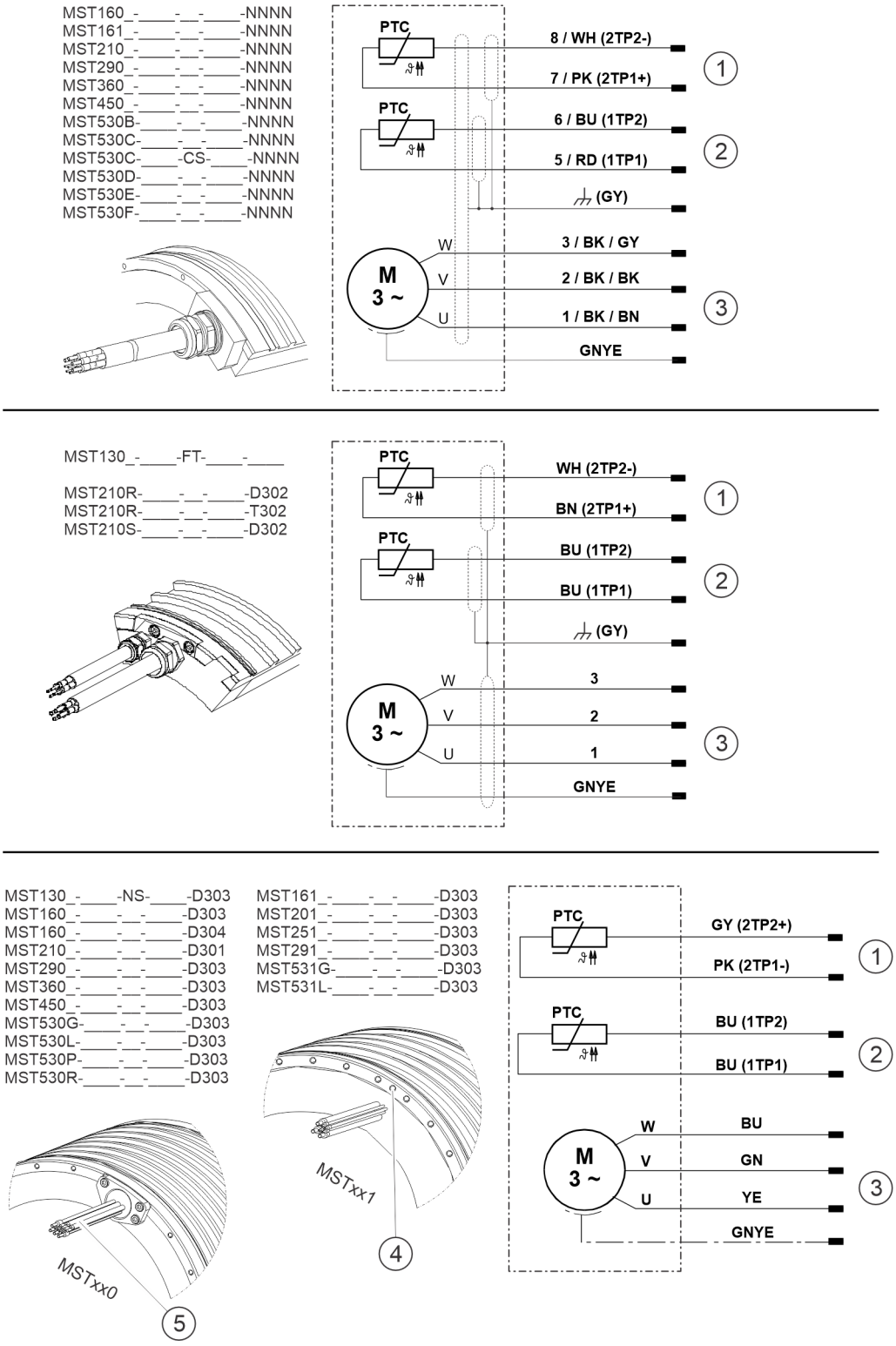


Fig. 230: Wire identification at MST stators with connection cable

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

④ With MSTxx1...D303 there is no stranded wire for the ground connection in the connection strand. An additional thread is provided for the ground connection, instead (see➥ Dimension sheet).

⑤ Wires for ground connection within connection strand

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

- Decision about connection type **terminal box** or **device connector** as well as acquisition of the components required.
- Shortening the power cable to the desired length (only if required).
- 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).
- 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 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

Table 57: Suppliers of terminal boxesTerminal box Suppliers

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

When selecting the components, please observe

- 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}.
- necessary cross sections and connection threads of the cable tread.
- tightness of the housing. Minimum protection class IP65 is recommended.

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

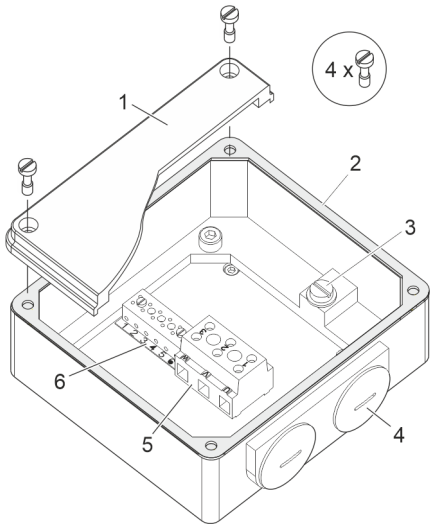


Fig. 231: Terminal box
① Cover
② Seal
③ PE connection
④ Cable entry
⑤ U-V-W power connection
⑥ Terminal strip

Selection connector set

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.

Connector sets can only be used for motors with a connection cable. For motors with a connection strand consisting of individual wires as per version "D30x", the connector attachment of the connector sets from ➦ Tab. 58 is not possible.

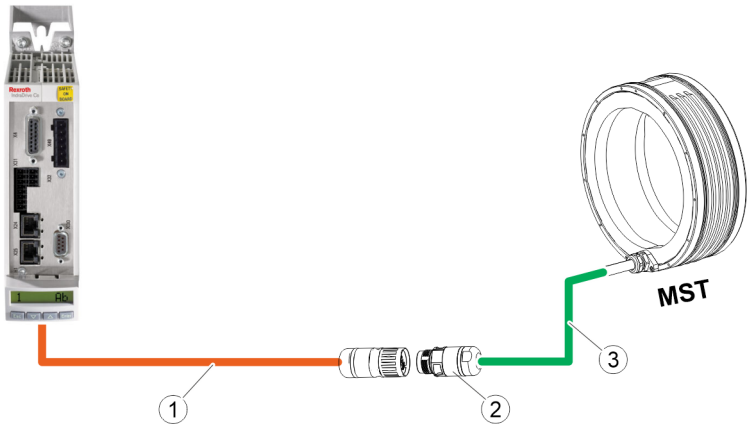


Fig. 232: Motor connection with device connector
① Power cable RL2...
② Connector (for order designation of connector sets refer to ➦ Tab.) 58)
③ Motor connection cable at the stator (see➦ Tab. 56 and ➦ Tab. 58)

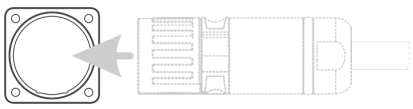
Table 58: Device connector

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		

Connector gland

To feed the connector through to the machine, the connectors listed in ➦ Tab. 58 can be fitted with a flange. The flange can be ordered as an accessory.

Table 59: Mounting flange

“Mounting flange connector gland”	Designation
 Fig. 233: Mounting flange	see ➦ Tab. 58 “Mounting flange connector gland”

Connection diagram of device connector

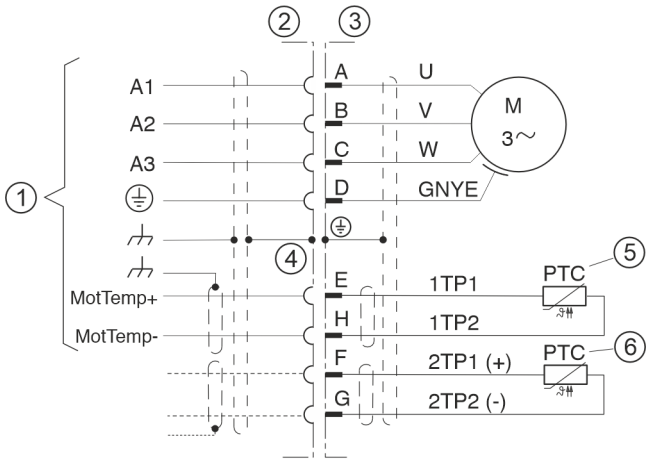


Fig. 234: Connection diagram of device connector
① Drive controller
② Connector

③ Flange socket / coupling
④ Shield connection via cable clamp of strain relief in the screwed cable connection
⑤ Connect temperature sensor SNM.150.DK to the drive controller for motor protection (wire designation see Fig.) 230)
⑥ Connect temperature sensor KTY84-130 to the drive controller for motor protection (wire designation see Fig.) 230)

7.2.3 Ground connection MSTxx1...D303

The MSTxx1 stators in version "D303" do not have a grounding wire. A threaded hole is provided on the stator front face for the ground connection.

Attach the protective conductor to this threaded hole using a ring terminal end in accordance with the state of the art. For details on the exact position and the connection thread of the threaded hole, refer to the dimensional drawing of the respective motor. The required minimum cross-section of the protective conductor depends on the respective motor type and is generally equal to the power conductor cross-section.

7.3 Power connection of stators with housing

7.3.1 General

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.

7.3.2 Stators with housing and device connector

Table 60: Stators with housing and device connector

Frame size MST.....-FH-xxPU-...	Device connector	Minimum cross section Continuative power cable [mm²]
210A-0027	RLS1200	see ➦ Table 56 Connection cables at the stator on page 249
210C-0027		
210C-0050		
210D-0070		
210E-0027		
290B-0018		
290D-0002		
290D-0004		
290D-0018		
290E-0004		
290E-0018		

Device connector RLS1200

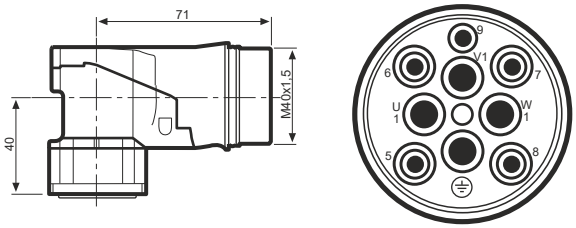


Fig. 235: Device connector RLS1200

Table 61: RLS1200 pin 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.

Device connector (coupling) RLS120x for device connector RLS1200

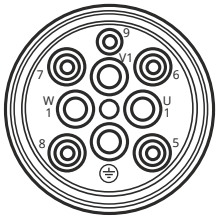


Fig. 236: View coupling RLS120x

Table 62: RLS1201 pin 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

7.3.3 Stators with housing and terminal box

Table 63: Stators with housing and terminal box

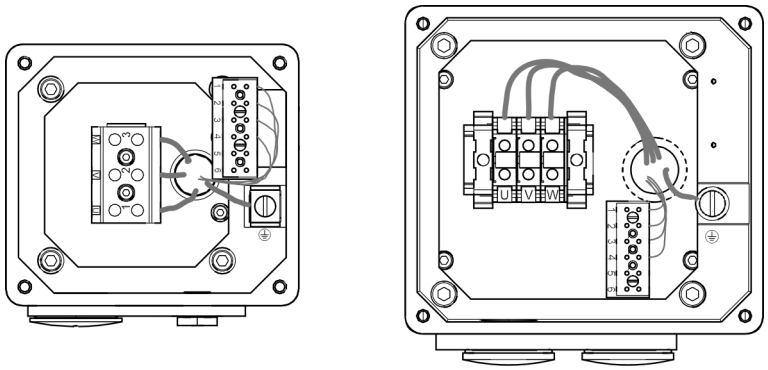
Frame size MST.....-FH-xxKR	Terminal box					Continuative power cable [mm²]
	Designation	U-V-W	Connection cross section [mm²]	ØPE	Connection thread	
360B-0006	RLK0003	WEF[1)]	2.5 10	RTE[2)] for thread M6	See motor dimension sheet	see ➦ Table 56 Connection cables at the stator on page 249
360B-0018						
360D-0009						
360D-0012						
360D-0018						
360E-0008						
360E-0018						
450B-0012	RLK0004		2.5 ... 16	RTE for thread M8		
450D-0006						
450D-0012						
450E-0006						
450E-0012						
530B-0010	RLK0004		2.5 ... 16	RTE for thread M8		
530C-0010						
530C-0014						
530D-0012						
530E-0010						
530F-0012			2.5 ... 35			
530G-0006	RLK1300		2.5 ... 35	RTE for thread M8		
530G-0007						
530G-0010						
530L-0003						
530L-0006						
530L-0007						
530P-0012	RLK0004		2.5 ... 35			
530R-0011						

1) WEF = wire end ferrule
2) RTE = ring terminal end

- 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.
- Pay particular attention to the orderly and tension-free routing of the connection cables in the terminal box in order to avoid chafing or pressure points on the cables.
- The connections of the internal motor windings in the terminal box must not be loosened.

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

Terminal box example



MST360x-__-FH-_KR-...

MST450x-__-FH-_KR-...

MST530B-__-FH-_KR-...
MST530C-__-FH-_KR-...
MST530D-__-FH-_KR-...
MST530E-__-FH-_KR-...
MST530F-__-FH-_KR-...
MST530P-__-FH-_KR-...
MST530R-__-FH-_KR-...

Fig. 237: Terminal boxes MST360 / -450 / -530B, -C, -D, -E, -F, -P, -R

Connection overview

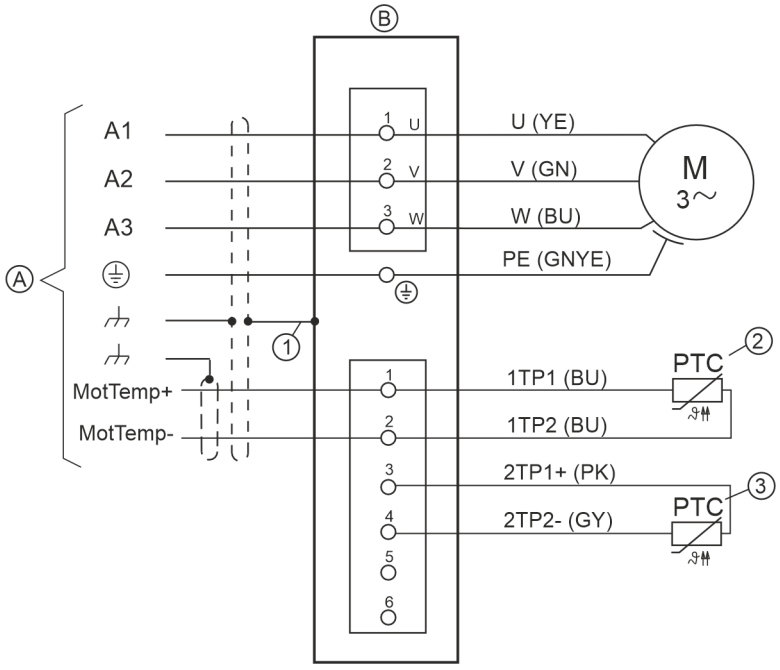


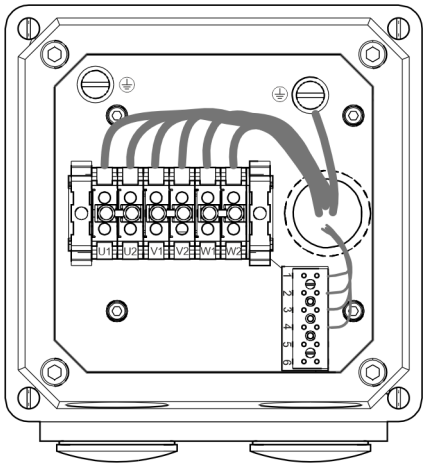
Fig. 238: Overview of connections to the terminal box

Ⓐ 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

7.3.5 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



MST530G-__-FH-_KR-...
MST530L-__-FH-_KR-...

Fig. 239: Terminal box RLK1300

Overview of double cabling

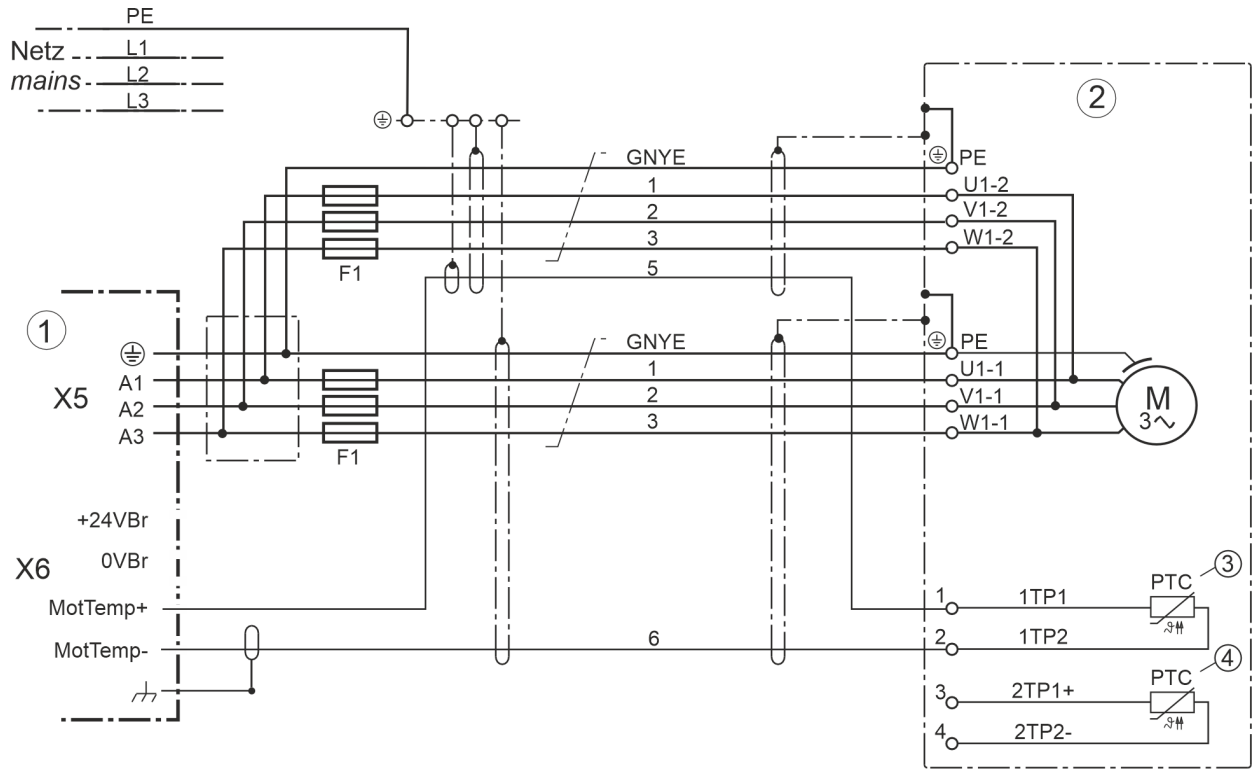


Fig. 240: Double cabling connection diagram

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

- 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:

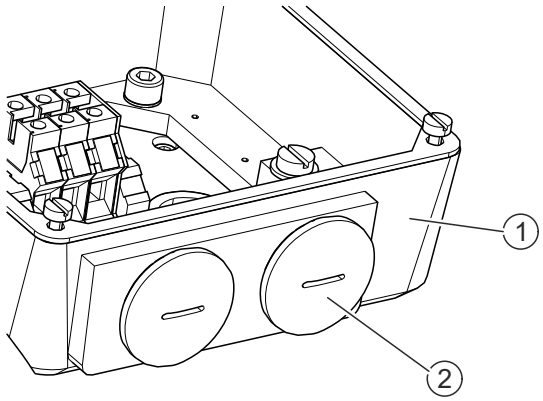


Fig. 241: Safety cover of cable gland
① Terminal box
② Safety cover of cable gland

1. Open the terminal box cover.

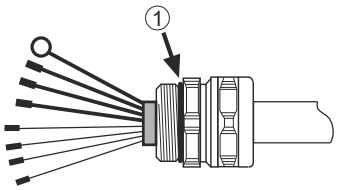


Fig. 242: O-ring at cable gland
① Position of the O-ring

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.

   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:

   Table 64: Screw tightening torques in Nm (±10%) for power connection

Stator MST.....-FH-xxKR	Terminal box	U-V-W	PE	
		M4	M6	M8
360	RLK0003	1.5	2.5	-/-
450	RLK0004	1.5	-/-	3.5
530B 530C 530D 530E 530F	RLK0004	1.5	-/-	3.5
530G 530L	RLK1300	1.5	-/-	3.5
530P 530R	RLK0004	1.5	-/-	3.5

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.

7.4 Sensors

7.4.1 Connection 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.

NOTICE

- 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.). 230).
- KTY84-130 is an ESD sensitive device! For this reason, the stranded wires of the sensor are protected by a protective foil at the connection cable. Before connecting the sensor, take measures regarding ESD protection.(ESD = electrostatic discharge).

Also note the information on motor temperature monitoring in ➦ Chapter. 8.10.

7.4.2 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. 12.5.

You will find more information about encoder manufacturers in ➦ Chapter. 8.12.1.

Please note:

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

7.5 Motor cooling

7.5.1 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 additional notes about motor cooling refer to ➦ Chapter 8.7 and ➦ Chapter. 8.10 Motor temperature monitoring .

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 additional notes about motor cooling refer to ➦ Chapter 8.7 and ➦ chapter 8.10 Motor temperature monitoring .

NOTICE	– Note that inlet and outlet are only allowed in the position specified in the dimension sheet. – Install systems in the cooling circuit for monitoring flow, pressure and temperature.

7.5.2 Operating pressure

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

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

Select well-spaced dimensioned connection screws and tube diameters.

8 Application and construction instructions

8.1 Installation altitude and ambient temperature

Convection-cooled motors

The performance data specified for the drive system applies to

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

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

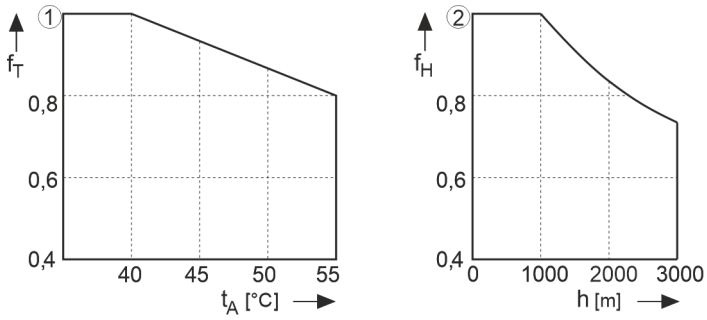


Fig. 243: Load factors/derating
① Utilization depending on the ambient temperature
② Utilization depending on the installation altitude
f_T Temperature utilization factor
t_A Ambient temperature in degrees Celsius
f_H Height utilization factor
h Installation altitude in meters

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

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

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

- Multiply the determined utilization factors f_T and f_H.
- 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

Liquid-cooled motors

Provided that the liquid cooling system is properly functioning and sufficiently dimensioned at installation altitudes of more than 1000 m above sea level, the performance data of the drive are reduced because the convection conditions are changing by 2.5% / 1000 m.

8.2 Environmental conditions during operation

Environmental conditions during operation

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

Table 65: Allowed classes of environmental conditions during operation according to EN IEC 60721-3-3:2019

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

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

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

Table 66: Allowed operation conditions

Environmental factor	Unit	Value
Temperature	°C	0 ... +40[1)] +5 ... +40[2)]
Relative air humidity	%	5 ... 95[1)]
Absolute air humidity	g/m³	1 ... 29[1)]
Installation altitude	m	up to 1,000 m above sea level
[1)] Deviating from EN IEC 60721-3-3:2019 [2)] for water cooling		

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

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

Problem areas

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

Possible effects

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

Possible countermeasures

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

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

8.4 Acceptances and approvals

8.4.1 CE Mark

CE

For MBT motors, declarations of conformity are available, confirming the design and the compliance with valid EN standards and directives. If required, download the declarations of conformity from - ➦ EU Declaration of conformity or request from the responsible sales office.

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

8.4.2 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 these products.

8.4.3 UKCA label

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

8.4.4 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.

8.5 Compatibility test

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

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

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

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

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

Construction information

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



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

8.7 Motor cooling

8.7.1 General

The motor power loss P_V is converted into heat and then dissipated via the liquid cooling system. 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!** – Be sure to take the motor data into account when designing cooling systems. – Observe the manufacturer's instructions when designing and operating cooling systems. – Do not use any cooling lubricants or cutting materials from machining processes. – Avoid contamination of the cooling medium as well as modifications of chemical composition and pH.

8.7.2 Coolant

General

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

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

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

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

- Use systems with a closed circuit and a fine filter ≤ 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.

Quality of cooling water

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

Aqueous solution

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

Emulsion with corrosion protection

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

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

Comply with instructions of the pump manufacturer!

Cleaning the coolant circuit

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

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

⚠ CAUTION	**Risk of damage to the motor cooling system by improper cleaning agents! Loss of warranty!** – The only liquids or materials allowed for cleaning and motor cooling are liquids which do not corrode the motor cooling system and do not react aggressively to the materials used in Bosch Rexroth motors. – Refer to the instructions of the manufacturers of the cleaning agent and the cooling system.

8.7.3 Coolant additives

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

Table 67: Coolant additives

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

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

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

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

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

Coolant additives of NALCO Deutschland GmbH (example):

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

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

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

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

8.7.4 Materials used

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

Table 68: Materials coming into contact with the coolant

Frame size MST	Cooling jacket	Housing	O-ring
130 ... 531	AlSi5Mg	-	Viton
360 530		AlSi5Mg	

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

8.7.5 Coolant inlet temperature

The motors are designed in compliance with DIN EN 60034-1 for operation at coolant temperatures of +5 ... +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: +5 ... +40 °C

Ambient temperature: +20 °C

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

Example 2:

Specified temperature range: +5 ... +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 +5 ... +40 °C and should only be max. 5 °C below the existing ambient temperature to avoid condensation.

8.7.6 Dimensioning the cooling circuit

General

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

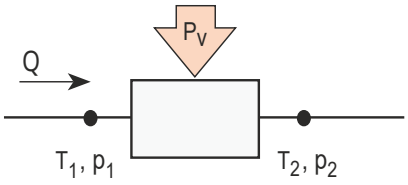


Fig. 244: Liquid-cooled component
Q Flow rate
T_1 Coolant inlet temperature
T_2 Coolant outlet temperature
p_1 Inlet pressure
p_2 Outlet pressure

Coolant temperature rise

$$\Delta T = T_2 - T_1$$

Fig. 245: Coolant temperature rise in K
ΔT Coolant temperature rise in K
T_2 Coolant outlet temperature in K
T_1 Coolant inlet temperature in K

Pressure drop

$$\Delta p = p_1 - p_2$$

Fig. 246: Pressure drop via flown through component
Δp Pressure drop
p_1 Inlet pressure
p_2 Outlet pressure

Flow rate

Coolant flow for compliance with the specified motor torque

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

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

The required coolant flow at deviating temperature increase and/or non-water coolants is determined according to Fig. 247 and ➥ Tab. 69:

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

Fig. 247: Coolant flow required for removing power loss.

Q Rated coolant flow in l/min
P_V Amount of power to be dissipated in W
c Specific heat capacity of the coolant in J / kg · K
ρ Density of the coolant in kg/m³
ΔT Coolant temperature rise in K

Table 69: Substance values of different coolants at 20°C

Coolants	Specific heat capacity c in J / kg · K	Density ρ in kg/m³
Water	4183	998.3
Thermal oil (example)	1,000	887
Air	1007	1.188

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

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

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

Fig. 248: Reduced motor torque with non-water coolant at identical flow rate

k_{cred} Motor torque reduction factor referred to water in percent
c_w Specific heat capacity of water in J / kg · K
ρ_w Density of water in kg/m³
c_x Specific heat capacity of the applied coolant in J / kg · K
ρ_x Density of the used coolant in kg/m³

Pressure drop

The flow resistance at the pipe walls, deflections and changes in cross section leads to a pressure drop in the flown through component (see Fig. 246).

The pressure drop Δp is increased with an increase in flow rate (see Fig. 249).

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

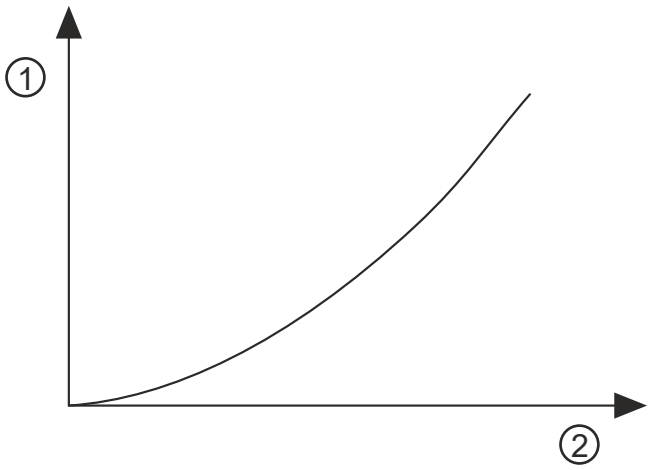


Fig. 249: Pressure drop depending on the flow rate; general representation
① Pressure drop Δp
② Flow rate Q

Cooling system principle

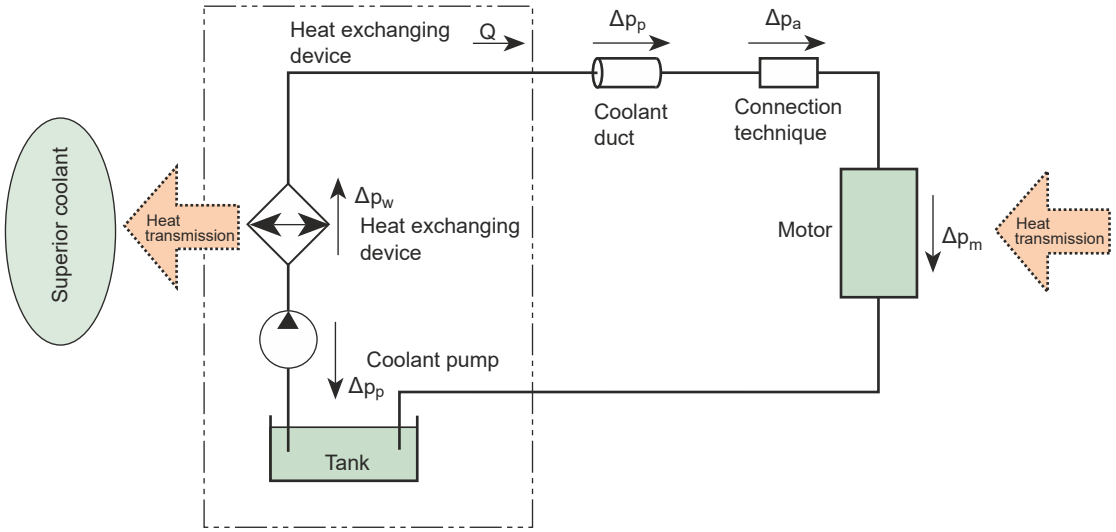


Fig. 250: General arrangement of a liquid cooled motor with heat removal facility

8.7.7 Liquid cooling system

General

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

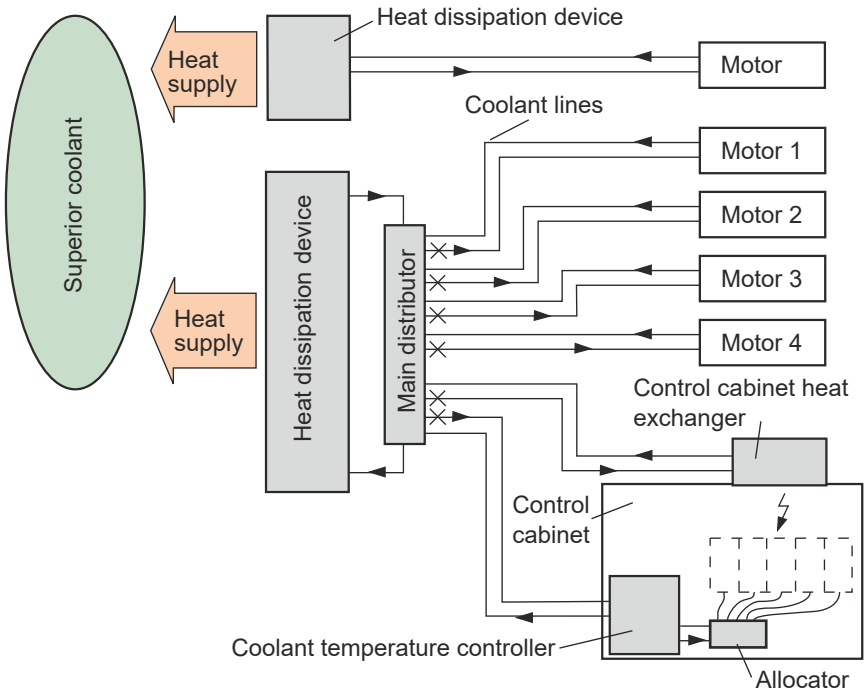


Fig. 251: General arrangement of cooling systems with one and more drive components

Heat dissipation device

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

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

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

A heat dissipation device includes a heat exchanger, a coolant pump and a coolant container (see Fig. 252).

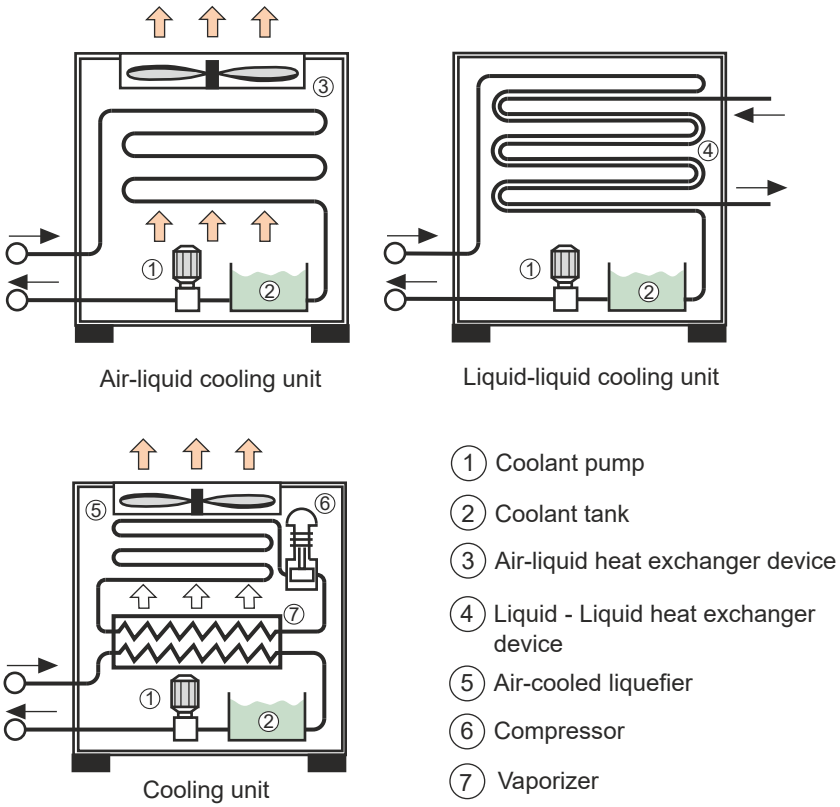


Fig. 252: Heat dissipation devices

Table 70: Overview of the heat dissipation deviceaccording to utilization criteria

	Air-to-liquid Cooling unit	Liquid-to-liquid cooling unit	Cooling unit
Coolant temperature control accuracy	Low (±5 K)	Low (±5 K)	Good (±1 K)
Superordinate coolant circuit required	No	Yes	No
Heating of ambient air	Yes	No	Yes
Power loss recovery	No	Yes	No
Size of the cooling unit	Small	Small	Large
Depending on ambient temperature	Yes	No	No
Environment-damaging coolant	No	No	Yes
Notes on operational criteria	Particularly suitable for stand-alone machines that do not have a superordinate coolant circuit and which do not have to fulfill high requirements on the stability of the coolant temperature.	This cooling type is particularly suitable for systems with existing central feedback cooler. It does not fulfill high requirements on the stability of the coolant temperature.	Particularly suitable for high requirements on the thermal stability e.g. for high-precision applications.

Coolant lines

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

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

Further optional components

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

Circuit types

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

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

Parallel connection

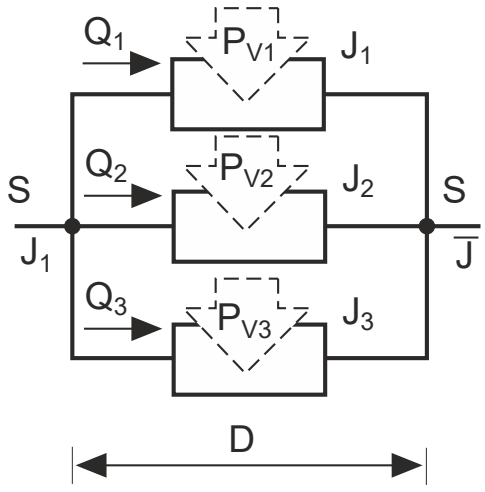


Fig. 253: Parallel connection of liquid-cooled drive components

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.

$$Q = Q1 + Q2 + ... + Q_n$$

$$\Delta p = \Delta p1 = \Delta p2 = \Delta pn$$

Fig. 254: Pressure drop and flow rate in the parallel connection of hydraulic components
Δp Pressure drop
Q Flow rate

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

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

Series connection

$$\vartheta < \vartheta_1 < \vartheta_2 < \vartheta_3$$

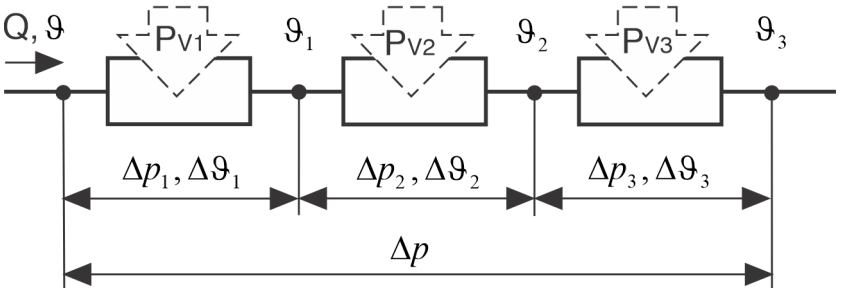


Fig. 255: Series connection of liquid-cooled drive components

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

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

$$Q = Q_1 = Q_2 = Q_n$$

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

Fig. 256: Pressure drop and flow rate in series connection of hydraulic components
Δp Pressure drop
Q Flow rate

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

- The required system pressure corresponds to the sum of all pressure drops of the individual components. This means a reduced hydraulic operational safety due to a high system pressure.
- The temperature level of the coolant 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.

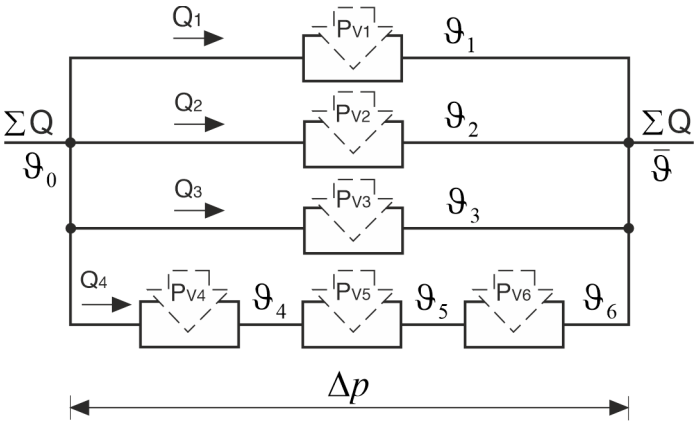


Fig. 257: Combination of series and parallel connection

8.8 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.

8.9 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.

8.10 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 so that reliable thermal monitoring of the motor is possible in every operation phase. These temperature sensors (referred to as motor protection temperature sensor below) have a switching characteristic (seeFig. 258) and are evaluated at all Rexroth drive controllers.

Furthermore all stators feature an additional temperature sensor for temperature measurement. This sensor (temperature measurement sensor) has a nearly linear characteristic curve (see Fig.). 259).

Temperature sensor for motor protection

Table 71: Reference values temperature sensor SNM.150.DK

Type	PTC SNM.150.DK.***
Rated response temperature ϑ_{NAT}	150 °C
Resistance at 25 °C	≈ 100 ... 250 ohm

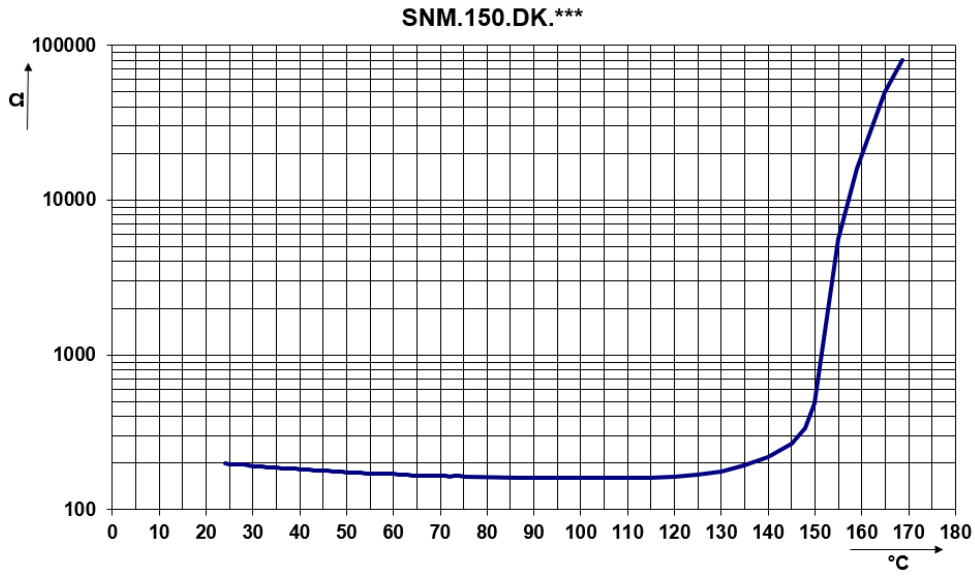


Fig. 258: Charakteristik SNM.150.DK

Temperature sensor for temperature measuring

Table 72: Reference values temperature sensor KTY84-130

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

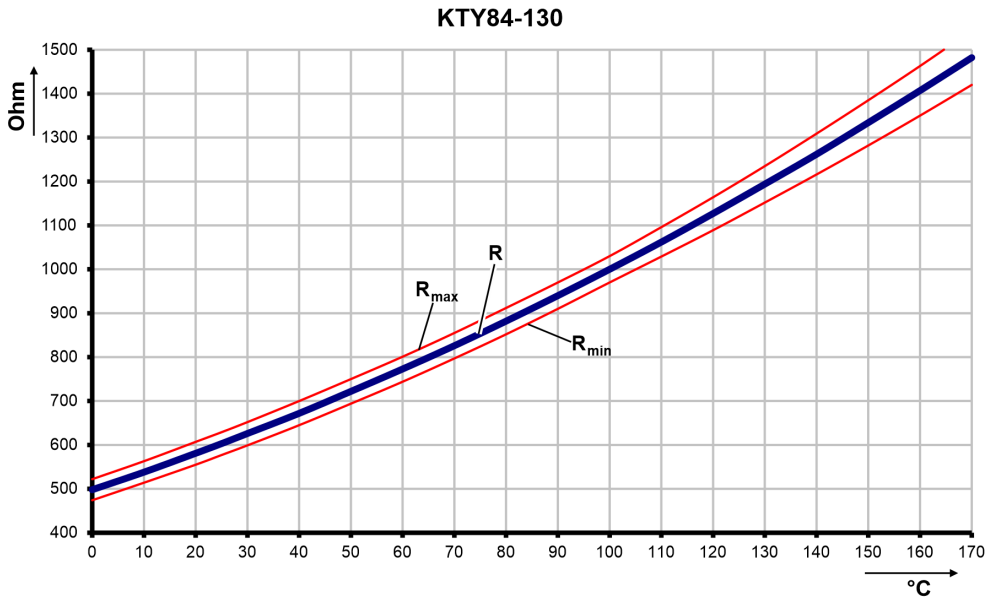


Fig. 259: Characteristic temperature sensor KTY84-130

KTY84-130 is an ESD sensitive device! For this reason, the stranded wires of the sensor are protected by a protective foil at the connection cable. Before connecting the sensor, take measures regarding ESD protection.(ESD = electrostatic discharge).

Protection from thermal overload during standstill operation

If the motor is to be operated at standstill or near standstill, special conditions apply. For means of simplification, this operation is indicated as standstill operation in the following. The standstill operation is marked by one of 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 will overheat and thermally damaged. 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

$$P_V = 1{,}5 \cdot I^2 \cdot R_{12} \cdot (1 + \Delta\vartheta \cdot \alpha_{Cu})$$

Fig. 260: Power loss coil

$\Delta\theta$ Temperature difference between operation temperature and 20 °C

α_{Cu} Temperature coefficient of the specific resistance of copper = 0.0039 Ohm * m / mm²

For the nominal current, a double power loss occurs in the affected coil.

Differentiate the following cases:

1. Use tripple sensor SNM.150.DK

If the SNM.150.DK drilling sensor is 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.

8.11 Attachment

8.11.1 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. 261).

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.

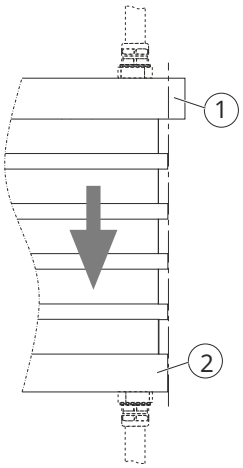


Fig. 261: Example: Stator assembly
① Side with larger outside diameter (enhanced representation)
② Side with smaller outside diameter

- 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. 11.2.

8.11.2 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.

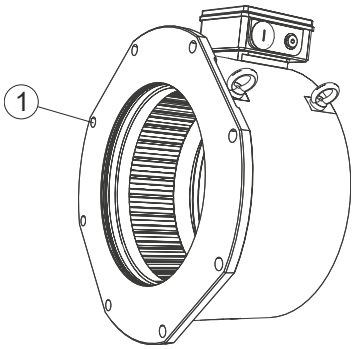


Fig. 262: Illustration example MST360 with housing
① Mounting holes (8 pieces) for flange mounting, example of MST360 with housing

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 ➥ Chapter . 3.16.
- For more information on assembly of motors with cooling jacket and housing, please refer to ➥ Chapter. 11.5.

8.11.3 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.

