Electric Drives and Controls | Hydraulics | Linear Motion and Assembly Technologies | Pneumatics | Service

Rexroth
Bosch Group

Rexroth IndraDyn T Synchronous-Torquemotors

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Project Planning Manual

Title
Rexroth IndraDyn T
Synchronous-Torquemotors

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Purpose of Documentation
This documentation....
- explains product features and applications, technical data as well as conditions and limits for operation.
- provides guidlines for product selection, application, handling and operation.

Record of Revisions

Description	Release Date	Notes
DOK-MOTOR*-MBT********-PR02-EN-P	06.2003	1st edition
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Validity
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Note
This document has been printed on chlorine-free bleached paper.

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1 Introduction to the Product

The IndraDyn T series of synchronous torque motors from Bosch Rexroth consist of a stator and a rotor – the MST and MRT, respectively. The stator comes with a laminated core with multipolar winding, a liquid cooling jacket and a connecting cable. The rotor is fitted with permanent magnets.

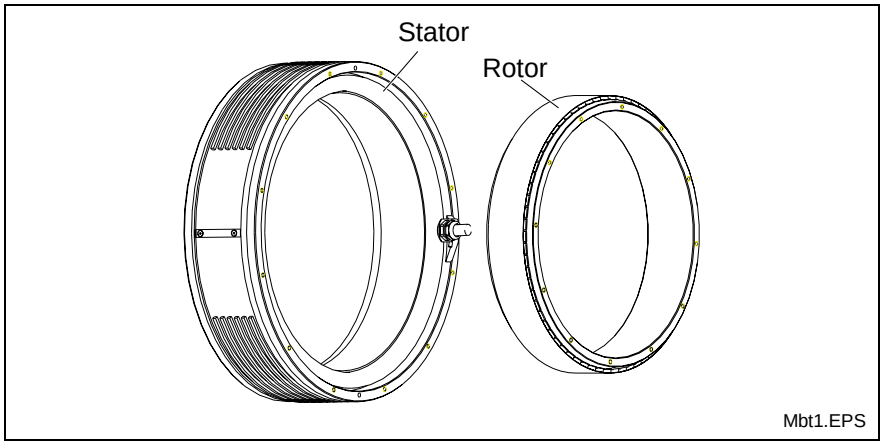

Fig. 1-1: IndraDyn T units

IndraDyn T synchronous torque motors have a high torque with an optimum residual ripple. These motors are extremely well-suited for compact direct drives for rotary tables.

In comination with digital control devices from the INDRADRIVE, DIAX or ECODRIVE series, the IndraDyn T series forms an intelligent drive solution with a high power density and open functions.

The following diagram provides an overview of the torque spectrum of IndraDyn T synchronous torque motors from Bosch Rexroth.

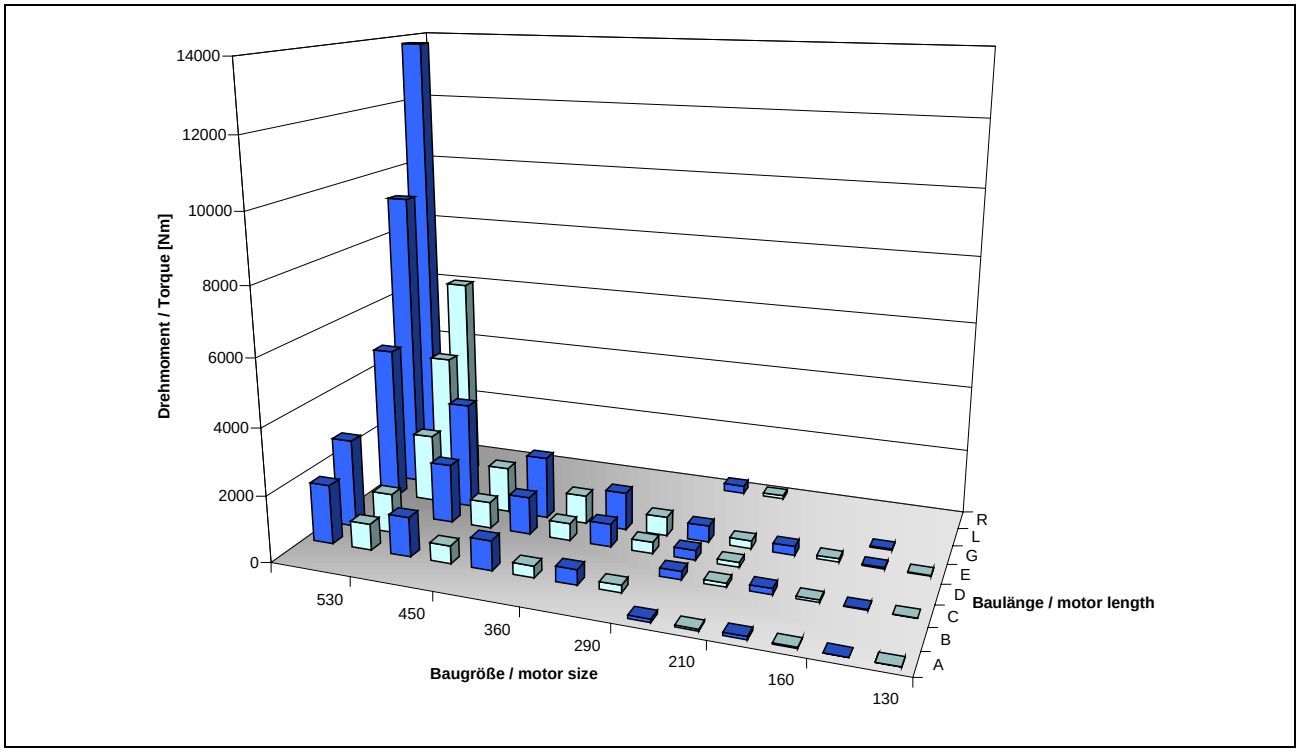

Fig. 1-2: IndraDyn T overview

1.1 About this Documentation

Document Structure

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

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Fig. 1-3: Chapter structure

Additional Documentation

To design IndraDyn T motor type drive systems, you may need additional documentation, depending on the devices used. Rexroth has made the entire product documentation available on DVD in PDF format or in the Internet under www.boschrexroth.com/BrcDoku/ (one-time registration required). The documentation on the DVD as a whole is not necessary to projecting individual systems.

Note: The entire documentation is also available in hard copy. You can order the necessary documentation through your local Rexroth representation.

Material No.	Title / description
R911281882	-Produktdokumentation Electric Drives and Controls Version **xx** [1)] DOK-GENRL-CONTR*DRIVE-GN**xx**-DE-D650 (German)
R911281883	-Product Documentation Electric Drives and Controls Version **xx** [1)] DOK-GENRL-CONTR*DRIVE-GN**xx**-EN-D650 (English)
1) The index (e.g. ...**02**-...) identifies the version.	

Fig. 1-4: Additional documentation

Standards

This documentation refers to German, European and international technical standards. Documents and sheets on standards underlie contact:

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Additional Components

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

For information on the manufacturers, see chapter 9 “Application Notes”.

Feedback

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

Please do not hesitate to inform us of any mistakes you detect in this documentation or of any modifications you might desire. We would appreciate your feedback.

Please send your remarks to:

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Dep. BRC/EDM1
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2 Important directions for use

2.1 Appropriate use

Introduction

Bosch Rexroth products represent state-of-the-art developments and manufacturing. They are tested prior to delivery to ensure operating safety and reliability.

The products may only be used in the manner that is defined as appropriate. If they are used in an inappropriate manner, then situations can develop that may lead to property damage or injury to personnel.

Note: Bosch Rexroth, as manufacturer, is not liable for any damages resulting from inappropriate use. In such cases, the guarantee and the right to payment of damages resulting from inappropriate use are forfeited. The user alone carries all responsibility of the risks.

Before using Bosch Rexroth products, make sure that all the pre-requisites for appropriate use of the products are satisfied:

- Personnel that in any way, shape or form uses our products must first read and understand the relevant safety instructions and be familiar with appropriate use.
- If the product takes the form of hardware, then they must remain in their original state, in other words, no structural changes are permitted. It is not permitted to decompile software products or alter source codes.
- Do not mount damaged or faulty products or use them in operation.
- Make sure that the products have been installed in the manner described in the relevant documentation.

Areas of use and application

Rexroth IndraDyn T motors are designed to be used as rotary drive motors in machines.

Several types of motors with differing drive power and different interfaces are available for application-specific uses.

Control and monitoring of the motors may require additional sensors and actors.

Note: The motors may only be used with the accessories and parts specified in this document. If a component has not been specifically named, then it may not be either mounted or connected. The same applies to cables and lines.

Operation is only permitted in the specified configurations and combinations of components using the software and firmware as specified in the relevant function descriptions.

Every drive controller has to be programmed before starting it up, making it possible for the motor to execute the specific functions of an application.

The motors may only be operated under the assembly, installation and ambient conditions as described here (temperature, system of protection, humidity, EMC requirements, etc.) and in the position specified.

2.2 Inappropriate use

Inappropriate use is defined as using the motors outside of the above-referenced areas of application or under operating conditions other than described in the document and the technical data specified.

IndraDyn T motors may not be used if

- they are subject to operating conditions that do not meet the above specified ambient conditions. This includes, for example, operation under water, in the case of extreme temperature fluctuations or extremely high maximum temperatures or if
- Bosch Rexroth has not specifically released them for that intended purpose. Please note the specifications outlined in the general Safety Guidelines!

3 Safety Instructions for Electric Drives and Controls

3.1 Introduction

Read these instructions before the initial startup of the equipment in order to eliminate the risk of bodily harm or material damage. Follow these safety instructions at all times.

Do not attempt to install or start up this equipment without first reading all documentation provided with the product. Read and understand these safety instructions and all user documentation of the equipment prior to working with the equipment at any time. If you do not have the user documentation for your equipment, contact your local Bosch Rexroth representative to send this documentation immediately to the person or persons responsible for the safe operation of this equipment.

If the equipment is resold, rented or transferred or passed on to others, then these safety instructions must be delivered with the equipment.

WARNING

Improper use of this equipment, failure to follow the safety instructions in this document or tampering with the product, including disabling of safety devices, may result in material damage, bodily harm, electric shock or even death!

3.2 Explanations

The safety instructions describe the following degrees of hazard seriousness in compliance with ANSI Z535. The degree of hazard seriousness informs about the consequences resulting from non-compliance with the safety instructions.

Warning symbol with signal word	Degree of hazard seriousness according to ANSI
 **DANGER**	Death or severe bodily harm will occur.
 **WARNING**	Death or severe bodily harm may occur.
 **CAUTION**	Bodily harm or material damage may occur.

Fig. 3-1: Hazard classification (according to ANSI Z535)

3.3 Hazards by Improper Use

DANGER

High voltage and high discharge current! Danger to life or severe bodily harm by electric shock!

DANGER

Dangerous movements! Danger to life, severe bodily harm or material damage by unintentional motor movements!

WARNING

High electrical voltage due to wrong connections! Danger to life or bodily harm by electric shock!

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

CAUTION

Surface of machine housing could be extremely hot! Danger of injury! Danger of burns!

CAUTION

Risk of injury due to improper handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock or incorrect handling of pressurized systems!

CAUTION

Risk of injury due to incorrect handling of batteries!

3.4 General Information

- Bosch Rexroth AG is not liable for damages resulting from failure to observe the warnings provided in this documentation.
- Read the operating, maintenance and safety instructions in your language before starting up the machine. If you find that you cannot completely understand the documentation for your product, please ask your supplier to clarify.
- Proper and correct transport, storage, assembly and installation as well as care in operation and maintenance are prerequisites for optimal and safe operation of this equipment.
- Only persons who are trained and qualified for the use and operation of the equipment may work on this equipment or within its proximity.
  - The persons are qualified if they have sufficient knowledge of the assembly, installation and operation of the equipment as well as an understanding of all warnings and precautionary measures noted in these instructions.
  - Furthermore, they must be trained, instructed and qualified to switch electrical circuits and equipment on and off in accordance with technical safety regulations, to ground them and to mark them according to the requirements of safe work practices. They must have adequate safety equipment and be trained in first aid.
- Only use spare parts and accessories approved by the manufacturer.
- Follow all safety regulations and requirements for the specific application as practiced in the country of use.
- The equipment is designed for installation in industrial machinery.
- The ambient conditions given in the product documentation must be observed.
- Use only safety features and applications that are clearly and explicitly approved in the Project Planning Manual. If this is not the case, they are excluded.
  The following areas of use and application, for example, include safety features and applications: construction cranes, elevators used for people or freight, devices and vehicles to transport people, medical applications, refinery plants, transport of hazardous goods, nuclear applications, applications in which electrical devices with vital functions can be electromagnetically disturbed, mining, food processing, control of protection equipment (also in a machine).
- The information given in the documentation of the product with regard to the use of the delivered components contains only examples of applications and suggestions.
  The machine and installation manufacturer must
  - make sure that the delivered components are suited for his individual application and check the information given in this documentation with regard to the use of the components,
  - make sure that his application complies with the applicable safety regulations and standards and carry out the required measures, modifications and complements.
- Startup of the delivered components is only permitted once it is sure that the machine or installation in which they are installed complies with the national regulations, safety specifications and standards of the application.

- Operation is only permitted if the national EMC regulations for the application are met.
  The instructions for installation in accordance with EMC requirements can be found in the documentation "EMC in Drive and Control Systems".
  The machine or installation manufacturer is responsible for compliance with the limiting values as prescribed in the national regulations.
- Technical data, connections and operational conditions are specified in the product documentation and must be followed at all times.

3.5 Protection Against Contact with Electrical Parts

Note: This section refers to equipment and drive components with voltages above 50 Volts.

Touching live parts with voltages of 50 Volts and more with bare hands or conductive tools or touching ungrounded housings can be dangerous and cause electric shock. In order to operate electrical equipment, certain parts must unavoidably have dangerous voltages applied to them.

DANGER

High electrical voltage! Danger to life, severe bodily harm by electric shock!

⇒ Only those trained and qualified to work with or on electrical equipment are permitted to operate, maintain or repair this equipment.

⇒ Follow general construction and safety regulations when working on high voltage installations.

⇒ Before switching on power the ground wire must be permanently connected to all electrical units according to the connection diagram.

⇒ Do not operate electrical equipment at any time, even for brief measurements or tests, if the ground wire is not permanently connected to the points of the components provided for this purpose.

⇒ Before working with electrical parts with voltage higher than 50 V, the equipment must be disconnected from the mains voltage or power supply. Make sure the equipment cannot be switched on again unintended.

⇒ The following should be observed with electrical drive and filter components:

⇒ Wait thirty (30) minutes after switching off power to allow capacitors to discharge before beginning to work. Measure the voltage on the capacitors before beginning to work to make sure that the equipment is safe to touch.

⇒ Never touch the electrical connection points of a component while power is turned on.

⇒ Install the covers and guards provided with the equipment properly before switching the equipment on. Prevent contact with live parts at any time.

⇒ A residual-current-operated protective device (RCD) must not be used on electric drives! Indirect contact must be prevented by other means, for example, by an overcurrent protective device.

⇒ Electrical components with exposed live parts and uncovered high voltage terminals must be installed in a protective housing, for example, in a control cabinet.

To be observed with electrical drive and filter components:

DANGER

High electrical voltage on the housing!
High leakage current! Danger to life, danger of injury by electric shock!

⇒ Connect the electrical equipment, the housings of all electrical units and motors permanently with the safety conductor at the ground points before power is switched on. Look at the connection diagram. This is even necessary for brief tests.

⇒ Connect the safety conductor of the electrical equipment always permanently and firmly to the supply mains. Leakage current exceeds 3.5 mA in normal operation.

⇒ Use a copper conductor with at least 10 mm² cross section over its entire course for this safety conductor connection!

⇒ Prior to startups, even for brief tests, always connect the protective conductor or connect with ground wire. Otherwise, high voltages can occur on the housing that lead to electric shock.

3.6 Protection Against Electric Shock by Protective Low Voltage (PELV)

All connections and terminals with voltages between 0 and 50 Volts on Rexroth products are protective low voltages designed in accordance with international standards on electrical safety.

WARNING

High electrical voltage due to wrong connections! Danger to life, bodily harm by electric shock!

⇒ Only connect equipment, electrical components and cables of the protective low voltage type (PELV = Protective Extra Low Voltage) to all terminals and clamps with voltages of 0 to 50 Volts.

⇒ Only electrical circuits may be connected which are safely isolated against high voltage circuits. Safe isolation is achieved, for example, with an isolating transformer, an opto-electronic coupler or when battery-operated.

3.7 Protection Against Dangerous Movements

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

- improper or wrong wiring of cable connections
- incorrect operation of the equipment components
- wrong input of parameters before operation
- malfunction of sensors, encoders and monitoring devices
- defective components
- software or firmware errors

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

The monitoring in the drive components will normally be sufficient to avoid faulty operation in the connected drives. Regarding personal safety, especially the danger of bodily injury and material 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.

DANGER

Dangerous movements! Danger to life, risk of injury, severe bodily harm or material damage!

⇒ Ensure personal safety by means of qualified and tested higher-level monitoring devices or measures integrated in the installation. Unintended machine motion is possible if monitoring devices are disabled, bypassed or not activated.

⇒ Pay attention to unintended machine motion or other malfunction in any mode of operation.

⇒ Keep free and clear of the machine's range of motion and moving parts. Possible measures to prevent people from accidentally entering the machine's range of motion:

- use safety fences
- use safety guards
- use protective coverings
- install light curtains or light barriers

⇒ Fences and coverings must be strong enough to resist maximum possible momentum, especially if there is a possibility of loose parts flying off.

⇒ Mount the emergency stop switch in the immediate reach of the operator. Verify that the emergency stop works before startup. Don't operate the machine if the emergency stop is not working.

⇒ Isolate the drive power connection by means of an emergency stop circuit or use a starting lockout to prevent unintentional start.

⇒ Make sure that the drives are brought to a safe standstill before accessing or entering the danger zone. Safe standstill can be achieved by switching off the power supply contactor or by safe mechanical locking of moving parts.

⇒ Secure vertical axes against falling or dropping after switching off the motor power by, for example:

- mechanically securing the vertical axes
- adding an external braking/ arrester/ clamping mechanism
- ensuring sufficient equilibration of the vertical axes

The standard equipment motor brake or an external brake controlled directly by the drive controller are not sufficient to guarantee personal safety!

⇒ Disconnect electrical power to the equipment using a master switch and secure the switch against reconnection 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 electronics circuits and supply leads. If the use of such equipment cannot be avoided, verify the system and the installation for possible malfunctions in all possible positions of normal use before initial startup. If necessary, perform a special electromagnetic compatibility (EMC) test on the installation.

3.8 Protection Against Magnetic and Electromagnetic Fields During Operation and Mounting

Magnetic and electromagnetic fields generated near current-carrying conductors and permanent magnets in motors represent a serious health hazard to persons with heart pacemakers, metal implants and hearing aids.

WARNING

Health hazard for persons with heart pacemakers, metal implants and hearing aids in proximity to electrical equipment!

⇒ Persons with heart pacemakers, hearing aids and metal implants are not permitted to enter the following areas:
- Areas in which electrical equipment and parts are mounted, being operated or started up.
- Areas in which parts of motors with permanent magnets are being stored, operated, repaired or mounted.

⇒ If it is necessary for a person with a heart pacemaker to enter such an area, then a doctor must be consulted prior to doing so. Heart pacemakers that are already implanted or will be implanted in the future, have a considerable variation in their electrical noise immunity. Therefore there are no rules with general validity.

⇒ Persons with hearing aids, metal implants or metal pieces must consult a doctor before they enter the areas described above. Otherwise, health hazards will occur.

3.9 Protection Against Contact with Hot Parts

CAUTION

Housing surfaces could be extremely hot! Danger of injury! Danger of burns!

⇒ Do not touch housing surfaces near sources of heat! Danger of burns!

⇒ After switching the equipment off, wait at least ten (10) minutes to allow it to cool down before touching it.

⇒ Do not touch hot parts of the equipment, such as housings with integrated heat sinks and resistors. Danger of burns!

3.10 Protection During Handling and Mounting

Under certain conditions, incorrect handling and mounting of parts and components may cause injuries.

CAUTION

Risk of injury by incorrect handling! Bodily harm caused by crushing, shearing, cutting and mechanical shock!

⇒ Observe general installation and safety instructions with regard to handling and mounting.

⇒ Use appropriate mounting and transport equipment.

⇒ Take precautions to avoid pinching and crushing.

⇒ Use only appropriate tools. If specified by the product documentation, special tools must be used.

⇒ Use lifting devices and tools correctly and safely.

⇒ For safe protection wear appropriate protective clothing, e.g. safety glasses, safety shoes and safety gloves.

⇒ Never stand under suspended loads.

⇒ Clean up liquids from the floor immediately to prevent slipping.

3.11 Battery Safety

Batteries contain reactive chemicals in a solid housing. Inappropriate handling may result in injuries or material damage.

CAUTION

Risk of injury by incorrect handling!

⇒ Do not attempt to reactivate discharged batteries by heating or other methods (danger of explosion and cauterization).

⇒ Never charge non-chargeable batteries (danger of leakage and explosion).

⇒ Never throw batteries into a fire.

⇒ Do not dismantle batteries.

⇒ Do not damage electrical components installed in the equipment.

Note: Be aware of environmental protection and disposal! The batteries contained in the product should be considered as hazardous material for land, air and sea transport in the sense of the legal requirements (danger of explosion). Dispose batteries separately from other waste. Observe the legal requirements in the country of installation.

3.12 Protection Against Pressurized Systems

IndraDyn motors and drive controllers, corresponding to the information in the respective Project Planning Manual, must be provided with pressurized media, such as compressed air, hydraulic oil, cooling fluid and cooling lubricant supplied by external systems. Incorrect handling of the supply and connections of pressurized systems can lead to injuries or accidents. In these cases, improper handling of external supply systems, supply lines or connections can cause injuries or material damage.

CAUTION

Danger of injury by incorrect handling of pressurized systems !

⇒ Do not attempt to disassemble, to open or to cut a pressurized system (danger of explosion).

⇒ Observe the operation instructions of the respective manufacturer.

⇒ Before disassembling pressurized systems, release pressure and drain off the fluid or gas.

⇒ Use suitable protective clothing (for example safety glasses, safety shoes and safety gloves)

⇒ Remove any fluid that has leaked out onto the floor immediately.

Note: Environmental protection and disposal! The media used in the operation of the pressurized system equipment may not be environmentally compatible. Media that are damaging the environment must be disposed separately from normal waste. Observe the legal requirements in the country of installation.

Notes

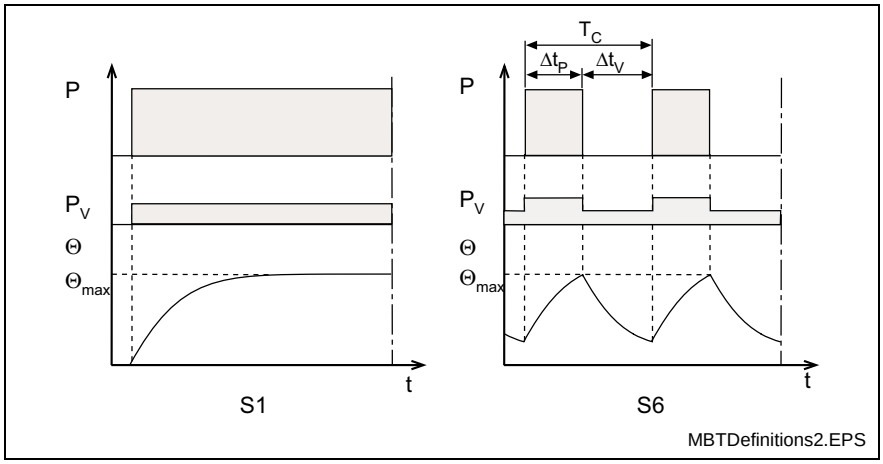
4 Technical Data

This chapter contains the technical data and definitions of all motor sizes and lengths of the IndraDyn T series.

4.1 Definitions

Operating Modes

Bosch Rexroth motors are documented according to the test criteria and measuring methods of EN 60034-1. Stated technical data refers to operating modes S1 (continuous operation) and S6 (periodic operation), each with liquid cooling using water as the cooling medium.



P: Load
P_V: Electric losses
Θ: Temperature
$Θ_{max}$: Highest temperature (stator)
t: Time
T_C: Cycle duration
$Δt_P$: Operating time with constant load
$Δt_V$: Idling time

Fig. 4-1: Operating modes according to EN 60034-1 :1998

Duty Cycle

Operating mode S6 is supplemented by the specification of the duty cylce (ED). The duty cycle is calculated as follows:

$$ED = \frac{\Delta t_P}{T_C} \cdot 100\%$$

ED: Duty cycle in %
T_C: Cycle duration
$Δt_P$: Operating time with constant load

Fig. 4-2: Duty cycle

Characteristics

Rated torque M_N Available torque, in Nm that can be output at the rated speed in operating mode S1 (continuous operation).

Rated power P_N Power consumption, in kW, of the motor at the rated speed and rated torque.

Rated current I_N The rms phase current of the motor running at rated speed and rated torque, in amps (A).

Rated speed n_N Typical working speed, in rpm, as defined by the manufacturer. Depending on the particular application, other working speeds are possible (see speed-torque curve).

Maximum torque M_{max} The torque in Nm, available at peak current, I_{max} . The maximum achievable torque depends on the drive controller used.

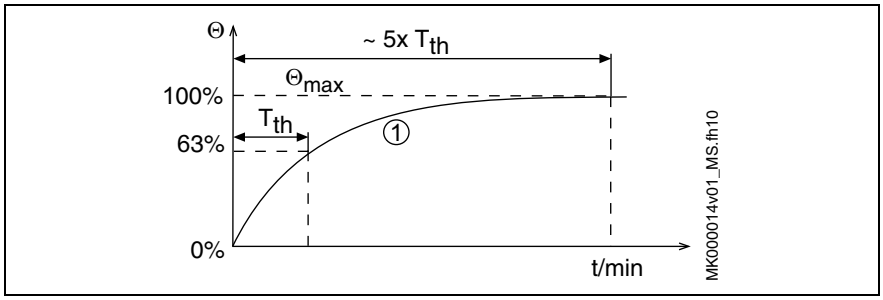
Peak current I_{max} Th rms (root mean square) current of the motor at M_{max}. Unit = ampere (A).

Maximum speed n_{max} Maximum allowable speed in rpm, of the motor in (rpm). This value is normally restricted by mechanical factors such as centrifugal forces or bearing loads.

Torque constant at 20°C K_{M_N} The ratio, in Nm/A, of the increase in torque versus the increase in the motors`s rms phase-current. Valid up to rated current, I_N.

Voltage constant at 20°C K_{EMF_1} Root mean square value ,in V/rpm, of the induced motor voltage versus the motor speed.

Thermal time constant T_{th} Length of time, in minutes, required for the temperature rise to 63% of the final temperature with the stator under rated torque, in S1 operation and using liquid cooling.



(1): Characteristic curve of the stator temperature versus time
Θ_{max}: max. stator temperature
T_{th}: thermal time constant

Fig. 4-3: Thermal time constant

Winding resistance at 20°C R_{12} The resistance, in ohms, measured between two phases.

Discharge capacity C_{ab} Capacity of short-circuited power connections U, V, W against the motor housing.

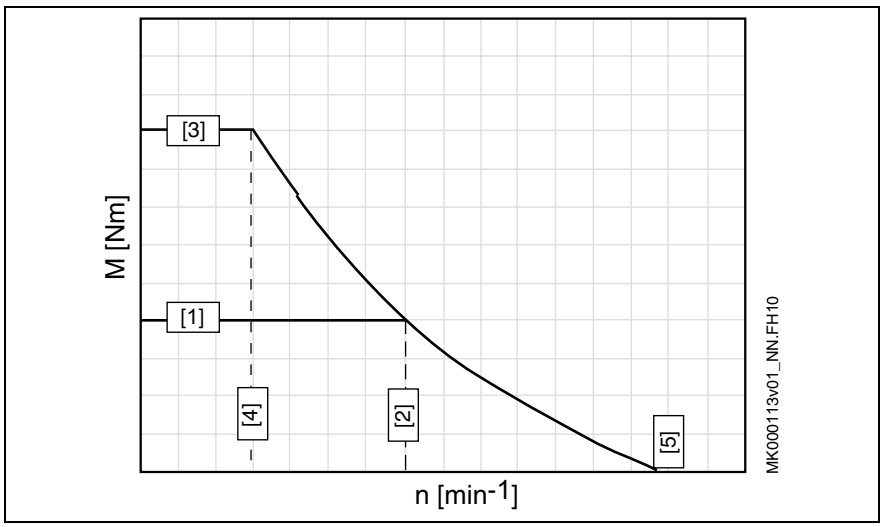
Number of pole pairs p Number of pole pairs of the motor.

Rotor moment of inertia J_{rot} The moment of inertia, in kgm², of the rotor without brake, bearing and encoder.

Stator/rotor mass m The mass, in kg, of the stator and rotor, without bearing and encoder.

Operating Characteristics

The following sample characteristic curve explains the operating characteristics of IndraDyn T motors, as does information found in the motor data sheet.



[1]: Rated torque M_N [2]: Rated speed n_N
[3]: Maximum speed M_{max} [4]: Max. torque n_{Mmax}
[5]: Max. torque n_{max}

Fig. 4-4: Example motor characteristic curve

Note: The achievable torque depends on the drive control used. The reference value for the characteristic curves of the motor assumes an unregulated intermediate circuit voltage of $540V_{DC}$.

The maximum torque M_{max} is available up to the speed n_{Mmax}. When the velocity rises, the available intermediate circuit voltage is reduced by the velocity-dependent reverse voltage of the motor. This leads to a reduction of the maximum torque with rising velocity.

The specified characteristic curves can be linearly extrapolated to the existing voltages if the connection voltages or mains voltages differ.

Example:

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

Fig. 4-5: Example for conversion

Conversion to intermediate circuit voltage $750V_{DC}$

$$M_{max\_750V} = M_{max} = constant$$
$$M_{nenn\_750V} = M_{nenn} = constant$$
$$n_{max\_750V} = \frac{750V}{540V} \cdot n_{max}$$
$$n_{nenn\_750V} = \frac{750V}{540V} \cdot n_{nenn}$$

Fig. 4-6: Conversion example to intermediate circuit voltage $750V_{DC}$

4.2 Data sheet, Size 130

Data Sheet for Frame Lengths 130A, 130C

Identification	Symbol	Unit	Size 130			
Motor data [1])						
Frame length			A		C	
Winding code			0200	0250	0050	0075
Rated torque	M_N	Nm	9	4.5	25	13.5
Rated power	P_N	kW	1.9	1.2	1.3	1.1
Rated current	I_N	A	7.5	3.5	7.5	3.5
Rated speed	n_N	rpm	2000	2500	500	750
Maximum torque [2])	M_{max}	Nm	15	13	40	40
Maximum current	I_{max}	A	16	12	12	12
Maximum speed	n_{max}	rpm	4000	4000	1200	1200
Minimum cross-section of cable [3])	A	mm^2	1	1	1	1
Torque constant at 20°C	K_{M_N}	Nm/A	1.2	1.3	3.3	3.9
Constant voltage at 20°C [4])	K_{EMF_1}	V/rpm	0.105	0.085	0.4	0.28
Thermal time constant	T_{th}	min	i.p.			
Winding resistance at 20°C	R_{12}	Ohm	2.5	5.9	6.3	6.3
Inductivity of mounted rotor	L_{12}	mH	19.4	17.5	42	42
Discharge capacity	C_{ab}	nF	2.19		6.56	
Number of pole pairs	p		10			
Rotor moment of inertia	J_{rot}	kgm^2	0.0008		0.0018	
Mass of the stator	m_{stat}	kg	2.4		5.1	
Mass of the rotor	m_{rot}	kg	0.65		1.5	
Environmental temperature (in operation)	T_{um}	°C	0...+40			
Insulation class according to EN 60034-1			F			
Motor protection class acc. to EN 60034-5			IP00			
Liquid cooling [5])						
Rated power loss	P_V	kW	0.5	(0.11)	1	(0.17)
Coolant temperature at inlet	T_{in}	°C	+10 ...+40	natural convect.	+10 ...+40	natural convect.
Temperature increase for P_V	ΔT_{diff}	K	10		10	
Coolant flow for ΔT_{diff}	Q_{min}	l/min	0.7		1.4	
Pressure drop for Q_{min}	Δp_{diff}	bar	0.1		0.1	
Permissible inlet pressure	p_{max}	bar	3		3	
Volume of coolant duct	V_{cool}	l	0.04		0.09	

[1]) Unless otherwise indicated, the values are root mean square values according to IEC 60034-1. Reference values assume a 540 V_{DC} bus voltage.
[2]) The maximum torque that can be attained depends on the drive controller used.
[3]) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross-sections may be necessary. For notes regarding the power and connection cables, see Chapter 8.
[4]) EMF = Electromagnetic Force. Root mean square value based on 1 rpm.
[5]) The data refer to operation with liquid cooling using water as the cooling medium. For further notes regarding the generation of the coolant inlet temperature, see Chapter 9.5 “Motor Cooling“.
i.p. = in preparation

Fig. 4-7: Data sheet for sizes 130A, 130C

Motor characteristic curves:
frame size 130

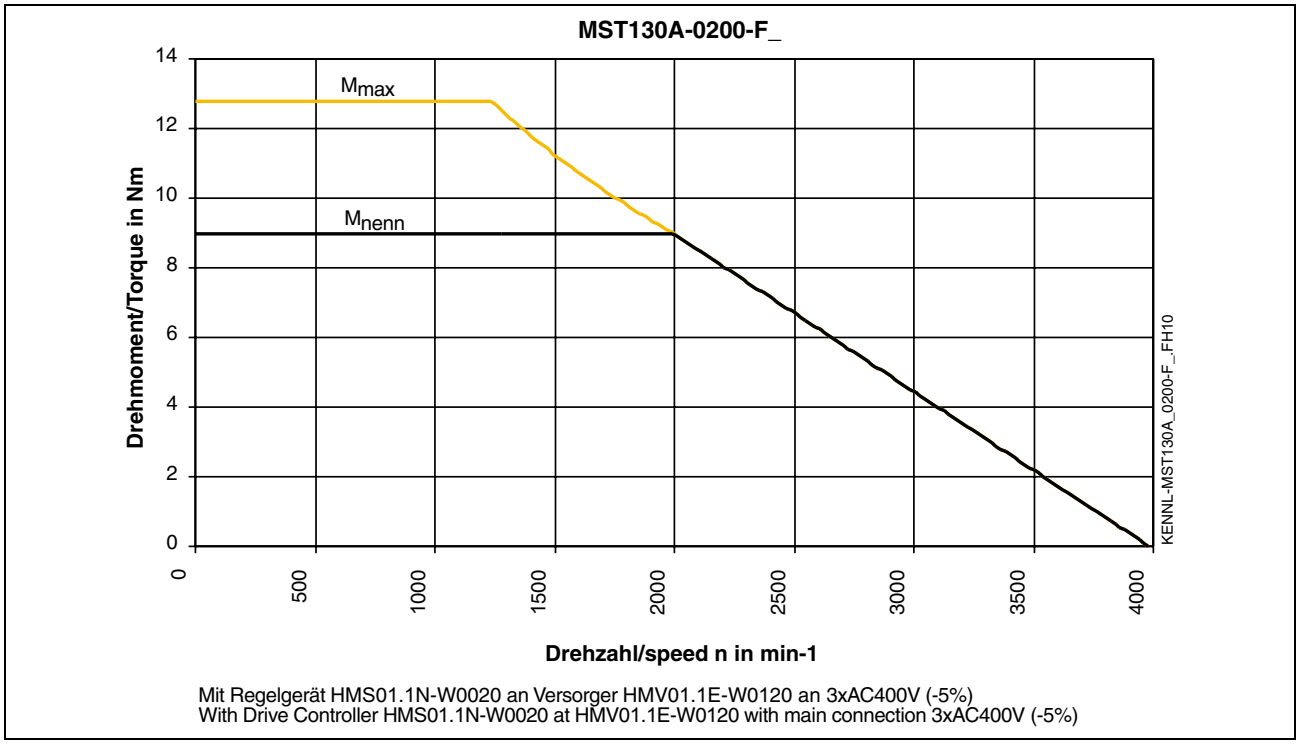


Fig. 4-8: MST130A-0200 motor characteristic curve

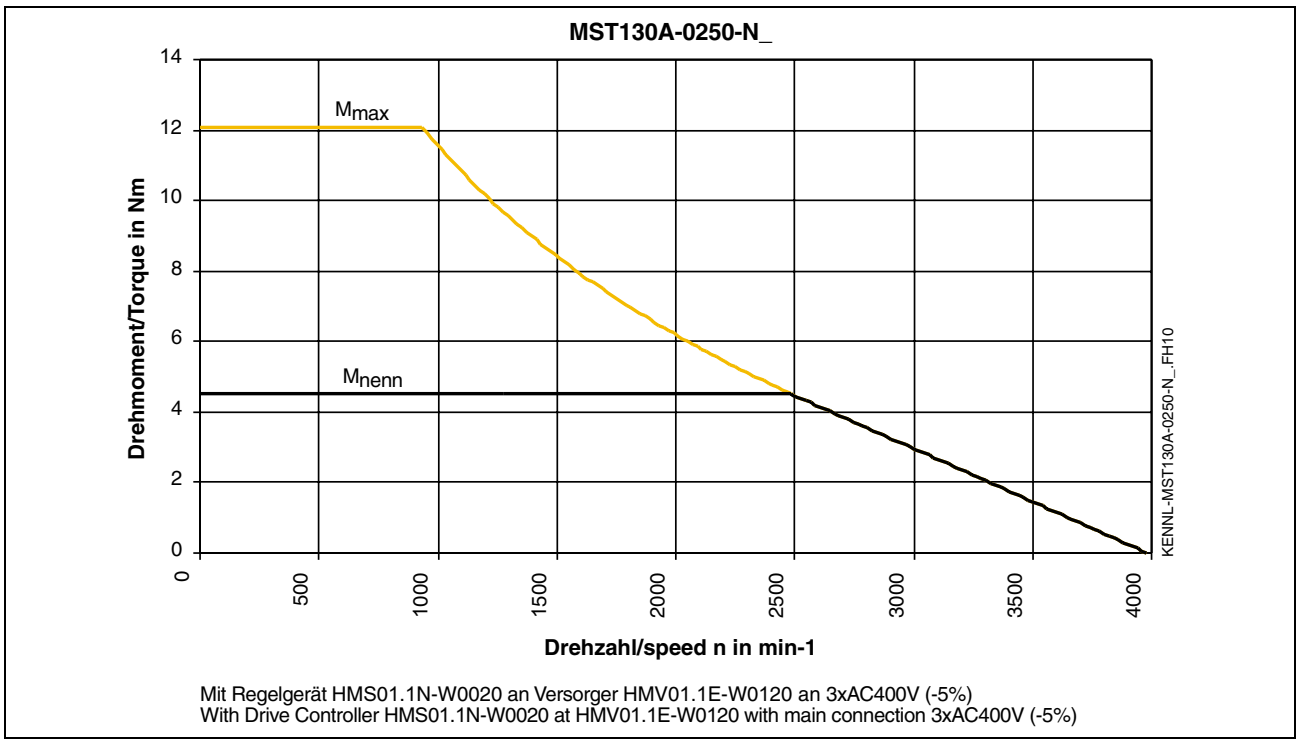


Fig. 4-9: MST130A-0250 motor characteristic curves

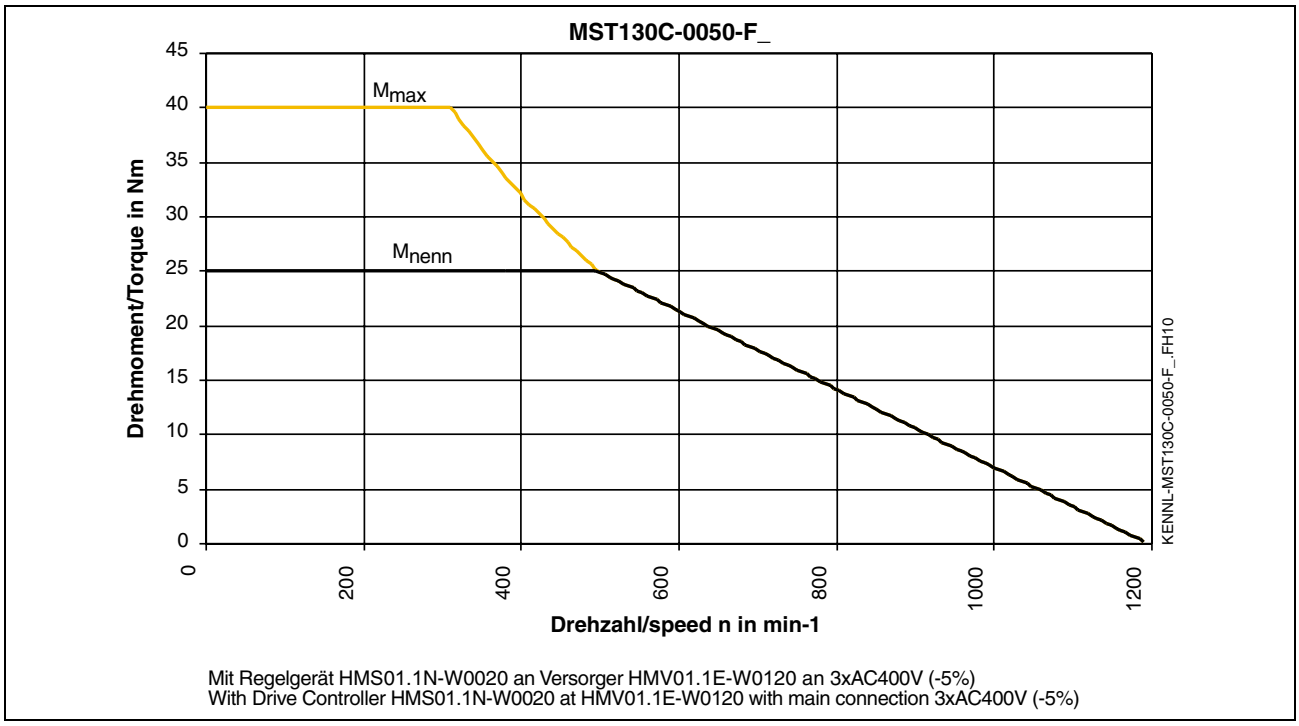


Fig. 4-10: MST130C-0050 motor characteristic curve

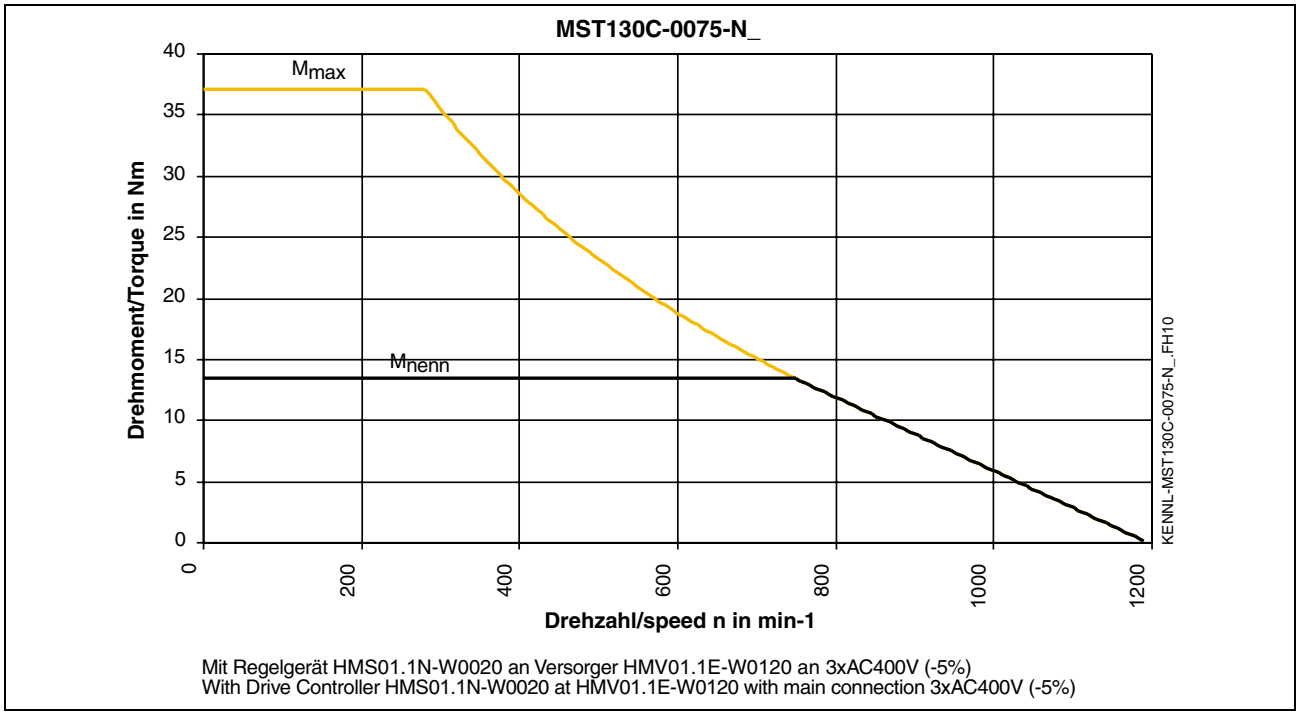


Fig. 4-11: MST130C-0075 motor characteristic curve

Data Sheet for Frame Lengths 130E, 130G

Identification	Symbol	Unit	Size 130		
Motor data [1])					
Frame length			E		G
Winding code			0020	0035	0035
Rated torque	M_N	Nm	42	22.5	31.5
Rated power	P_N	kW	0.9	0.6	1.2
Rated current	I_N	A	7.5	3.5	4.9
Rated speed	n_N	rpm	200	350	350
Maximum torque [2])	M_{max}	Nm	65	65	80
Maximum current	I_{max}	A	12	12	18
Maximum speed	n_{max}	rpm	700	700	700
Minimum cross-section of cable [3])	A	mm²	1	1	1
Torque constant at 20°C	K_{M_N}	Nm/A	5.6	6.6	6.4
Constant voltage at 20°C [4])	K_{EMF_1}	V/rpm	1.05	0.34	0.52
Thermal time constant	T_{th}	min	i.p.		
Winding resistance at 20°C	R_{12}	Ohm	15.2	14.9	17.4
Inductivity of mounted rotor	L_{12}	mH	61.4	65.8	98.6
Discharge capacity	C_{ab}	nF	10.93		15.31
Number of pole pairs	p		10		
Rotor moment of inertia	J_{rot}	kgm²	0.0029		0.0039
Mass of the stator	m_{stat}	kg	7.7		10.2
Mass of the rotor	m_{rot}	kg	2.2		3
Environmental temperature (in operation)	T_{um}	°C	0 ...+40		
Insulation class according to EN 60034-1			F		
Motor protection class acc. to EN 60034-5			IP00		
Liquid cooling [5])					
Rated power loss	P_V	kW	1.4	(0.22)	(0.29)
Coolant temperature at inlet	T_{in}	°C	+10 ...+40	natural convect.	natural convect.
Temperature increase for P_V	ΔT_{diff}	K	10		
Coolant flow for ΔT_{diff}	Q_{min}	l/min	2		
Pressure drop for Q_{min}	Δp_{diff}	bar	0.1		
Permissible inlet pressure	p_{max}	bar	3		
Volume of coolant duct	V_{cool}	l	0.16		

[1]) Unless otherwise indicated, the values are root mean square values according to IEC 60034-1. Reference values assume a 540 V_{DC} bus voltage.
[2]) The maximum torque that can be attained depends on the drive controller used.
[3]) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross-sections may be necessary. For notes regarding the power and connection cables, see Chapter 8.
[4]) EMF = Electromagnetic Force. Root mean square value based on 1 rpm.
[5]) The data refer to operation with liquid cooling using water as the cooling medium. For further notes regarding the generation of the coolant inlet temperature, see Chapter 9.5 “Motor Cooling“.
i.p. = in preparation

Fig. 4-12: Data sheet for sizes 130E, 130G

Motor characteristic curves:
frame size 130

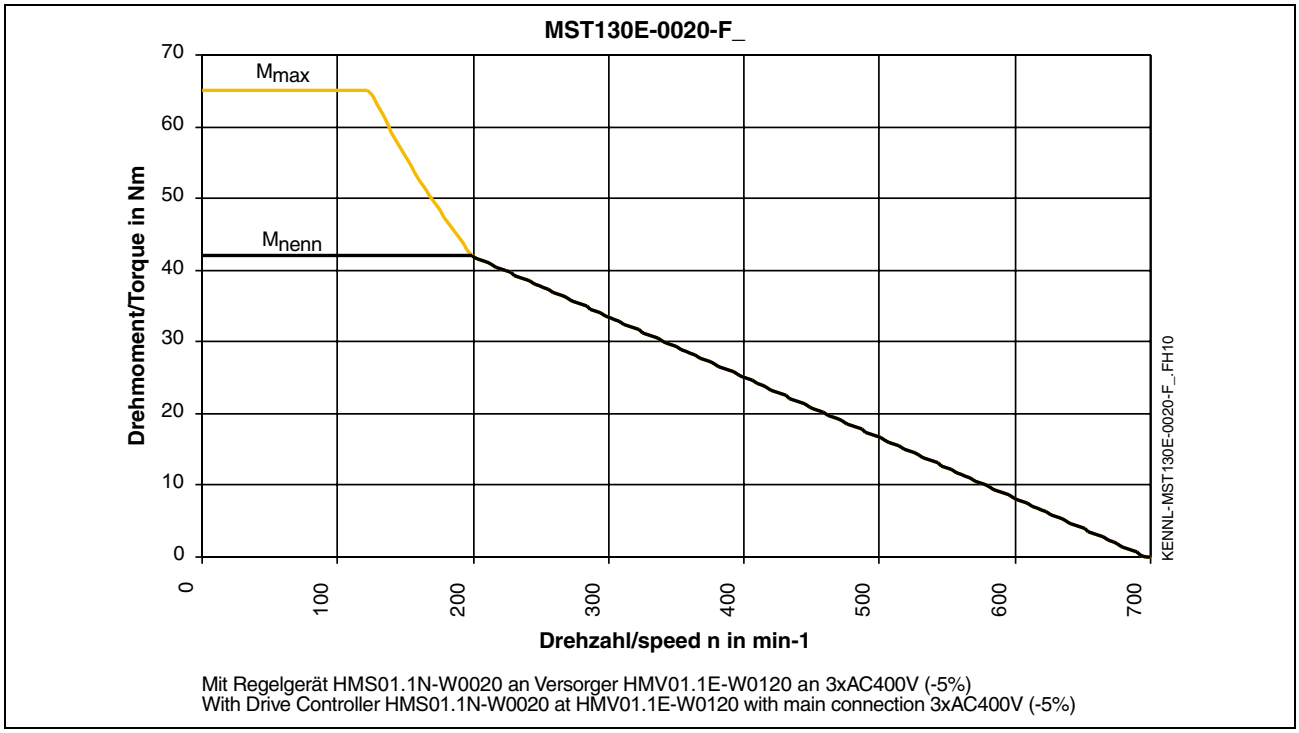


Fig. 4-13: MST130E-0020 motor characteristic curve

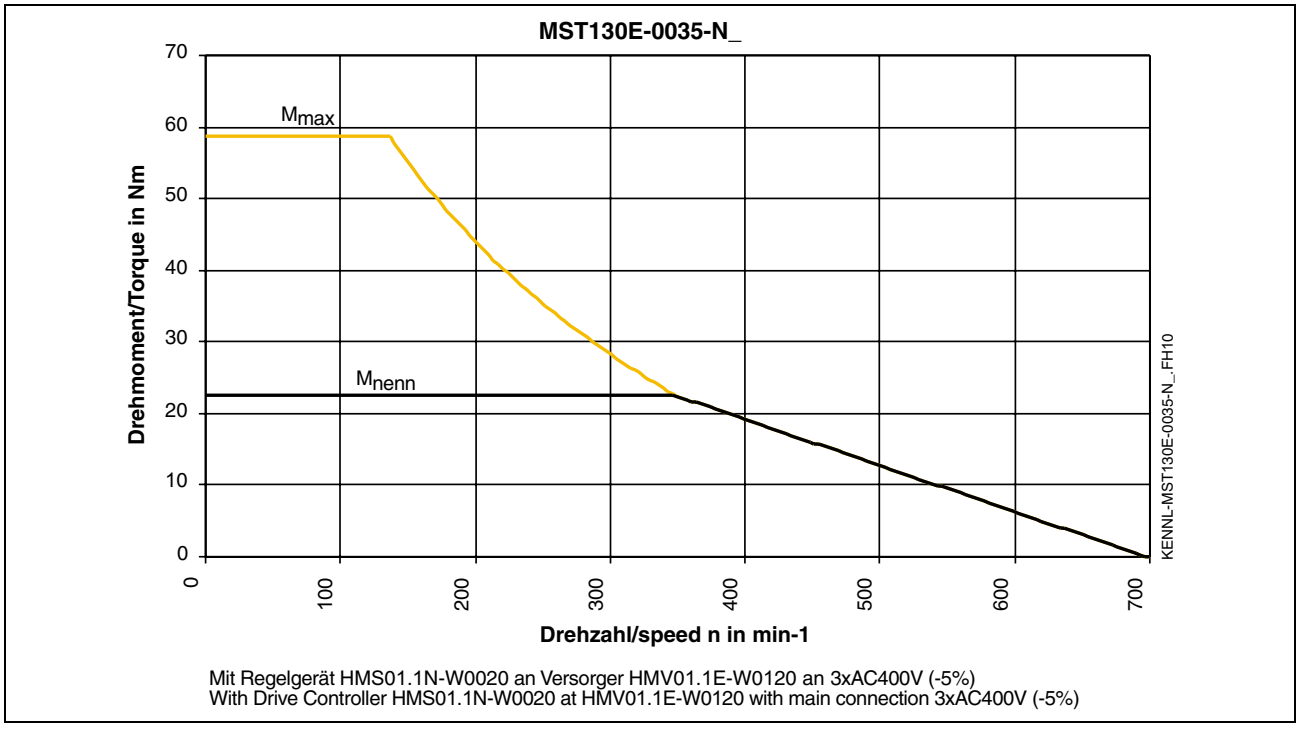


Fig. 4-14: MST130E-0035 motor characteristic curve

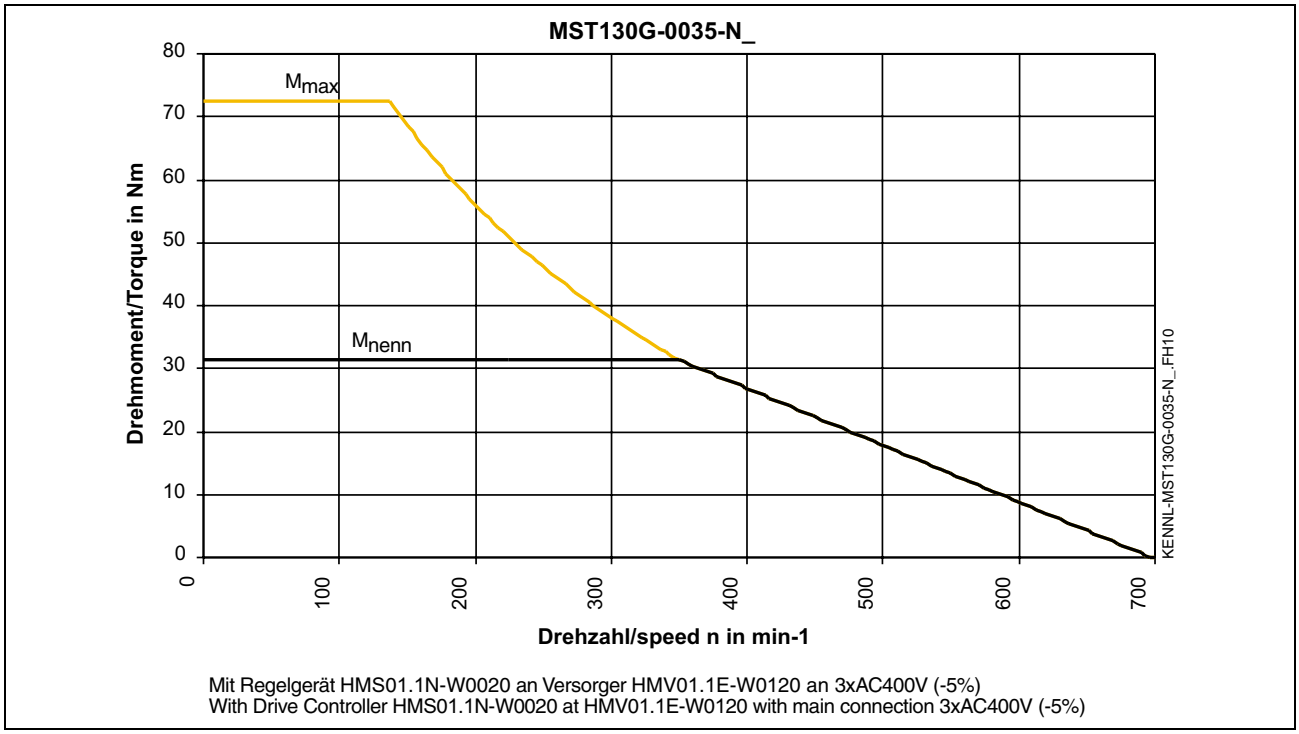


Fig. 4-15: MST130G-0035 motor characteristic curve

4.3 Data Sheet, Size 160

Identification	Symbol	Unit	Size 160		
Motor data [1])					
Frame length			A	C	E
Winding code			0050	0050	0050
Rated torque	M_N	Nm	35	70	105
Rated power	P_N	kW	1.8	3.7	5.5
Rated current	I_N	A	6.5	13	19.5
Rated speed	n_N	rpm	500	500	500
Maximum torque [2])	M_{max}	Nm	90	180	270
Maximum current	I_{max}	A	20	40	60
Maximum speed	n_{max}	rpm	1000	1000	1000
Minimum cross-section of cable [3])	A	mm²	1	1	2.5
Torque constant at 20°C	K_{M_N}	Nm/A	5.4	5.5	5.4
Constant voltage at 20°C [4])	K_{EMF_1}	V/rpm	0.42	0.42	0.42
Thermal time constant	T_{th}	min	i.p.		
Winding resistance at 20°C	R_{12}	Ohm	8.3	3.7	3.2
Inductivity of mounted rotor	L_{12}	mH	31.4	15.1	12.8
Discharge capacity	C_{ab}	nF	4.4	11.66	17.49
Number of pole pairs	p		15		
Rotor moment of inertia	J_{rot}	kgm²	0.006	0.011	0.016
Mass of the stator	m_{stat}	kg	5.6	9.6	13.9
Mass of the rotor	m_{rot}	kg	2.4	4.3	6.2
Environmental temperature (in operation)	T_{um}	°C	0 ...+40		
Insulation class according to EN 60034-1			F		
Motor protection class acc. to EN 60034-5			IP00		
Liquid cooling [5])					
Rated power loss	P_V	kW	1.3	2.1	3
Coolant temperature at inlet	T_{in}	°C	+10 ...+40		
Temperature increase for P_V	ΔT_{diff}	K	10		
Coolant flow for ΔT_{diff}	Q_{min}	l/min	1.9	3	4.3
Pressure drop for Q_{min}	Δp_{diff}	bar	0.1	0.1	0.1
Permissible inlet pressure	p_{max}	bar	3		
Volume of coolant duct	V_{cool}	l	0.07	0.16	0.26

[1]) Unless otherwise indicated, the values are root mean square values according to IEC 60034-1. Reference values assume a 540 V_{DC} bus voltage.
[2]) The maximum torque that can be attained depends on the drive controller used.
[3]) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross-sections may be necessary. For notes regarding the power and connection cables, see Chapter 8.
[4]) EMF = Electromagnetic Force. Root mean square value based on 1 rpm.
[5]) The data refer to operation with liquid cooling using water as the cooling medium. For further notes regarding the generation of the coolant inlet temperature, see Chapter 9.5 “Motor Cooling“.
i.p. = in preparation