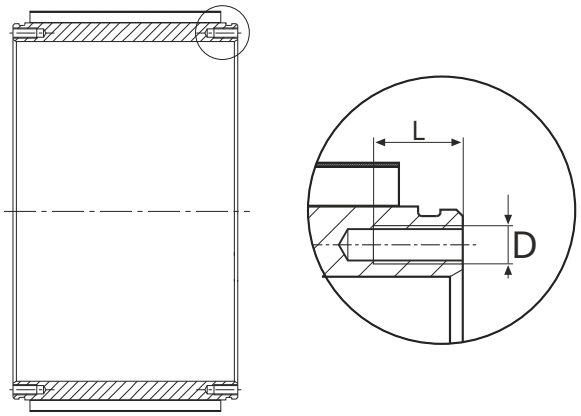


Fig. 263: Rotor attachment
(L) Screw-in depth
(D) Thread diameter

- 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.
- You will find further notes about rotor assembly under➥ Chapter 11.2 Mechanical assembly on page 308.

8.12 Third-party components

8.12.1 Motor encoder

General information

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

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

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

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

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

Selection

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

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

Measuring principle

Absolute encoder

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

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

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

Incremental encoder

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

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

Source of supply motor encoder

Suppliers for encoder systems include:

Table 73: Motor encoder suppliers

Components	Supplier
Angle measuring instruments ER....	**DR. JOHANNES HEIDENHAIN GmbH** Dr.-Johannes-Heidenhain-Strasse 5 83301 Traunreut, Germany Tel.: +49 (0) 86 69 31 – 0 Fax: +49 (0) 86 69 50 61 Internet: ➦ https://www.heidenhain.de

Components	Supplier
Angle measuring systems RESR	**RENISHAW GmbH** Karl-Benz Strasse 12 72124 Pliezhausen, Germany Tel.: +49 (0) 71 27 / 98 10 Fax: +49 (0) 71 27 / 88 23 7 Internet: ➦https://www.renishaw.de
Gear wheel encoder GEL....	**Lenord, Bauer &Co.GmbH** Dohlenstraße 32 46145 Oberhausen, Germany Tel.: +49 (0) 208 / 9963 – 0 Fax: +49 (0) 208 / 6762 – 92 Internet: ➦https://www.lenord.de

8.12.2 Bearing

Selection

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

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

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

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

Suppliers for bearings include:

Table 74: Motor bearing suppliers

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

Components	Supplier
Bearings	**NTN Wälzlager GmbH** Max-Planck-Straße 23 40699 Erkrath, Germany Tel.:+49 (0)-211-2508-0 Fax: +49 (0)-211-2508-400 Internet: ➦ www.ntn-snr.com

9 Motor dimensioning

9.1 General procedure

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

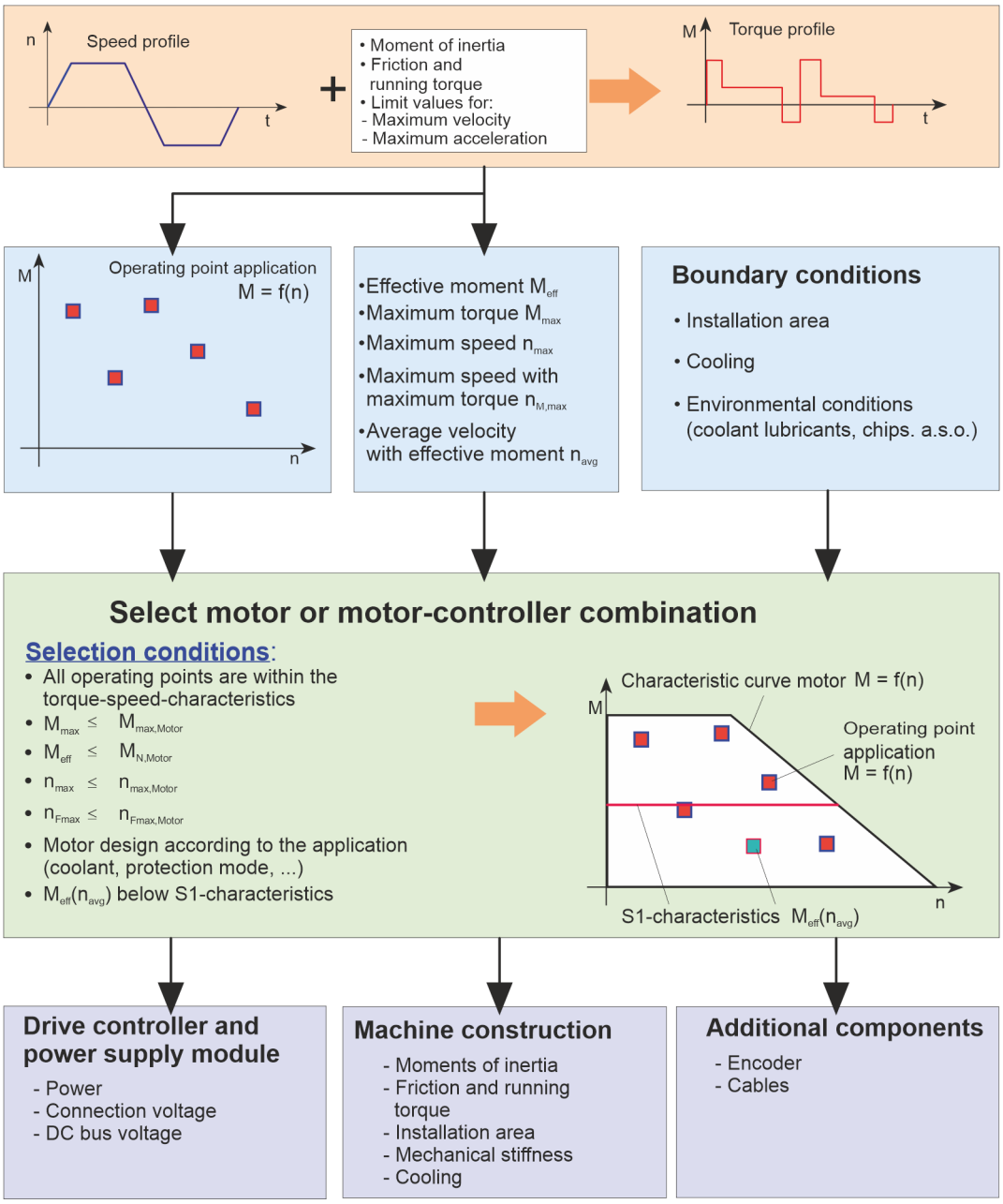


Fig. 264: Sequence of torque drive dimensioning

9.2 Basic formulae

9.2.1 General movement equations

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

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

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

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

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

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

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

Fig. 265: General equations of motion

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

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

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

9.2.2 Torques

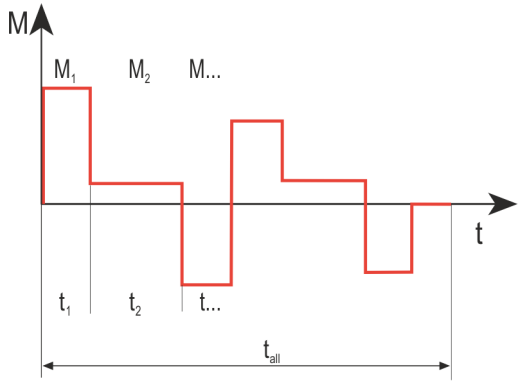


Fig. 266: Determining torques

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

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

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

Fig. 267: Determining torques

M_{acc} Acceleration torque in N
M_F Friction and running torque
M_{max} Maximum torque in N
M_{eff} Effective force in N
a Acceleration in m/s²
J_{rot} Moment of inertia of rotor
t_{all} Total duty cycle time in s

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

9.2.3 Mean speed

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

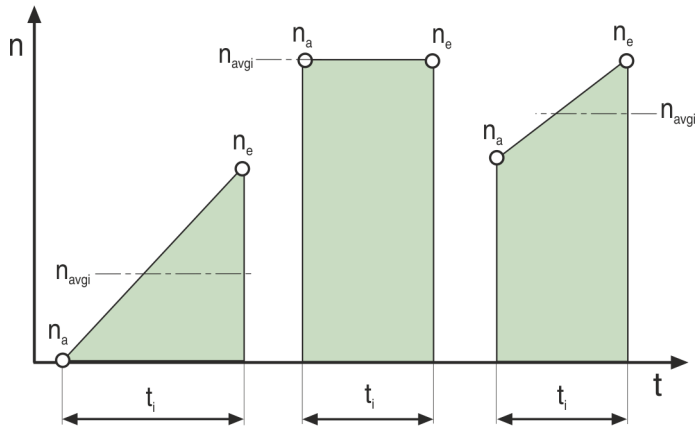


Fig. 268: Triangular or trapezoidal velocity profile

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

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

Fig. 269: Determining the mean speed of triangular or trapezoidal speed profiles

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

9.2.4 Trapezoidal speed

General

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

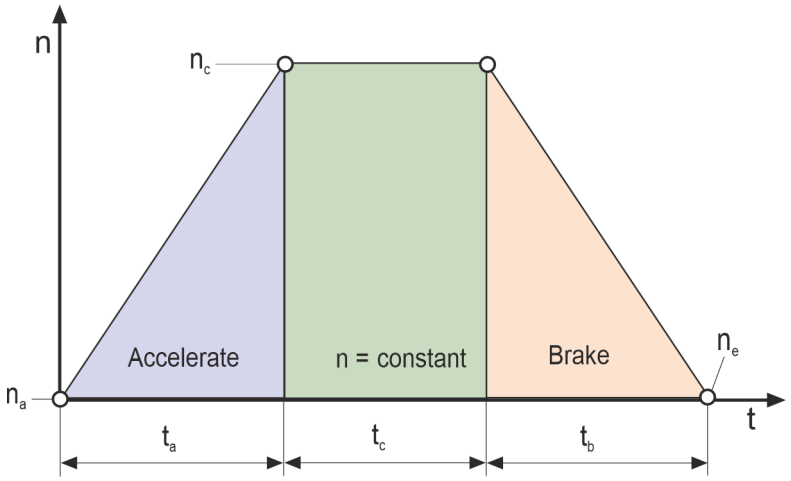


Fig. 270: Trapezoidal speed profile

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

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

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

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

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

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

Fig. 271: Uniformly accelerated motion, initial speed = 0 (for trapezoidal speed profile)

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

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

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

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

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

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

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

Fig. 272: Uniformly accelerated motion, initial speed ≠ 0 (for trapezoidal speed profile)

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

Constant speed

- Speed n = constant
- Acceleration a = 0

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

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

$$\varphi_c = n_c \times t_c$$

Fig. 273: Constant speed (for trapezoidal speed profile)
n_c Constant speed in min^{-1}
t_c Time during constant speed in s
φ_c Phase during constant speed in ° (' ")

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

- Speed n ≠ constant
- Final speed n_e = 0 min^{-1}
- Acceleration a = constant and negative

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

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

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

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

Fig. 274: Constantly decelerated motion, final speed = 0 (for trapezoidal speed profile)
a Acceleration in m/s^2
v_c Final speed in min^{-1}
t_b Braking time in s
φ Phase during deceleration in ° (' ")

Decelerate, final speed ≠ 0 min^{-1}

- Speed n ≠ constant
- Final speed n_e ≠ 0 min^{-1}
- Acceleration a = constant and negative

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

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

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

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

Fig. 275: Constantly decelerated motion, final speed ≠ 0 min^{-1} (for trapezoidal speed profile)

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 ° (' ")

9.2.5 Triangular speed

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

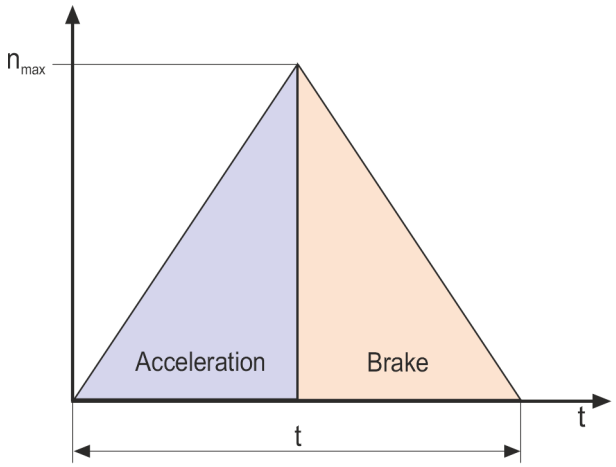


Fig. 276: Triangular speed profile

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

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

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

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

Fig. 277: Calculation of triangular speed profile
n_{max} Maximum reachable speed in min^{-1}
a Acceleration in m/s^2
φ_{all} Total travel path
t Positioning time in s

9.3 Duty cycle and torque

9.3.1 General

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

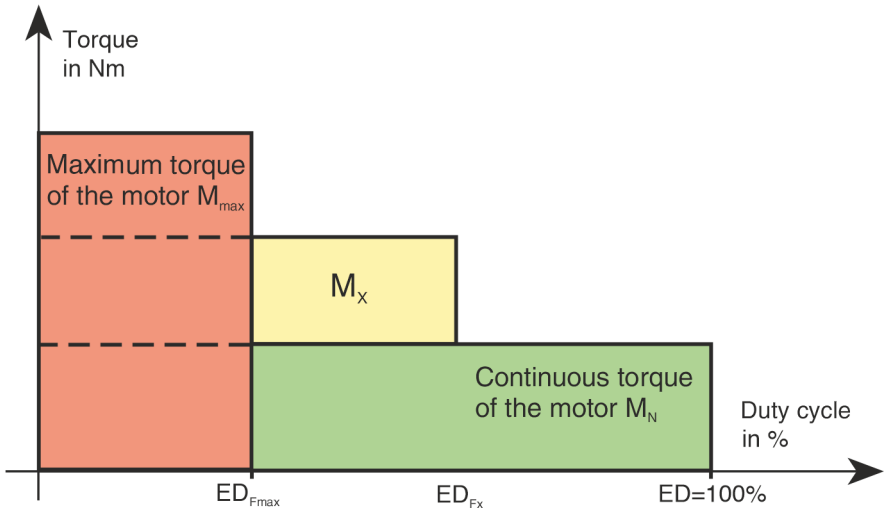


Fig. 278: Correlation between duty cycle and torque.

9.3.2 Determining the duty cycle

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

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

Fig. 279: Approximate determination of duty cycle ED

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

Prerequisites: Linear correlation between torque and current.

For MBT motors acc. to Fig. 279, 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 MBT motors, use Fig. 279 or Fig. 281.

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. 279.

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

Fig. 280: Determining the duty cycle ED

ED_{real} Possible relative duty cycle in %
P_{vN} Maximum heat dissipation of the motor in W (for continuous power loss see➥ Chapter) Technical data)
$P_{AVG\ a}$ Average motor power loss in application over a duty cycle time including idle time in W

Prerequisites: Duty cycle time ≤ Thermal time constant of motor

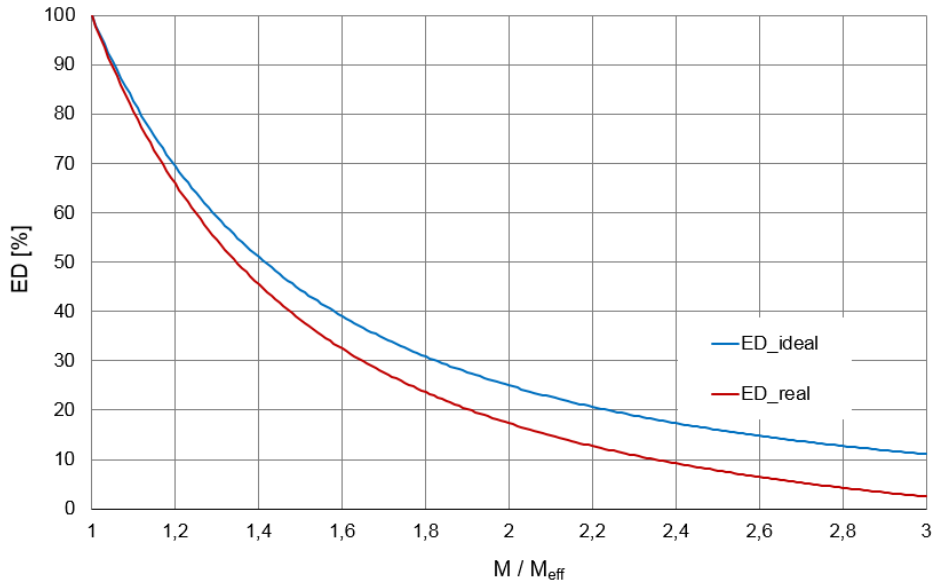


Fig. 281: Duty cycle via force

9.4 Determining the drive power

9.4.1 General

To size the power supply module or the mains connected load, you must determine the rated (continuous) and maximum power of the rotary drive.

Take the corresponding simultaneity factor into account when determine the total power of several drives that are connected to a single power supply module.

9.4.2 Continuous power

The continuous power corresponds to the sum of the mechanical and electrical motor power.

$$Total\ rated\ output: \quad P_c = P_{cm} + P_{ce}$$

$$Mechanical\ rated\ output: P_{cm} = F_{eff} \times v_{avg}$$

$$Rated\ electrical\ output: \quad P_{ce} = \left(\frac{F_{eff}}{F_{dn}}\right)^2 \times P_{vn}\ with\ F_{eff} \leq F_{dn}$$

Fig. 282: Continuous power of the linear motor

P_c Continuous power in W
P_{cm} Mechanical continuous power in W
P_{ce} Electrical continuous power loss of motor in W
F_{eff} Effective force in N (from application)
v_{avg} Average velocity in m/s
F_{dn} Nominal force of the motor in N (see ➦ Chapter) Technical data)
P_{vn} Nominal power loss of the motor in W (see➦ Chapter) Technical data)

When reducing the continuous torque, the electirc continuous poweris also reduced (seeFig.). 282).

9.4.3 Maximum output

The maximum output is also the sum of the mechanical and electrical maximum output. It must be made available to the drive during acceleration and deceleration phase or for very high machining forces, for example.

$$Total\ \max imum\ power: \qquad P_{\max} = P_{\max\, m} + P_{\max\, e}$$

$$Mechanical\ \max imum\ power: \quad P_{\max\, m} = F_{\max} \times v_{F\max}$$

Fig. 283: Maximum power of the linear motor

P_{max} Total maximum power in W
$P_{max\ m}$ Mechanical maximum power in W
$P_{max\ e}$ Electrical maximum power in W (see the following diagram)
F_{max} Maximum feed force in N
v_{Fmax} Maximum velocity with F_{max} in N

When reducing the maximum torque compared to the maximum torque of the motor, the electric maximum power is also reduced $P_{max\ e}$. To determine the reduced electrical maximum output $P_{max\ e}$, use Fig. 284.

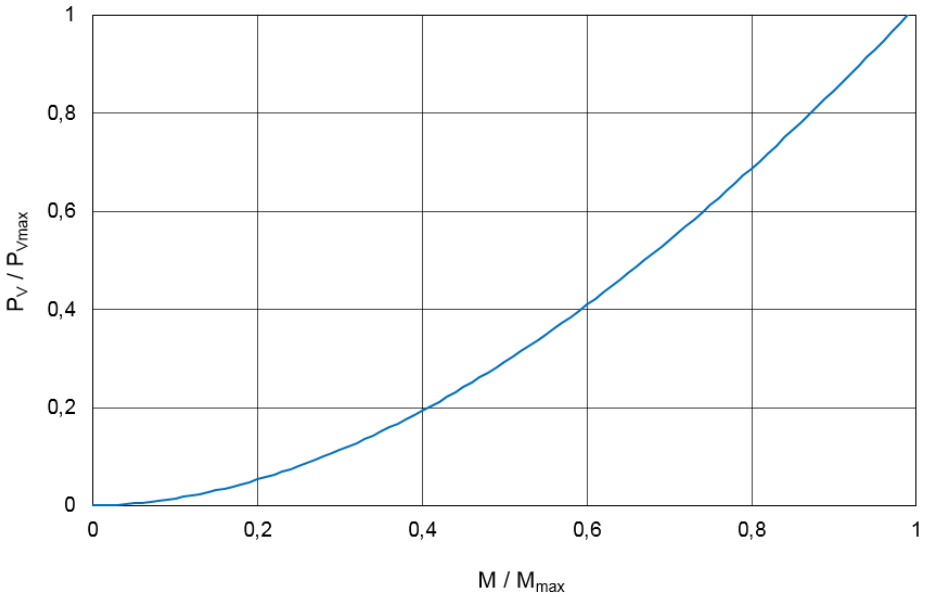


Fig. 284: Diagram used for determining the reduced electrical power loss

M Maximum torque of application in N
M_{max} Maximum torque of the motor in N
P_V Power loss of motor application in W
P_{Vmax} Maximum power loss of the motor in W

9.4.4 Cooling capacity

The necessary cooling capacity corresponds the electric continuous power loss of the motor. In case of increasing speed, the additional losses such as iron losses (hysteresis and eddy current losses) in sheet-metal and solenoids.

$$P_{co} = P_{ce} = \left(\frac{M_{eff}}{M_N} \right)^2 \times P_V$$

$$P_{ce} = P_{Cu} = \frac{3}{2} \times R_{12} \times \left(1 + \Delta\vartheta \times \alpha_{Cu}\right)^2$$

Fig. 285: Required cooling capacity of the motor

P_{co} Required cooling capacity in W
P_{ce} Electrical dissipation (copper loss) of motor in W
M_{eff} Effective force in N
M_N Rated torque of motor in N (see➥ Chapter Technical data)
P_V Power loss of motor in kW (see➥ Chapter Technical data)
P_{Cu} Copper loss
R_{12} Winding resistance at 20 °C (see➥ Chapter Technical data)
$\Delta\vartheta$ Temperature difference between inlet and outlet at the cooling connections of the motor
α_{Cu} Temperature coefficient 0.0039 1/K

The required flow rate to dissipate the cooling capacity of➥ Chapter 9.4.4 Cooling capacity on page 299 for the cooling medium water is calculated from:

$$Q = \frac{P_{co} \times 60}{C_{H2O} \times \Delta\vartheta} = \frac{P_{co} \times 60}{4186{,}8 \frac{J}{kg \times K} \times \Delta\vartheta}$$

Fig. 286: Required flow rate

Q Flow rate due to cooling jacket of motor in l/min
P_{co} Required cooling capacity in W
$\Delta\vartheta$ Temperature difference between inlet and outlet at the cooling connections of the motor

10 Handling, transport and storage

10.1 Delivery condition

10.1.1 General

MBT motors are delivered in wooden crates or cartons.

⚠ 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).

10.1.2 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.

10.1.3 Customer testing

Since all motors are subjected to a standardized test procedure, high-voltage tests by the customer are not necessary. Motors and components could be damaged if they are subjected to repeated high-voltage tests.

⚠ CAUTION	**Destruction of motor components due to improperly executed high-voltage test! Loss of warranty!**
	– Avoid repeated inspections. – Observe the guidelines of DIN EN 60034-1.

10.1.4 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 type plate , 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. Reclaim deviations immediately.

10.2 Transport and storage

10.2.1 General notes

Also refer to the notes regarding storage and transport on the package and accompanying papers.

⚠ WARNING	**The rotor is magnetic! Risk of injury and danger of crushing body parts by magnetic forces!**
	– ⇒ Remove or secure any movable metal objects. – ⇒ Carefully handle all magnetic components.

⚠ CAUTION	**Damage or injuries and loss of the warranty due to improper handling! Heavy weight!** – ⇒ **Strictly comply with all safety and warning notes (see also➥ Chapter 2 Safety instructions on page 20).** – ⇒ Protect the products against moisture and corrosion. – ⇒ Avoid mechanical loads, strokes, throwing, tilting or dropping of the products. – ⇒ Use only suitable lifting gear. – ⇒ To transport the stators with housings, use the mounted eye bolt. – ⇒ Do not lift the motor at its connectors, cables or connection fittings. – ⇒ Use suitable protective equipment and protective clothing during transport. – ⇒ **Transport** the motors horizontally in a dry, vibration-free, dust-free and corrosion-protected condition. – ⇒ **Store** the motors horizontally in a dry, vibration-free, dust-free and corrosion-protected condition.

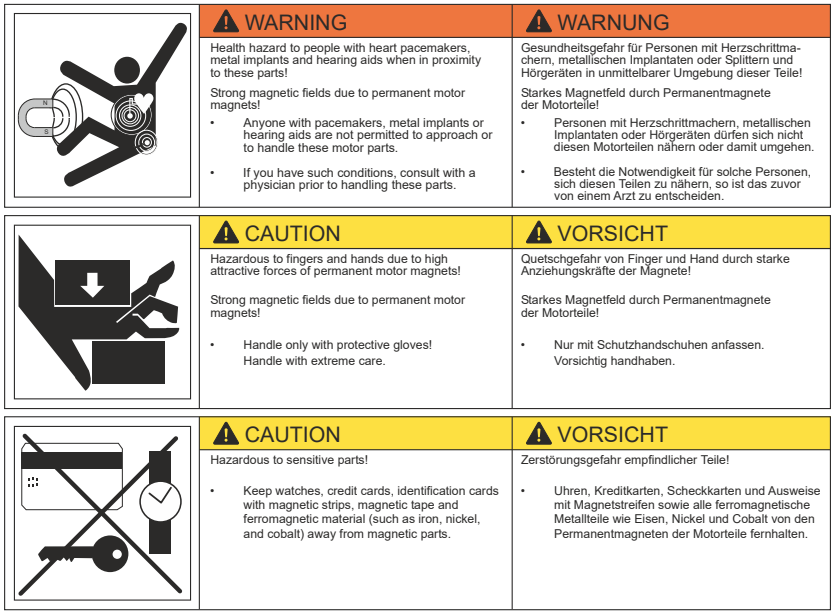


Fig. 287: Warning label on and in the packaging.

The self-adhesive warning label (dimensions approx. 110 mm x 150 mm) can be ordered from Rexroth (MNR R911278745) for the user's own purposes.

10.2.2 Transport instructions

Environmental conditions during transport

Transport our products only in their original package. Also refer to the specific ambient factors to protect the products from transport damage.

Based on EN IEC 60721-3-2:2018, the tables below specify classifications and limit values which are allowed for our products while they are transported by land, sea or air. Refer to the detailed description of the classifications to take all of the factors which are specified in the particular class into account.

Table 75: Allowed classes of environmental conditions during transport according toEN IEC 60721-3-2:2018

Classification type	Class
climatic environmental conditions	2K11
environmental conditions	2B1
chemically active substances	2C1
mechanically active substances	2S5
climatic environmental conditions	2M4

For a better overview, some essential environmental influencing variables of the previously mentioned classifications are listed. Unless otherwise specified, the values given are the values of the particular class. However, Bosch Rexroth reserves the right to adjust these values at any time based on future experiences or changed environmental factors.

Table 76: Permissible ambient conditions deviating from EN IEC 60721-3-2:2018

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) Deviating from EN IEC 60721-3-2:2018		

Before transport, discharge the liquid coolant from liquid-cooled motors to avoid frost damage.

Lifting eyebolts

To lift the motor out of the transport crate or to install it in the machine, use the transport or lifting eyebolts at the motor.

The lifting eyebolts at least meet the requirements of DIN 580. Before each transport, ensure that the lifting eyebolts have been screwed down fully to the contact surface and that your selected lifting equipment and lifting method does not overstress the lifting eyebolts.

Please comply with DIN 580 on the transport of motors using the attached lifting eyebolts. Non-observance of the information in this standard can cause overstress to the lifting eyebolts and result in personal injury and/or product damage.

Transporting stators in the Rexroth housing

Stators which have already been ordered with housing ex factory feature one or two lifting eye bolts on the upper face of the housing (see dimension sheet of the stator), depending on the stator length or size, for transport. These lifting eye bolts also have to be used to lift and position the stators during assembly.

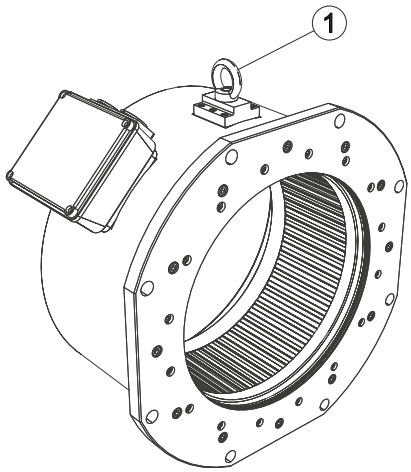


Fig. 288: Lifting eyebolt on MST450E with housing
① Lifting eyebolt for transport

Transporting stators with and without mounting ring

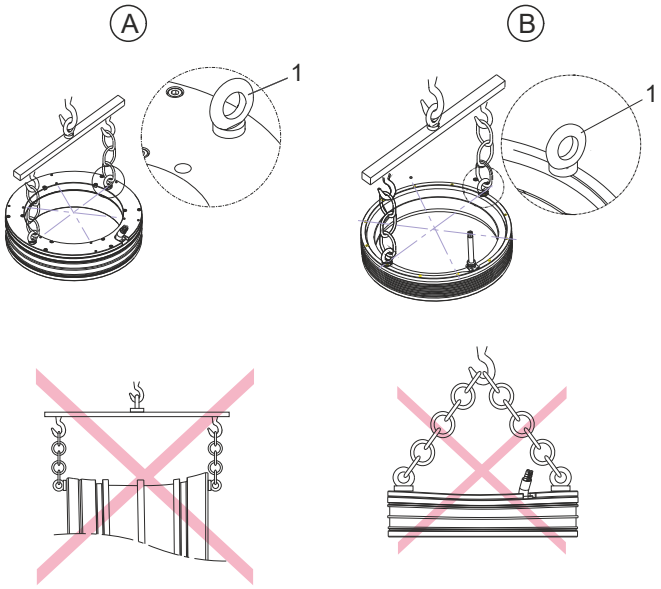


Fig. 289: Transport of the MST stators
Ⓐ Handling with mounting ring
Ⓑ Handling without mounting ring
① Lifting eyebolt for transport

Please note:

- Use only suitable lifting gear.
- Use lifting eye bolts 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 are shipped by air, the DGR (**D**angerous **G**oods **R**egulations) of the IATA (International Air Transport Association) for hazardous materials of class 9 which also include magnetized substances and objects has to be complied with. This involves, for example:

- Secondary parts of synchronous linear motors
- Rotors of synchronous kit motors
- Rotors of synchronous housing motors (if these are dispatched as motor component, i.e. separate from the stator or motor housing, in service cases)

For details on the maximum allowed magnetic field strengths as well as information on measurement methods for these magnetic field strengths, please refer to the current IATA DGR.

10.2.3 Storage instructions

Store the motor only horizontally according to the following figure.

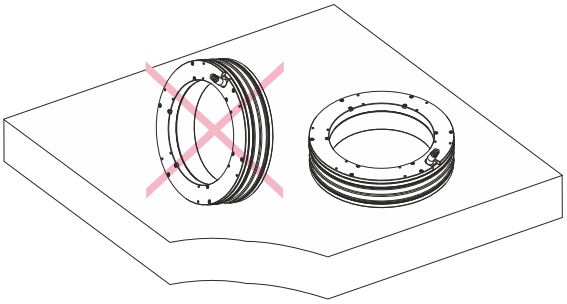


Fig. 290: Storing of motor components

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.

Environmental conditions during storage

NOTICE	**Damage or destruction of motor components due to improperly handling during storage and transport!**
	– Observe the permitted environmental conditions for storage. – Covers fitted to the motor at the factory must remain on the motor during transport and storage.

Generally, Bosch Rexroth recommends storing all components until they are actually installed in the machine as follows:

- at a dry and dustfree location
- at room temperature
- free from vibrations and oscillations
- protected against light or direct sunlight

Based on EN IEC 60721-3-1:2018, the tables below specify classifications and limit values which are allowed for our products while they are stored. Refer to the detailed description of the classifications to take all of the factors which are specified in the particular classification into account.

Table 77: Allowed classes of environmental conditions during storage according to EN IEC 60721-3-1:2018

Classification type	Class
Classification of climatic environmental conditions	1K21
Classification of biological environmental conditions	1B1
Classification of chemically active materials	1C1

Classification type	Class
Classification of mechanically active materials	1S10
Classification of mechanical environmental conditions	1M11

For a better overview, some essential environmental influencing variables of the previously mentioned classifications are listed. Unless otherwise specified, the values given are the values of the particular class. However, Bosch Rexroth reserves the right to adjust these values at any time based on future experiences or changed environmental factors.

Table 78: Permissible ambient conditions deviating from EN IEC 60721-3-1:2018

Environmental factor	Unit	Value
Air temperature	°C	-25 ... +55[1)]
Relative air humidity	%	5 ... 75[1)]
Absolute air humidity	g/m³	1 ... 29[1)]
Direct solar radiation	-	Not permitted
1) Deviating from EN IEC 60721-3-1:2018		

NOTICE

Damage due to moisture and humidity!

- Protect the products from dampness and corrosion.
- Store them only in rainproof and dry rooms.
- Before storage, discharge the liquid coolant from liquid-cooled motors to avoid damage.

Storage times

The maximum storage duration is 2 years.

Storage durations of more than 6 months require conservation measures by the customer. Untreated metallic surfaces (e.g. shaft or flange) must be treated with a preserving agent to protect against corrosion.

Additional measures have to taken upon commissioning to ensure smooth functioning – irrespective of the storage time which may be longer than the warranty period of our products. However, this does not entail any additional warranty claims.

Table 79: Measures to be taken before commissioning motors or motor components in long-term storage

Storage time / months				Measures prior to commissioning
> 1	> 6	> 12	> 24	
●	●	●	●	Visual inspection of all parts to be damage-free
●	●	●	●	Resurface the holding brake [1]
	●	●	●	Check conservation measures. Renew corrision protection if necessary. Remove the preserving agent before commissioning
		●	●	Check the electric contacts to verify that they are free from corrosion
		●	●	Let the motor run in without load for one hour at ~20% of the specified nominal speed [2)]
		●	●	Measure insulation resistance. Dry the winding at a value of < 1kOhm per volt rated voltage.
			●	Function test and product revision if necessary by Bosch Rexroth Service

Storage time / months				Measures prior to commissioning
> 1	> 6	> 12	> 24	
1) Only motors with holding brake are affected				
2) Only motors with roller bearings are affected				

11 Assembly

11.1 Basic precondition

Thorough execution of the described work steps ensures:

- correct and safe mounting and dismounting of the components,
- correct function of the motor.

If there are bearings to the left and to the right of the motor, e.g. also encoders, all bearings have to insulated on one side, e.g. insulation of the stator.

11.1.1 Safety instructions

Strictly observe the listed safety instructions in the following mounting procedure➥ Chapter 2 Safety instructions on page 20 . They support the prevention of accidents and damage at material due to incorrect handling.

⚠ WARNING	Injuries caused by live parts! Lifting of heavy loads! Risk of damage!
	– Carry out all work steps with particular care. This minimizes the risk of accidents and damage. – Use suitable lifting equipment and protective equipment and wear protective clothing during transport. – Do not lift or move the motor at the cable strand. – Install the motors only when they are de-energized and not connected electrically.

The volume and order of the steps described can be affected by special features of the machine construction and deviate from the schematic procedure. The following description only serves for orientation. The machine manufacturer's mounting instructions are the only binding guidelines.

General information

Take the strong magnetic field around the rotor into account. Do not unpack the rotors from the original packaging before they are required for assembly.

Keep the rotor away from ferromagnetic bodies (e.g. tools, workbench made from metal, ...)

Workwear

Wear appropriate protective workwear when mounting such as

- Safety glasses
- Safety gloves

Work space, handling and transport

Sufficiently mark your work space with notes according to Fig. 287 and observe the handling and transport instructions under ➥ Chapter 10 Handling, transport and storage on page 300.

Accident prevention

The accident prevention “Electrical plant and apparatus” (VBG 4) has to be complied with:

Prior to working on shock-hazardous parts of electrical systems, ensure that these parts are de-energized and remain de-energized during the duration of the work. The electrical systems and equipment have to be checked before initial startup by an electrician to ensure that they are in proper condition.

The user is responsible for proper grounding of the complete system. To prevent accidents due to touching of live parts, protective measures against direct and indirect touch are necessary. For notes, refer to DIN VDE 0100, Part 410.

Emergency tools

For removal of magnetically attached objects, have ready emergency tools like wedges (angle 10°-15°) and a hammer made of non-magnetic material.

11.1.2 Screw lock

All screwed connections must be secured against potential impacts and vibrations during operation of the machine. A suitable and field-tested screw lock for all metal thread connections is, e.g., Loctite 243.

Loctite 243 is a liquid screw lock (medium-hard) and is applied to the parts to be mounted immediately prior to assembly. For detailed information on correct handling and processing, please refer to the manufacturer's data sheets under ➦ www.loctite.de. The manufacturer's homepage also provides information on hardening accelerators or other screw locks.

11.2 Mechanical assembly

11.2.1 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. – Carefully handle all magnetic components. – Wear protecting clothes and use installation aids

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 screw connections are to be equipped with a liquid screw lock. See also ➦ Chapter 11.1.2 Screw lock on page 308.

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 are correctly connected, the cooling ducts and the necessary separator are available (see Fig. 291)).

⚠ 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.). 291). If the stator has been commissioned without a separator, insufficient cooling can result in damaging the stator.

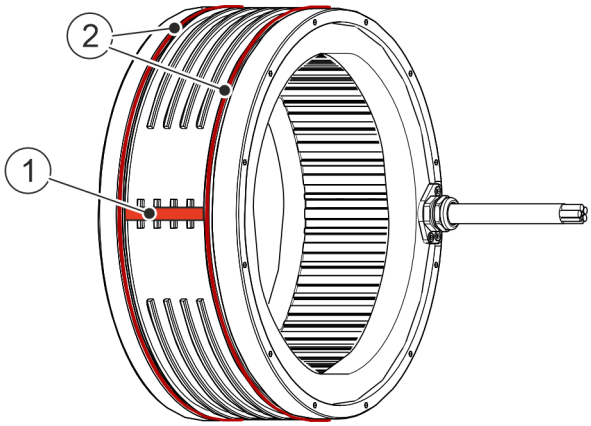


Fig. 291: Glued in separator taking the example ol MST360
① Separator
② O-rings

NOTICE	Damage of stator due to penetrating cooling water (protection mode IP00)! Water, liquids or humidty can lead to a damage and thus to failure of the stator. During installation, make absolutely sure that the O-rings used are in perfect condition, seeFig. 291. It is not recommended to use O-rings more often.

Suitable o-rings for sealing the coolant ducts are supplied with. For information about spare parts refer to ➥Chapter 6.1 O-rings for stators on page 239.

11.2.2 Preparation

Initial state: The motor lies on a clean and a flat surface.

- Check whether the components are damaged. Damaged components must not be mounted.
- 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.
- 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.
- Prior to assembly, clean the contact surfaces of the stators design "...-NS-.." with a suitable cleaning agent (e.g., RIVOLTA A.C.S.3).
- 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.
- 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.

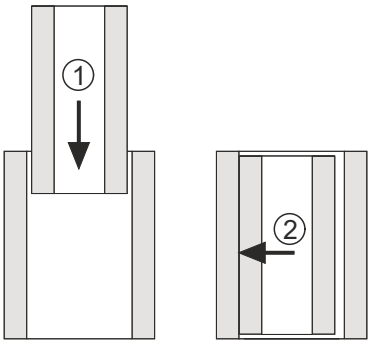


Fig. 292: Attractive forces during mounting
① F_{axial}
② F_{radial}

Table 80: Magnetic attractive forces during mounting

Frame size ...		F_{axial} [N]	F_{radial} [N]
110	A	90	100
130	A	105	120
	C		370
	E		610
	G		850
160	A	145	410
	C		820
	E		1,230
161	C	145	535
	E		1,070
	G		1,105
	M		910
201	C	185	690
	D		1,040
	F		1,740
210	A	195	330
	C		830
	D		1,160
	E		1650
	U		3,630
251	F	250	2460
290	B	290	1,000
	D		1,500
	E		2490
	F		3000
	G		3500
291	C	290	1,250
	D		1870
	E		2490
360	B	370	1,280
	D		1910
	E		3,190

Frame size ...		F_{axial} [N]	F_{radial} [N]
450	B	480	1,660
	D		2,480
	E		4,130
530	B	565	1940
	C		2920
	D		3,890
	E		4,860
	F		5,830
	G		9,710
	L		14,560
	P		6,800
	R		8,750
531	E	565	4,590
	L		13,770

11.3 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 ➥ Chapter 11.1.2.

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.

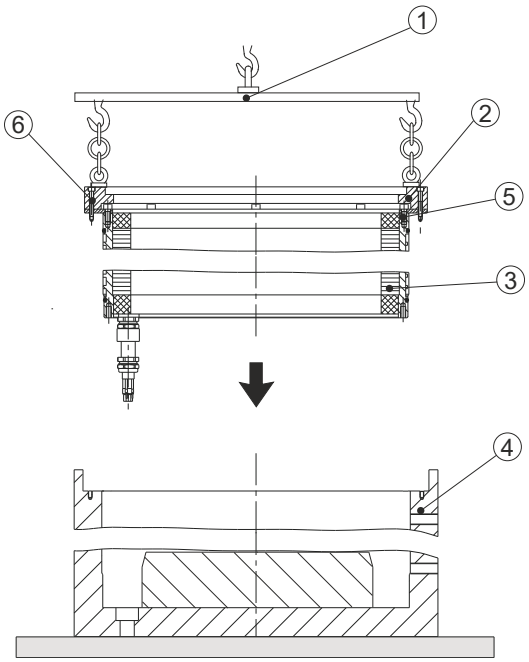


Fig. 293: Stator installation
① Lifting gear
② Stator flange
③ Stator
④ Machine housing
⑤ Mounting screws for stator flange
⑥ Mounting screws for stator flange - machine housing

2. Center the stator with a suitable tool ① in the machine housing ④ and bring it into its final position without jam.
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.

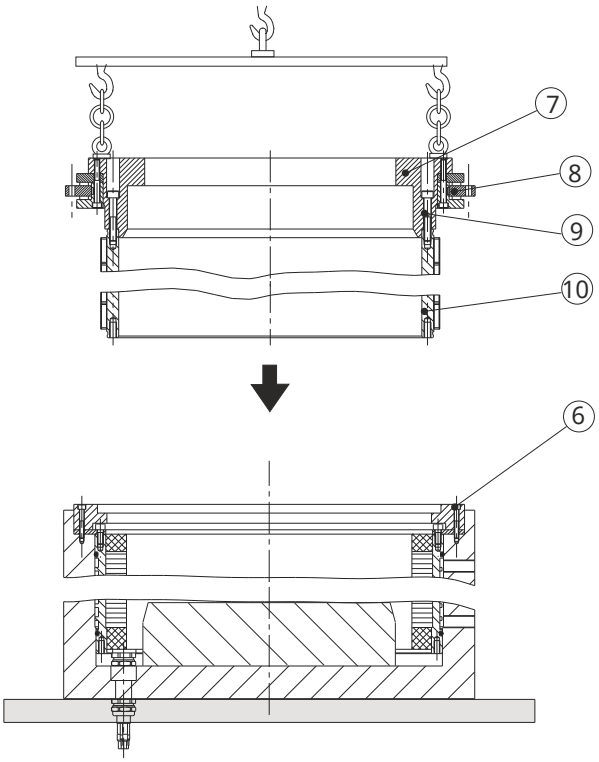


Fig. 294: Rotor installation

⑥ Mounting screws for stator flange - machine housing
⑦ Rotor flange
⑧ Axial radial bearing
⑨ Rotor mounting screws
⑩ Rotor

7. Insert the rotor package centered (make forced guidance) into the stator until it reaches its final position.

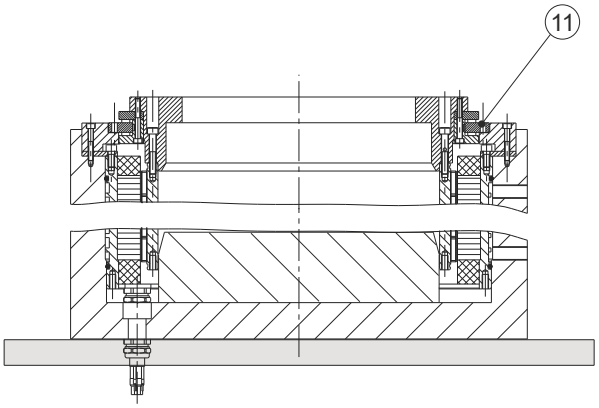


Fig. 295: MBT installation

⑪ Bearing mounting screws

8. Fasten the bearing ring with the fastening screws ⑪ to the stator flange.
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.

11.4 Mounting stators with cooling jacket and mounting ring (option)

- 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 6.2 Mounting ring on page 240.
- All screw connections are to be equipped with a liquid screw lock. See also ➥ Chapter 11.1.2 Screw lock on page 308.

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:

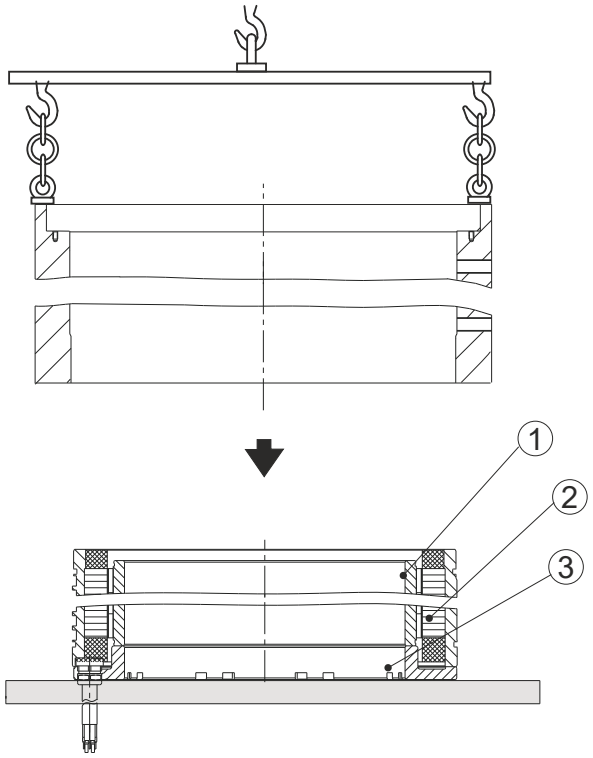


Fig. 296: Mounting the stator-rotor package
① Rotor
② Stator
③ Mounting ring

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.

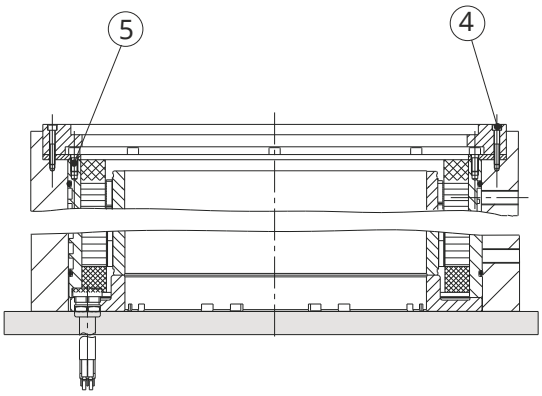


Fig. 297: Mounting the stator flange
④ Mounting screws for stator flange - machine housing
⑤ Mounting screws for stator flange - stator

2. Fasten the stator flange to the stator and also to the machine housing using the mounting screws ④ and ⑤.

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.

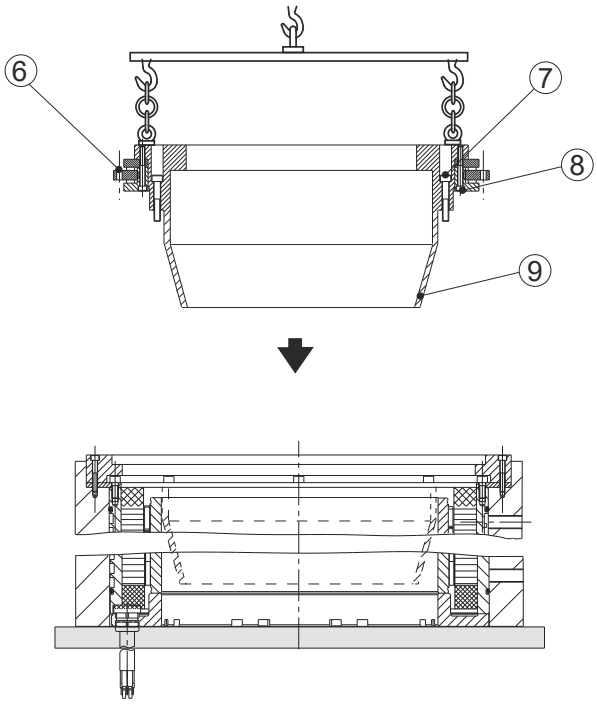


Fig. 298: Mounting the rotor flange with bearing
⑥ Bearing ring mounting holes
⑦ Rotor flange mounting screws
⑧ Rotor bearing ring mounting screws
⑨ Centering collar

5. Loosen the mounting screws of the mounting ring on the stator (**not on the rotor**). Do not unscrew them completely yet.

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.

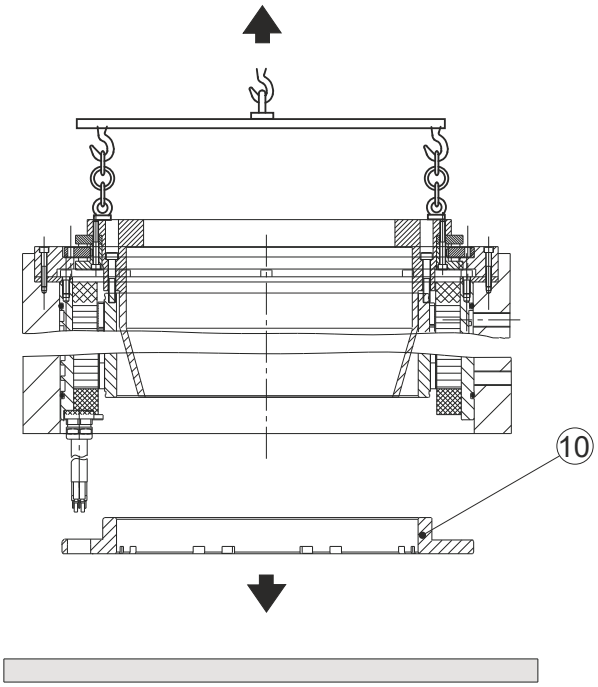


Fig. 299: Disassembling the mounting ring
⑩ Mounting ring

8. Loosen and remove all mounting screws from the mounting ring ⑩ and remove it.
9. Check the accuracy and stability of all mounted parts and mechanical connections.

After proper mechanical assembly, continue with the other connections.

11.5 Mounting stators with cooling jacket and housing

11.5.1 General

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 screw connections are to be equipped with a liquid screw lock. See also ➥ Chapter 11.1.2 Screw lock on page 308.

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 ➦ 4 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:

- Mount the stator to the machine.
- Connect rotor and spacer sleeve to the clamping plate.
- Position the rotor with spacer sleeve on the shaft and fasten it with a clamping ring.
- Attach the motor encoder.
- Mount the housing lid and the encoder cover.
- Make the electrical connection and the coolant connection.

11.5.2 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) have to be dimensioned taking the bending of the shaft into account, the air gap S_2 (see ➦ Tab. 81) never falls below the minimum value after installation between rotor and stator.

Table 81: Radially acting magnetic forces during operation

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
161M		270
201C		280
201D		410
201F		615
210A		170

MRT...	Air gap s_2 min [mm] (rotor and stator mounted)	Radial force $F_{radial, operation}$ [N]
210C		420
210D		580
210E		830
210U		1870
251 F		1,380
290B		500
290D		750
290E		1,250
290 F		1,500
290G		1,750
291C		530
291D		800
291E		1,060
360B		540
360D		800
360E		1,330
450B	0.30	770
450D		1,150
450E		1910
530B	0.35	910
530C		1,360
530D		1820
530E		2,270
530F		2730
530G		4,560
530L		6,840
530P		3,180
530R		4090
531E		1960
531L		5,860

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 ➥ Chapter). 11.2).

11.5.3 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 screw connections are to be equipped with a liquid screw lock. Refer to ➦Chapter 11.1.2 Screw lock on page 308.
- 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.

Mounting the stator

1. **Ensure cleanliness during all working steps!**
   Refer to the instruction on how to prepare mounting in ➦Chapter. 11.2.

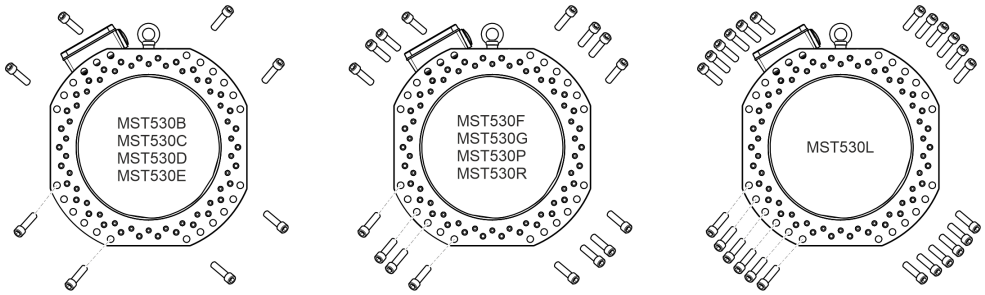


Fig. 300: MST530 Housing fastening

2. Lift and position the stator on the machine via suitable lifting tools and the lifting eye bolt on the stator housing.
   ℹ Avoid...
   - jamming or clamping the housing while mounting it to the machine,
   - damaging the centering collar on the housing and the machine.

   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.

   ℹ 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 82).

3. Check the correct position of the stator and tighten all mounting screws crosswise to the required tightening torque.

   Table 82: Mounting screws with tightening torque

Screws (property class 8.8)	M_{GA} [Nm] at μ_G 0.12
M16 x ...	206
M20 x ...	415
MGA - Tightening torque in Newton meters µG - Friction coefficient	

11.5.4 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.
- Carefully handle all magnetic components.
- 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,
- min. screw-in depth and screw-dependent tightening torques.

- The screw length required depends on the machine construction.
- The screw 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 screw connections are to be equipped with a liquid screw lock. Refer to ➥Chapter 11.1.2 Screw lock on page 308.

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 ➥Chapter) are guided on the spacer sleeve.

   Connect the rotor to a mounting tool for inserting the rotor into the stator (for example see ➥Chapter).

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 details about occurring radial forces in➥ Chapter. 11.2.2.

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.

11.6 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:

- Mount the motor encoder to the shaft.
- Close the motor housing and the encoder installation space with the provided covers.
- Make the electric connection and the coolant connection according to Chapter 7 Connection technique on page 247.

11.7 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 stranded wires might require longer distances between two motors. Also refer to the instructions in Chapter 7.2.2 Connecting the stators on page 247.

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.

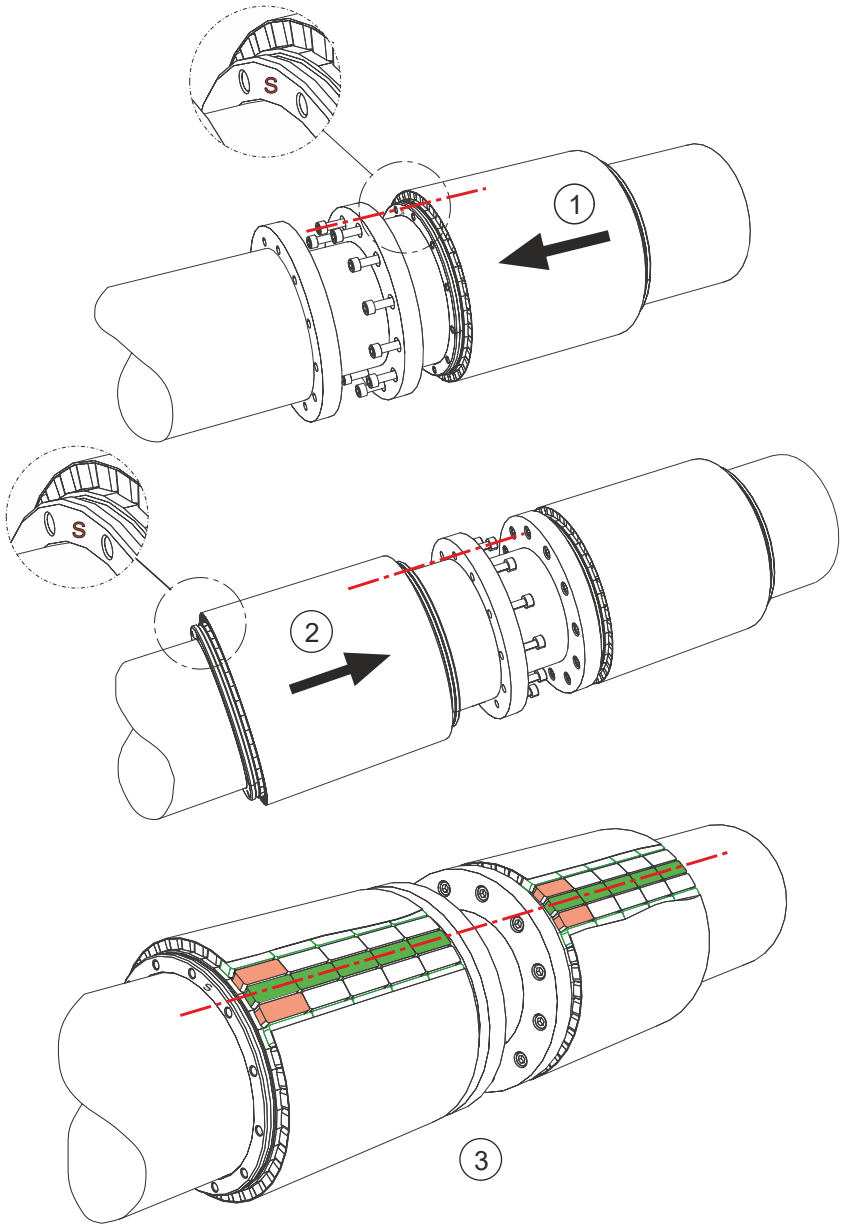


Fig. 301: Mounting the rotor with parallel motor arrangement
① Mount the first rotor (transfer "S" mark to machine)
② Mount the second rotor (align "S" mark according to "S" position of first rotor)
③ Correct assembly = aligned pole rows of the magnets

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. 302 and Fig.. 303).

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 ➦Tab. 83.

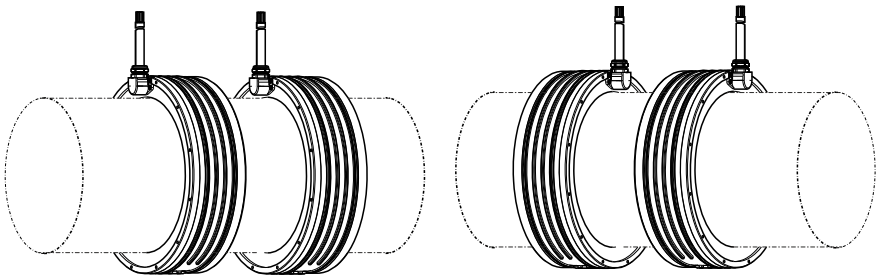


Fig. 302: Parallel motor arrangement (cable outlet in the same direction)

Table 83: Connecting the power wires in case of parallel arrangement of stators with equal cable outlet direction on a drive controller

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)

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. 84.

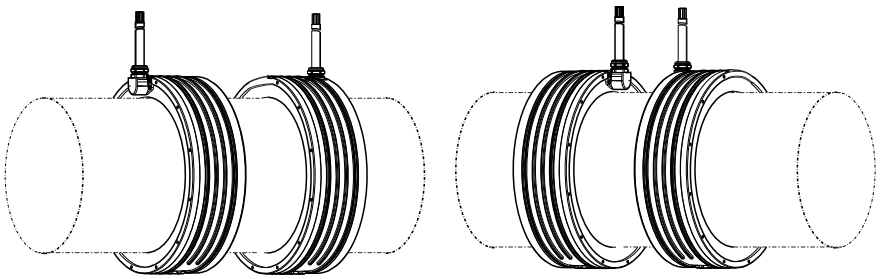


Fig. 303: Parallel motor arrangement (cable outlet in opposite directions)

Table 84: Connection of the power wires in case of parallel arrangement of primary parts on a drive controller

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)**

11.8 Coolant connection

Establish the connection of the coolant supply for the motor according to ➦ Chapter 7.5.1 Coolant connection on page 265 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.

11.9 Electrical connection

Connect the motor electrically according to the connection diagrams and the instructions in ➦ Chapter 7 Connection technique on page 247. Refer to the references to supplementary documentation.

- When using self-manufactured cables, ensure EMC-compliant design and installation.
- Where applicable, ensure that connectors and lines are fastened for strain relief purposes.
- The connection diagrams of the product documentation serve to create system circuit diagrams. Only the machine manufacturer's system wiring diagrams are relevant for the connection of the drive components in the machine.

11.10 Mounting examples

11.10.1 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

11.10.2 Mounting examples MBT130

Rotor MRT130, mounted

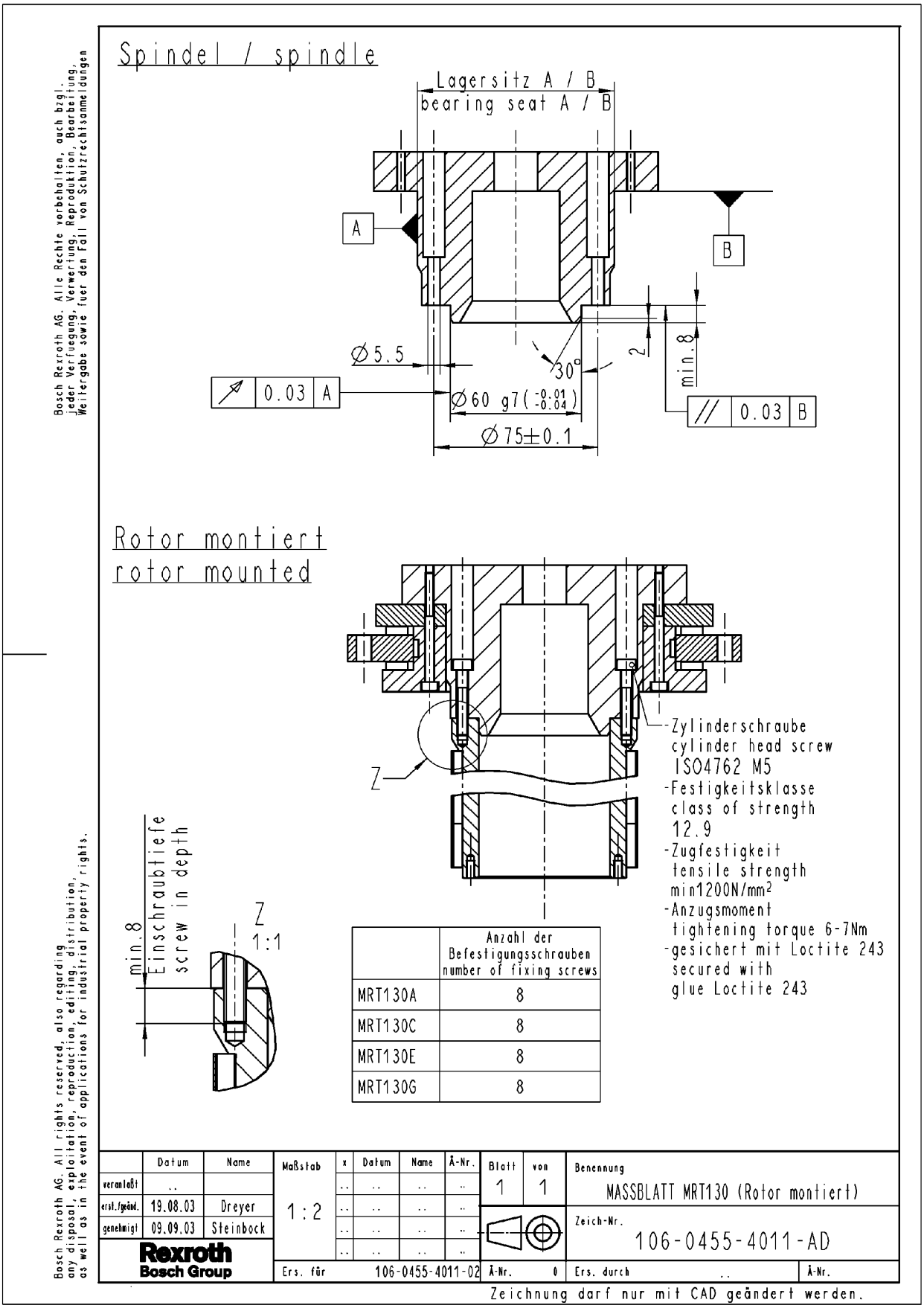
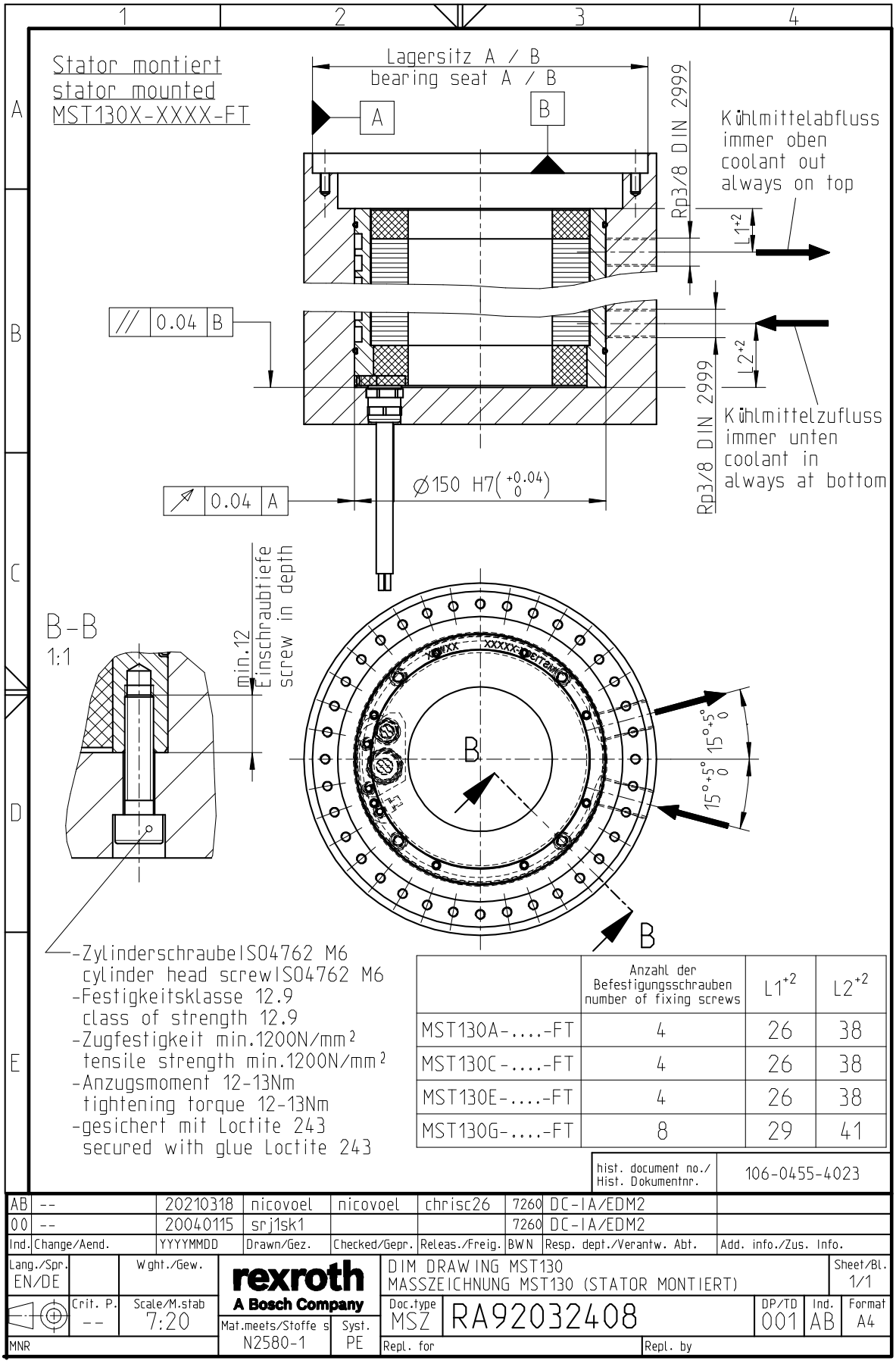


Fig. 304: Rotor MRT130, mounted

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

hist. document no./ Hist. Dokumentnr.: 106-0455-4023

Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.
AB	--	20210318	nicovoel	nicovoel	chrisc26	7260	DC-IA/EDM2	
00	--	20040115	srj1sk1			7260	DC-IA/EDM2	

Lang./Spr.: EN/DE | Wght./Gew. | Crit. P.: -- | Scale/M.stab: 7:20 | Mat.meets/Stoffe s: N2580-1 | Syst.: PE | MNR

rexroth A Bosch Company

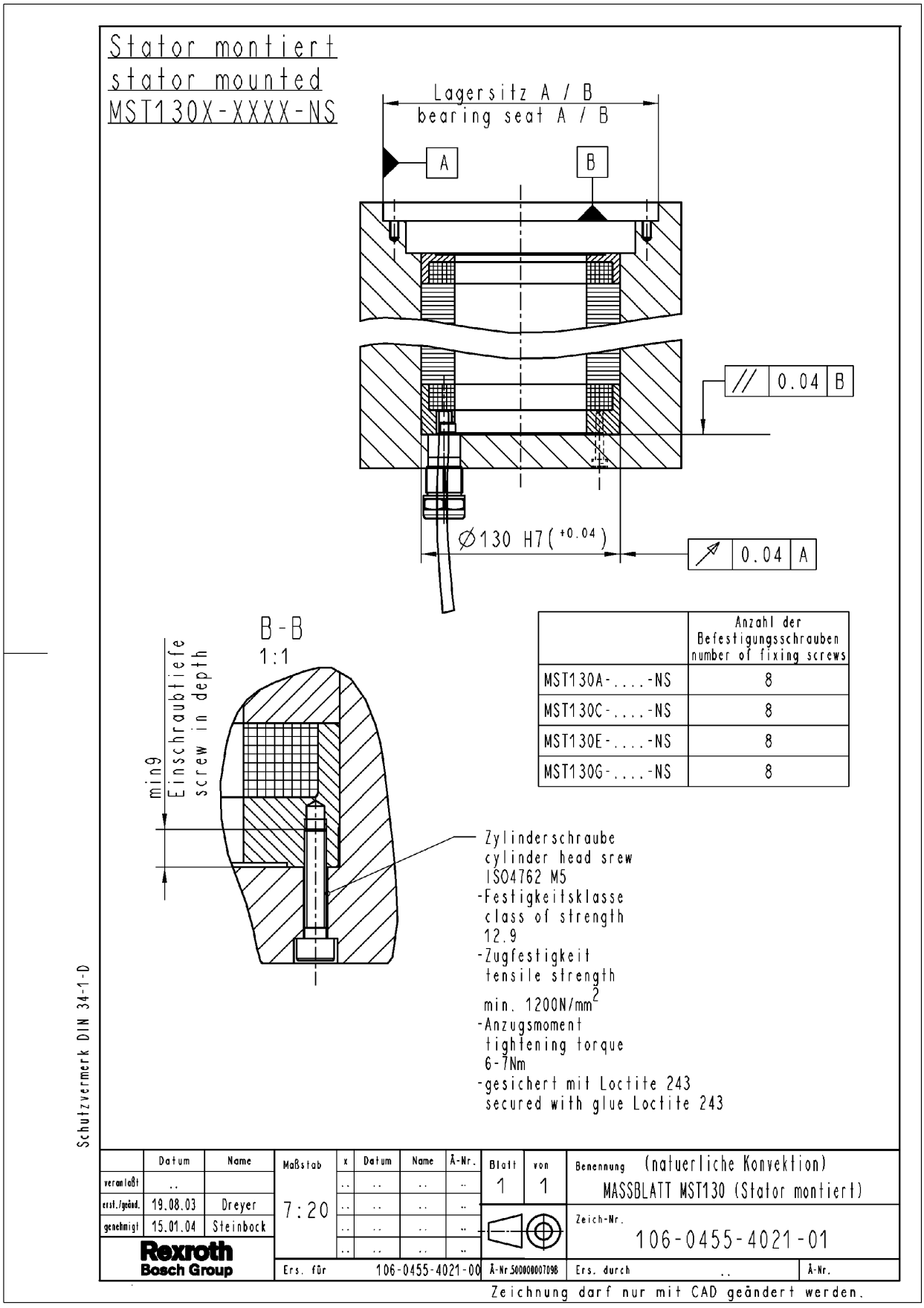
DIM DRAWING MST130
MASSZEICHNUNG MST130 (STATOR MONTIERT)

Doc.type: MSZ | RA92032408 | DP/TD: 001 | Ind.: AB | Format: A4 | Sheet/Bl.: 1/1

Repl. for | Repl. by

Fig. 305: 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

	Datum	Name
veranlaßt	..	
erst./geänd.	19.08.03	Dreyer
genehmigt	15.01.04	Steinbock

Rexroth Bosch Group

Maßstab 7:20

x	Datum	Name	Ä-Nr.
..	..	..	..
..	..	..	..
..	..	..	..
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Blatt 1 von 1

Benennung (natuerliche Konvektion)
MASSBLATT MST130 (Stator montiert)

Zeich-Nr. 106-0455-4021-01

Ers. für 106-0455-4021-00 | Ä-Nr.S0000007098 | Ers. durch .. | Ä-Nr.

Fig. 306: MST130, natural convection, mounted

Rotor and stator, natural convection, mounted

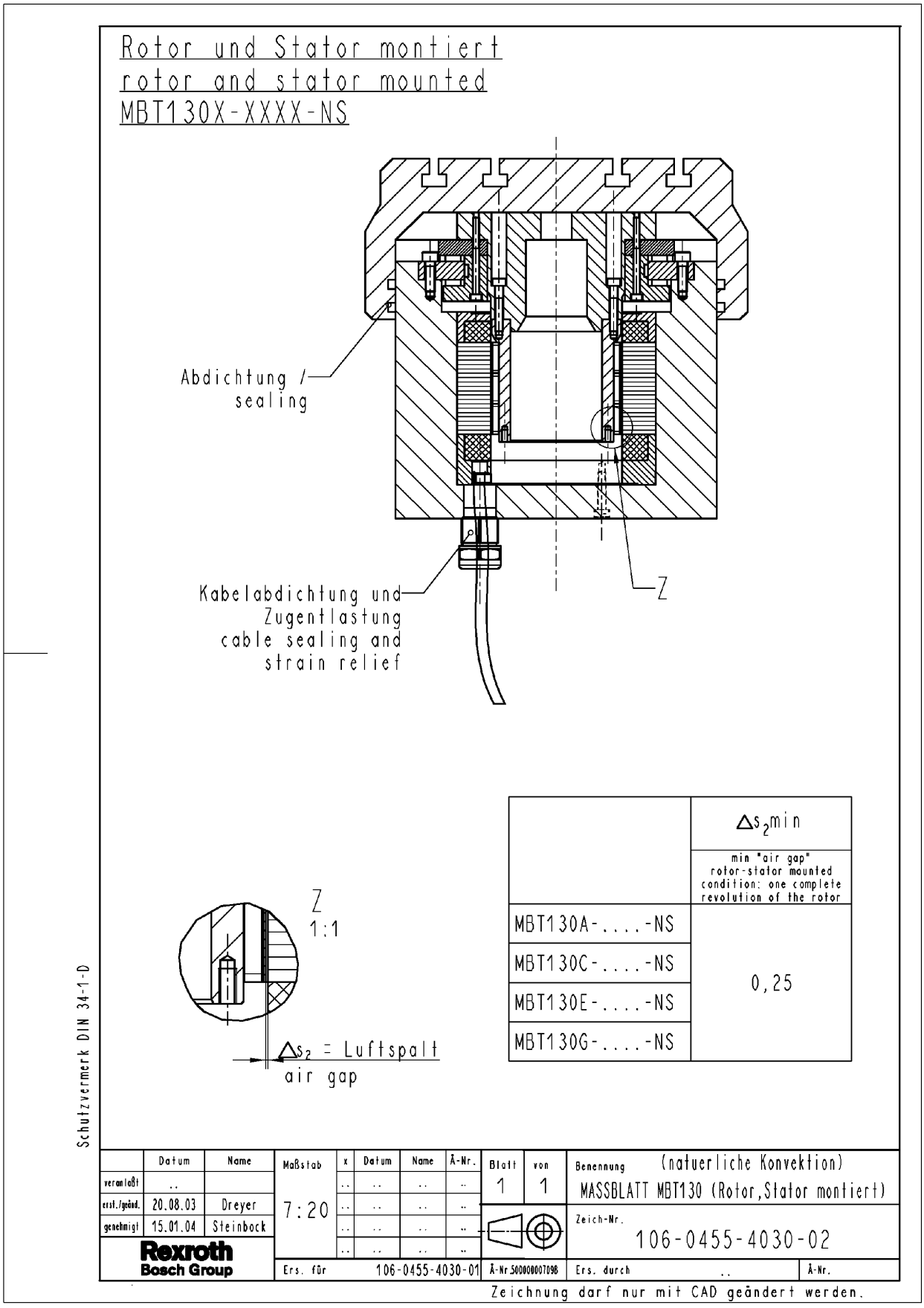


Fig. 307: Rotor and stator, natural convection, mounted

11.10.3 Mounting example MBT160

Rotor MRT160, mounted

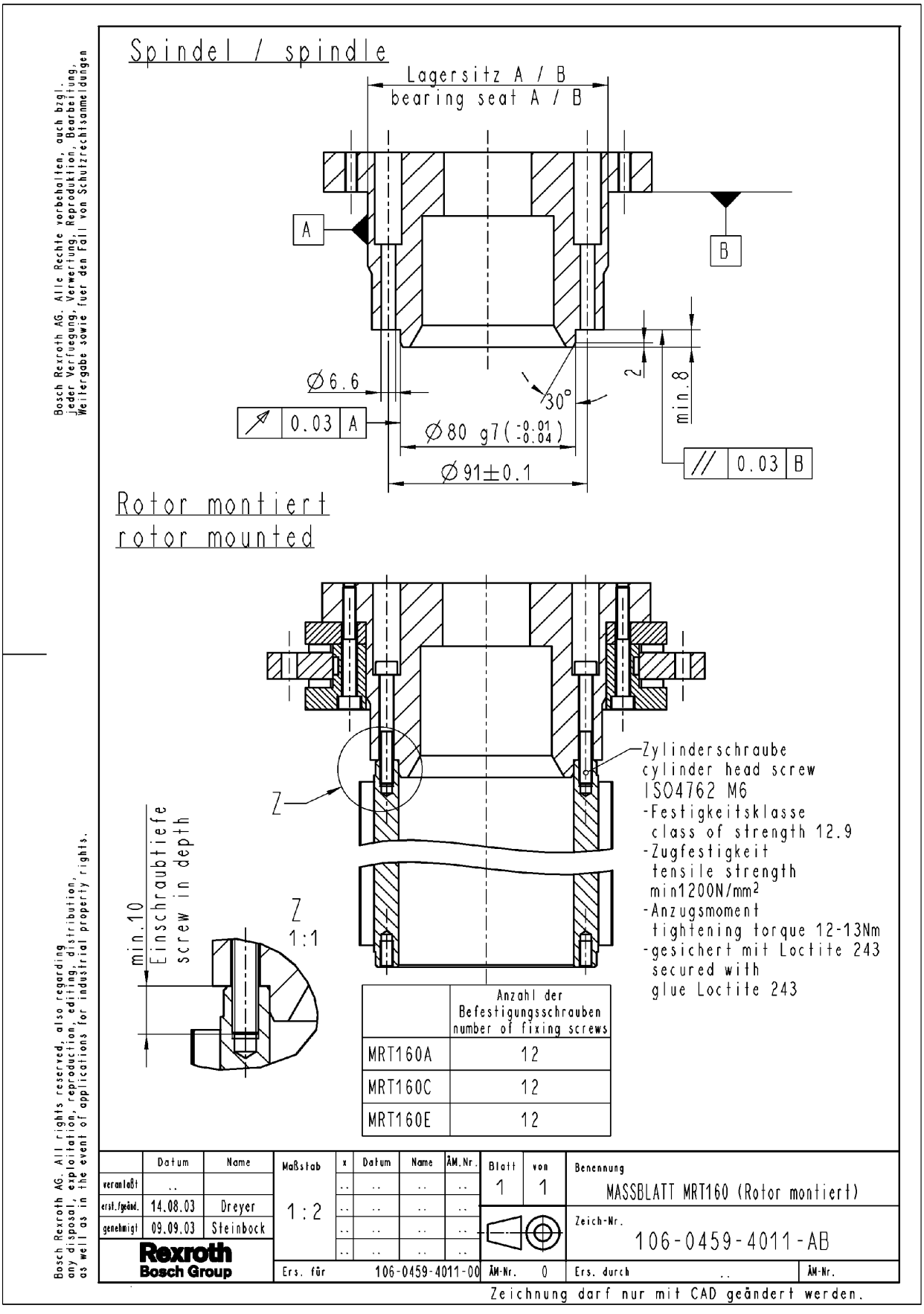


Fig. 308: Rotor MRT160, mounted

Stator MST160, mounted

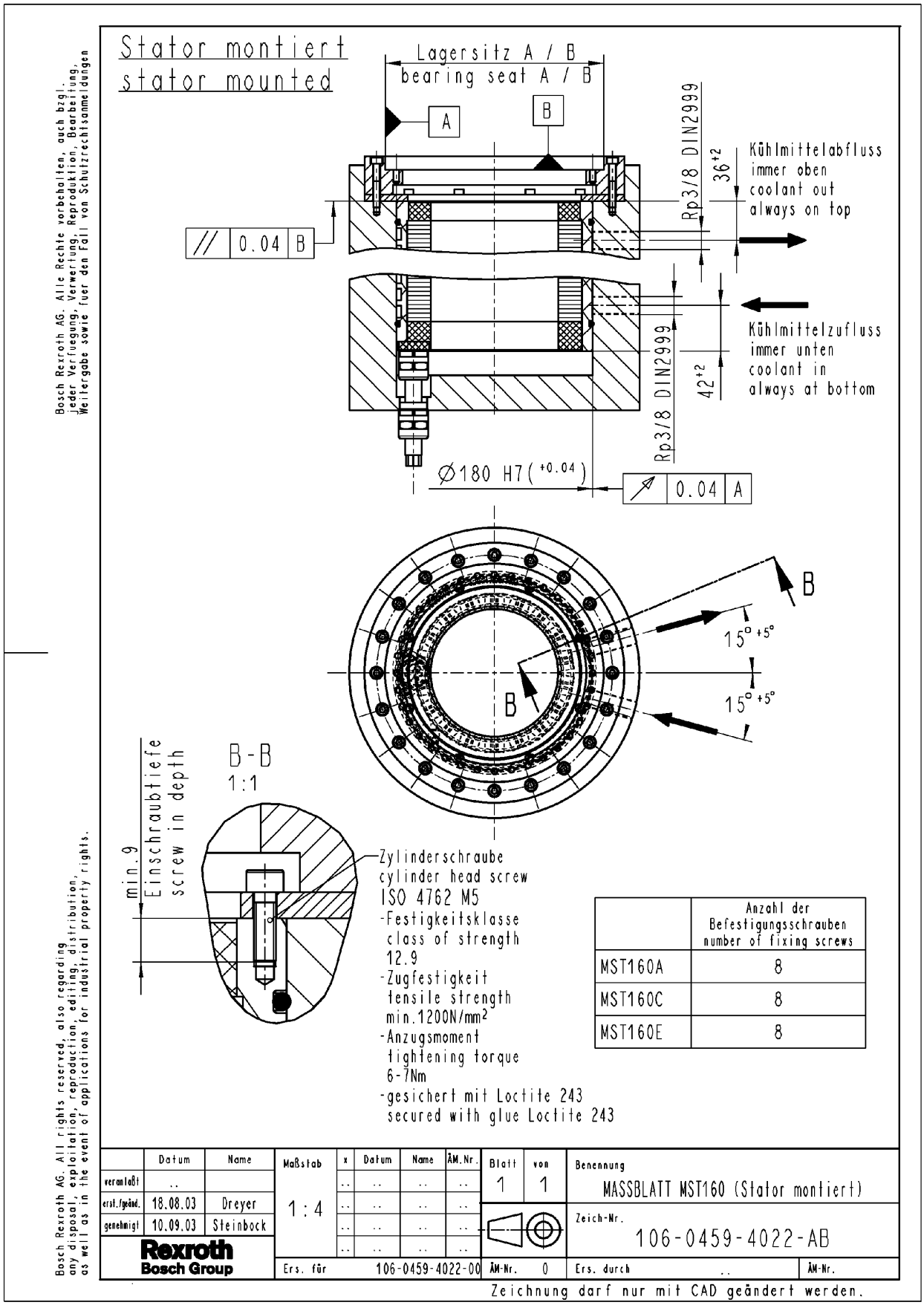


Fig. 309: Stator MST160, mounted

Rotor and stator, mounted

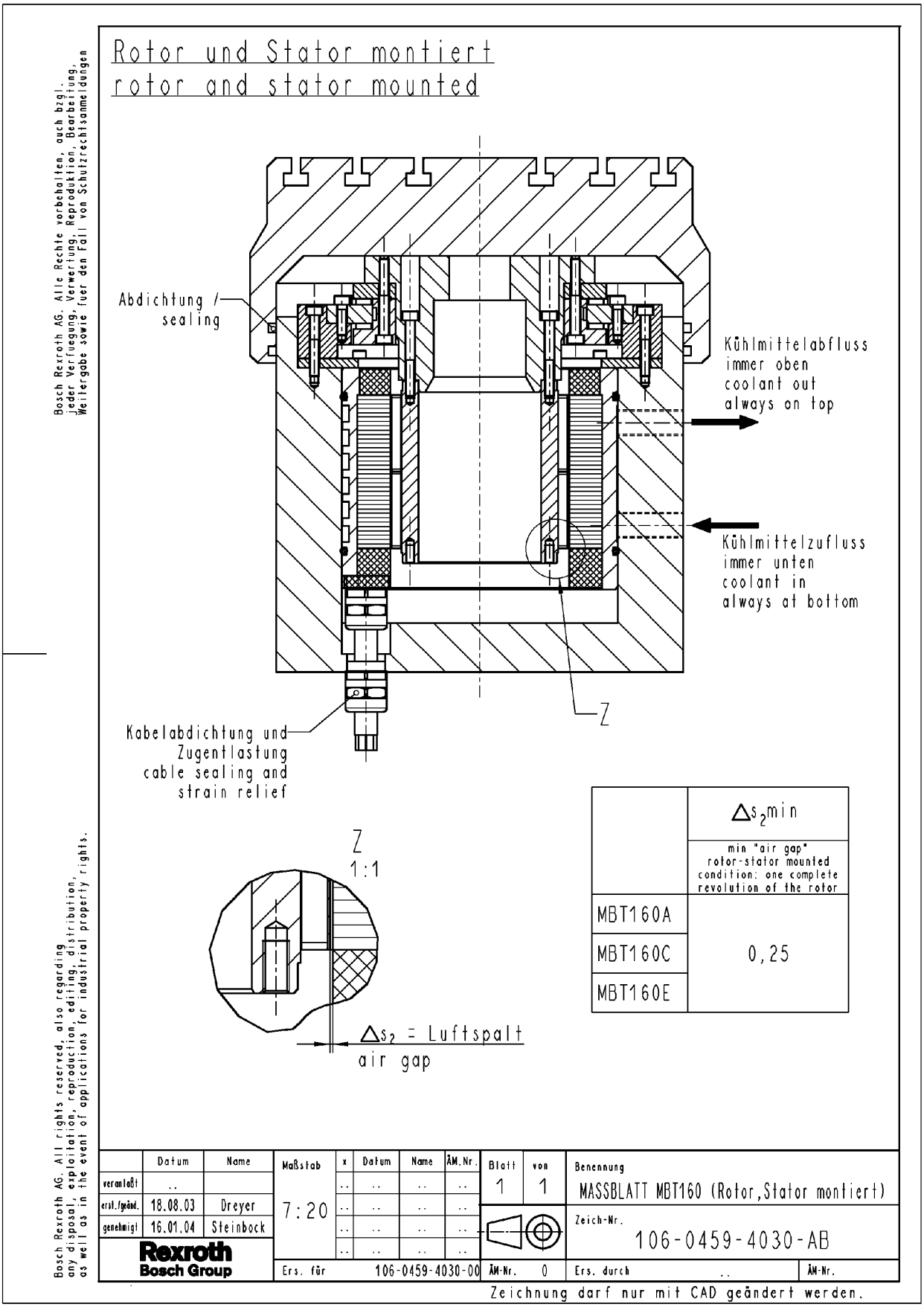


Fig. 310: Rotor and stator mounted

11.10.4 Mounting example MBT161

Rotor MRT161, mounted

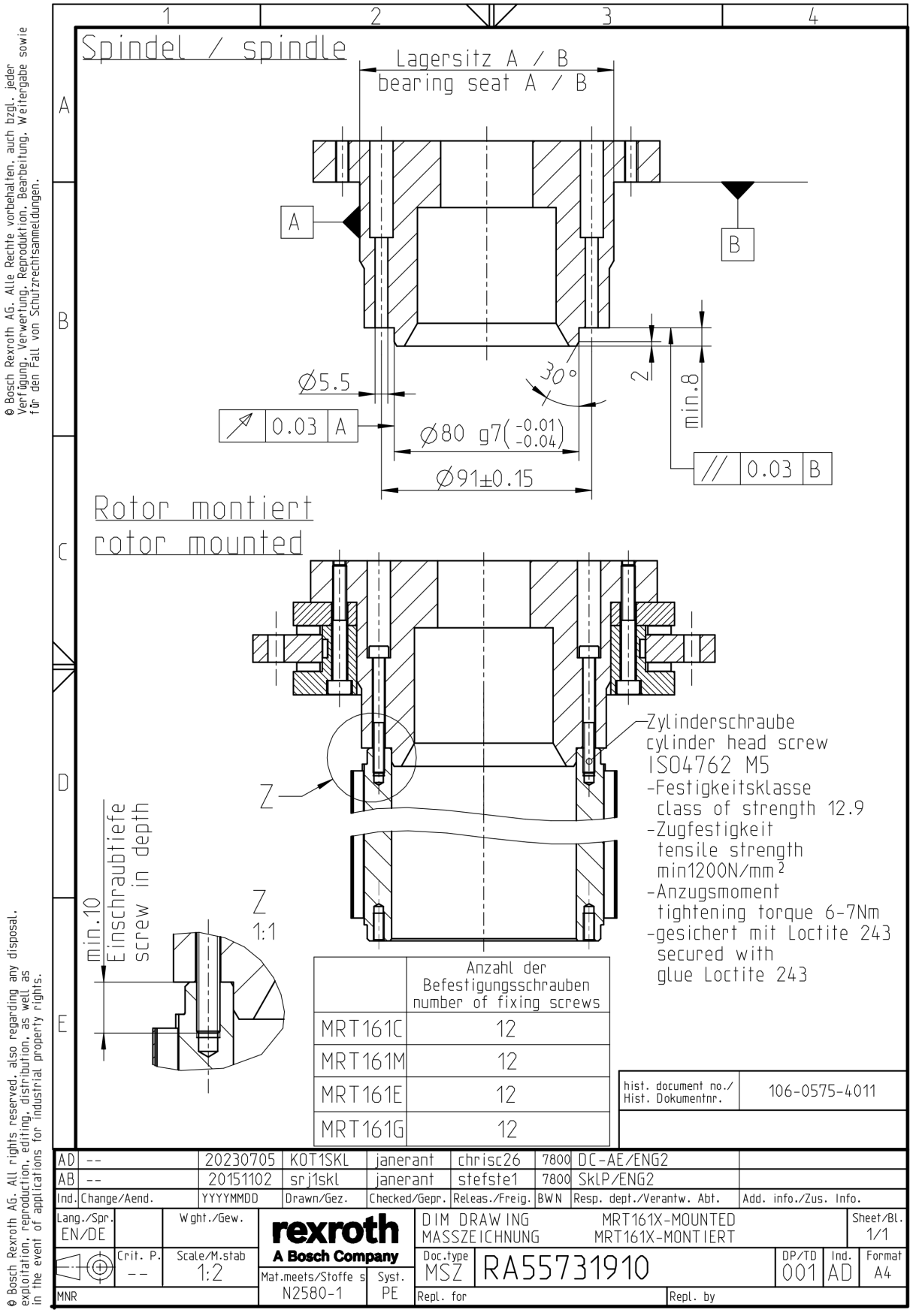
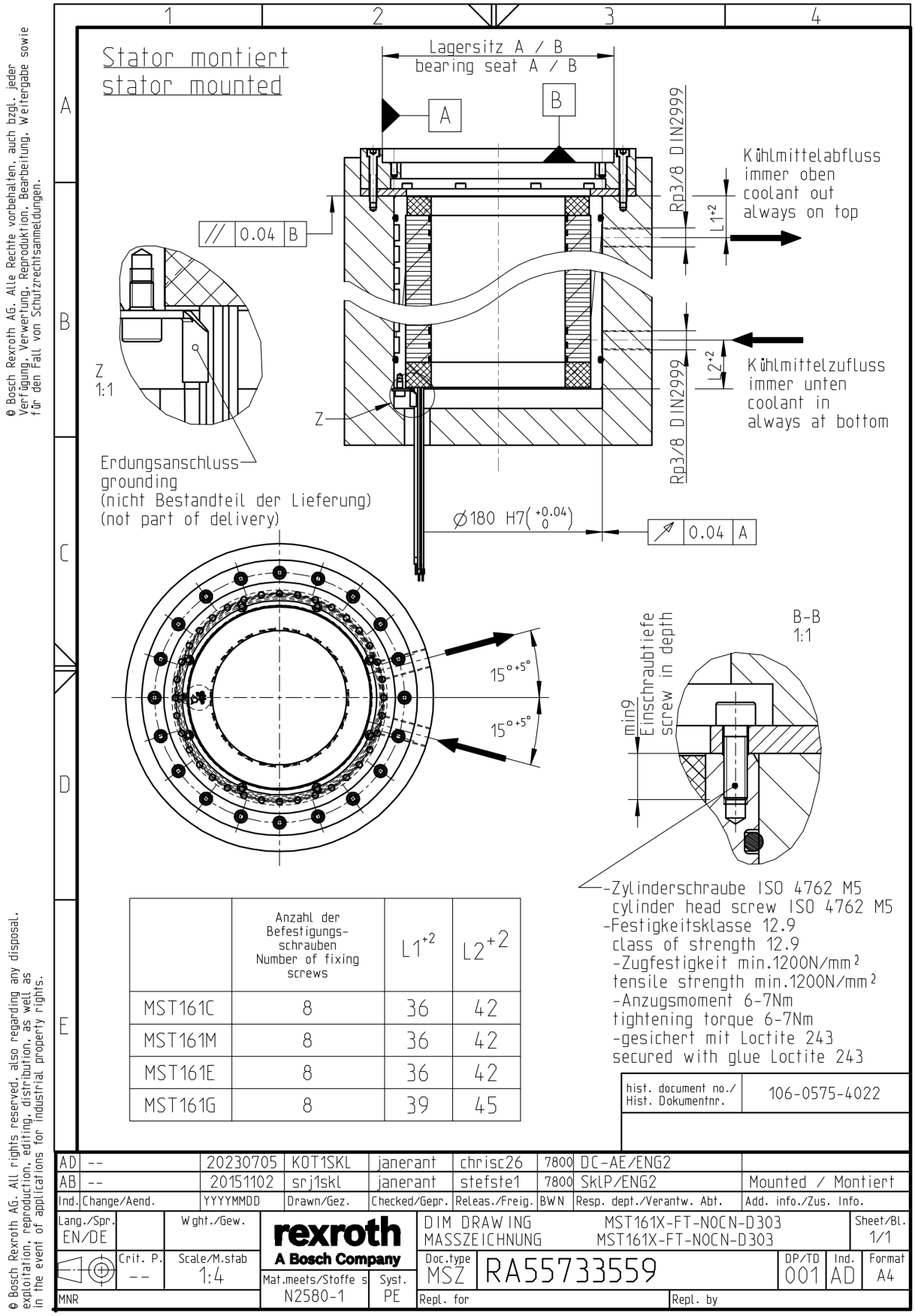