Fig. 4-16: Data sheet, size 160

Motor characteristic curves:
frame size 160

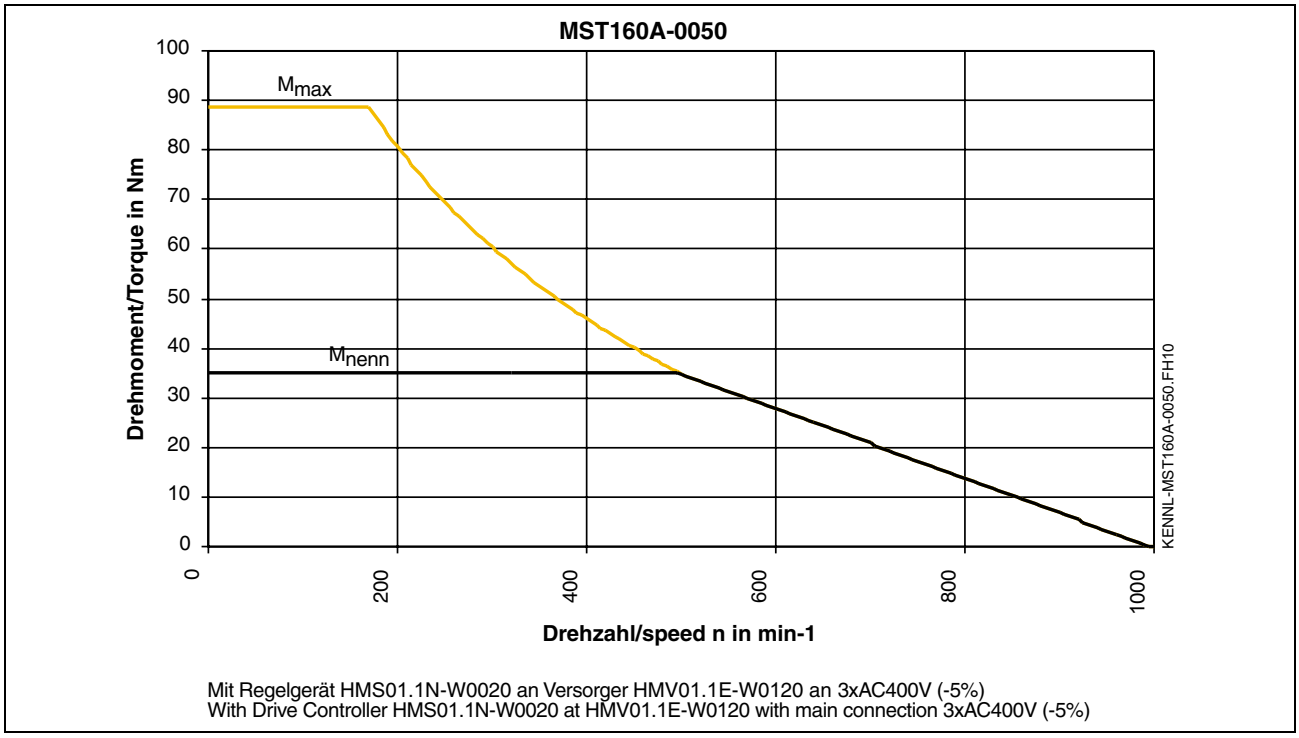


Fig. 4-17: MST160A-0050 motor characteristic curve

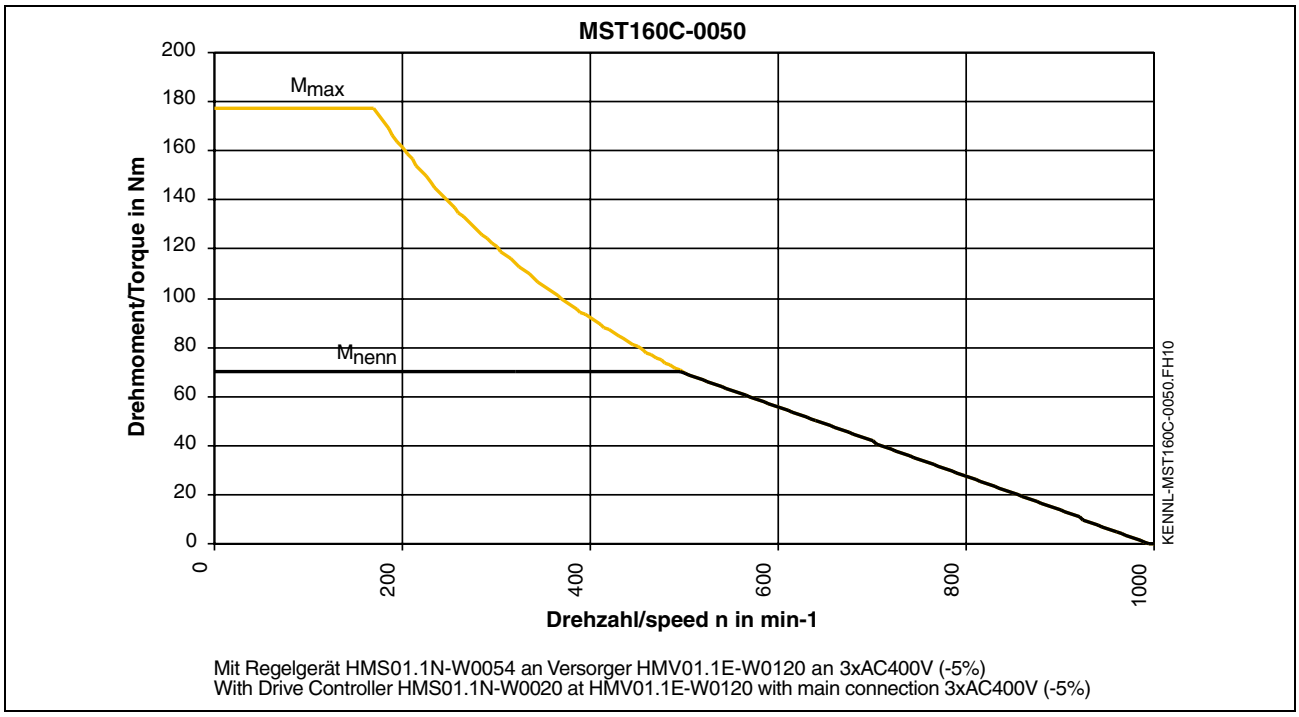


Fig. 4-18: MST160C-0050 motor characteristic curve

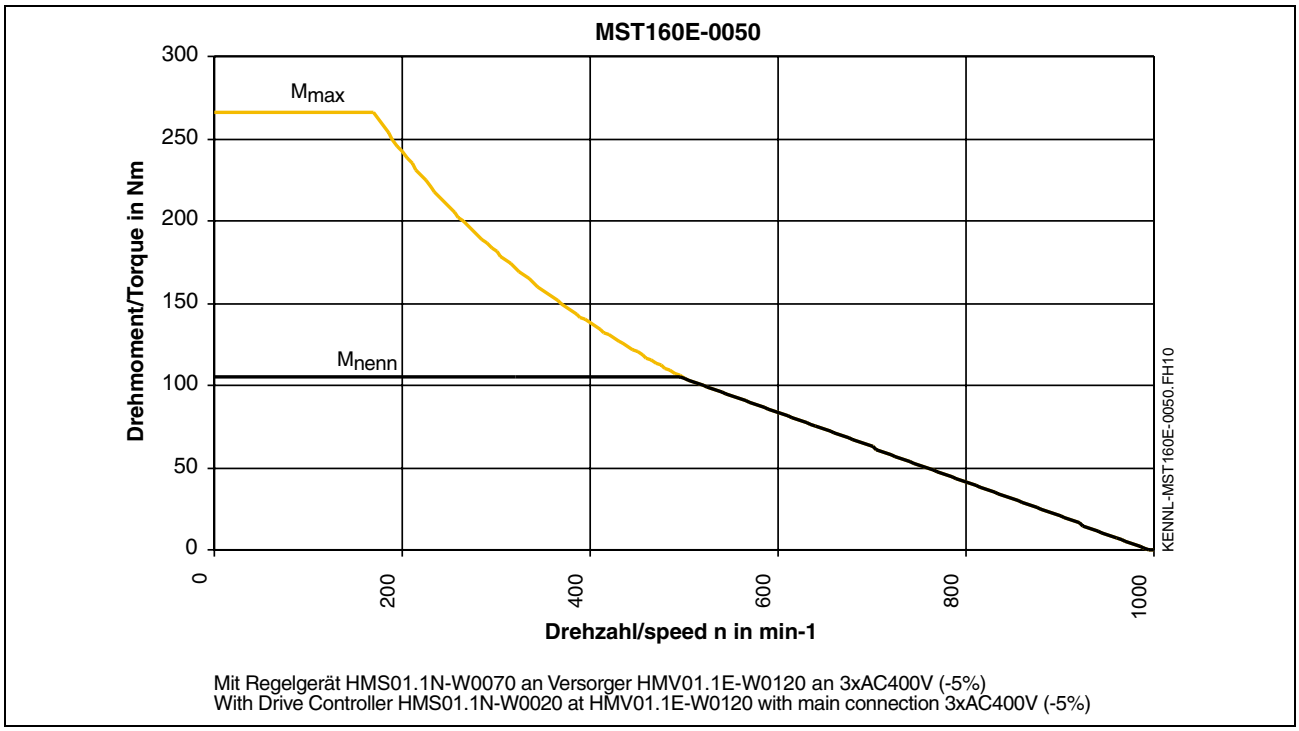


Fig. 4-19: MST160E-0050 motor characteristic curve

4.4 Data Sheet, Size 210

Data Sheet for Frame Lengths 210A, 210C, 210D

Identification	Symbol	Unit	Size 210			
Motor data [1])						
Frame length			A	C		D
Winding code			0027	0027	0050	0070
Rated torque	M_N	Nm	50	120		150
Rated power	P_N	kW	1.4	3.4	6.9	11
Rated current	I_N	A	7	13	25	32
Rated speed	n_N	rpm	270	270	500	700
Maximum torque [2])	M_{max}	Nm	100	250		300
Maximum current	I_{max}	A	25	50	100	120
Maximum speed	n_{max}	rpm	600	600	1200	1200
Minimum cross-section of cable [3])	A	mm²	1	1	4	6
Torque/force constant at 20°	K_{M_N}	Nm/A	7.1	9.2	4.8	4.7
Constant voltage at 20°C [4])	K_{EMF_1}	V/rpm	0.51	0.62	0.31	0.31
Thermal time constant	T_{th}	min	2.4			
Winding resistance at 20°C	R_{12}	Ohm	11.1	4.88	1.23	1.4
Inductivity of mounted rotor	L_{12}	mH	53.3	28.6	7.6	6.9
Discharge capacity	C_{ab}	nF	4.8	9.51		13.32
Number of pole pairs	p		20			
Rotor moment of inertia	J_{rot}	kgm²	0.012	0.023		0.027
Mass of the stator	m_{stat}	kg	7.2	11.5	11.5	13.8
Mass of the rotor	m_{rot}	kg	3	4.8		5.8
Ambient temperature (in operation)	T_{um}	°C	0 ...+40			
Insulation class according to EN 60034-1			F			
Motor protection class acc. to EN 60034-5			IP00			
Liquid cooling [5])						
Rated power loss	P_V	kW	1.2	2.6	2.8	3.4
Coolant temperature at inlet	T_{in}	°C	+10 ...+40			
Temperature increase for P_V	ΔT_{diff}	K	10			
Coolant flow for ΔT_{diff}	Q_{min}	l/min	6			
Pressure drop for Q_{min}	Δp_{diff}	bar	0.1			
Permissible inlet pressure	p_{max}	bar	3			
Volume of coolant duct	V_{cool}	l	0.175	0.175		0.21

[1]) Unless otherwise indicated, the values are root mean square values according to IEC 60034-1. Reference values assume a 540 V_{DC} bus voltage.
[2]) The maximum torque that can be attained depends on the drive controller used.
[3]) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross-sections may be necessary. For notes regarding the power and connection cables, see Chapter 8.
[4]) EMF = Electromagnetic Force. Root mean square value based on 1 rpm.
[5]) The data refer to operation with liquid cooling using water as the cooling medium. For further notes regarding the generation of the coolant inlet temperature, see Chapter 9.5 “Motor Cooling“.

Fig. 4-1: Data sheet for sizes 210A, 210C, 210D

Motor characteristic curves:
frame size 210

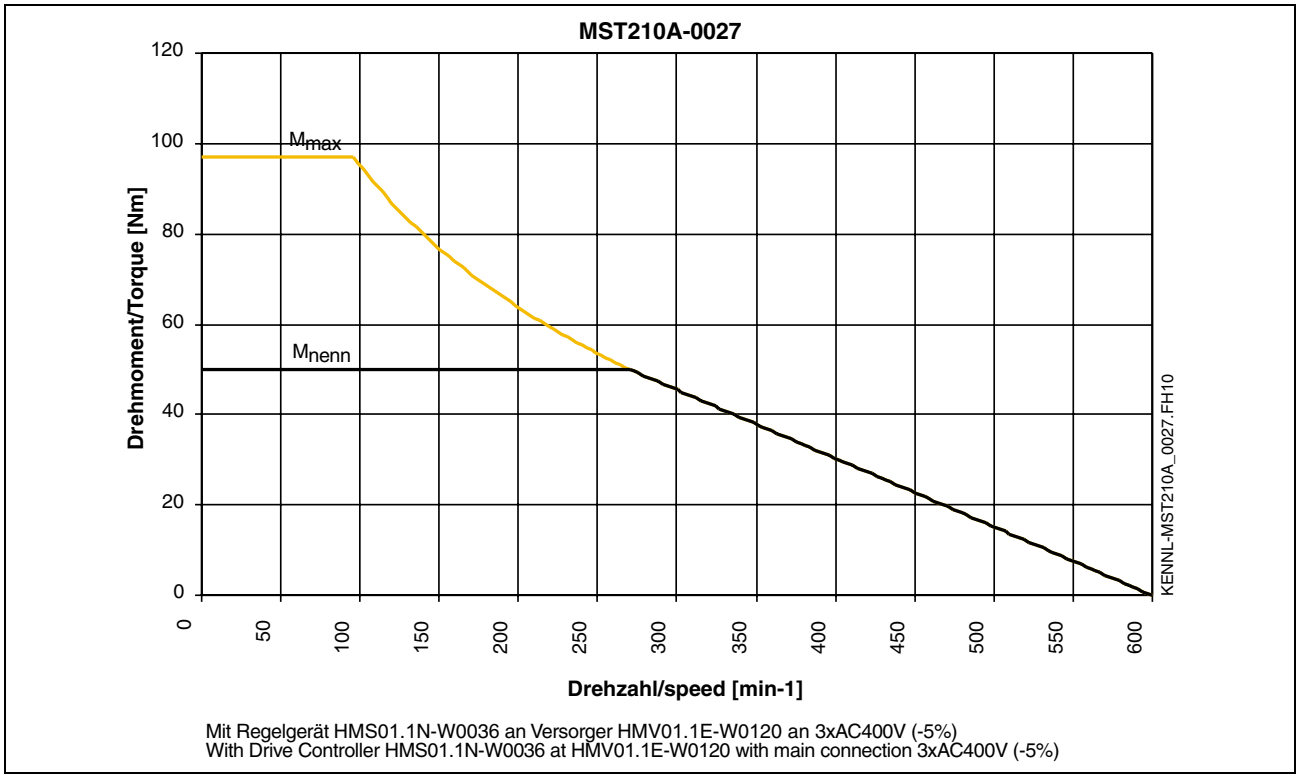


Fig. 4-21: MST210A-0027 motor characteristic curve

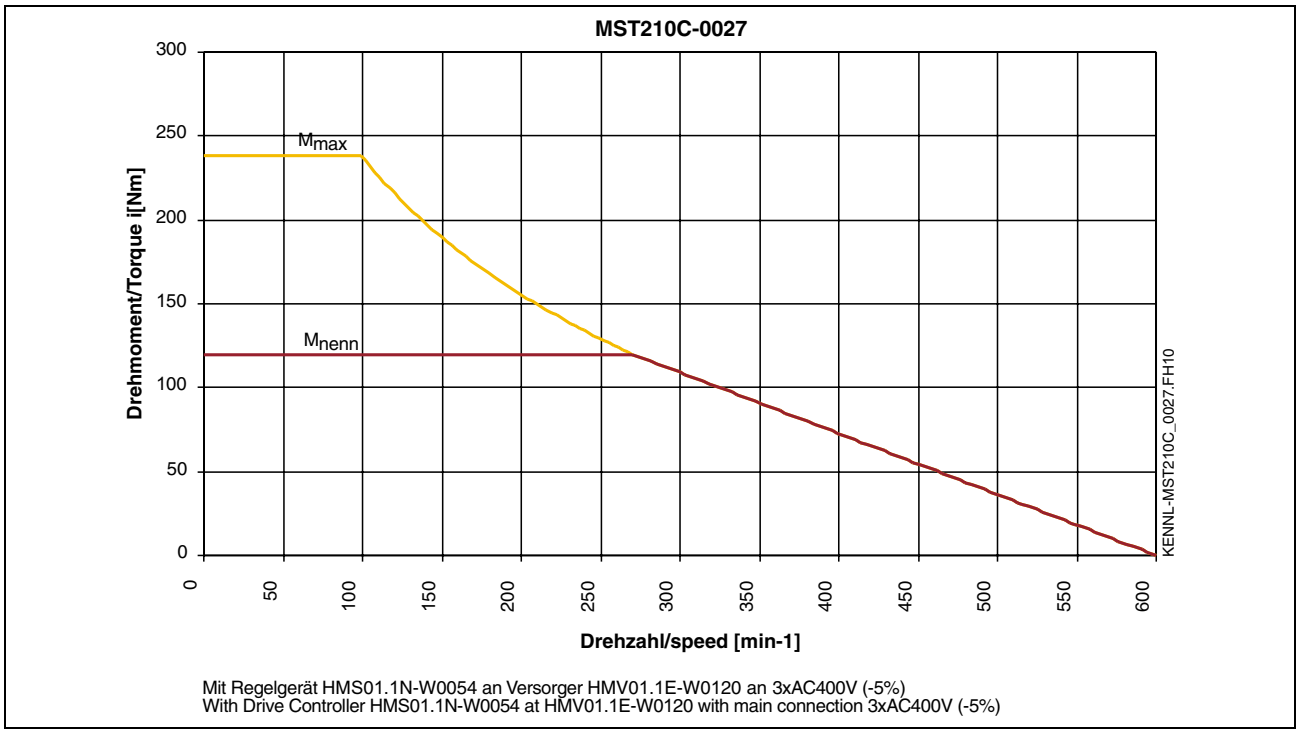


Fig. 4-22: MST210C-0027 motor characteristic curve

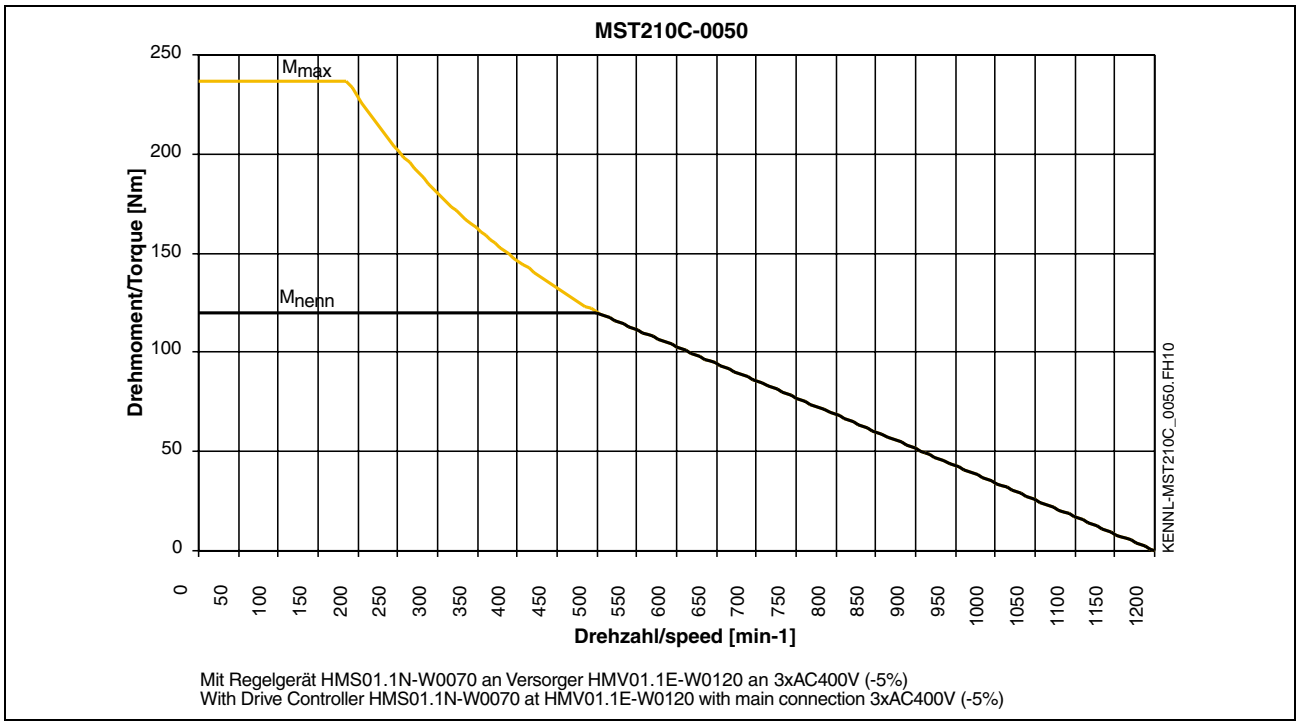


Fig. 4-23: MST210C-0050 motor characteristic curve

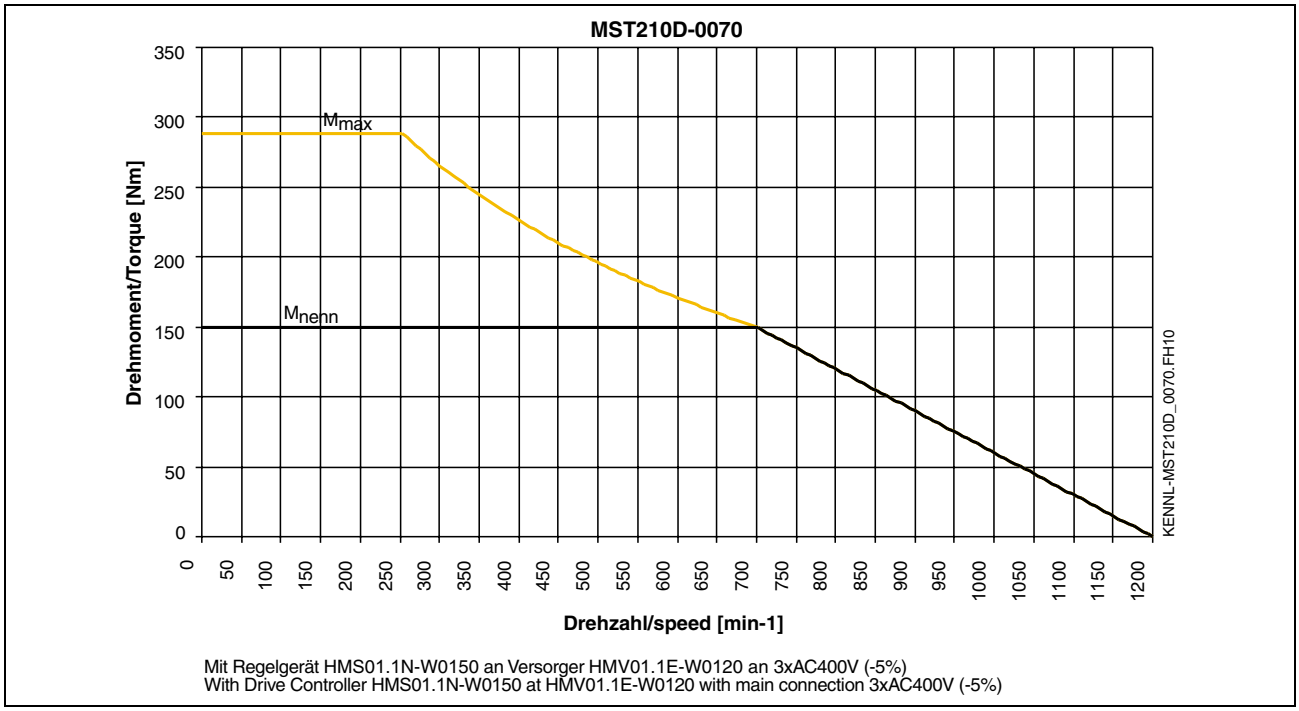


Fig. 4-24: MST210D-0070 motor characteristic curve

Data Sheet for Frame Lengths 210E, 210R

Identification	Symbol	Unit	Size 210		
Motor data [1])					
Frame length			E	R	
Winding code			0027	0010	0035
Rated torque	M_N	Nm	240	105	
Rated power	P_N	kW	6.8	2	3.8
Rated current	I_N	A	24	6.5	13
Rated speed	n_N	rpm	270	180	350
Maximum torque [2])	M_{max}	Nm	500	240	
Maximum current	I_{max}	A	90	22	44
Maximum speed	n_{max}	rpm	600	300	750
Minimum cross-section of cable [3])	A	mm²	4	1	1
Torque/force constant at 20°	K_{M_N}	Nm/A	10	16.15	8.08
Constant voltage at 20°C [4])	K_{EMF_1}	V/rpm	0.7	1.06	0.53
Thermal time constant	T_{th}	min	2.4		
Winding resistance at 20°C	R12	Ohm	2.16	21.2	5.25
Inductivity of mounted rotor	L12	mH	14.1	79.7	19.9
Discharge capacity	C_{ab}	nF	19.03	8.25	
Number of pole pairs	p		20		
Rotor moment of inertia	J_{rot}	kgm²	0.042	0.024	
Mass of the stator	m_{stat}	kg	18.8	8.8	8.8
Mass of the rotor	m_{rot}	kg	7.8	4.4	
Ambient temperature (in operation)	T_{um}	°C	0 ...+40		
Insulation class according to EN 60034-1			F		
Motor protection class acc. to EN 60034-5			IP00		
Liquid cooling [5])					
Rated power loss	P_V	kW	4	1.5	
Coolant temperature at inlet	T_{in}	°C	+10 ...+40		
Temperature increase for P_V	ΔT_{diff}	K	10		
Coolant flow for ΔT_{diff}	Q_{min}	l/min	6	3	
Pressure drop for Q_{min}	Δp_{diff}	bar	0.1	0.4	
Permissible inlet pressure	p_{max}	bar	3		
Volume of coolant duct	V_{cool}	l	0.37	0.185	

[1]) Unless otherwise indicated, the values are root mean square values according to IEC 60034-1. Reference values assume a 540 V_{DC} bus voltage.
[2]) The maximum torque that can be attained depends on the drive controller used.
[3]) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross-sections may be necessary. For notes regarding the power and connection cables, see Chapter 8.
[4]) EMF = Electromagnetic Force. Root mean square value based on 1 rpm.
[5]) The data refer to operation with liquid cooling using water as the cooling medium. For further notes regarding the generation of the coolant inlet temperature, see Chapter 9.5 “Motor Cooling“.

Fig. 4-25: Data sheet for sizes 210E, 210R

Motor characteristic curves:
frame size 210

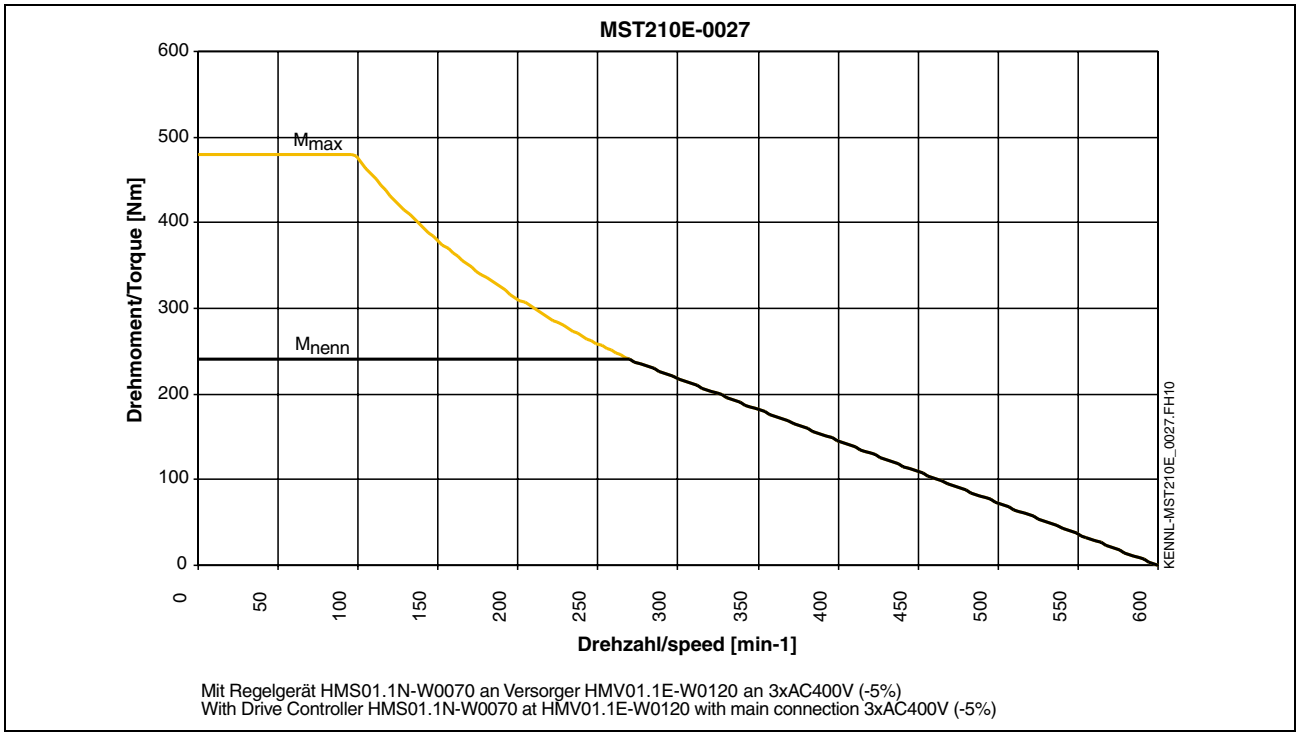


Fig. 4-26: MST210E-0027 motor characteristic curve

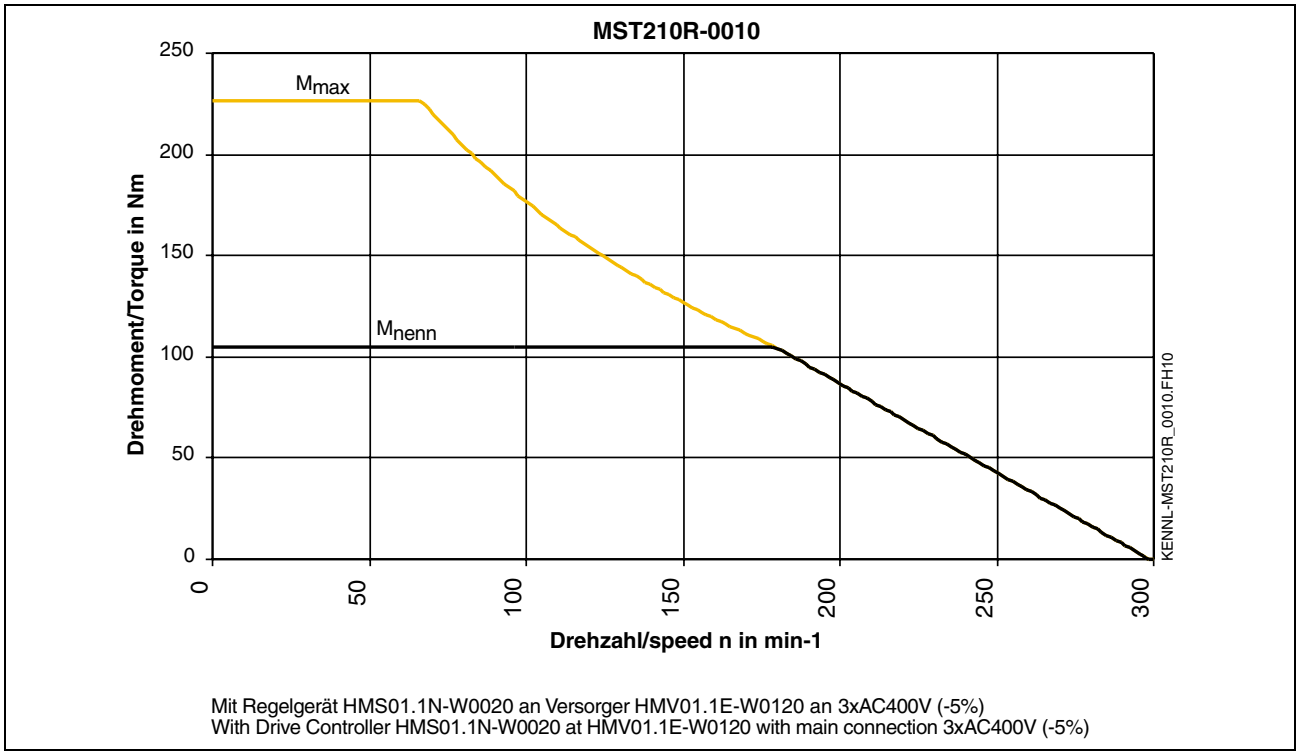


Fig. 4-27: MST210R-0010 motor characteristic curves

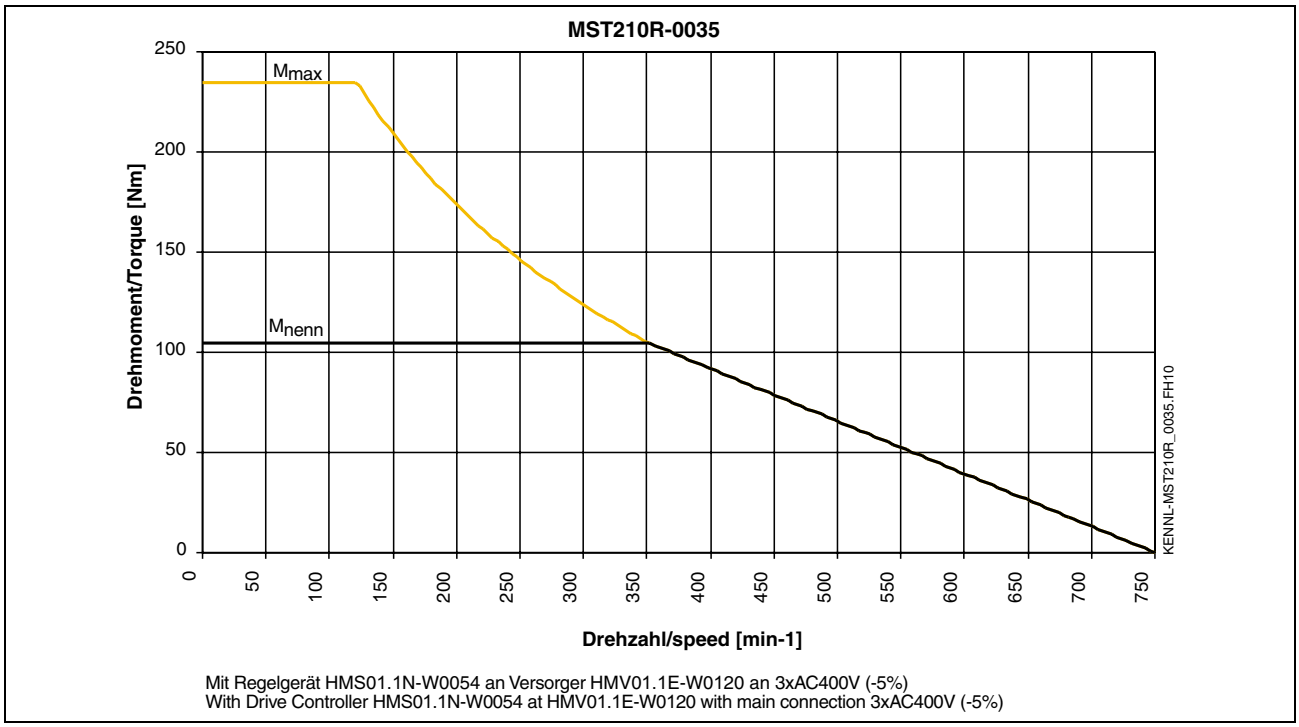


Fig. 4-28: MST210R-0035 motor characteristic curves

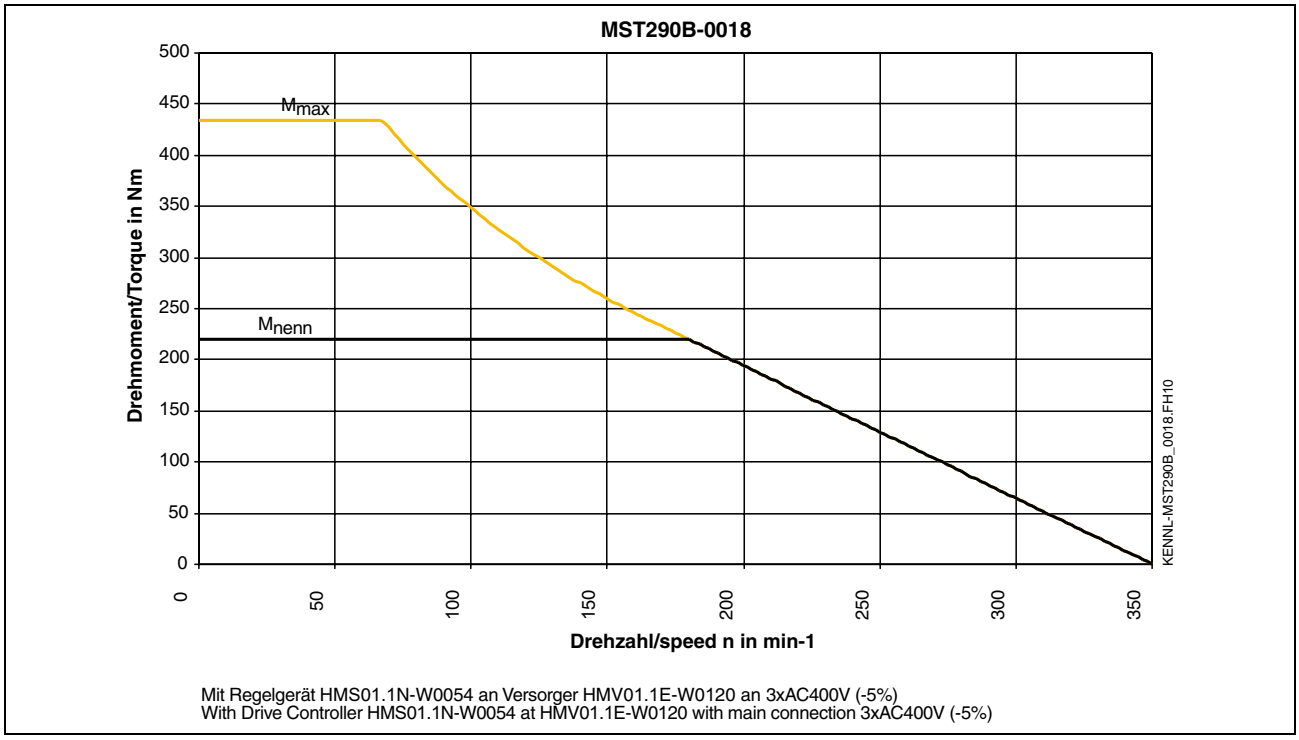
4.5 Data Sheet, Size 290

Identification	Symbol	Unit	Size 290				
Motor data [1])							
Frame length			B	D		E	
Winding code			0018	0002	0018	0004	0018
Rated torque	M_N	Nm	220	350		575	
Rated power	P_N	kW	4.1	0.9	6.6	2.4	10.8
Rated current	I_N	A	14.8	6.3	26	12.5	35
Rated speed	n_N	rpm	180	25	180	40	180
Maximum torque [2])	M_{max}	Nm	460	700		1150	
Maximum current	I_{max}	A	60	25	100	50	125
Maximum speed	n_{max}	rpm	350	90	350	130	350
Minimum cross-section of cable [3])	A	mm²	1.5	1	4	1	6
Torque/force constant at 20°	K_{M_N}	Nm/A	14.9	55.5	13.5	46	16.4
Constant voltage at 20°C [4])	K_{EMF_1}	V/rpm	1.64	4.67	0.962	3.62	1.037
Thermal time constant	T_{th}	min	3.3				
Winding resistance at 20°C	R12	Ohm	6.3	20.6	2.25	8.22	1.59
Inductivity of mounted rotor	L12	mH	35.3	122.4	13.4	50.3	9.1
Discharge capacity	C_{ab}	nF	8.41	15.6	12.62	21.03	20
Number of pole pairs	p		30				
Rotor moment of inertia	J_{rot}	kgm²	0.08	0.11		0.17	
Mass of the stator	m_{stat}	kg	13.5	20	20	25.1	25.1
Mass of the rotor	m_{rot}	kg	6.2	9		11.6	
Ambient temperature (in operation)	T_{um}	°C	0 ...+40				
Insulation class according to EN 60034-1			F				
Motor protection class acc. to EN 60034-5			IP00				
Liquid cooling [5])							
Rated power loss	P_V	kW	3	4.2		5.2	5.5
Coolant temperature at inlet	T_{in}	°C	+10 ...+40				
Temperature increase for P_V	ΔT_{diff}	K	10				
Coolant flow for ΔT_{diff}	Q_{min}	l/min	5	7		9	
Pressure drop for Q_{min}	Δp_{diff}	bar	0.1				
Permissible inlet pressure	p_{max}	bar	3				
Volume of coolant duct	V_{cool}	l	0.2	0.31		0.55	

[1]) Unless otherwise indicated, the values are root mean square values according to IEC 60034-1. Reference values assume a 540 V_{DC} bus voltage.
[2]) The maximum torque that can be attained depends on the drive controller used.
[3]) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross-sections may be necessary. For notes regarding the power and connection cables, see Chapter 8.
[4]) EMF = Electromagnetic Force. Root mean square value based on 1 rpm.
[5]) The data refer to operation with liquid cooling using water as the cooling medium. For further notes regarding the generation of the coolant inlet temperature, see Chapter 9.5 “Motor Cooling“.

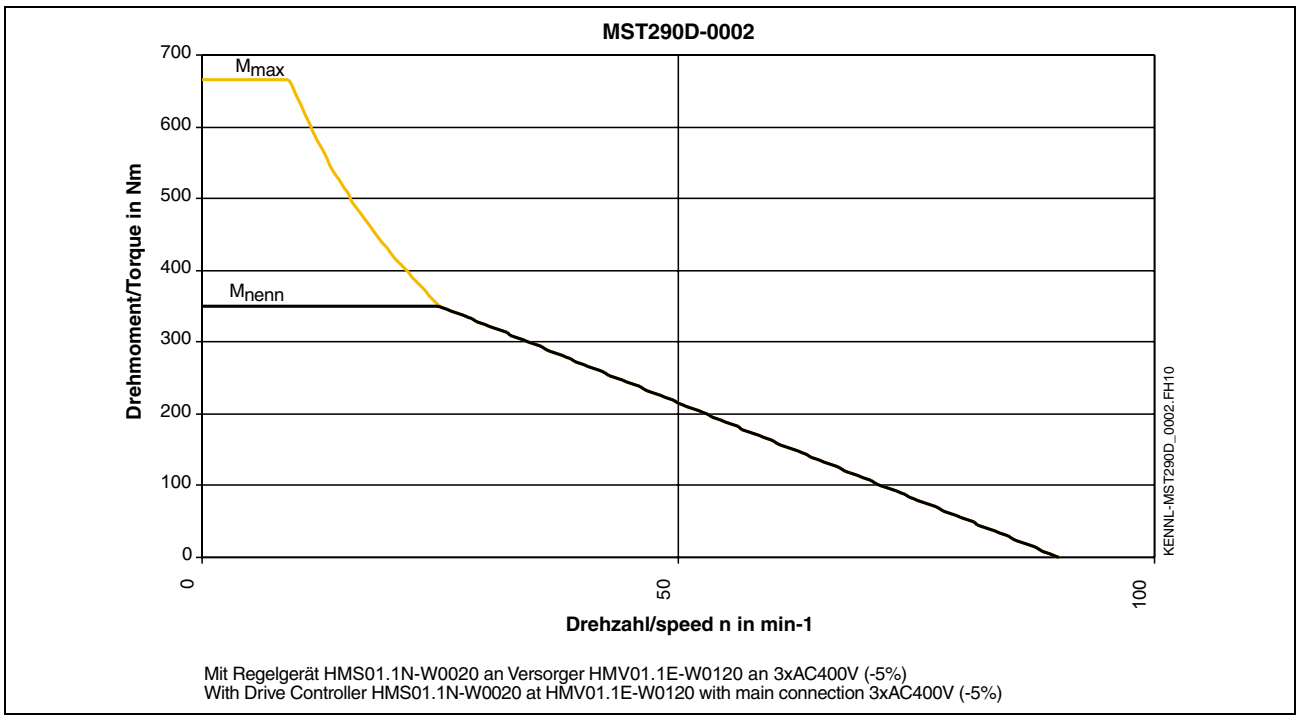
Fig. 4-29: Data sheet, size 290

Motor characteristic curves:
frame size 290



Mit Regelgerät HMS01.1N-W0054 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

Fig. 4-30: MST290B-0018 motor characteristic curve



Mit Regelgerät HMS01.1N-W0020 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0020 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

Fig. 4-31: MST290D-0002 motor characteristic curves

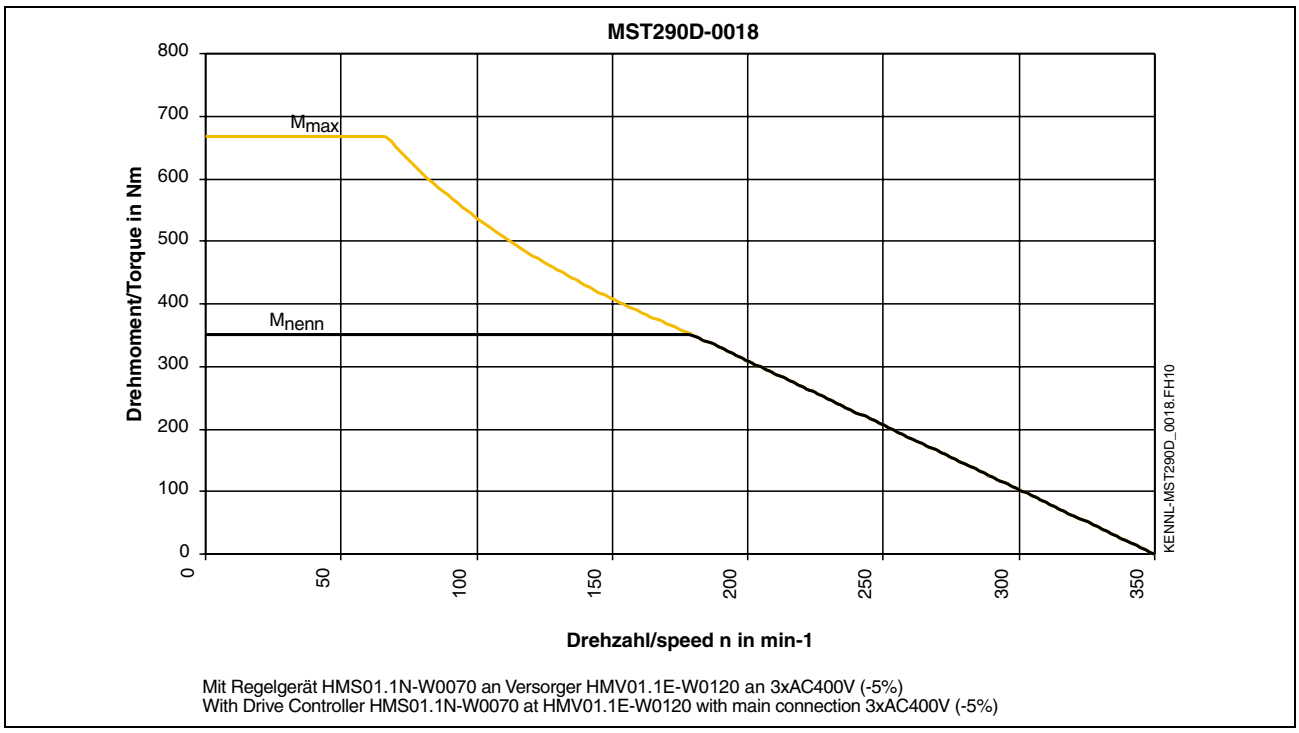


Fig. 4-32: MST290D-0018 motor characteristic curve

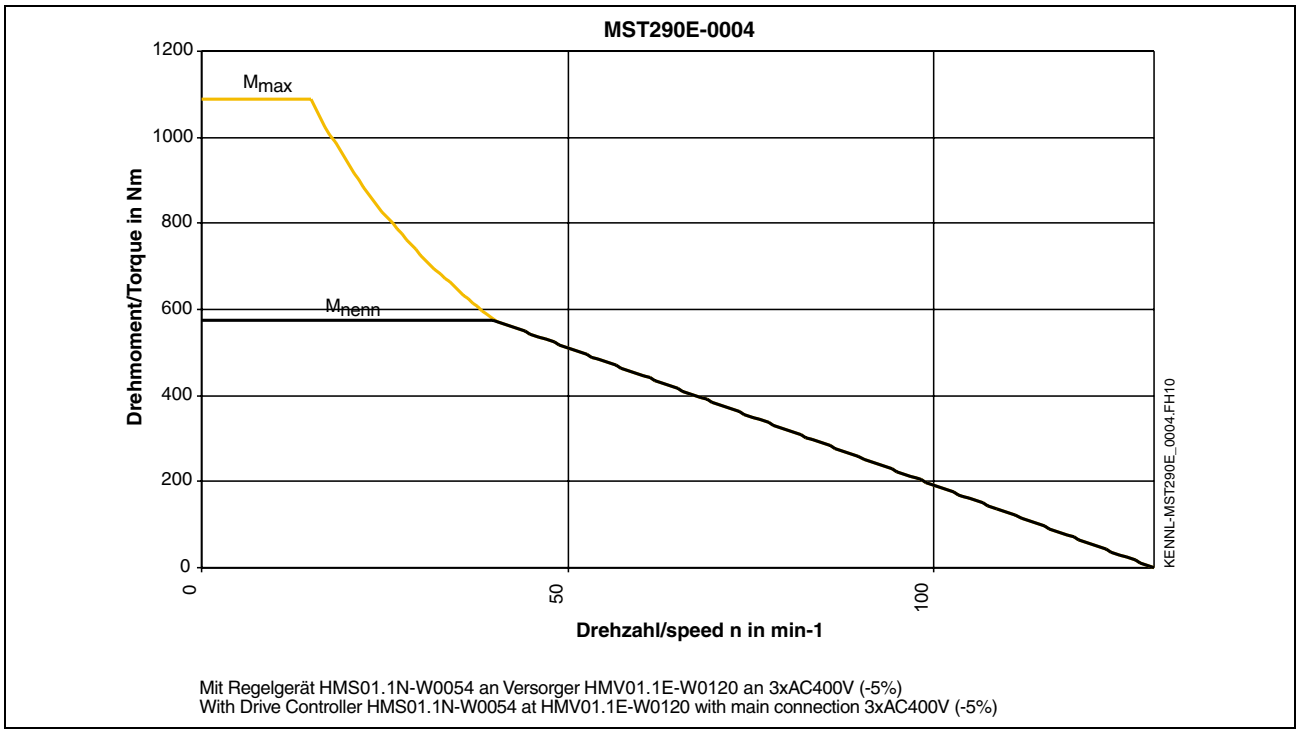


Fig. 4-33: MST290E-0004 motor characteristic curve

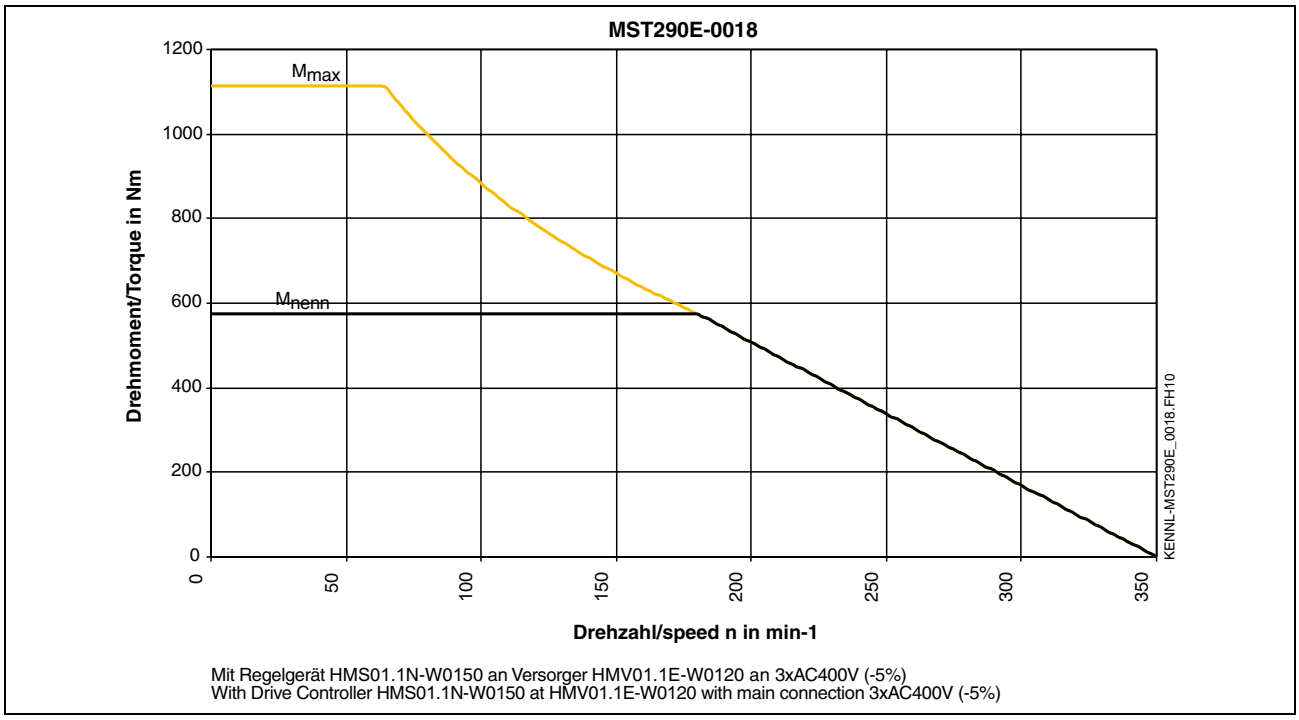


Fig. 4-34: MST290E-0018 motor characteristic curve

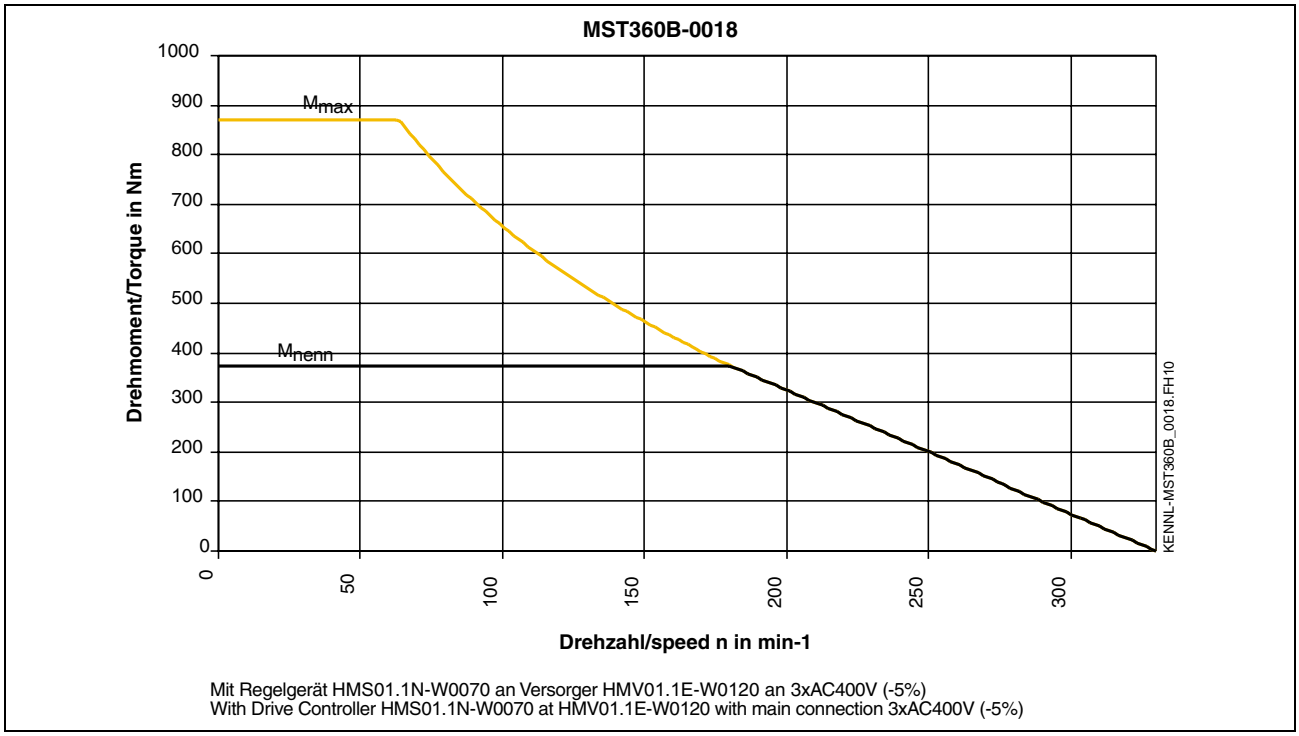
4.6 Data Sheet, Size 360

Identification	Symbol	Unit	Size 360			
Motor data [1])						
Frame length			B	D		E
Winding code			0018	0012	0018	0018
Rated torque	M_N	Nm	375	525		875
Rated power	P_N	kW	7.1	6.6	9.9	16.5
Rated current	I_N	A	20	16.5	28	42
Rated speed	n_N	rpm	180	120	180	180
Maximum torque [2])	M_{max}	Nm	900	1150		1900
Maximum current	I_{max}	A	70	60	100	141
Maximum speed	n_{max}	rpm	330	250	300	300
Minimum cross-section of cable [3])	A	mm²	2.5	2.5	4	10
Torque/force constant at 20°	K_{M_N}	Nm/A	18.8	31.82	18.8	20.8
Constant voltage at 20°C [4])	K_{EMF_1}	V/rpm	1.93	2.58	1.72	1.89
Thermal time constant	T_{th}	min	4			
Winding resistance at 20°C	R12	Ohm	2.25	5.7	1.9	1.3
Inductivity of mounted rotor	L12	mH	18.2	43.2	15.5	20.8
Discharge capacity	C_{ab}	nF	9	13.49		20
Number of pole pairs	p		25			
Rotor moment of inertia	J_{rot}	kgm²	0.19	0.27		0.44
Mass of the stator	m_{stat}	kg	23	28.8	28.8	40.3
Mass of the rotor	m_{rot}	kg	9.8	13.5		20.9
Ambient temperature (in operation)	T_{um}	°C	0 ...+40			
Insulation class according to EN 60034-1			F			
Motor protection class acc. to EN 60034-5			IP00			
Liquid cooling [5])						
Rated power loss	P_V	kW	2.7	3.6	3.6	4
Coolant temperature at inlet	T_{in}	°C	+10 ...+40			
Temperature increase for P_V	ΔT_{diff}	K	10			
Coolant flow for ΔT_{diff}	Q_{min}	l/min	6			
Pressure drop for Q_{min}	Δp_{diff}	bar	0.1			
Permissible inlet pressure	p_{max}	bar	3			
Volume of coolant duct	V_{cool}	l	0.27	0.39	0.39	0.69

[1]) Unless otherwise indicated, the values are root mean square values according to IEC 60034-1. Reference values assume a 540 V_{DC} bus voltage.
[2]) The maximum torque that can be attained depends on the drive controller used.
[3]) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross-sections may be necessary. For notes regarding the power and connection cables, see Chapter 8.
[4]) EMF = Electromagnetic Force. Root mean square value based on 1 rpm.
[5]) The data refer to operation with liquid cooling using water as the cooling medium. For further notes regarding the generation of the coolant inlet temperature, see Chapter 9.5 “Motor Cooling“.