Fig. 311: MRT161 (rotor mounted)

Stator MST161 with liquid cooling, mounted



	Anzahl der Befestigungs-schrauben Number of fixing screws	$L1^{+2}$	$L2^{+2}$
MST161C	8	36	42
MST161M	8	36	42
MST161E	8	36	42
MST161G	8	39	45

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RA55733559 / DB227001 / AD.2 / DB226997 / ASSEM / AC.1

Fig. 312: MST161 with liquid cooling, mounted

Motor MBT161 with liquid cooling, rotor and stator mounted

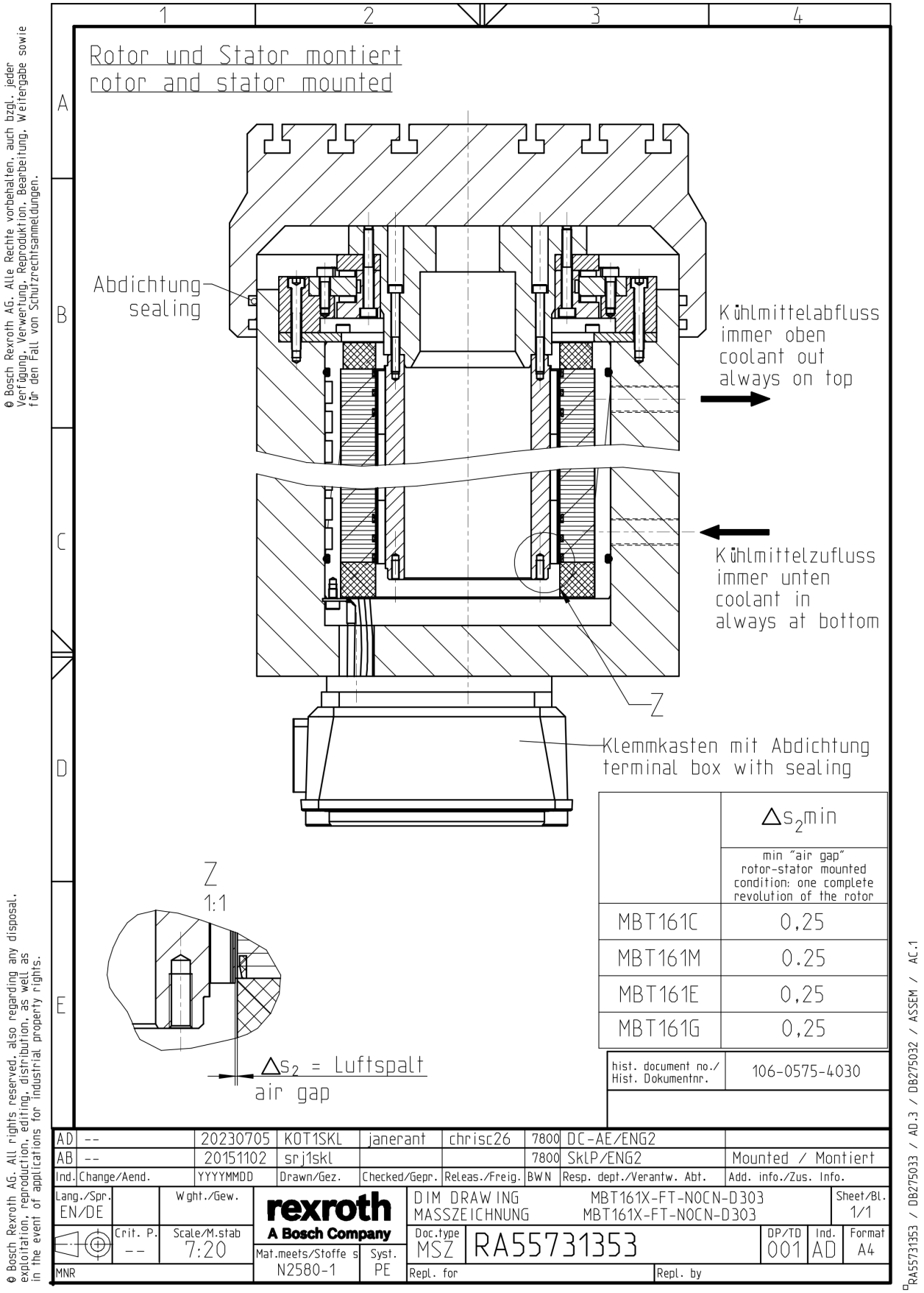


Fig. 313: MBT161 with liquid cooling, rotor and stator mounted

Stator MST161 with self-cooling, mounted

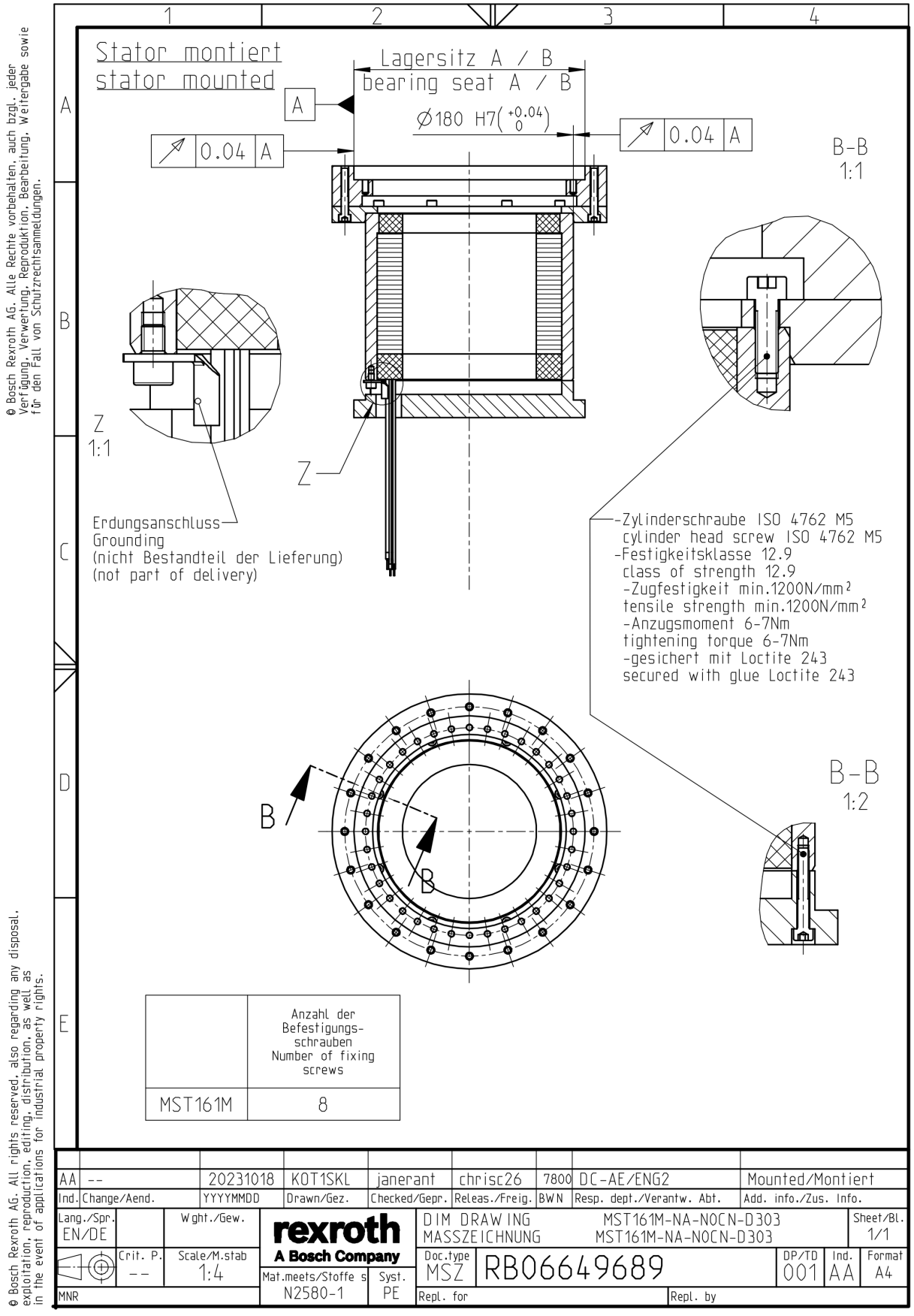


Fig. 314: MST161 with self-cooling, mounted

Motor MBT161 with self-cooling, rotor and stator mounted

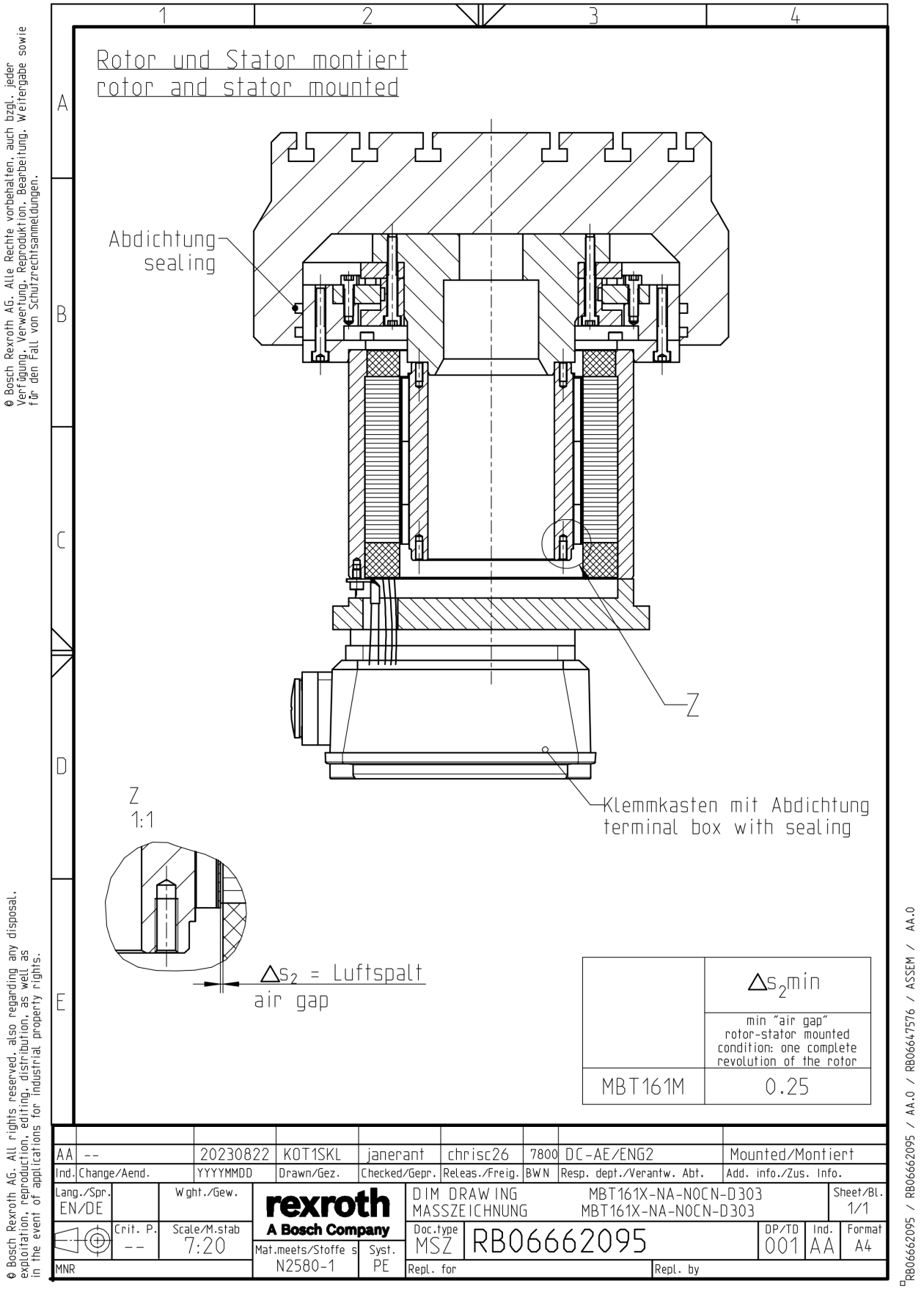


Fig. 315: MBT161 with self-cooling, rotor and stator mounted

11.10.5 Mounting example MBT201

Rotor MRT201, mounted

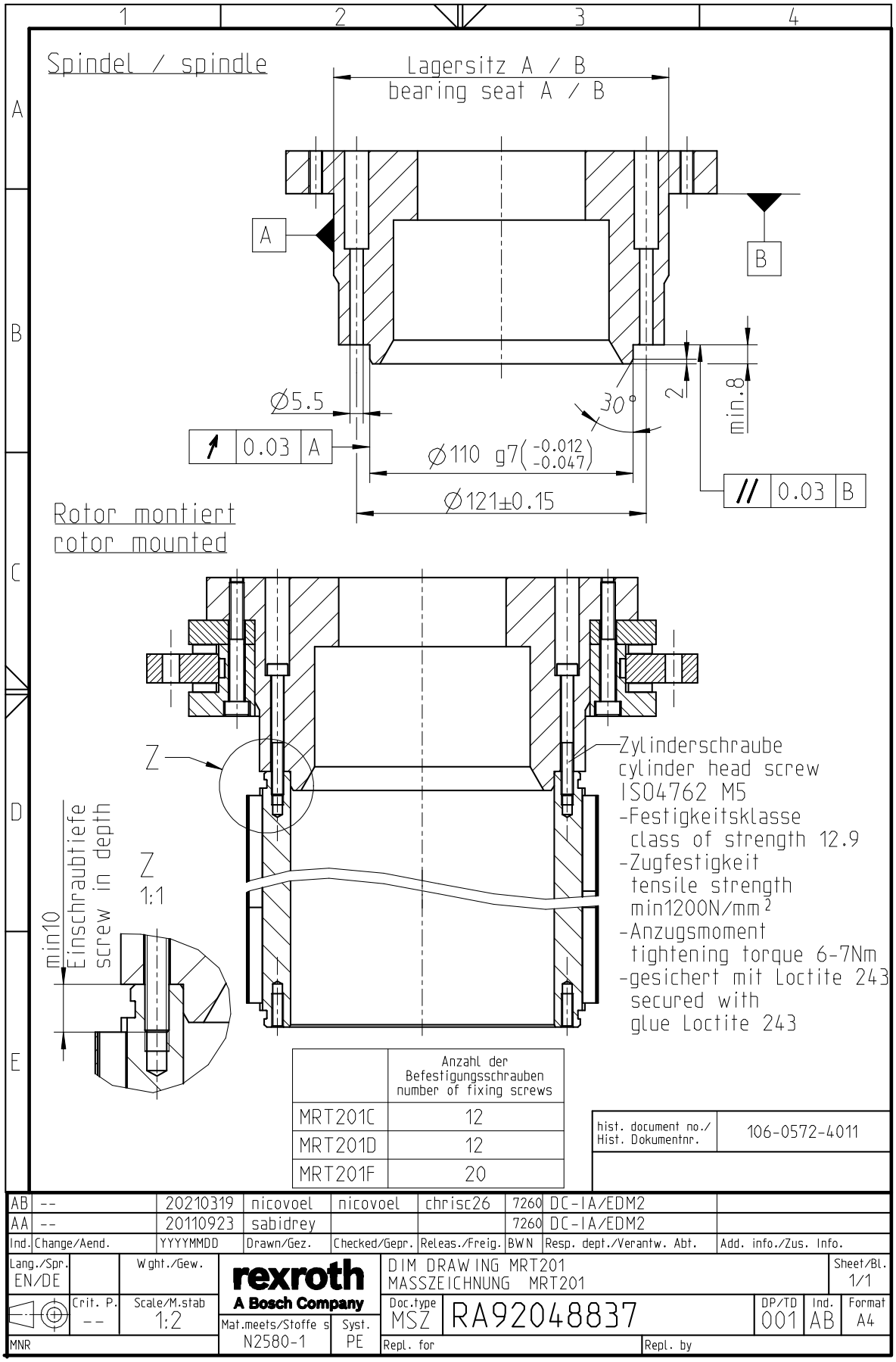
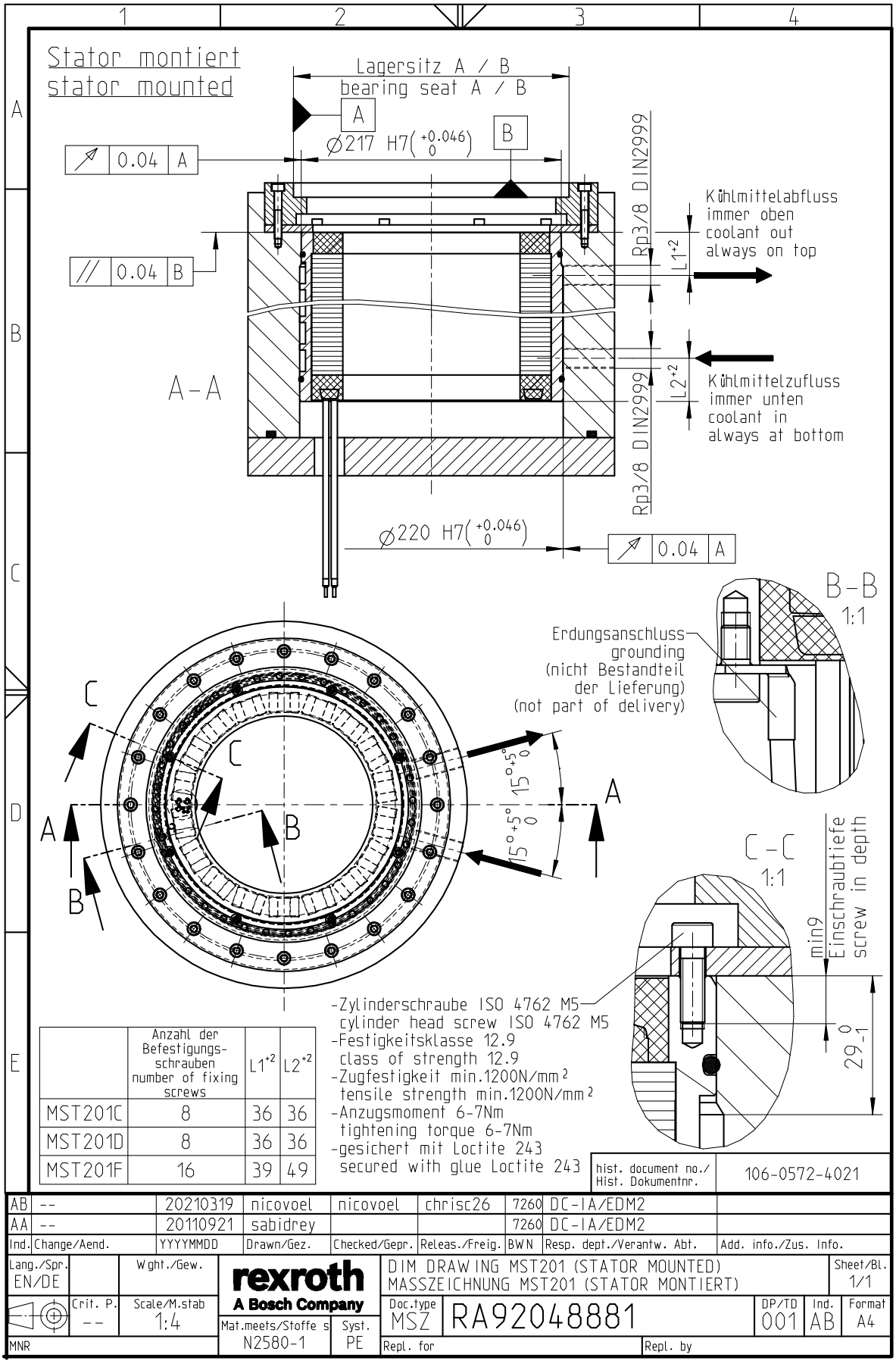


Fig. 316: MRT201 (rotor mounted)

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

AB	--	20210319	nicovoel	nicovoel	chrisc26	7260	DC-IA/EDM2	
AA	--	20110921	sabidrey			7260	DC-IA/EDM2	
Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.

Fig. 317: MST201 (stator mounted)

Motor MBT201, rotor and stator, mounted

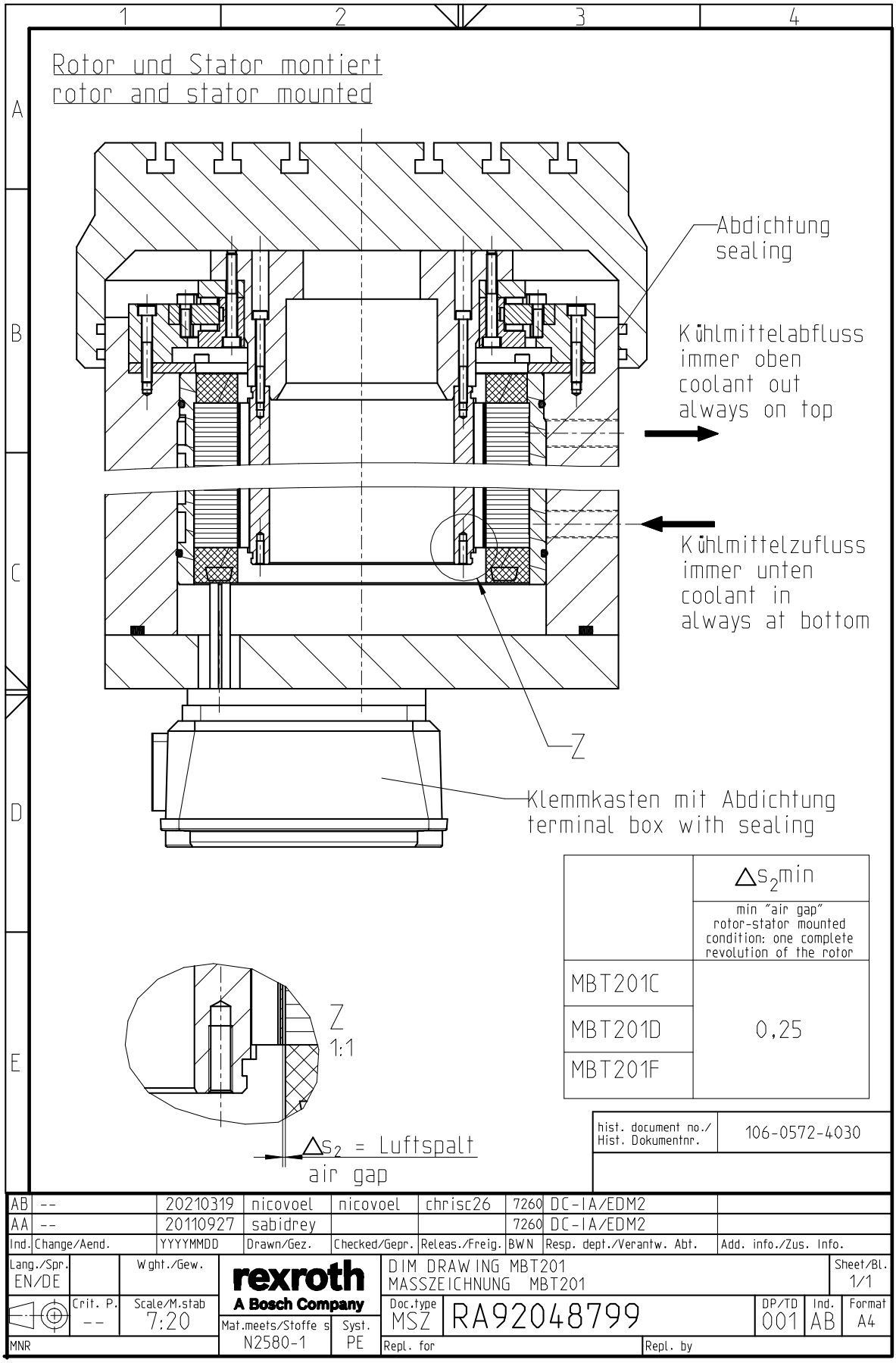


Fig. 318: MBT201 (rotor and stator mounted)

11.10.6 Mounting example MBT210

Rotor MRT210A/ -C/ -D/ -E, mounted

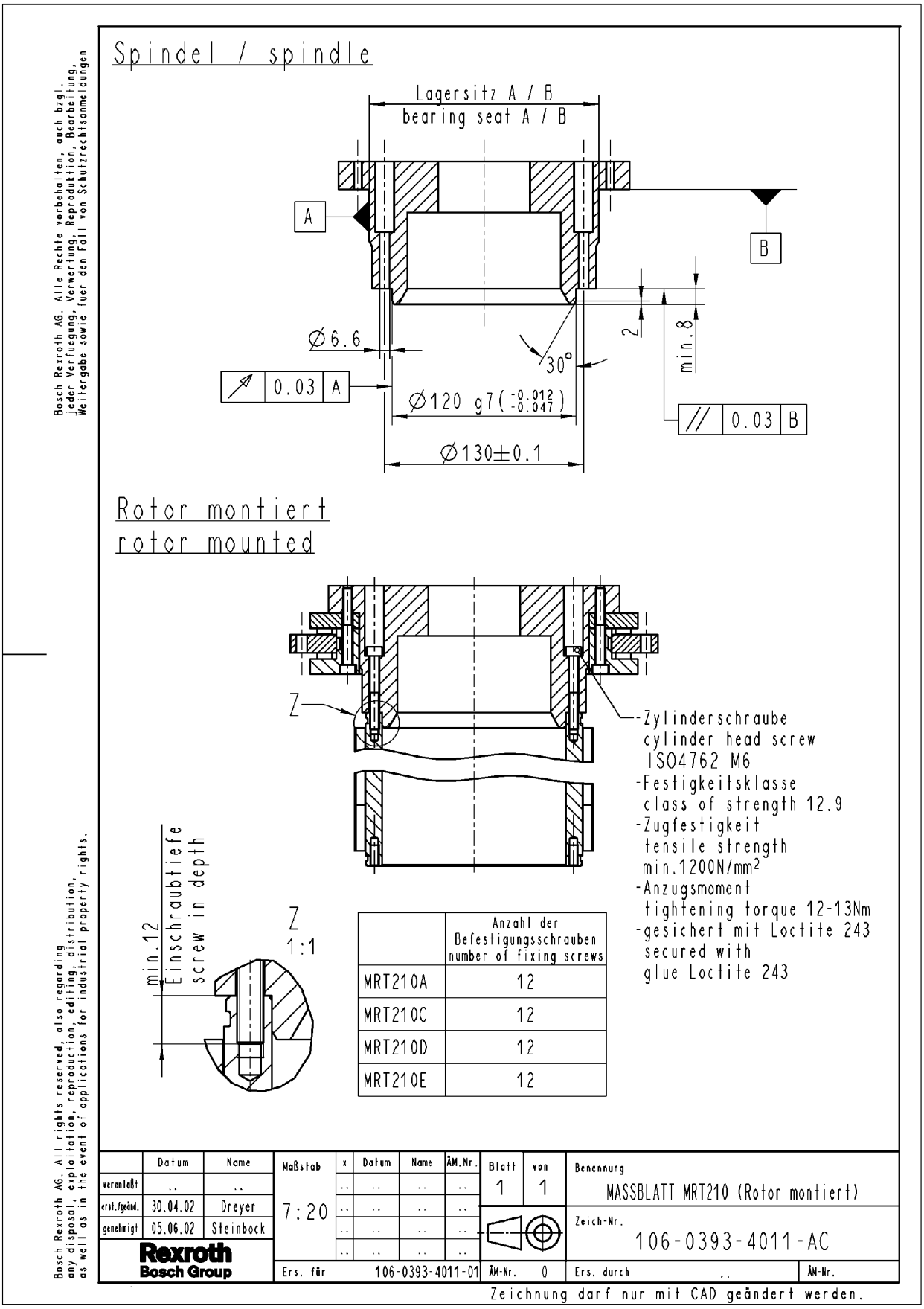
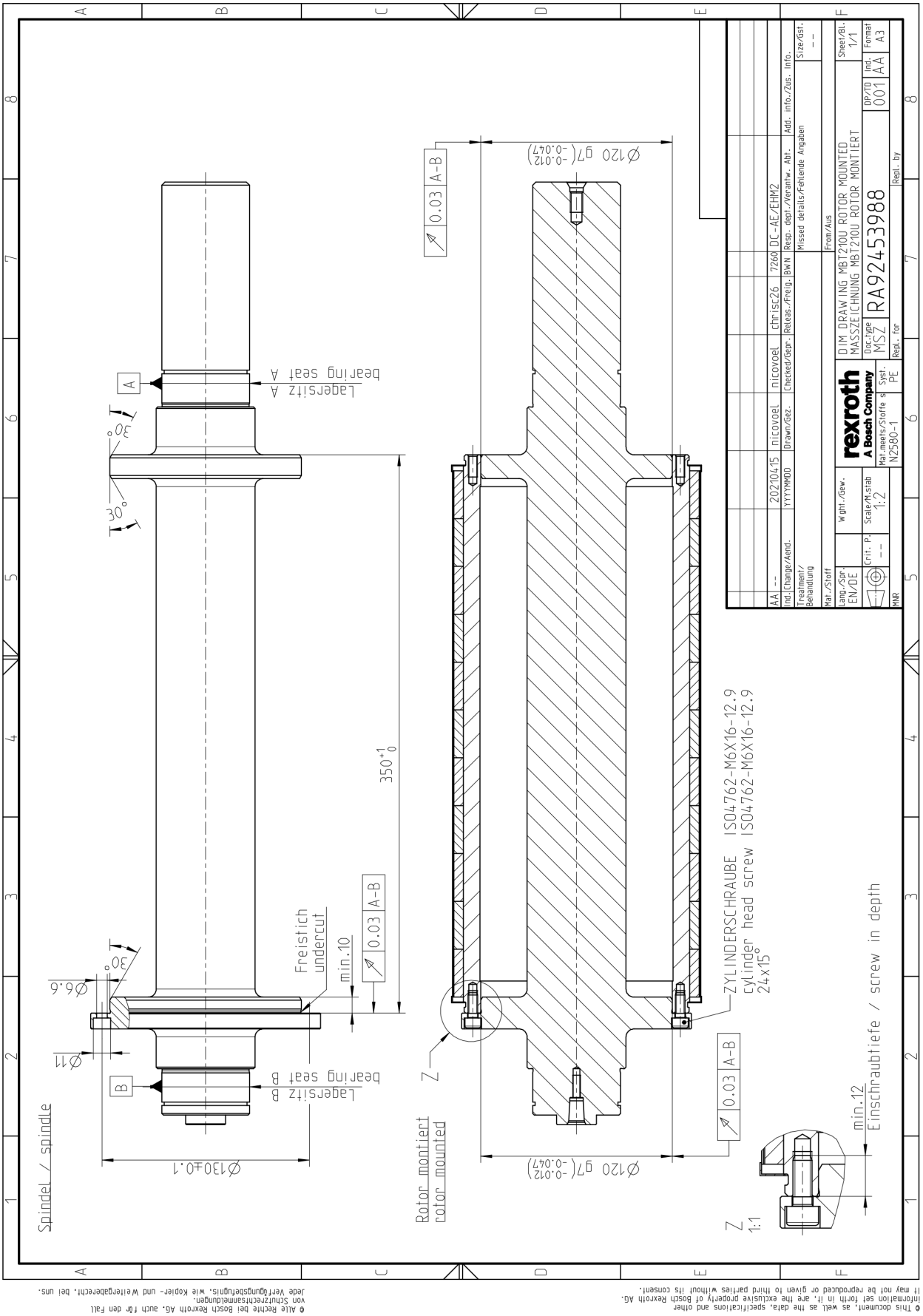


Fig. 319: MRT210, rotor mounted

Rotor MRT210U, mounted



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Fig. 320: MRT210U (rotor mounted)

Stator MST210A/ -C/ -D/ -E ("SN") mounted

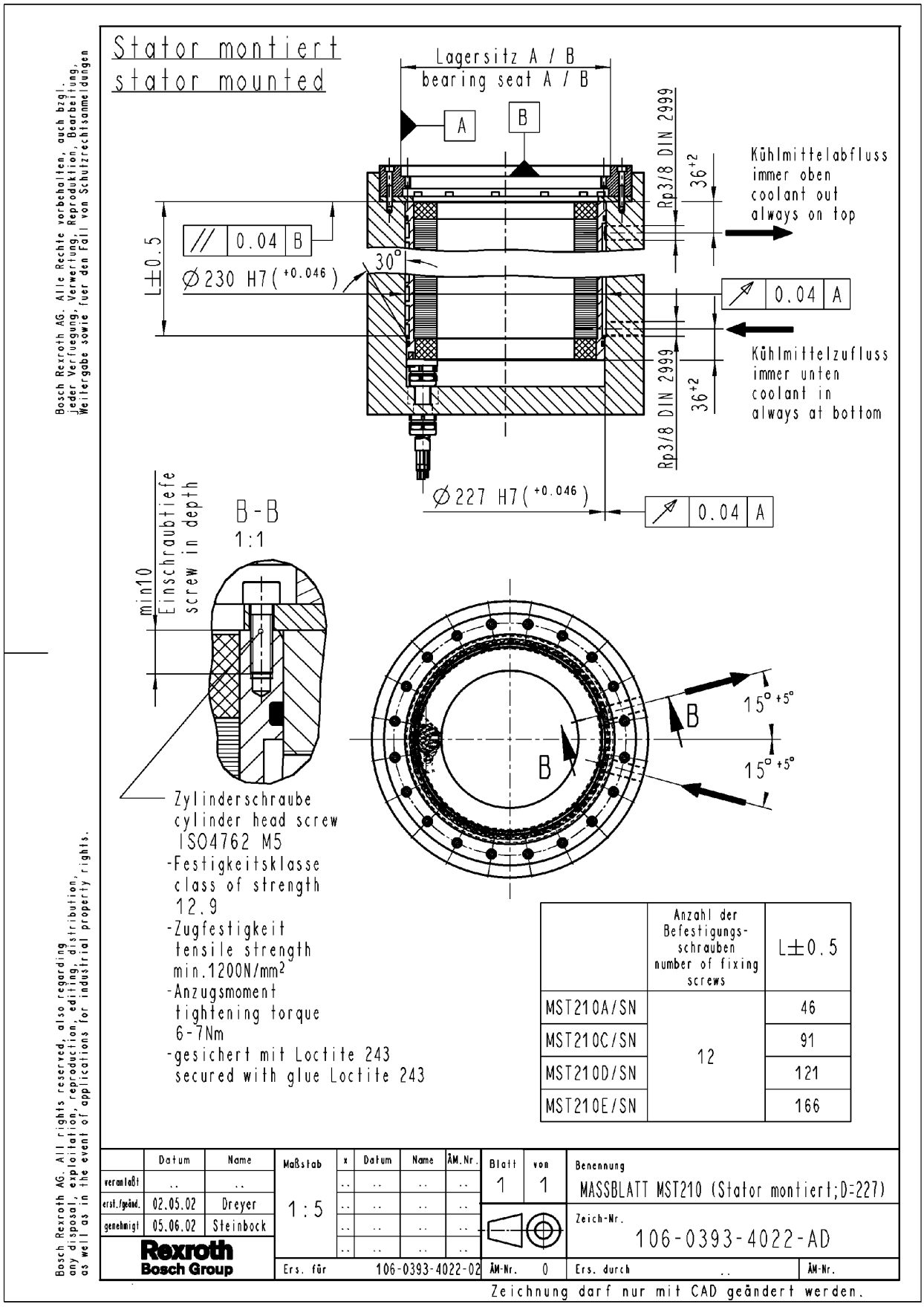


Fig. 321: MST210, stator mounted (“SN”)

Stator MST210A/ -C/ -D/ -E ("CN") mounted

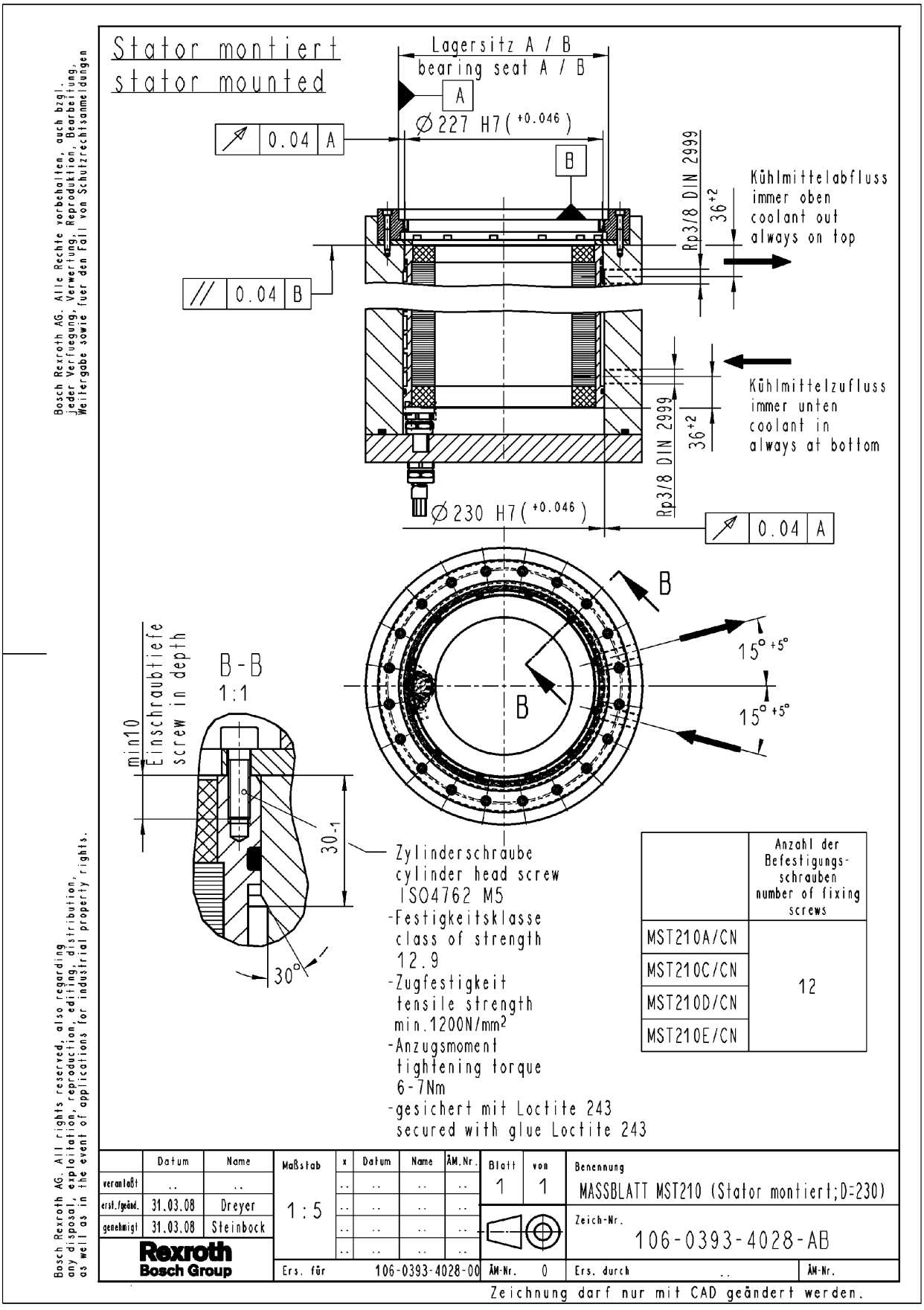
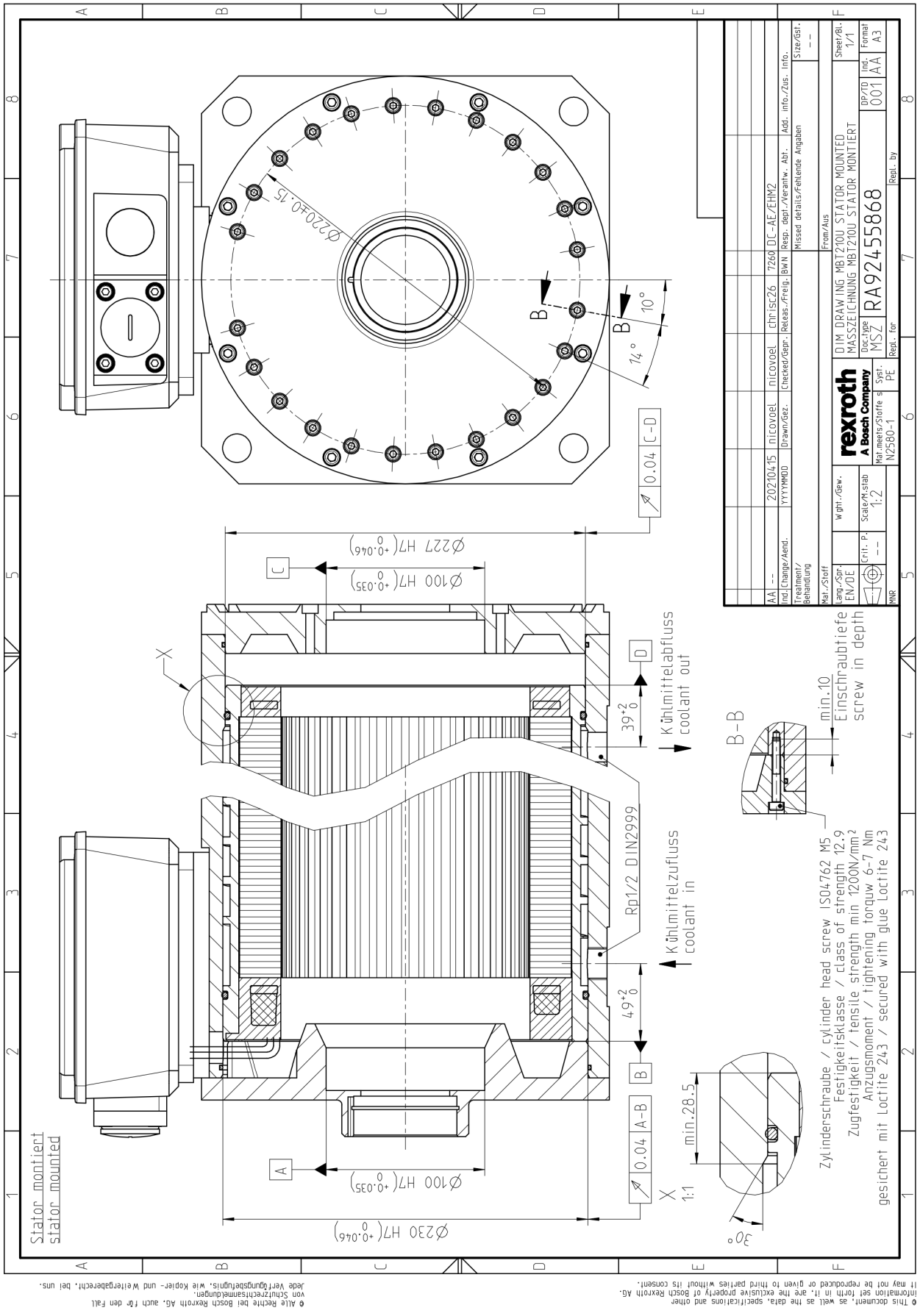


Fig. 322: MST210, stator mounted (“CN”)

Stator MST210U, Mounted



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Fig. 323: Stator MST210U, Mounted

Motor MBT210A/ -C/ -D/ -E, rotor and stator mounted

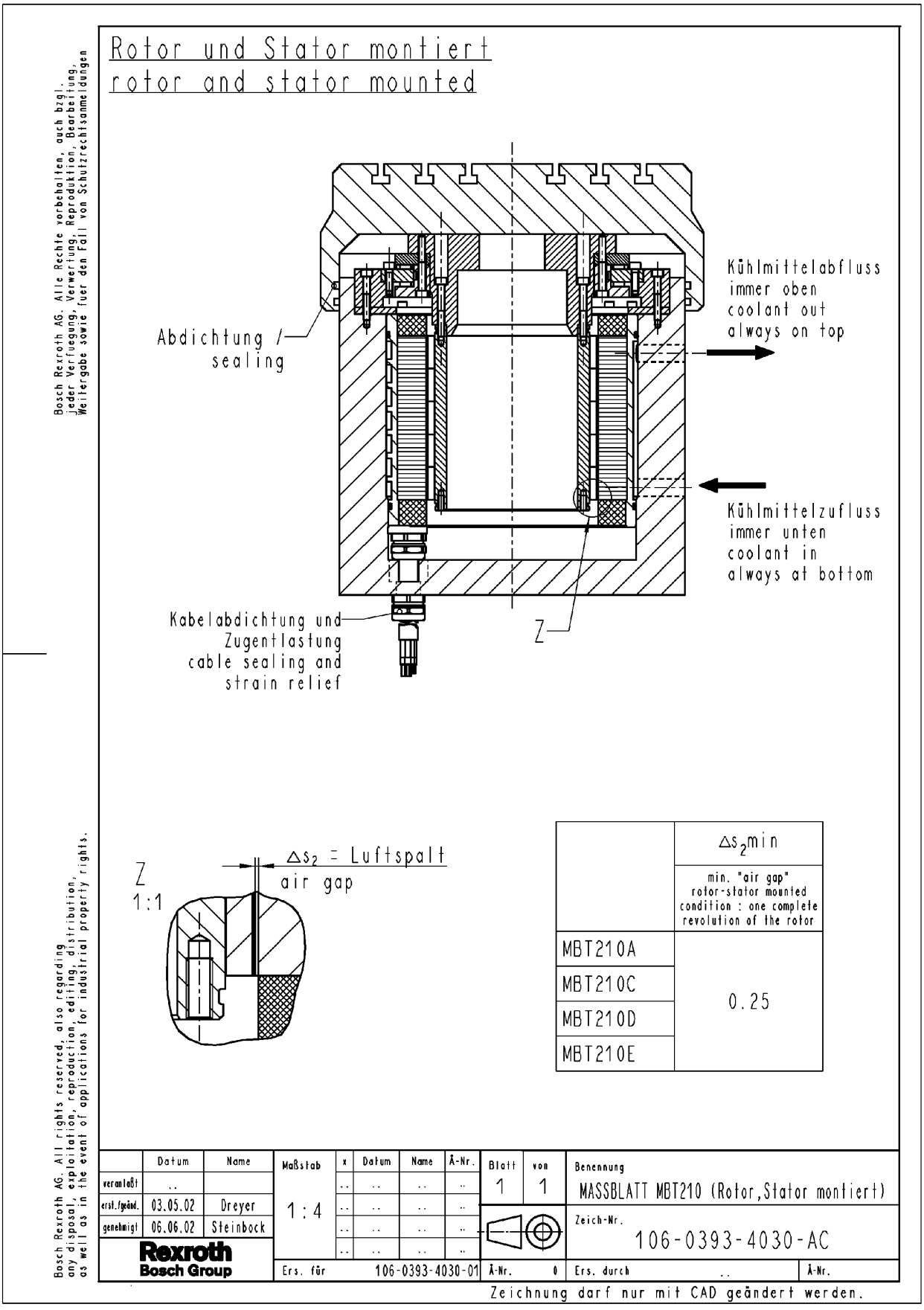
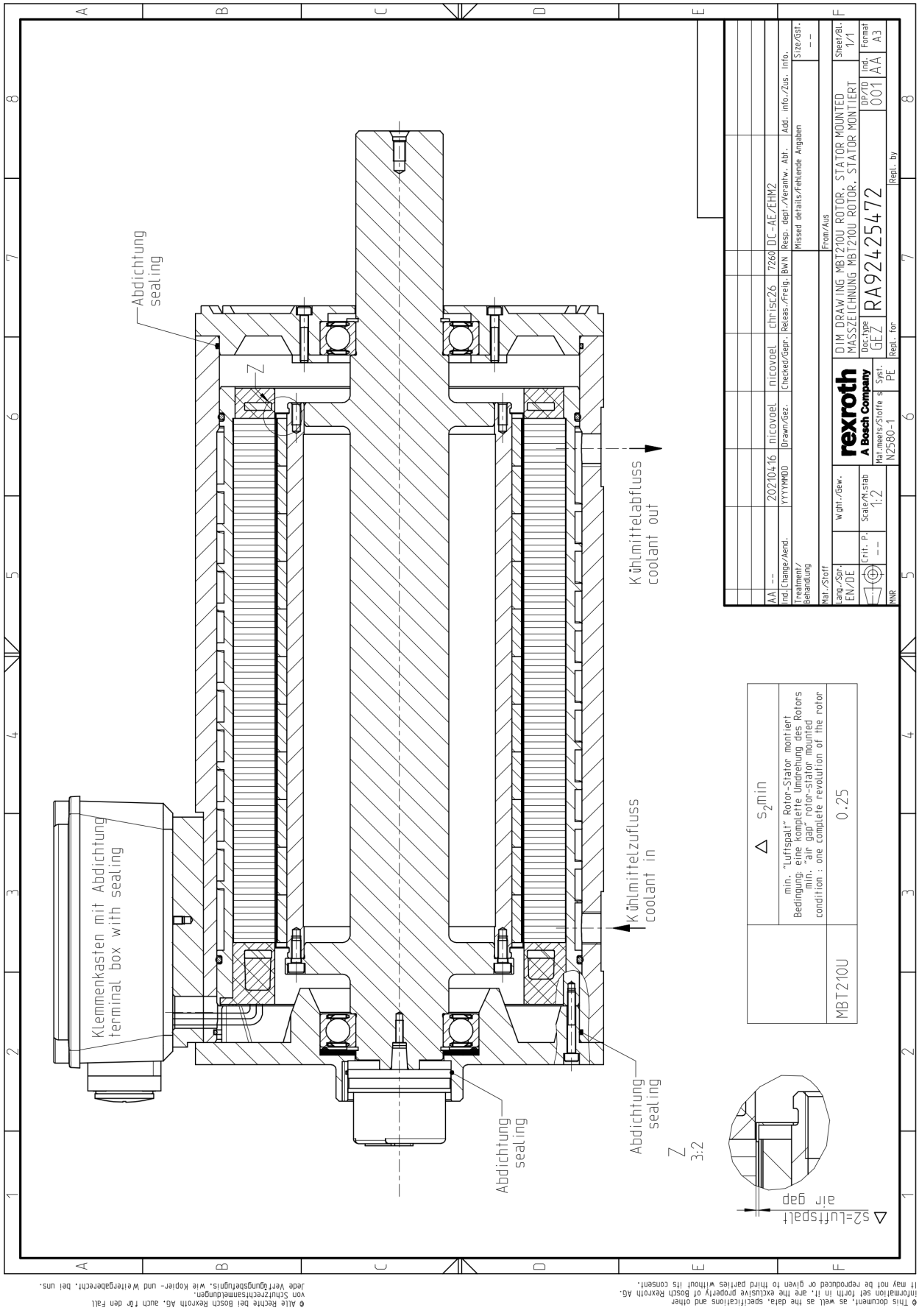


Fig. 324: MBT210, rotor and stator mounted

Motor MBT210U, rotor and stator, mounted



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Fig. 325: MBT210U, mounted

11.10.7 Mounting example MBT251

Rotor MRT251, mounted

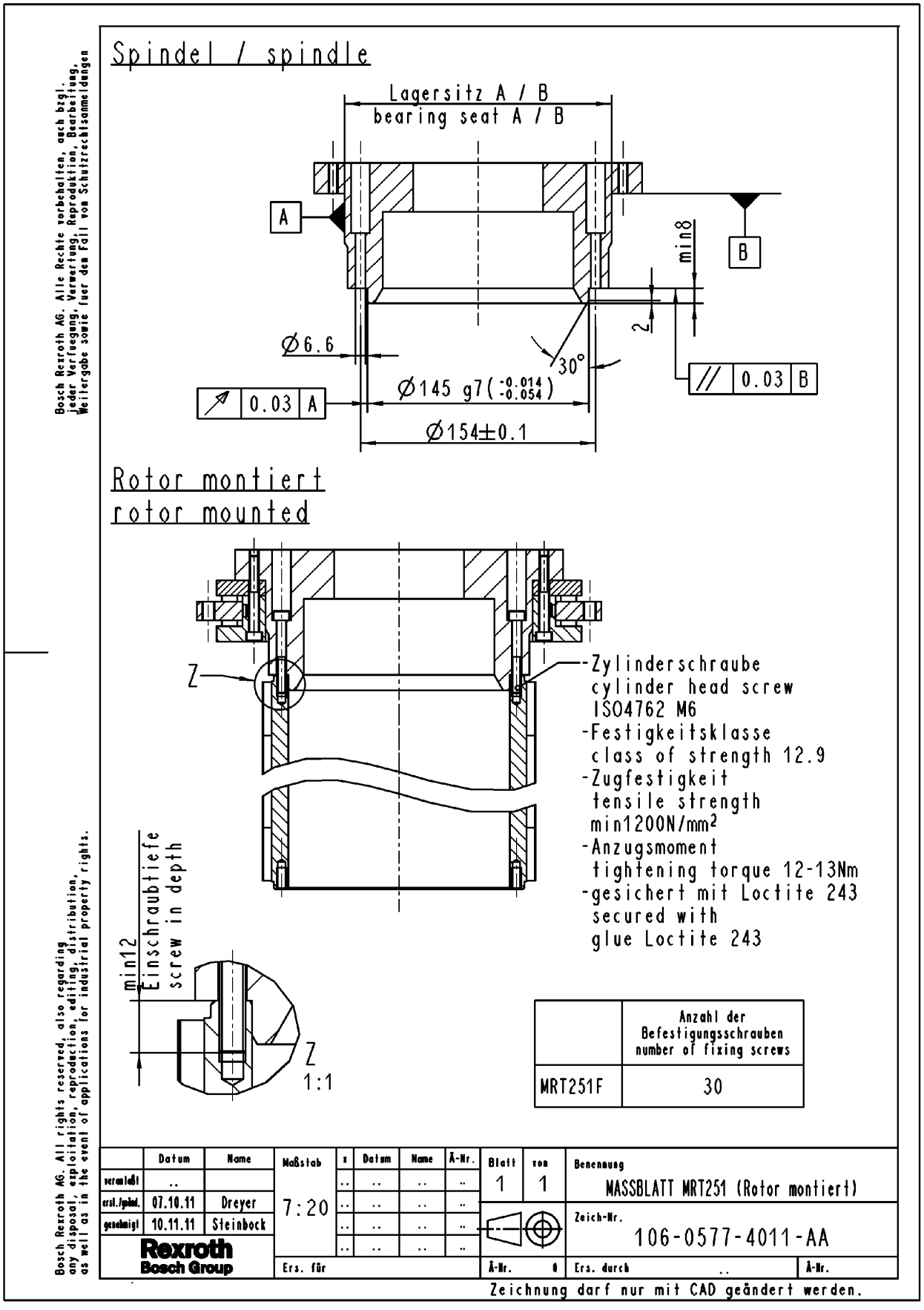


Fig. 326: MRT251 (rotor mounted)

Stator MST251, mounted

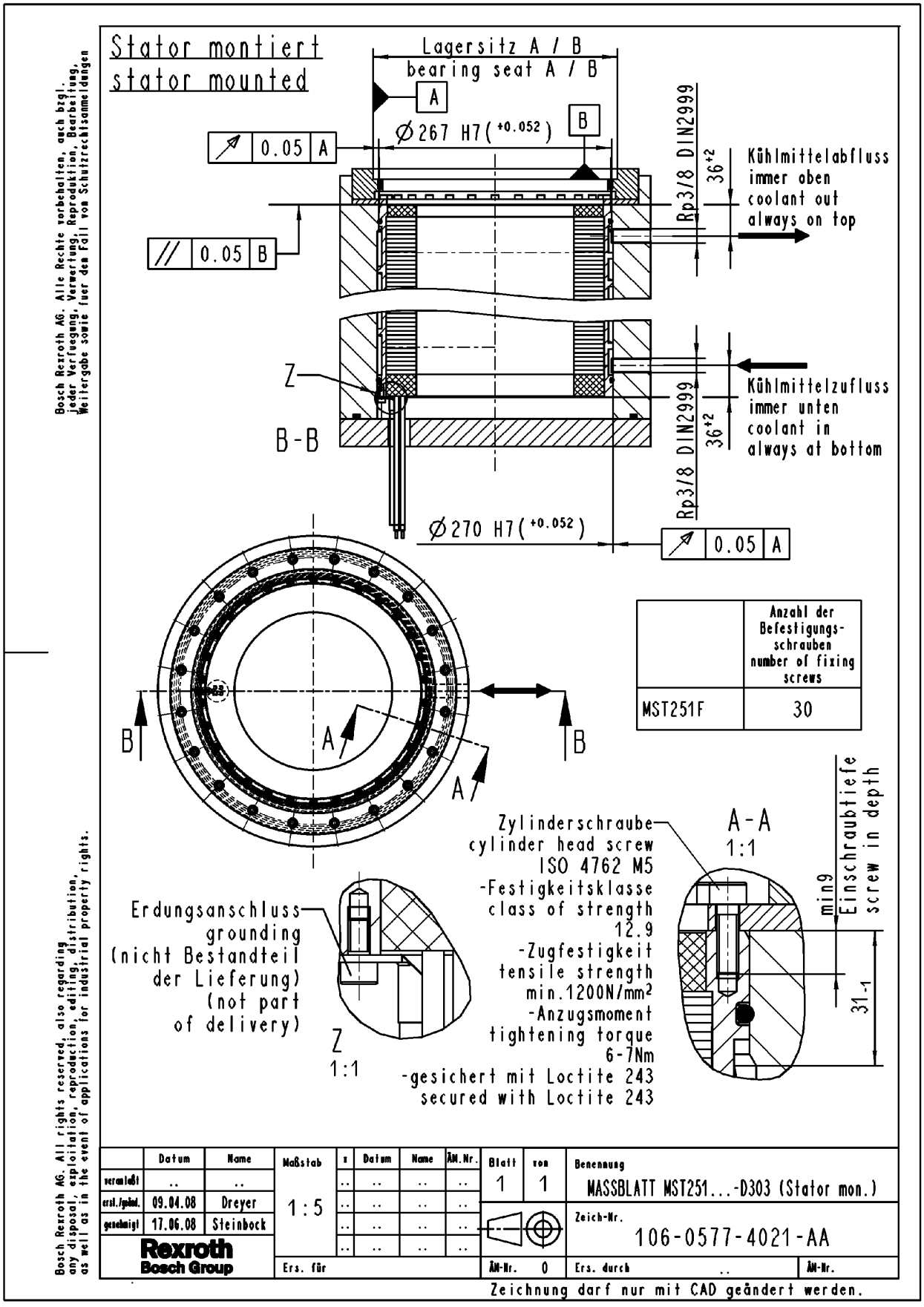


Fig. 327: MST251 (stator mounted)

Motor MBT251, rotor and stator, mounted

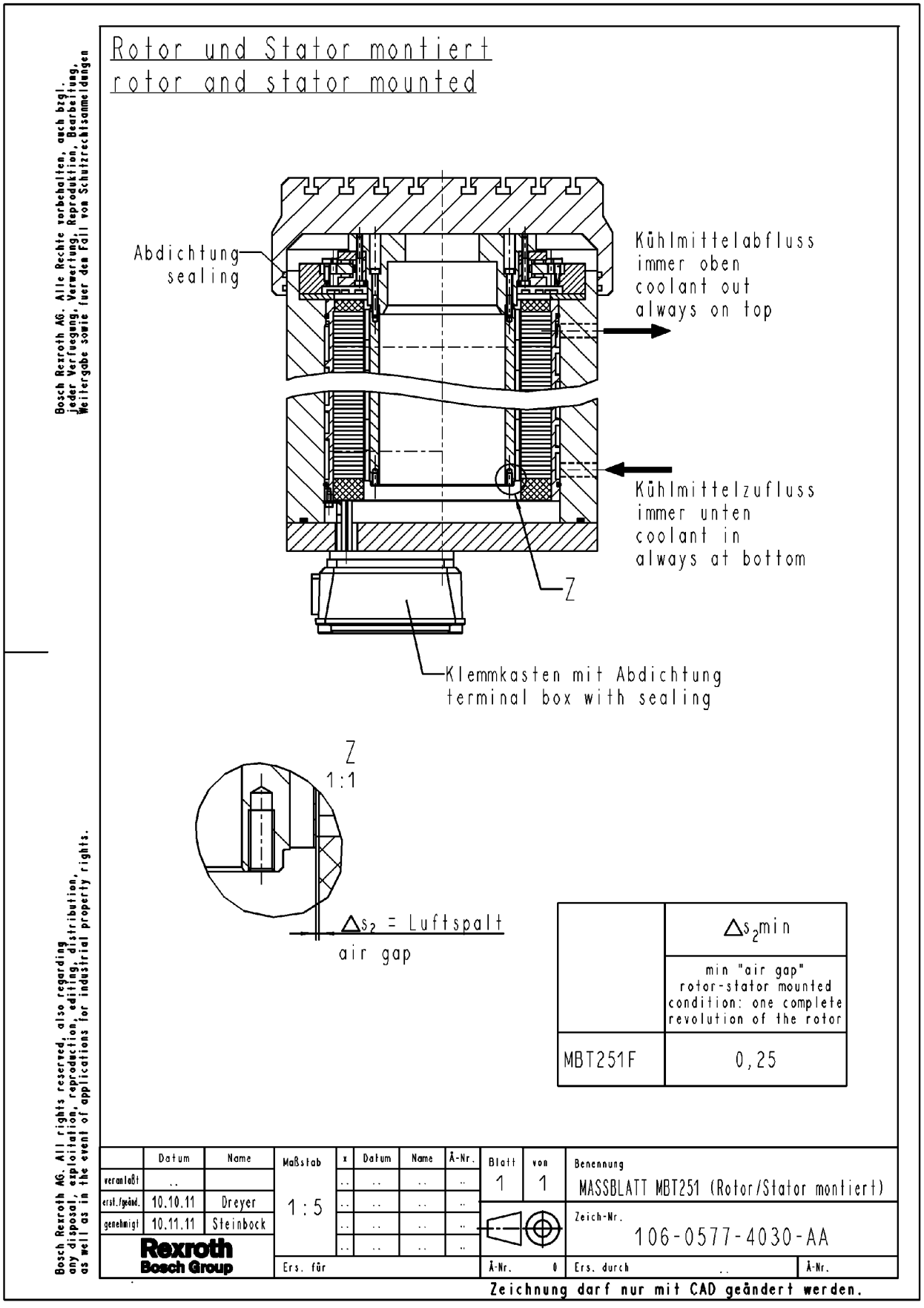
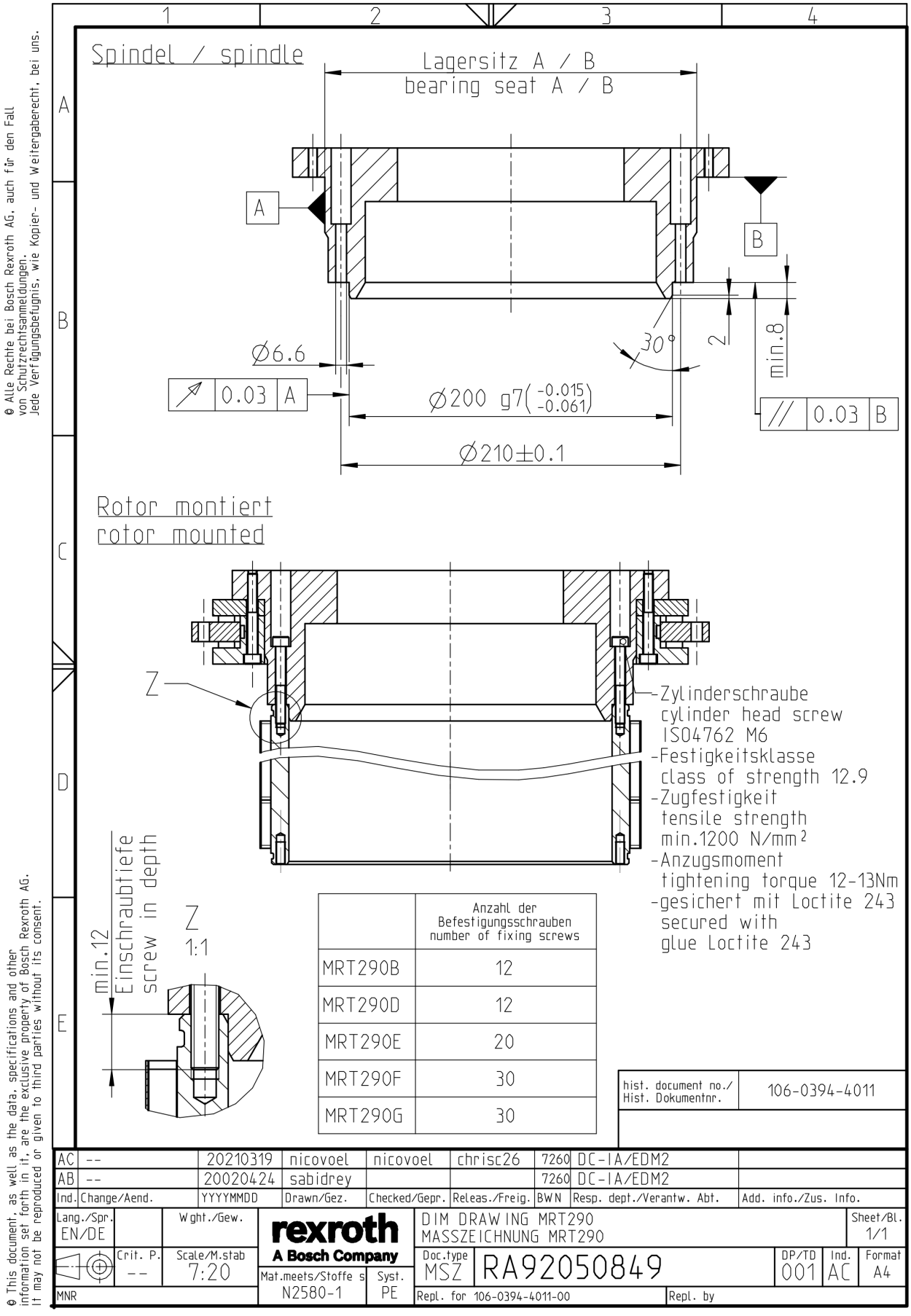


Fig. 328: MBT251 (rotor and stator mounted)

11.10.8 Mounting example MBT290

Rotor MRT290, mounted



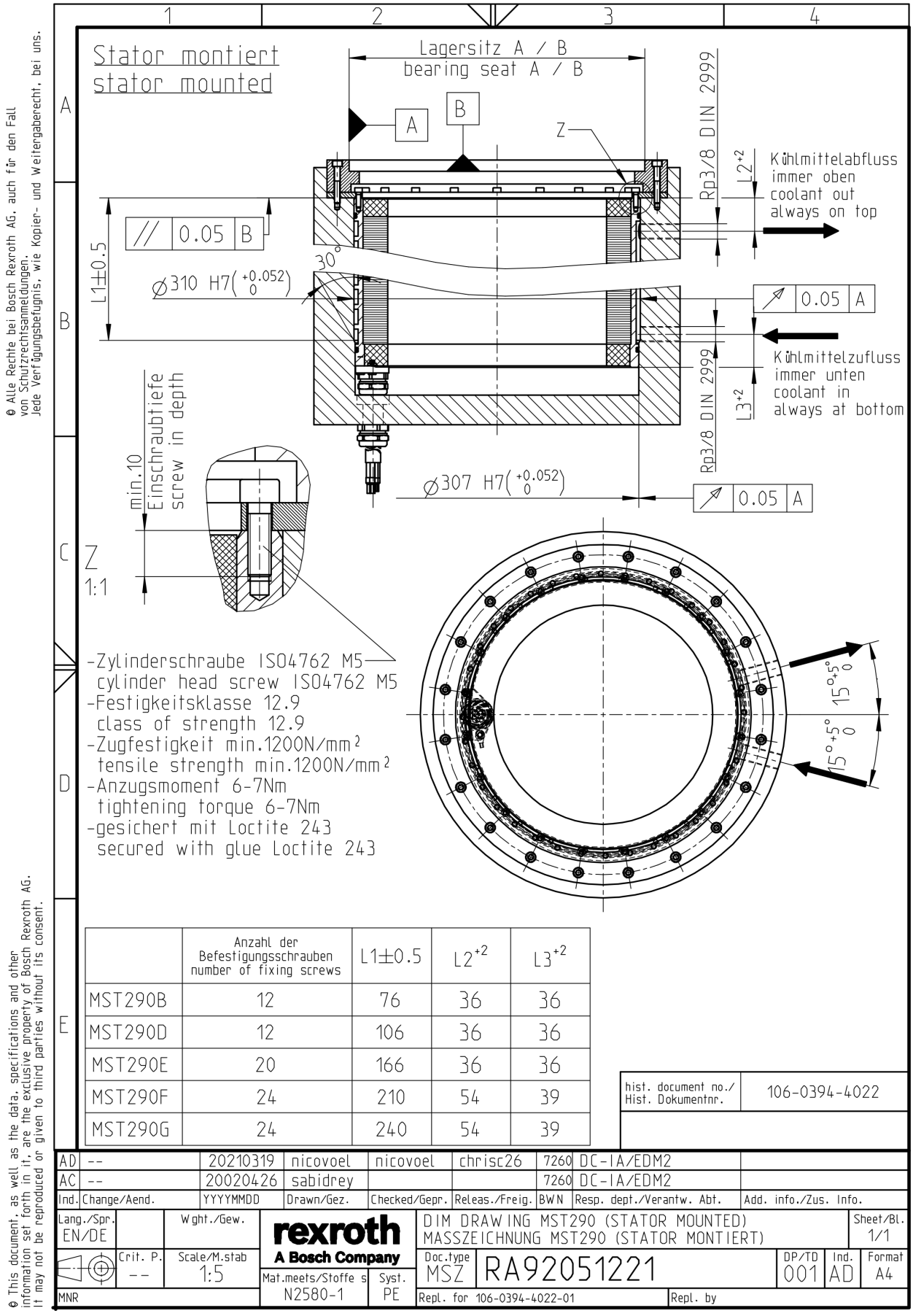
	Anzahl der Befestigungsschrauben number of fixing screws
MRT290B	12
MRT290D	12
MRT290E	20
MRT290F	30
MRT290G	30

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Fig. 329: MRT290, rotor mounted

Stator MST290, mounted



	Anzahl der Befestigungsschrauben number of fixing screws	L1±0.5	L2+2	L3+2
MST290B	12	76	36	36
MST290D	12	106	36	36
MST290E	20	166	36	36
MST290F	24	210	54	39
MST290G	24	240	54	39

hist. document no./ Hist. Dokumentnr.: 106-0394-4022

Ind.	Change/Aend.	YYYYMMDD	Drawn/Gez.	Checked/Gepr.	Releas./Freig.	BWN	Resp. dept./Verantw. Abt.	Add. info./Zus. Info.
AD	--	20210319	nicovoel	nicovoel	chrisc26	7260	DC-IA/EDM2	
AC	--	20020426	sabidrey			7260	DC-IA/EDM2	

Lang./Spr.: EN/DE | Wght./Gew. | Crit. P.: -- | Scale/M.stab: 1:5 | MNR

rexroth A Bosch Company

Mat.meets/Stoffe s: N2580-1 | Syst.: PE

DIM DRAWING MST290 (STATOR MOUNTED)
MASSZEICHNUNG MST290 (STATOR MONTIERT)

Sheet/Bl.: 1/1

Doc.type: MSZ | RA92051221 | DP/TD: 001 | Ind.: AD | Format: A4

Repl. for 106-0394-4022-01 | Repl. by

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Fig. 330: MST290, stator mounted

Motor MBT290, rotor and stator, mounted

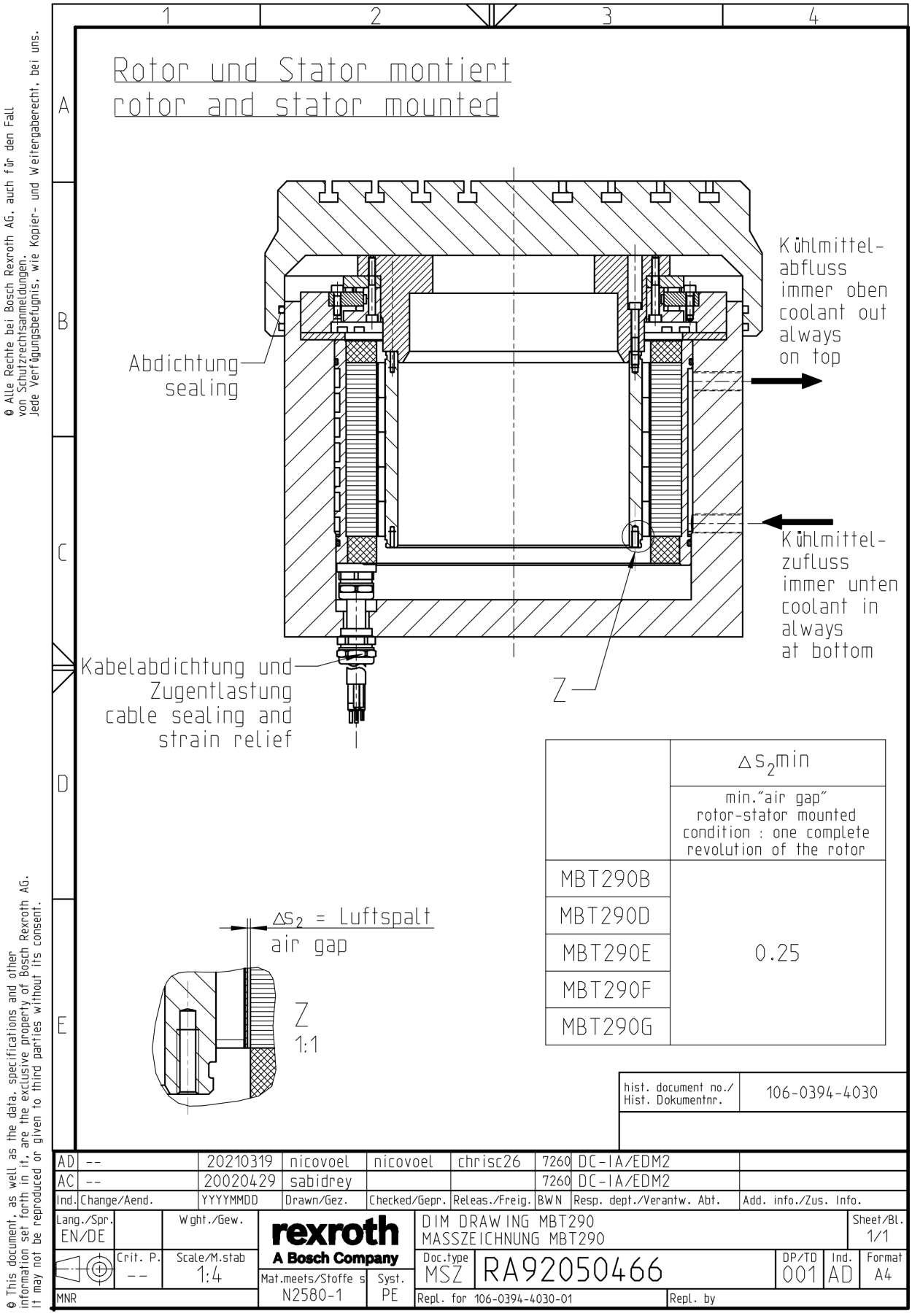


Fig. 331: MBT290, rotor and stator mounted

11.10.9 Mounting example MBT291

Rotor MRT291, mounted

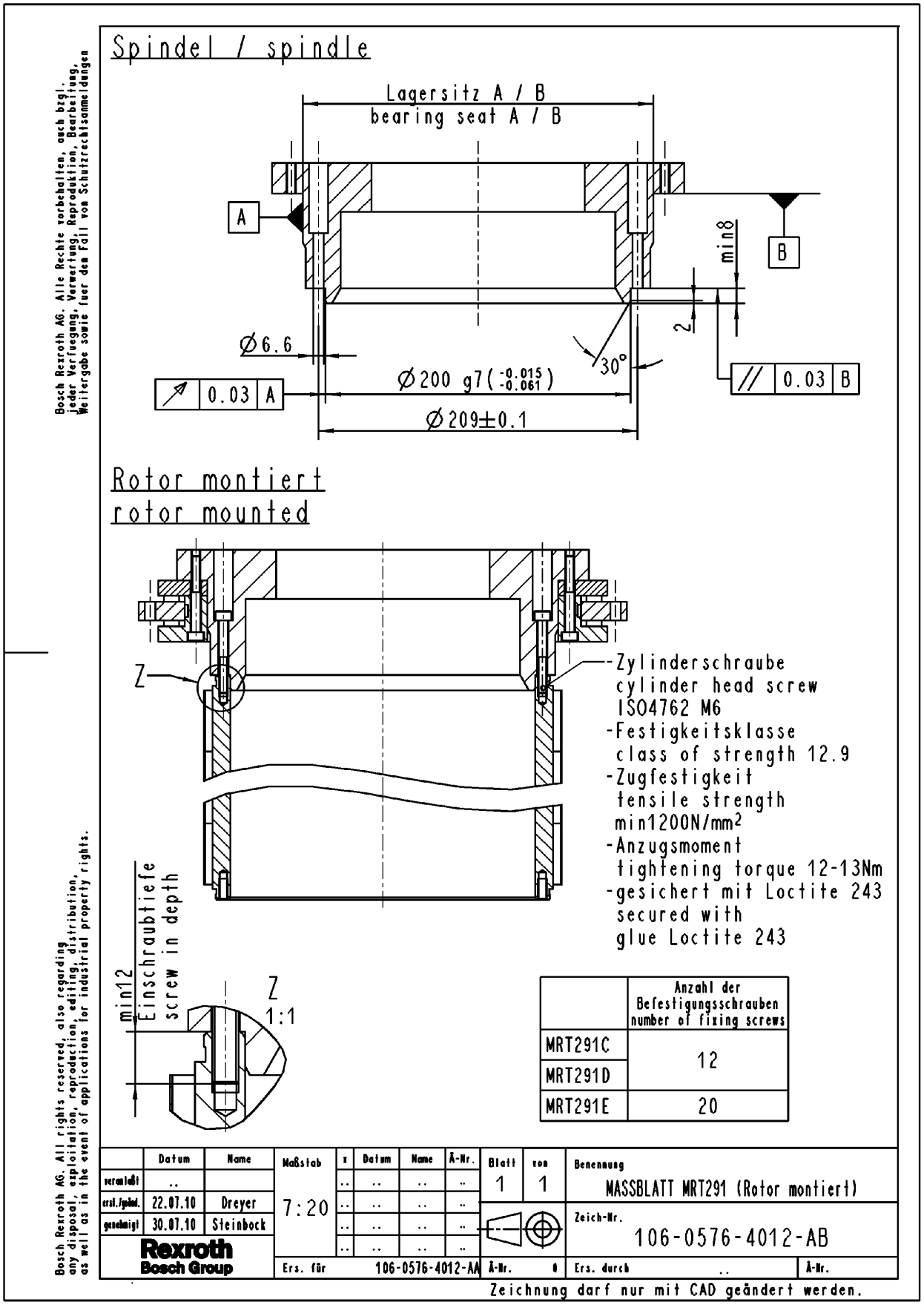


Fig. 332: MRT291 (rotor mounted)

Stator MST291, mounted

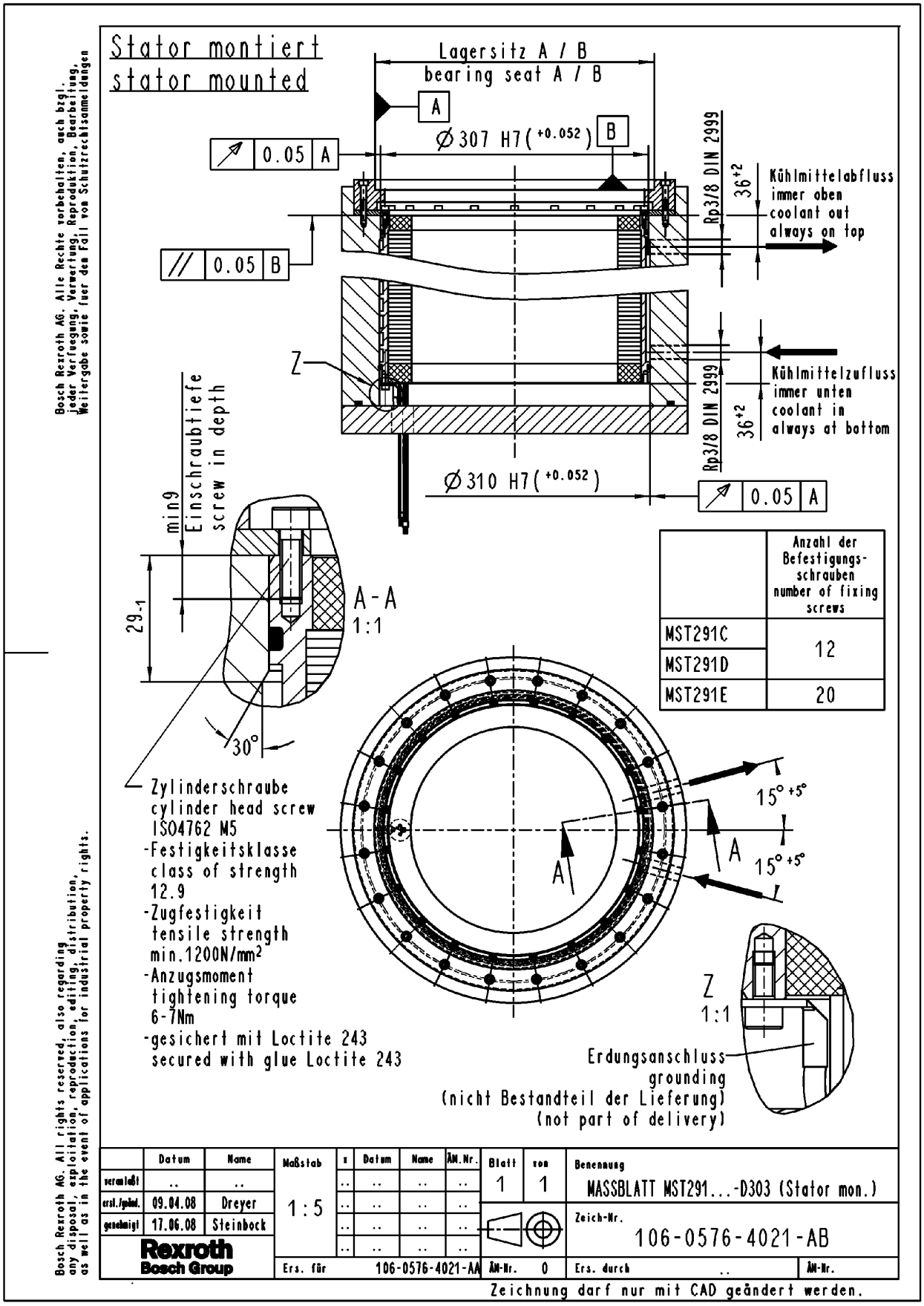


Fig. 333: MST291 (stator mounted)

Motor MBT291, rotor and stator, mounted

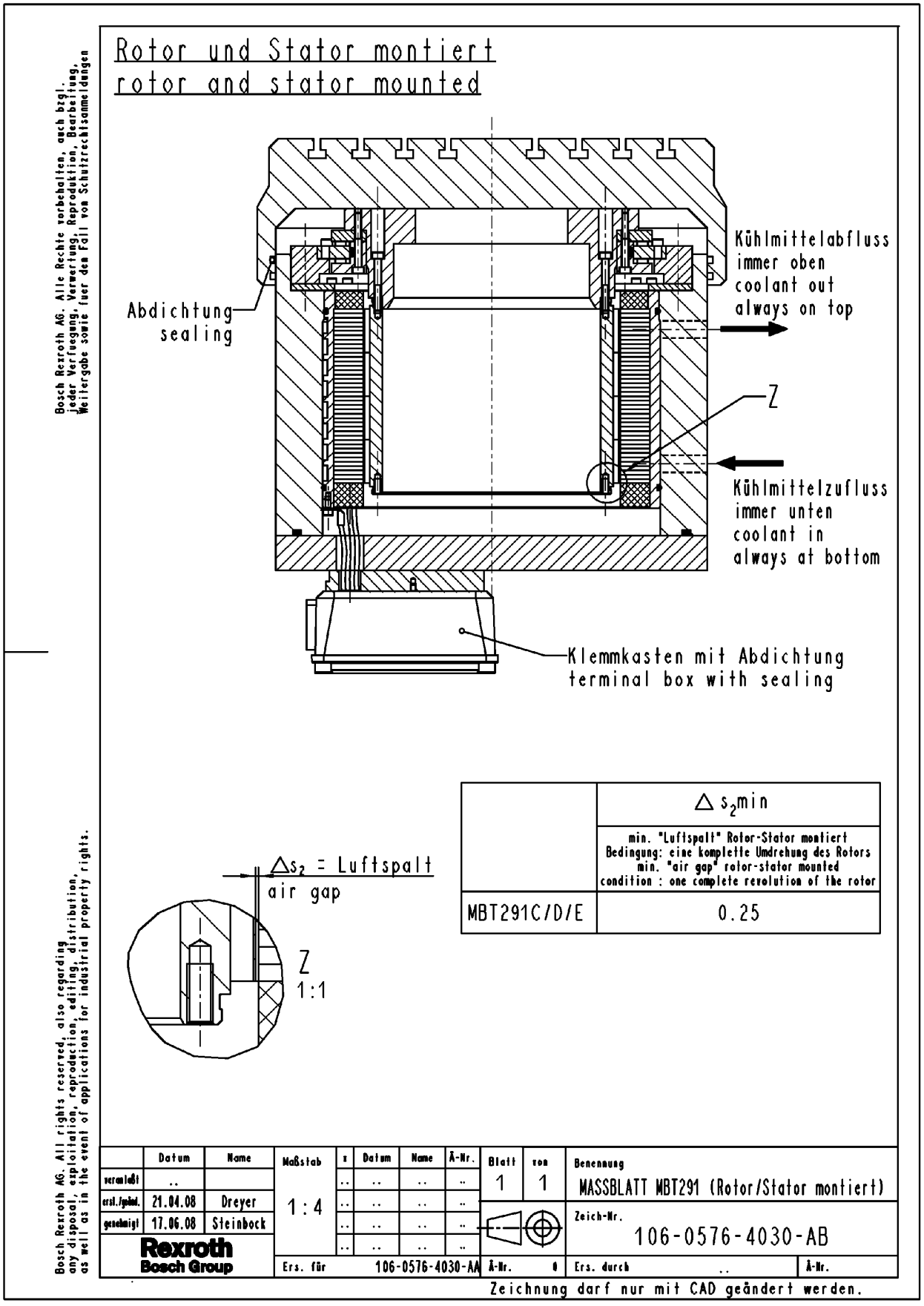
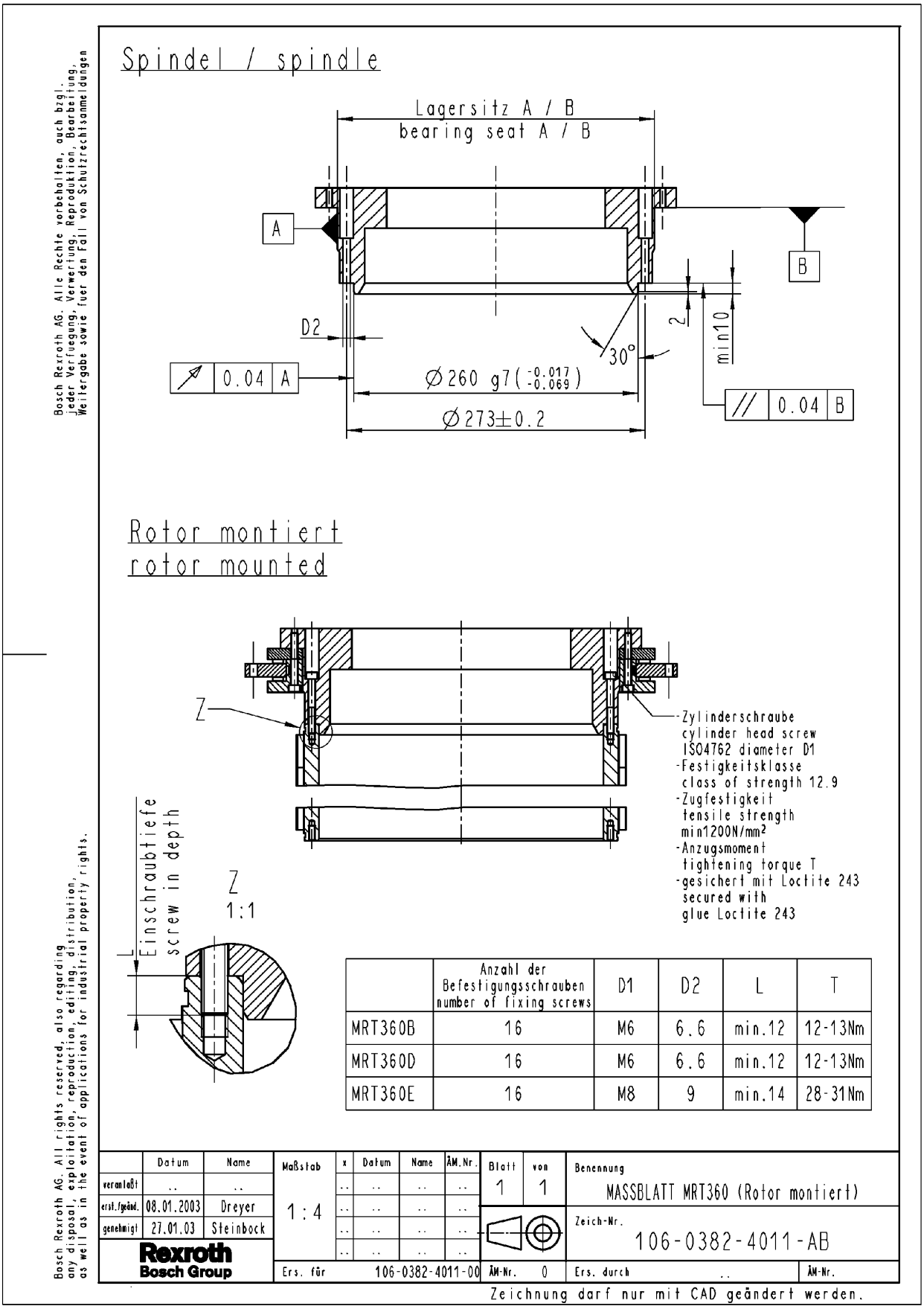


Fig. 334: MBT291 (rotor and stator mounted)

11.10.10 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. 335: MRT360, rotor mounted

Stator MST360 mounted, electrical connection "SN"