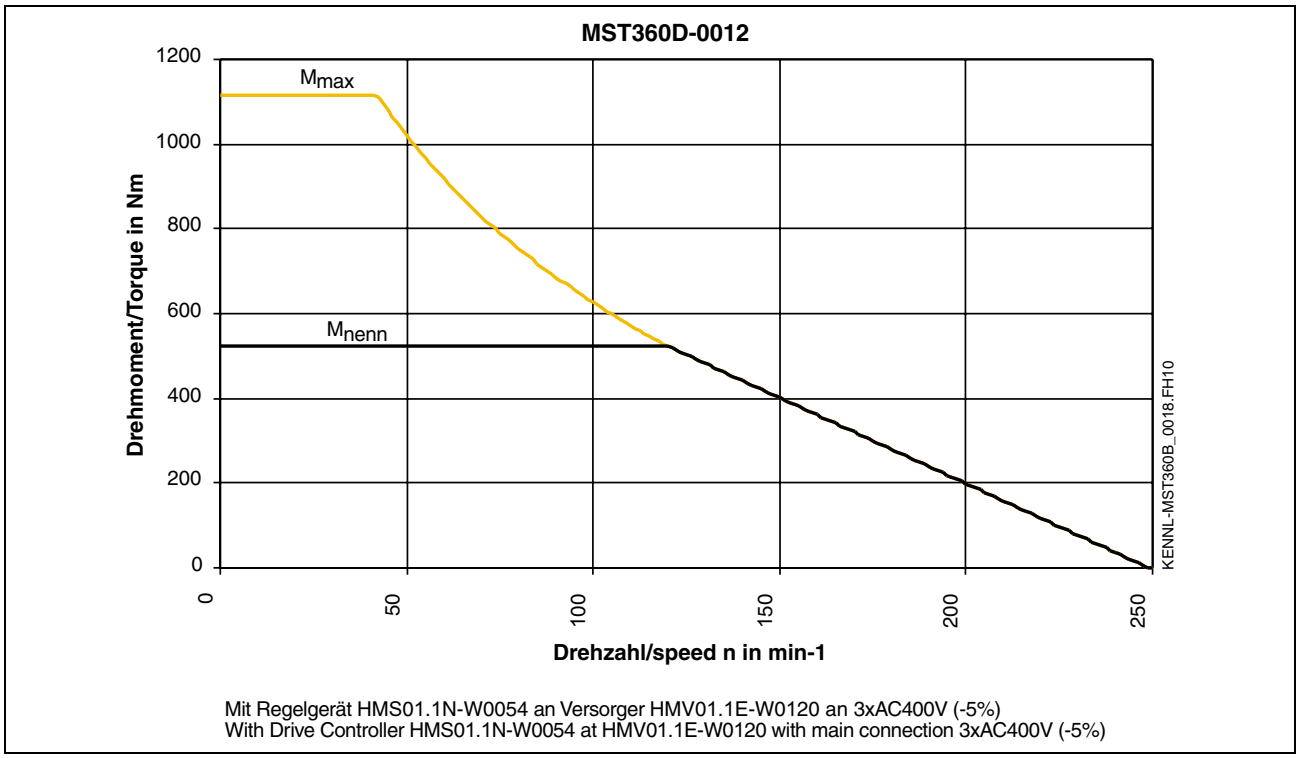
Fig. 4-35: Data sheet, size 360

Motor characteristic curves:
frame size 360



Mit Regelgerät HMS01.1N-W0070 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0070 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

Fig. 4-26: MST360B-0018 motor characteristic curve



Mit Regelgerät HMS01.1N-W0054 an Versorger HMV01.1E-W0120 an 3xAC400V (-5%)
With Drive Controller HMS01.1N-W0054 at HMV01.1E-W0120 with main connection 3xAC400V (-5%)

Fig. 4-37: MST360D-0012 motor characteristic curve

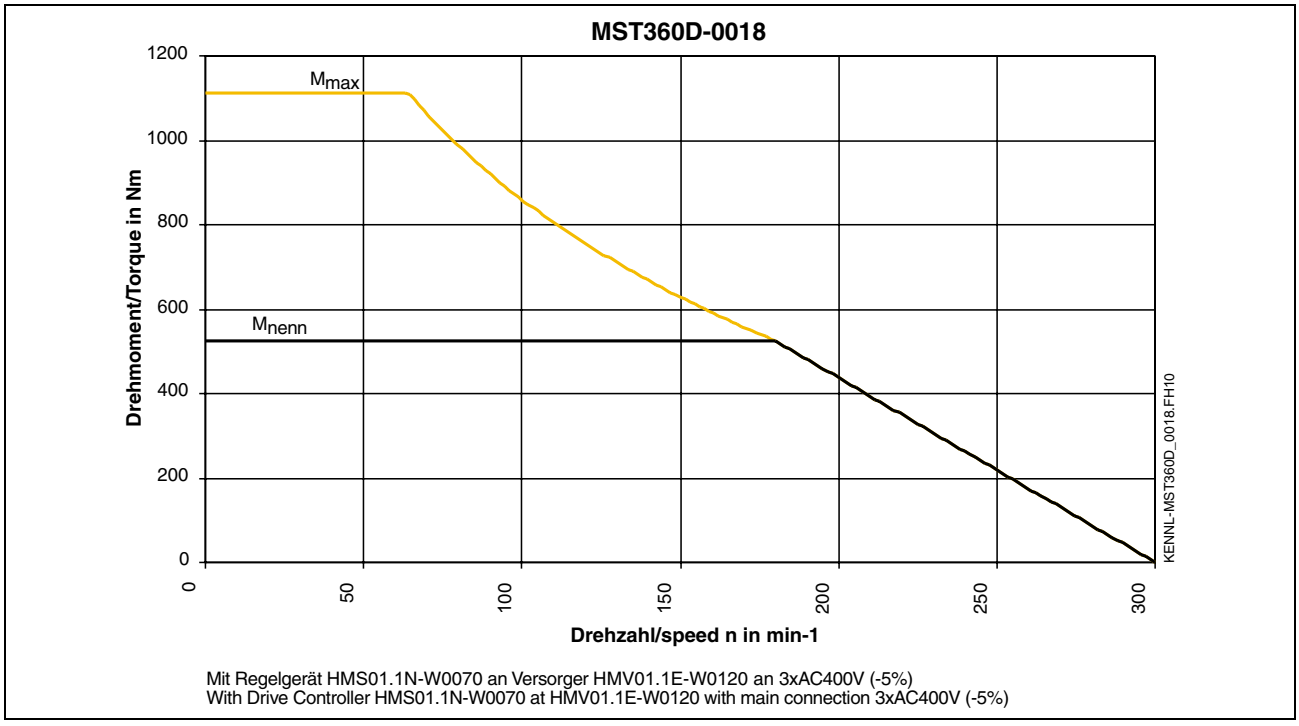


Fig. 4-38: MST360D-0018 motor characteristic curve

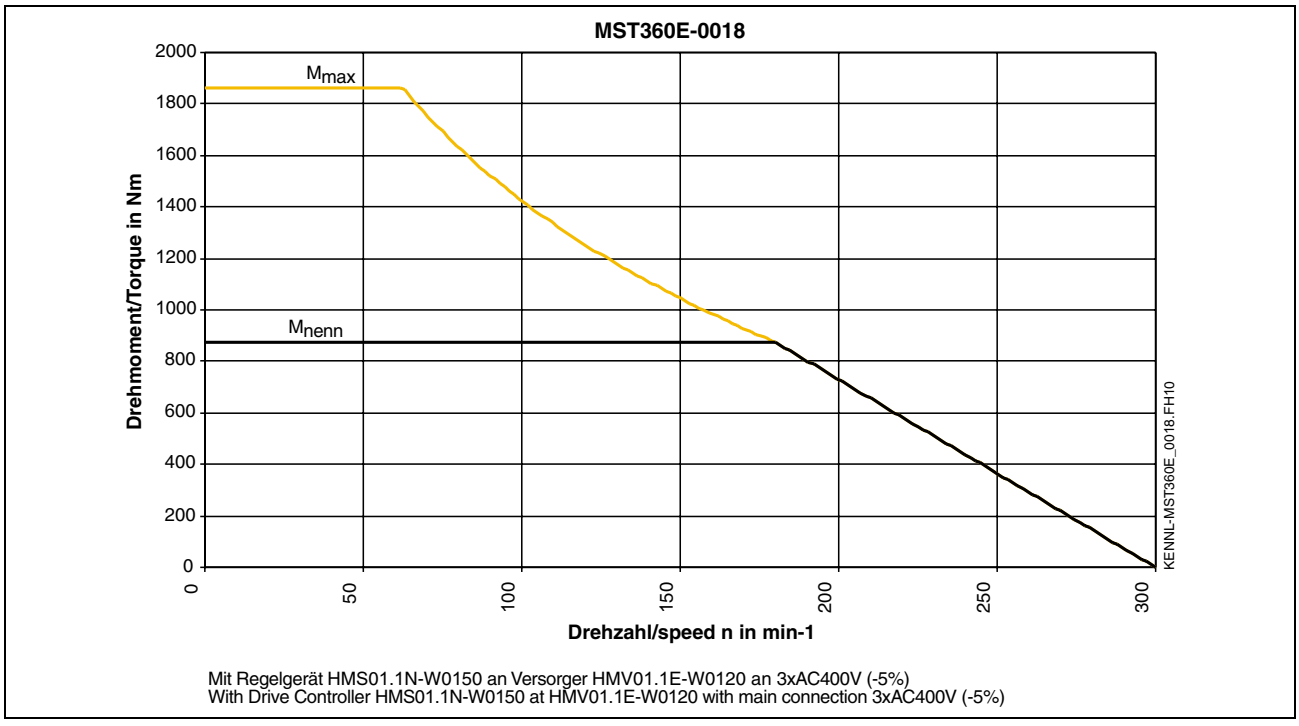


Fig. 4-39: MST360E-0018 motor characteristic curve

4.7 Data Sheet, Size 450

Identification	Symbol	Unit	Size 450				
Motor data [1])							
Frame length			B	D		E	
Winding code			0012	0006	0012	0006	0012
Rated torque	M_N	Nm	540	810		1400	
Rated power	P_N	kW	6.8	5.1	10.2	8.8	17.6
Rated current	I_N	A	22	18.8	33	32	46
Rated speed	n_N	rpm	120	60	120	60	120
Maximum torque [2])	M_{max}	Nm	1200	1800		3250	
Maximum current	I_{max}	A	70	50	100	88	125
Maximum speed	n_{max}	rpm	250	130	250	120	220
Minimum cross-section of cable [3])	A	mm²	2.5	2.5	6	6	10
Torque/force constant at 20°	K_{M_N}	Nm/A	24.5	43.1	24.5	43.8	30.4
Constant voltage at 20°C [4])	K_{EMF_1}	V/rpm	1.48	2.83	1.48	3.86	1.93
Thermal time constant	T_{th}	min	4.5				
Winding resistance at 20°C	R12	Ohm	1.48	3.95	1.35	3.2	1.1
Inductivity of mounted rotor	L12	mH	19	31	12.7	30	10
Discharge capacity	C_{ab}	nF	9.64	14.46		24.1	
Number of pole pairs	p		30				
Rotor moment of inertia	J_{rot}	kgm²	0.45	0.64		1.01	
Mass of the stator	m_{stat}	kg	31	38.7	38.7	54.2	54.2
Mass of the rotor	m_{rot}	kg	13	17.9		27.7	
Ambient temperature (in operation)	T_{um}	°C	0 ...+40				
Insulation class according to EN 60034-1			F				
Motor protection class acc. to EN 60034-5			IP00				
Liquid cooling [5])							
Rated power loss	P_V	kW	3.5	4		6.6	
Coolant temperature at inlet	T_{in}	°C	+10 ...+40				
Temperature increase for P_V	ΔT_{diff}	K	10				
Coolant flow for ΔT_{diff}	Q_{min}	l/min	6			9.6	
Pressure drop for Q_{min}	Δp_{diff}	bar	0.1				
Permissible inlet pressure	p_{max}	bar	3				
Volume of coolant duct	V_{cool}	l	0.33	0.48		0.86	

[1]) Unless otherwise indicated, the values are root mean square values according to IEC 60034-1. Reference values assume a 540 V_{DC} bus voltage.
[2]) The maximum torque that can be attained depends on the drive controller used.
[3]) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross-sections may be necessary. For notes regarding the power and connection cables, see Chapter 8.
[4]) EMF = Electromagnetic Force. Root mean square value based on 1 rpm.
[5]) The data refer to operation with liquid cooling using water as the cooling medium. For further notes regarding the generation of the coolant inlet temperature, see Chapter 9.5 “Motor Cooling“.

Fig. 4-40: Data sheet, size 450

Motor characteristic curves:
frame size 450

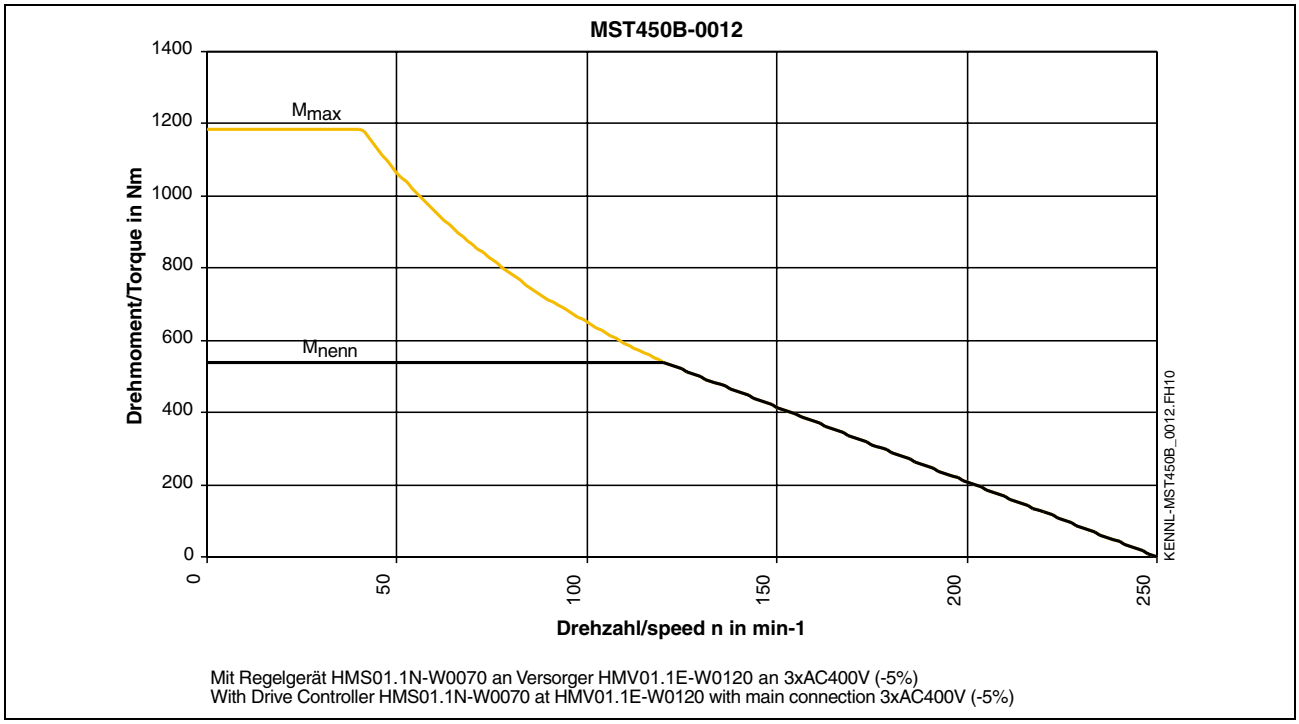


Fig. 4-41: MST450B-0012 motor characteristic curve

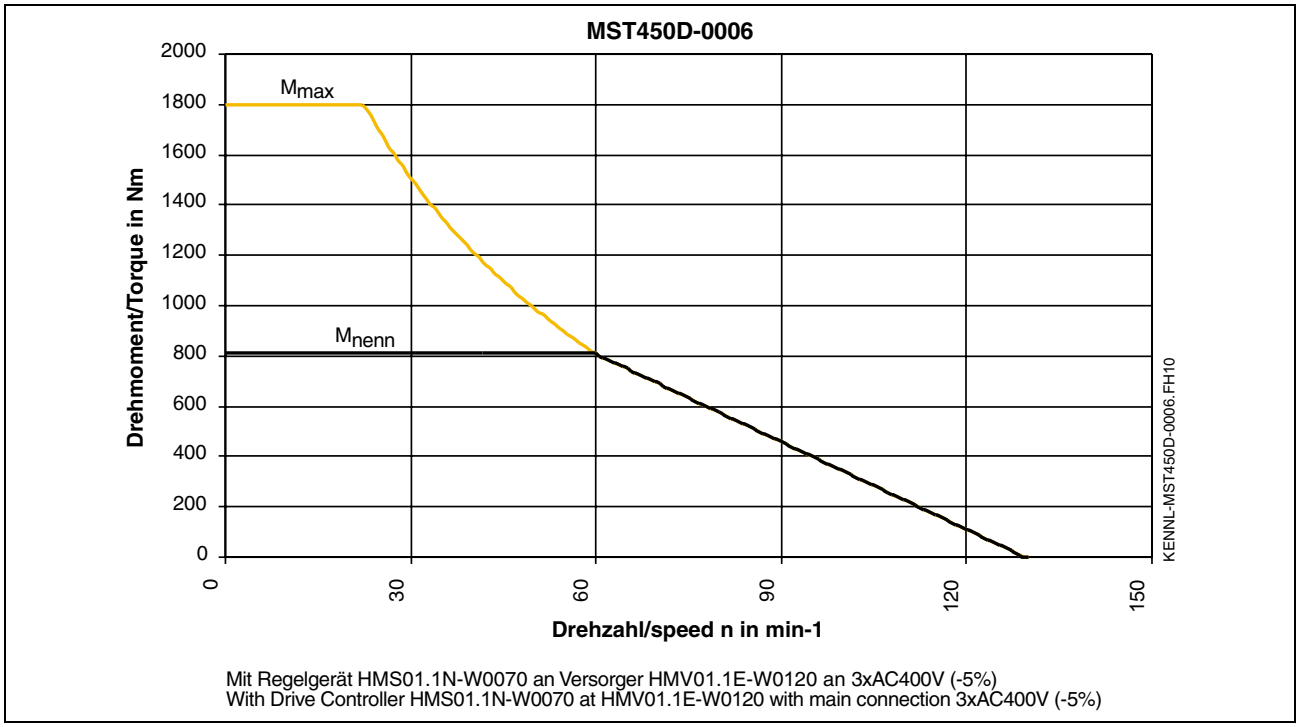


Fig. 4-42: MST450D-0006 motor characteristic curve

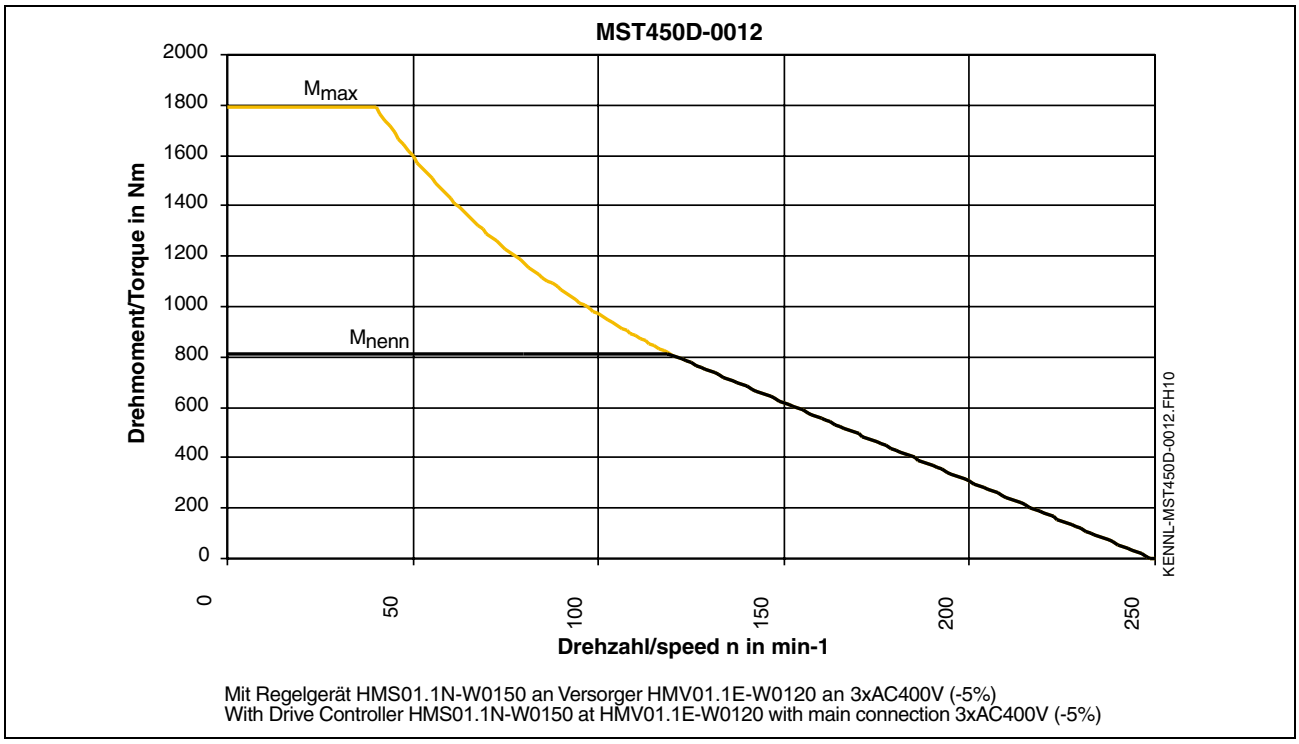


Fig. 4-43: MST450D-0012 motor characteristic curve

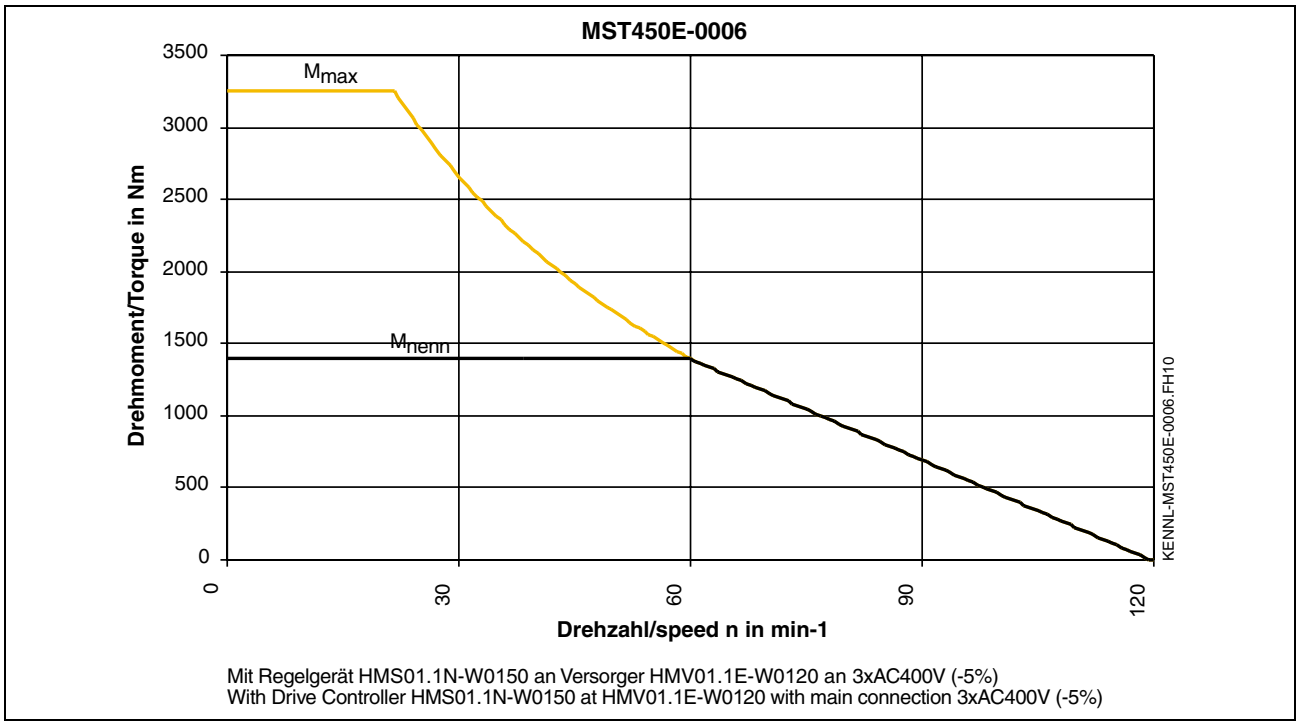


Fig. 4-44: MST450E-0006 motor characteristic curve

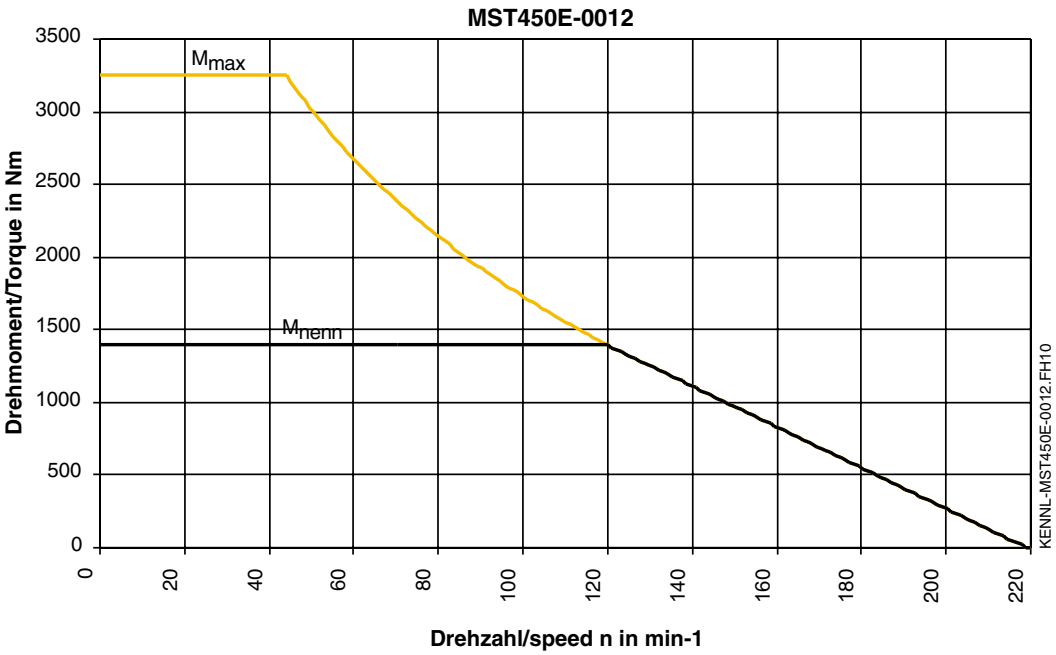


Fig. 4-45: MST450E-0012 motor characteristic curve

4.8 Data Sheet, Size 530

Data Sheet for Frame Lengths 530B, 530C, 530E

Identification	Symbol	Unit	Size 530			
Motor data [1])						
Frame length			B	C (..-FT-..)	C (..-ST-..)	E
Winding code			0010	0010	0010	0010
Rated torque	M_N	Nm	800	1200	580	2100
Rated power	P_N	kW	8.4	12.6	6.1	22
Rated current	I_N	A	28.6	31.2	15	64
Rated speed	n_N	rpm	100	100		100
Maximum torque [2])	M_{max}	Nm	1800	2700		4700
Maximum current	I_{max}	A	71	88		212
Maximum speed	n_{max}	rpm	200	150		200
Minimum cross-section of cable [3])	A	mm²	4	6	6	16
Torque/force constant at 20°	K_{M_N}	Nm/A	28	38.5		32.8
Constant voltage at 20°C [4])	K_{EMF_1}	V/rpm	1.89	2.81		2.09
Thermal time constant	T_{th}	min	8.3			
Winding resistance at 20°C	R12	Ohm	1.39	1.9		0.52
Inductivity of mounted rotor	L12	mH	16.2	23.2		7.5
Discharge capacity	C_{ab}	nF	10.14	15.21		23
Number of pole pairs	p		35			
Rotor moment of inertia	J_{rot}	kgm²	0.92	1.25		1.92
Mass of the stator	m_{stat}	kg	36	45		63
Mass of the rotor	m_{rot}	kg	22	27.5		38.5
Ambient temperature (in operation)	T_{um}	°C	0 ...+40			
Insulation class according to EN 60034-1			F			
Motor protection class acc. to EN 60034-5			IP00			
Liquid cooling [5])						
Rated power loss	P_V	kW	3.7	5.5	(1.3)	6.5
Coolant temperature at inlet	T_{in}	°C	+10 ...+40		Surface ventilat.	+10 ...+40
Temperature increase for P_V	ΔT_{diff}	K	10			10
Coolant flow for ΔT_{diff}	Q_{min}	l/min	6	6		9.5
Pressure drop for Q_{min}	Δp_{diff}	bar	0.1	0.1		0.2
Permissible inlet pressure	p_{max}	bar	3			3
Volume of coolant duct	V_{cool}	l	0.6	0.9		1.5

[1]) Unless otherwise indicated, the values are root mean square values according to IEC 60034-1. Reference values assume a 540 V_{DC} bus voltage.
[2]) The maximum torque that can be attained depends on the drive controller used.
[3]) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross-sections may be necessary. For notes regarding the power and connection cables, see Chapter 8.
[4]) EMF = Electromagnetic Force. Root mean square value based on 1 rpm.
[5]) The data refer to operation with liquid cooling using water as the cooling medium. For further notes regarding the generation of the coolant inlet temperature, see Chapter 9.5 “Motor Cooling“.

Fig. 4-46: Data sheet, size 530

Motor characteristic curves:
frame size 530

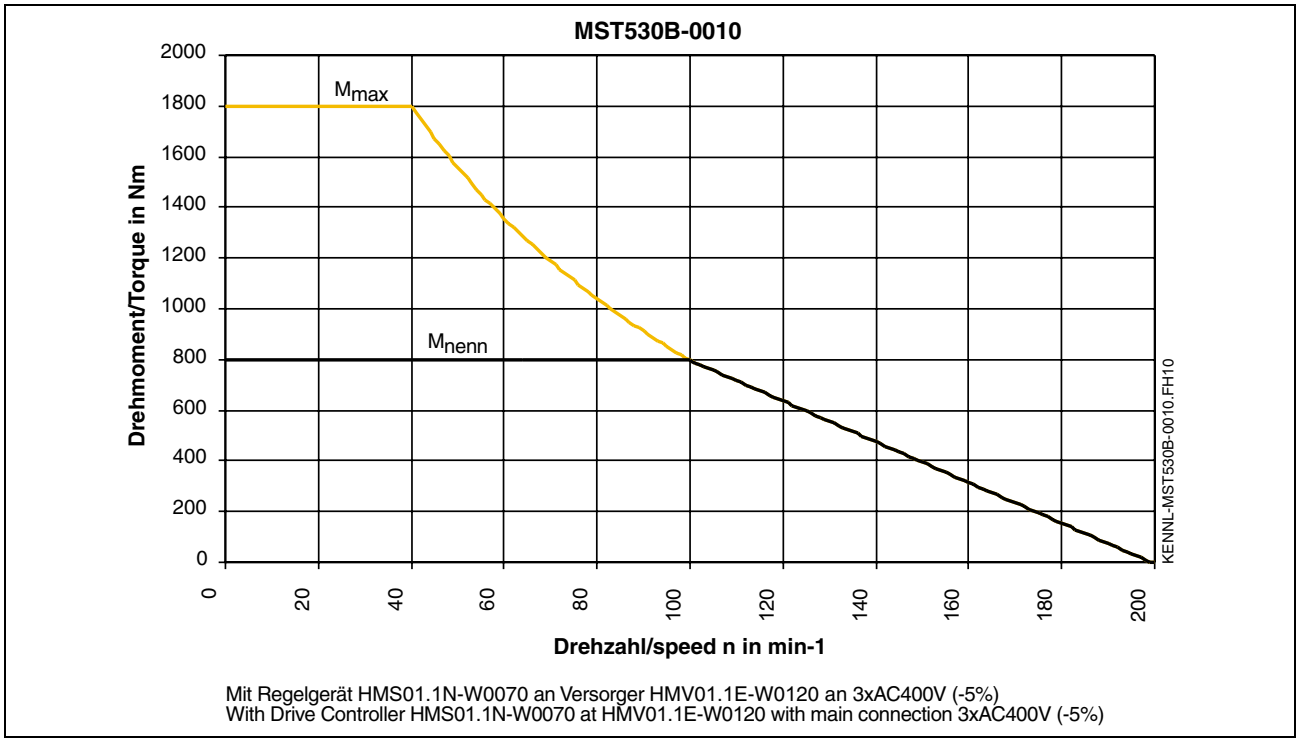


Fig. 4-47: MST530B-0010 motor characteristic curve

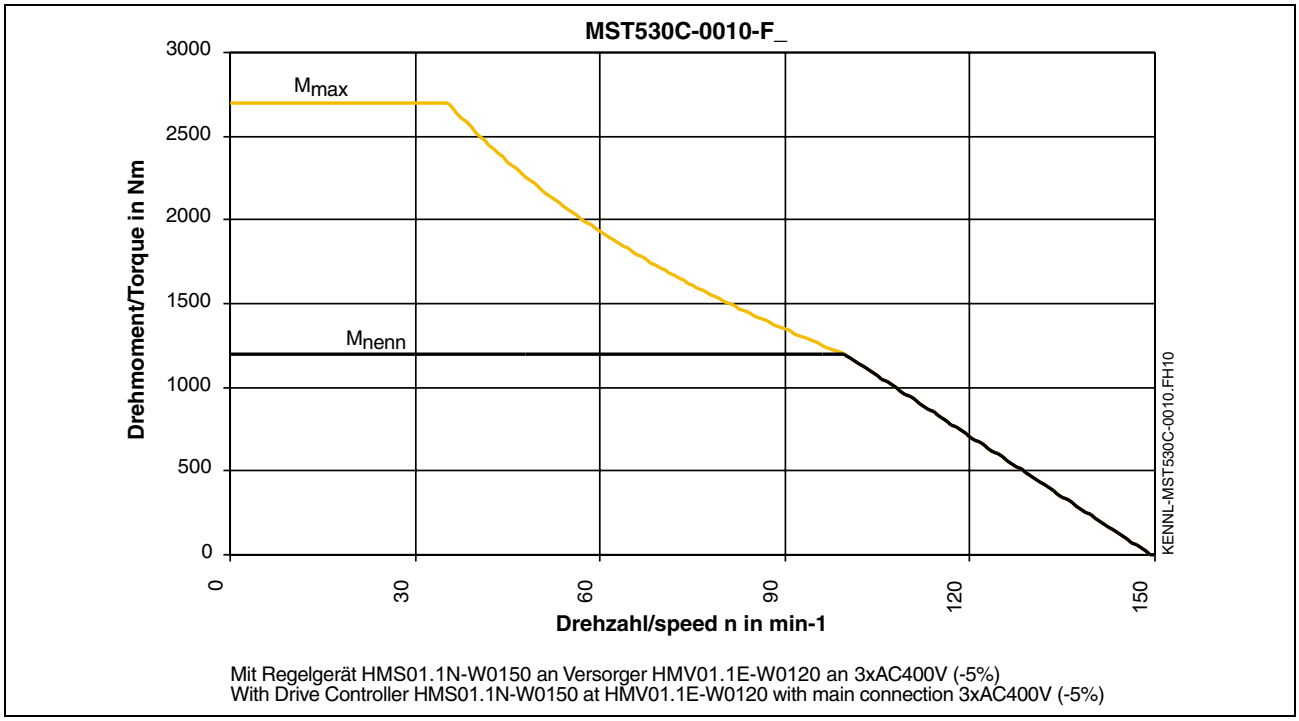


Fig. 4-48: MST530C-0010-FT motor characteristic curve

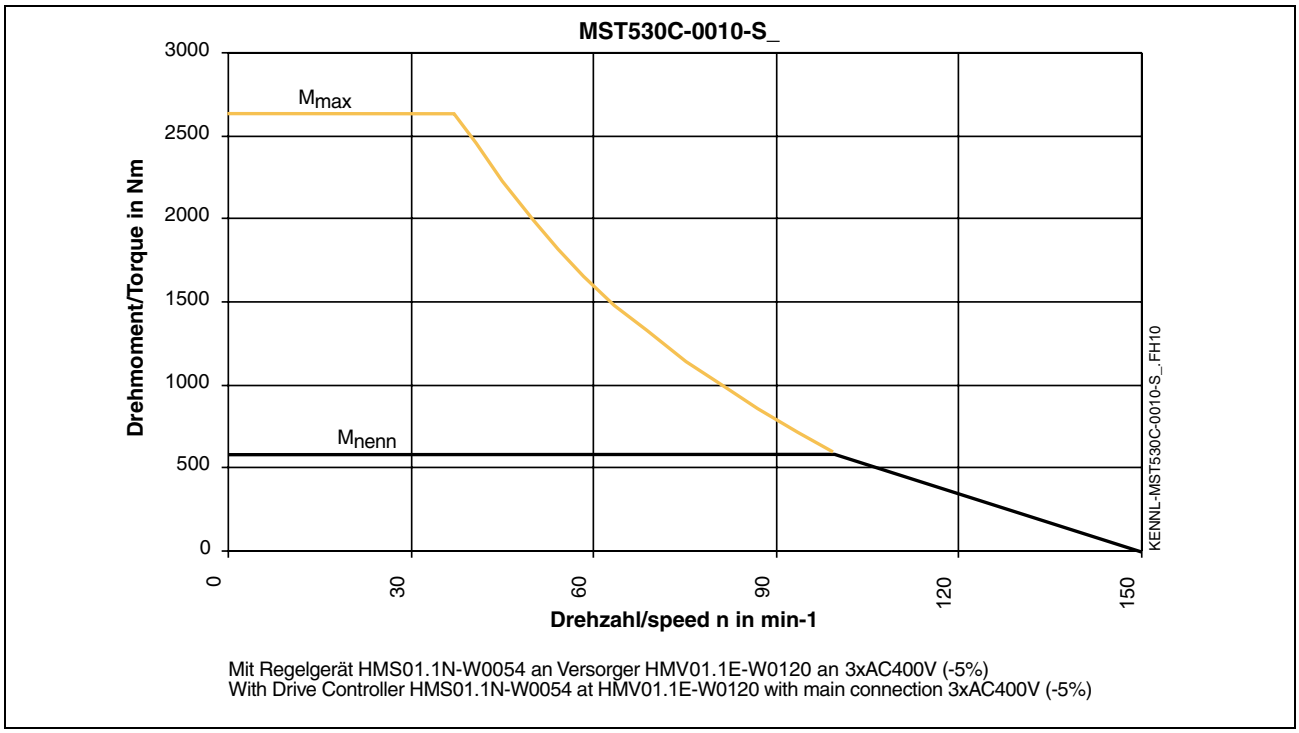


Fig. 4-49: MST530C-0010-ST motor characteristic curve

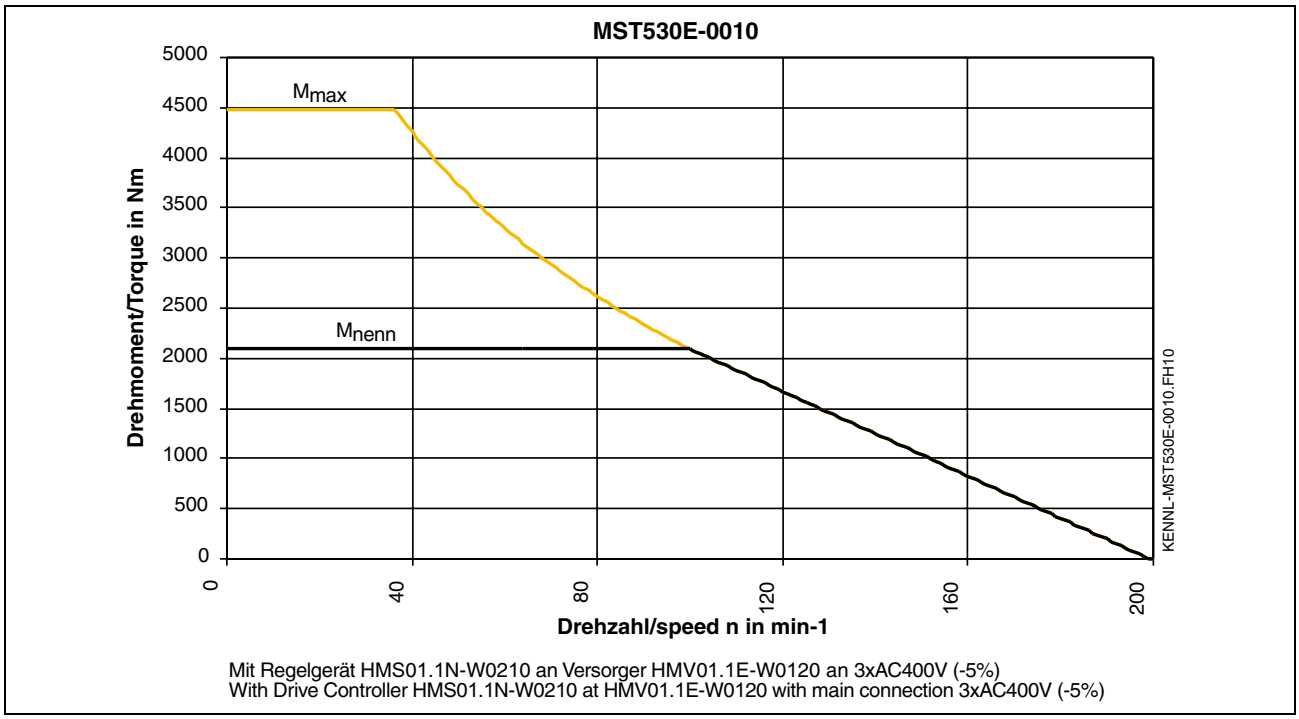


Fig. 4-50: MST530E-0010 motor characteristic curve

Data Sheet, Sizes 530G, 530L

Identification	Symbol	Unit	Size 530	
Motor data [1])				
Frame length			G	L
Winding code			0007	0006
Rated torque	M_N	Nm	4200	6300
Rated power	P_N	kW	31	39.6
Rated current	I_N	A	96	120
Rated speed	n_N	rpm	70	60
Maximum torque [2])	M_{max}	Nm	9200	13800
Maximum current	I_{max}	A	305	380
Maximum speed	n_{max}	rpm	130	100
Minimum cross-section of cable [3])	A	mm²	2x16	2x16
Torque/force constant at 20°	K_{M_N}	Nm/A	43.8	52.5
Constant voltage at 20°C [4])	K_{EMF_1}	V/rpm	3.65	3.35
Thermal time constant	T_{th}	min	8.3	
Winding resistance at 20°C	R12	Ohm	0.9	0.63
Inductivity of mounted rotor	L12	mH	10.8	6.4
Discharge capacity	C_{ab}	nF	50.71	76.06
Number of pole pairs	p		35	
Rotor moment of inertia	J_{rot}	kgm²	3.84	5.76
Mass of the stator	m_{stat}	kg	144	205
Mass of the rotor	m_{rot}	kg	77	115
Ambient temperature (in operation)	T_{um}	°C	0 ...+40	
Insulation class according to EN 60034-1			F	
Motor protection class acc. to EN 60034-5			IP00	
Liquid cooling [5])				
Rated power loss	P_V	kW	9.5	11.5
Coolant temperature at inlet	T_{in}	°C	+10 ...+40	
Temperature increase for P_V	ΔT_{diff}	K	10	
Coolant flow for ΔT_{diff}	Q_{min}	l/min	14	17
Pressure drop for Q_{min}	Δp_{diff}	bar	0.2	0.2
Permissible inlet pressure	p_{max}	bar	3	
Volume of coolant duct	V_{cool}	l	2	3.2

[1]) Unless otherwise indicated, the values are root mean square values according to IEC 60034-1. Reference values assume a 540 V_{DC} bus voltage.
[2]) The maximum torque that can be attained depends on the drive controller used.
[3]) Rated according to EN60204-1 (1993), installation mode B2 and conversion factor for Bosch Rexroth cables at 40°C ambient temperature. When using other cables, larger cross-sections may be necessary. For notes regarding the power and connection cables, see Chapter 8.
[4]) EMF = Electromagnetic Force. Root mean square value based on 1 rpm.
[5]) The data refer to operation with liquid cooling using water as the cooling medium. For further notes regarding the generation of the coolant inlet temperature, see Chapter 9.5 “Motor Cooling“.

Fig. 4-51: Data sheet, sizes 530G, 530L

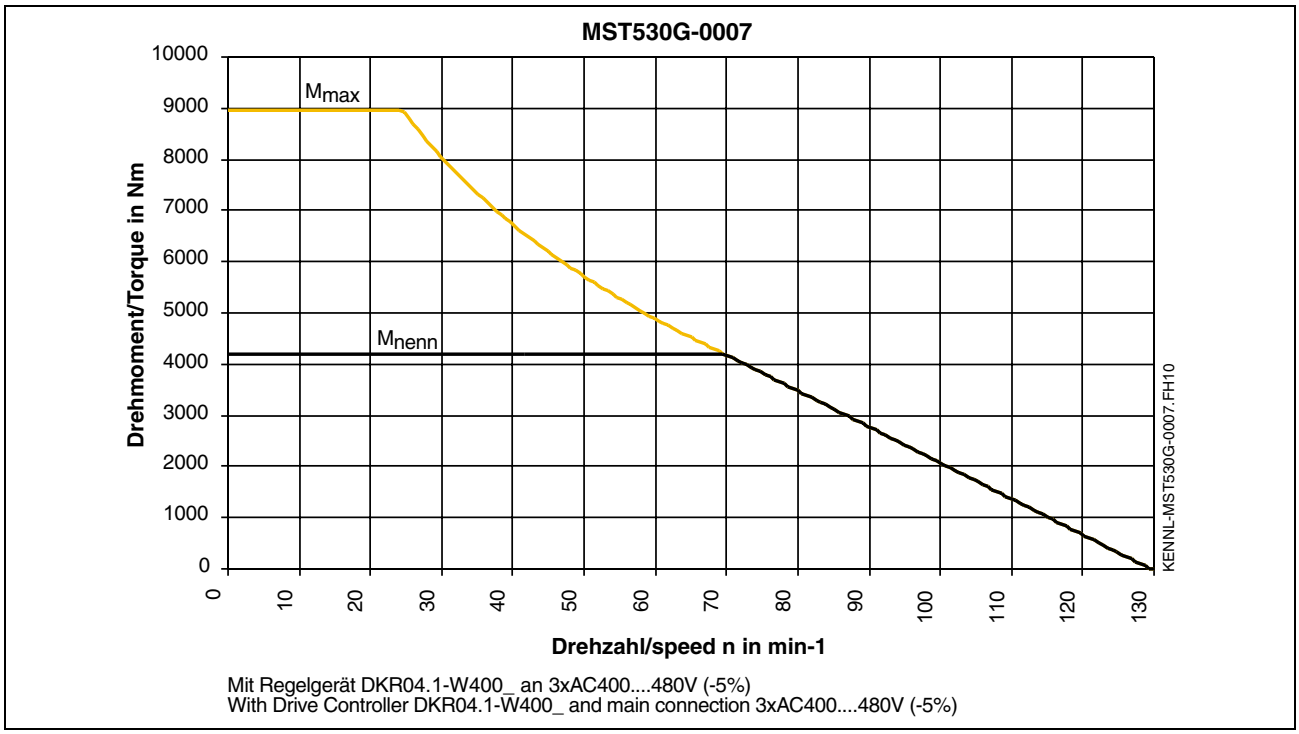


Fig. 4-52: MST530G-0007 motor characteristic curve

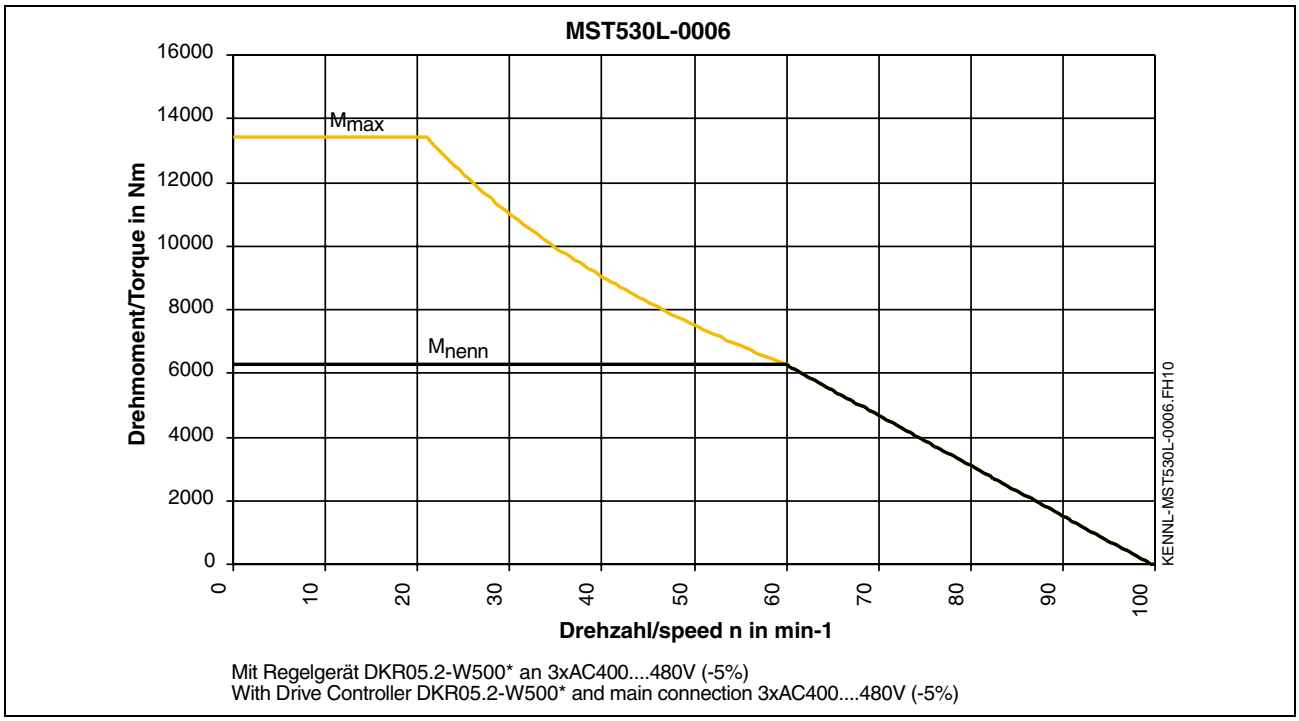


Fig. 4-53: MST530L-0006 motor characteristic curve

5 Dimension Sheets

For your orientation:

The dimensions and sample installation drawings in this chapter are combined according to the sizes. The drawings for each size always follow in this order:

- Standard dimension sheet of complete motors. One dimension sheet per “electrical connection” variant.
- Component drawing of the rotor.
- Sample installation drawing of a mounted rotor.
- Component drawing of the stator. One drawing per “electrical connection” variant.
- Sample installation drawing of a mounted stator
- Sample installation drawing of complete mounted rotor and stator

Note: For reasons of clarity, you can find the dimension sheets of motor sizes MBT210R, MBT 530G and MBT530L in the appendix of this documentation.

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

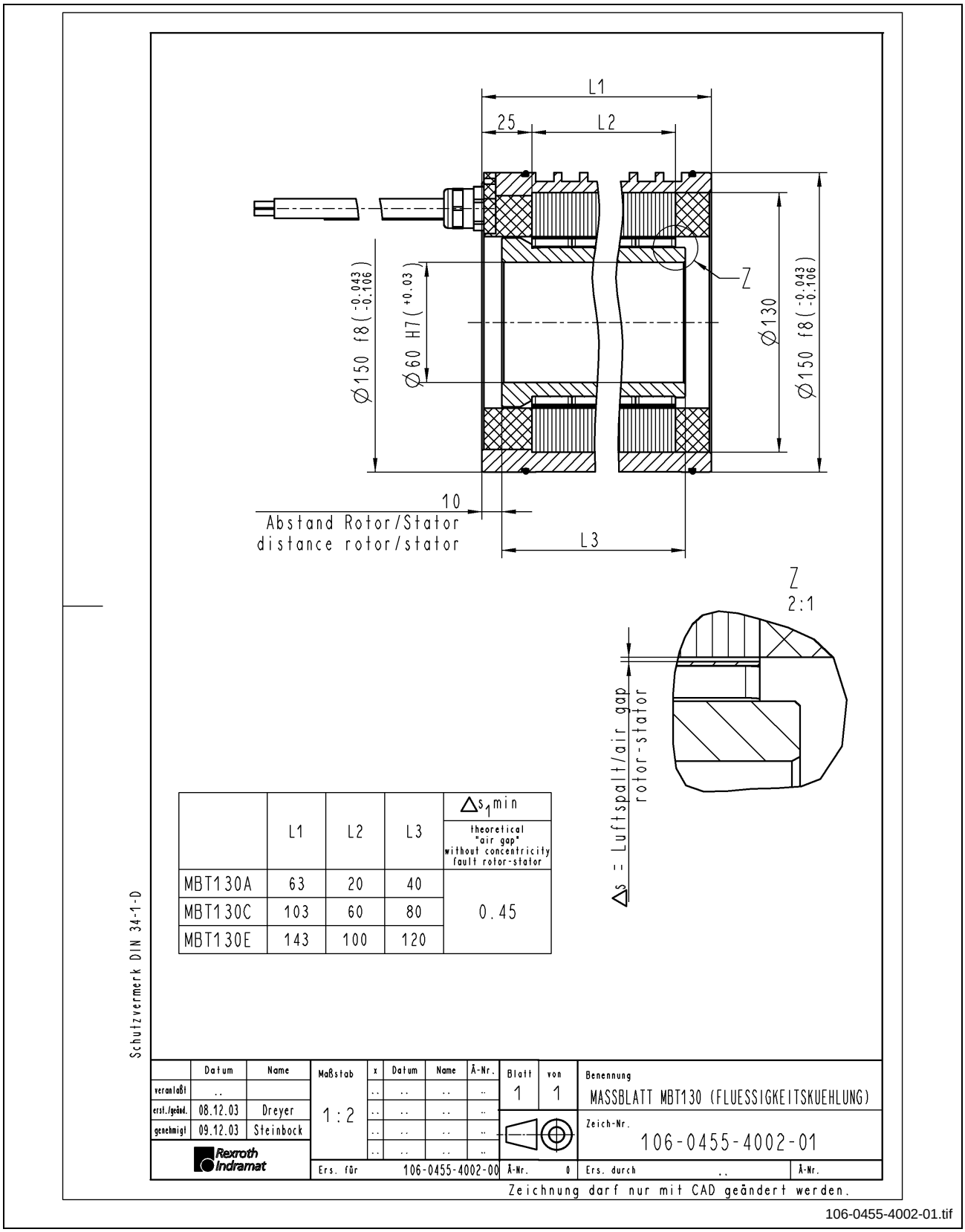
Length dimensions:	DIN ISO 2768, part 1
Angular dimension:	DIN 7168, avg.
Form and position tolerance:	DIN ISO 1101

Note: The sample installation drawings are only examples of one installation possibility. It is not possible to show all installation variants of the different machines and applications.

The legally-binding installation drawings for a specific machine or application are made by the machine OEM.