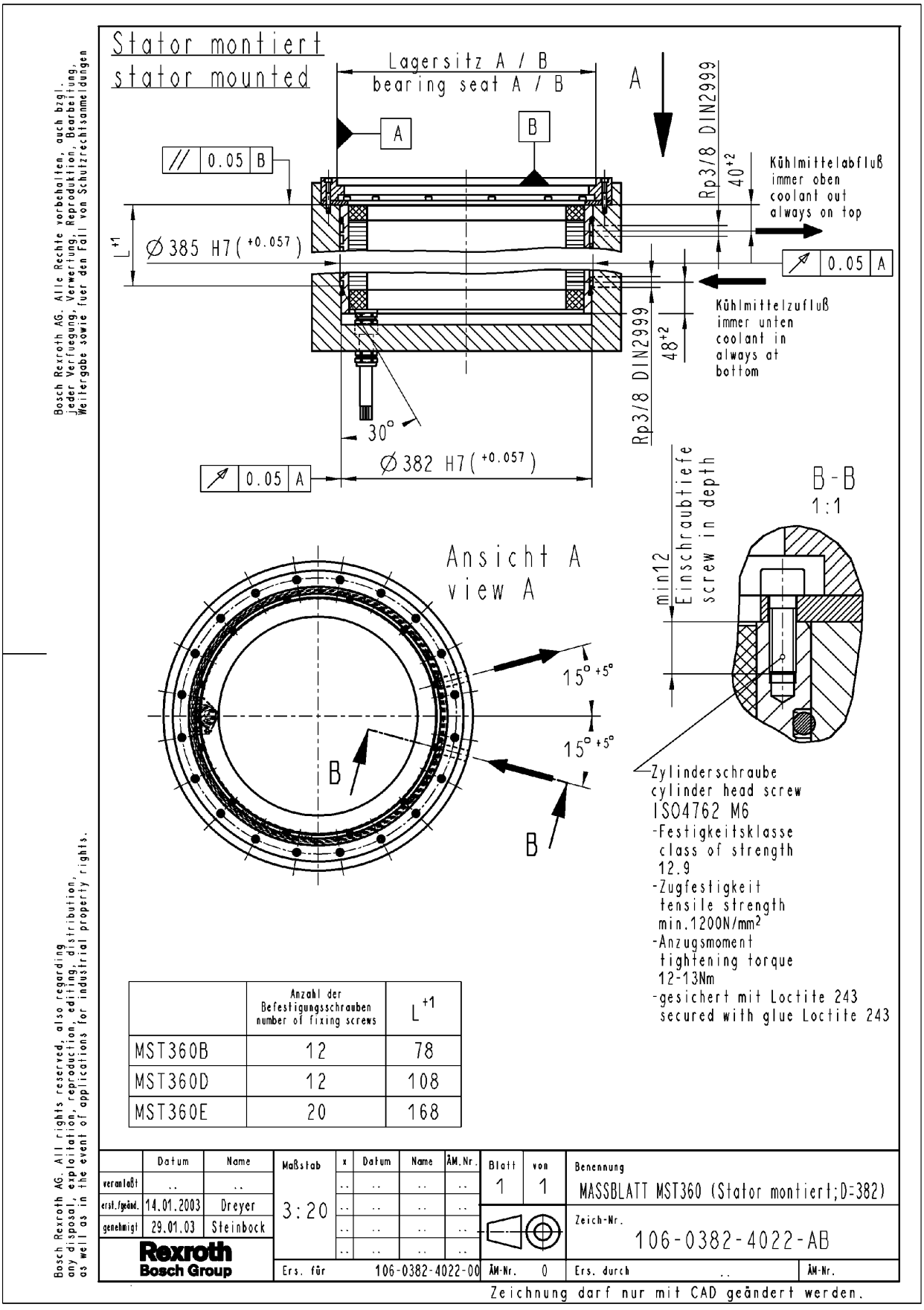


Fig. 336: MST360 mounted, electrical connection “SN”

Stator MST360 mounted, electrical connection "CN"

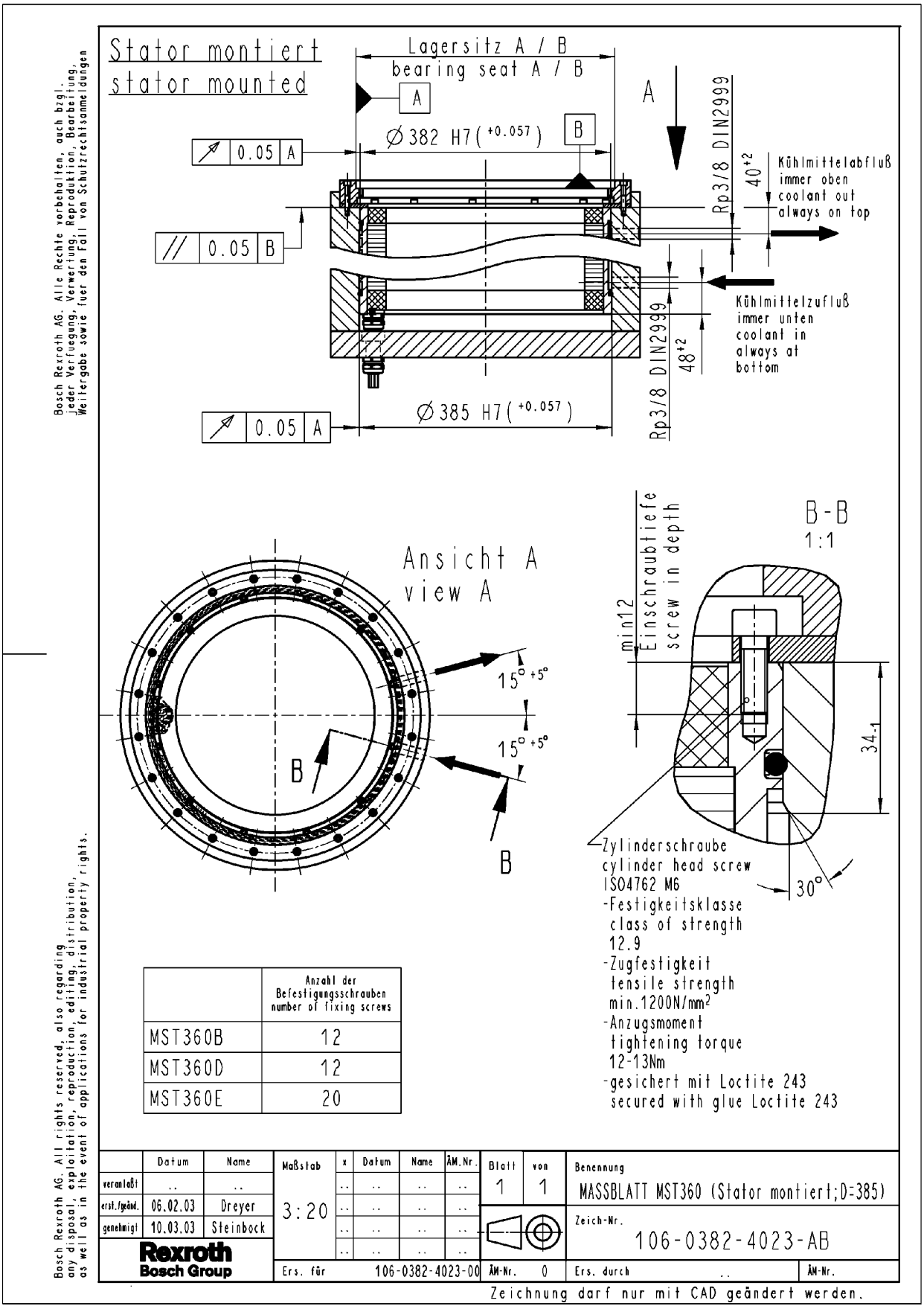


Fig. 337: MST360 mounted, electrical connection “CN”

Rotor and stator, mounted

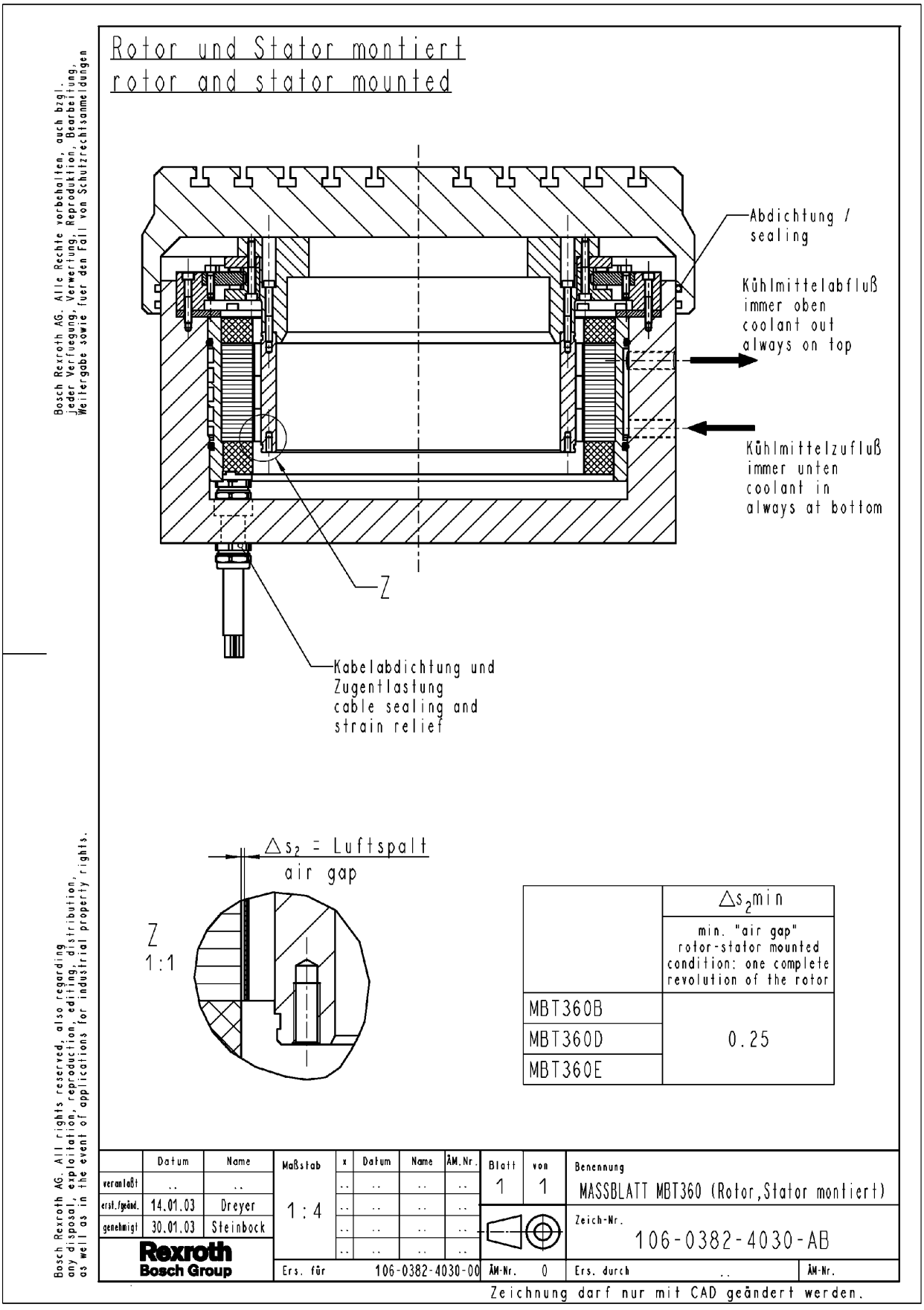


Fig. 338: Frame size 360, rotor and stator mounted

11.10.11 Mounting example MBT450

Rotor MRT450, mounted

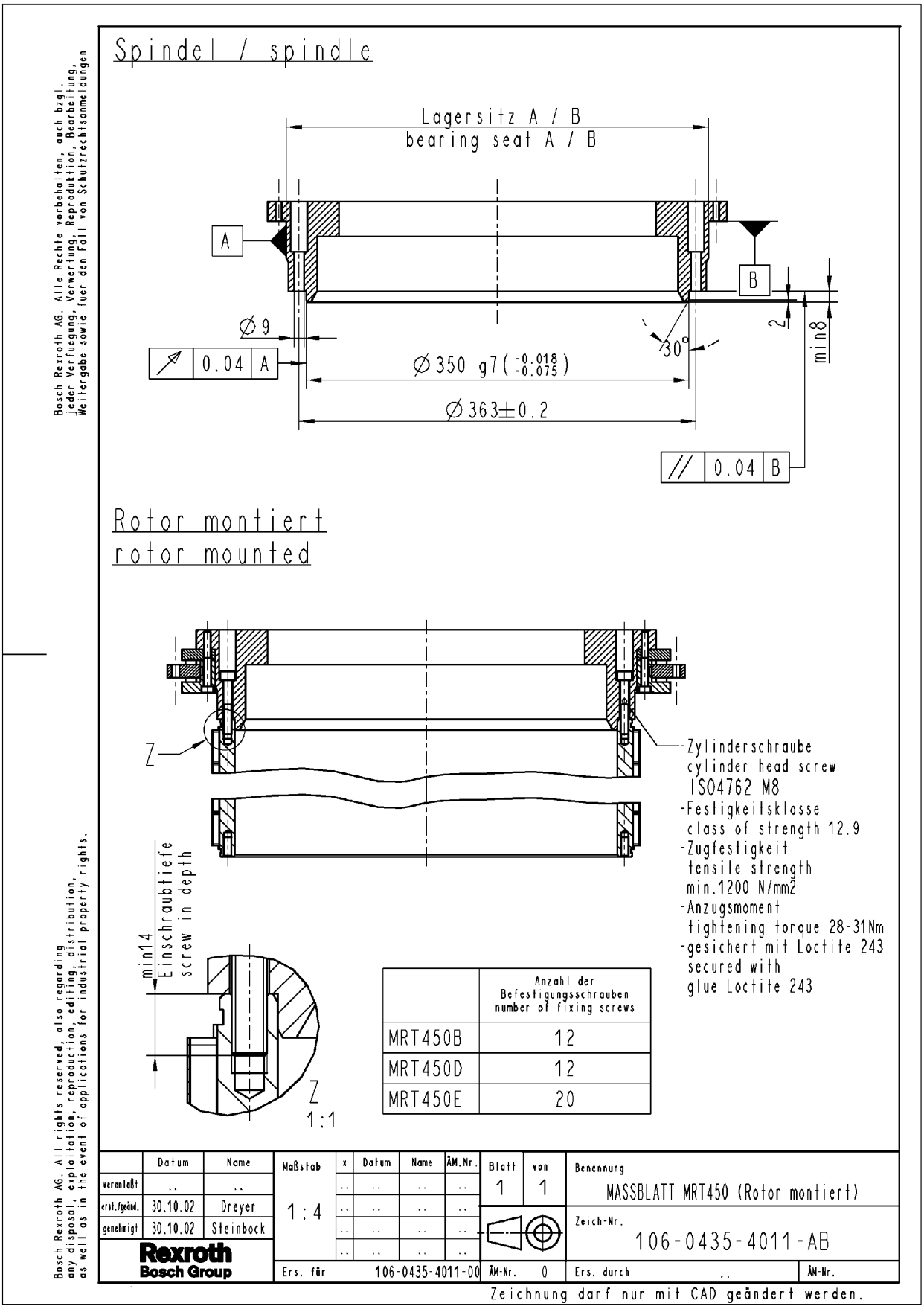


Fig. 339: MRT450, rotor mounted

Stator MST450, mounted

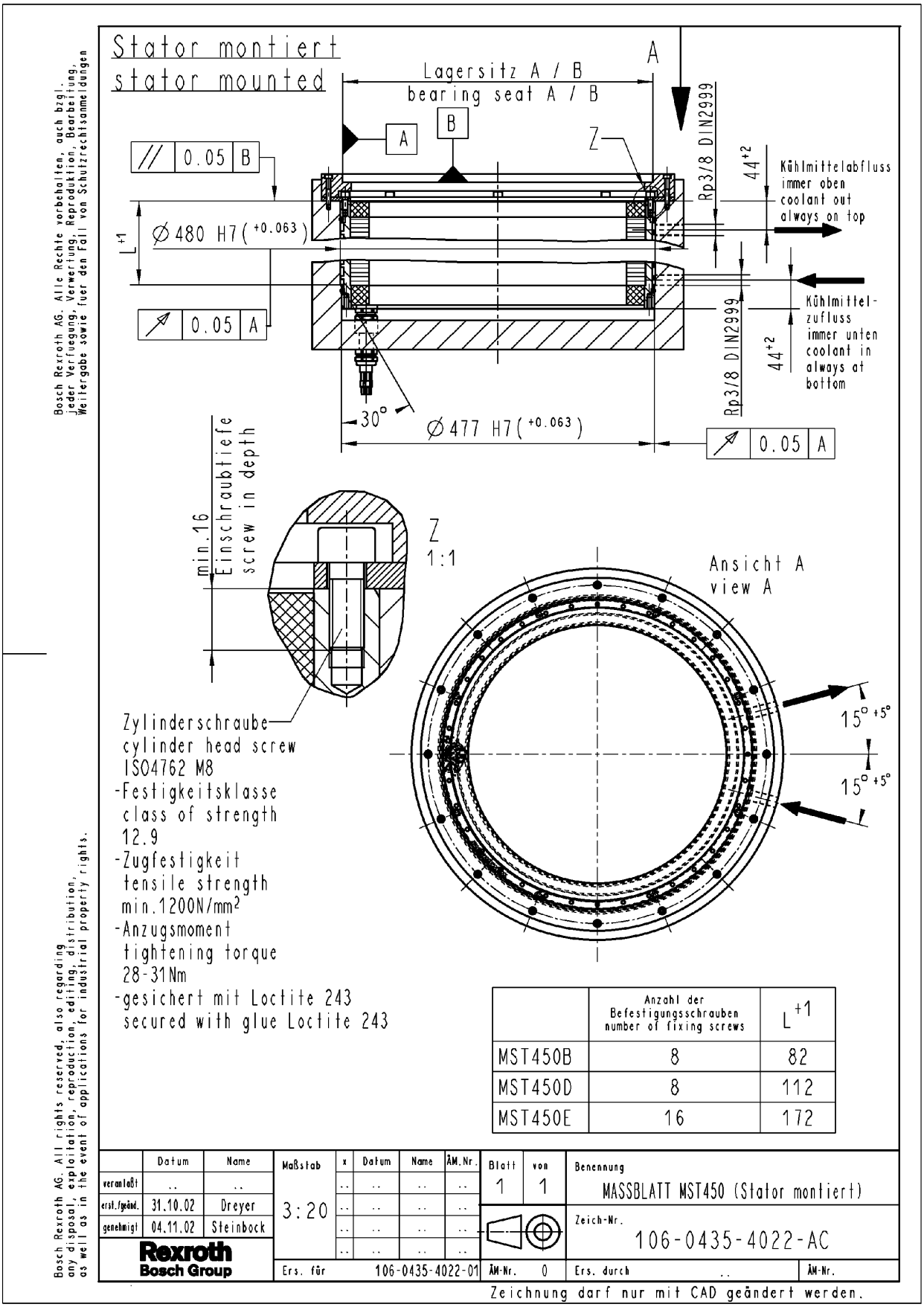


Fig. 340: Stator MST450, mounted

Rotor and stator, mounted

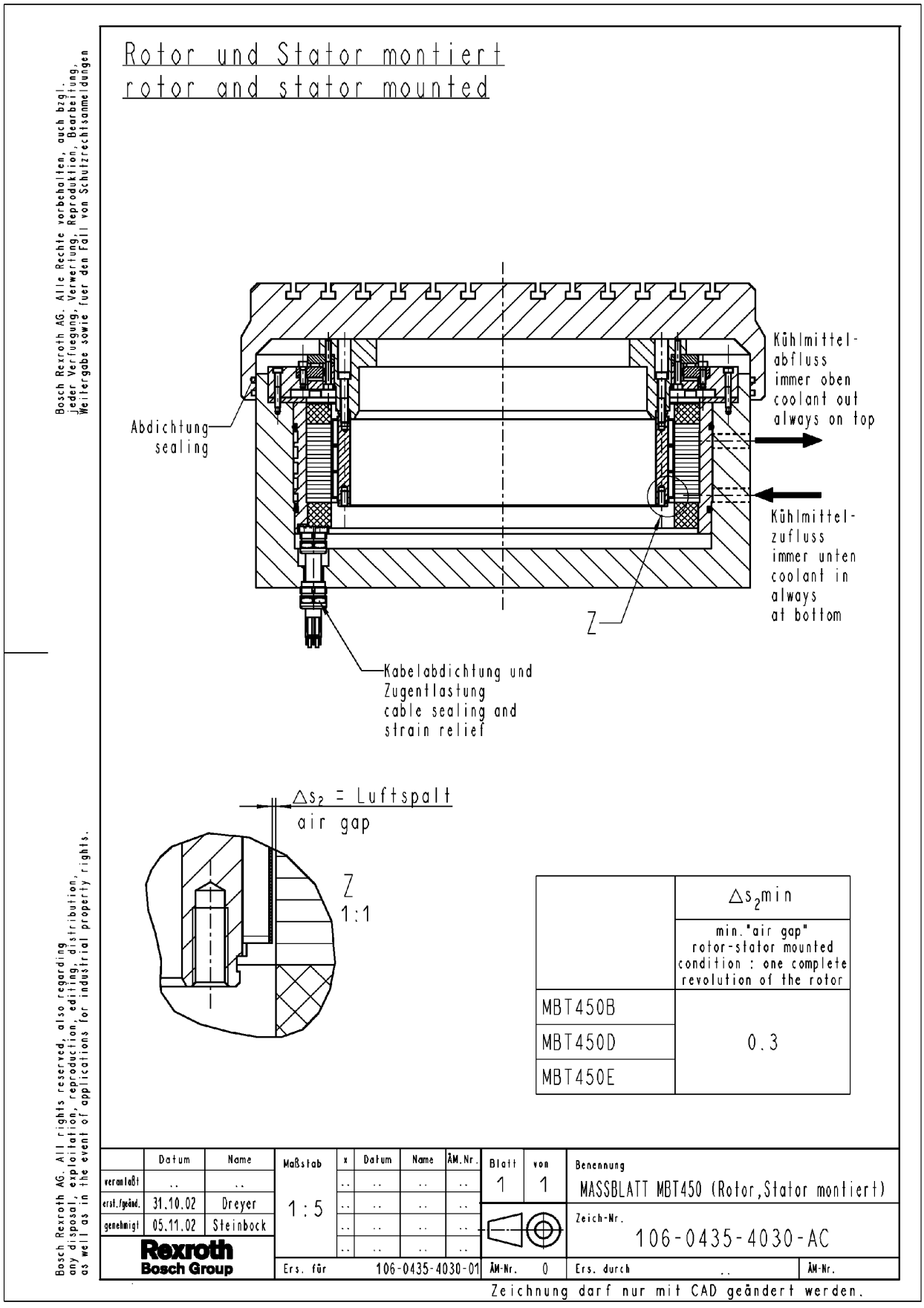
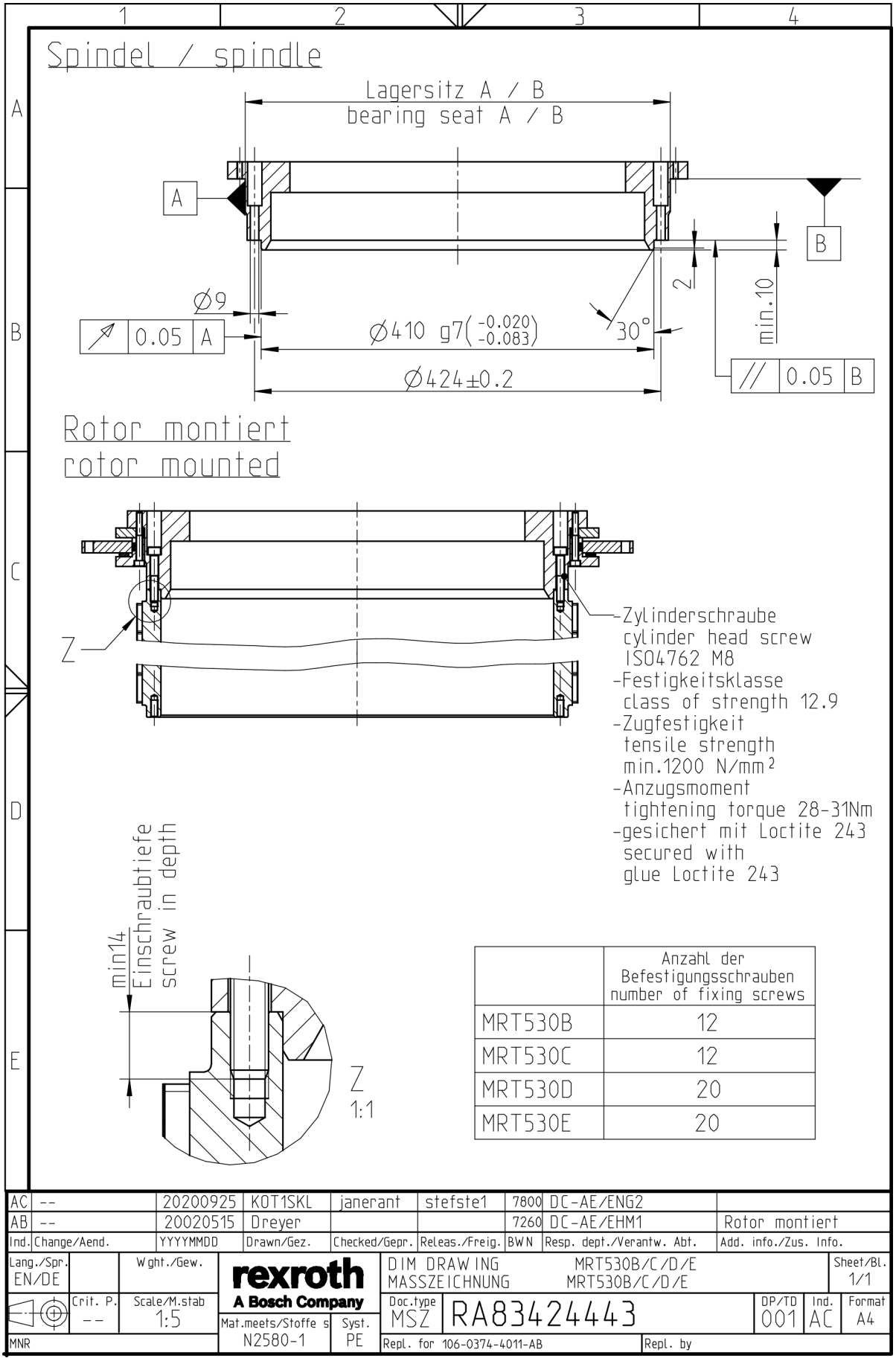


Fig. 341: Frame size 450, rotor and stator mounted

11.10.12 Mounting examples MBT530

Rotor MRT530B/ -C/ -D/ -E, mounted



	Anzahl der Befestigungsschrauben number of fixing screws
MRT530B	12
MRT530C	12
MRT530D	20
MRT530E	20

AC	--	20200925	KOT1SKL	janerant	stefste1	7800	DC-AE/ENG2	
AB	--	20020515	Dreyer			7260	DC-AE/EHM1	Rotor montiert
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	MRT530B/C/D/E MRT530B/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	RA83424443	DP/TD 001 / Ind. AC / Format A4
MNR					Repl. for 106-0374-4011-AB	Repl. by	

Fig. 342: Rotor MRT530B/ -C/ -D/ -E, mounted

Rotor MRT530F/ -G/ -L/ -P/ -R, mounted

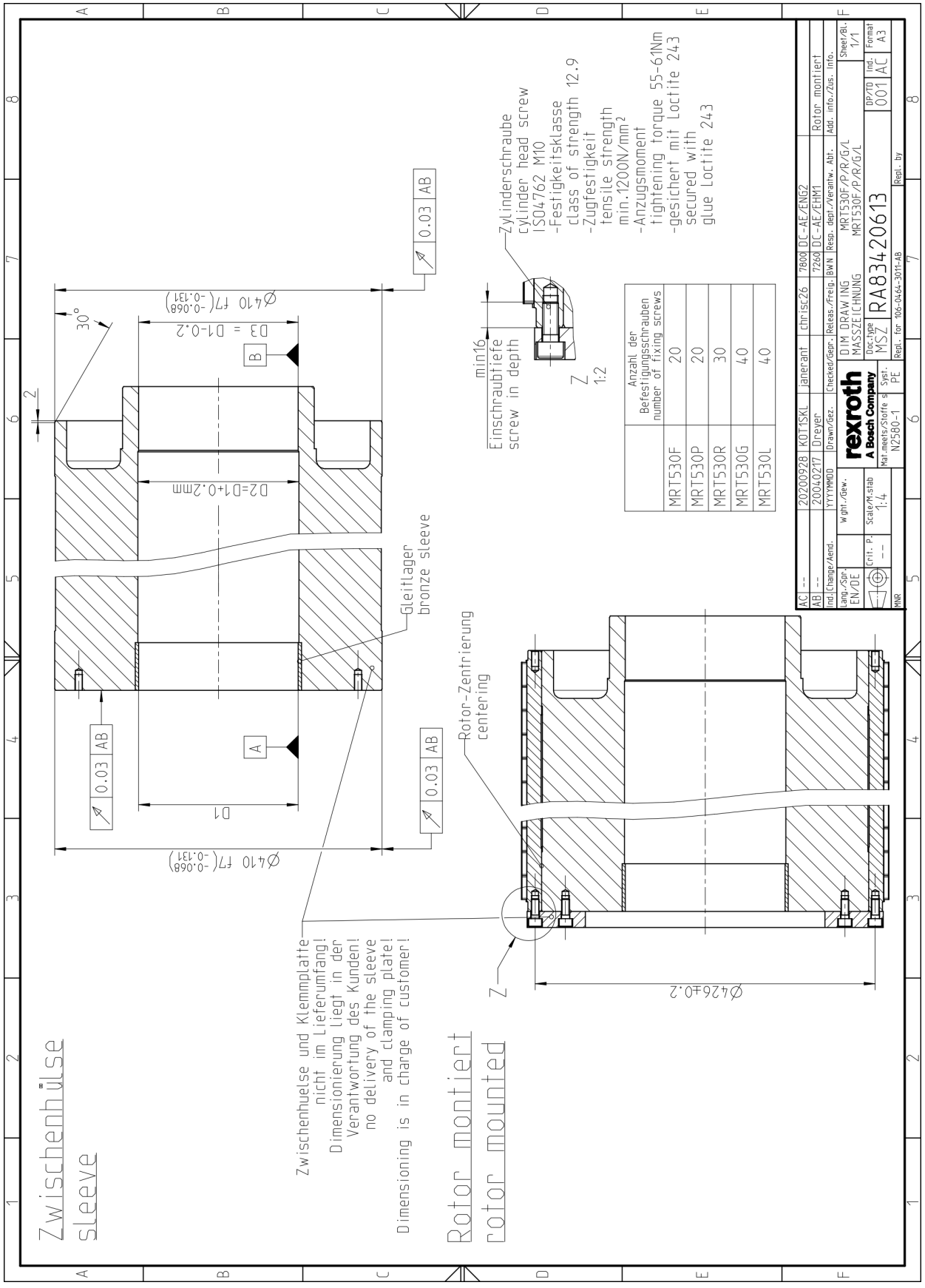
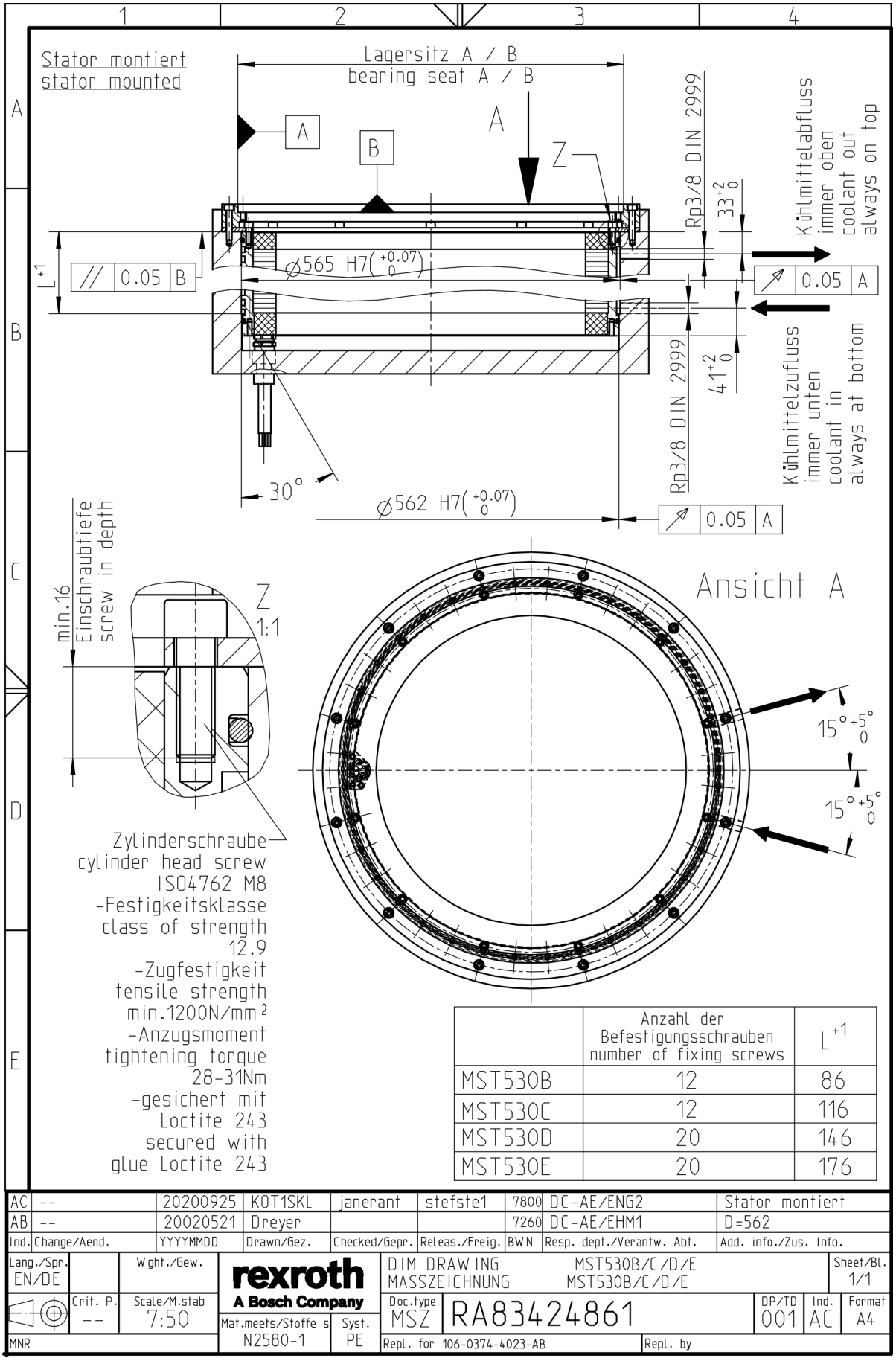


Fig. 343: Rotor MRT530F/ -G/ -L/ -P/ -R, mounted

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

AC	--	20200925	KOT1SKL	janerant	stefste1	7800	DC-AE/ENG2	Stator montiert	
AB	--	20020521	Dreyer			7260	DC-AE/EHM1	D=562	
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	MST530B/C/D/E 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. 344: Stator MST530B/ -C/ -D/ -E, electrical connection "SN", mounted