5.2 Dimension Sheets, Size 130

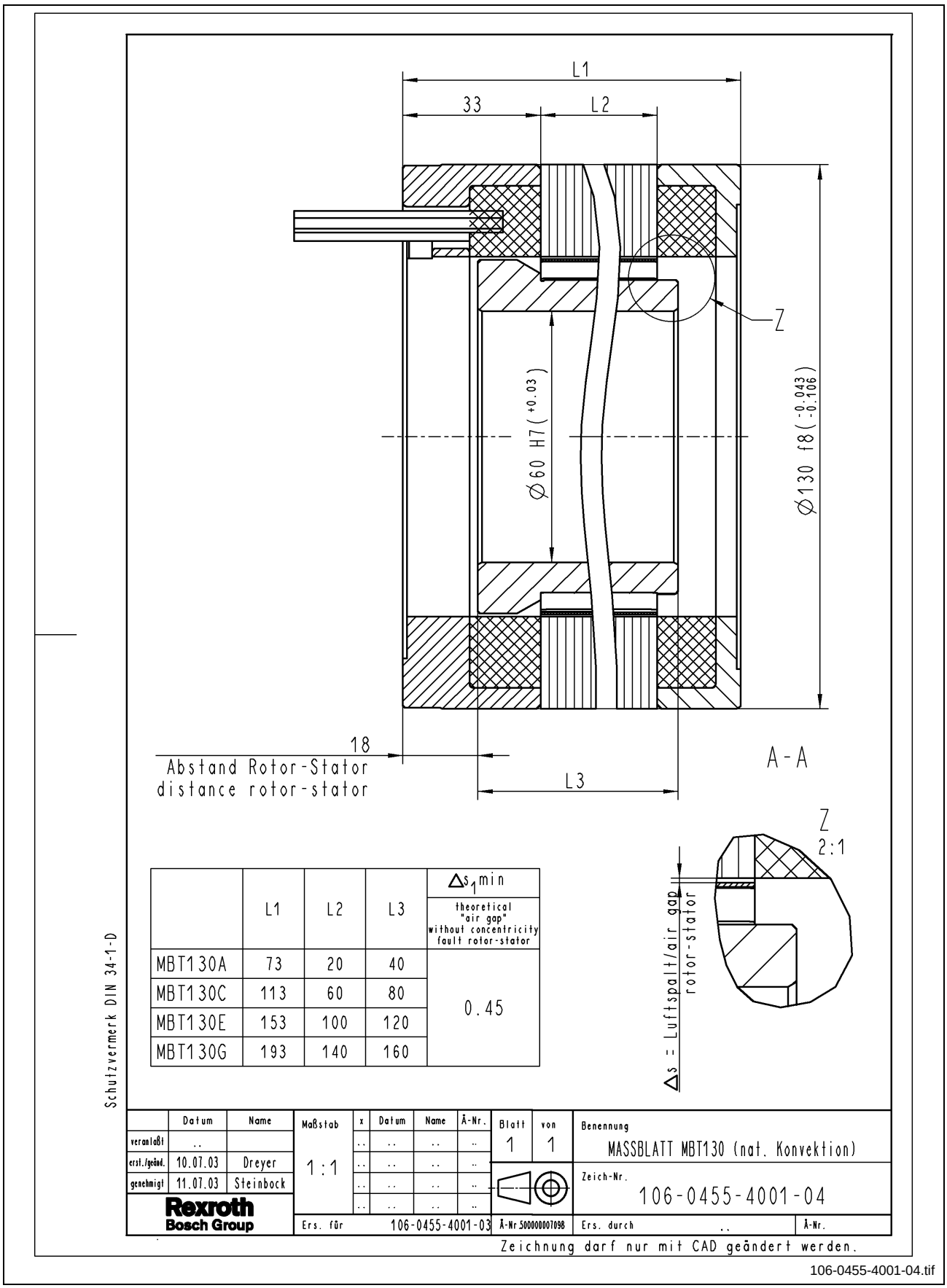
Liquid Cooling



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

Fig. 5-1: Dimension sheet MBT130 with liquid cooling

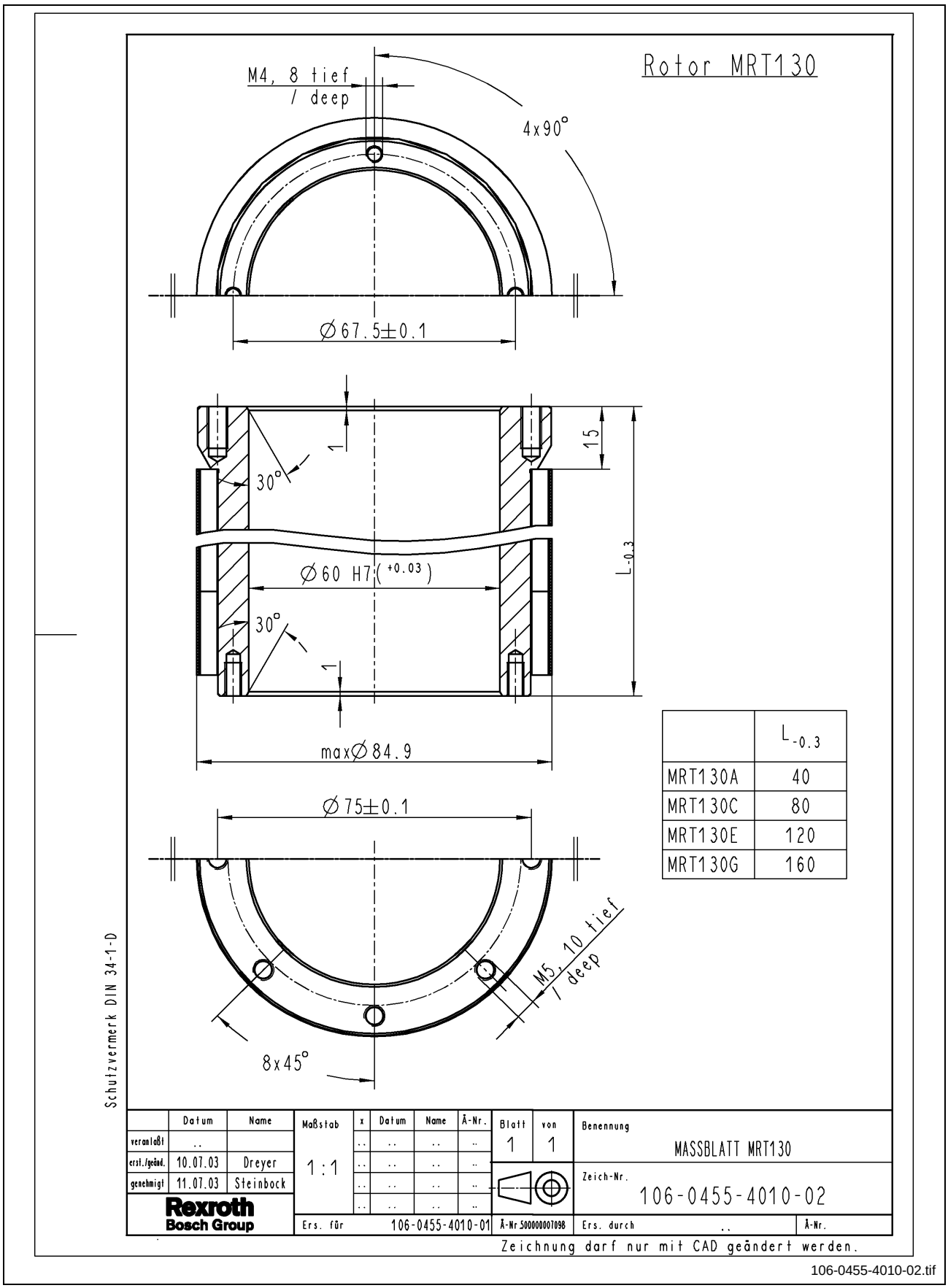
Natural Convection



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

Fig. 5-2: Dimension sheet MBT130 with natural convection

Rotor MRT130

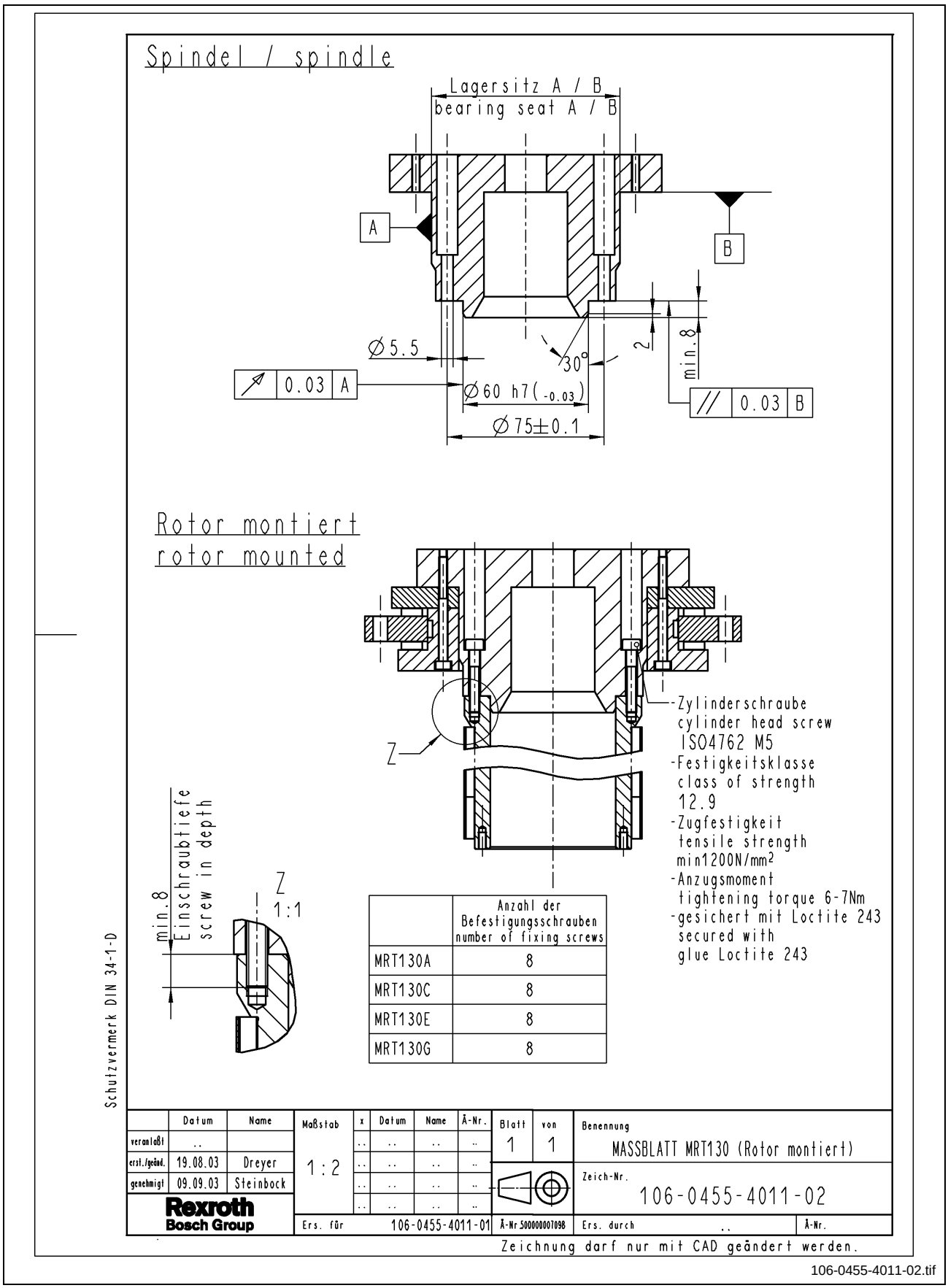


	$L_{-0.3}$
MRT130A	40
MRT130C	80
MRT130E	120
MRT130G	160

106-0455-4010-02.tif

Fig. 5-3: Dimension sheet Rotor MRT130

Rotor MRT130, mounted

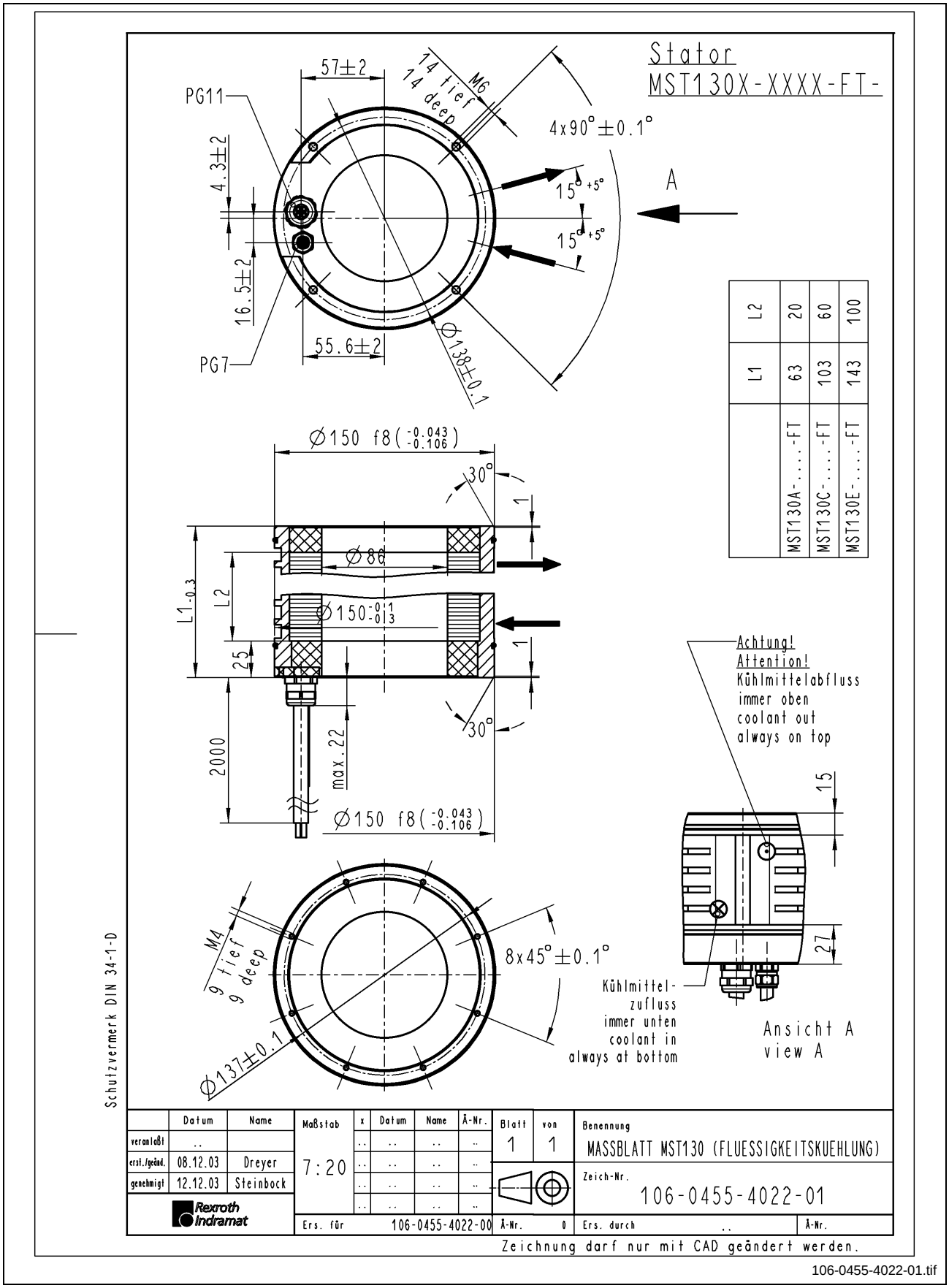


	Anzahl der Befestigungsschrauben number of fixing screws
MRT130A	8
MRT130C	8
MRT130E	8
MRT130G	8

	Datum	Name
veranlaßt	..	
erst./geänd.	19.08.03	Dreyer
genehmigt	09.09.03	Steinbock

Fig. 5-4: Dimension sheet Rotor MRT130, mounted

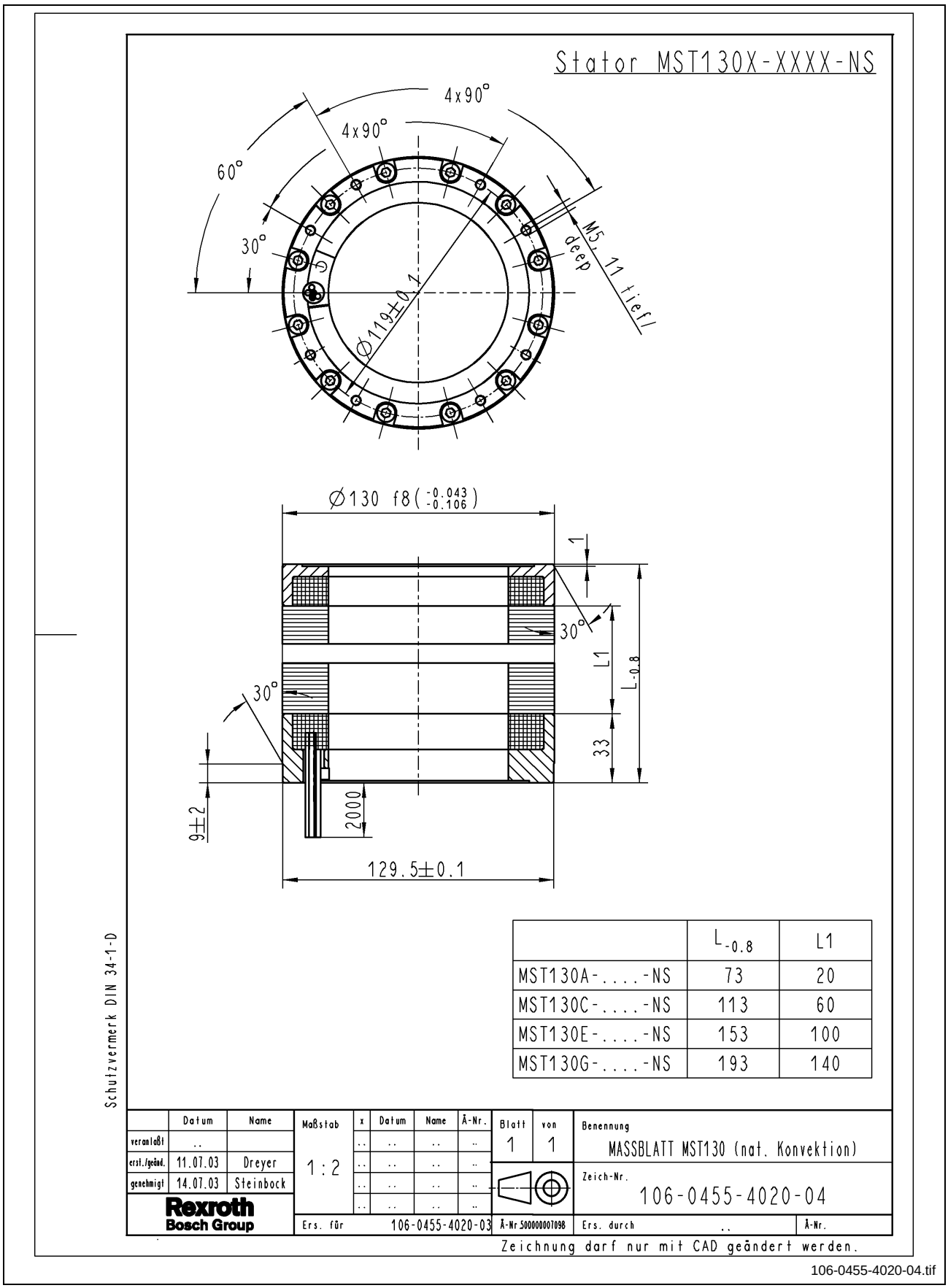
Stator MST130, liquid cooled



106-0455-4022-01.tif

Fig. 5-5: Dimension sheet MST130, liquid cooled

Stator MST130, natural convection

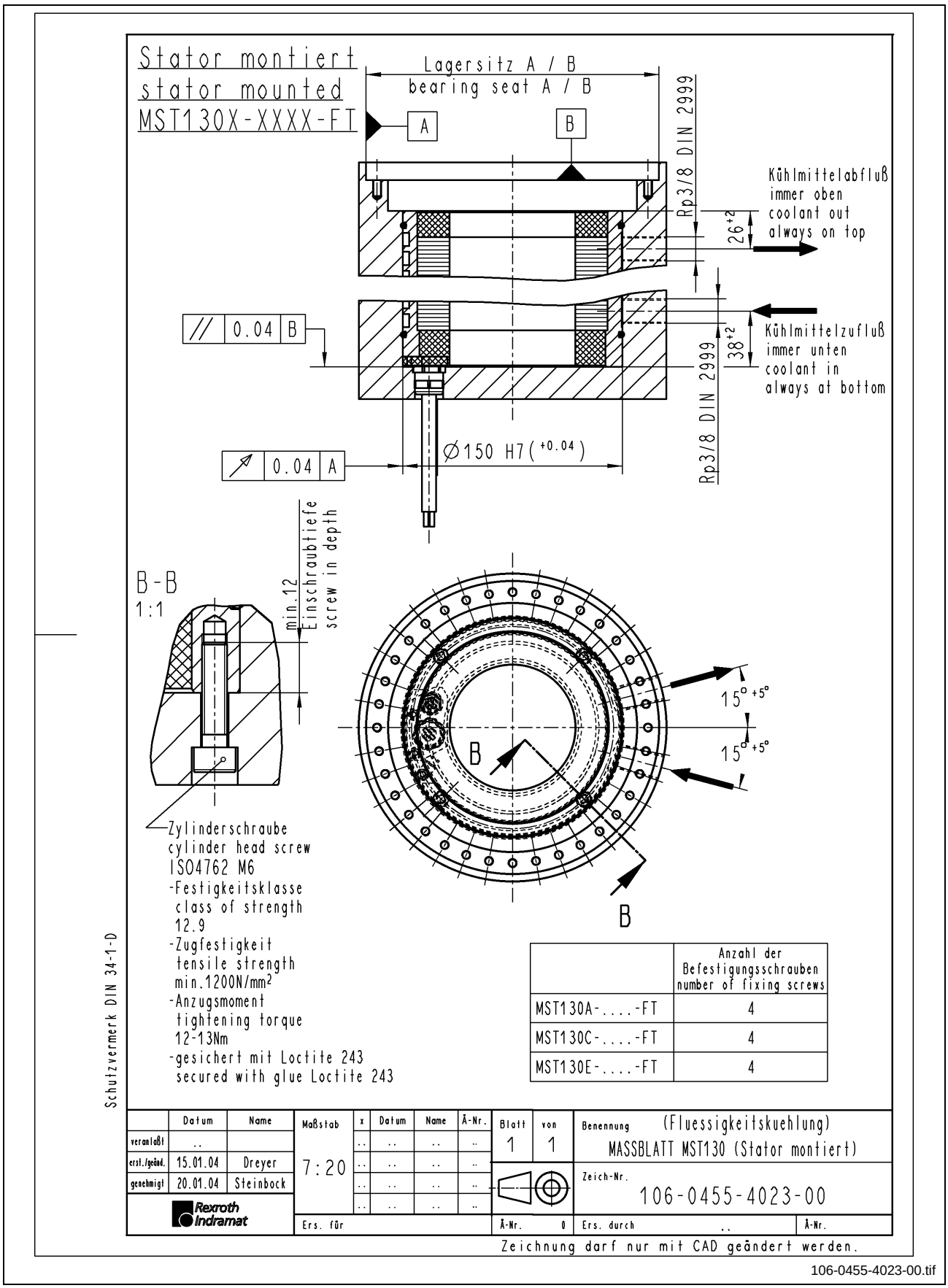


	$L_{-0.8}$	L1
MST130A-....-NS	73	20
MST130C-....-NS	113	60
MST130E-....-NS	153	100
MST130G-....-NS	193	140

106-0455-4020-04.tif

Fig. 5-6: Dimension sheet MST130, natural convection

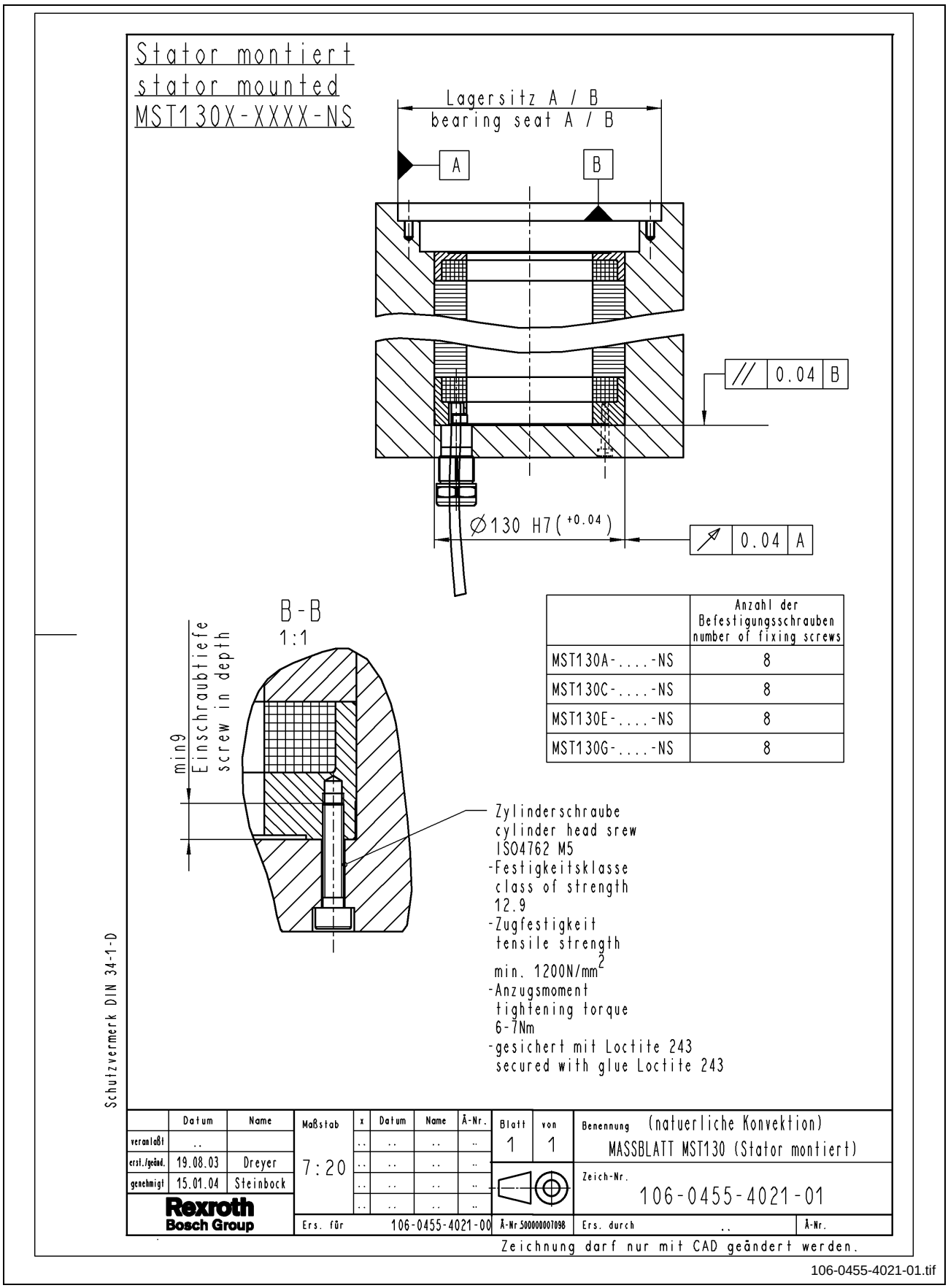
Stator MST130, liquid cooled, mounted



106-0455-4023-00.tif

Fig. 5-7: Dimension sheet Stator 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

106-0455-4021-01.tif

Fig. 5-8: Dimension sheet MST130, natural convection, mounted

Rotor and Stator (nat. convection), mounted

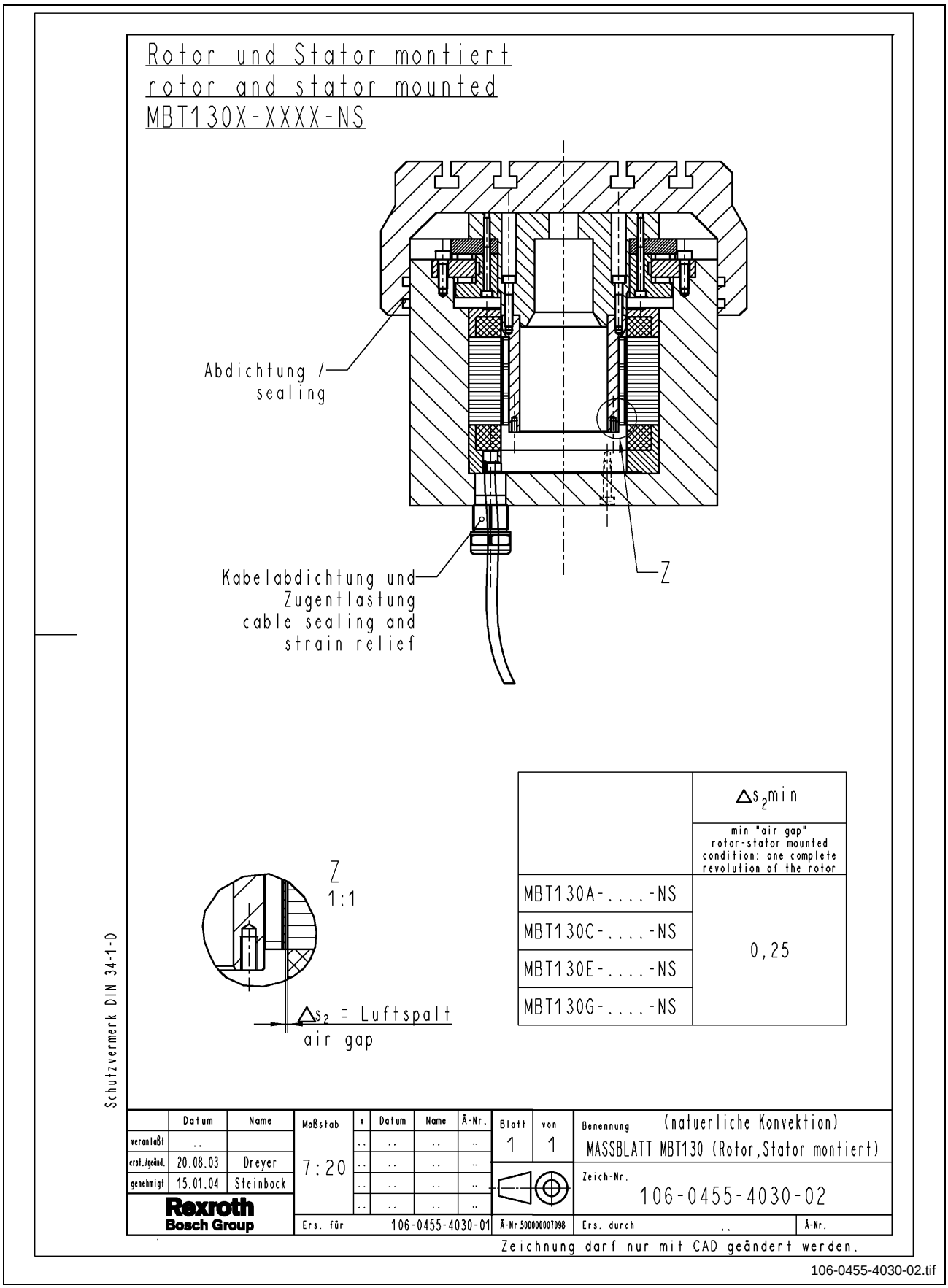
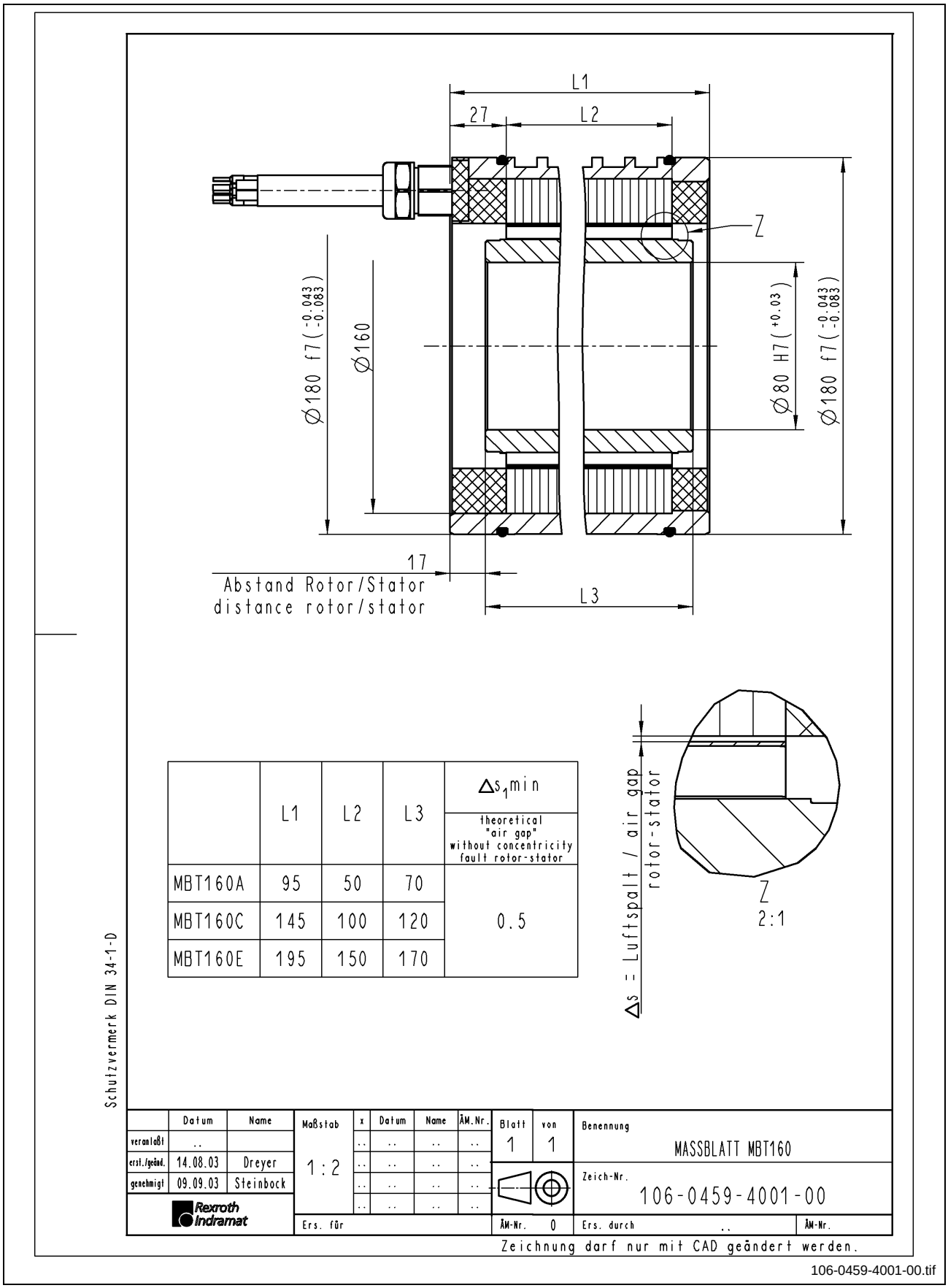


Fig. 5-9: Dimension sheet Rotor and Stator (nat. convection), mounted

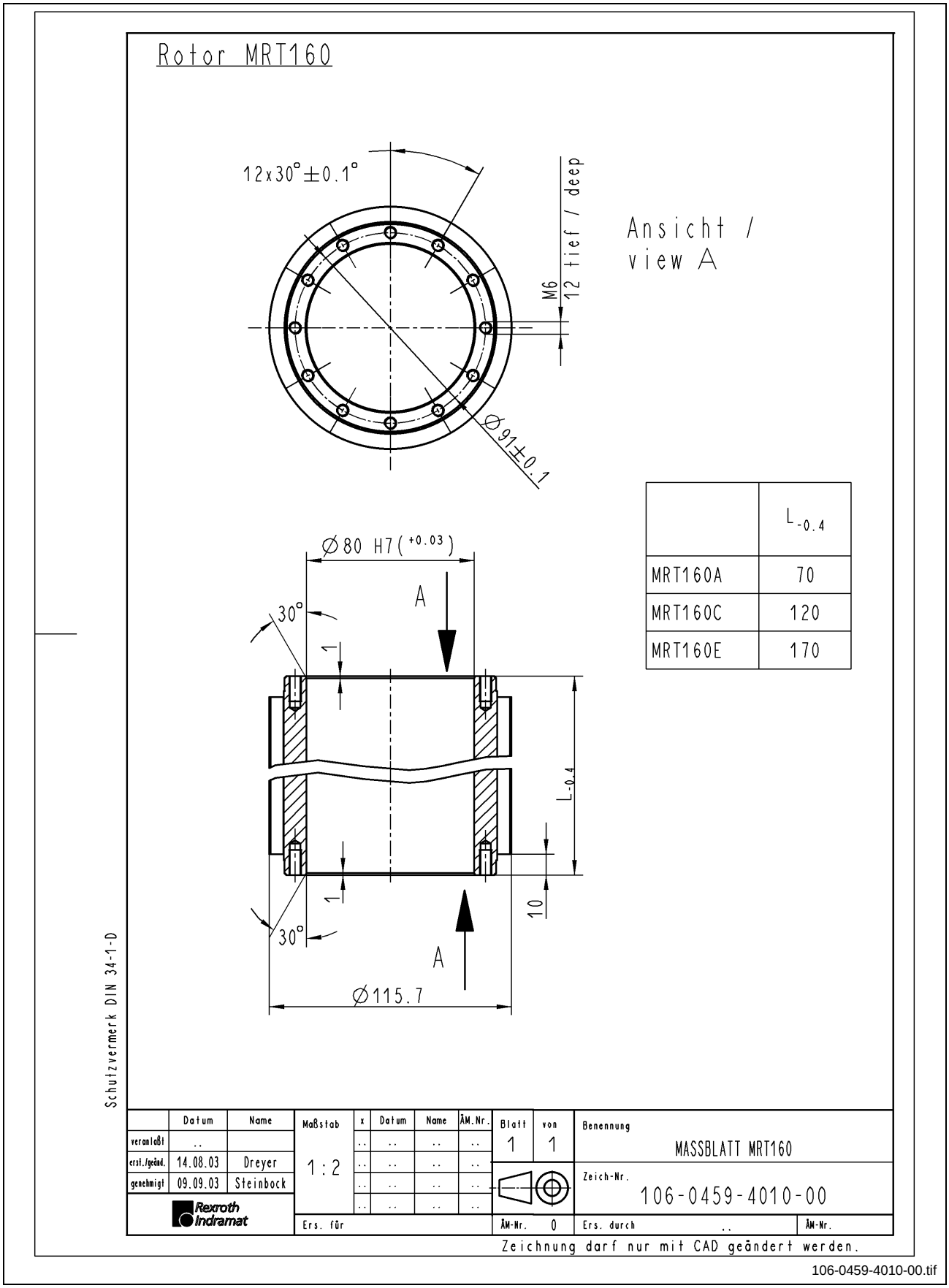
5.3 Dimension Sheets, Size 160



	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. 5-10: Dimension sheet MBS160

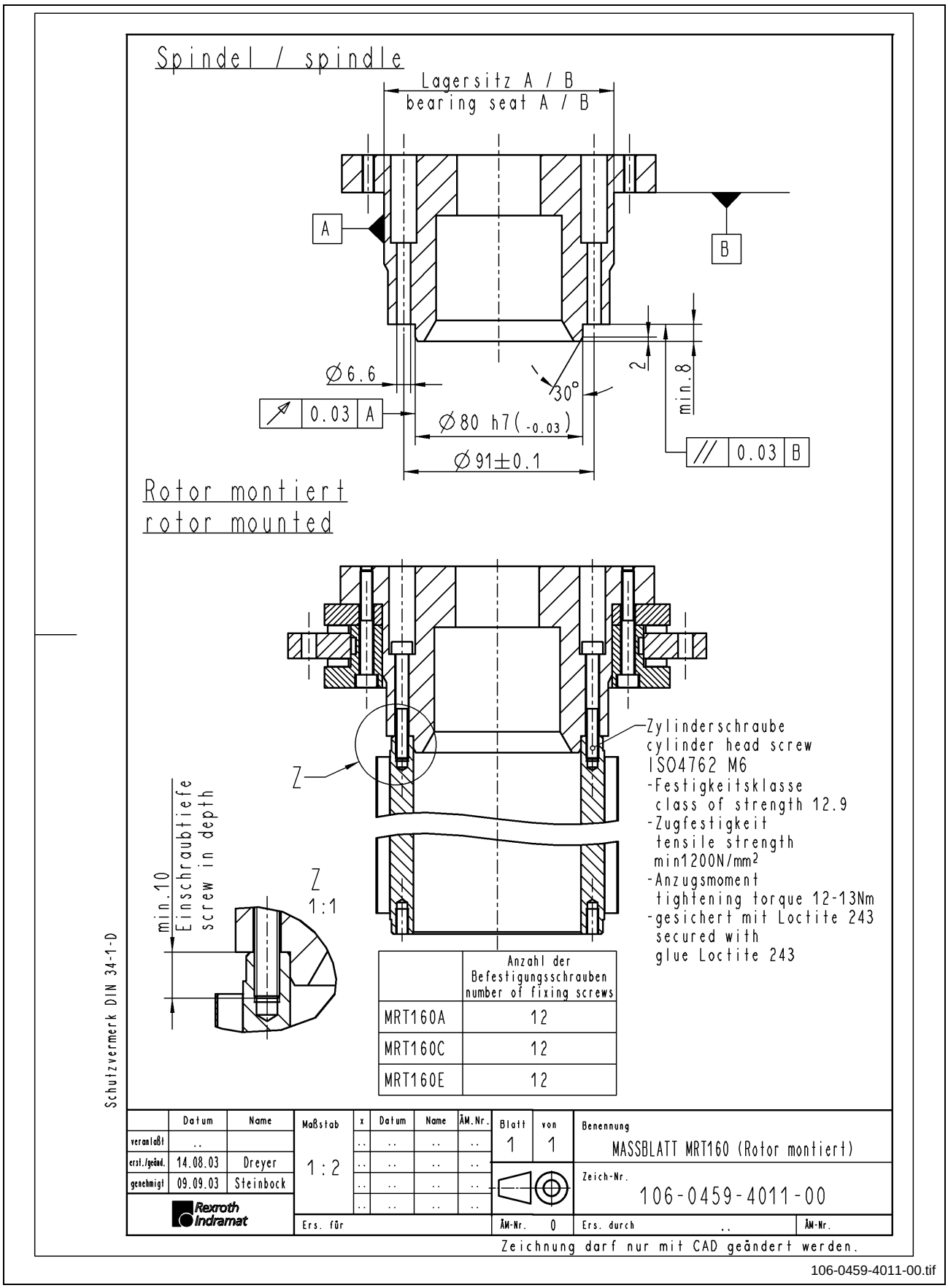
Rotor MRT160



	L -0.4
MRT160A	70
MRT160C	120
MRT160E	170

Fig. 5-11: Dimension sheet Rotor MRT160

Rotor MRT160, mounted



106-0459-4011-00.tif

Fig. 5-12: Dimension sheet Rotor MRT160, mounted

Stator MST160

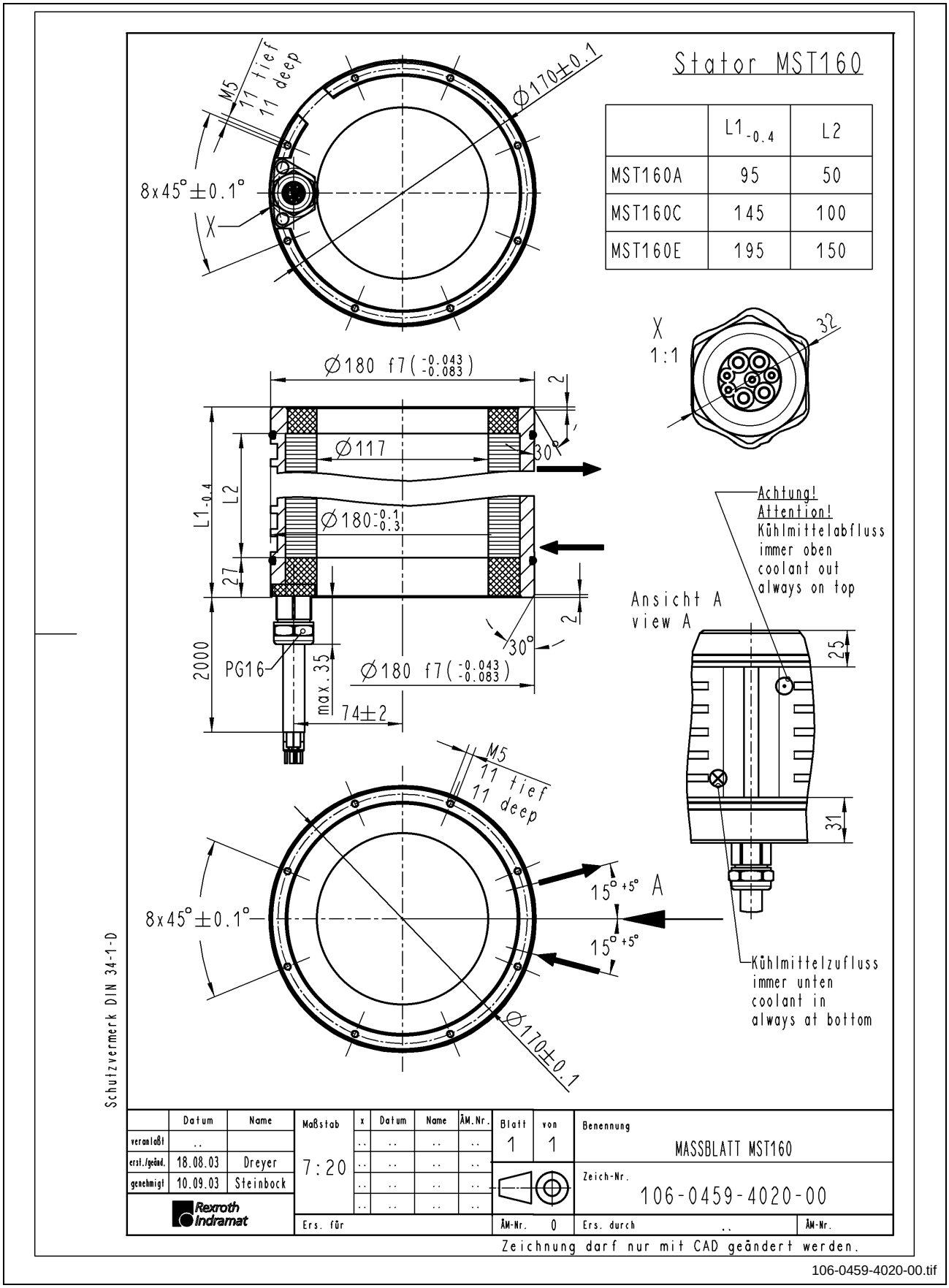
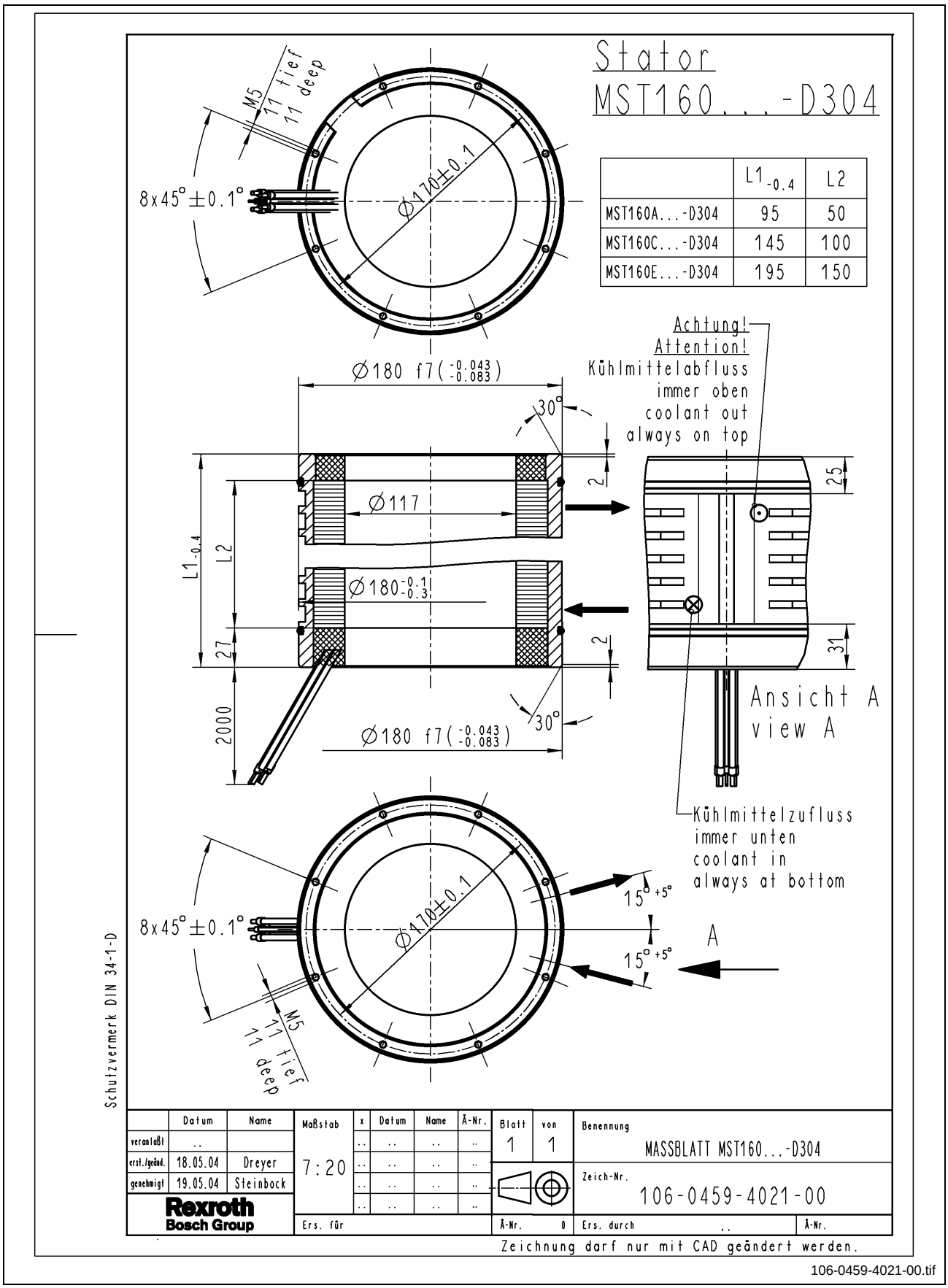


Fig. 5-13: Dimension sheet Stator MST160

Stator MST160 in “Other Design” .....-D304

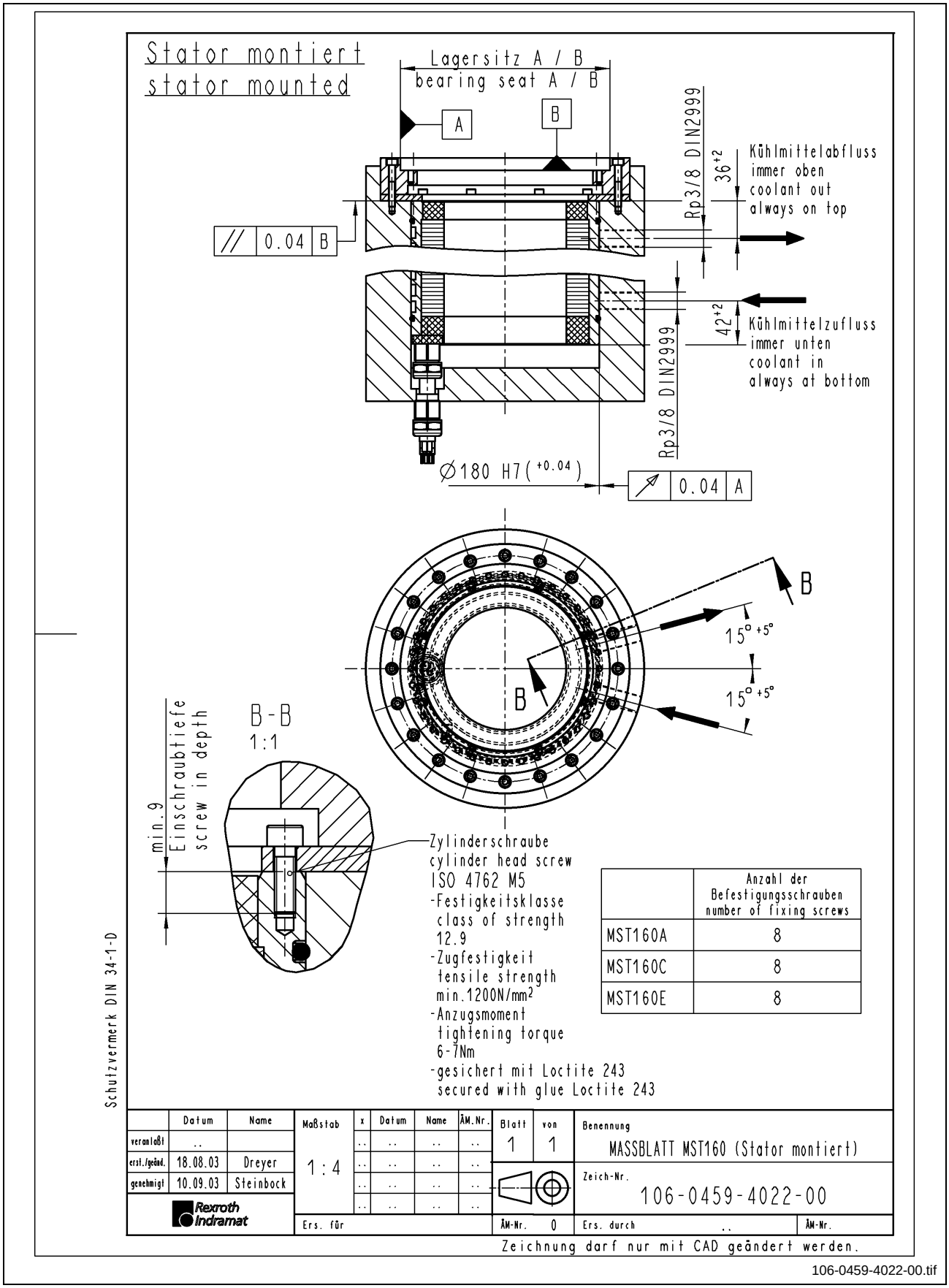


	L1 -0.4	L2
MST160A...-D304	95	50
MST160C...-D304	145	100
MST160E...-D304	195	150

106-0459-4021-00.tif

Fig. 5-14: Dimension sheet MST160-....-D304

Stator MST160, mounted



106-0459-4022-00.tif

Fig. 5-15: Dimension sheet Stator MST160, mounted

Rotor and Stator, mounted

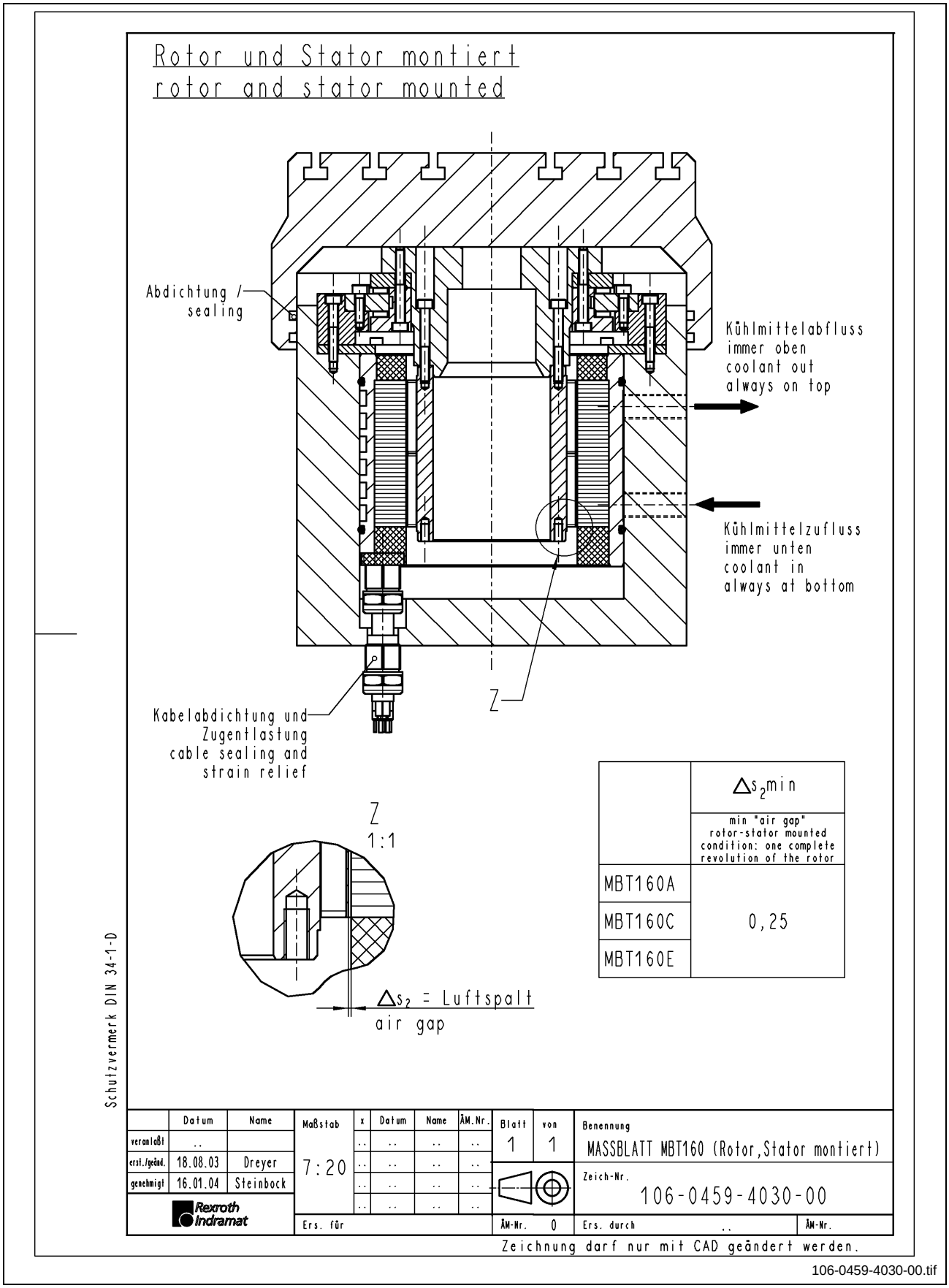
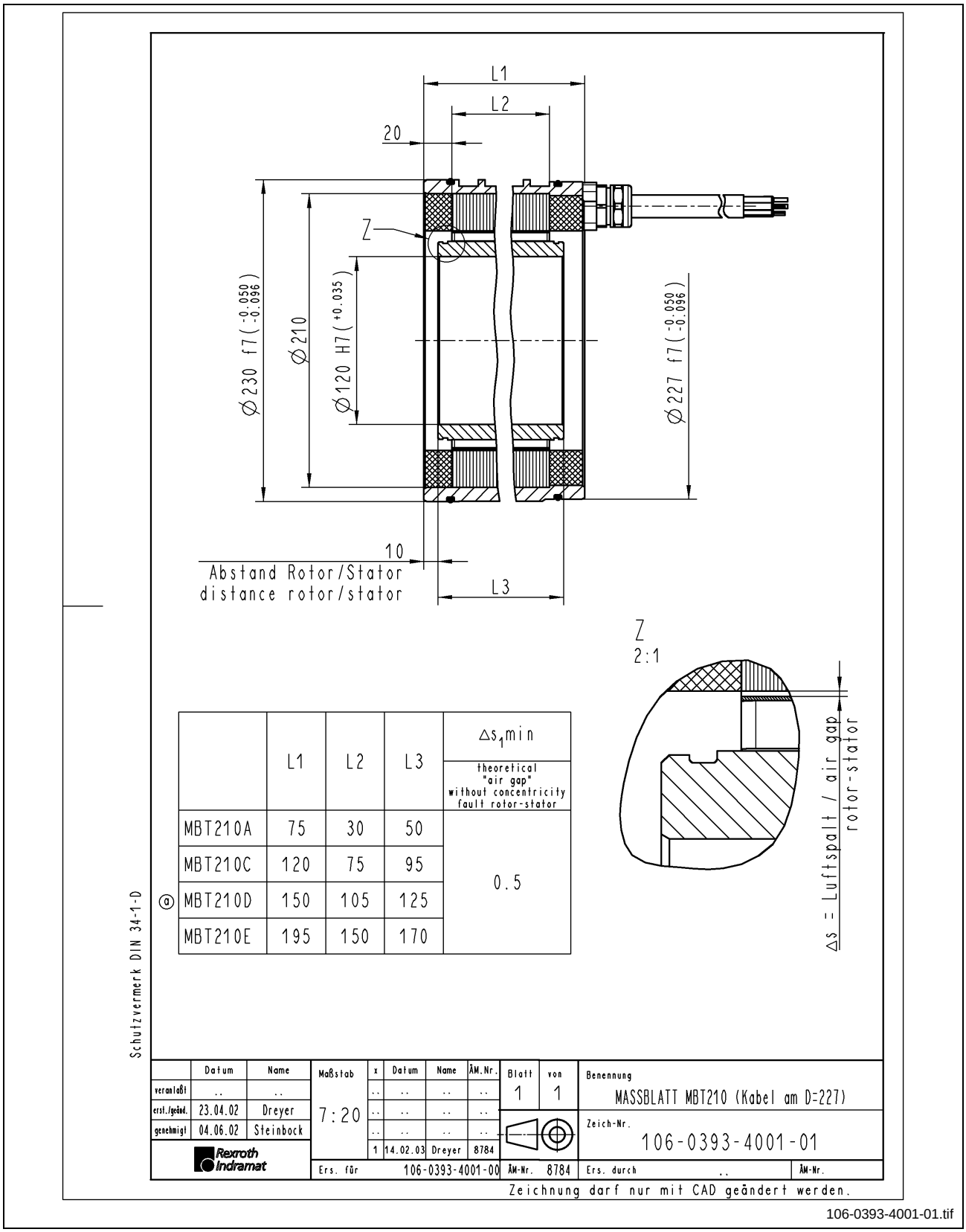


Fig. 5-16: Dimension sheet Rotor and Stator, mounted

5.4 Dimension Sheets, Size 210

Electrical Connection "SN"



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

	Datum	Name
veranlaßt	..	..
erst./geänd.	23.04.02	Dreyer
genehmigt	04.06.02	Steinbock

Maßstab 7:20

x	Datum	Name	ÄM.Nr.
..	..	..	..
..	..	..	..
..	..	..	..
1	14.02.03	Dreyer	8784

Blatt 1 von 1

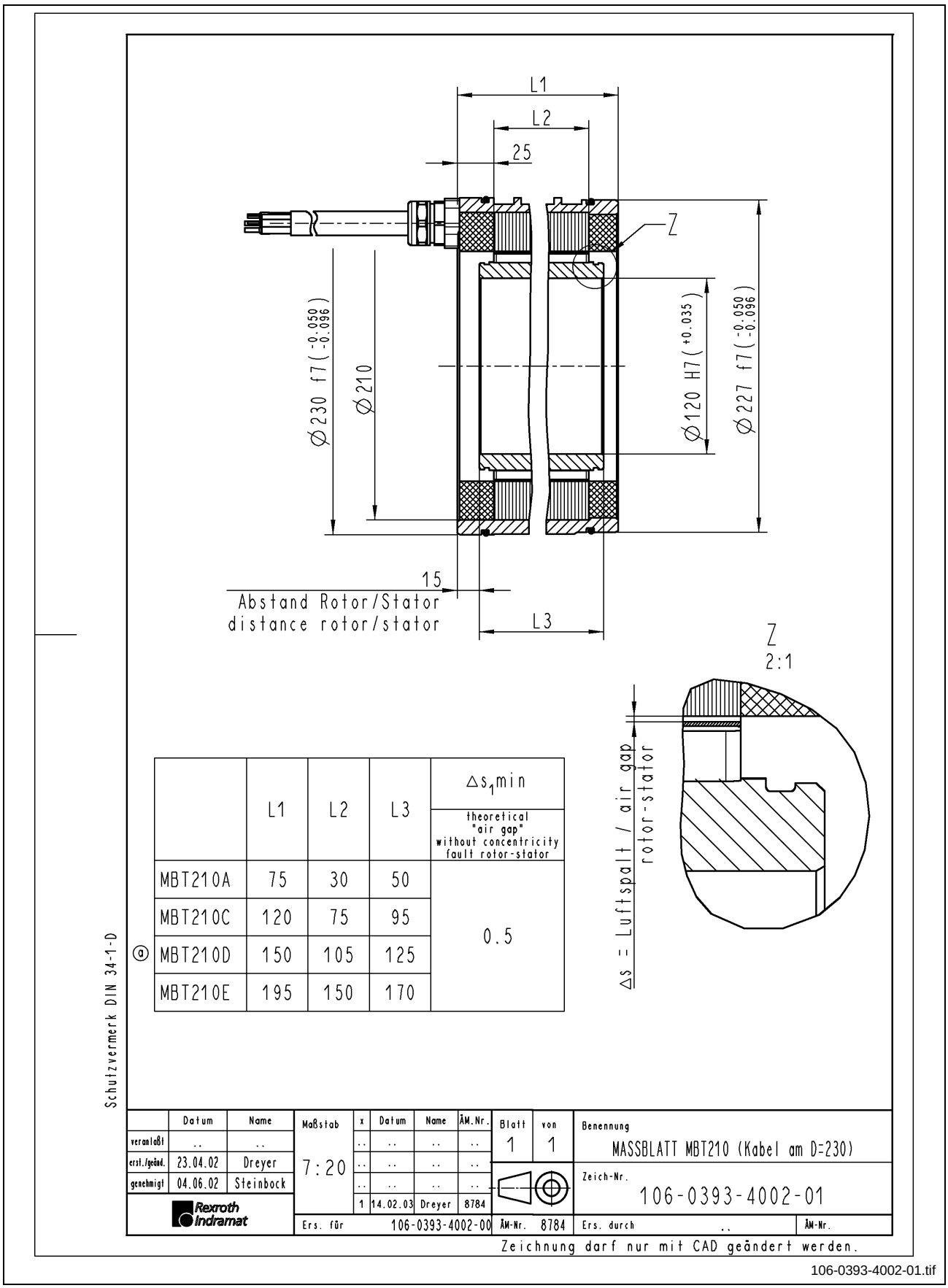
Benennung: MASSBLATT MBT210 (Kabel am D=227)

Zeich-Nr.: 106-0393-4001-01

Ers. für 106-0393-4001-00 ÄM-Nr. 8784 Ers. durch .. ÄM-Nr.

Fig. 5-17: Dimension sheet size 210, electrical connection "SN"

Electrical Connection "CN"



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

	Datum	Name
veranlaßt	..	..
erst./geänd.	23.04.02	Dreyer
genehmigt	04.06.02	Steinbock

Rexroth Indramat

Maßstab 7:20

x	Datum	Name	ÄM.Nr.
..	..	..	..
..	..	..	..
..	..	..	..
1	14.02.03	Dreyer	8784

Ers. für 106-0393-4002-00

Blatt 1 von 1

ÄM-Nr. 8784

Benennung: MASSBLATT MBT210 (Kabel am D=230)

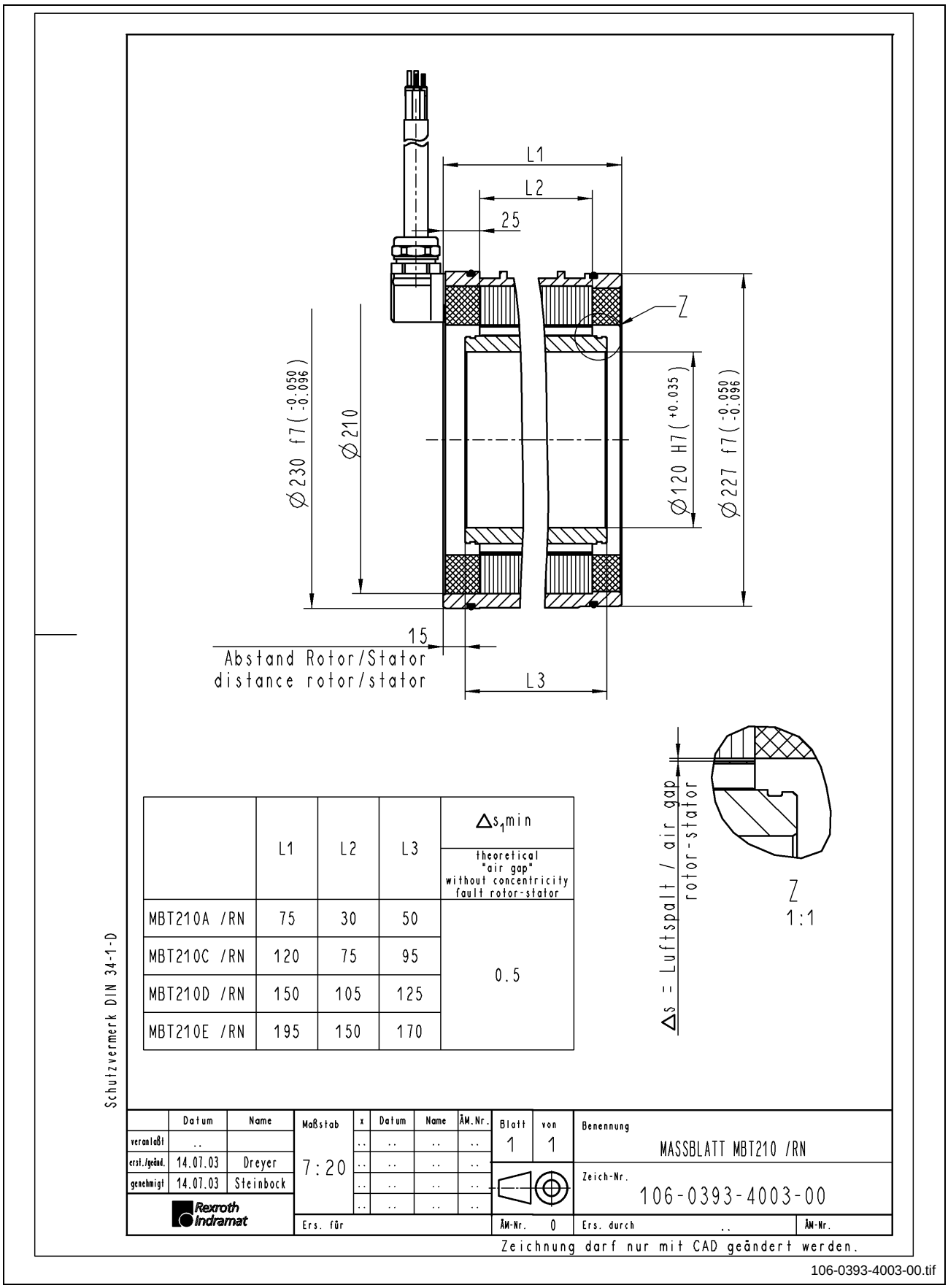
Zeich-Nr.: 106-0393-4002-01

Ers. durch .. ÄM-Nr.

106-0393-4002-01.tif

Fig. 5-18: Dimension sheet size 210, electrical connection "CN"

Electrical Connection "RN"

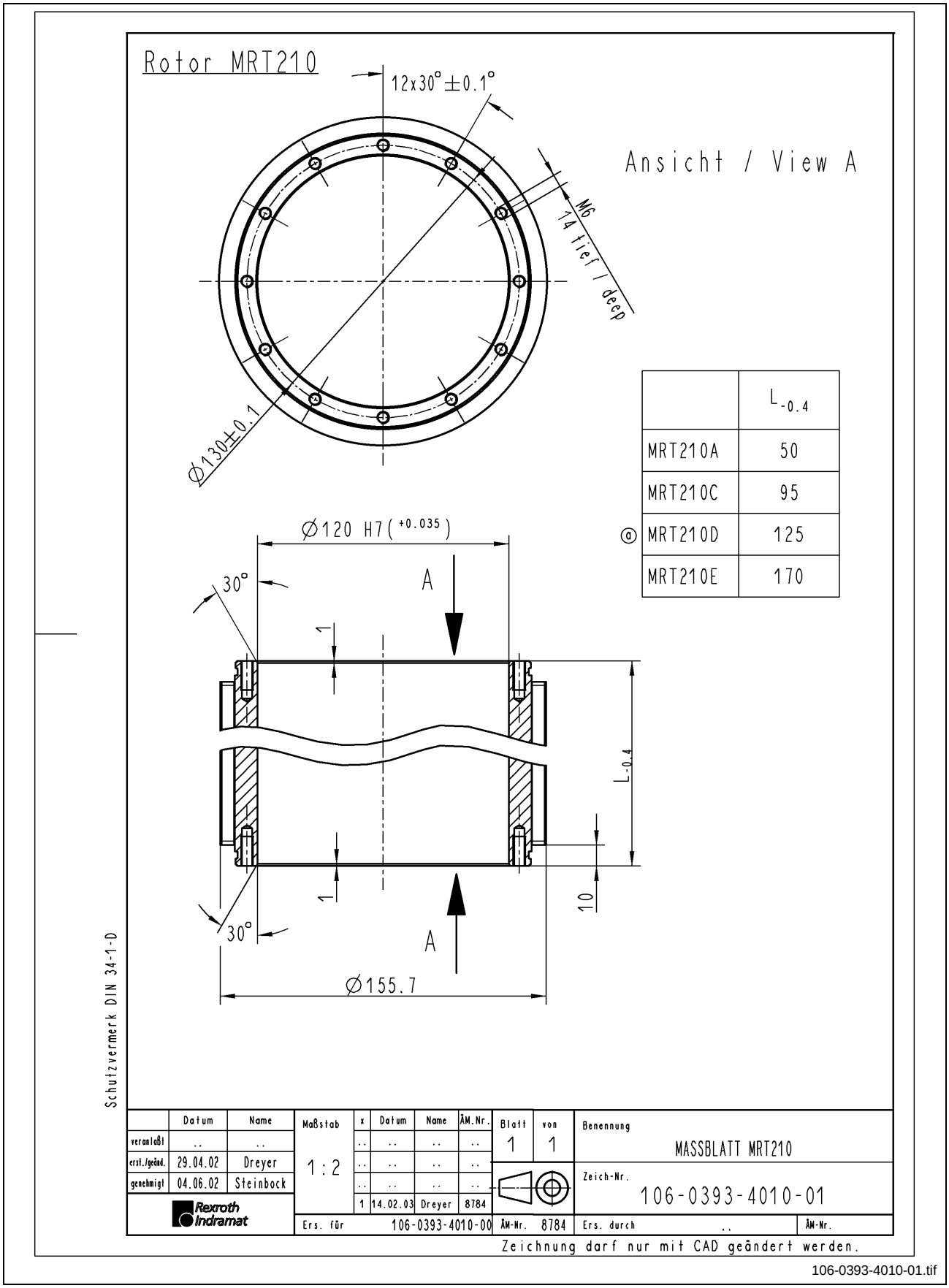


	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT210A /RN	75	30	50	0.5
MBT210C /RN	120	75	95	
MBT210D /RN	150	105	125	
MBT210E /RN	195	150	170	

106-0393-4003-00.tif

Fig. 5-19: Dimension sheet size 210, electrical connection "RN"

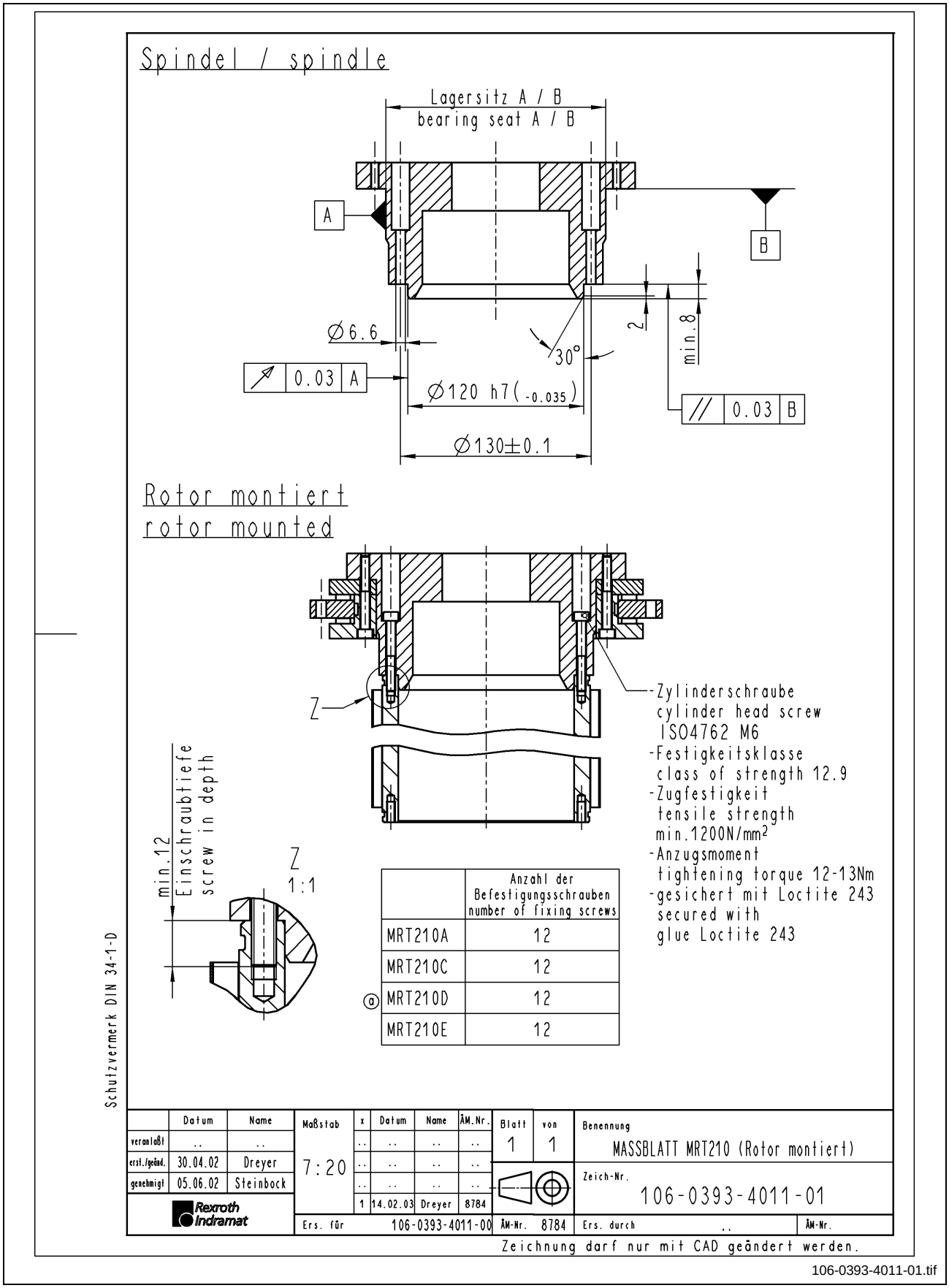
Rotor MRT210



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

Fig. 5-20: Dimension sheet MRT210

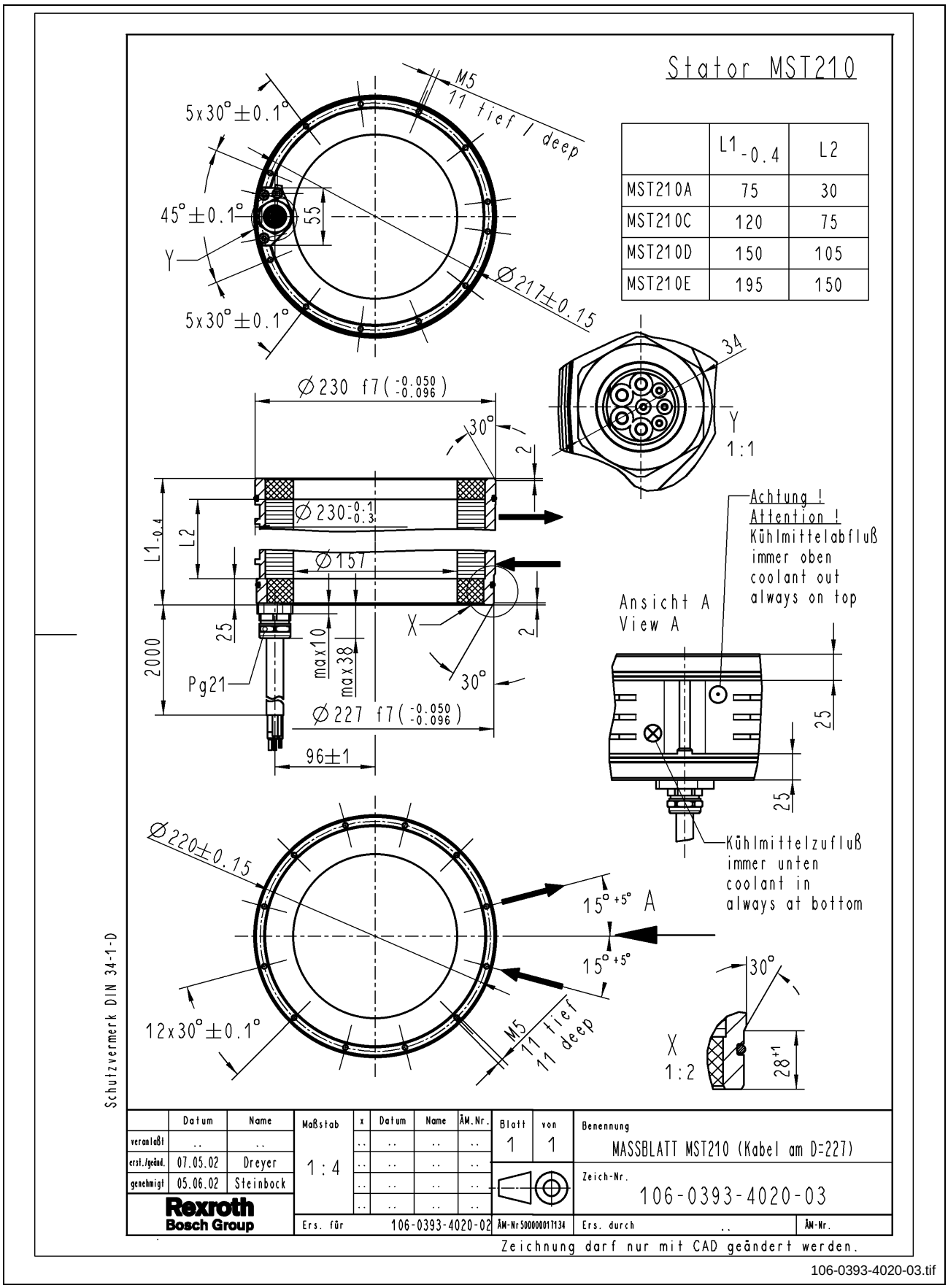
Rotor MRT210, mounted



106-0393-4011-01.tif

Fig. 5-21: Dimension sheet Rotor MRT210, mounted

Stator MST210, Electrical Connection "SN"

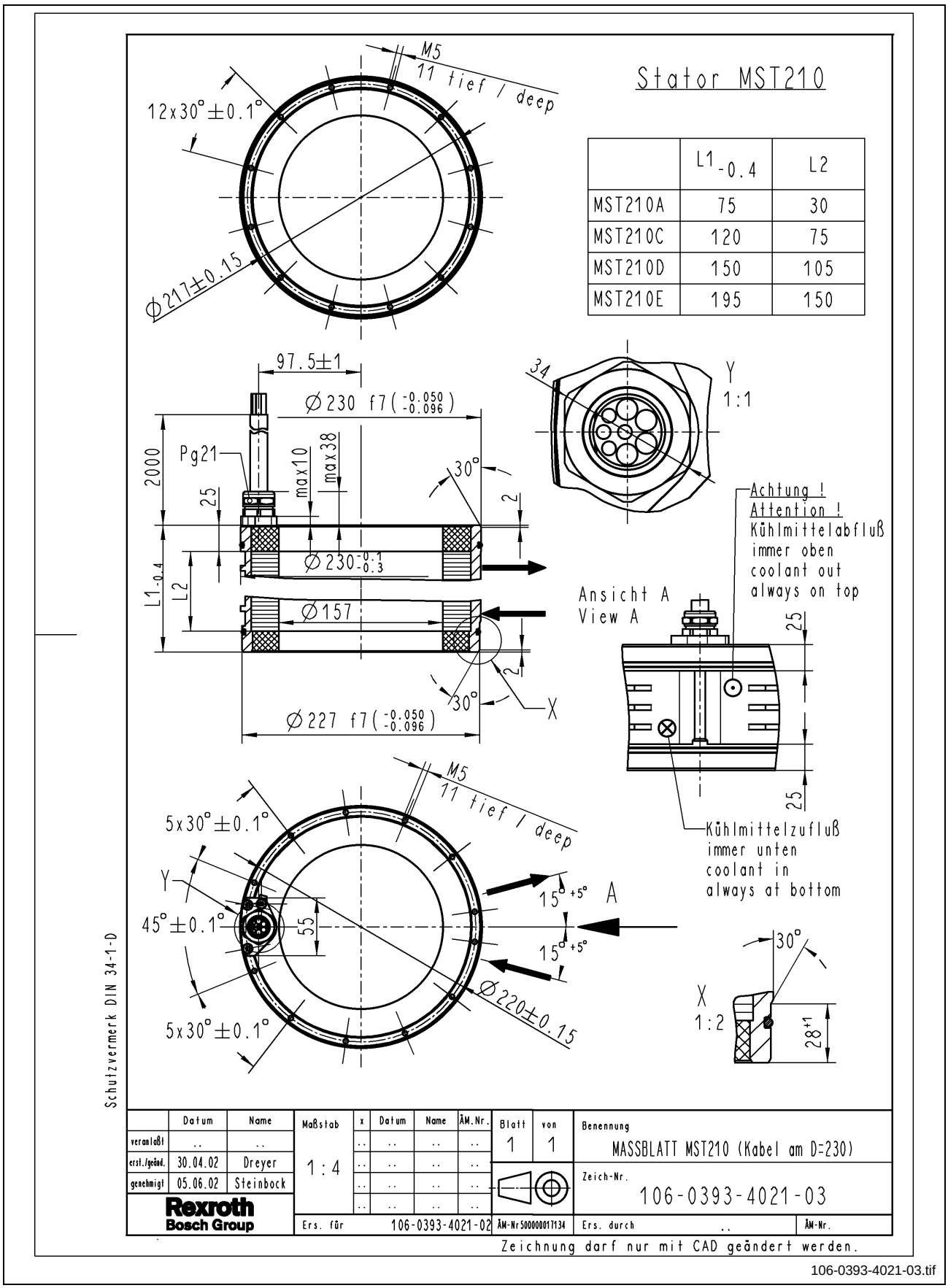


	L1 -0.4	L2
MST210A	75	30
MST210C	120	75
MST210D	150	105
MST210E	195	150

106-0393-4020-03.tif

Fig. 5-22: Dimension sheet MST210, electrical connection "SN"

Stator MST210, Electrical Connection "CN"



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

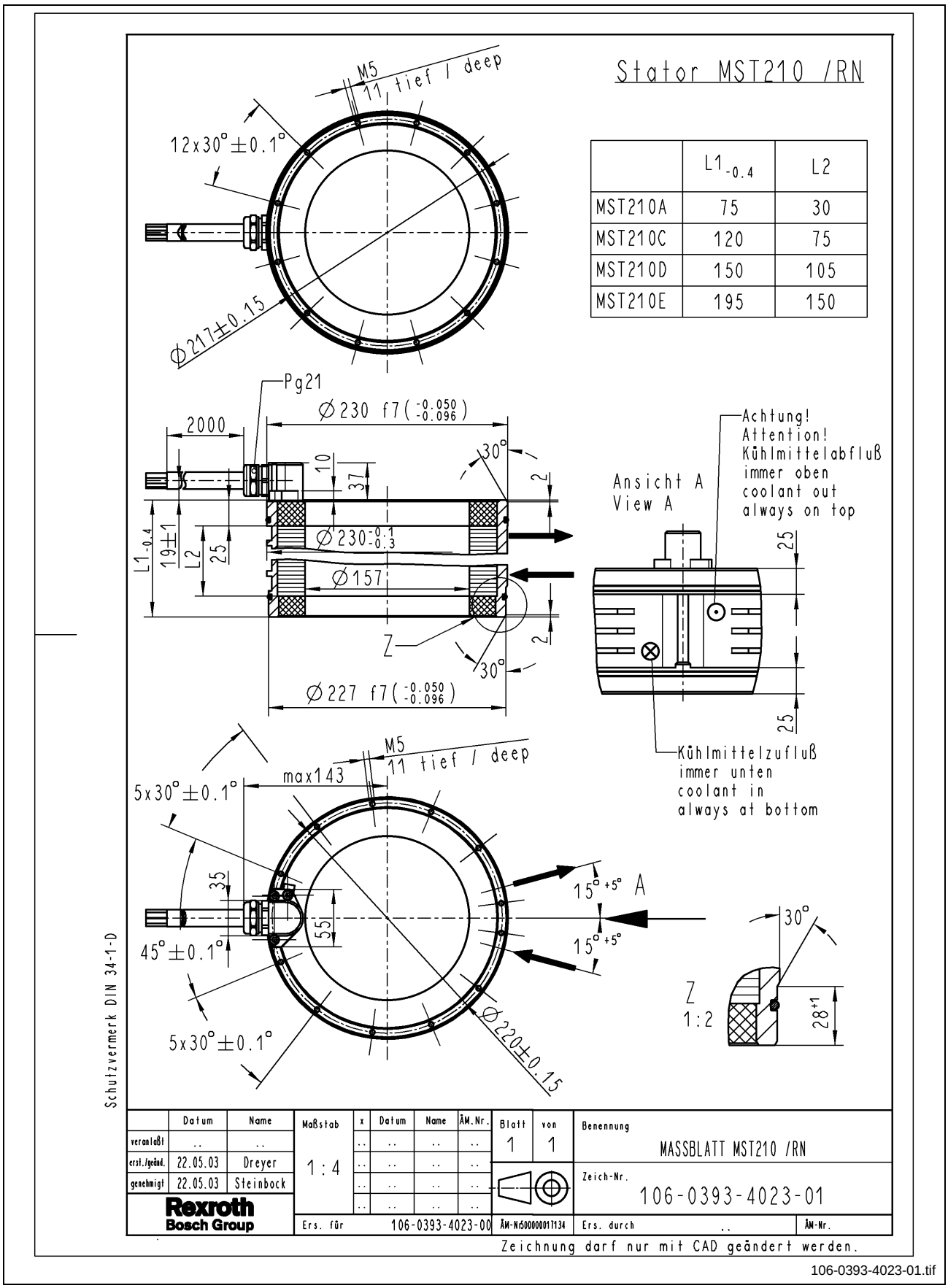
	Datum	Name
veranlaßt	..	..
erst./geänd.	30.04.02	Dreyer
genehmigt	05.06.02	Steinbock

Rexroth Bosch Group

106-0393-4021-03.tif

Fig. 5-23: Dimension sheet MST210, electrical connection "CN"

Stator MST210, Electrical Connection “RN”

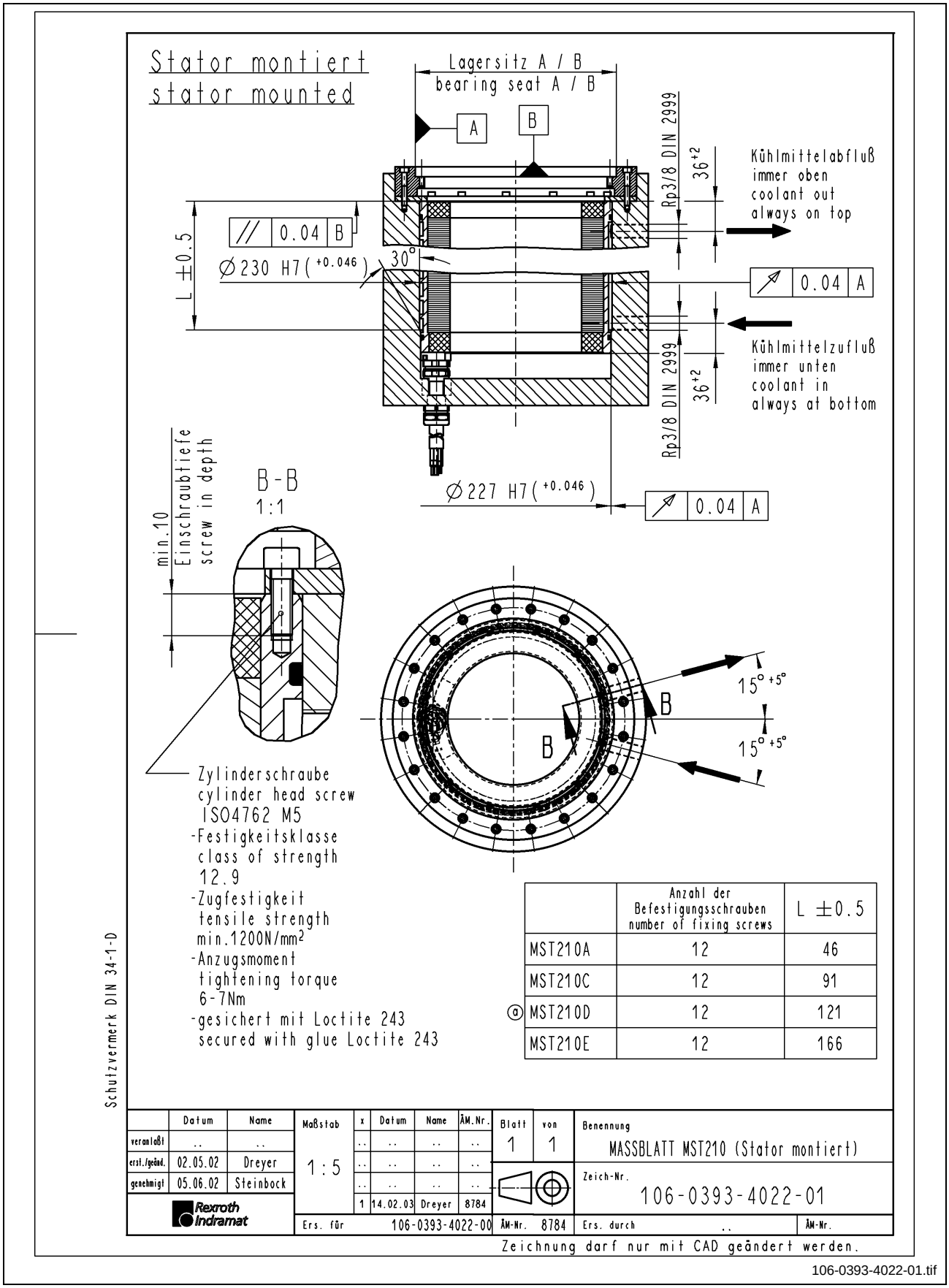


	L1 -0.4	L2
MST210A	75	30
MST210C	120	75
MST210D	150	105
MST210E	195	150

106-0393-4023-01.tif

Fig. 5-24: Dimension sheet MST210, electrical connection “RN”

Stator, mounted

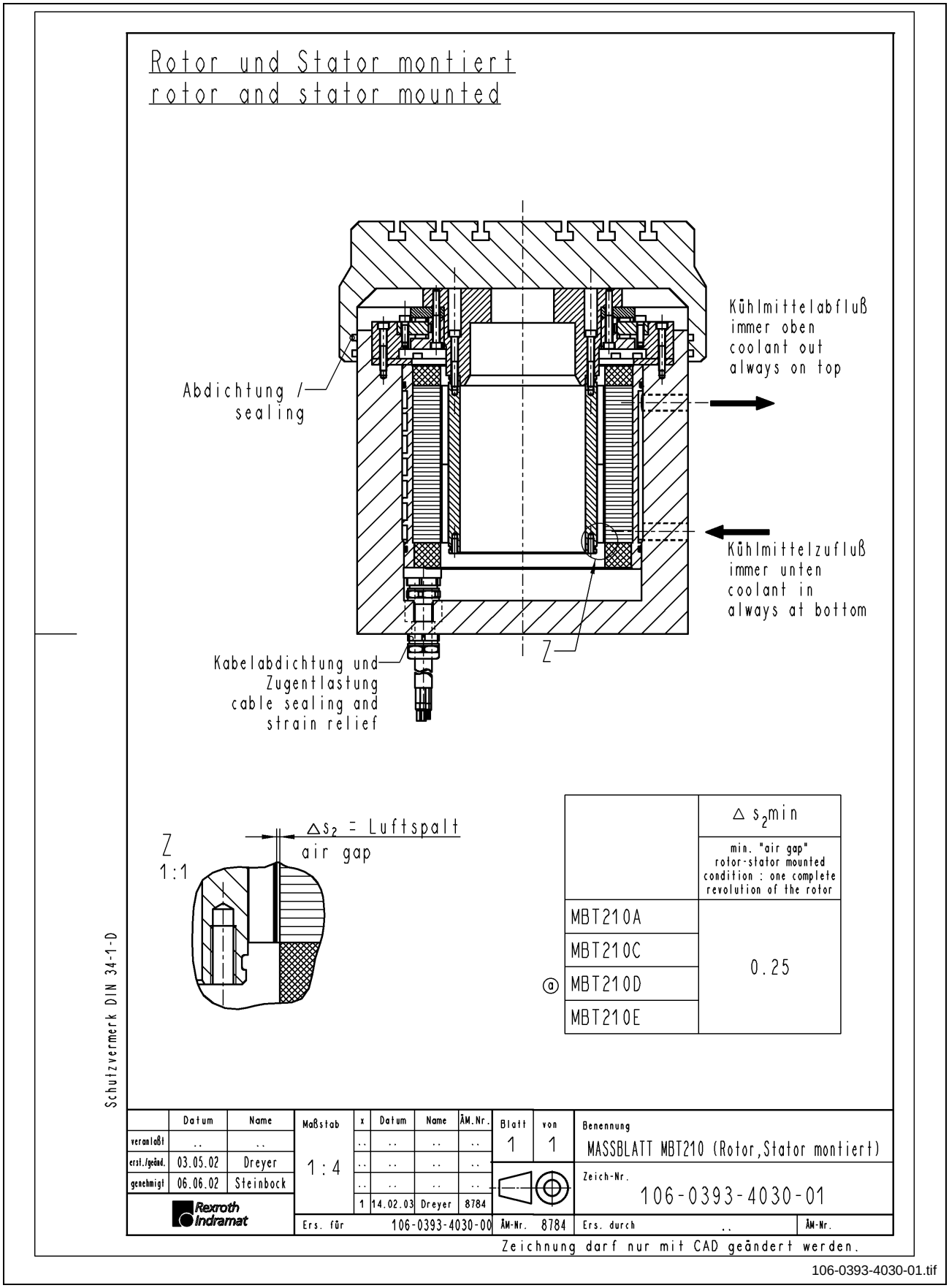


	Anzahl der Befestigungsschrauben number of fixing screws	L ±0.5
MST210A	12	46
MST210C	12	91
ⓐ MST210D	12	121
MST210E	12	166

106-0393-4022-01.tif

Fig. 5-25: Dimension sheet Stator MST210, mounted

Rotor and Stator, mounted

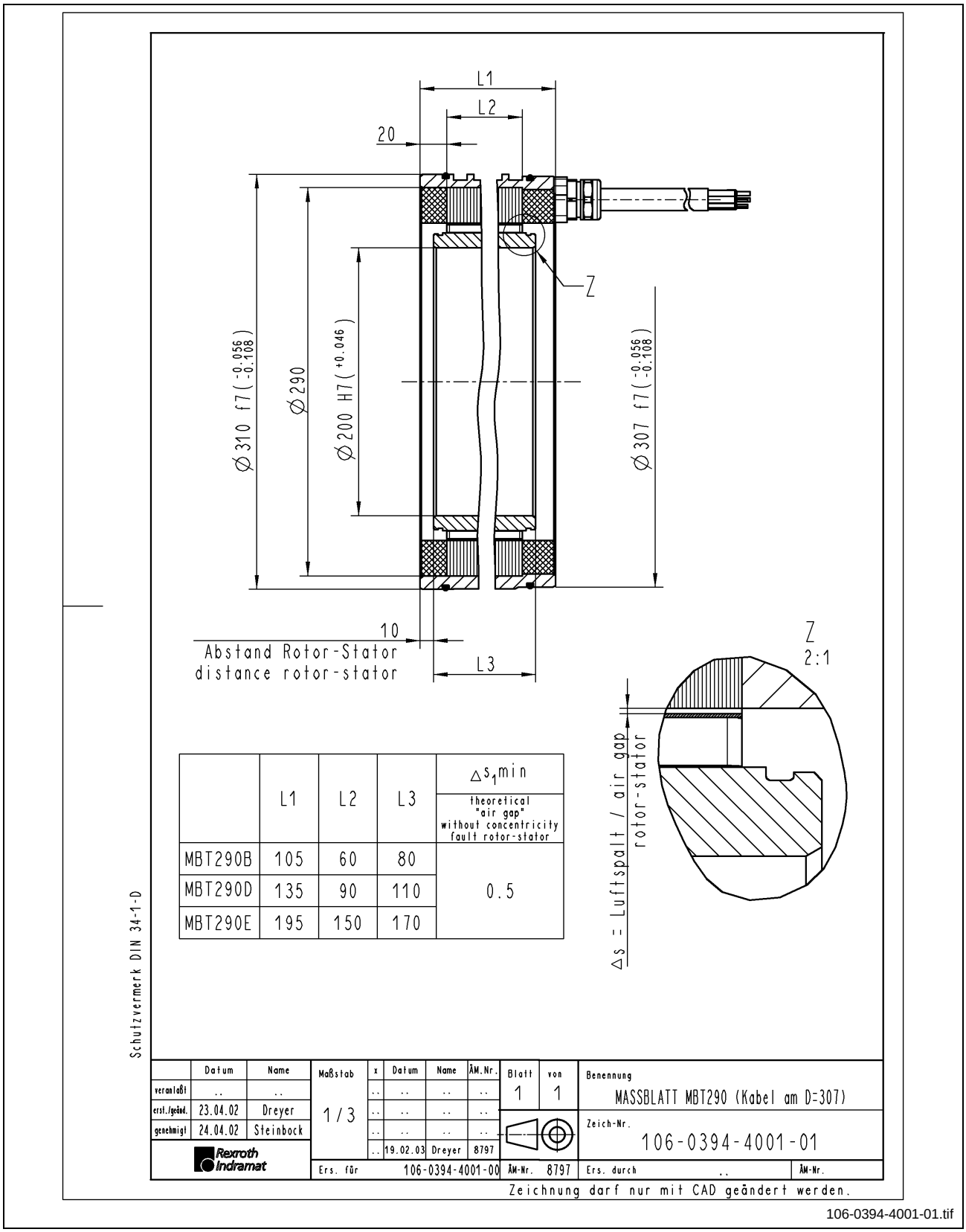


106-0393-4030-01.tif

Fig. 5-26: Dimension sheet size 210, Rotor and Stator, mounted

5.5 Dimension Sheets, Size 290

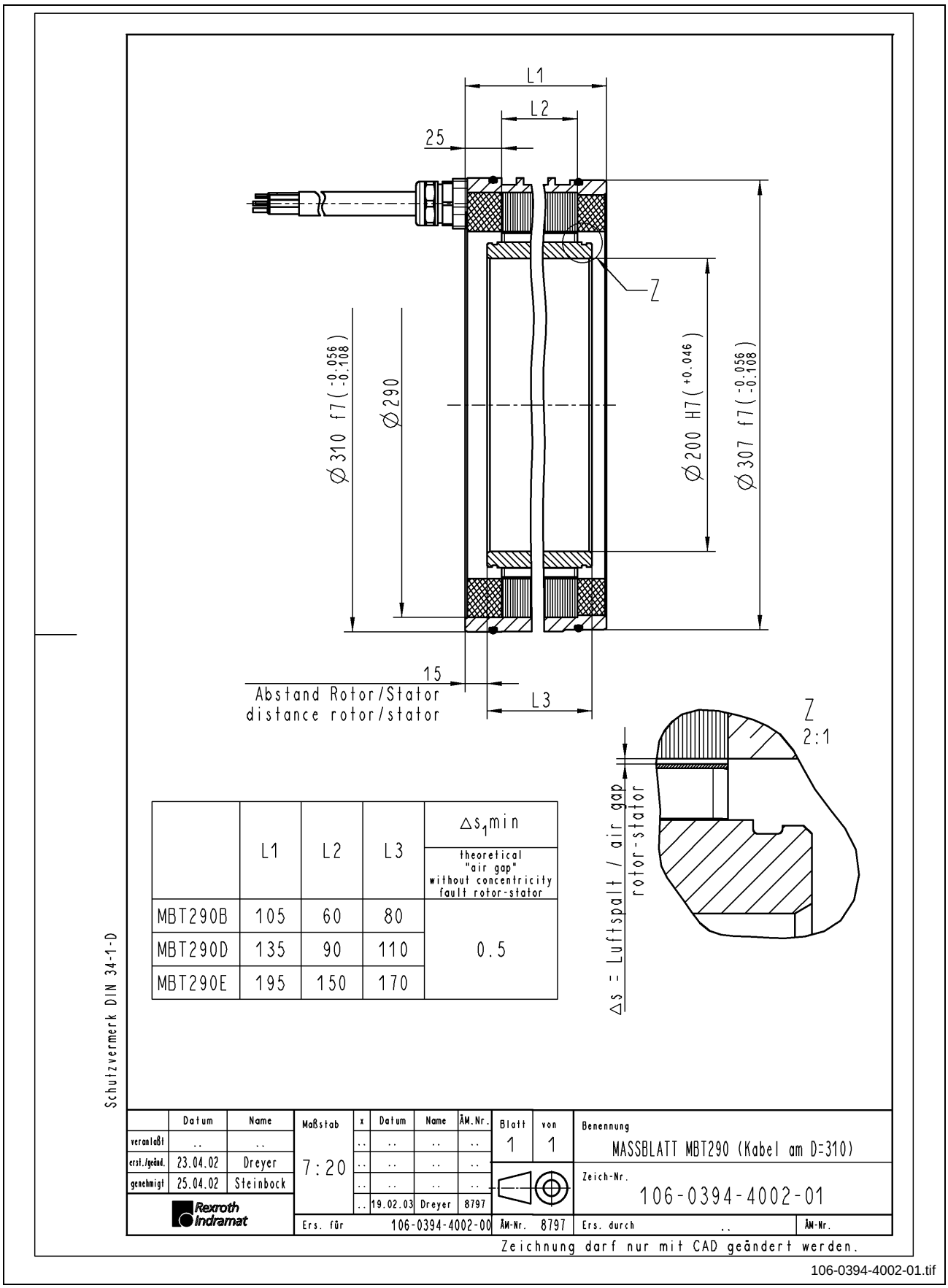
Electrical Connection "SN"



	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. 5-27: Dimension sheet size 290, electrical connection "SN"

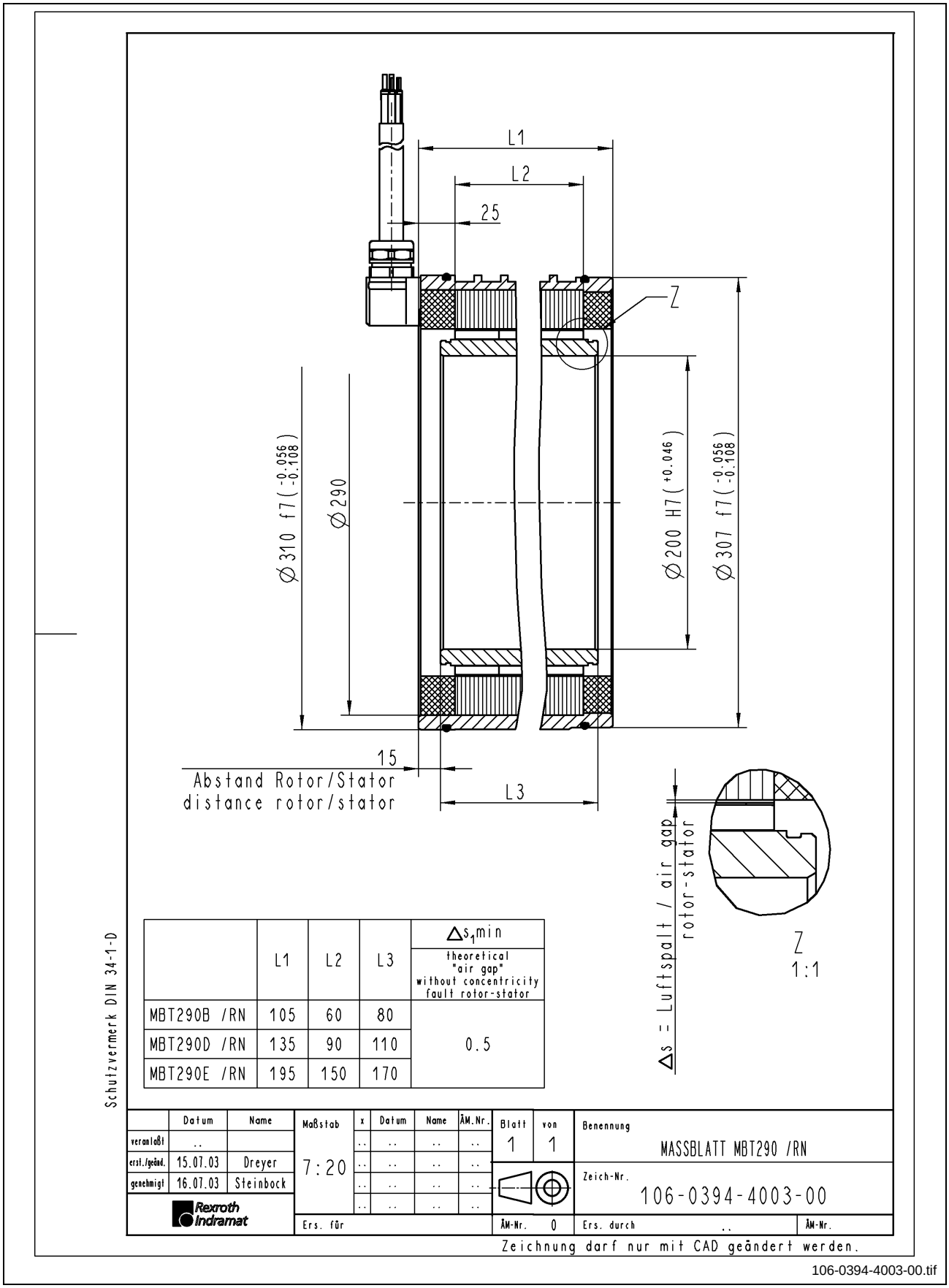
Electrical Connection "CN"



	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. 5-28: Dimension sheet size 290, electrical connection "CN"

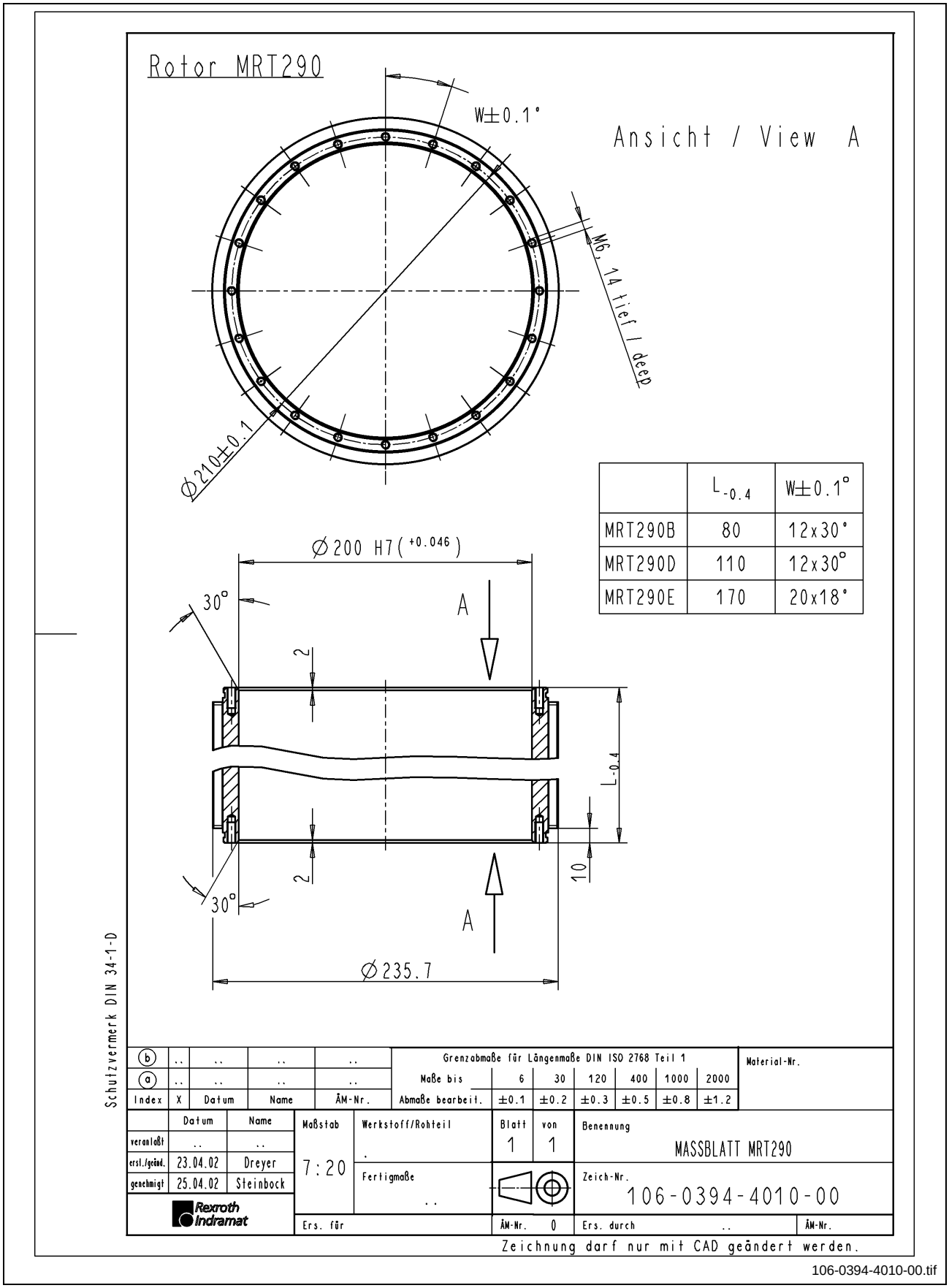
Electrical Connection "RN"



	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	

Fig. 5-29: Dimension sheet size 290, electrical connection "RN"

Rotor MRT290



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

106-0394-4010-00.tif

Fig. 5-30: Dimension sheet MRT290

Rotor MRT290, mounted

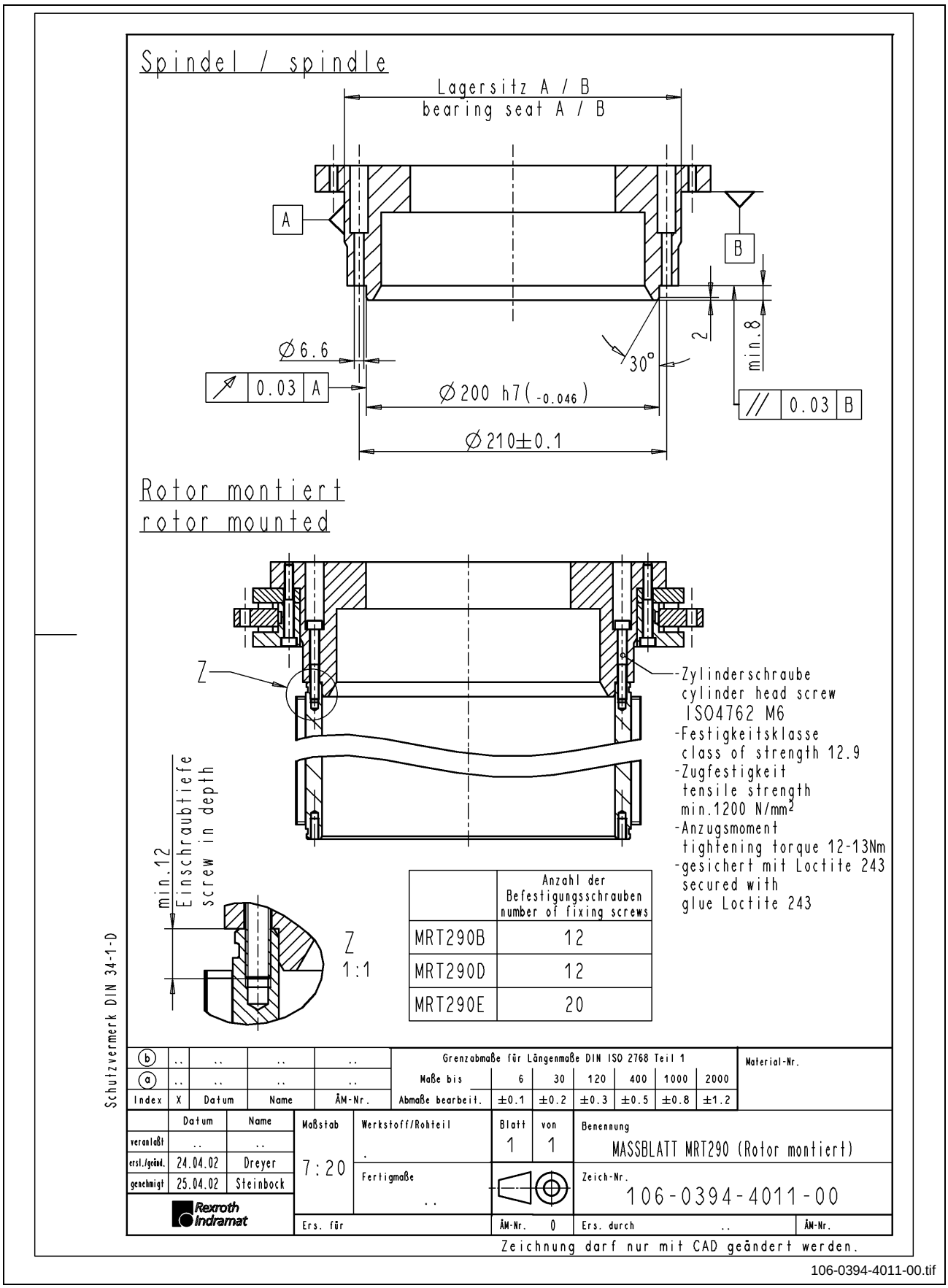
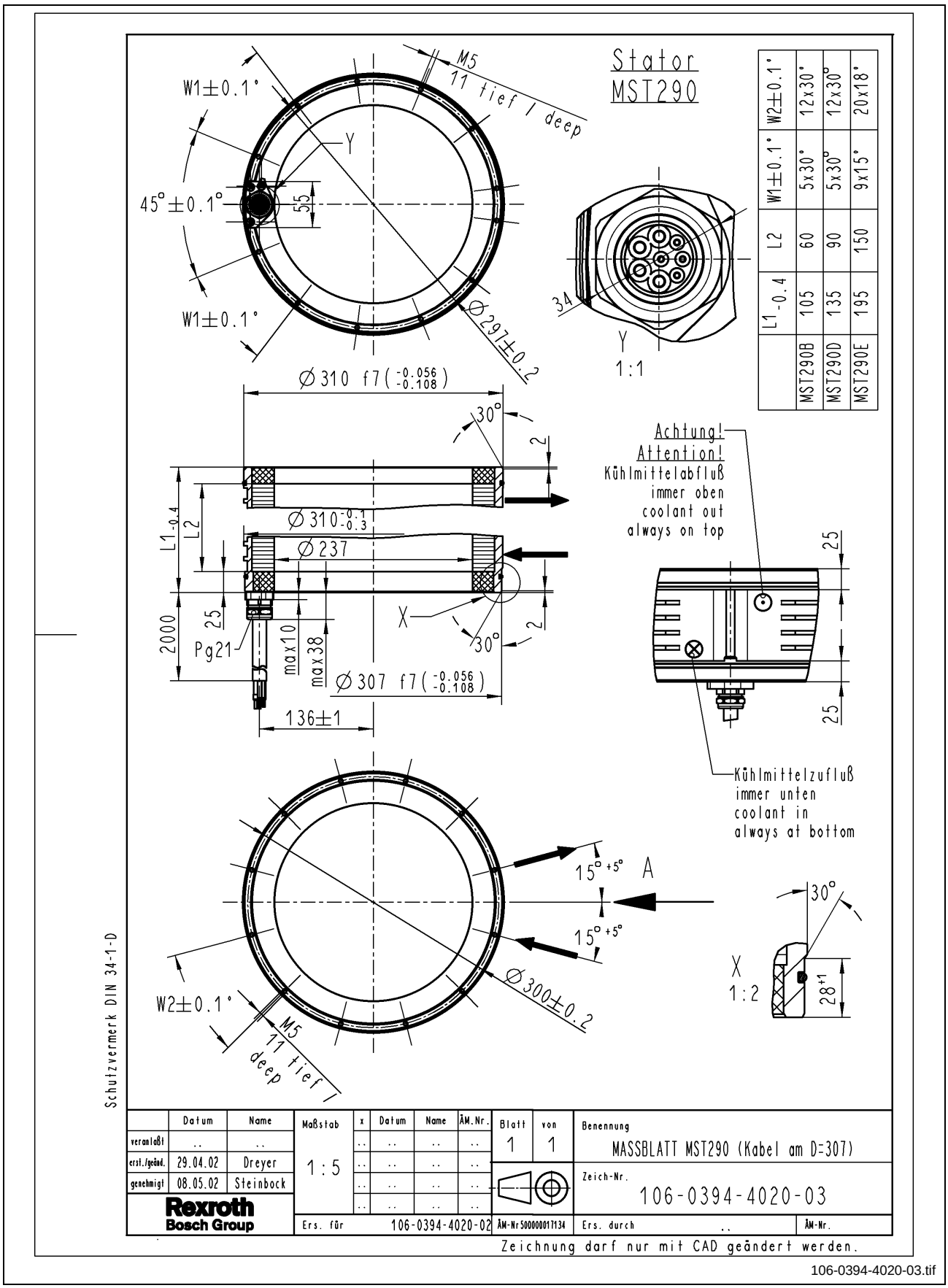


Fig. 5-31: Dimension sheet Rotor MRT290, mounted

Stator MST290, Electrical Connection "SN"

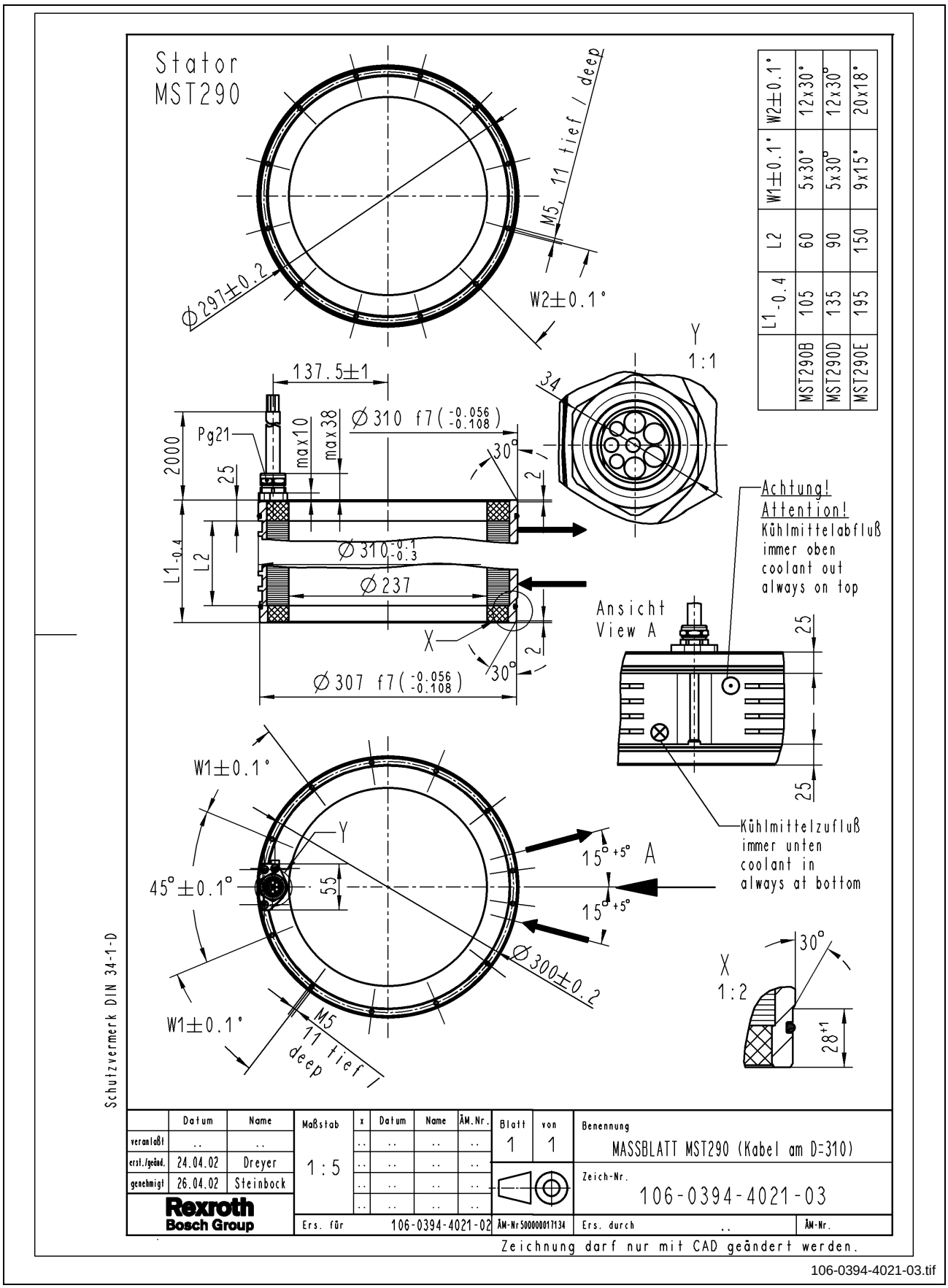


	L1-0.4	L2	W1±0.1°	W2±0.1°
MST290B	105	60	5x30°	12x30°
MST290D	135	90	5x30°	12x30°
MST290E	195	150	9x15°	20x18°