Stator MST530B/ -C/ -D/ -E, electrical connection "CN", mounted

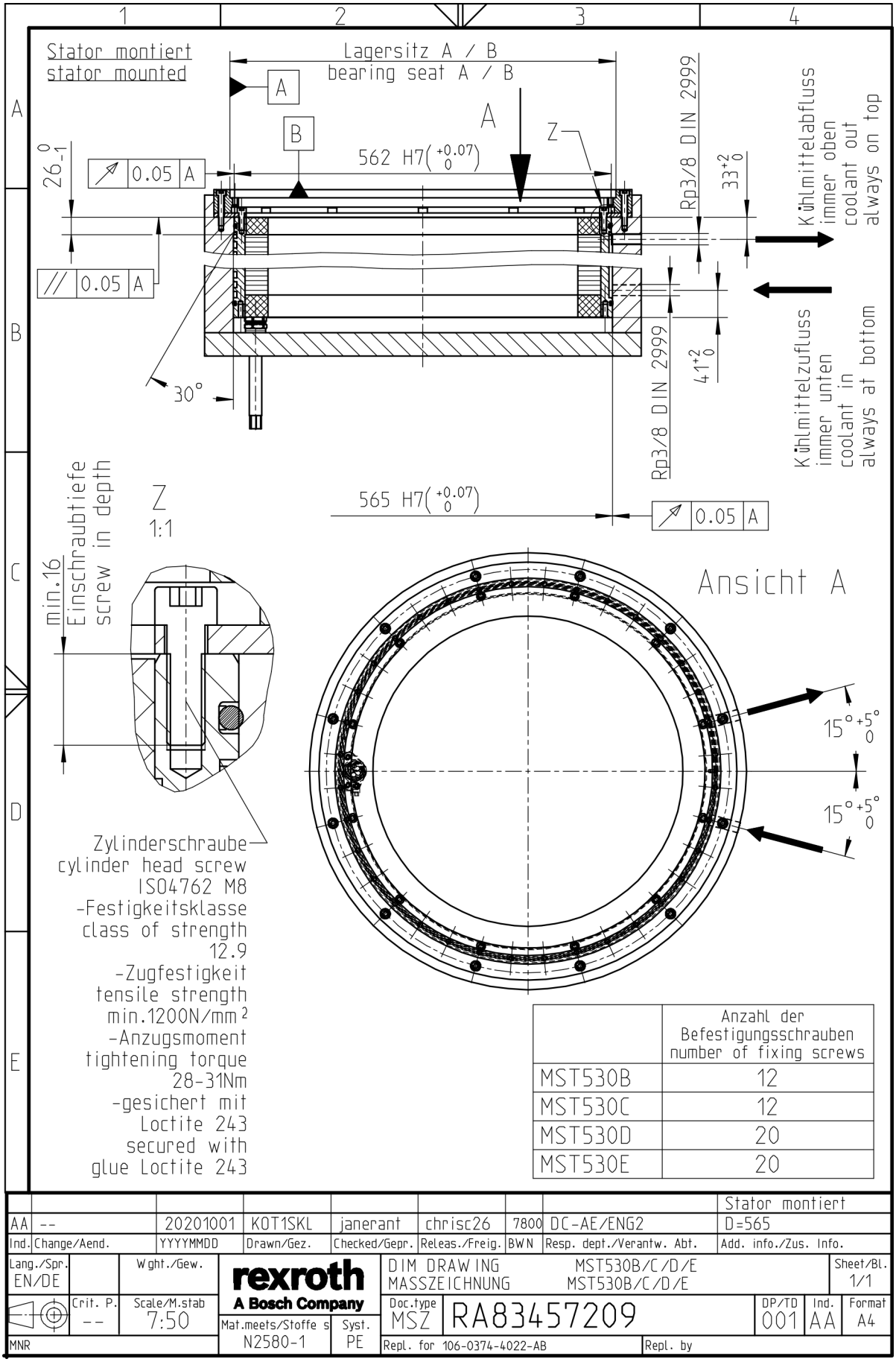


Fig. 345: Stator MST530B/ -C/ -D/ -E, electrical connection "CN", mounted

Frame size 530B/ -C/ -D/ -E, rotor and stator mounted

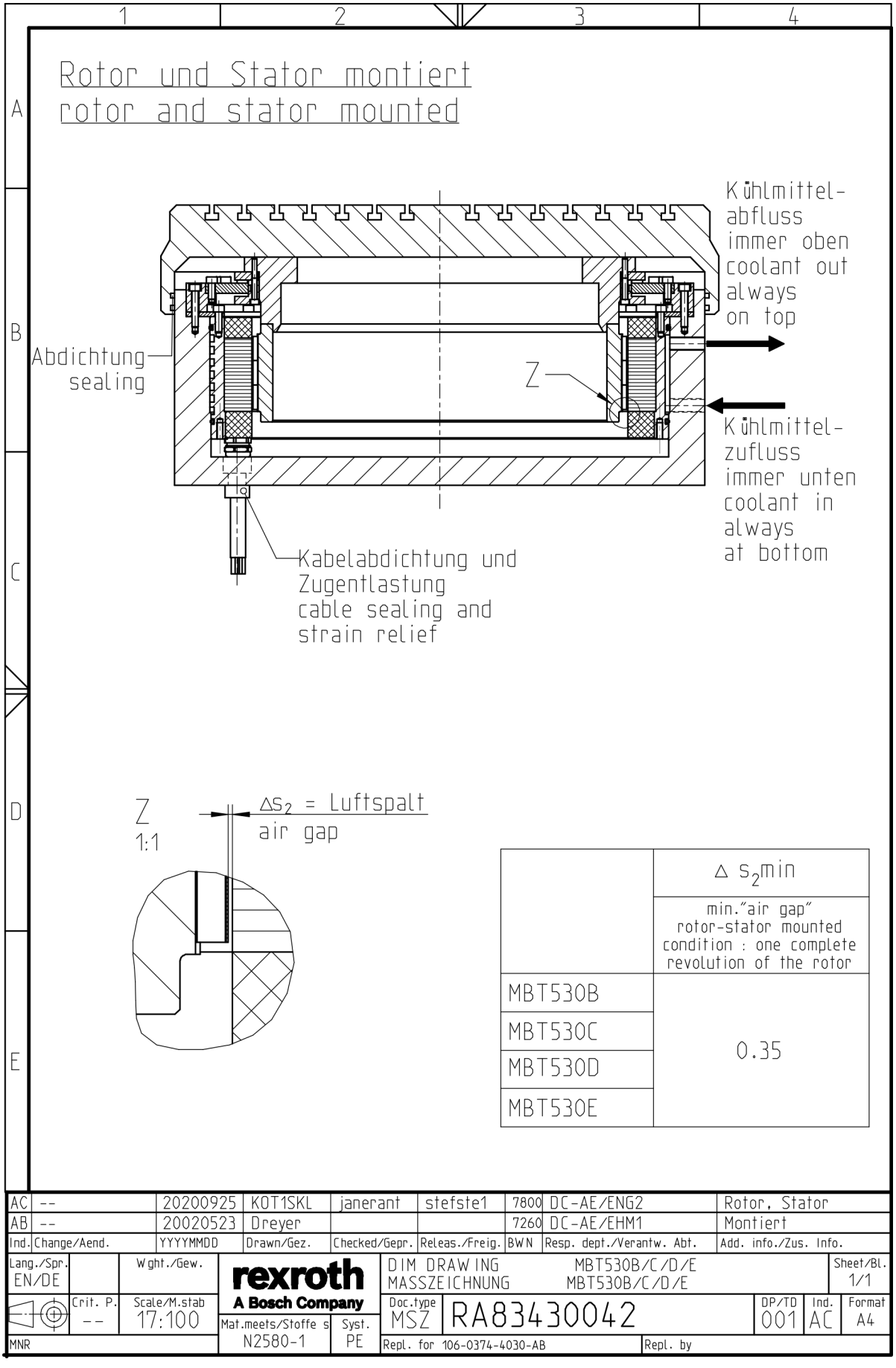


Fig. 346: Frame size 530B/ -C/ -D/ -E, rotor and stator mounted

MST530F/ -G/ -L/ -P/ -R, mounting housing

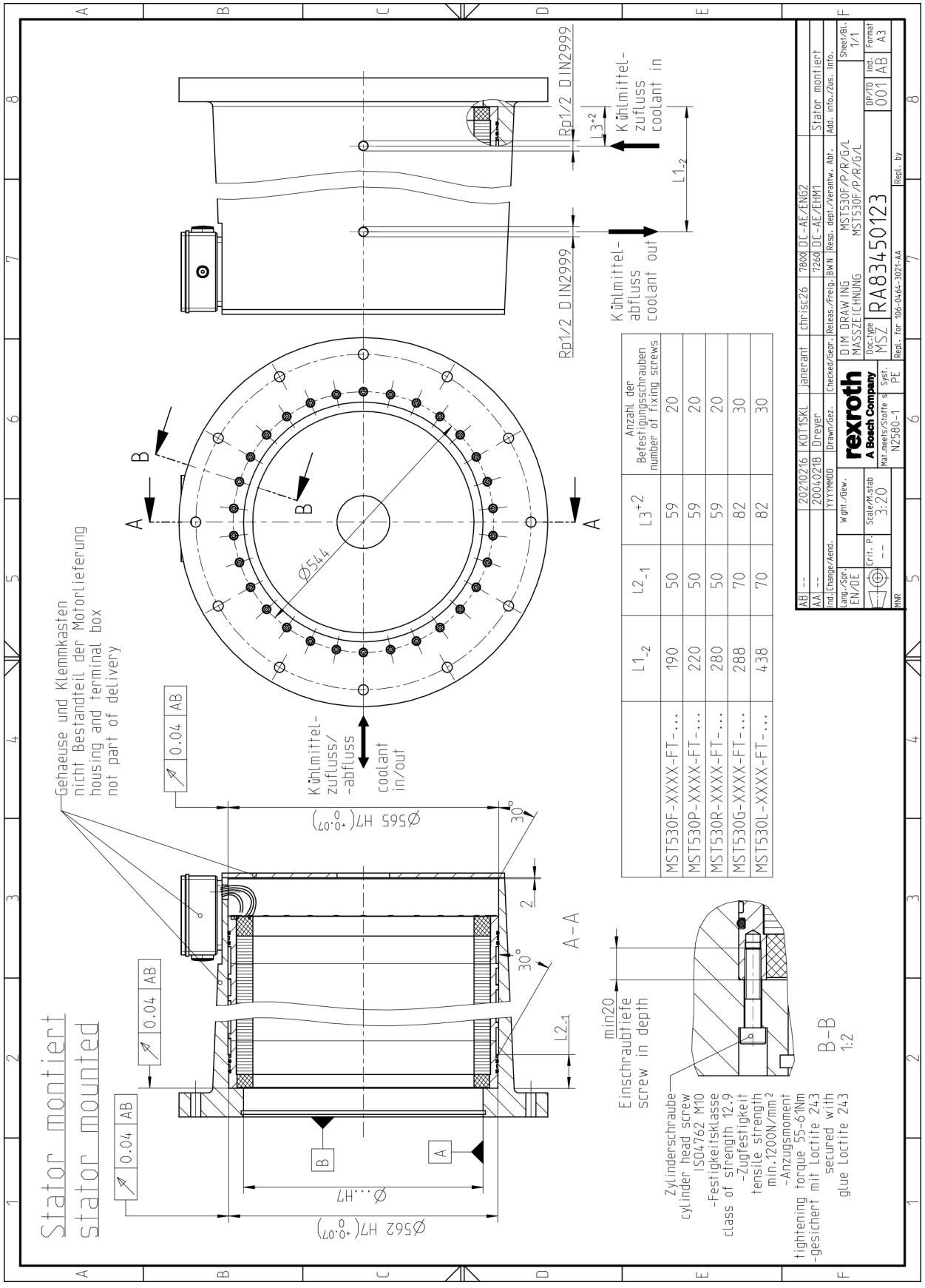


Fig. 347: MST530F/ -G/ -L/ -P/ -R, mounting housing

Frame size 530F/ -G/ -L/ -P/ -R, mounting with housing

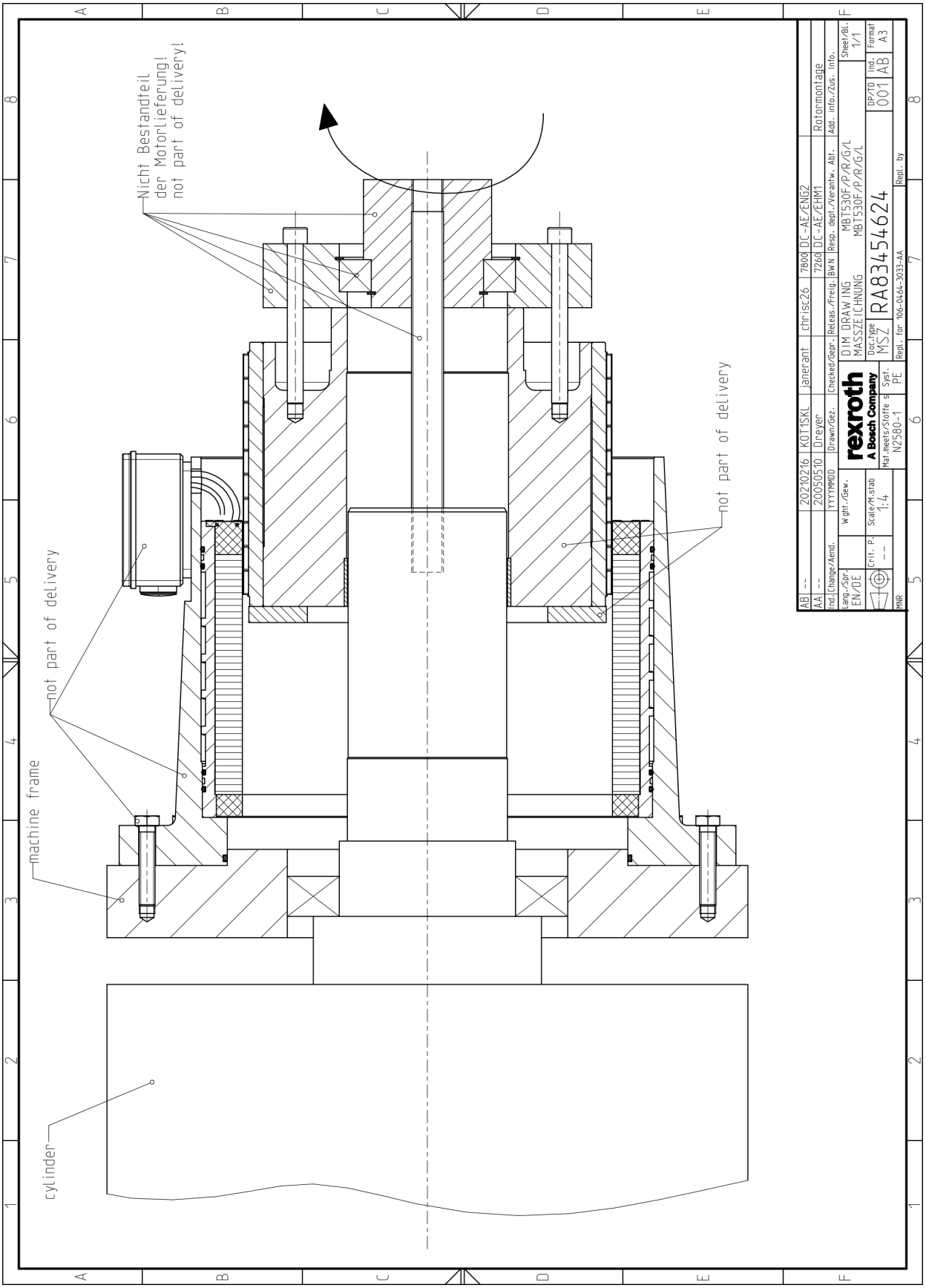


Fig. 348: Frame size 530F/ -G/ -L/ -P/ -R, mounting with housing

Frame size 530F/ -G/ -L/ -P/ -R with housing, mounted

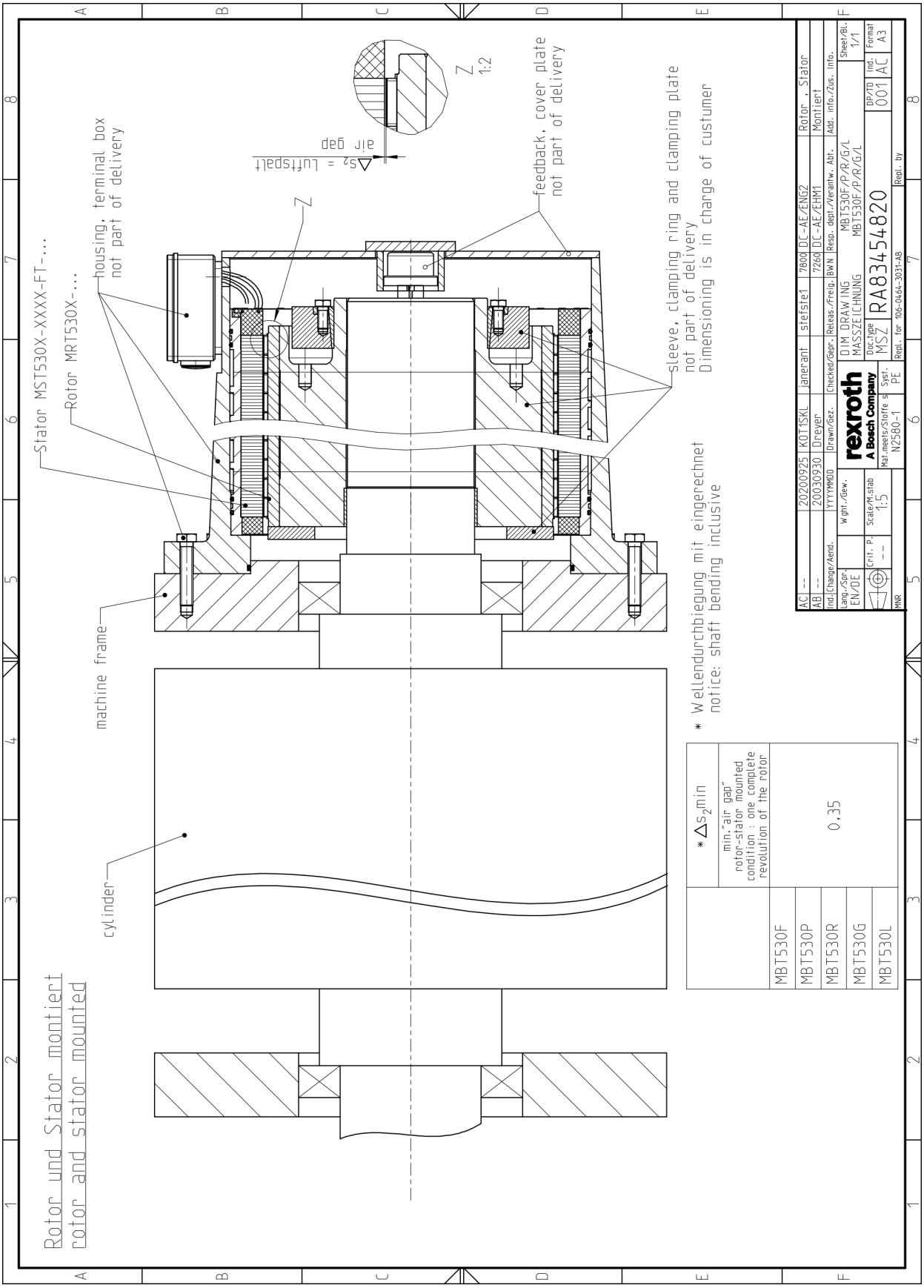


Fig. 349: Frame size 530F/ -G/ -L/ -P/ -R with housing, mounted

Dimensioning of shaft and stator for MBT530F/ -G/ -L/ -P/ -R

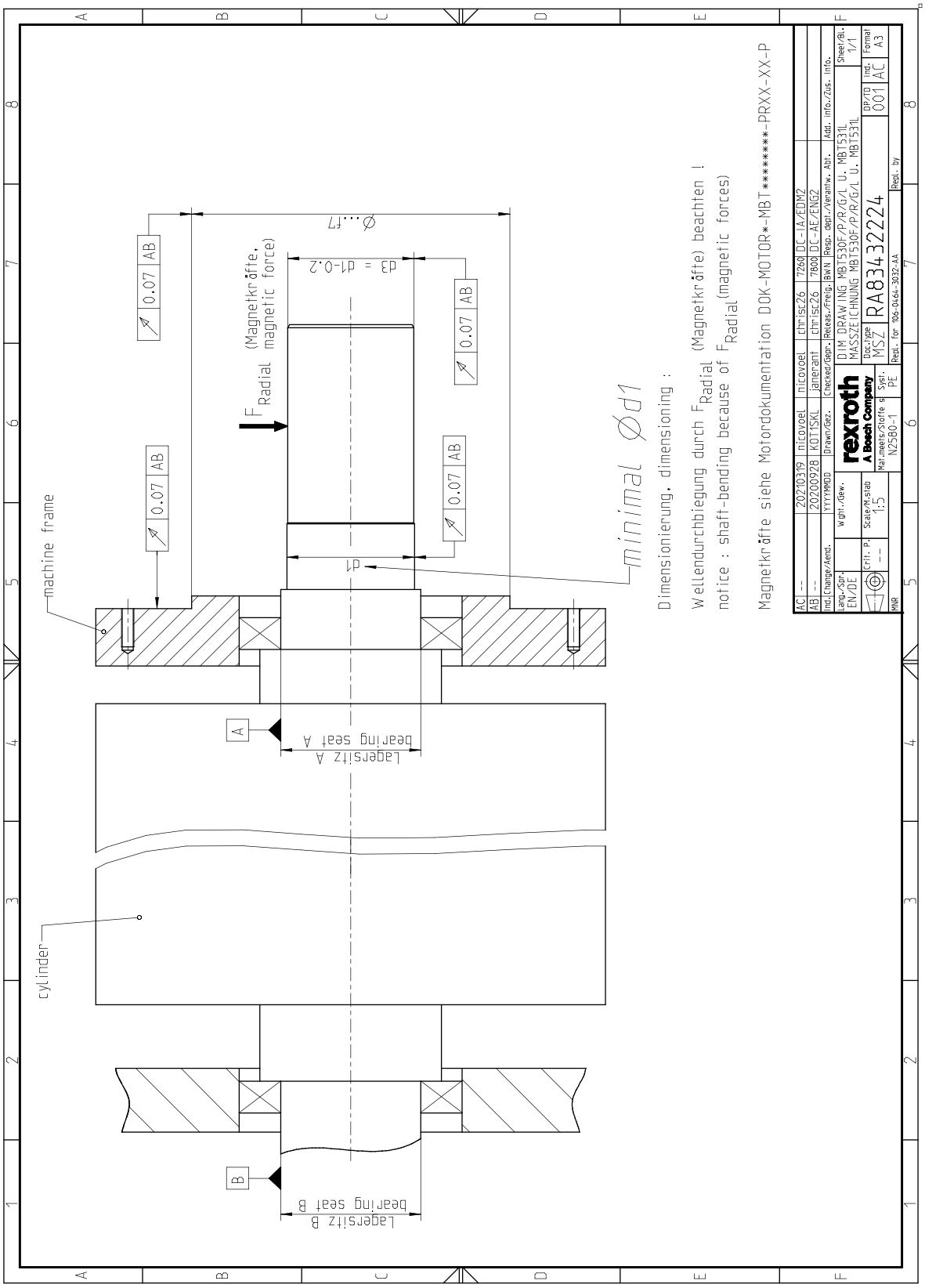


Fig. 350: Dimensioning of shaft for MBT530F/ -G/ -L/ -P/ -R

Example of a assembly aid for MBT530F/ -G/ -L/ -P/ -R

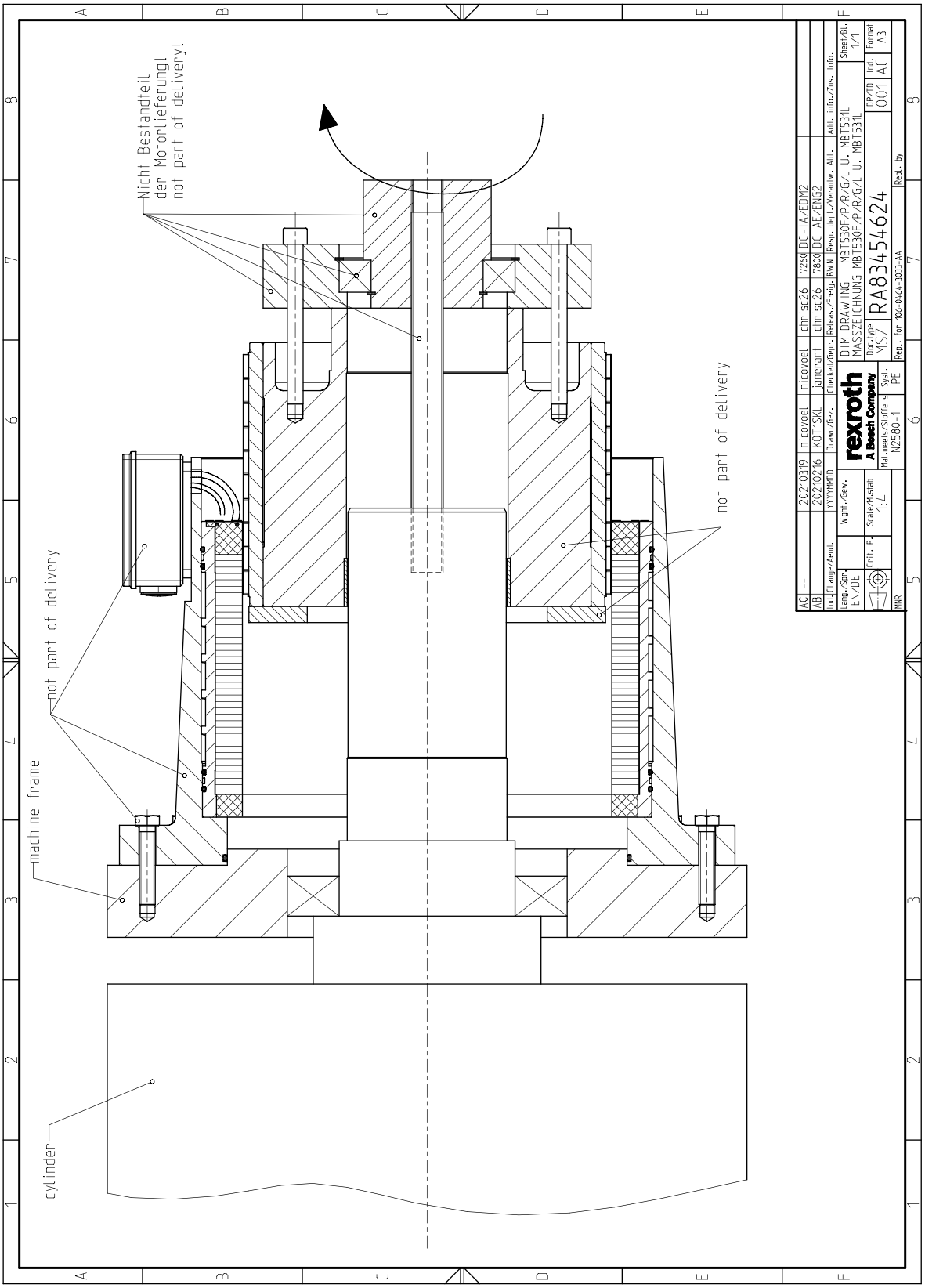


Fig. 351: Example of a assembly aid for MBT530F/ -G/ -L/ -P/ -R

Motor MBT530F/ -G/ -L/ -P/ -R, rotor and stator mounted

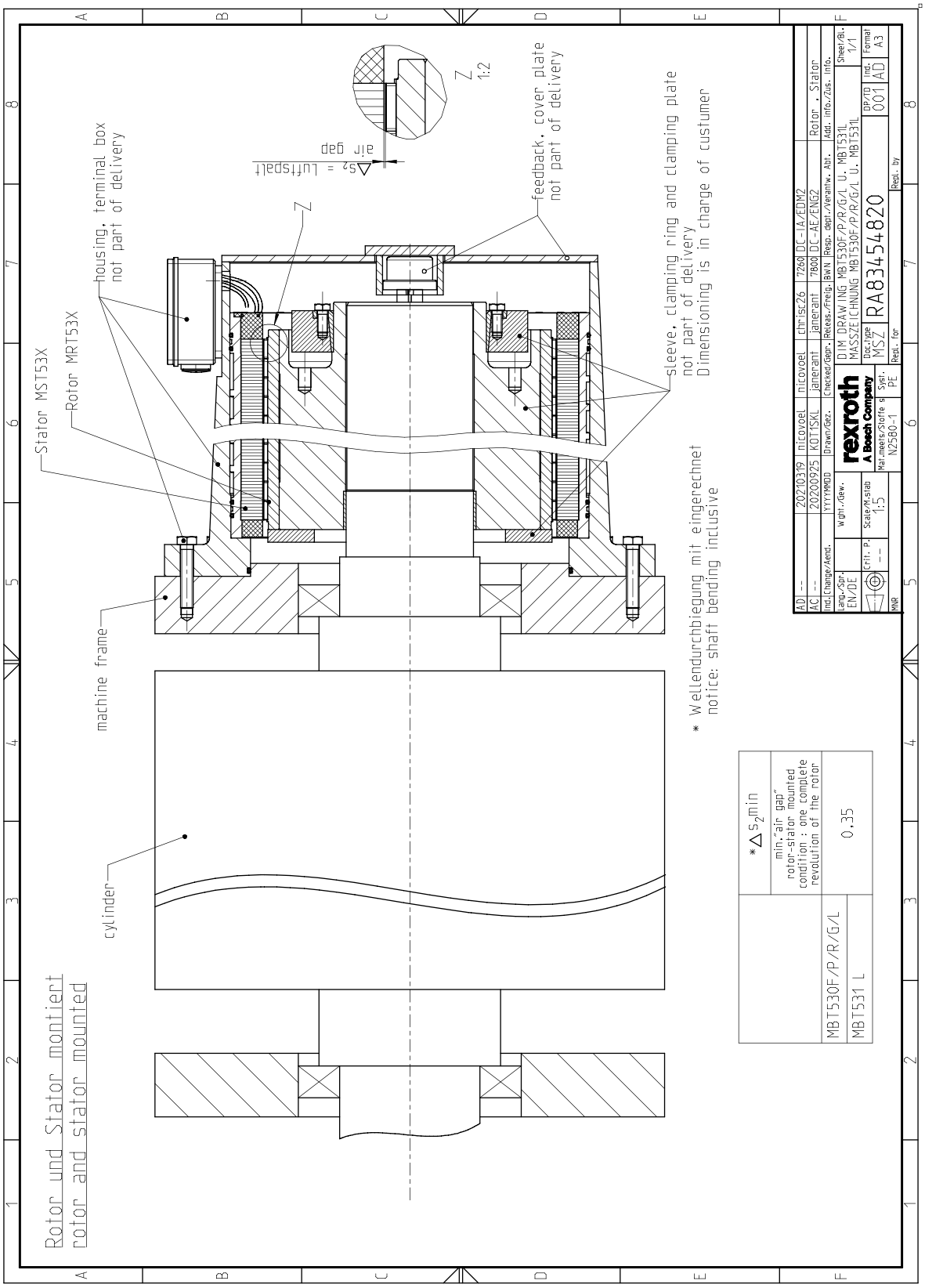


Fig. 352: Motor MBT530F/ -G/ -L/ -P/ -R, rotor and stator mounted

11.10.13 Mounting example MBT531

Rotor MRT531E, mounted

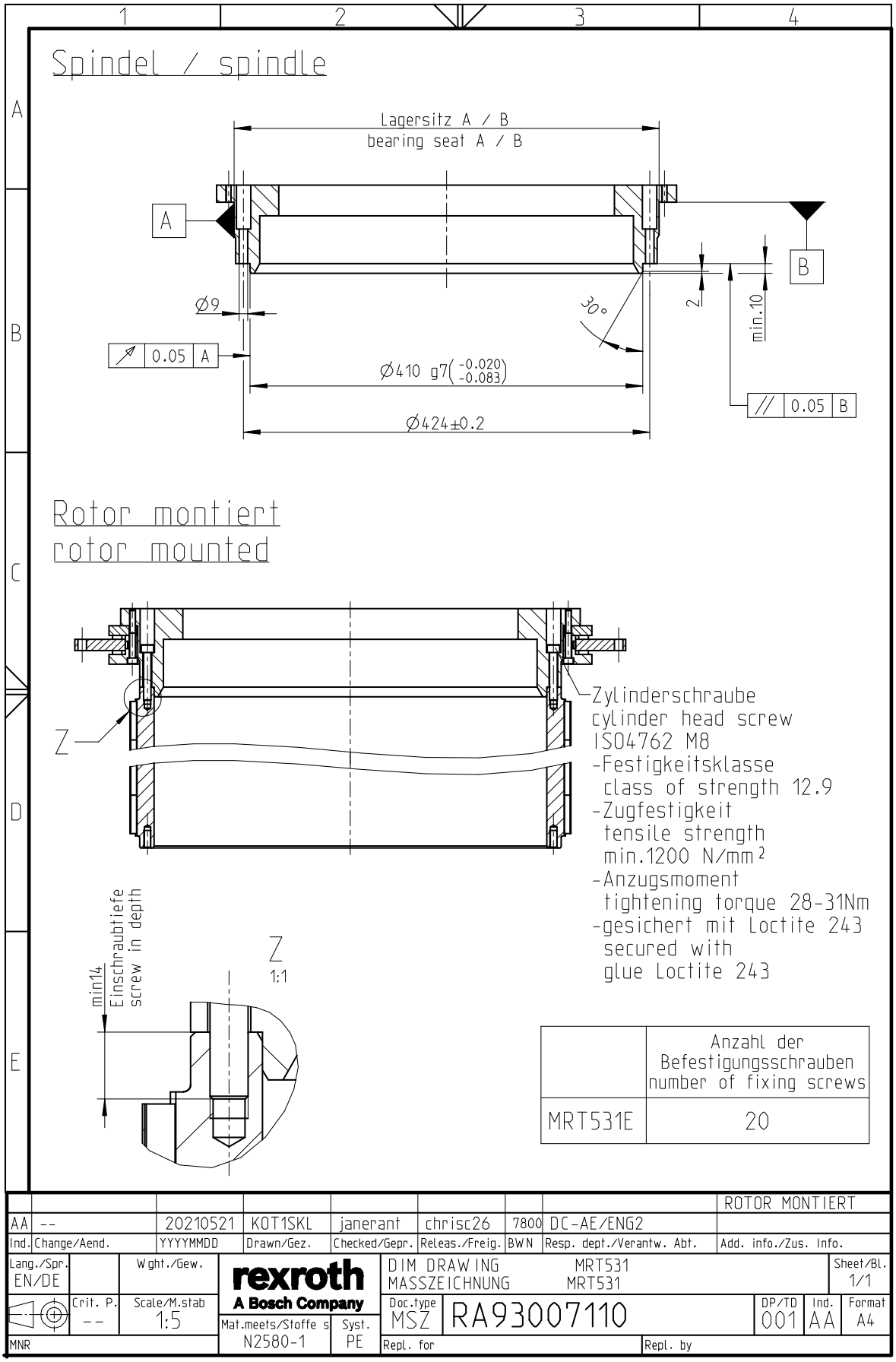


Fig. 353: MRT531E (rotor mounted)

Stator MST531E, mounted

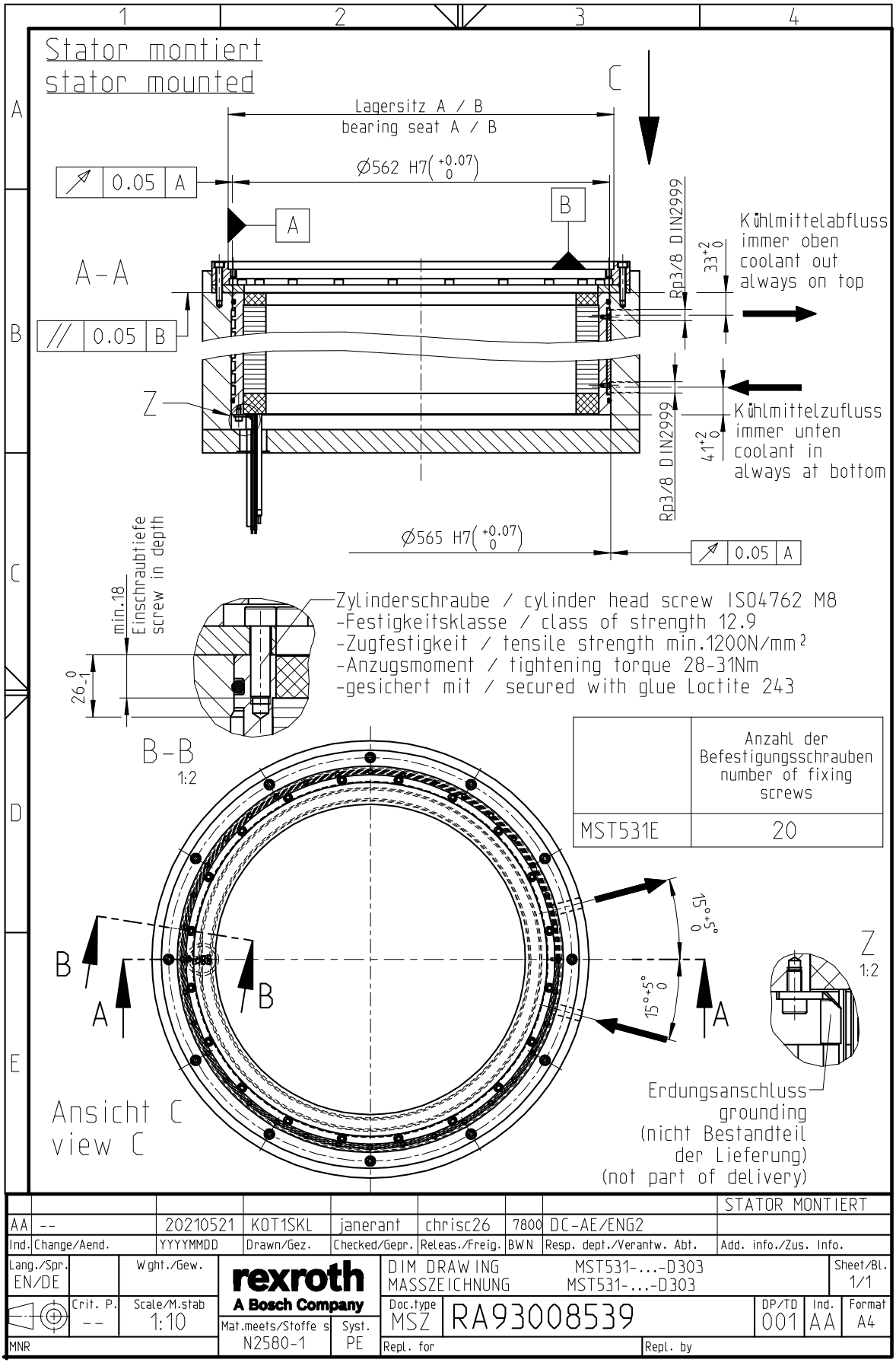


Fig. 354: MST531E (stator mounted)

Motor MBT531E, rotor and stator, mounted

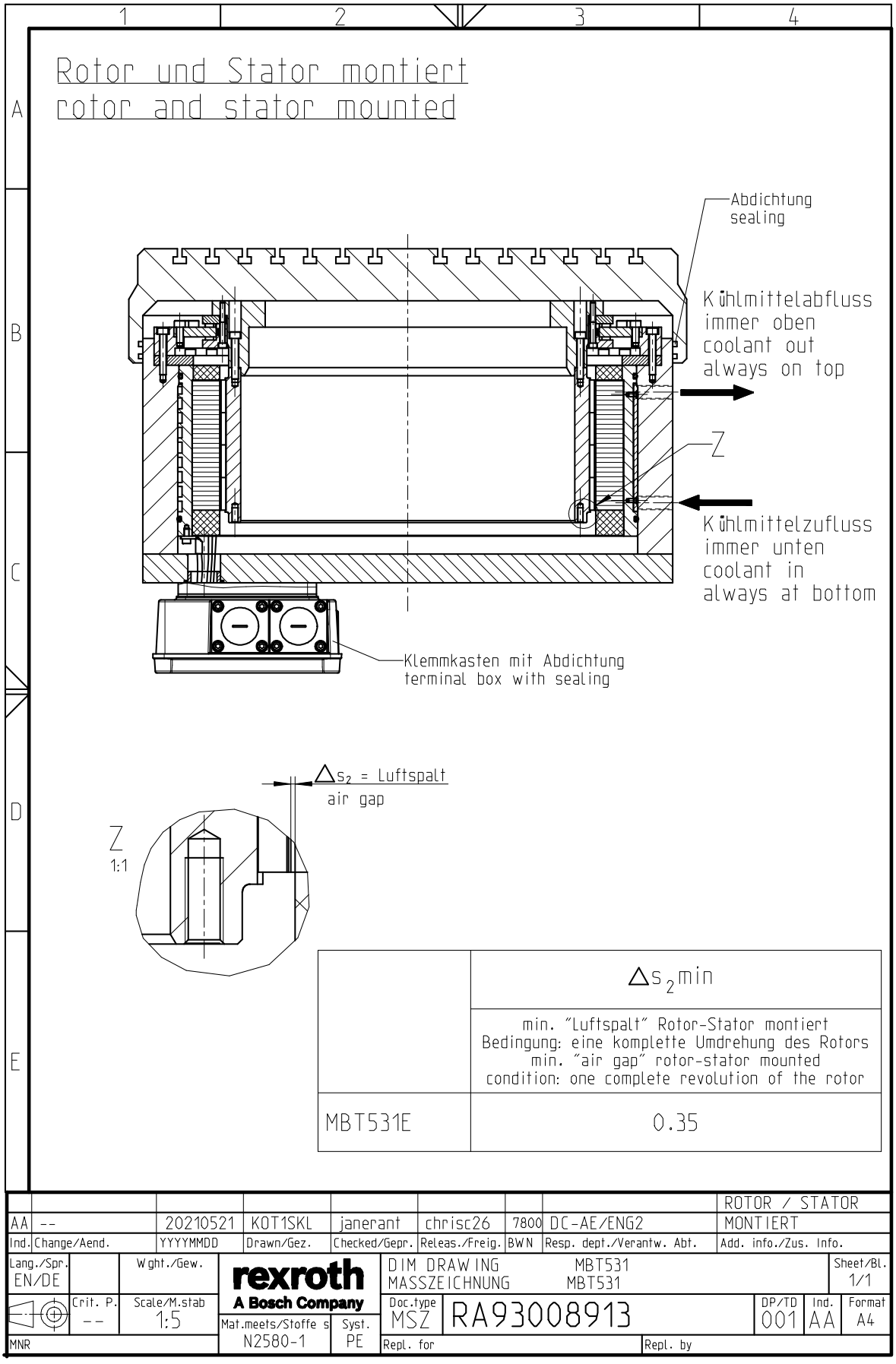


Fig. 355: MBT531E (rotor and stator mounted)

Dimensionsing of shaft for rotor MRT531L

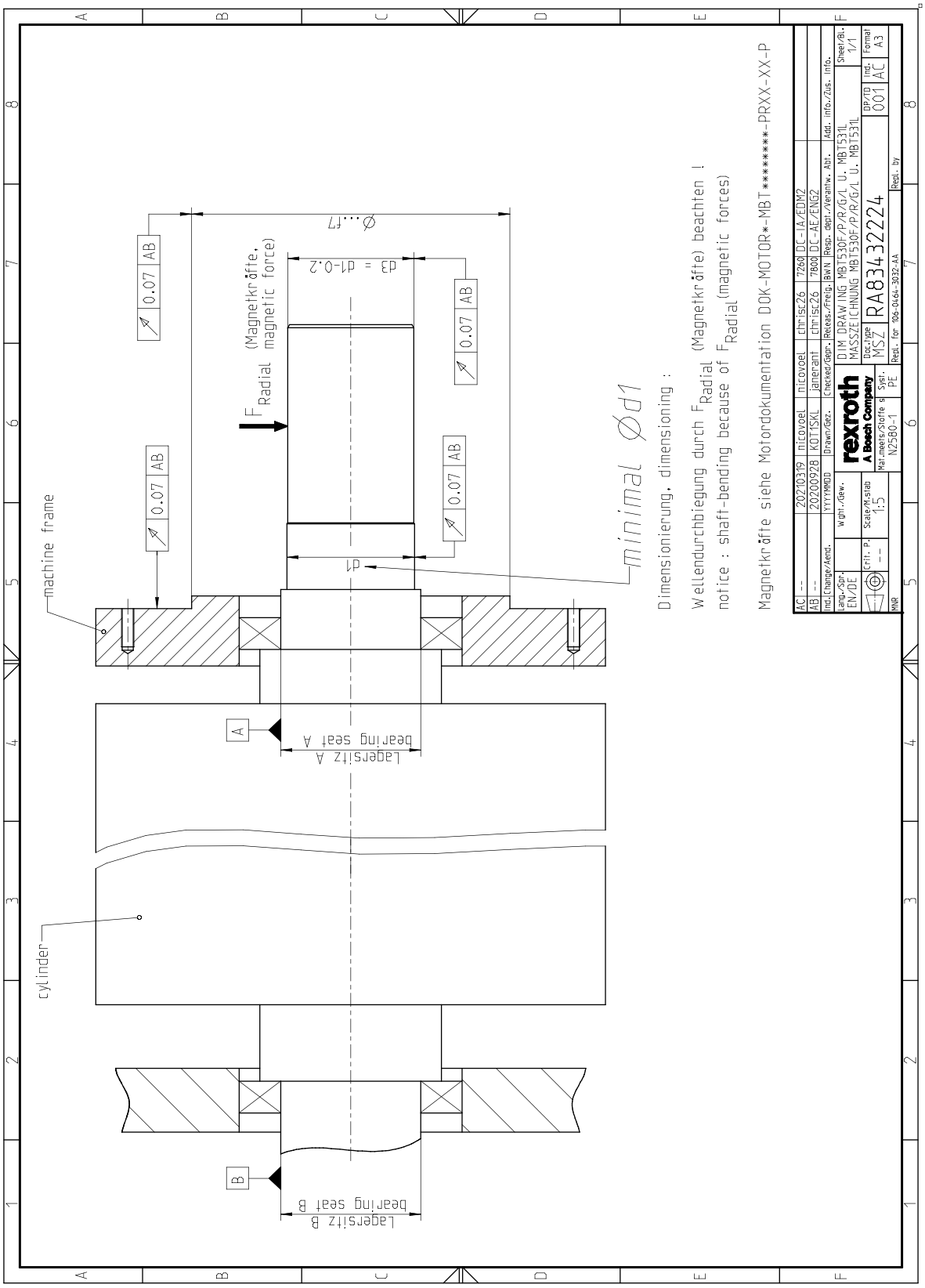


Fig. 356: Dimensionsing of shaft for rotor MRT531L

Rotor mounted - MRT531L

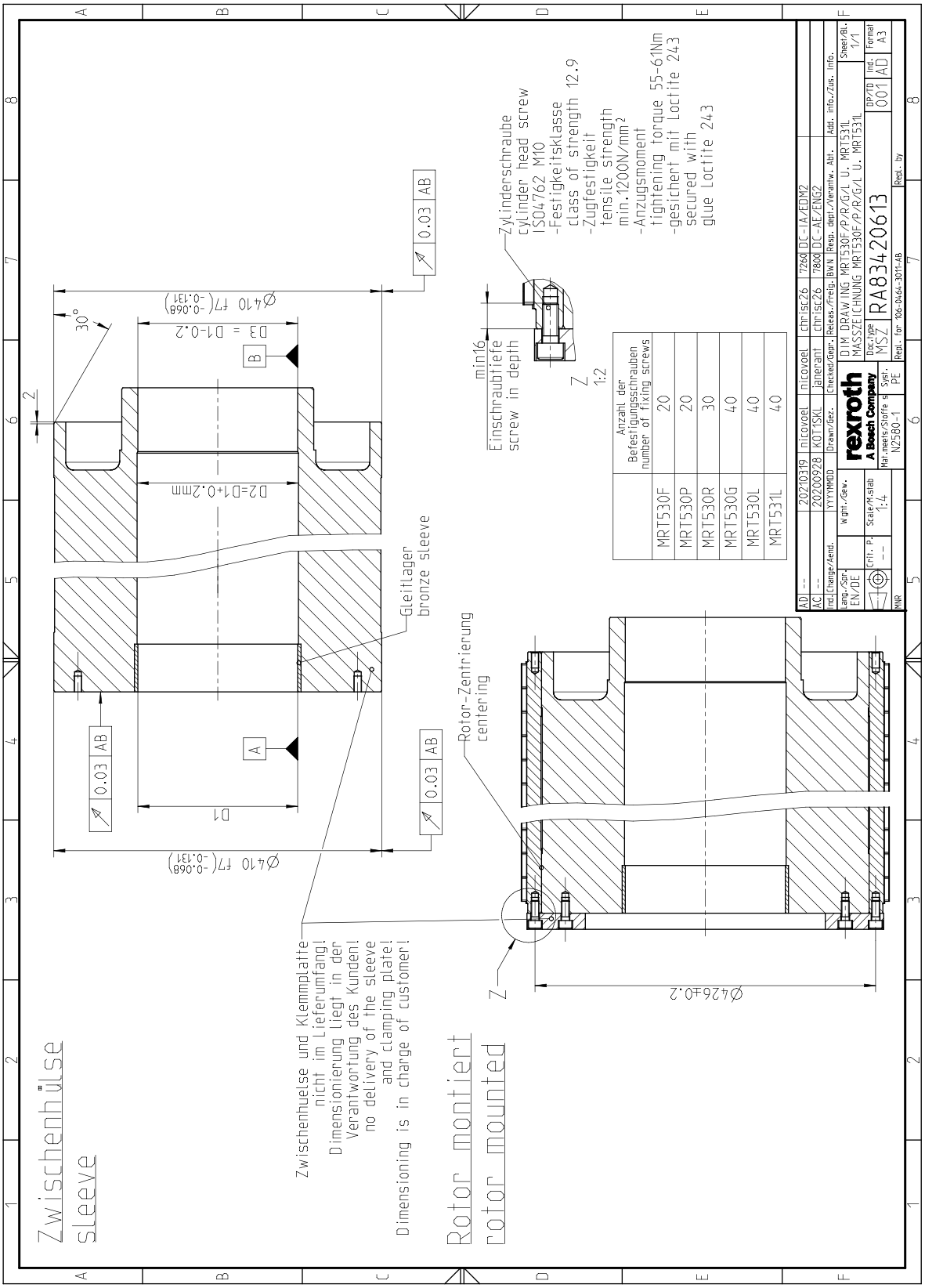


Fig. 357: MRT531L, rotor mounted

Stator mounted into housing - MST531L

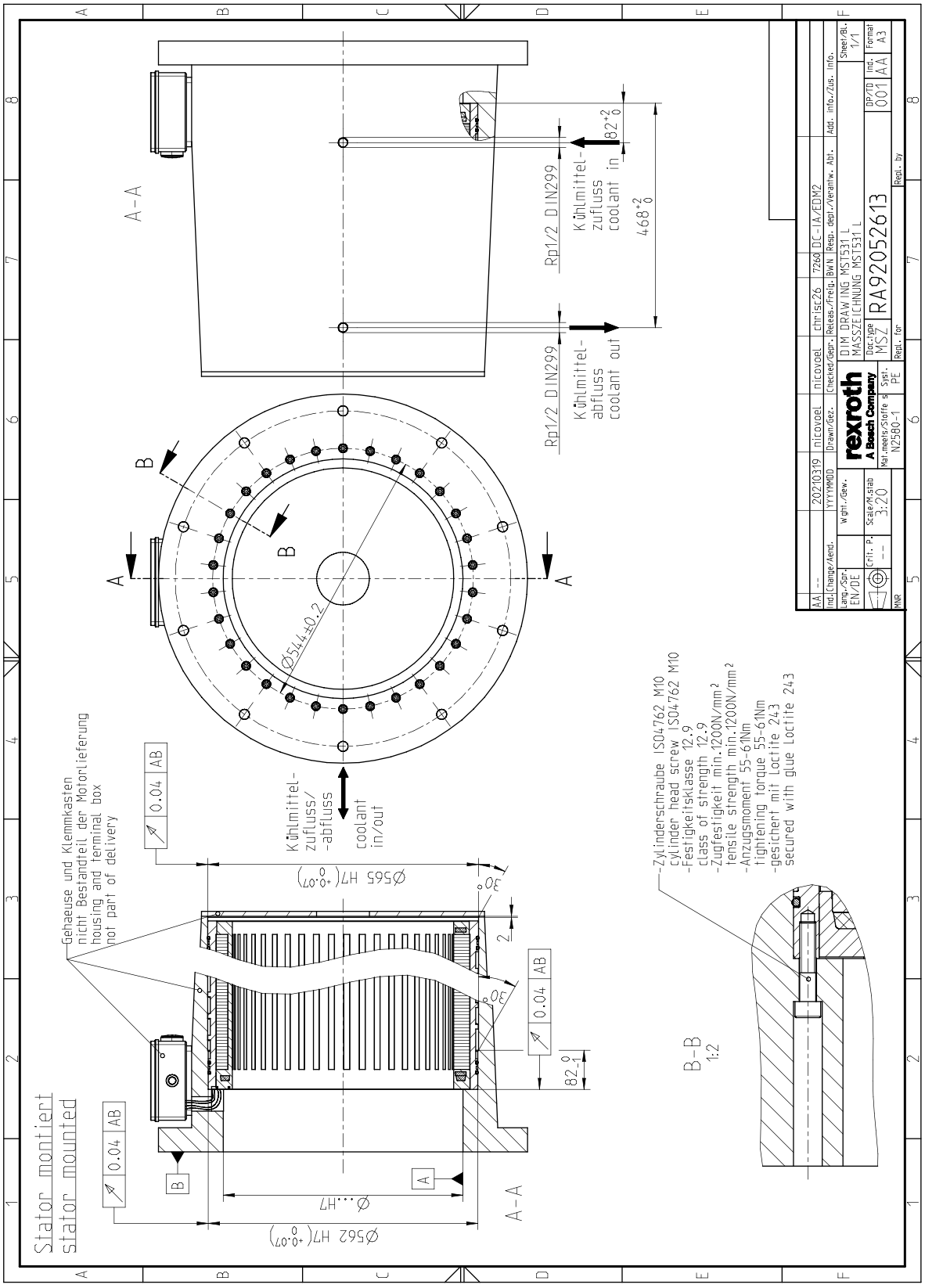


Fig. 358: MST531L, stator mounted into housing

Example of an assembly aid for MBT531L

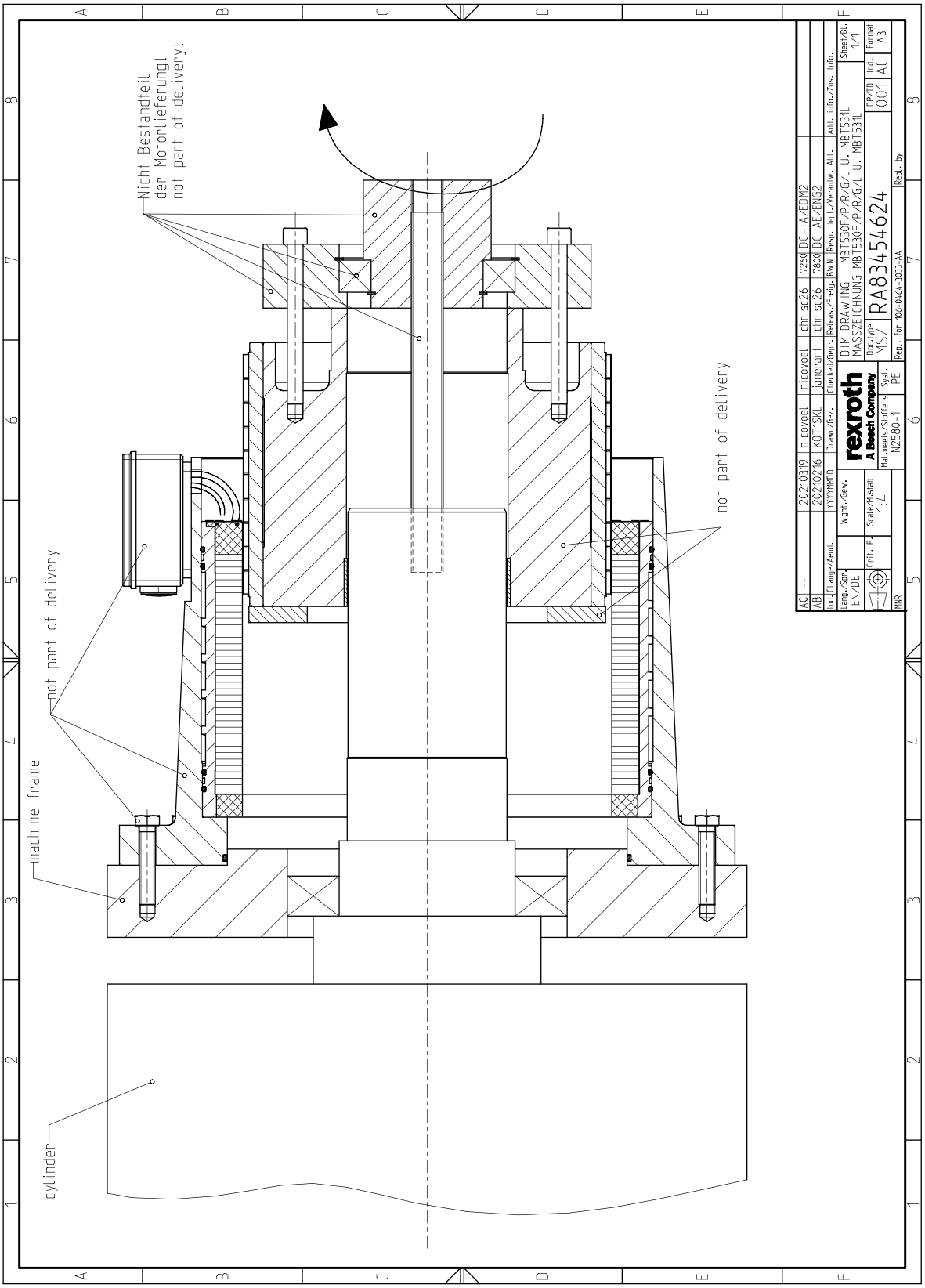


Fig. 359: Assembly aid MBT531L

Motor MBT531L, rotor and stator, mounted

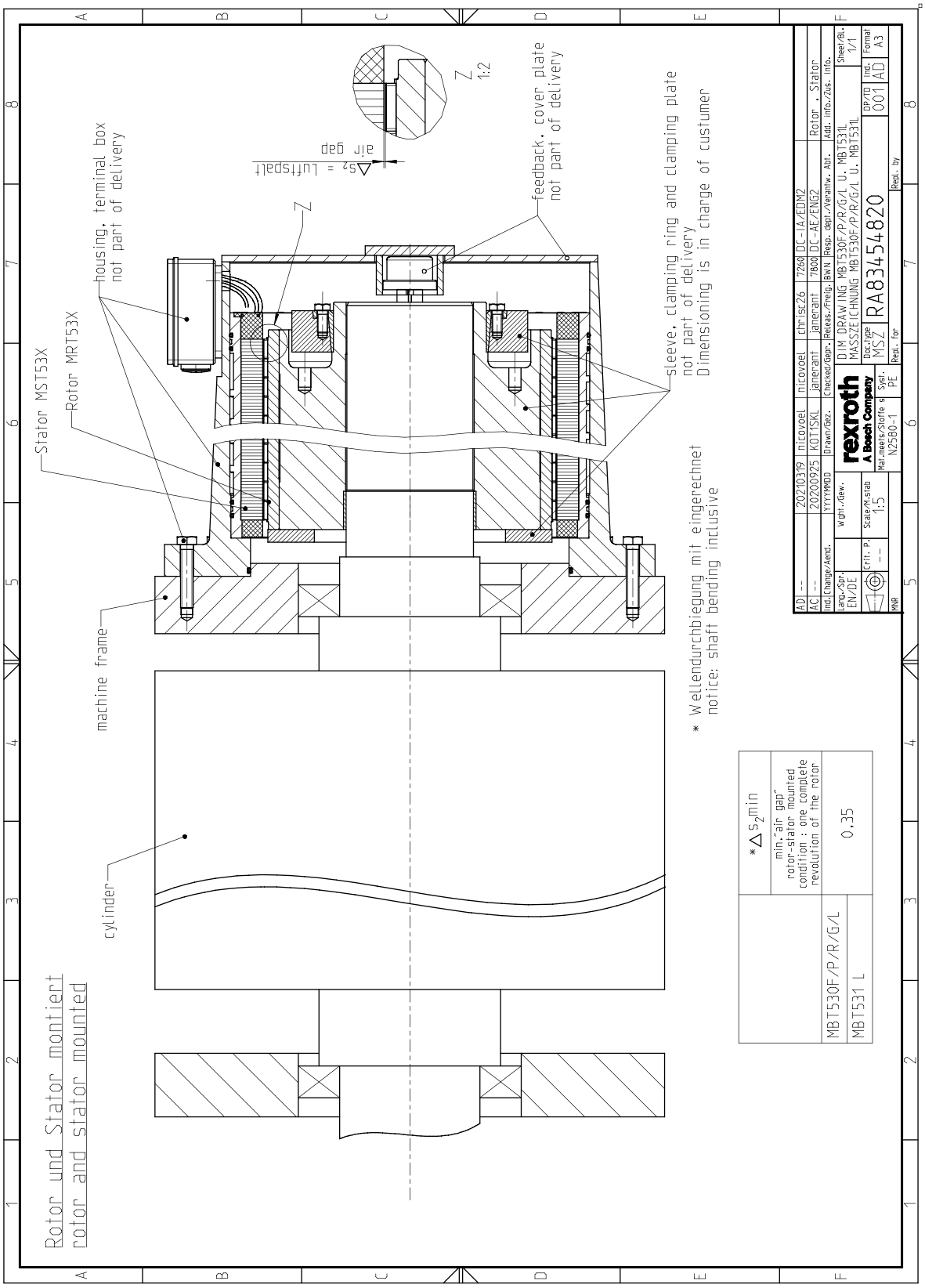


Fig. 360: MBT531L, mounted

12 Commissioning, operation and maintenance

12.1 Instructions on commissioning

General

NOTICE	**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 may 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

- Make sure you have the documentations of all used products ready.
- Record all measures taken in the commissioning log.
- Check the products for damage.
- Check all mechanical and electrical connections.
- When setting up and programming the machine, ensure proper allocation of the directions of rotation of the motor and the encoder.
- Activate the safety and monitoring equipment of the system.