106-0394-4020-03.tif

Fig. 5-32: Dimension sheet MST290, electrical connection "SN"

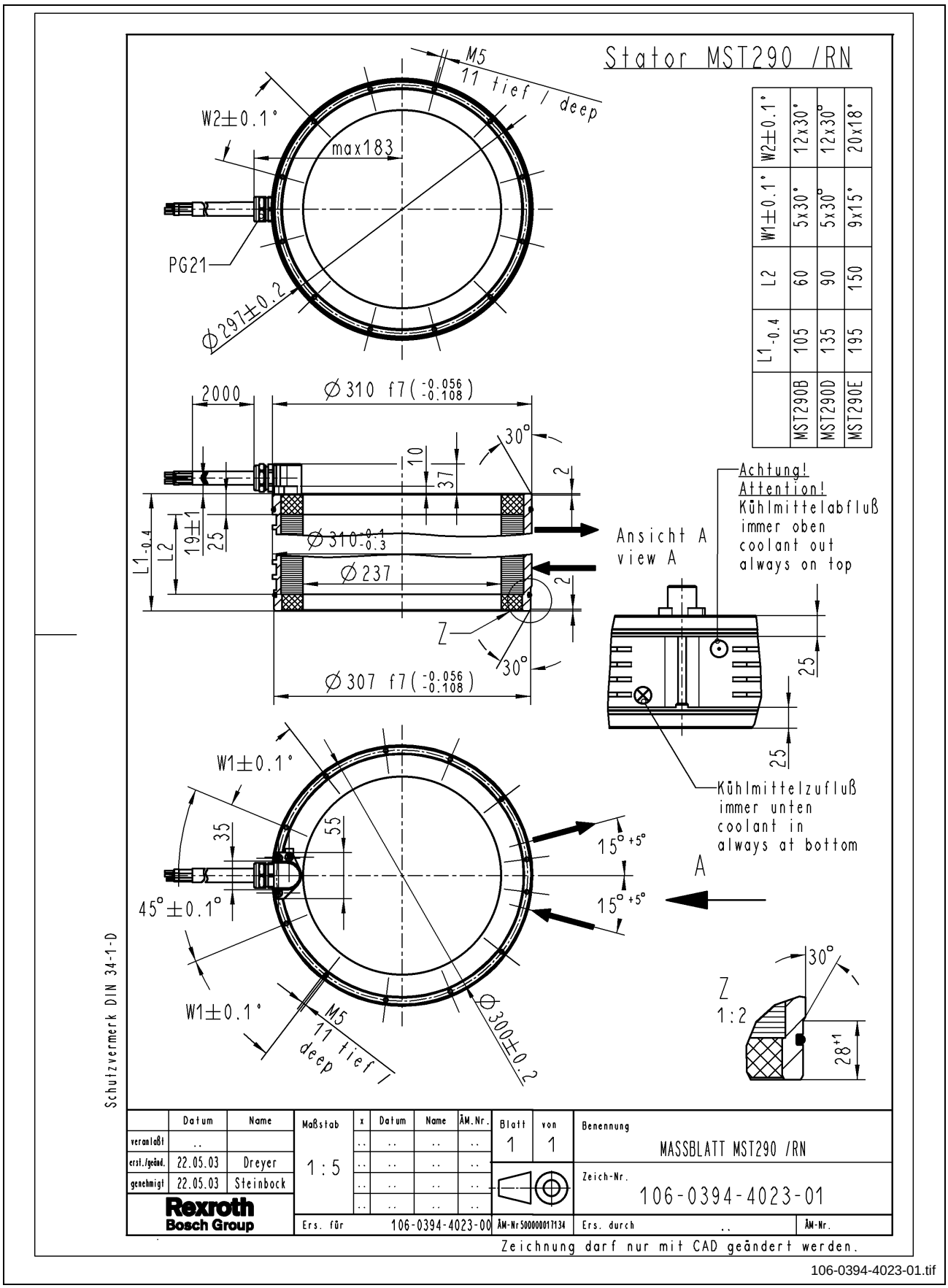
Stator MST290, Electrical Connection "CN"



106-0394-4021-03.tif

Fig. 5-33: Dimension sheet MST290, electrical connection "CN"

Stator MST290, Electrical Connection “RN”

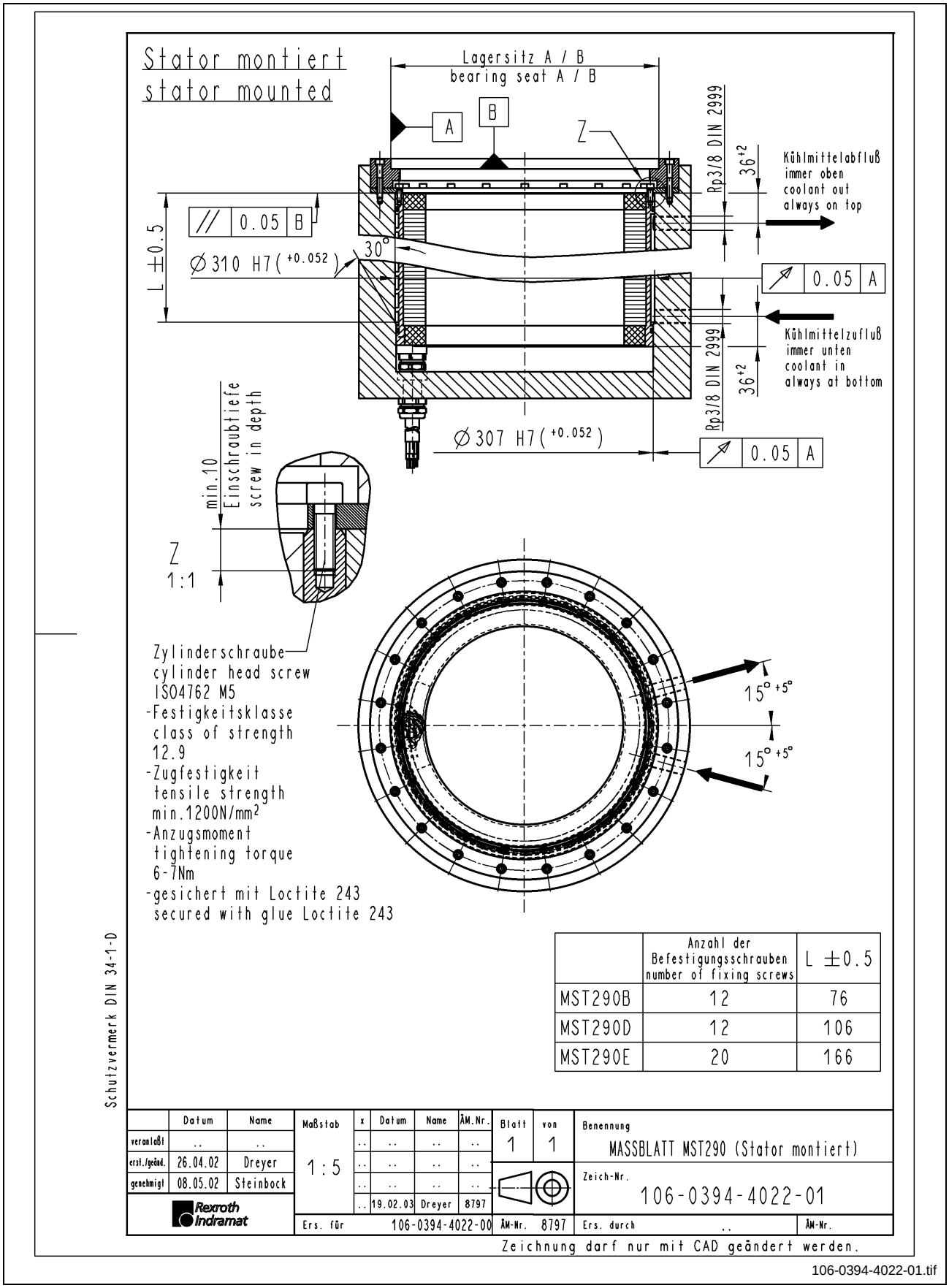


	L1 -0.4	L2	W1±0.1°	W2±0.1°
MST290B	105	60	5x30°	12x30°
MST290D	135	90	5x30°	12x30°
MST290E	195	150	9x15°	20x18°

106-0394-4023-01.tif

Fig. 5-34: Dimension sheet MST290, electrical connection “RN”

Stator, mounted



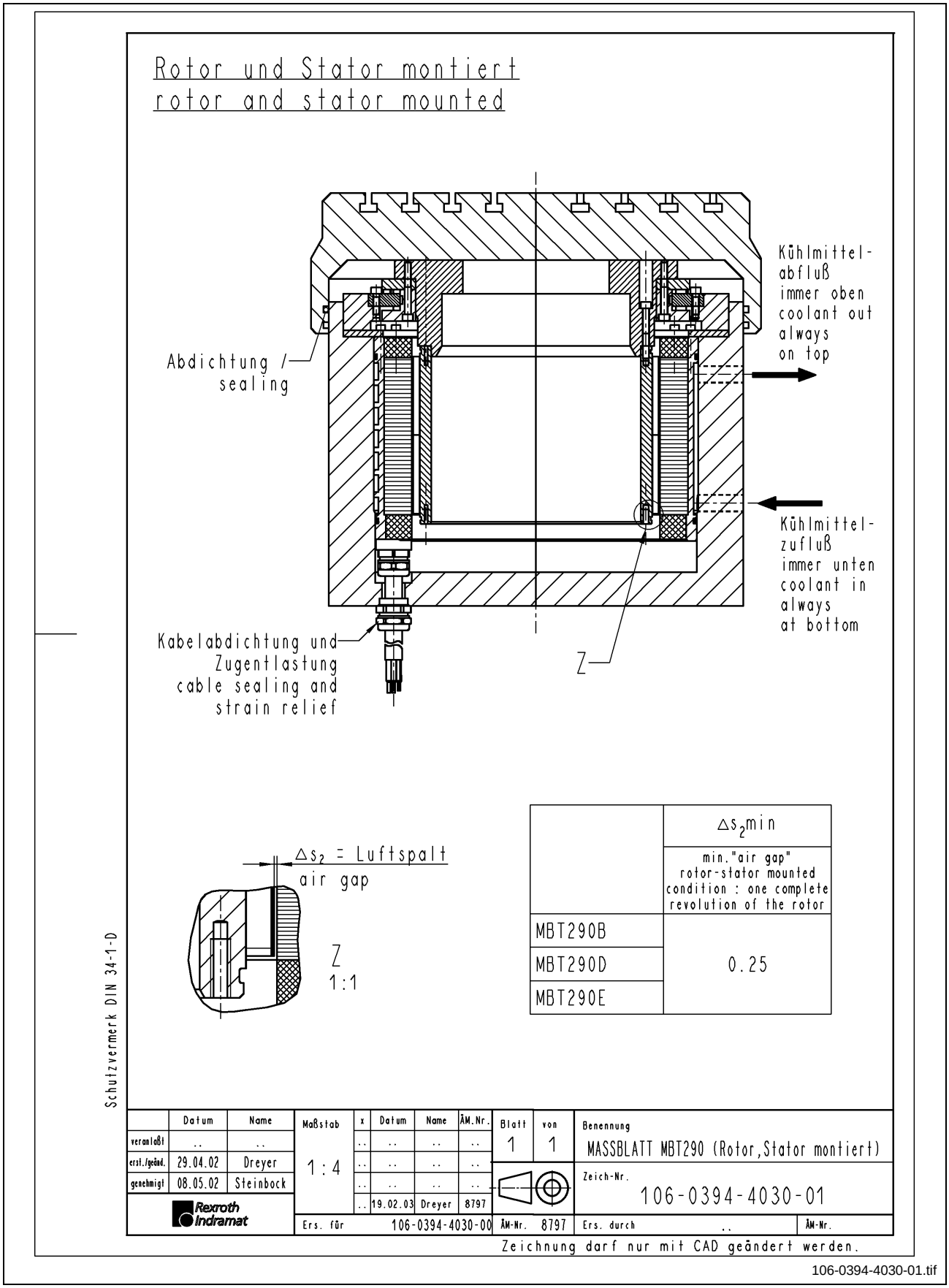
	Anzahl der Befestigungsschrauben number of fixing screws	L ±0.5
MST290B	12	76
MST290D	12	106
MST290E	20	166

	Datum	Name
veranlaßt	..	..
erst./geänd.	26.04.02	Dreyer
genehmigt	08.05.02	Steinbock

x	Datum	Name	ÄM.Nr.
..	..	..	..
..	..	..	..
..	..	..	..
..	19.02.03	Dreyer	8797

Fig. 5-35: Dimension sheet Stator MST290, mounted

Rotor and Stator, mounted

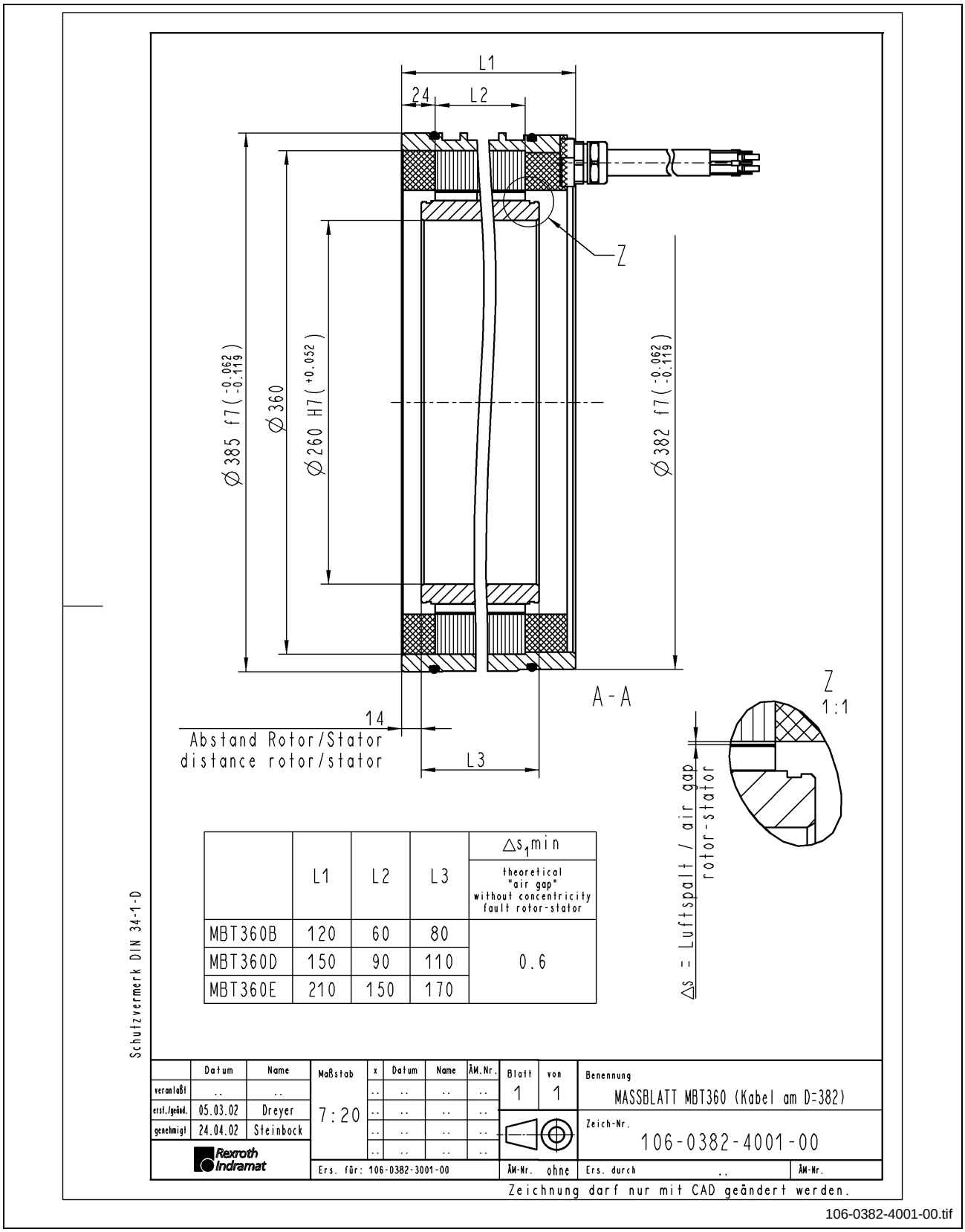


106-0394-4030-01.tif

Fig. 5-36: Dimension sheet size 290, Rotor and Stator, mounted

5.6 Dimension Sheets, Size 360

Electrical Connection "SN"

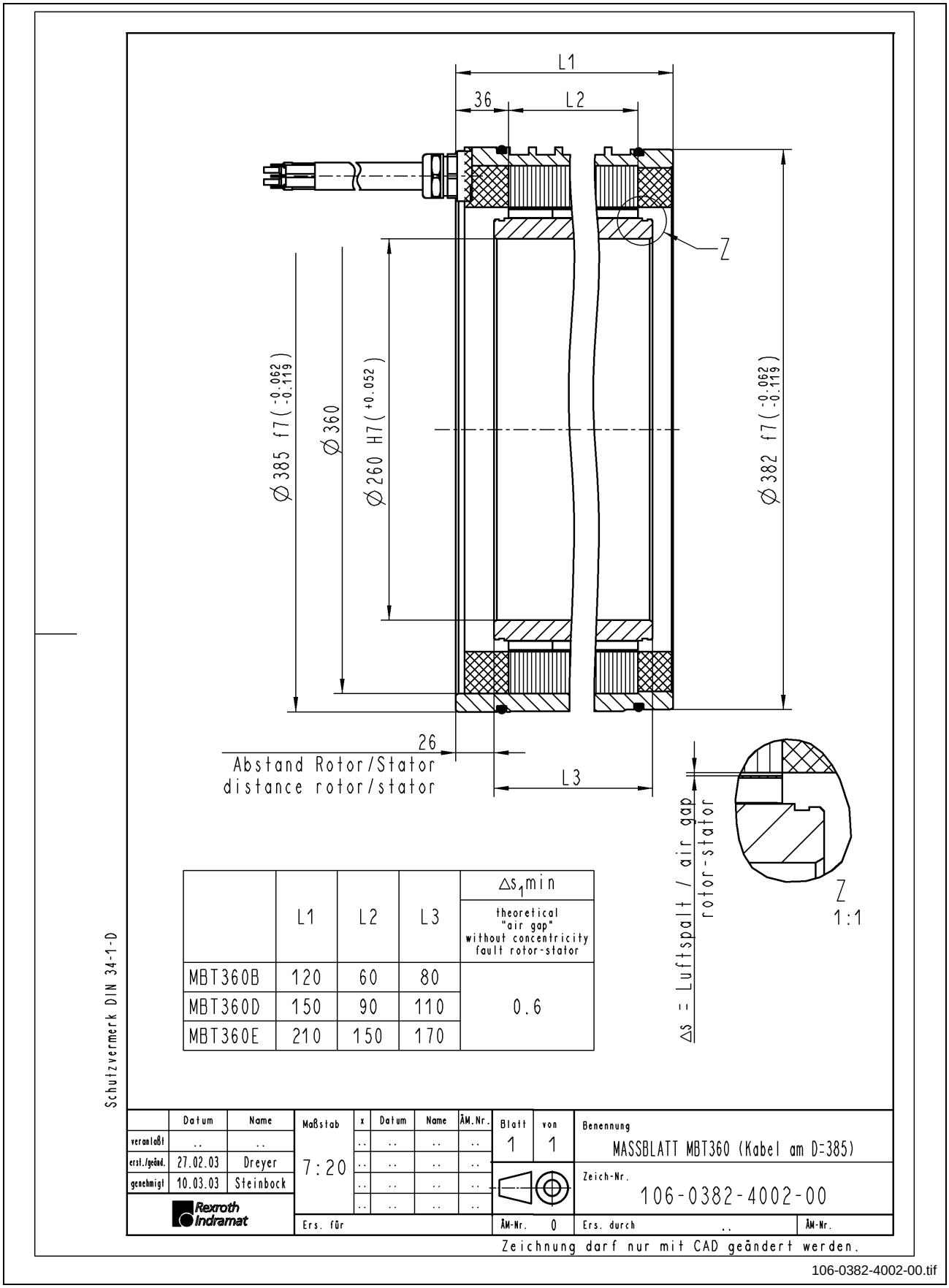


	L1	L2	L3	Δs1min theoretical "air gap" without concentricity fault rotor-stator
MBT360B	120	60	80	0.6
MBT360D	150	90	110	
MBT360E	210	150	170	

106-0382-4001-00.tif

Fig. 5-37: Dimension sheet size 360, electrical connection "SN"

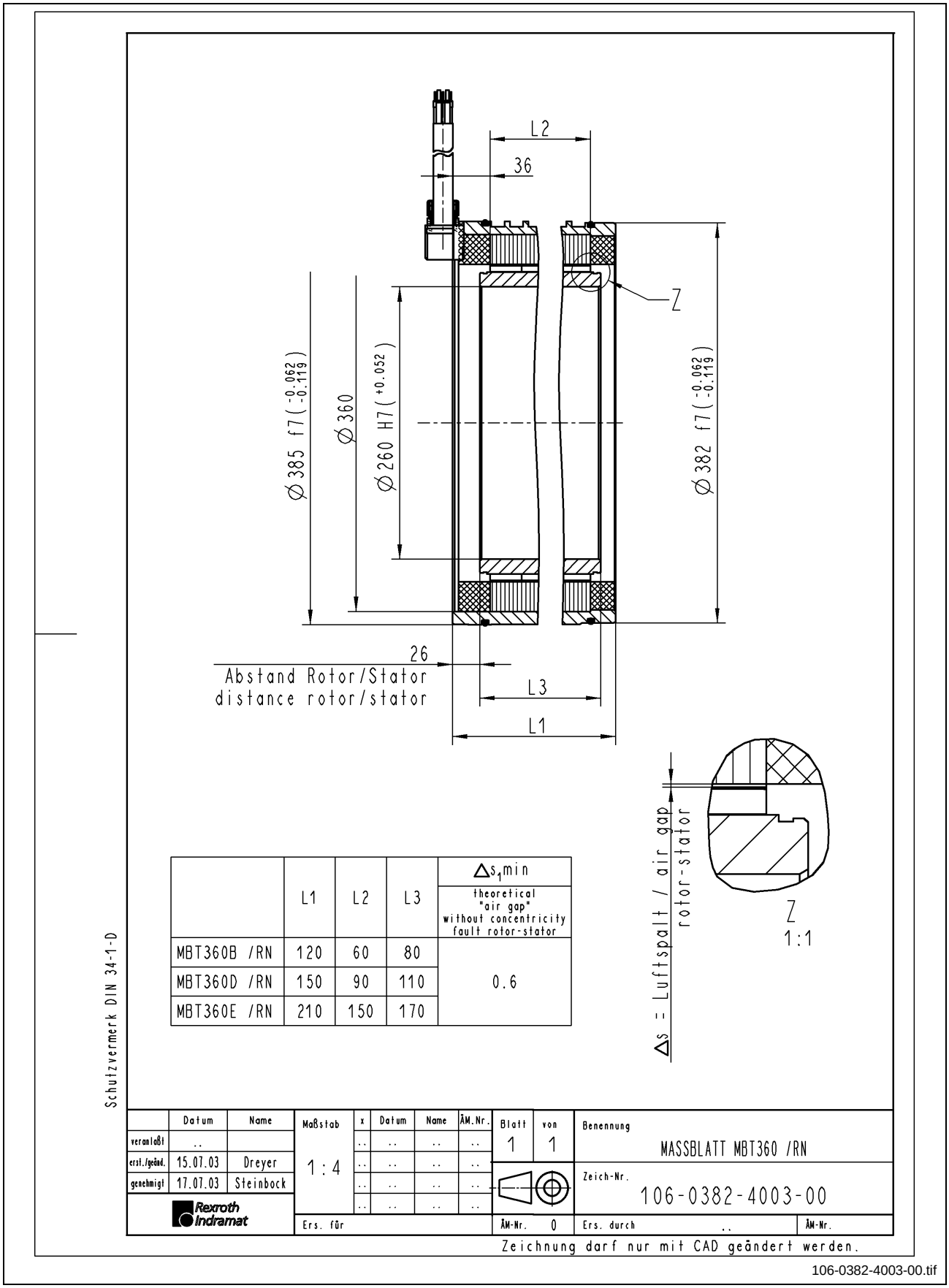
Electrical Connection "CN"



	L1	L2	L3	Δs1 min theoretical "air gap" without concentricity fault rotor-stator
MBT360B	120	60	80	0.6
MBT360D	150	90	110	
MBT360E	210	150	170	

Fig. 5-38: Dimension sheet size 360, electrical connection "CN"

Electrical Connection "RN"

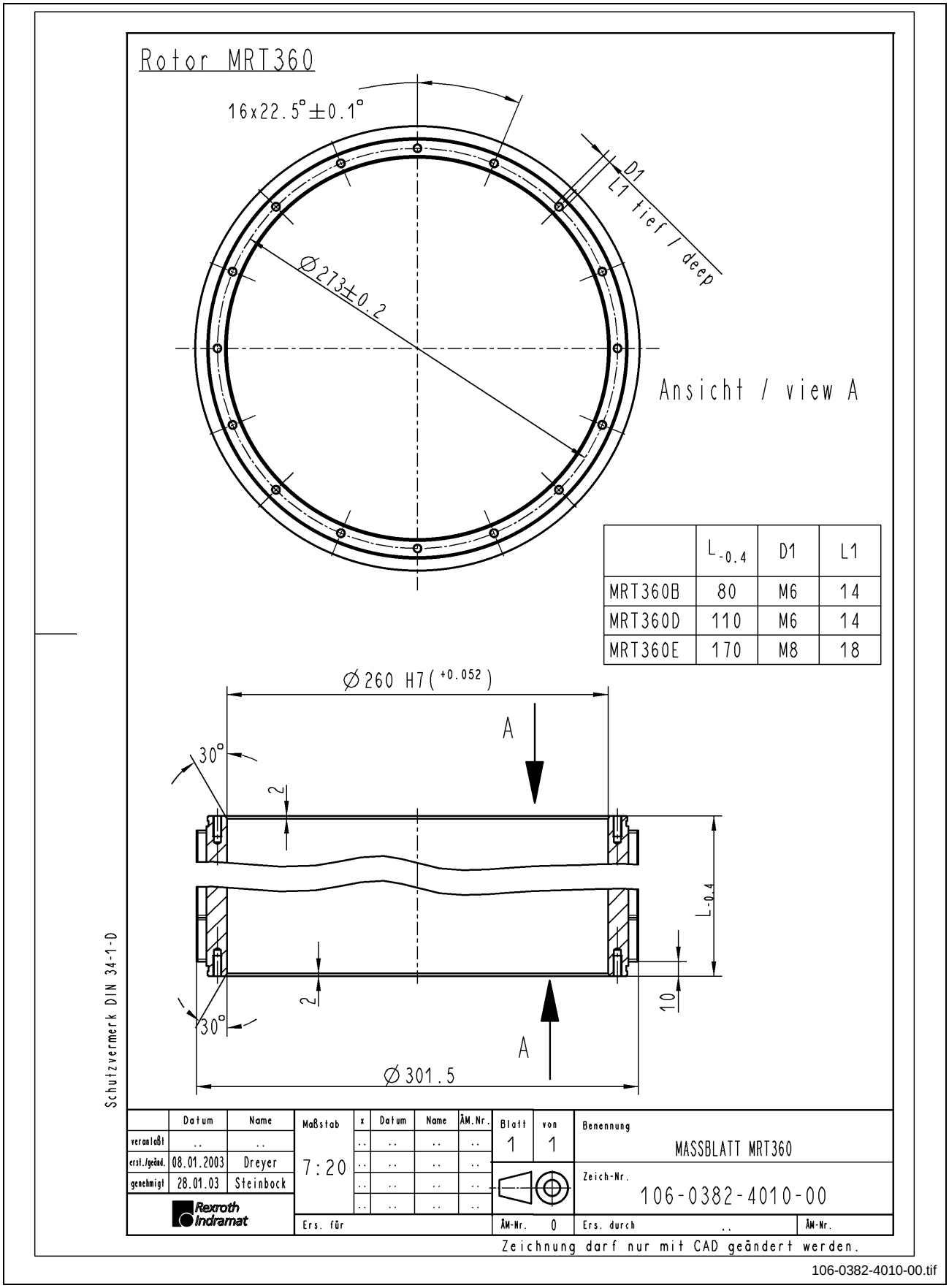


	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT360B /RN	120	60	80	0.6
MBT360D /RN	150	90	110	
MBT360E /RN	210	150	170	

106-0382-4003-00.tif

Fig. 5-39: Dimension sheet size 360, electrical connection "RN"

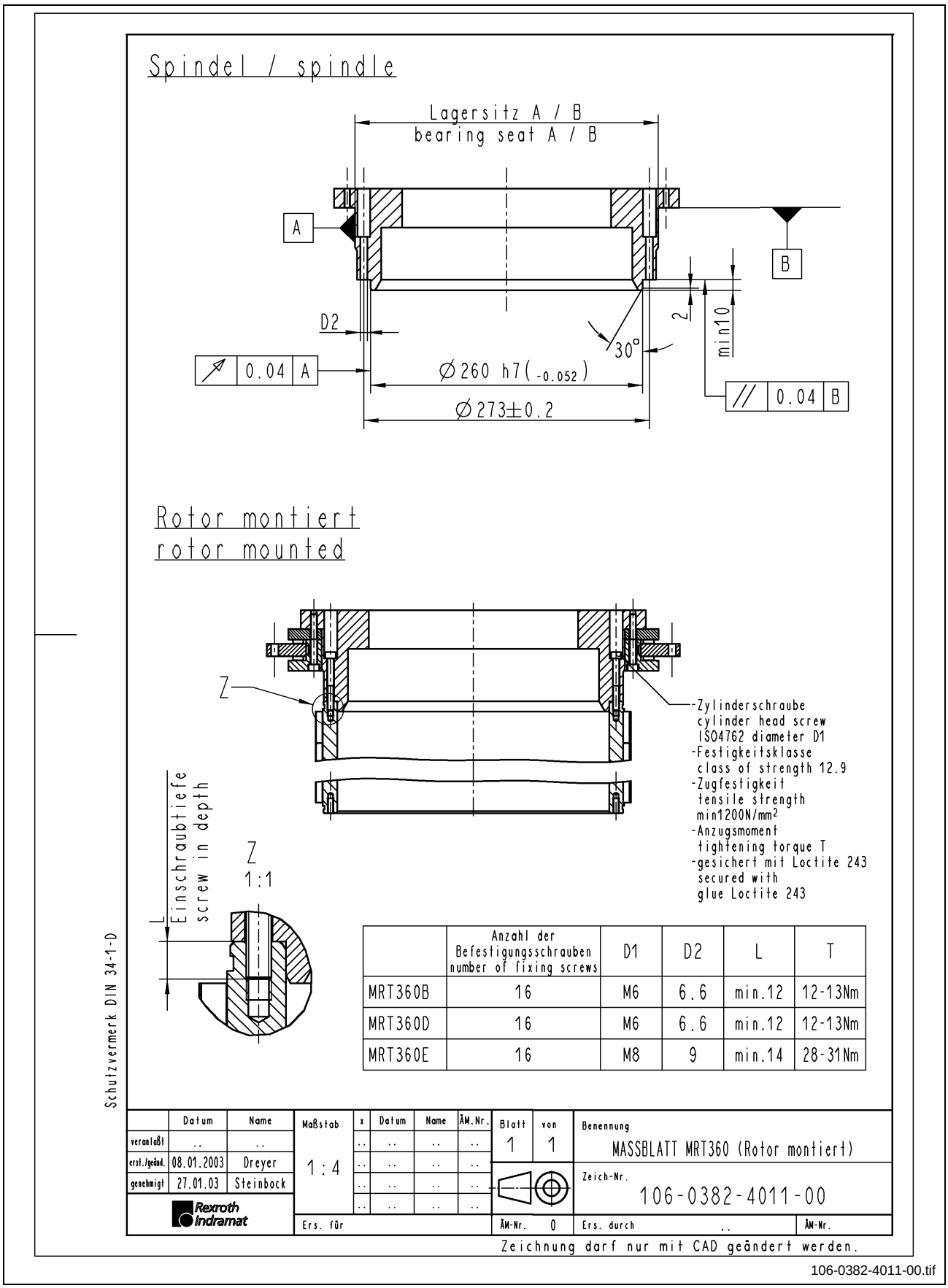
Rotor MRT360



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

Fig. 5-40: Dimension sheet MRT360

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

	Datum	Name
veranlaßt	..	..
erst./geänd.	08.01.2003	Dreyer
genehmigt	27.01.03	Steinbock

Rexroth Indramat

Maßstab 1:4

x	Datum	Name	ÄM.Nr.
..	..	..	..
..	..	..	..
..	..	..	..
..	..	..	..

Ers. für

Blatt 1 von 1

ÄM-Nr. 0

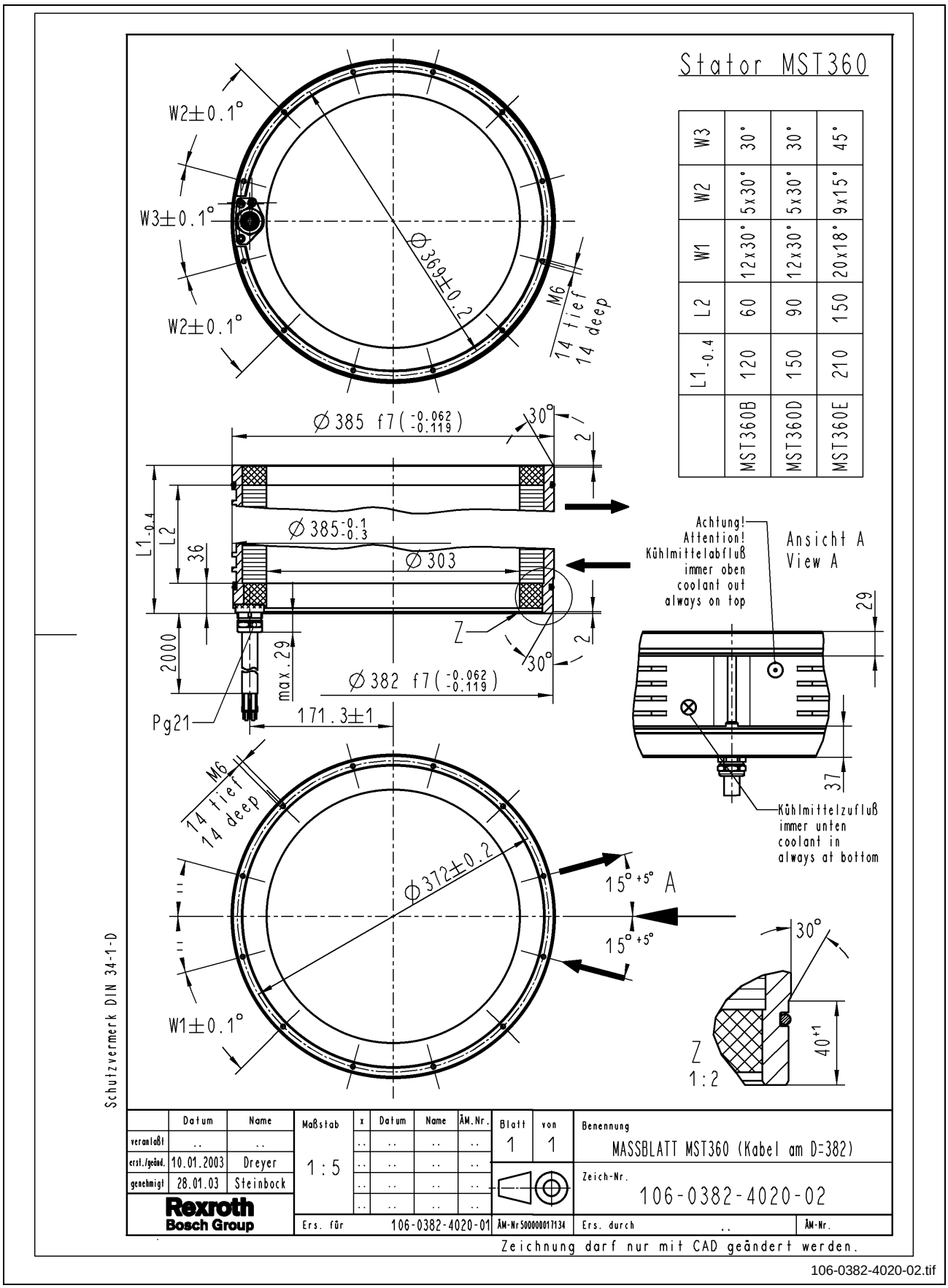
Benennung: MASSBLATT MRT360 (Rotor montiert)

Zeich-Nr.: 106-0382-4011-00

Ers. durch .. ÄM-Nr.

Fig. 5-41: Dimension sheet Rotor MRT360, mounted

Stator MST360, Electrical Connection "SN"



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

	Datum	Name
veranlaßt	..	..
erst./geänd.	10.01.2003	Dreyer
genehmigt	28.01.03	Steinbock

Rexroth Bosch Group

Maßstab 1:5

x	Datum	Name	ÄM.Nr.
..	..	..	..
..	..	..	..
..	..	..	..
..	..	..	..

Ers. für 106-0382-4020-01

Blatt 1 von 1

ÄM-Nr 500000017134

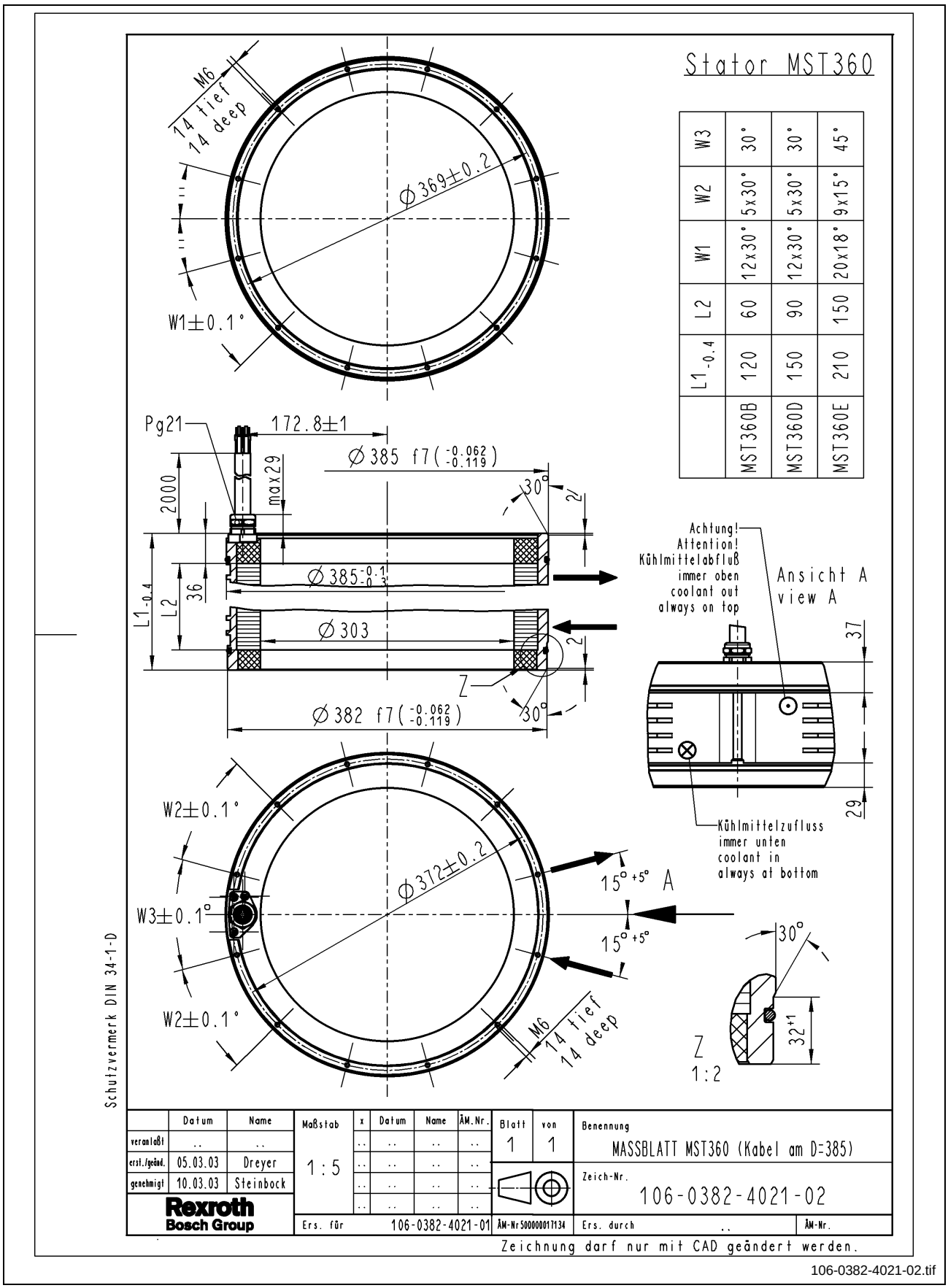
Benennung: MASSBLATT MST360 (Kabel am D=382)

Zeich-Nr.: 106-0382-4020-02

Ers. durch .. ÄM-Nr.

Fig. 5-42: Dimension sheet Stator MST360, electrical connection "SN"

Stator MST360, Electrical Connection "CN"

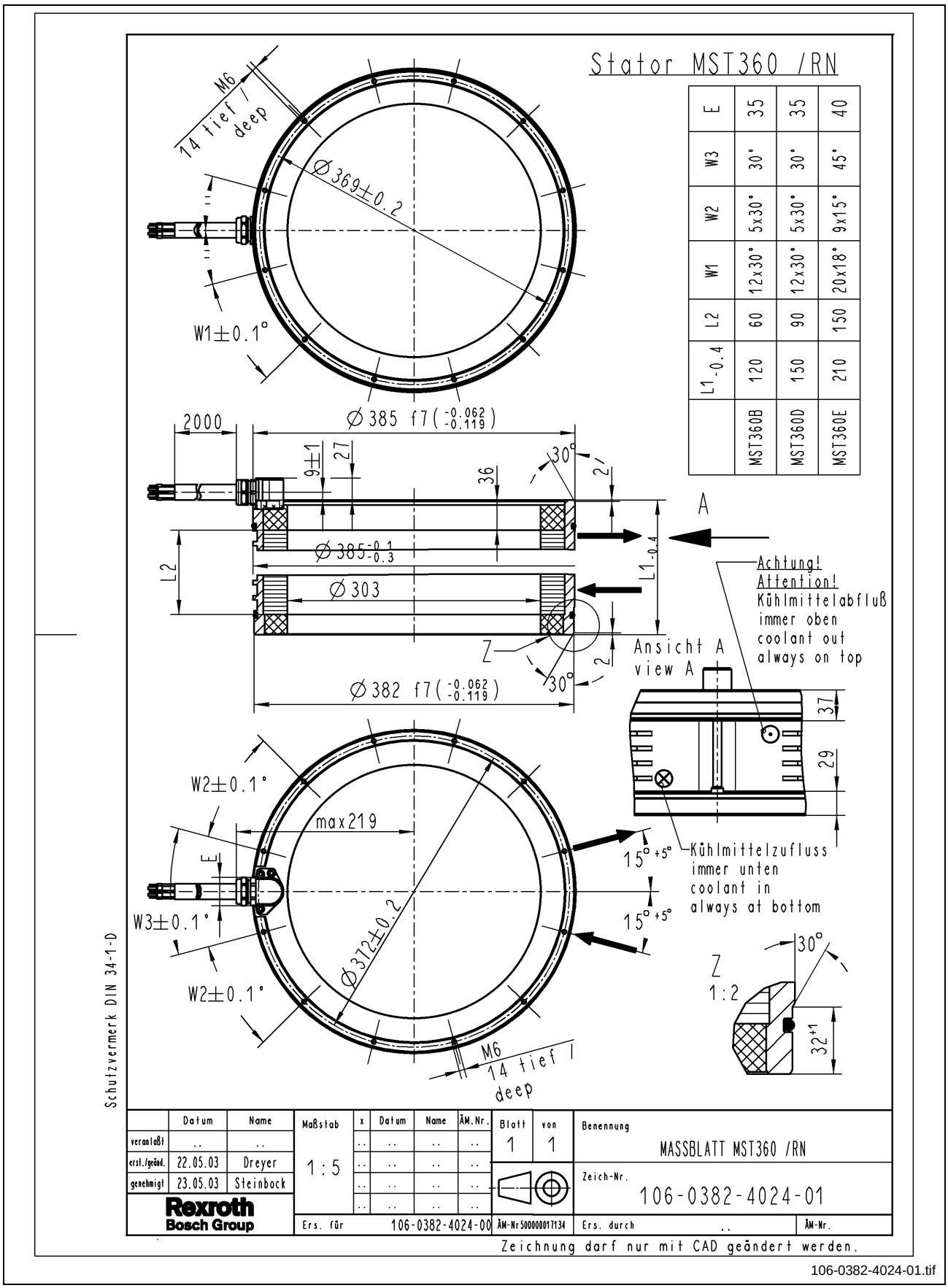


	L1 -0.4	L2	W1	W2	W3
MST360B	120	60	12x30°	5x30°	30°
MST360D	150	90	12x30°	5x30°	30°
MST360E	210	150	20x18°	9x15°	45°

106-0382-4021-02.tif

Fig. 5-43: Dimension sheet Stator MST360, electrical connection "CN"

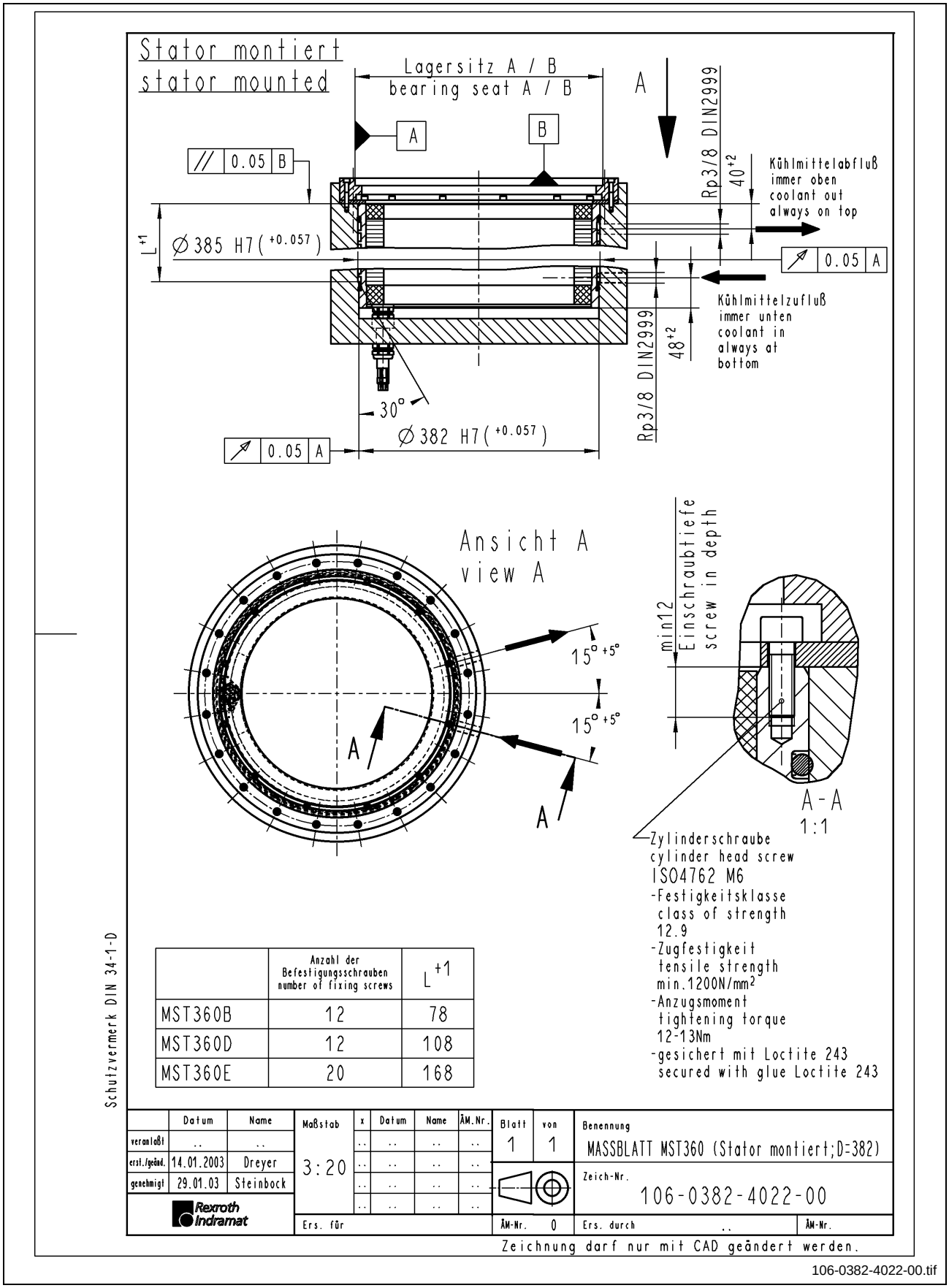
Stator MST360, Electrical Connection "RN"



106-0382-4024-01.tif

Fig. 5-44: Dimension sheet MST360, electrical connection “RN”

Stator MST360, Electrical Connection "SN", mounted

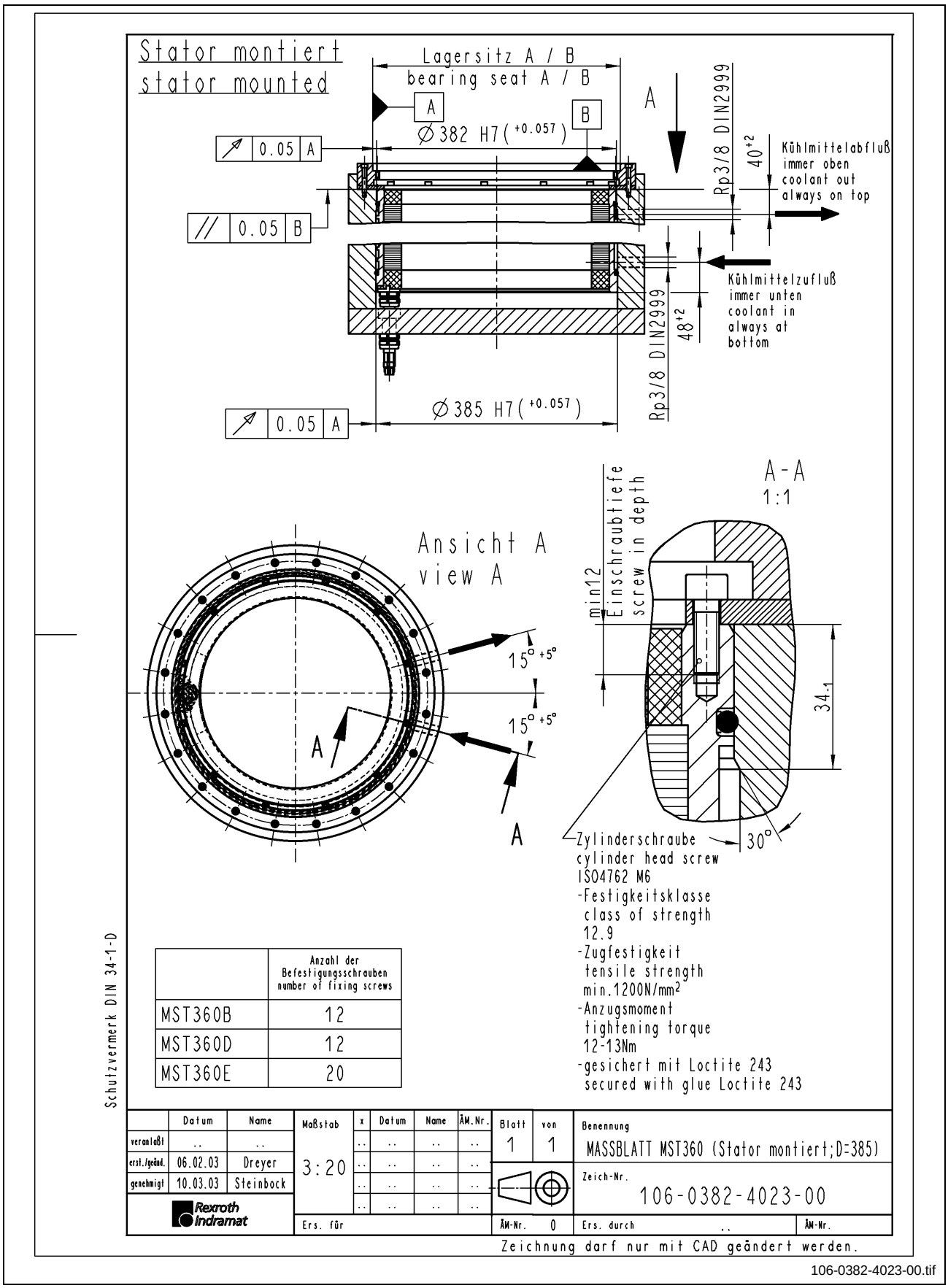


	Anzahl der Befestigungsschrauben number of fixing screws	L^{+1}
MST360B	12	78
MST360D	12	108
MST360E	20	168

106-0382-4022-00.tif

Fig. 5-45: Dimension sheet MBT360, electrical connection "SN", mounted

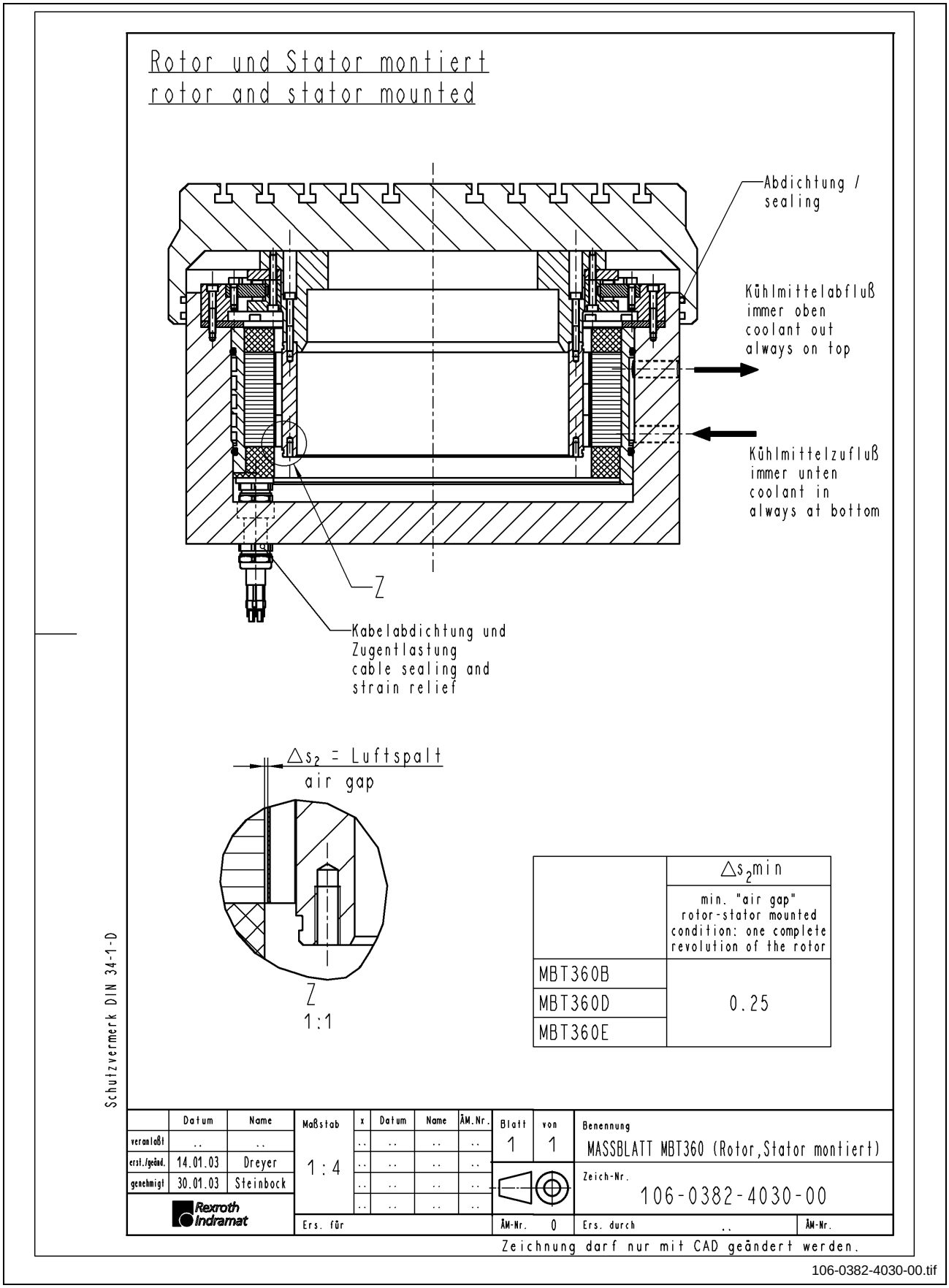
Stator MST360, Electrical Connection "CN", mounted



106-0382-4023-00.tif

Fig. 5-46: Dimension sheet MBT360, electrical connection "CN", mounted

Rotor and Stator, mounted

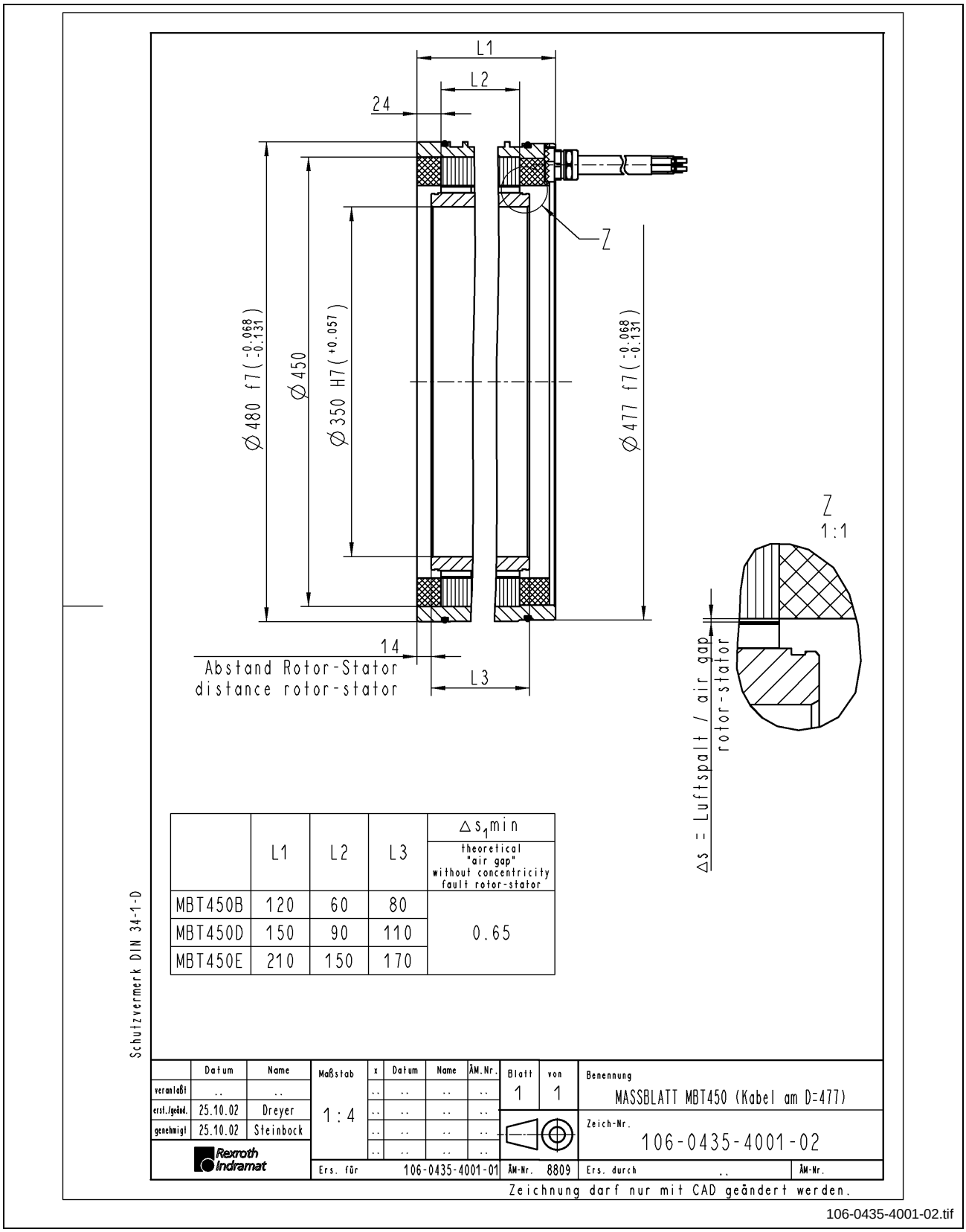


106-0382-4030-00.tif

Fig. 5-47: Dimension sheet size 360, Rotor and Stator, mounted

5.7 Dimension Sheets, Size 450

Electrical Connection "SN"



	L1	L2	L3	Δs1min theoretical "air gap" without concentricity fault rotor-stator
MBT450B	120	60	80	0.65
MBT450D	150	90	110	
MBT450E	210	150	170	

	Datum	Name
veranlaßt	..	..
erst./geänd.	25.10.02	Dreyer
genehmigt	25.10.02	Steinbock

Maßstab 1 : 4 | Blatt 1 | von 1 | ÄM.Nr. 8809

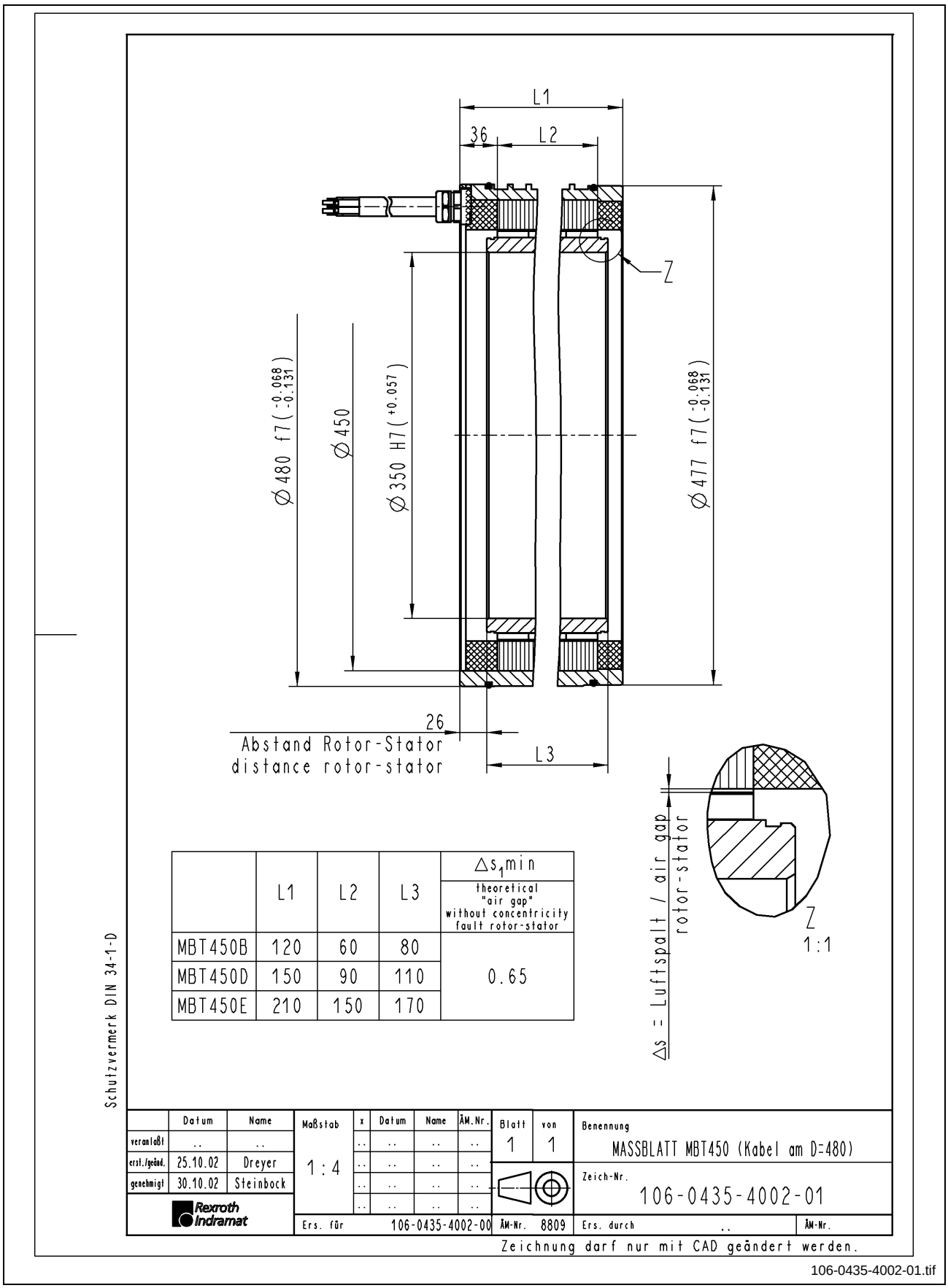
Benennung: MASSBLATT MBT450 (Kabel am D=477)

Zeich-Nr.: 106-0435-4001-02

Ers. für 106-0435-4001-01 | Ers. durch .. | ÄM-Nr.

Fig. 5-48: Dimension sheet size 450, electrical connection "SN"

Electrical Connection "CN"

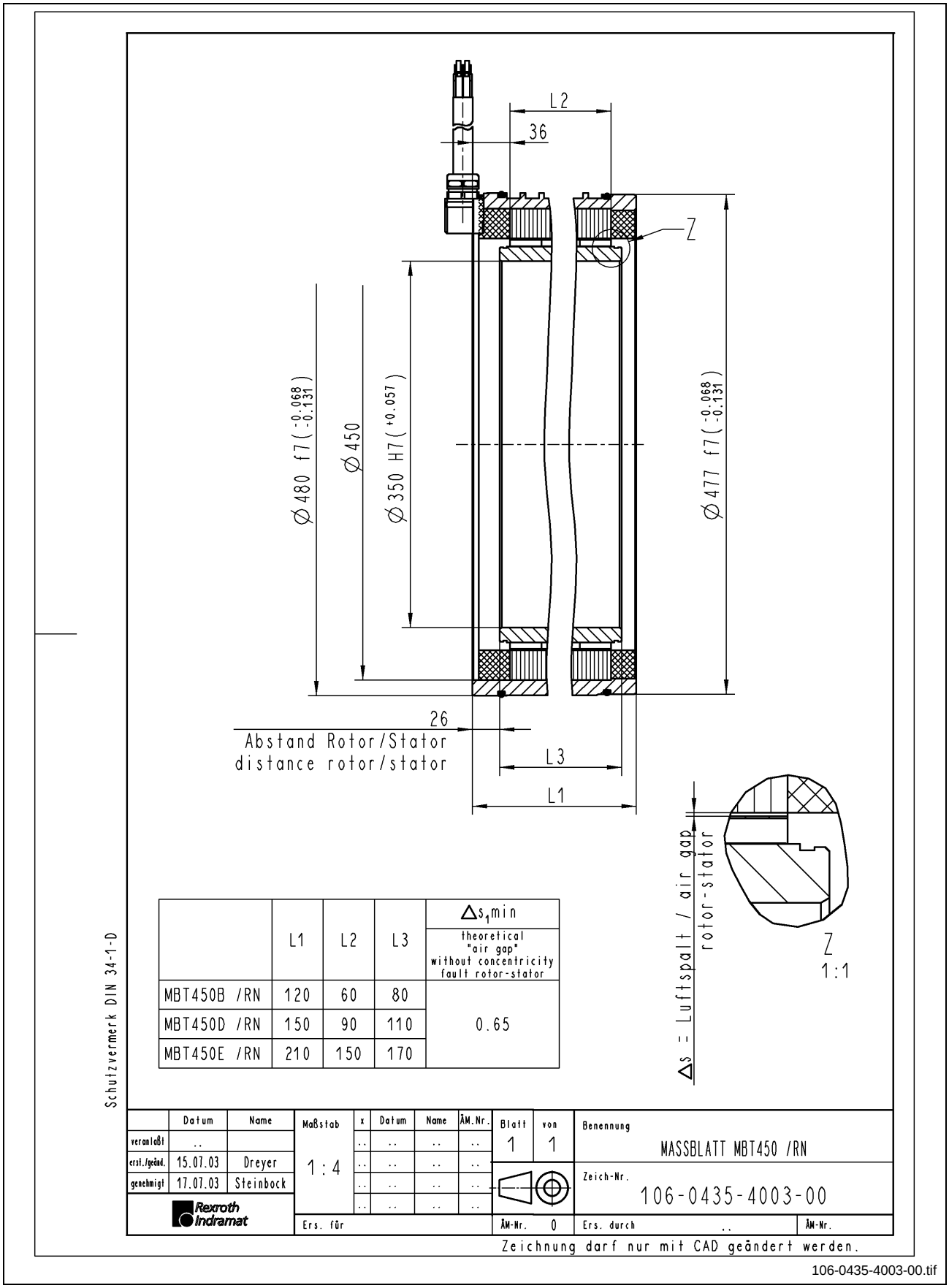


	L1	L2	L3	$\Delta s_1 min$ theoretical "air gap" without concentricity fault rotor-stator
MBT450B	120	60	80	0.65
MBT450D	150	90	110	
MBT450E	210	150	170	

106-0435-4002-01.tif

Fig. 5-49: Dimension sheet size 450, electrical connection "CN"

Electrical Connection "RN"

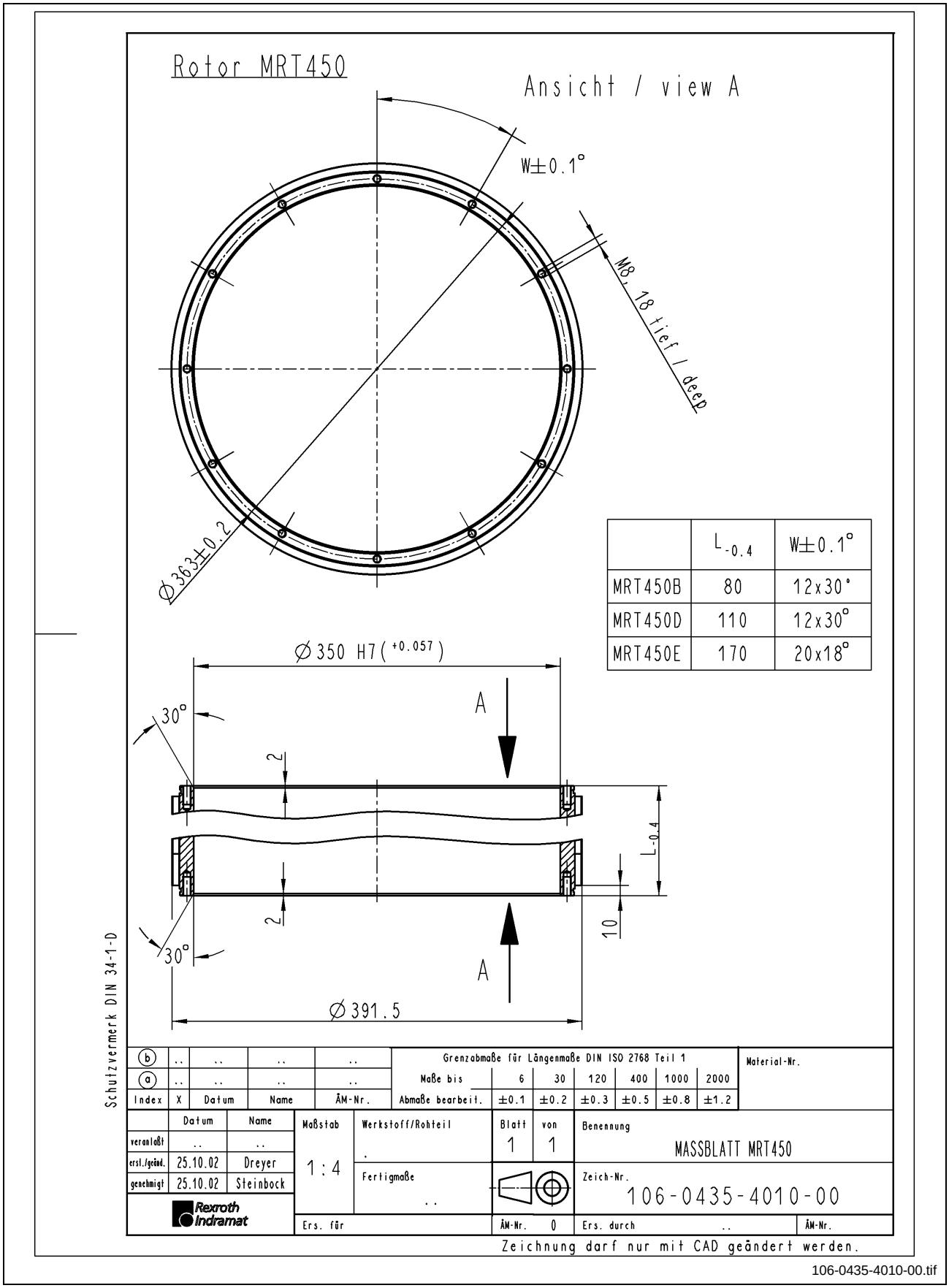


	L1	L2	L3	Δs_1 min theoretical "air gap" without concentricity fault rotor-stator
MBT450B /RN	120	60	80	0.65
MBT450D /RN	150	90	110	
MBT450E /RN	210	150	170	

106-0435-4003-00.tif

Fig. 5-50: Dimension sheet size 450, electrical connection "RN"

Rotor MRT450

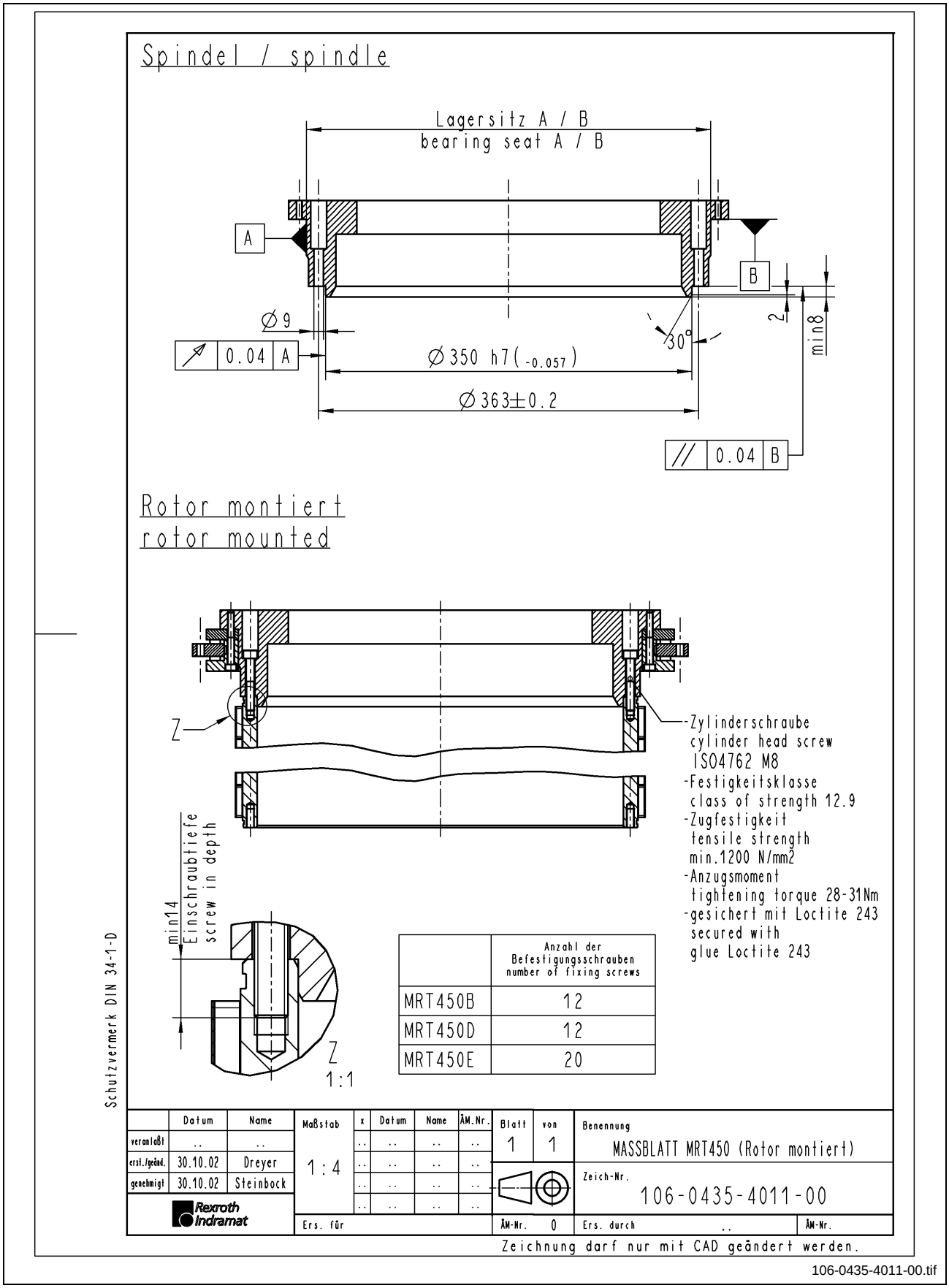


	$L_{-0.4}$	W±0.1°
MRT450B	80	12x30°
MRT450D	110	12x30°
MRT450E	170	20x18°

106-0435-4010-00.tif

Fig. 5-51: Dimension sheet MRT450

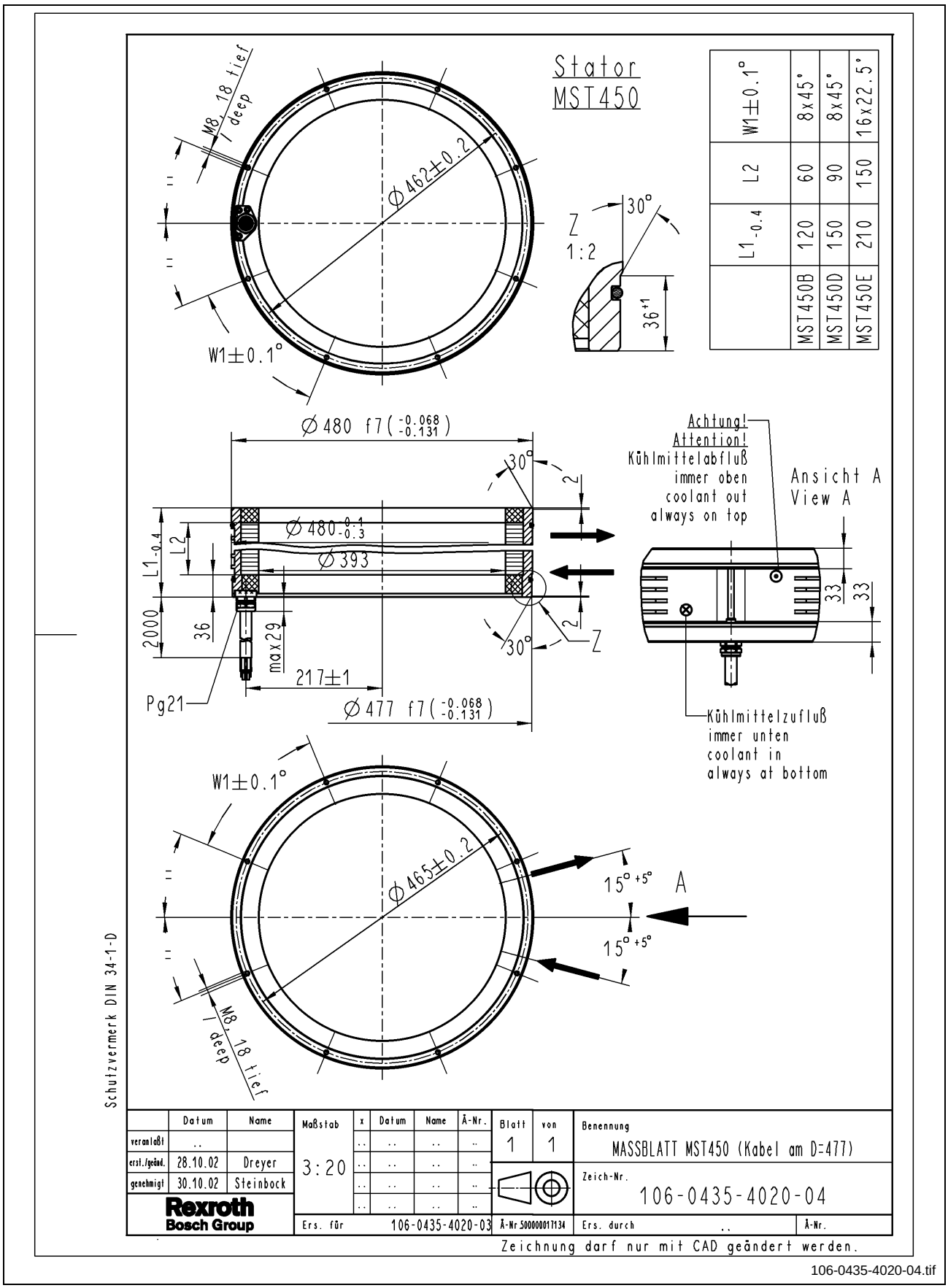
Rotor MRT450, mounted



106-0435-4011-00.tif

Fig. 5-52: Dimension sheet Rotor MRT450, mounted

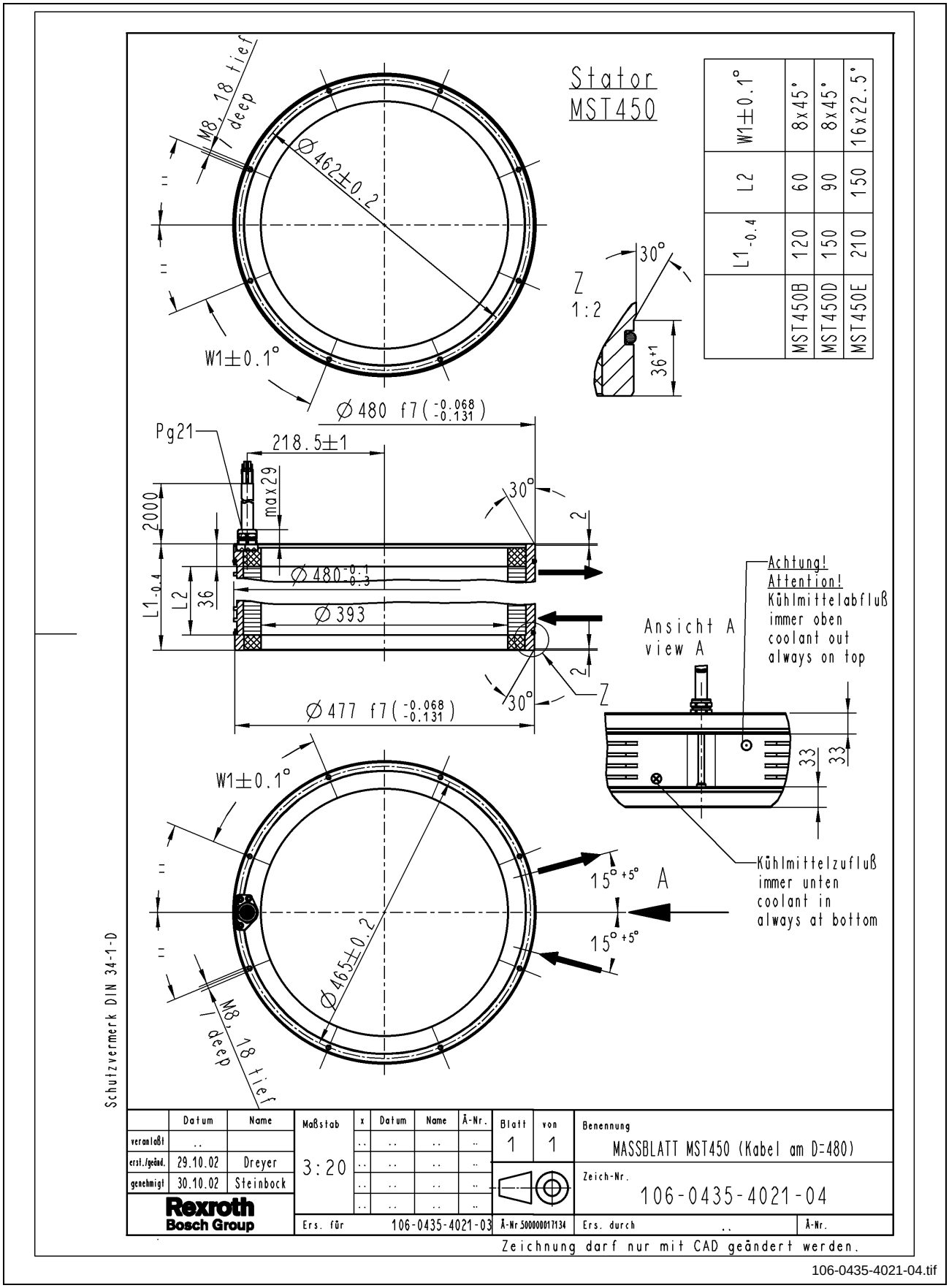
Stator MST450, Electrical Connection "SN"



106-0435-4020-04.tif

Fig. 5-53: Dimension sheet MST450, electrical connection "SN"

Stator MST450, Electrical Connection "CN"



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

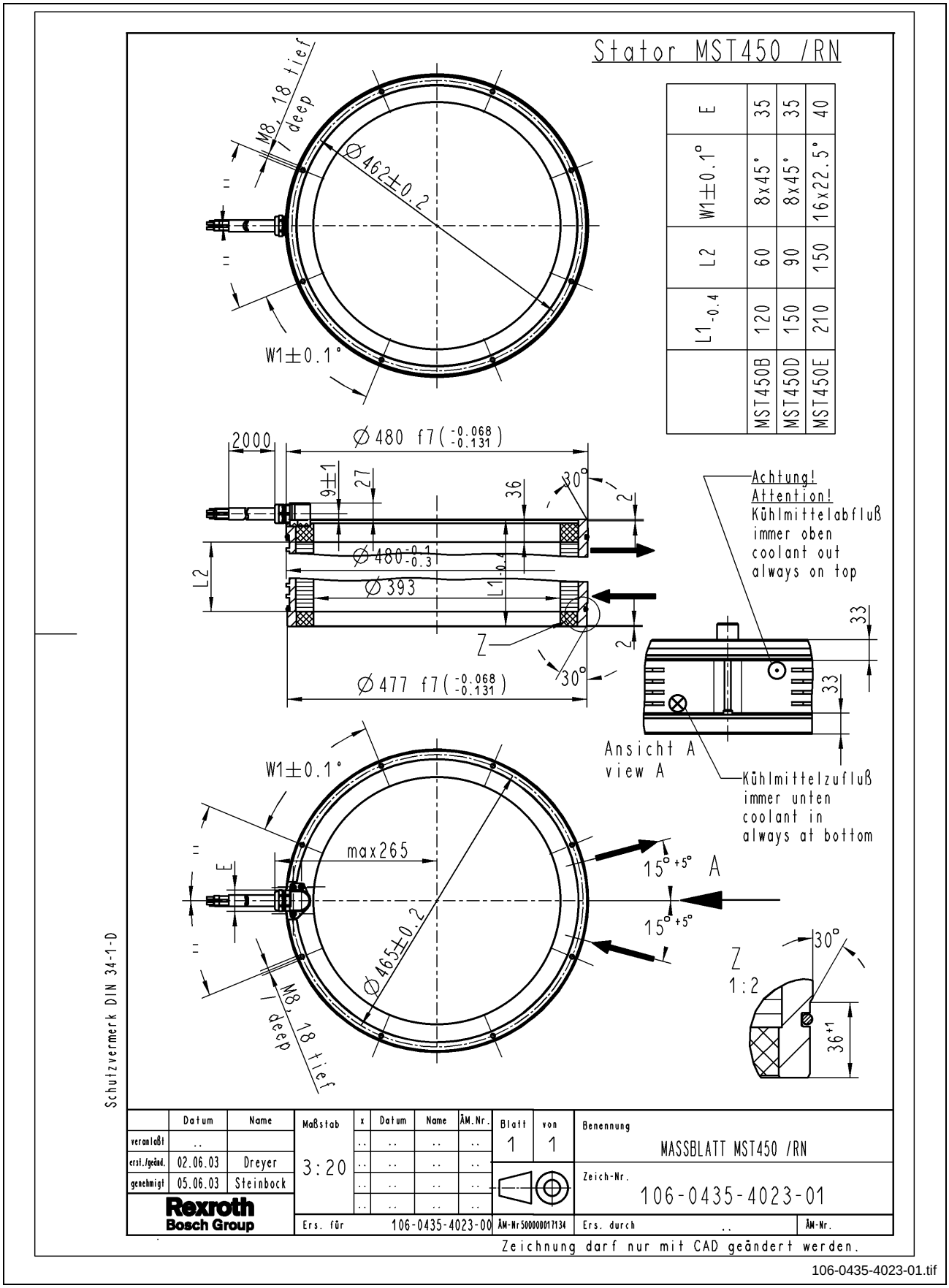
	Datum	Name
veranlaßt	..	
erst./geänd.	29.10.02	Dreyer
genehmigt	30.10.02	Steinbock

Rexroth Bosch Group

106-0435-4021-04.tif

Fig. 5-54: Dimension sheet MST450, electrical connection "CN"

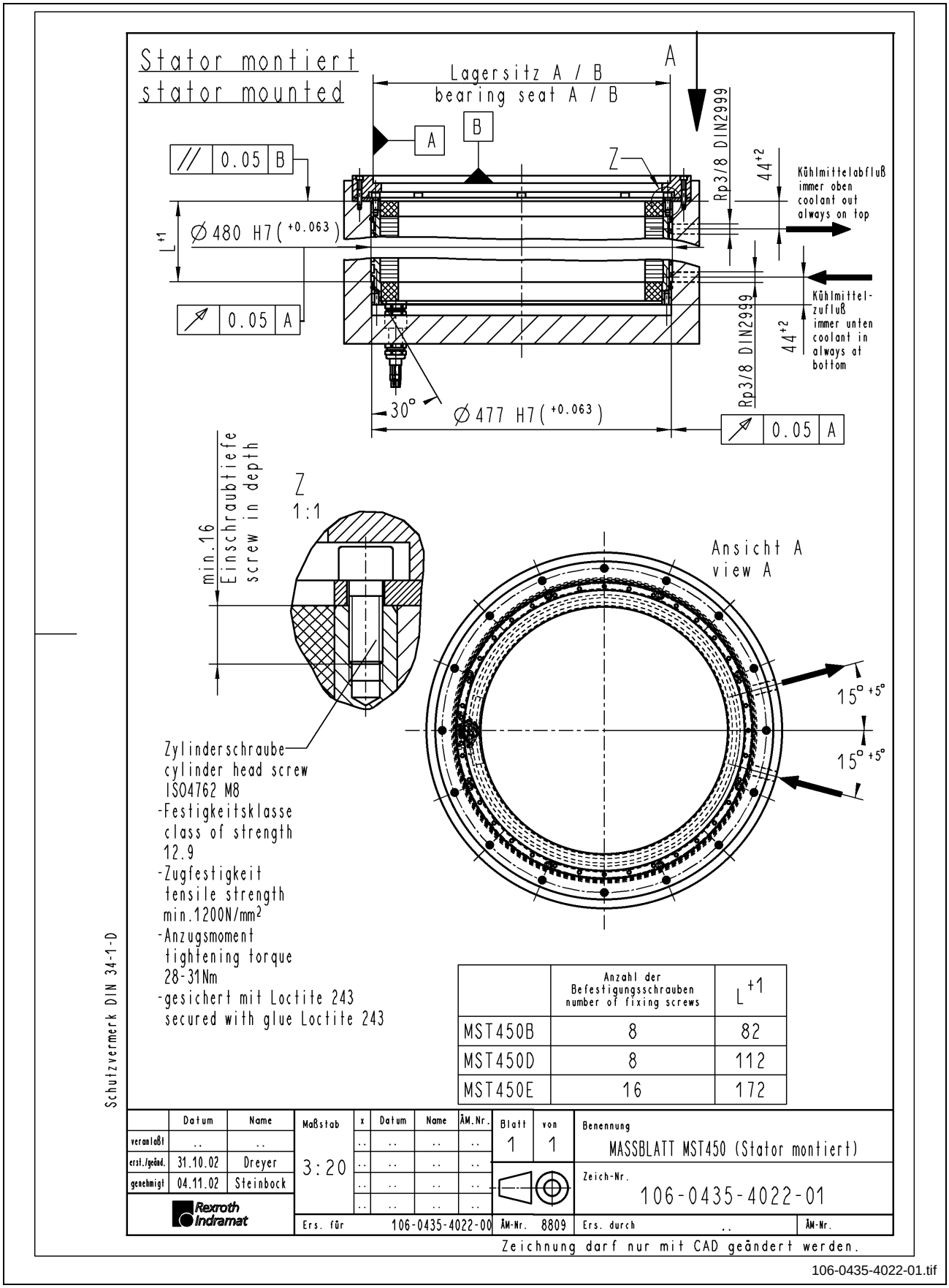
Stator MST450, Electrical Connection "RN"



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

Fig. 5-55: Dimension sheet MST450, electrical connection "RN"

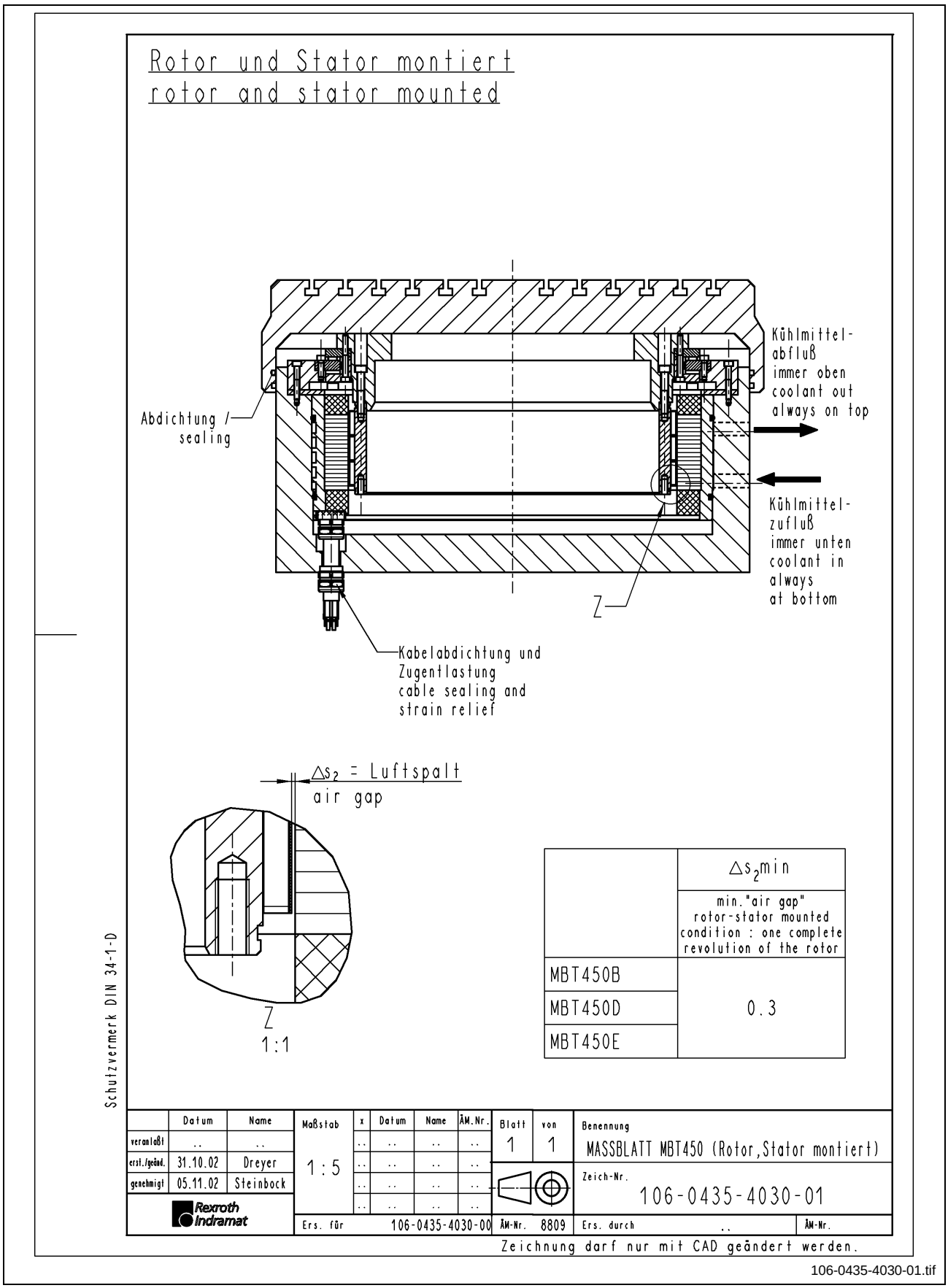
Stator MST450, mounted



	Anzahl der Befestigungsschrauben number of fixing screws	L+1
MST450B	8	82
MST450D	8	112
MST450E	16	172

Fig. 5-56: Dimension sheet Stator MST450, mounted

Rotor and Stator, mounted

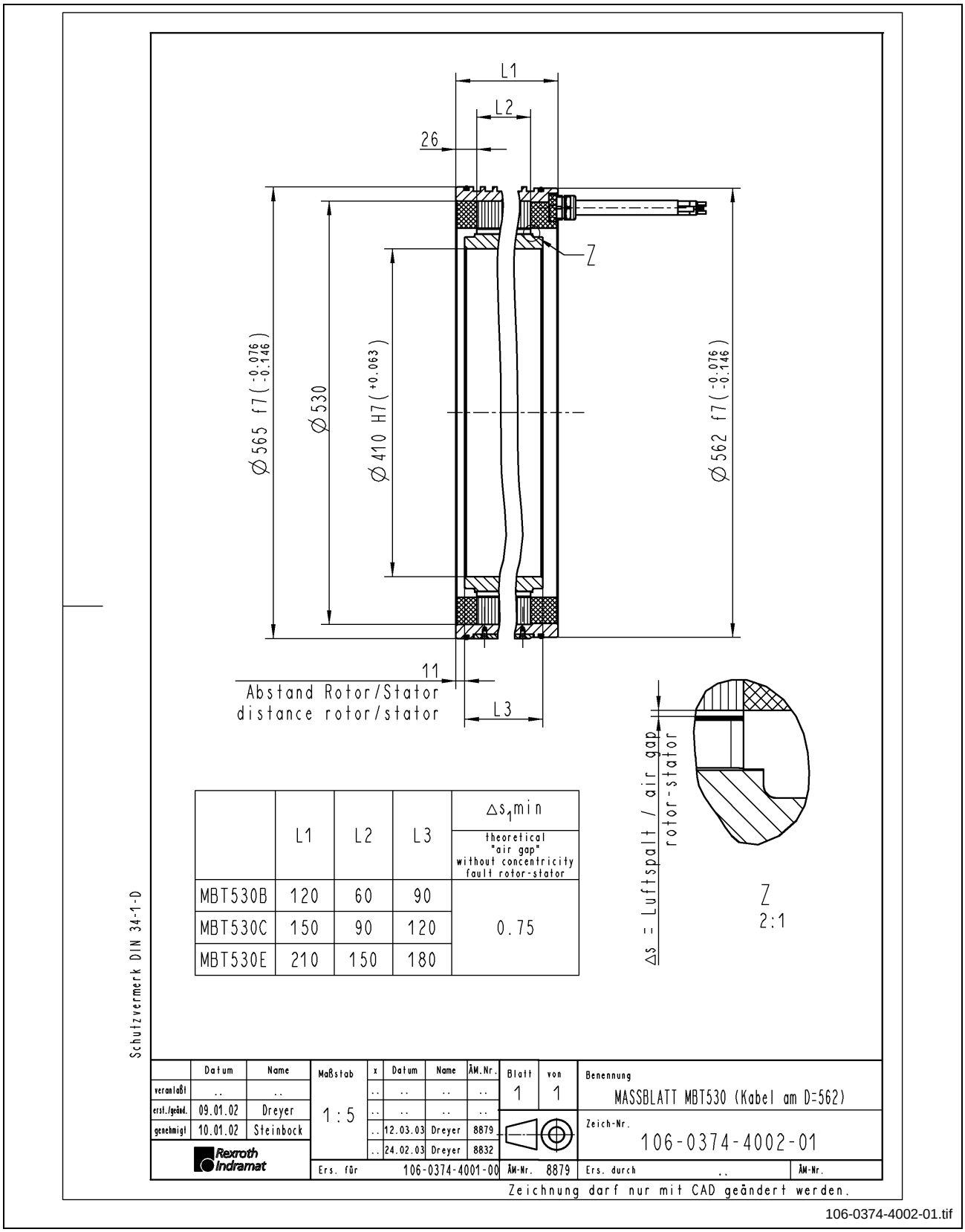


106-0435-4030-01.tif

Fig. 5-57: Dimension sheet size 450, Rotor and Stator, mounted

Dimension Sheets, Size 530

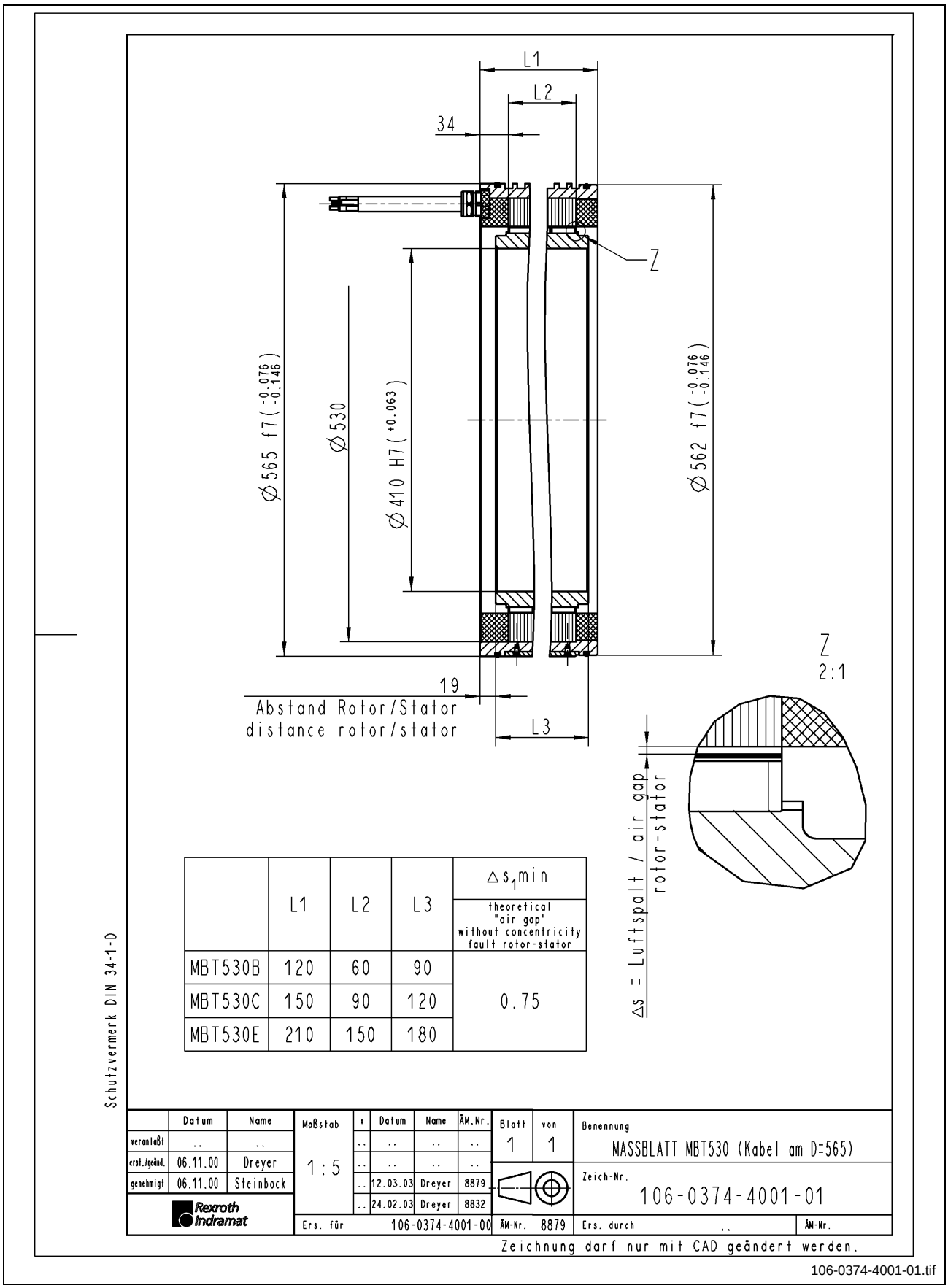
Electrical Connection "SN"



	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	
MBT530E	210	150	180	

Fig. 5-58: Dimension sheet size 530, electrical connection "SN"

Electrical Connection "CN"



	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	
MBT530E	210	150	180	

	Datum	Name
veranlaßt	..	..
erst./geänd.	06.11.00	Dreyer
genehmigt	06.11.00	Steinbock

Rexroth Indramat

Maßstab 1 : 5

x	Datum	Name	ÄM.Nr.
..	..	..	..
..	..	..	..
..	12.03.03	Dreyer	8879
..	24.02.03	Dreyer	8832

Ers. für 106-0374-4001-00

Blatt 1 von 1

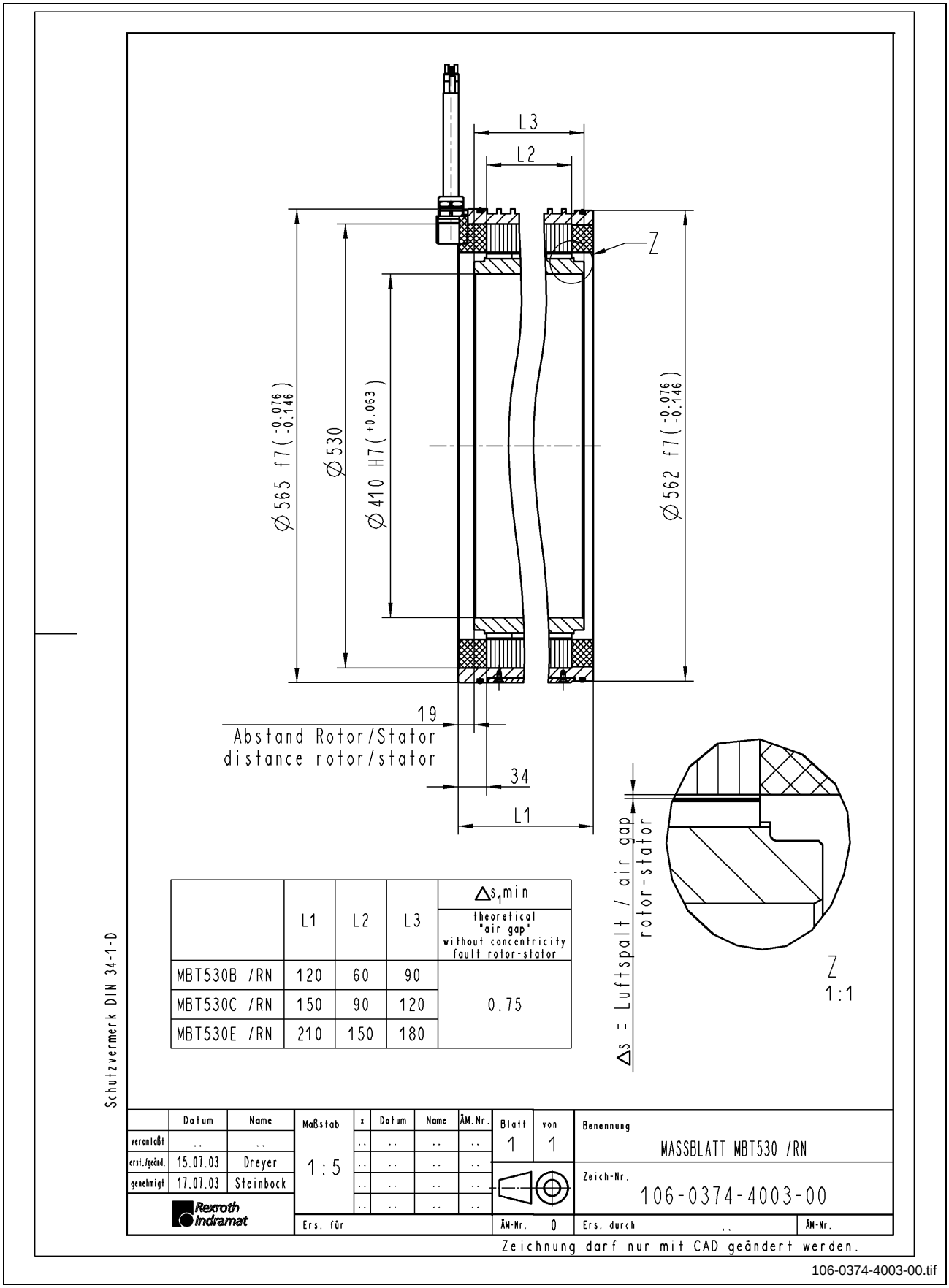
ÄM-Nr. 8879

Benennung: MASSBLATT MBT530 (Kabel am D=565)

Zeich-Nr.: 106-0374-4001-01

Ers. durch .. ÄM-Nr.

Electrical Connection "RN"

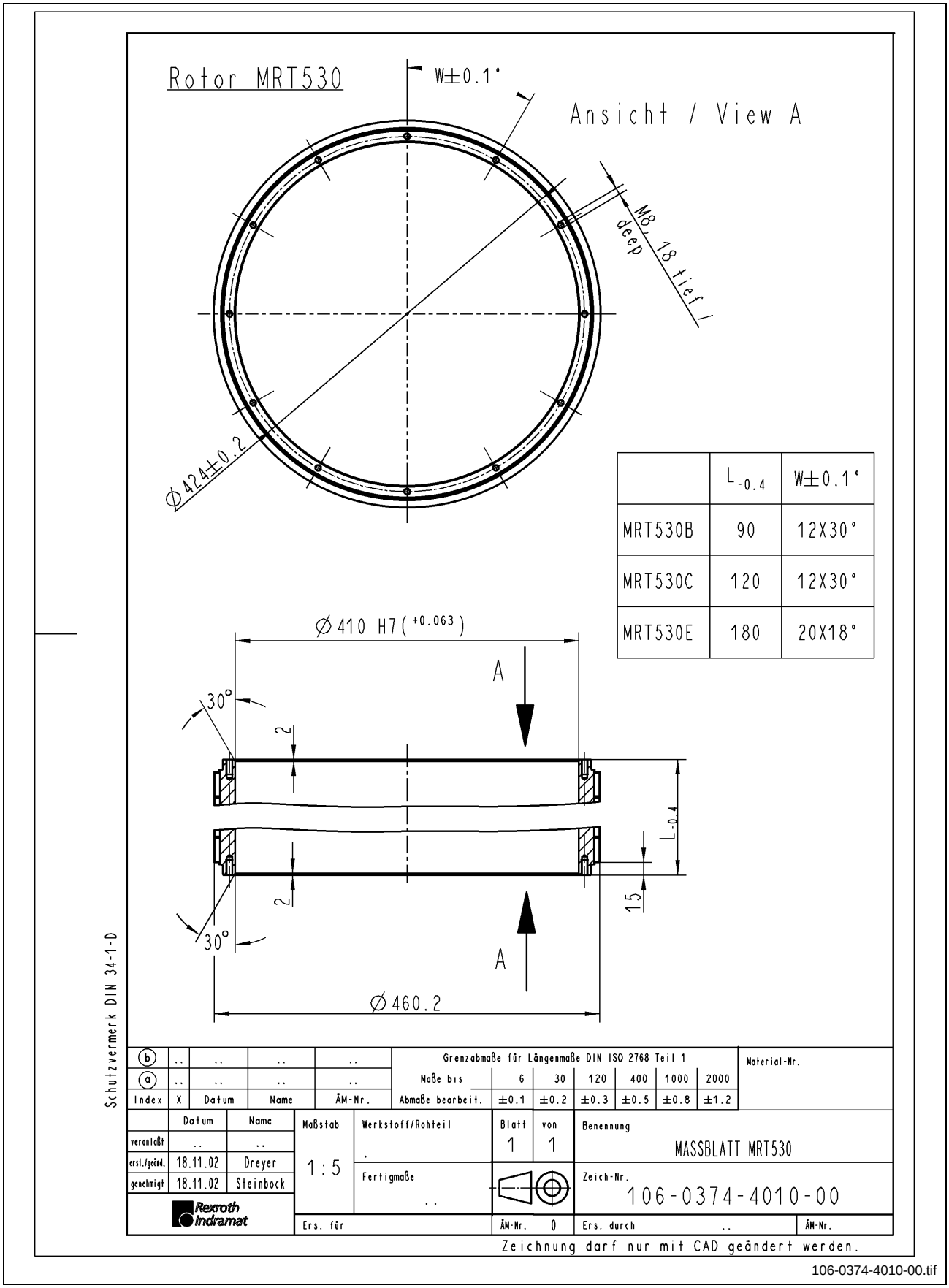


	L1	L2	L3	Δs_1min theoretical "air gap" without concentricity fault rotor-stator
MBT530B /RN	120	60	90	0.75
MBT530C /RN	150	90	120	
MBT530E /RN	210	150	180	

106-0374-4003-00.tif

Fig. 5-60: Dimension sheet size 530, electrical connection "RN"

Rotor MRT530



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

106-0374-4010-00.tif

Fig. 5-61: Dimension sheet MRT530

Rotor MRT530, mounted

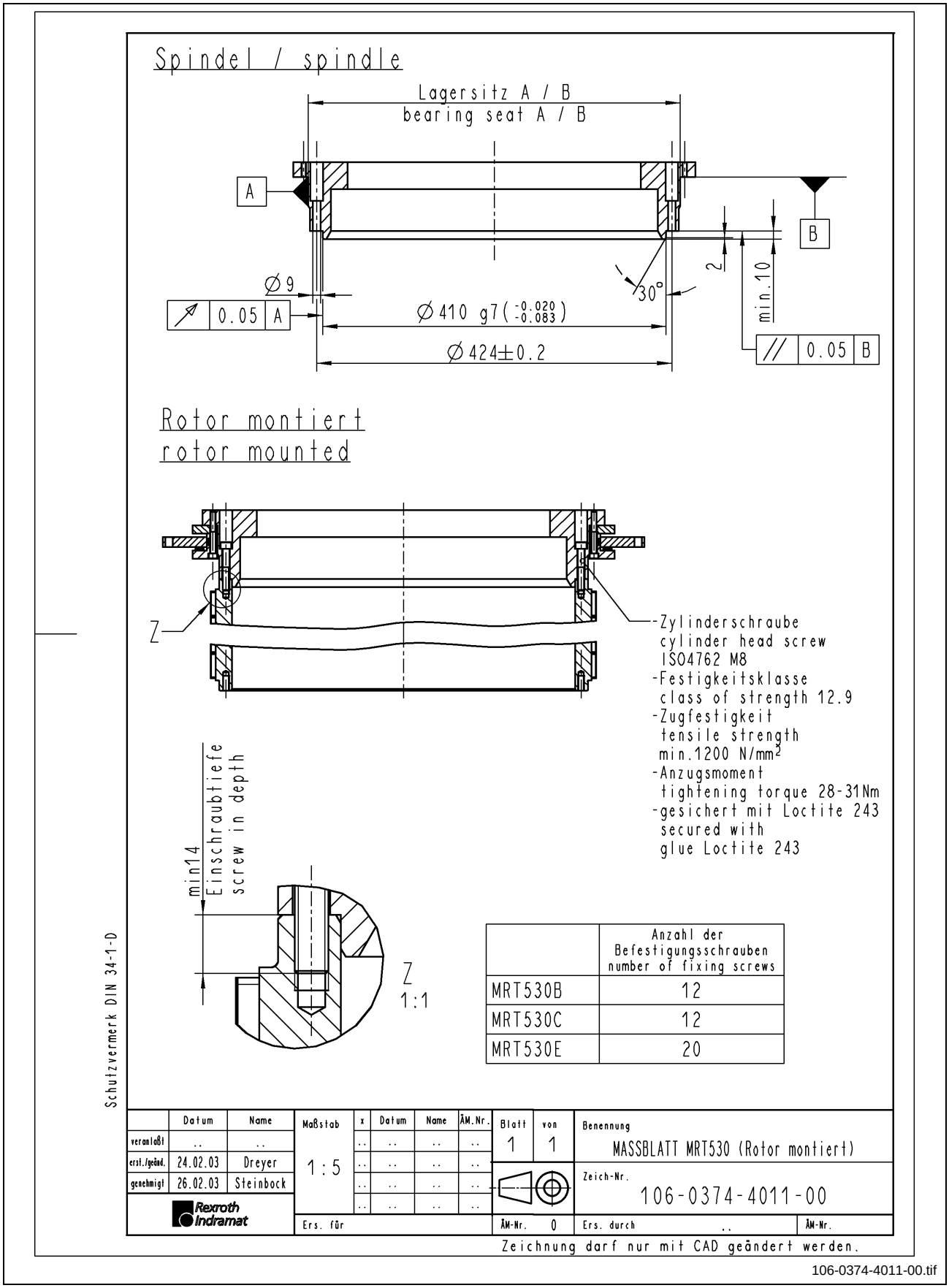
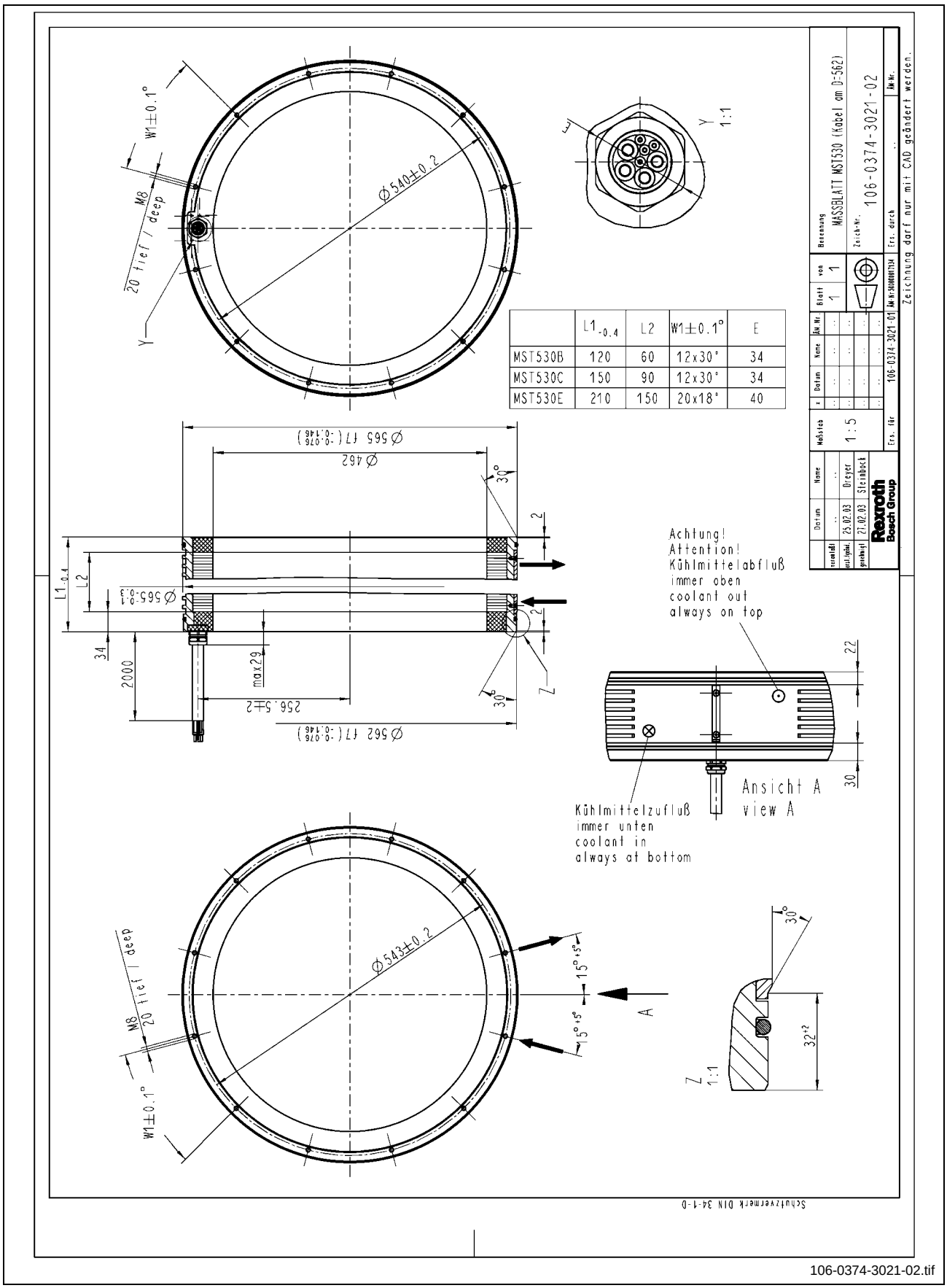