Procedure

Once all requirements are met, proceed as follows:

- Activate the external cooling system for supplying the motor and check for proper operation. The motor cooling circuit has to be completely filled with coolant. Comply with the manufacturer's instructions.
- Commission the drive system in accordance with the instructions in the respective product and firmware descriptions.
- Record all measures taken in the commissioning log.

12.2 Commissioning

In addition to the motor documentation contained herein, commissioning of the motors requires further documentation. They are listed in ➦ Chapter 12.2.1

The following points have to be noted when commissioning MBT motors in particular:

Parameters

MBT are kit motors whose single components are directly installed into the machine by the manufacturer – completed by an encoder system. As a result, kit motors do not feature any data memory to provide motor parameters, standard controller settings, etc. All parameters must be manually entered or loaded to the drive during commissioning. Rexroth provides various commissioning tools such as IndraWorks or ctrlX WORKS for commissioning.

Encoder polarity

The encoder polarity has to be set before the commutation is adjusted, taking the direction of rotation of the rotor into account.

Commutation adjustment

For 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.

12.2.1 Applicable documents

Project Planning Manual

Title ctrlX DRIVE	Document type	Documentation type[1)]	Material number
ctrlXDRIVE Drive systems	Project Planning Manual	DOK-XDRV**-X**********-PRxx-EN-P	➦R911386579
IndraDrive Drive systems with HMV01/02 HMS01/02, HMD01, HCS02/03	Project Planning Manual	DOK-INDRV*-SYSTEM*****-PRxx-EN-P	➦R911309636
1) In the documentation types, xx is a placeholder for the current issue status of the documentation (example: PR02 means the second issue of a reference document)			

Firmware/Runtime IndraDriveX

Table 85: Documentation - Firmware

Title ctrlX DRIVE	Document type	Documentation type[1)]	Material number
AXS-V-05 Functions	Application Manual	DOK-XDRV**-AXS-05VRS**-APxx-EN-P	➦R911422255
AXS-V-05 (CoE) Functions	Application Manual	DOK-XDRV**-AXS-05VRS*C-APxx-EN-P	➦R911422257
Diagnostic messages of runtime AXS-V-05RS	Reference	DOK-XDRV**-GEN5-DIAG**-RExx-EN-P	R911422251
Parameter/Objects of Runtime AXS-V-05RS	Reference	DOK-XDRV**-GEN5-PARA*C-RExx-EN-P	R911422253
AXS-V-04 Functions	Application Manual	DOK-XDRV**-AXS-04VRS**-APxx-EN-P	➦R911421281
AXS-V-04 (CoE) Functions	Application Manual	DOK-XDRV**-AXS-04VRS*C-APxx-EN-P	➦R911421283
Diagnostic messages of runtime AXS-V-04RS	Reference	DOK-XDRV**-GEN4-DIAG**-RExx-EN-P	➦R911421277
Parameter/Objects of Runtime AXS-V-04RS	Reference	DOK-XDRV**-GEN4-PARA*C-RExx-EN-P	➦R911421279
AXS-V-03 Functions	Application Manual	DOK-XDRV**-AXS-03VRS**-APxx-EN-P	➦R911398021
AXS-V-03 (CoE) Functions	Application Manual	DOK-XDRV**-AXS-03VRS*C-APxx-EN-P	➦R911398021
Diagnostic messages of runtime AXS-V-03RS	Reference	DOK-XDRV**-GEN3-DIAG**-RExx-EN-P	➦R911409763

Title ctrlX DRIVE	Document type	Documentation type[1)]	Material number
Parameter of Runtime AXS-V-03RS	Reference	DOK-XDRV**-GEN3-PARA**-RExx-EN-P	➦R911409808
Parameter/Objects of Runtime AXS-V-03RS	Reference	DOK-XDRV**-GEN3-PARA*C-RExx-EN-P	➦R911419643
AXS-V-02 Functions	Application Manual	DOK-XDRV**-AXS-02VRS**-APxx-EN-P	➦R911398021
Diagnostic messages of runtime AXS-V-02RS	Reference	DOK-XDRV**-GEN2-DIAG**-RExx-EN-P	➦R911383776
Parameter of Runtime AXS-V-02RS	Reference	DOK-XDRV**-GEN2-PARA**-RExx-EN-P	➦R911383778
1) In the documentation types, xx is a placeholder for the current issue status of the documentation (example: RE02 means the second issue of a reference document)			

Firmware

Table 86: Documentation - Overview

Title Rexroth IndraDrive ...	Document type	Documentation type[1)] DOK-INDRV*-...	Material number R911...
Firmware for drive controllers MPH-08, MPB-08, MPD-08, MPC-08	Functional description	MP*-08VRS**-APxx-EN-P	➦R911332643
Firmware for drive controllers MPH-07, MPB-07, MPD-07, MPC-07	Functional description	MP*-07VRS**-FKxx-EN-P	➦R911328670
Firmware for drive controllers MPH-06, MPB-06, MPD-06, MPC-06	Functional description	MP*-06VRS**-FKxx-EN-P	R911326766
Firmware for drive controllers MPH-05, MPB-05, MPD-05	Functional description	MP*-05VRS**-FKxx-EN-P	➦R911320182
Firmware for drive controllers MPH-04, MPB-04, MPD-04	Functional description	MP*-04VRS**-FKxx-EN-P	➦R911315485
Firmware for drive controllers MPH-03, MPB-03, MPD-03	Functional description	MP*-03VRS**-FKxx-EN-P	➦R911308329
Firmware for drive controllers MPH-02, MPB-02, MPD-02	Functional description	MP*-02VRS**-FKxx-EN-P	➦R911299223
Drive controllers MPx-02 up to MPx-08	Parameter description	GEN-**VRS**-PAxx-EN-P	➦R911297317
MPx-02 up to MPx-08 and HMV	Notes on troubleshooting	GEN-**VRS**-WAxx-EN-P	➦R911297319
Integrated Safety Technology	Functional description and application manual	SI*-**VRS**-FKxx-EN-P	➦R911297838
Integrated Safety Technology acc. to IEC61508	Functional description	SI2-**VRS**-FKxx-EN-P	➦R911327664
Rexroth IndraMotion MLD	Application Manual	MLD-**VRS**-AWxx-EN-P	➦R911306084
Rexroth IndraMotion MLD Library	Library description	MLD-SYSLIB*-FKxx-EN-P	➦R911308317

Title Rexroth IndraDrive ...	Document type	Documentation type[1)] DOK-INDRV*-...	Material number R911...
1) In the documentation types, xx is a placeholder for the current issue status of the documentation (example: FK02 means the first issue of the functional description)			

Table 87: Documentation - Firmware

Title	Document type	Documentation type[1)] DOK-INDRV*-...	Material number R911...
IndraDrive MPx-21 Functions	Application Manual	MP*-21VRS**-APxx-EN-P	➦ R911385758
IndraDrive MPx-20 Functions	Application Manual	MP*-20VRS**-APxx-EN-P	➦ R911345608
IndraDrive MPx-20 Version Notes	Release Notes	MP*-20VRS**-RNxx-EN-P	➦ R911345606
IndraDrive Power Supply Basic PSB-21 Functions	Application Manual	PSB-21VRS**-APxx-EN-P	➦ R911385754
IndraDrive Power Supply Basic PSB-21 Version Notes	Release Notes	PSB-21VRS**-RNxx-EN-P	R911385752
IndraDrive Power Supply Basic PSB-20 Functions	Application Manual	PSB-20VRS**-APxx-EN-P	➦ R911345610
Rexroth IndraDrive Power Supply Basic PSB-19 Functions	Application Manual	PSB-19VRS**-APxx-EN-P	➦ R911345602
Rexroth IndraDrive MPx-18 Functions	Application Manual	MP*-18VRS**-APxx-EN-P	➦ R911338673
Rexroth IndraDrive MPx-18 Version Notes	Release Notes	MP*-18VRS**-RNxx-EN-P	➦ R911338658
Rexroth IndraDrive MPx-17 Functions	Application Manual	MP*-17VRS**-APxx-EN-P	➦ R911331236
Rexroth IndraDrive MPx-17 Version Notes	Release Notes	MP*-17VRS**-RNxx-EN-P	➦ R911331588
Rexroth IndraDrive MPx-16 Functions	Application Manual	MP*-16VRS**-APxx-EN-P	➦ R911326767

Title	Document type	Documentation type[1)] DOK-INDRV*-...	Material number R911...
Rexroth IndraDrive MPx-16 Version Notes	Release Notes	MP*-16VRS**-RNxx-EN-P	➦R911329272
IndraDrive MPx-16 up to MPx-21 and PSB Parameter	Reference	GEN1-PARA**-RExx-EN-P	➦R911328651
IndraDrive MPx-16 up to MPx-21 and PSB Diagnostics	Reference	GEN1-DIAG**-RExx-EN-P	➦R911326738
Rexroth IndraDrive Integrated Safety Technology "Safe Torque Off" (from MPx-16)	Application Manual	SI3-**VRS**-APxx-EN-P	➦R911332634
IndraDrive Integrated Safety Technology "Safe Motion" (as of MPx-18)	Application Manual	SI3*SMO-VRS-APxx-EN-P	➦R911338920
Rexroth IndraDrive Rexroth IndraMotion MLD Libraries from MPx-17	Reference	MLD-SYSLIB2-RExx-EN-P	➦R911332627
IndraDrive Rexroth IndraMotion MLD Libraries from MPx-18	Reference	MLD-SYSLIB3-RExx-EN-P	➦R911338916
Rexroth IndraDrive Rexroth IndraMotion MLD from MPx-17	Application Manual	MLD2-**VRS*-APxx-EN-P	➦R911334351
IndraDrive IndraMotion MLD from MPx-18	Application Manual	MLD3-**VRS*-APxx-EN-P	➦R911338914
1) In the documentation types, xx is a placeholder for the current issue status of the documentation (example: RE02 means the second issue of a reference document)			

12.3 General requirements

12.3.1 General

The following requirements have to be met to ensure successful commissioning:

- Compliance with safety-related guidelines and instructions
- Check of electrical and mechanical components for reliable functioning
- Availability and provision of required tools
- Adherence to the commissioning procedure described below

12.3.2 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.

12.3.3 Tools

Commissioning software

Commissioning can be carried out using a standard PC and special commissioning software. The commissioning software provided by Rexroth for this purpose enables, among other things, menu-guided, application- and motor-specific parameterization and optimization of the drives.

Commissioning via controller

Commissioning via the control unit requires access to all drive parameters and functionalities.

Multimeter

Troubleshooting and component checks can be facilitated by a multimeter allowing the measurement of voltage, current and resistance values.

12.3.4 General commissioning procedure

The following flow chart illustrates the general commissioning procedure. The individual items are explained in more detail in the chapters following thereafter.

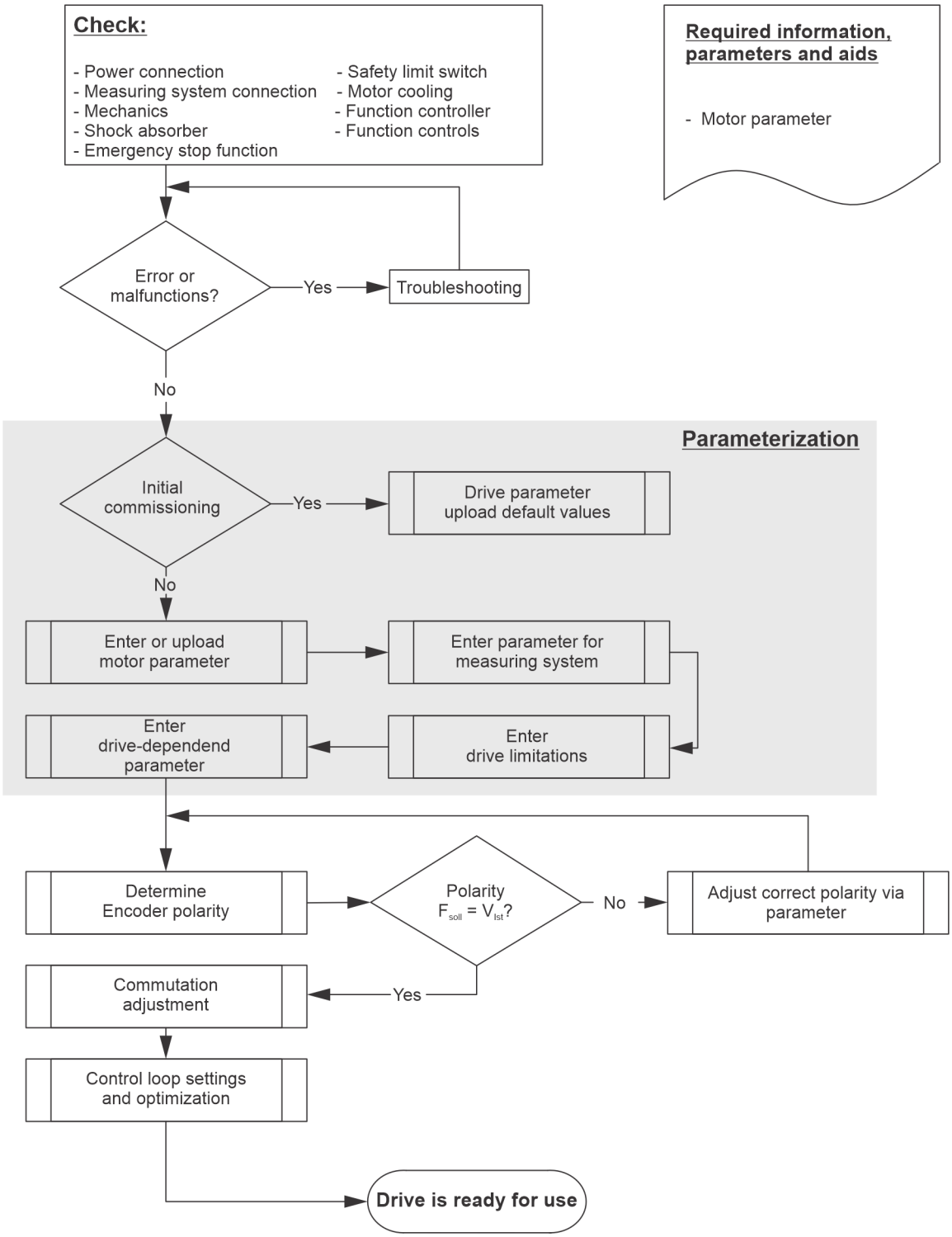


Fig. 361: General commissioning procedure for synchronous torque motors

12.4 Parameterization

12.4.1 General

The input or modification of certain parameters and the execution of commands during commissioning takes place within menu-guided dialogs and can optionally also be carried out via the control terminal.

12.4.2 Entering motor parameters

Motor parameters are specified by Rexroth and cannot be changed by the user. If these parameters are not available, commissioning is not possible! In this case, please contact your Rexroth Sales and Service Facility.

⚠ WARNING

Activation of the motor immediately after motor parameter input may result in injury and mechanical damage! The motor is not yet ready for operation after the motor parameters have been entered!

- Do not switch on the motor immediately after entering the motor parameters
- Enter the parameters for the encoder system
- Check and adjust the encoder polarity
- Configure the commutation settings

The motor parameters should be entered as follows:

Load all motor parameters via commissioning software.

If the commissioning software is not available, manually type the parameters via the controller. A list of the corresponding motor parameters is available from your sales partner.

Table 88: MBT Motor parameters

Parameter		Description
CanBus	Sercos	
0x2220:05	P-0-0004.0.0	Velocity controller: Filter time constant
0x2010:03	P-0-0018.0.0	Basic data motor: Pole pair number / Pole pair width
0x210C:01	P-0-0045.0.0	Motor control function: Configuration 1
0x2010:02	P-0-0051.0.0	Basic data motor: Torque/force constant
0x2024:01	P-0-0512.0.0	Motor temperature sensor: Type
0x211C:01	P-0-0533.0.0	Motor - voltage control: Proportional gain
0x211C:02	P-0-0534.0.0	Motor - voltage control: Integral action time
0x211C:03	P-0-0535.0.0	Motor - voltage control: Voltage reference value 2
0x211C:04	P-0-0536.0.0	Motor - voltage control: Voltage reference value 1
0x2008:08	P-0-4005.0.0	Synchronous motor data: DC current limit value
0x2010:01	P-0-4014.0.0	Basic data motor: Type
0x2008:03	P-0-4016.0.0	Synchronous motor data: Longitudinal inductance
0x2008:04	P-0-4017.0.0	Synchronous motor data: Cross inductance
0x202A:02	P-0-4034.0.0	Motor thermal model 1 config.: Time constant, motor winding
0x202A:03	P-0-4035.0.0	Motor thermal model 1 config.: Time constant, motor housing
0x2010:05	P-0-4036.0.0	Basic data motor: Rated speed
0x202A:04	P-0-4037.0.0	Motor thermal model 1 config.: Short-termin overload factor
0x2010:07	P-0-4048.0.0	Basic data motor: Motor winding resistance
0x2220:01	S-0-0100.0.0	Velocity controller: Proportional gain
0x2220:03	S-0-0101.0.0	Velocity controller: Integral action time
0x2102:05	S-0-0106.0.0	Motor - current control: Proportional gain 1
0x2102:06	S-0-0107.0.0	Motor - current control: Integral action time 1
0x2010:08	S-0-0109.0.0	Basic data motor: Peak current
0x6075:00	S-0-0111.0.0	Basic data motor: Standstill current motor

Parameter		Description
CanBus	Sercos	
0x6080:00	S-0-0113.0.0	Basic data motor: Max. Motor velocity
0x2022:01	S-0-0201.0.0	Motor temperature monitoring Warning threshold
0x2022:02	S-0-0204.0.0	Motor temperature monitoring Switch-off threshold

12.4.3 Parameterization encoder system

The parameterization of the encoder system must comply with the encoder system used. For corresponding details refer to the specific firmware description (see ➥ Chapter 12.2.1).

12.4.4 Entering drive limitations and application-related parameters

Drive limitations

The drive limitations that can be set, include:

- Current limitation
- Torque limitation
- Velocity limitation
- Travel range limitations

Application-related parameters

Application-related drive parameters include, for example, parameterization of the drive fault reaction.



For detailed descriptions refer to the specific functional description (see ➥ Chapter). 12.2.1).

12.5 Determining the polarity of the encoder system

In order to avoid direct feedback in the velocity control loop, the effective direction of the motor torque and the count direction of the encoder system must be identical.

NOTICE	When adjusting the polarity of the encoder, ensure that the count direction of the encoder and the direction of rotation of the motor are the same. In deviating cases adjust the encoder polarity via the parameters listed in the firmware description (see➥ Chapter 12.2.1).

⚠ WARNING	**Different effective directions of motor torque and count direction of the encoder system cause uncontrolled movements of the motor upon switch-on!** – Secure against uncontrolled movement – Setting the effective direction of the motor torque to the counter direction of the encoder system

Position, velocity and force data may not be inverted when the encoder system count direction is set. Ensure that the following parameters are set before the encoder polarity is checked:

Table 89: Polarity parameters

Parameter		Description	Value
CanBus	Sercos		
0x290A:03	S-0-0085.0.0	Axis polarity: Torque / force	0000000000000000
0x290A:02	S-0-0043.0.0	Axis polarity: Velocity	0000000000000000
0x290A:01	S-0-0055.0.0	Axis polarity: Position	0000000000000000

The correct setting of the encoder polarity is set via the separate parameters of the firmware used. Observe the following table:

Table 90: Setting direction of rotation of encoder

Parameter		Description	Value Bit 3
CanBus	Sercos		
0x241A:02	S-0-0602.2.2	Phys. encoder configuration OPT_2: Properties	000000000000>**0**<000
Bit 3 at encoder		**Design**see Fig. 362**)**	
		A	**B**
rotating clockwise (positive)		1	0
rotating counterclockwise (positive)		0	1

Direction of rotation of the motor

The direction of rotation of the motor or the rotor of 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.

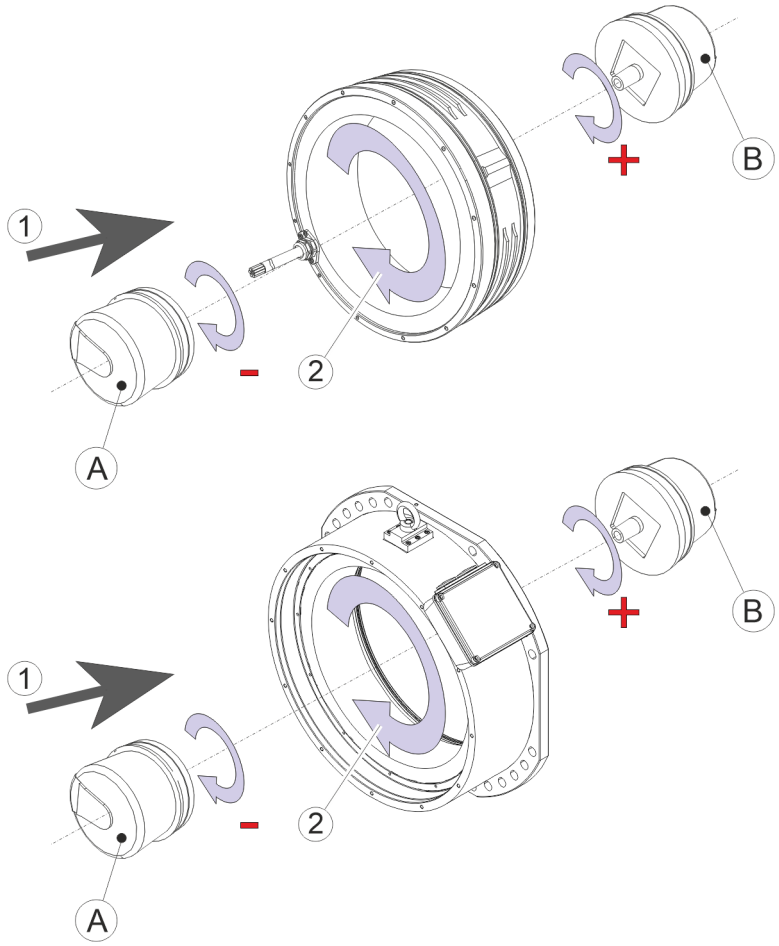


Fig. 362: Direction of rotation of the rotor, as viewed from the cable output side at the stator (MST)

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)
A Encoder attachment side “A”
B Encoder attachment side “B”

Parametrization encoder attachment side “A”

If the encoder rotates clockwise (looking at the encoder shaft from the front, the encoder counts as positive when turning clockwise), the direction of encoder rotation must be changed by the corresponding parameters (see ➦Tab. 90).

If the encoder rotates counterclockwise (looking at the encoder shaft from the front, the encoder counts negatively when turning clockwise), the encoder direction of rotation does NOT have to be turned.

Parametrization encoder attachment side “B”

If the encoder turns clockwise (looking at the encoder shaft from the front, the encoder counts as positive when turning clockwise), the encoder direction of rotation does NOT have to be turned.

If the encoder rotates counterclockwise (looking at the encoder shaft from the front, the encoder counts negatively when turning clockwise), the direction of encoder rotation must be changed using the corresponding parameters (see ➥ Tab. 90).

12.6 Commutation adjustment

⚠ DANGER	**Errors while activating motors and moving elements! Commutation adjustment always has to be performed in the following cases:** – Upon initial commissioning – Change of the mechanical attachment of the encoder system – Replacement of the encoder system – Change the mechanical attachment of stator and/or rotor
⚠ WARNING	**Errors in commutation adjustment can result in malfunctions and/or uncontrolled movements of the motor!** – Effective direction of motor torque = count direction of encoder system – Complying with the described setting procedures – Correct motor and encoder parameterization – Appropriate parameterization of current and velocity control loops – Correct connection of motor power cable – Protection against uncontrolled movements

The torque of the synchronous torque motor can only develop to a maximum and constant degree, if the commutation phase is set correctly.

This procedure ensures that the angle between the current vector of the stator and the flux vector of the rotor is always 90°. The motor supplies the maximum torque in this state.

Motor connection

The individual phases of the motor power connection have to be assigned correctly. See also ➥ Chapter 7 Connection technique on page 247.

Adjustment procedure

Different commutation adjustment procedures have been implemented in the firmware. The following figure shows an overview of the connection between the encoder system used and the procedure to be applied.

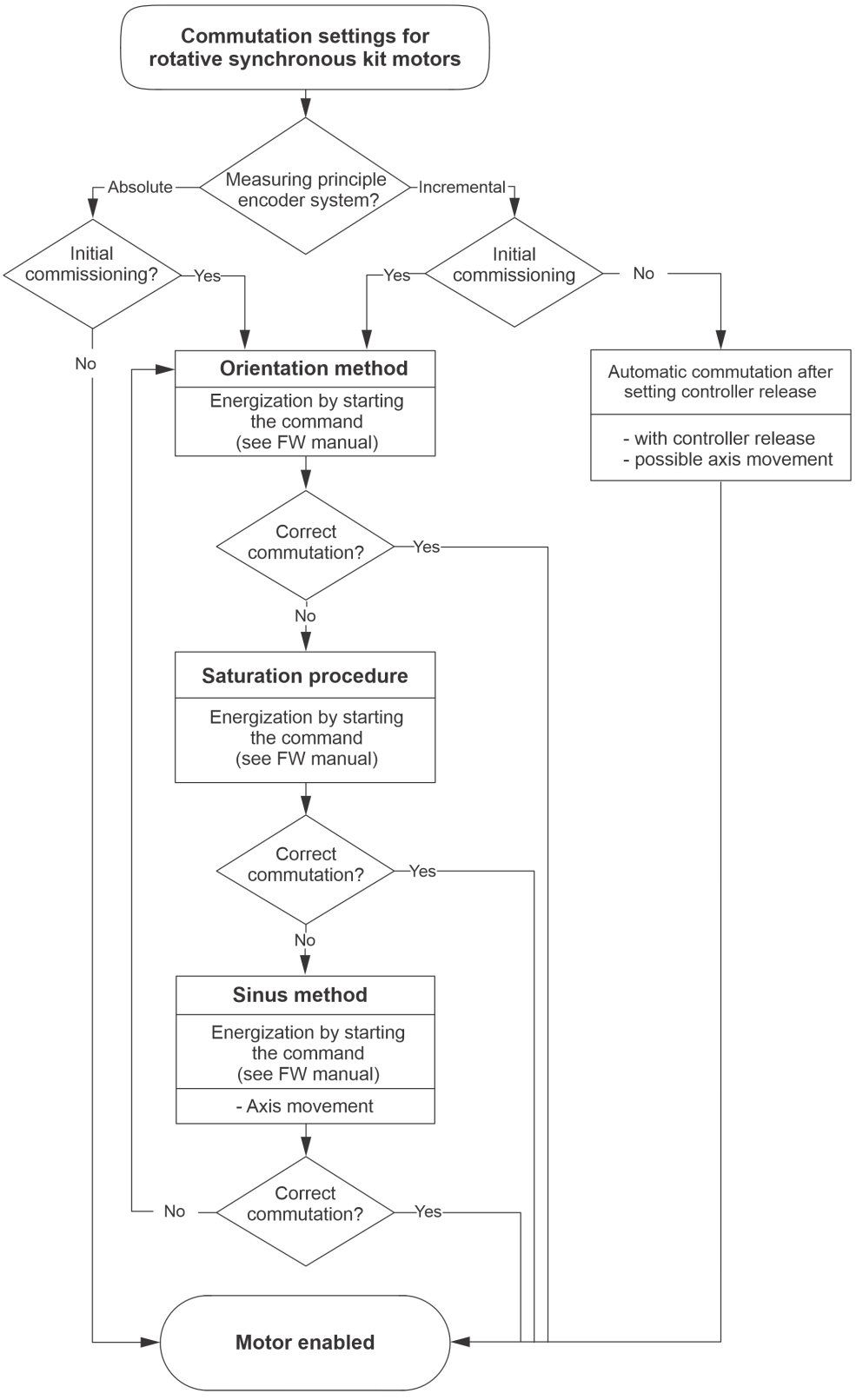


Fig. 363: Commutation adjustment

A detailed description of the different methods is given in the firmware description for Rexroth controllers (see ➥ Chapter 12.2.1 Applicable documents on page 383).

12.7 Setting and optimizing the control loop

12.7.1 General procedure

The control loop settings in a digital drive controller have an essential importance for the properties of the servo axis. The control loop structure consists of a cascaded position, velocity and current controller. Which controller is active is defined by the operation mode.

Defining the control loop settings requires the corresponding expertise.

Refer to the functional description of the drive controller for more detailed information.

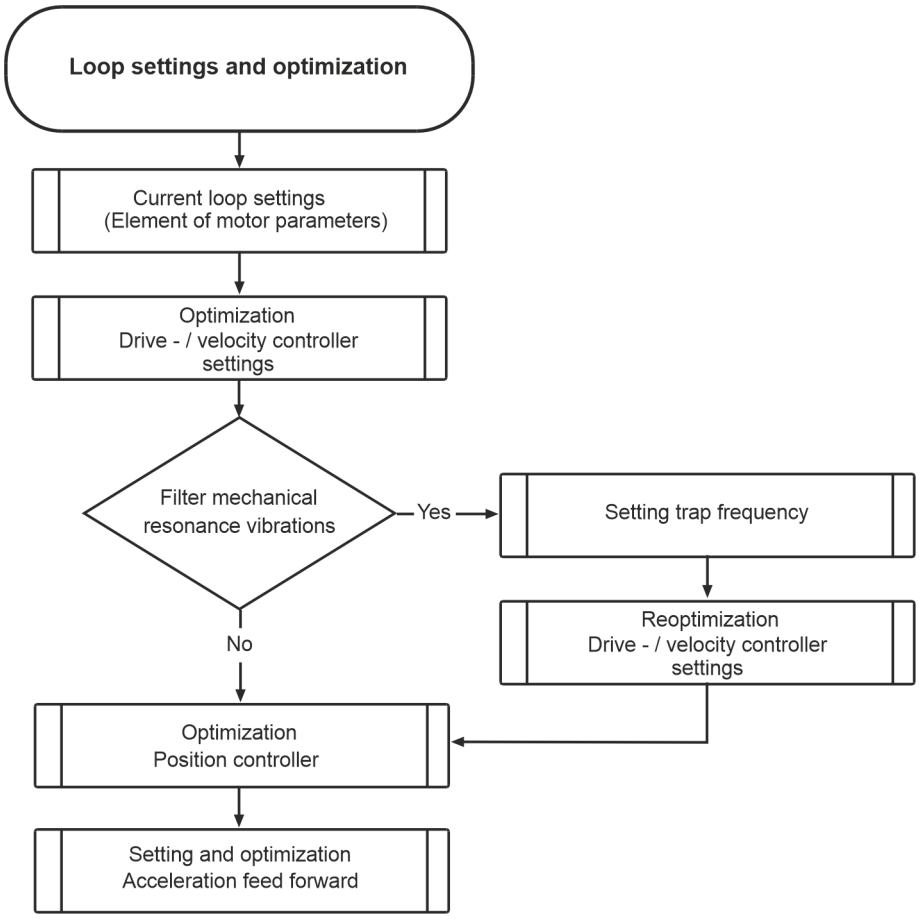


Fig. 364: Setting and optimizing the control loop of synchronous torque motors

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!

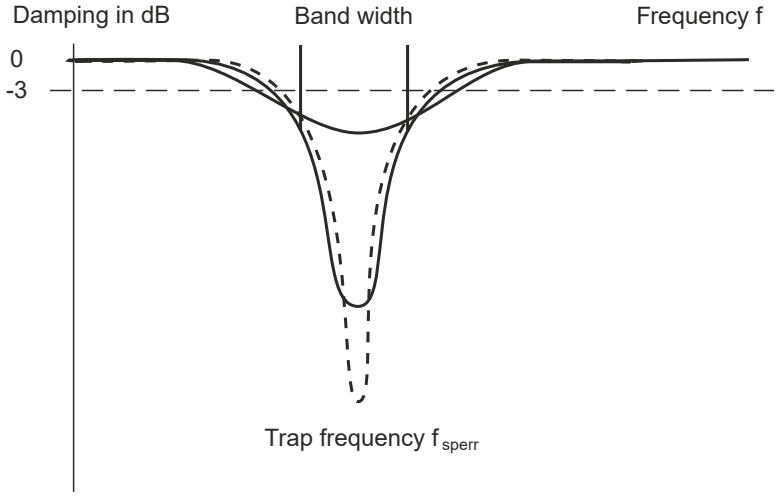


Fig. 365: Amplitude response of the rejection filter in relation to the bandwidth, qualitative

12.8 Shutdown

In the case of malfunctions, maintenance measures or to deactivate the motors, proceed as follows:

- Comply with the instructions in the machine documentation.
- Use the machine-side control commands to decelerate the drive to a controlled standstill.
- Switch off the power and control voltage of the controller.
- Switch off the main switch of the machine and deactivate external systems according to the instructions of the manufacturer.
- Secure the machine against accidental movements and against unauthorized operation.
- Wait until the discharge time of the electrical systems has elapsed and then disconnect all electrical connections. Secure electric cables and contacts against contact with other electrical parts.
- Document all executed measures in the commissioning report and the machine maintenance plan.

12.9 Disassembly

12.9.1 General notes about disassembly

⚠ DANGER **Fatal injury due to errors during the activation of motors or work on moving elements!**

- Work on machines is only allowed if they are secured and while they are not running.
- Before starting disassembly, secure the machine against unforeseeable movements and against unauthorized operation.
- Before dismounting the motor and the supply lines, secure them against dropping or moving and disconnect the mechanical connections only thereafter.

⚠ WARNING **High electric voltage! Danger to life, risk of injury by electric shock!**

- Life parts are dangerous.
  - Do not open any covers or flange sockets during operation.
  - Do not connect or disconnect plug-connectors and connection clamps.

NOTICE The machine manufacturer must observe the special features of the construction and create a special disassembly instruction for the motor components. Only this disassembly instruction of the machine manufacturer is binding.

Basic procedure for disassembly:

1. Observe the disassembly instruction of the machine manufacturer.
2. Use the machine-side control command to decelerate the drive to a controlled standstill.
3. Switch off the power and control voltage of the controller.
4. Switch off the main switch of the machine and deactivate external systems according to the instructions of the manufacturer.
5. Secure the machine against accidental movements and against unauthorized operation.
6. Wait until the discharge time of the electrical systems has elapsed and then disconnect all electrical connections. Secure electric cables and contacts against contact with other electrical parts.
7. Remove dirt, chips and other any kind of residues from the motor.
8. Before disassembling the motor and the supply lines, secure them against dropping or movements. Subsequently, disconnect the mechanical connections.
9. Right after disassambly, store or transport the motor components in its origin package.
10. If necessary, record all measures in the commissioning log or machine maintenance plan.

NOTICE

Information on stators with encapulation “T”

During disassembly, please observe to disassembled all stator parts. Ensure that the separator between inlet and outlet at the cooling jacket is also removed from the machine after disassembling the stator.

12.10 Maintenance

12.10.1 General

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.

12.10.2 Measures

⚠ DANGER

Risk of injury due to moving elements! Risk of injury due to hot surfaces!

⇒ Do not carry out any maintenance measures while the machine is running.

⇒ While carrying out maintenance work, secure the machine such that it cannot restart or be used by unauthorized persons.

⇒ Do not work on hot surfaces.

Bosch Rexroth recommends the following maintenance measures, based on the maintenance plan of the machine manufacturer:

Table 91: Maintenance measures

Measure	Interval
Check the cooling system for proper functioning.	According to the specifications in the machine maintenance plan, but at least every 1000 operating hours.
Check the mechanical and electrical connections.	According to the specifications in the machine maintenance plan, but at least every 1000 operating hours.
Check the machine for smooth running, vibrations and bearing noise.	According to the specifications in the machine maintenance plan, but at least every 1000 operating hours.
Remove dust, chips and other dirt from the motor housing, cooling fins and the connections.	Depending on the degree of soiling, but after one operating year at the latest.

12.10.3 Coolant supply

It can be necessary to disassemble the coolant supply for maintenance measures or troubleshooting.

- This work may only be carried out by skilled personnel.
- Do not carry out any maintenance measures while the machine is running. Comply with the safety instructions.
- Protect open supply lines and connections against ingress of dirt.

12.10.4 Electrical check of motor components

Electrical defects at stators 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 Technical data. The individual values of resistance and inductance measured between the connections 1-2, 2-3 and 1-3 should be identical within a certain tolerance. If one or several values deviate considerably, an inter-phase short circuit, an interturn fault or a short circuit occurred.



In case of considerable deviations in resistance, please contact the Bosch Rexroth customer service.

Insulation resistance

The insulation resistance – measured between the motor connection wires and ground – should be at least 1 MΩ (MegaOhm).



If the resistance too low, please contact the Bosch Rexroth customer service.

12.11 Troubleshooting

12.11.1 General

⚠ DANGER	**Risk of injury due to moving elements! Risk of injury due to hot surfaces!** ⇒ Do not carry out any maintenance measures while the machine is running. ⇒ Switch off the controller and the machine and wait until the discharging time of the electrical systems has elapsed before starting troubleshooting. ⇒ While carrying out maintenance work, secure the machine such that it cannot restart or be used by unauthorized persons. ⇒ Do not work on hot surfaces.
⚠ WARNING	**The rotor is magnetic! Risk of injury and danger of crushing body parts by magnetic forces!** ⇒ Remove or secure any movable metal objects. ⇒ Carefully handle all magnetic components. ⇒ Wear protecting clothes and use installation aids.

Possible causes for failures of motors can be restricted to the following areas:

- Motor cooling circuit and temperature curve
- Internal temperature sensor
- Mechanical damage of the motor
- Mechanical connection to machine

Encoder and temperature sensor are controlled by the controller or the control unit; corresponding diagnostic messages are displayed. Observe the instructions in the corresponding documentation.

The sections below describe examples of some fault statesFault states along with possible causes. This list is not exhaustive.

12.11.2 Excessive temperature of motor housing

State

The housing temperature of the motor rises to unusually high values.

⚠ CAUTION	**Damage to motor or machine by restarting after excessive motor temperature!** – Liquid-cooled motors may not be restarted or supplied with cold coolant immediately after a failure of the cooling system and an increased motor temperature. Risk of damage! – Wait until the motor temperature has dropped under +40 °C before the restart

Possible causes

- Failure or malfunction in the cooling system.
- The original machining cycle has been changed.
- The original motor parameters have been changed.
- Motor bearings are worn or defective.

Measures for

- Check the cooling system. Clean or rinse the cooling circuit as required. Contact the machine manufacturer in the case of a cooling system failure.
- Check the sizing of the drive for changed requirements. Stop operation in case of overload. Risk of damage!
- Restore the original parameters. Check the sizing of the drive if requirements have been changed.
- Contact the machine manufacturer.

12.11.3 High motor temperature values, but housing temperature is normal

State

The diagnostic system of the machine shows unusually high winding temperature values via display or operator software. However, the temperature of the motor housing is normal.

Possible causes

- Wiring error or cable break in sensor cable.
- Diagnostic system defective.
- Failure of the winding temperature sensor (PTC).

Measures for

- Check the wiring and connection of the temperature sensor according to the interconnection diagram.
- Check the diagnostic system at the controller or the control unit.
- Check the resistance value of the temperature sensor using a multimeter.
  - Shut down the system and wait until the discharging time has elapsed.
  - Disconnect the connection of the temperature sensor at the controller. Set the measuring device to resistance measurement mode and connect the wire pair to the measuring device (this also checks the sensor line). Check values according to the characteristic curves in “Chapter Motor temperature monitoring”.

12.11.4 Motor or machine generate vibrations

State

Audible or tactile vibrations occur on the motor or on the machine.

Possible causes

- Driven machine elements are insufficiently coupled or damaged.
- Motor bearings are worn or defective. Available bearing lifetime or grease lifetime has elapsed.
- Motor mount has loosened.
- Drive system is instable from a control point of view.

Countermeasures

- Contact the machine manufacturer.
- Contact the machine manufacturer.
- Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
- Check the parameterization of the drive system (motor and encoder data). Comply with the instructions in the controller documentations.

12.11.5 Specified position is not reached

State

The positioning command of the control unit is executed either not precisely or not at all. No malfunction displayed by the controller or the control unit.

Possible causes

- Wiring of encoder cable is incorrect or defective. Pin assignment (encoder signals) in cable or plug may be interchanged.
- Insufficient shielding of encoder cable against interference signals.
- Incorrect parameterization of encoder data in controller.
- Motor-machine element connection has loosened.
- Encoder defective.

Countermeasures

- Check wiring according to interconnection diagram of machine and check cables for damage.
- Check shielding; if necessary, increase effective contact surfaces of shielding.
- Correct the parameterization. Observe the commissioning log.
- Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
- The encoder has to be replaced. Contact the machine manufacturer.

12.12 Operation with third-party controllers

Rate of rise of voltage

The electrical insulationInsulation system of the motor is subject to a higher dielectric load in converter mode than when it is operated with a merely sinusoidal source voltage. The voltage load of the winding insulation in converter mode is mainly defined by the following factors:

- Crest value of voltage
- Rise time of pulses at the motor terminals

- Switching frequency of final converter stage
- Length of power cable to the motor

Main components are the switching times of the final converter stage and the length of the power cable to the motor. The rates of rise of the voltage occurring at the motor may not exceed the pulse voltage limits specified in **DIN VDE 0530-25 (VDE 0530-25): 2009-08 (picture 14, limit curve A)**, measured at the motor terminals of two strands in relation to the rise time.



These limits are complied with by the final stages of Rexroth converters.

13 Environmental protection and disposal

Disposal of the motor components can be done according to the applicable legal process in normal recycling process.

Recycling

Most of the products can be recycled due to their high content of metal. In order to recycle the metal in the best possible way, the products must be disassembled into individual assemblies. Metals contained in electric and electronic assemblies can also be recycled by means of special separation processes.

Basic components

Basically, our motors consist of the following components:

- Steel, stainless steel, aluminum, copper, brass
- Plastic parts, insulation and composite material
- Electronic components
- Permanent magnets

Plastic parts of the products may contain flame retardants. These plastic parts are labeled according to EN ISO 1043-1:2011 + A1:2016. They have to be recycled separately or disposed of according to the applicable legal provisions.

Magnets

⚠ WARNING	**Danger due to permanent magnets!** – Health hazard for persons with heart pacemakers, metallic implants and hearing aids in direct environment of permanent magnets. – Crushing hazard of fingers and hand due to heavy attractive forces of the magnets. – Risk of destruction of sensitive parts like watches, credit cards, ...



Remark

The permanent magnets must be demagnetized before disposal to avoid injuries or damage. The demagnetization is reached via thermal treatment. The duration of the treatment depends on the size (guide value: 300 °C, 30 min).

Packaging

Our packaging materials do not contain any problematic materials and can therefor be easily disposed. Packaging materials are: wood, cardboard and polystyrene.

Batteries and accumulators



The symbol indicating "separate collection" for all batteries and accumulators is the crossed-out wheeled bin. End users in the EU are legally bound to return used batteries and accumulators. Outside the scope of the EU Directive 2006/66/EC, the applicable regulations must be followed. Batteries and accumulators can contain hazardous substances which can harm the environment or people's health when improperly stored or disposed of. The batteries or accumulators must be returned to the country-specific collection systems for proper disposal.

Disposal by the manufacturer

Our products can be returned to us for disposal. However, this requires that the products are free from oil, grease or other dirt. The motor components must be returned in a suitable packaging (origin package if possible). In the case of a transport by air freight, please observe the dangerous goods regulations (IATA) for the secondary part.
Send the products to the following address, carriage free:

Bosch Rexroth AG
Bgm.-Dr.-Nebel-Str. 2
97816 Lohr a.Main, Germany

14 Service and support

Our worldwide service network provides an optimized and efficient support. Our experts provide you with advice and assistance. You can contact us **24/7**.

Service Germany

Our technology-oriented Competence Center in Lohr, Germany, is responsible for all your service-related queries for electric drive and controls.

Contact the **Service Hotline** and **Service Helpdesk** under:

Phone:	**+49 9352 40 5060**
Fax:	**+49 9352 18 4941**
Email:	➦ service.svc@boschrexroth.de
Internet:	➦ http://www.boschrexroth.com

Additional information on service, repair (e.g. delivery addresses) and training can be found on our internet sites.

Service worldwide

Outside Germany, please contact your local service office first. For hotline numbers, refer to the sales office addresses on the internet.

Preparing information

To be able to help you more quickly and efficiently, please have the following information ready:

- Detailed description of malfunction and circumstances
- Type plate specifications of the affected products, in particular type codes and serial numbers
- Your contact data (phone and fax number as well as your e-mail address)

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