Fig. 5-62: Dimension sheet Rotor MRT530, mounted

Stator MST530, Electrical Connection "SN"

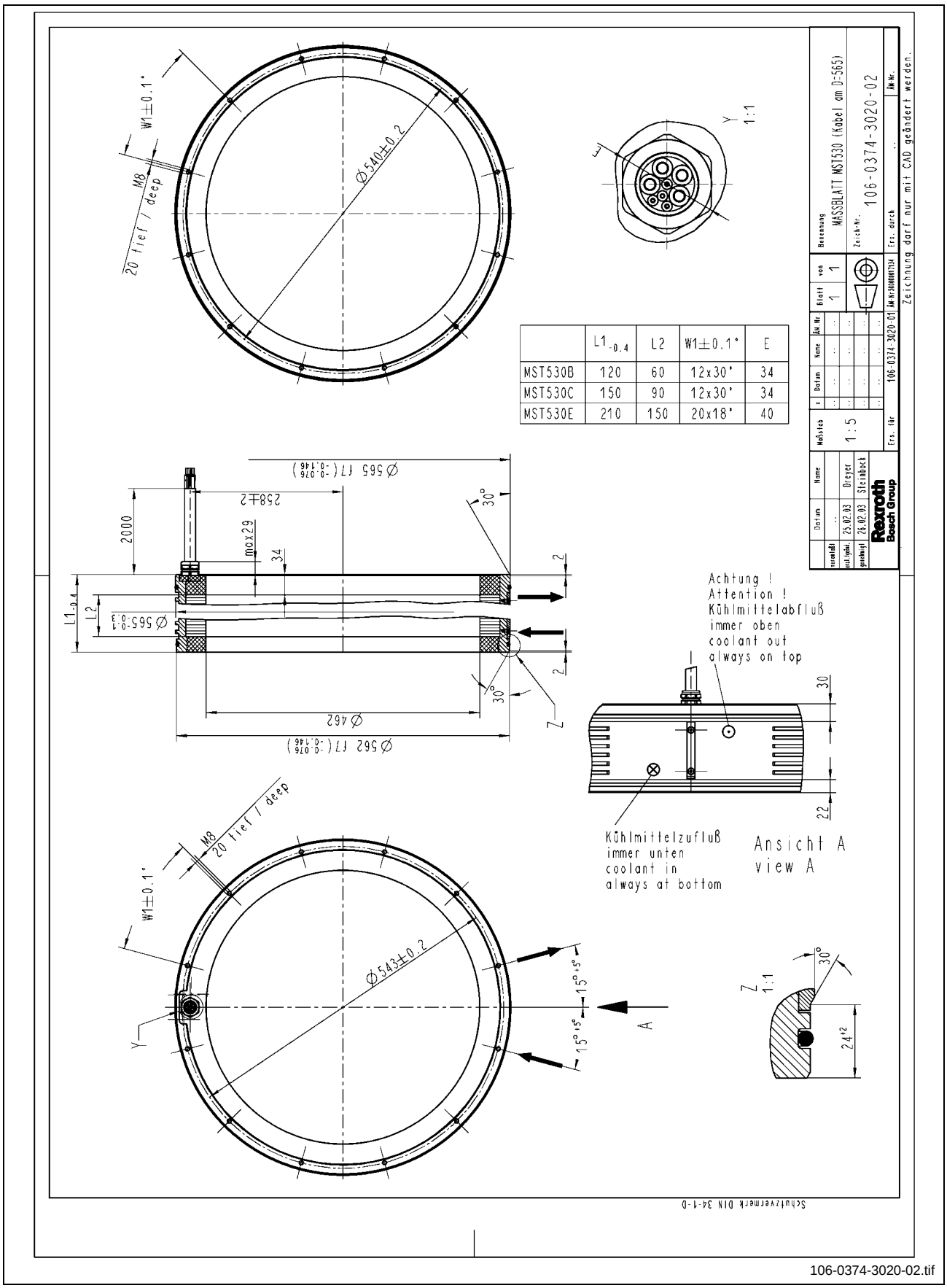


	L1 -0.4	L2	W1±0.1°	E
MST530B	120	60	12x30°	34
MST530C	150	90	12x30°	34
MST530E	210	150	20x18°	40

106-0374-3021-02.tif

Fig. 5-63: Dimension sheet MST530, electrical connection "SN"

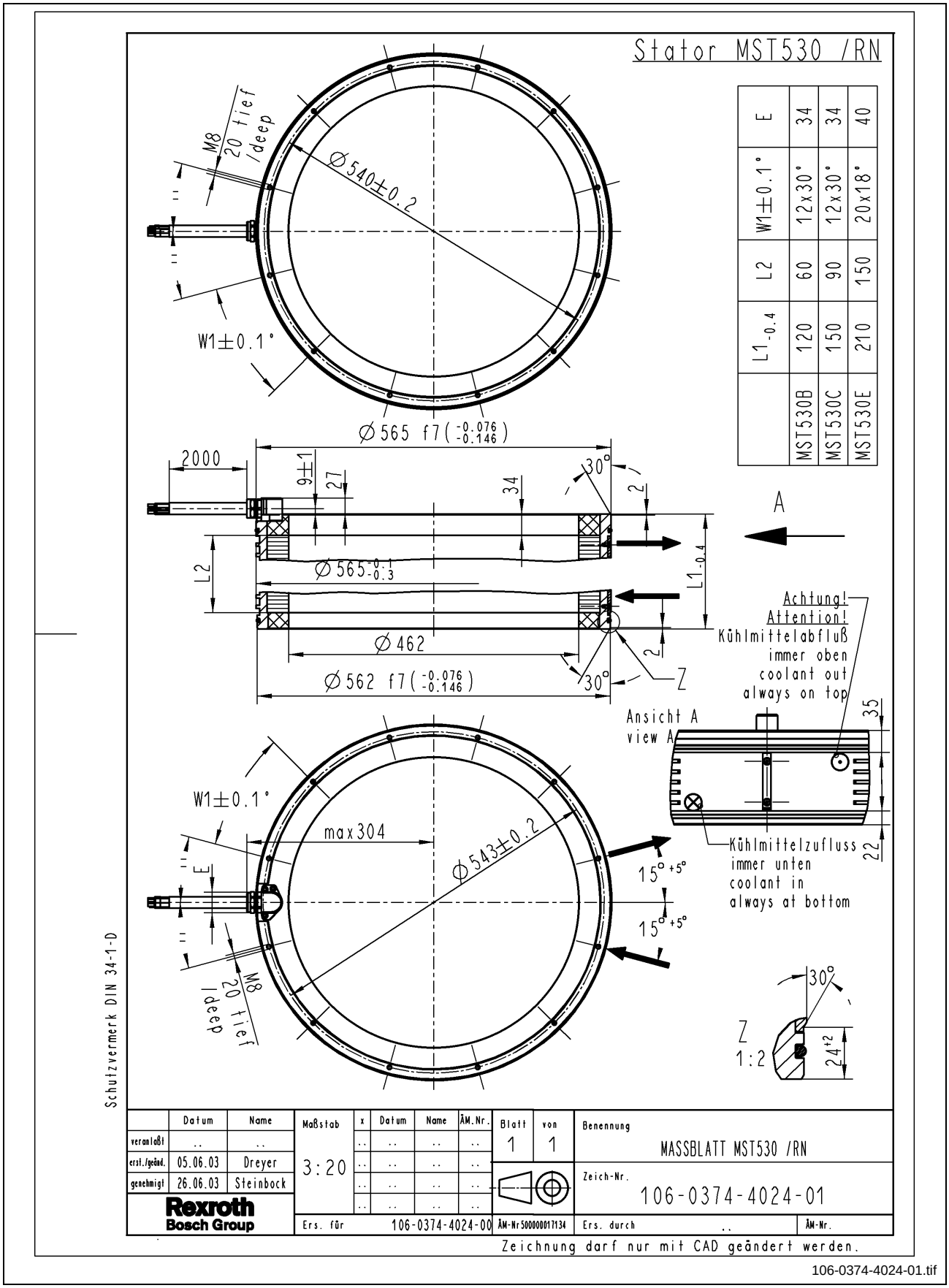
Stator MST530, Electrical Connection "CN"



106-0374-3020-02.tif

Fig. 5-64: Dimension sheet MST530, electrical connection "CN"

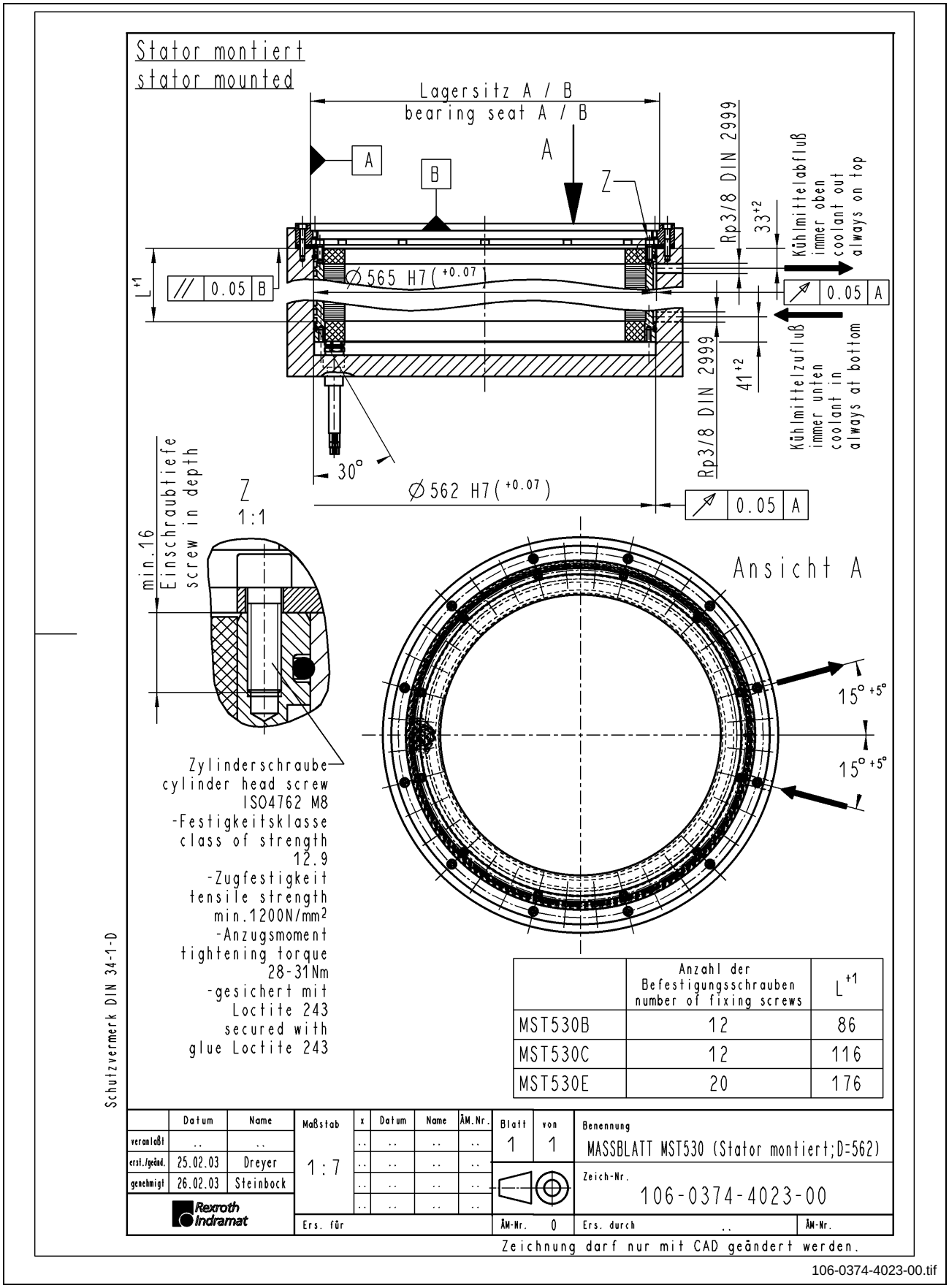
Stator MST530, Electrical Connection "RN"



106-0374-4024-01.tif

Fig. 5-65: Dimension sheet MST530, electrical connection "RN"

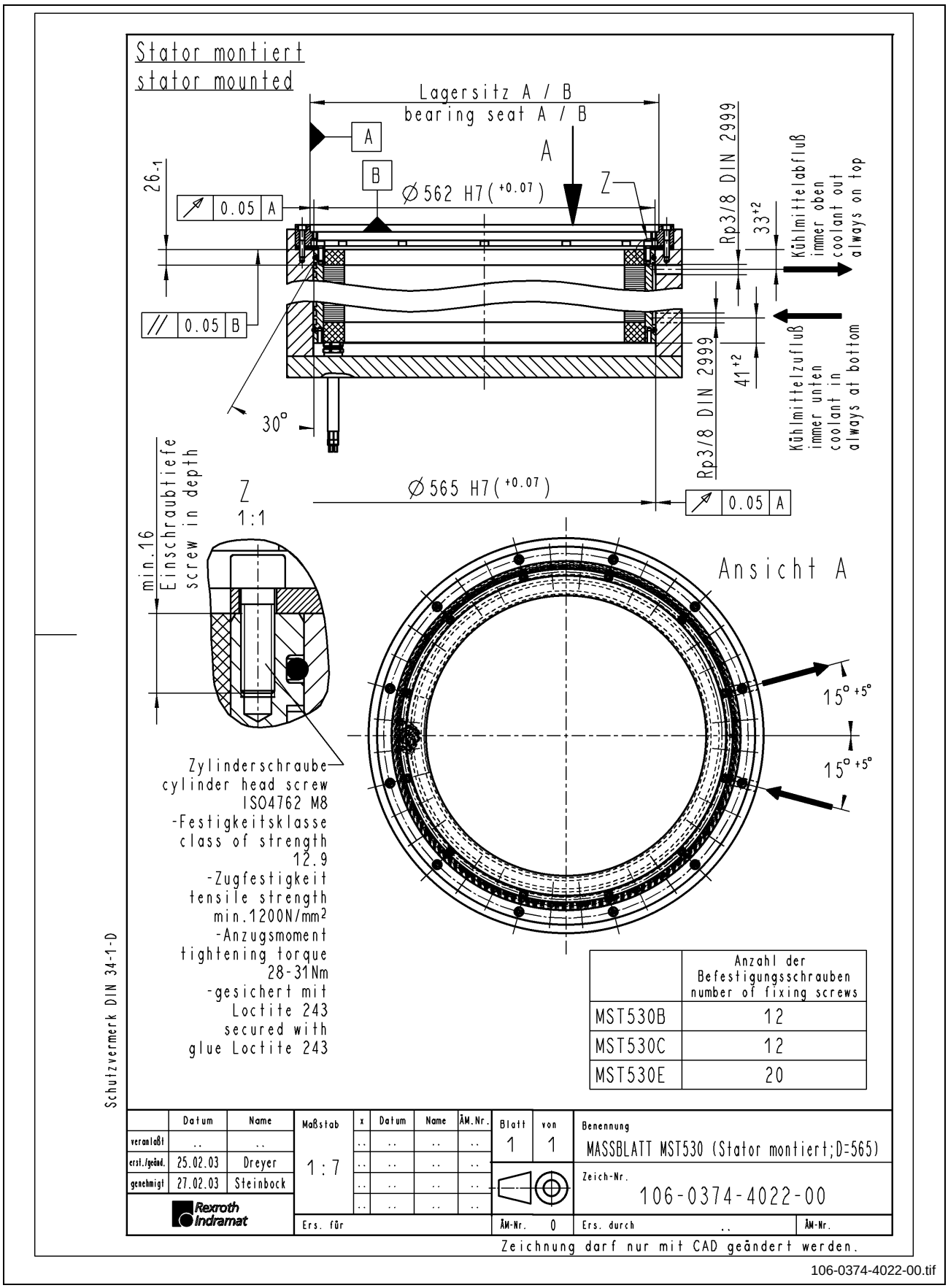
Stator MST530, Electrical Connection "SN", mounted



106-0374-4023-00.tif

Fig. 5-66: Dimension sheet MBT530, electrical connection "SN", mounted

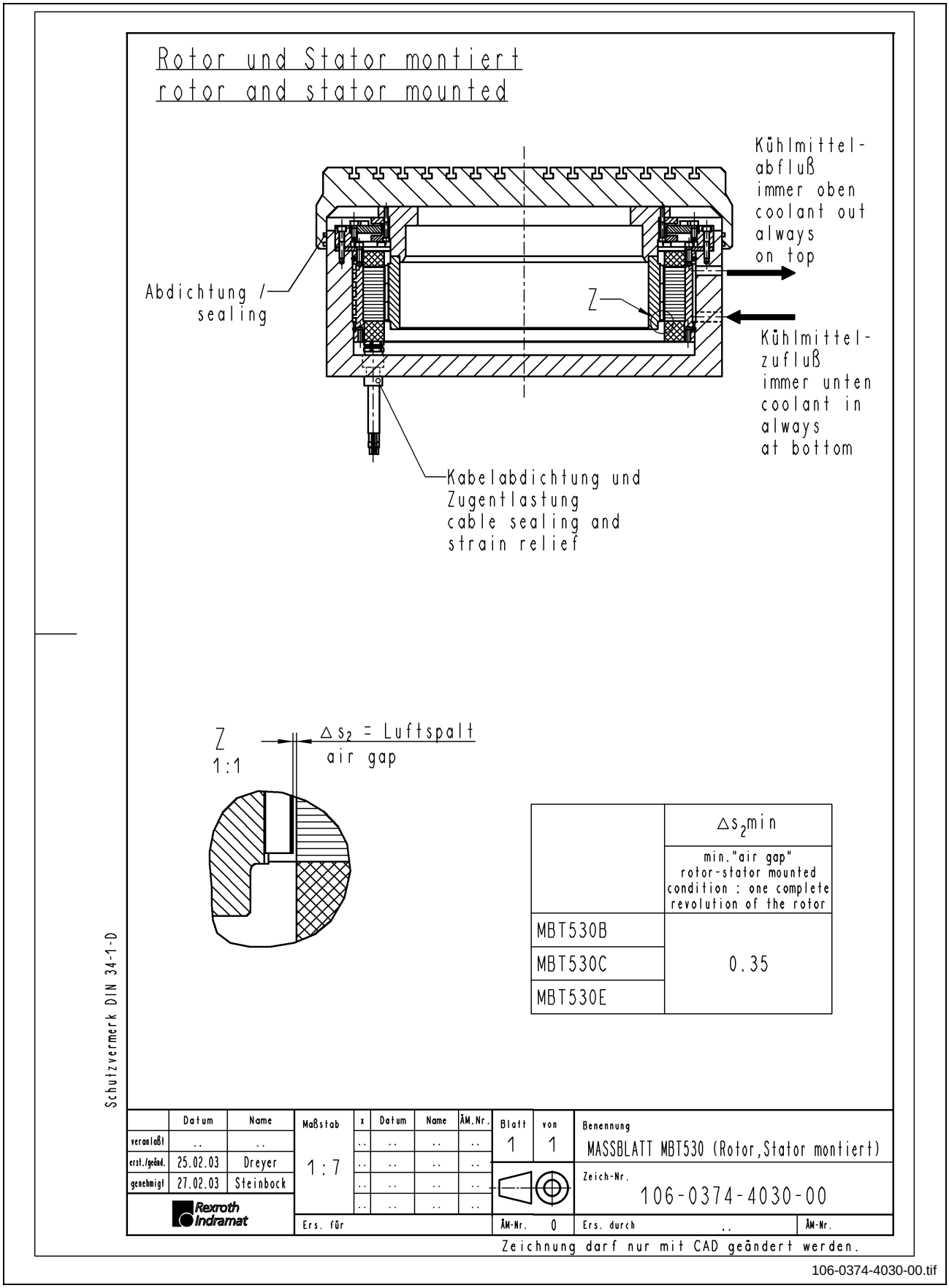
Stator MST530, Electrical Connection "CN", mounted



106-0374-4022-00.tif

Fig. 5-67: Dimension sheet MBT530, electrical connection "CN", mounted

Rotor and Stator, mounted



106-0374-4030-00.tif

Fig. 5-68: Dimension sheet size 530, Rotor and Stator, mounted

Stator MST530, Cooling Type "S"

in preparation

Fig. 5-69: Dimension sheet MST530, cooling type "S"

6 Type Codes

The type code describes the motor variants that are supplied; it is the basis for selecting and ordering products from Bosch Rexroth. This applies to both new products as well as spare parts and repairs.

Rexroth IndraDyn T torque motors consist of the components “Stator” and “Rotor”. The type code is divided into “type code for Stator MST...” and “type code for Rotor MRT...”.

The following description gives an overview of the individual positions of the type code (“Abbrev. column”) and their meanings. You can find the type code for a particular unit in the following chapter.

Type Codes for Rotor MRT

1. Product Group

Abbrev. columns 1 2 3

MRT is the designation of an IndraDyn T rotor unit.

2. Motor Frame Size

Abbrev. columns 4 5 6

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

3. Motor Frame Length

Abbrev. column 7

Within a series, the graduation of increasing motor frame length is indicated by ID letters in alphabetic order.

Frame lengths are, for example, **A**, **B**, **C** and **D**.

4. Shape / Mechanical Construction

Abbrev. columns 9 10

3N represents the fastening of the rotor by bolts.

5. Rotor - Internal Diameter

Abbrev. columns 12 13 14 15

Indicates the internal diameter of the rotor in millimeters (mm).

6. Other designs

Abbrev. columns 17 18 19 20

Reserved for optional types. You can find a short description in the appropriate type code; mechanical details are in the corresponding dimension sheet.

Type Codes for Stator MST

1. Product

Abbrev. columns 1 2 3

MST is the designation of an IndraDyn T stator unit.

2. Motor Frame Size

Abbrev. columns 4 5 6

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

3. Motor Frame Length

Abbrev. column 7

Within a series, the graduation of increasing motor frame length is indicated by ID letters in alphabetic order. The higher the motor frame length, the higher the torque.

Frame lengths are, for example, **A**, **B**, **C** and **D**.

4. Winding Code

Abbrev. columns 9 10 11 12

Winding codes "**0010**", "**0027**", etc. act to differentiate the winding variants and indicate the rated speed.

Example: The rated speed for the winding “0027” is n_N = 270 rpm· The intermediate circuit voltage of 540 V_{DC}. is a fixed reference value.

A drive combination is selected based on the corresponding selection data and operating characteristics.

5. Type of Cooling

Abbrev. column 14

The IndraDyn T motors are always fitted with a stator-cooling jacket for operation with **liquid cooling**.

The MST130 also has the option “**Natural convection**”, while the MST530 has the option “**Surface ventilation**”.

Operation without liquid cooling is permitted only under certain conditions. In general, reduced power data apply here. For notes, see chapter 9.5 “Motor Cooling”.

6. Encapsulation

Abbrev. column 15

The **thermal encapsulation** consists of an aluminum cooling jacket, ensuring the thermal isolation of the motor and the machine.

The MST130 also has the option **standard encapsulation** (only in combination with the “natural convection” cooling type). In the standard encapsulation, the stator package is installed in the machine housing without a cooling jacket.

7. Motor Encoder

Abbrev. columns 17 18

IndraDyn T motors are available without a motor encoder. For information about the selection of motor encoder, see chapter 9 “Application notes”.

8. Electrical Connection

Abbrev. columns 19 20

The electrical connection is always made using an approx. 2 m-long cable (for design “...D30_”, with approx. 2m-long individual braids with wire end sleeves; for MST210, with approx. 1.5m-long braids). All wires are provided with wire end sleeves.

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

For further information, see chapter 8, "Connection Techniques".

9. Other Designs

Abbrev. columns 22 23 24 25

Reserved for optional types. You can find a short description in the appropriate type codes. The mechanical details can be found in the appropriate dimension sheet.

6.2 Size 130

Rotor MRT130

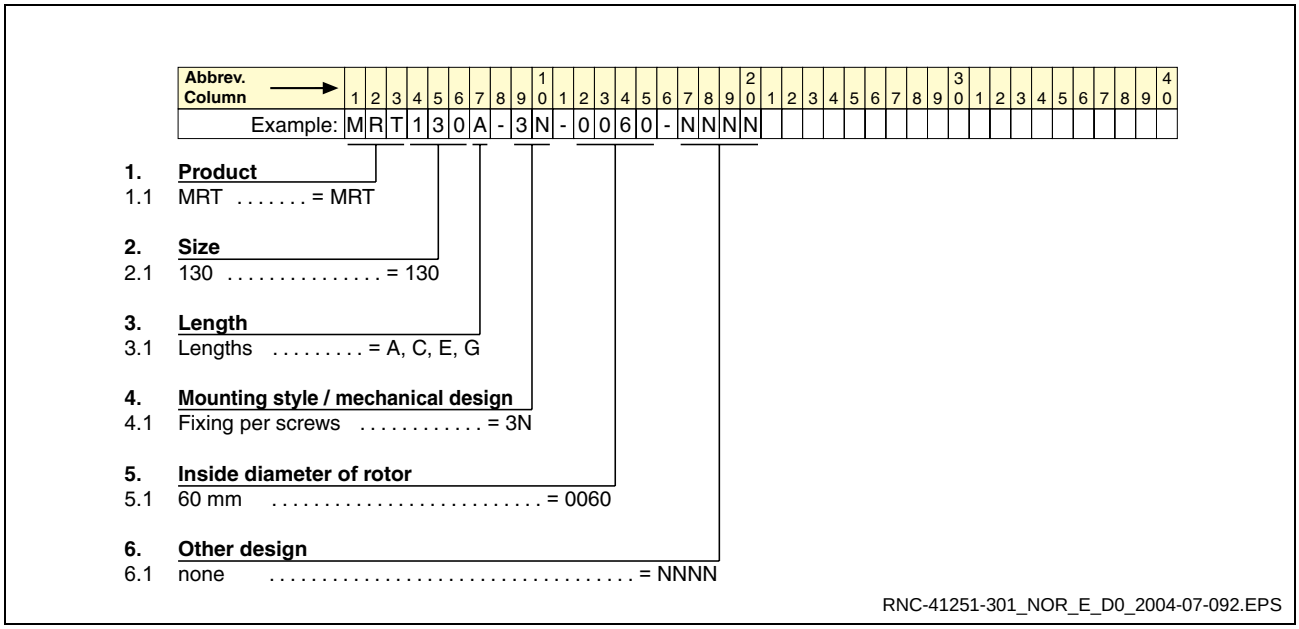


Fig. 6-1: Type code Rotor MRT130

Stator MST130

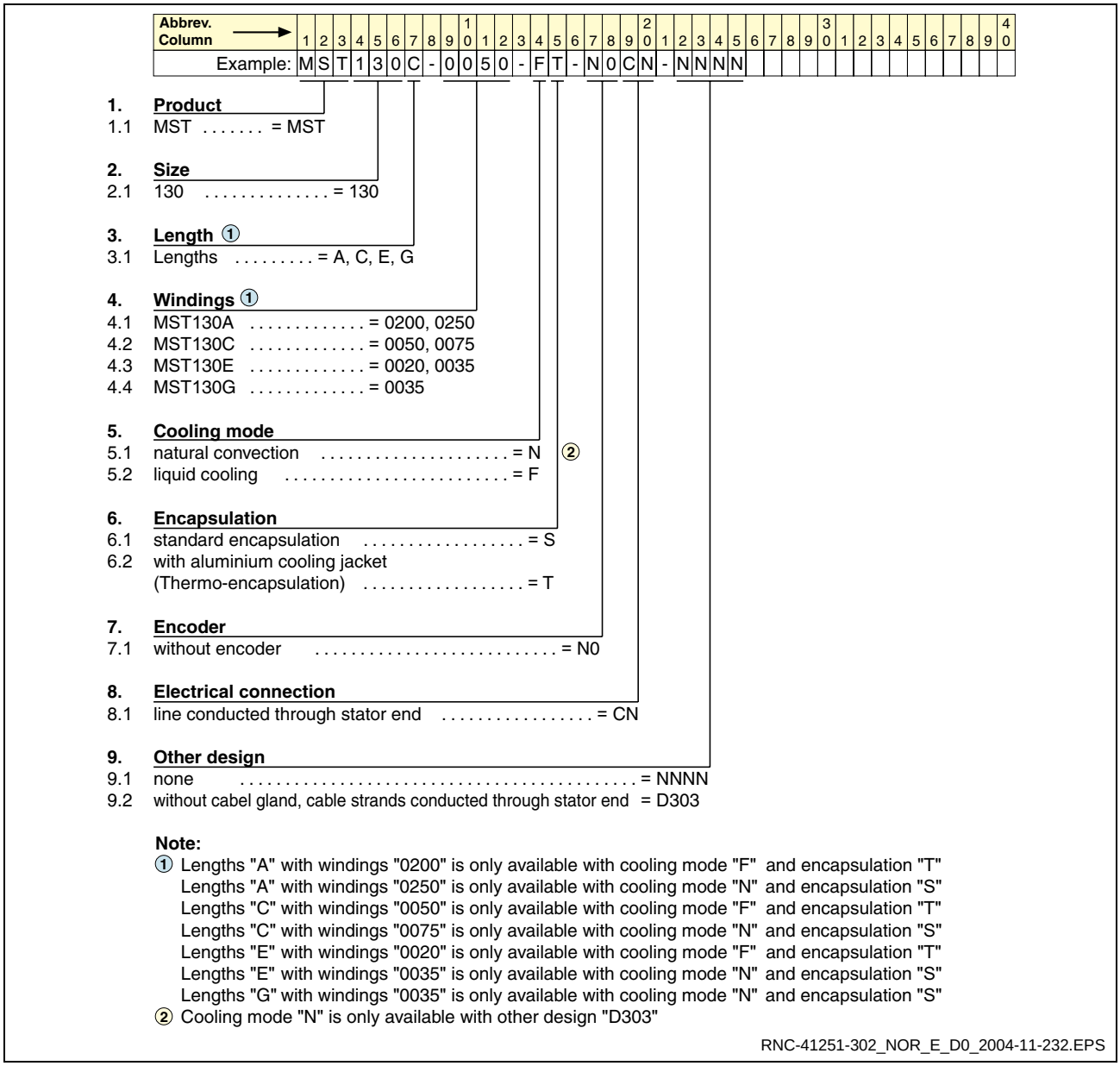


Fig. 6-2: Type code Stator MST130

6.3 Size 160

Rotor MRT160

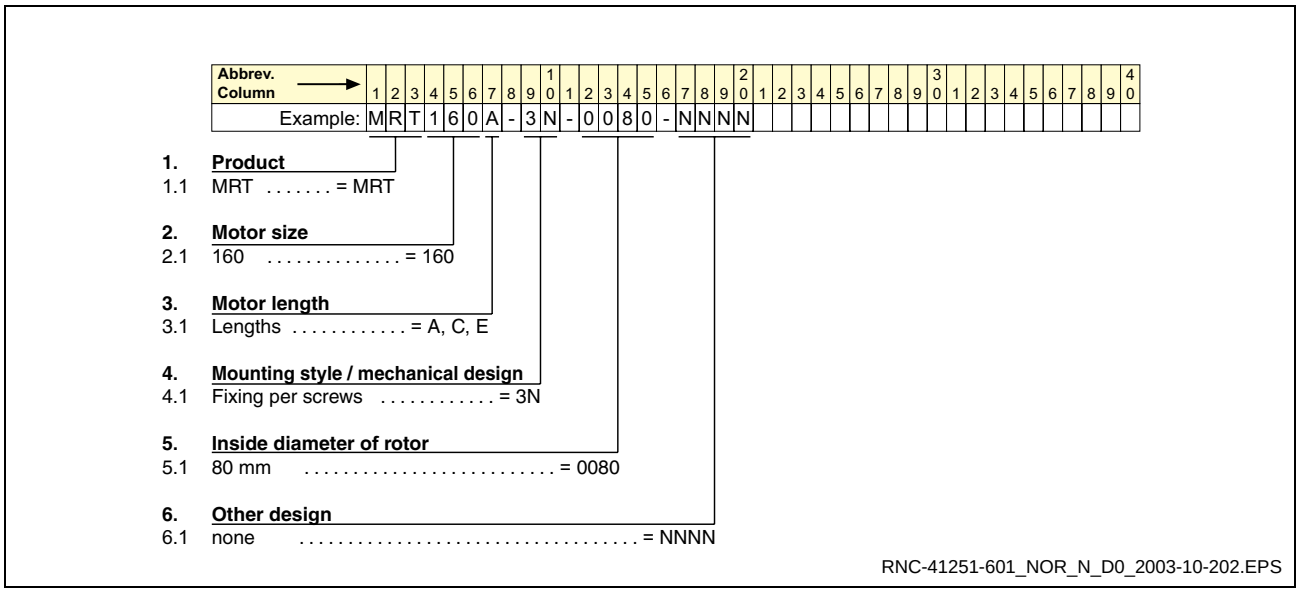


Fig. 6-3: Type code Rotor MRT160

Stator MST160

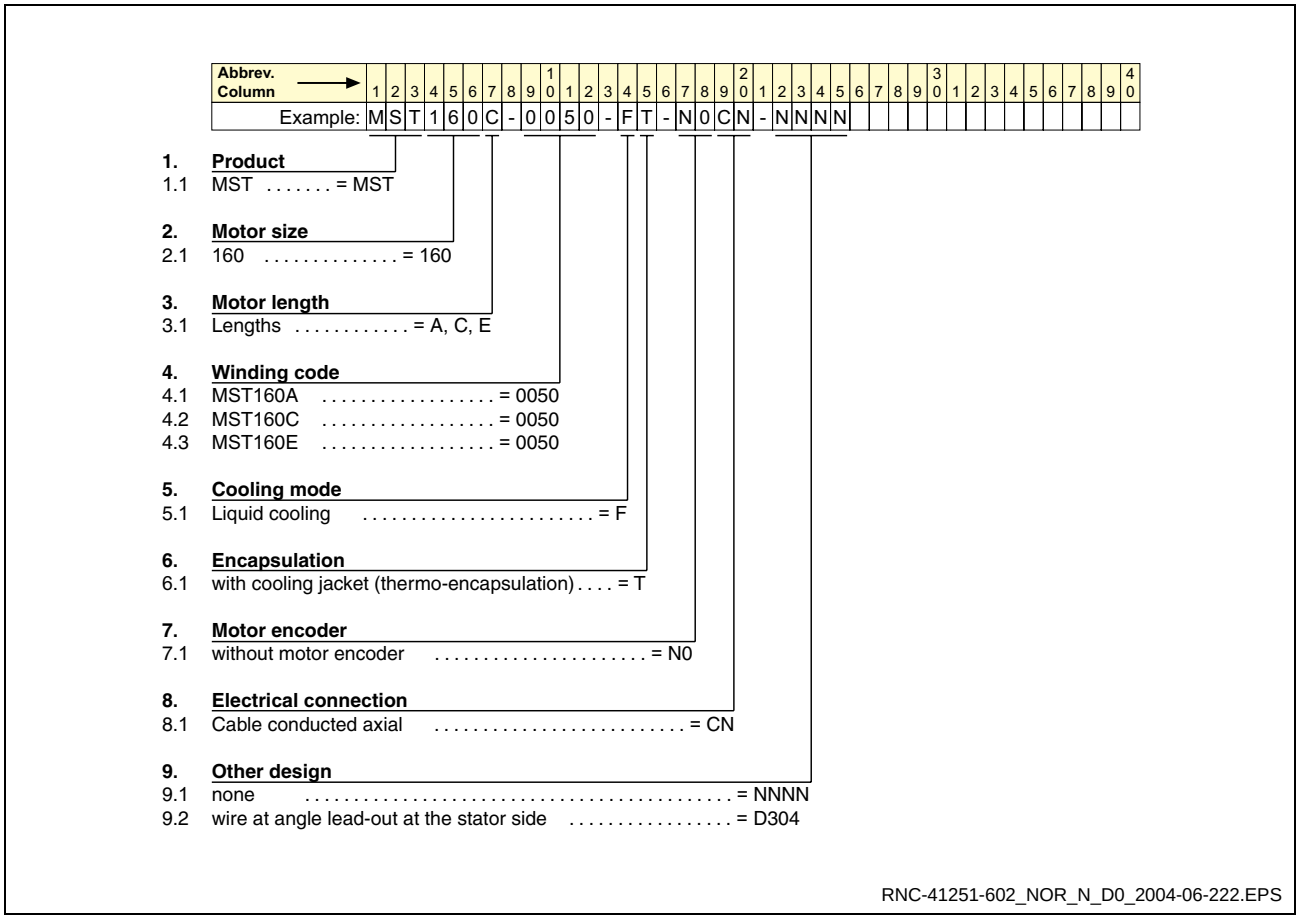


Fig. 6-4: Type code Stator MST160

6.4 Size 210

Rotor MRT210

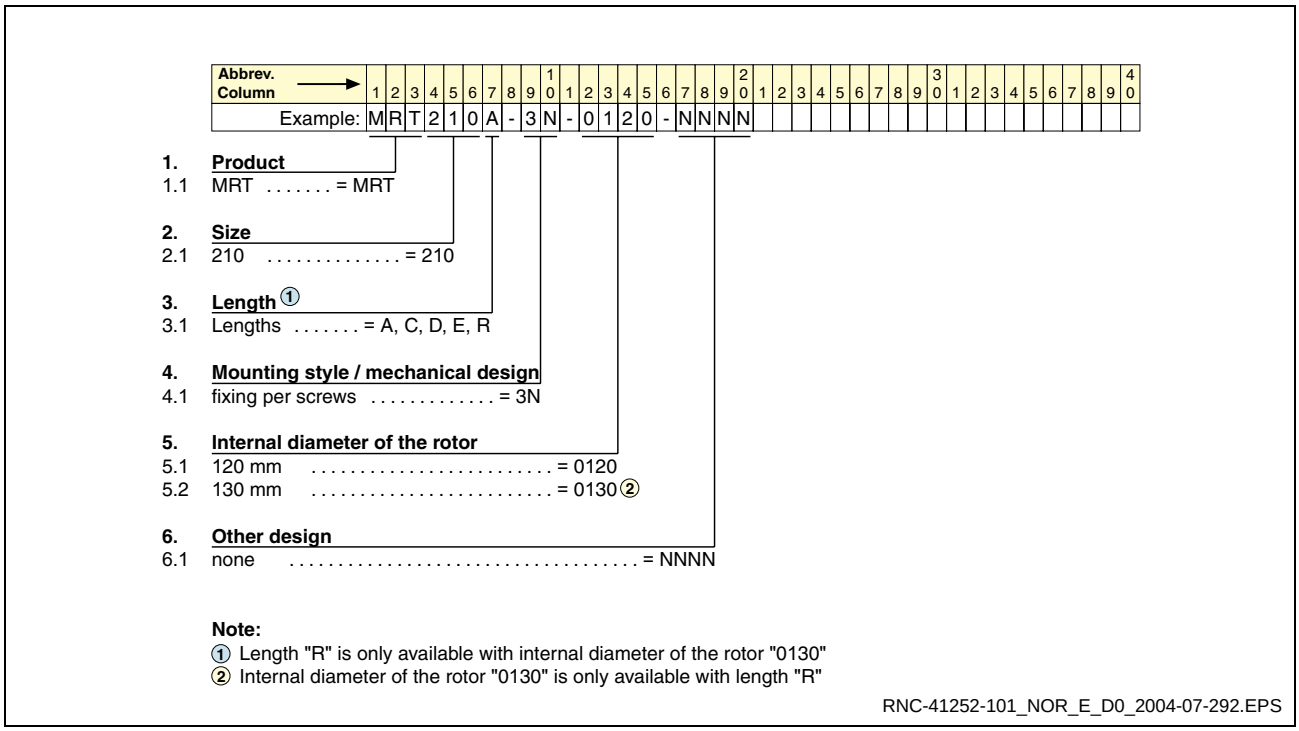


Fig. 6-5: Type code Rotor MRT210

Stator MST210

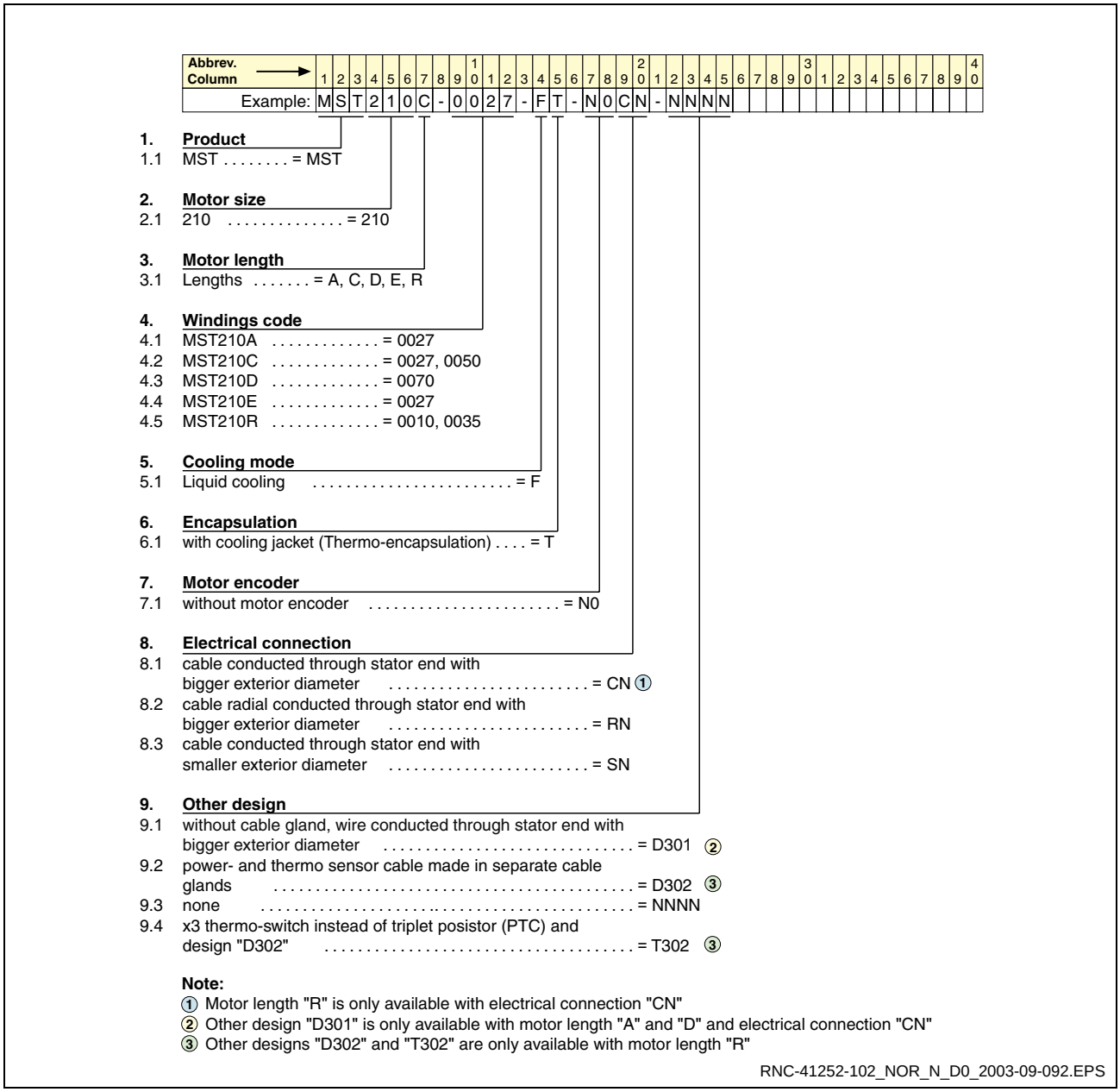


Fig. 6-6: Type code Stator MST210

6.5 Size 290

Rotor MRT290

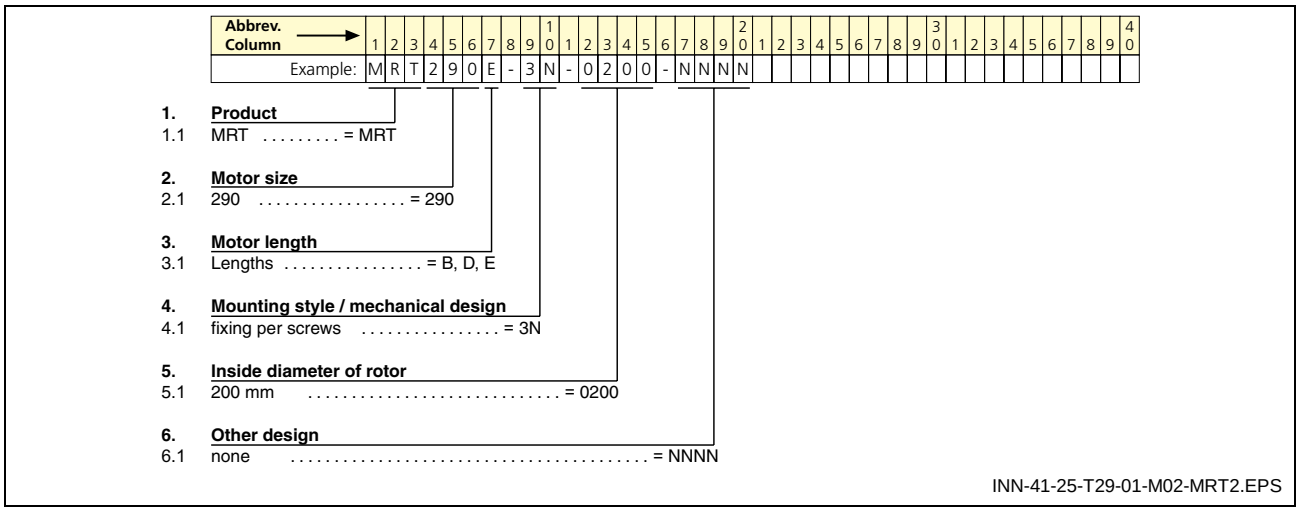


Fig. 6-7: Type code Rotor MRT290

Stator MST290

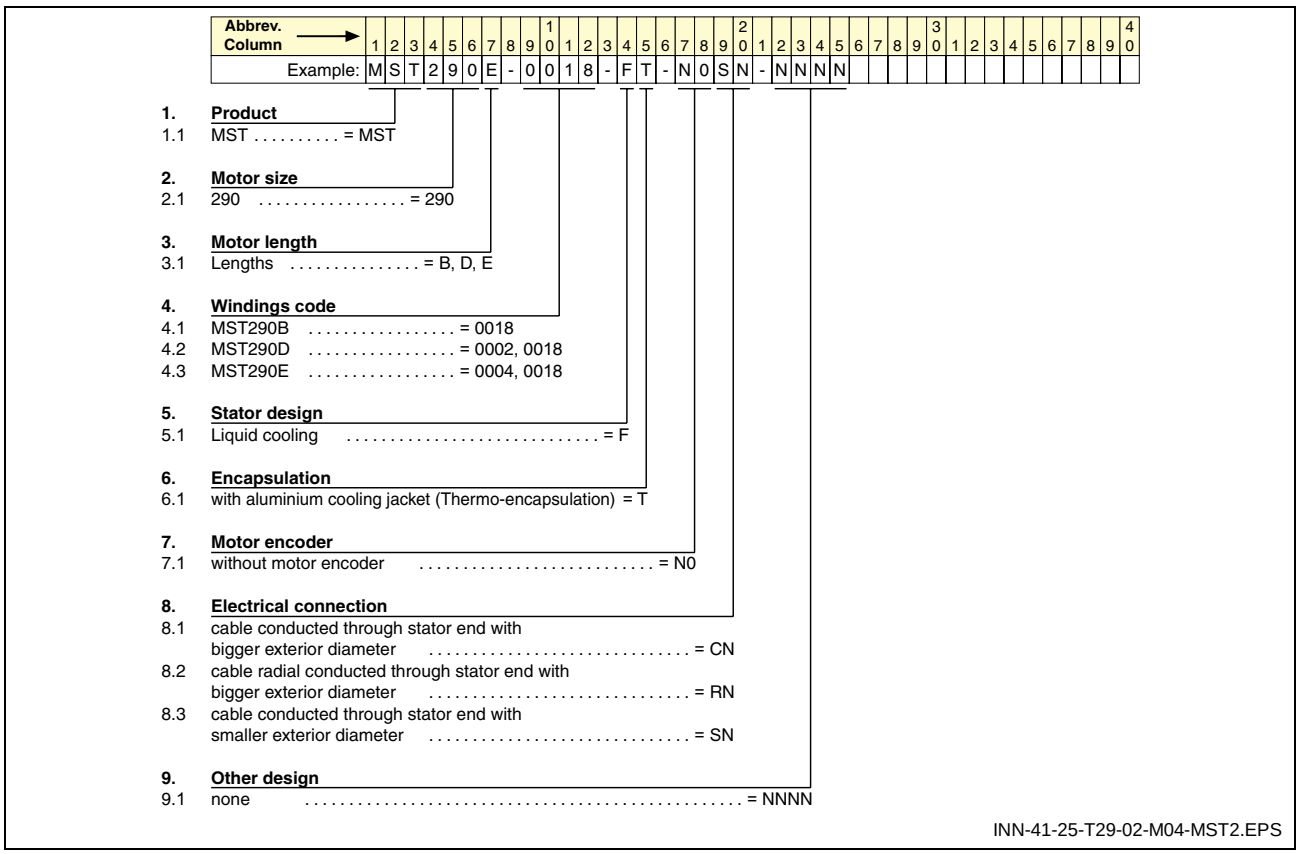


Fig. 6-8: Type code Stator MST290

6.6 Size 360

Rotor MRT360

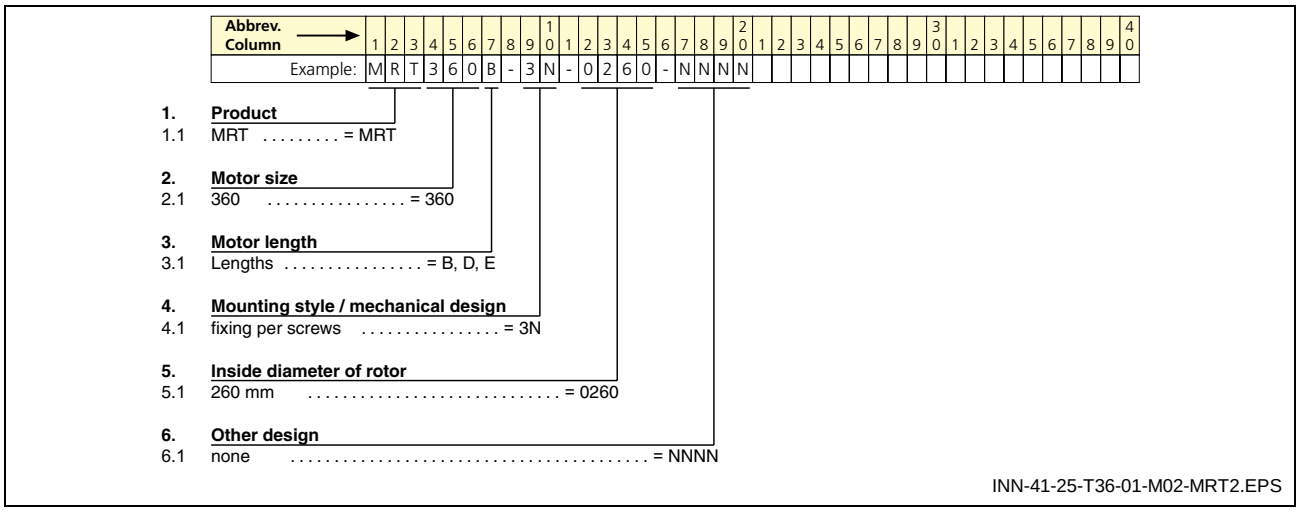


Fig. 6-9: Type code Rotor MRT360

Stator MST360

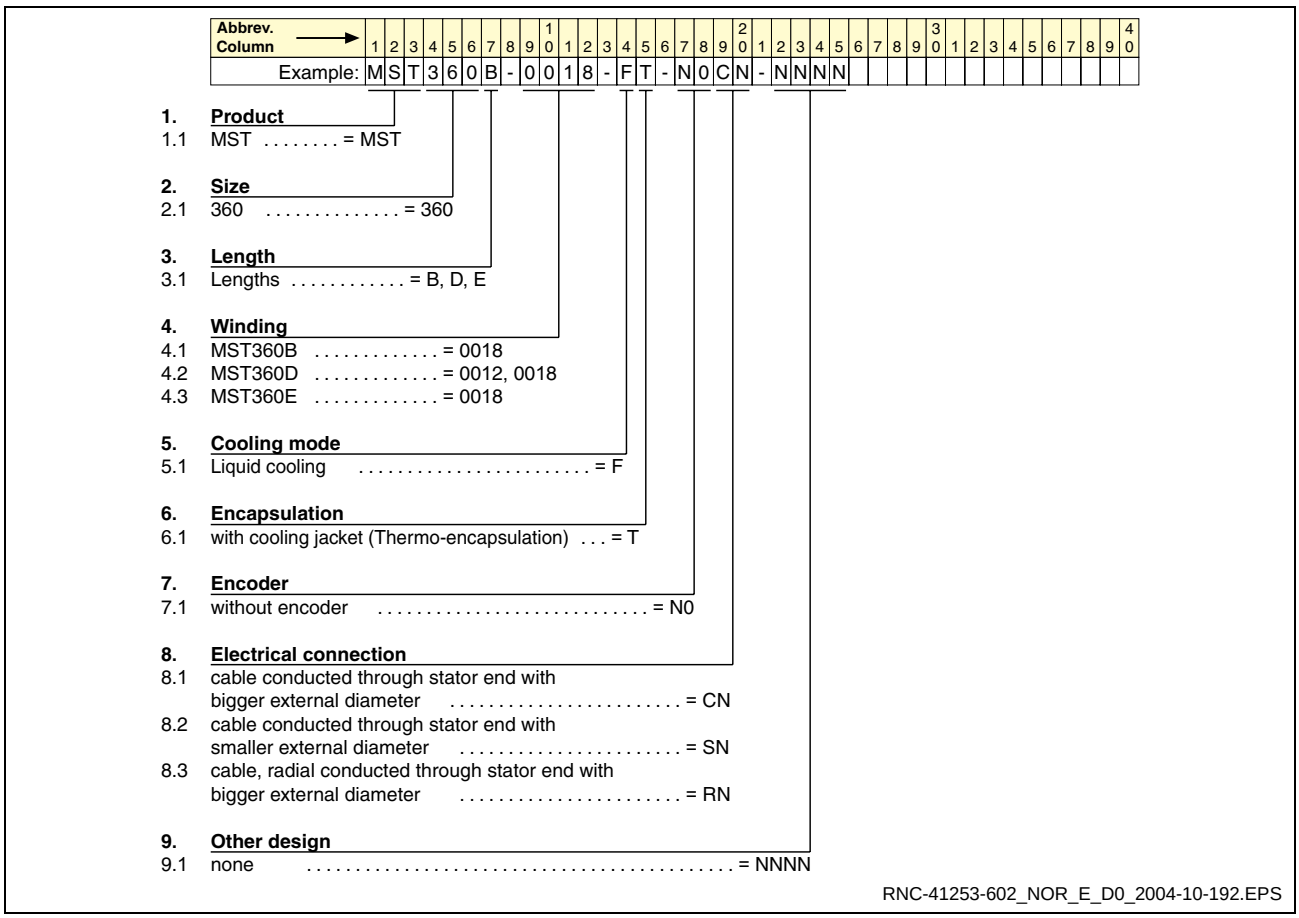


Fig. 6-10: Type code Stator MST360

6.7 Size 450

Rotor MRT450

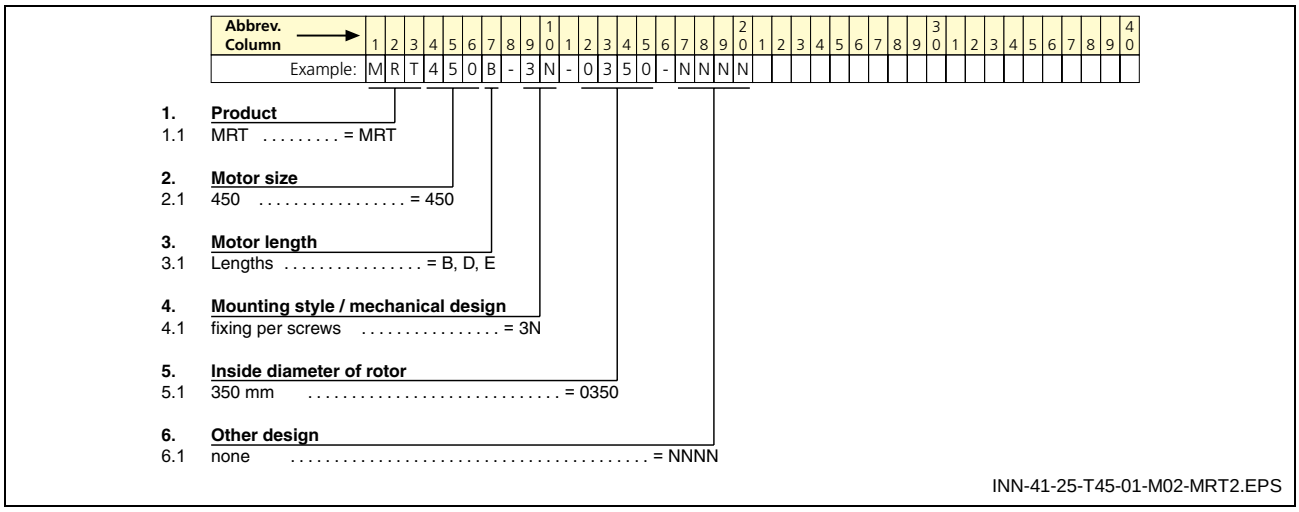


Fig. 6-11: Type code Rotor MRT450

Stator MST450

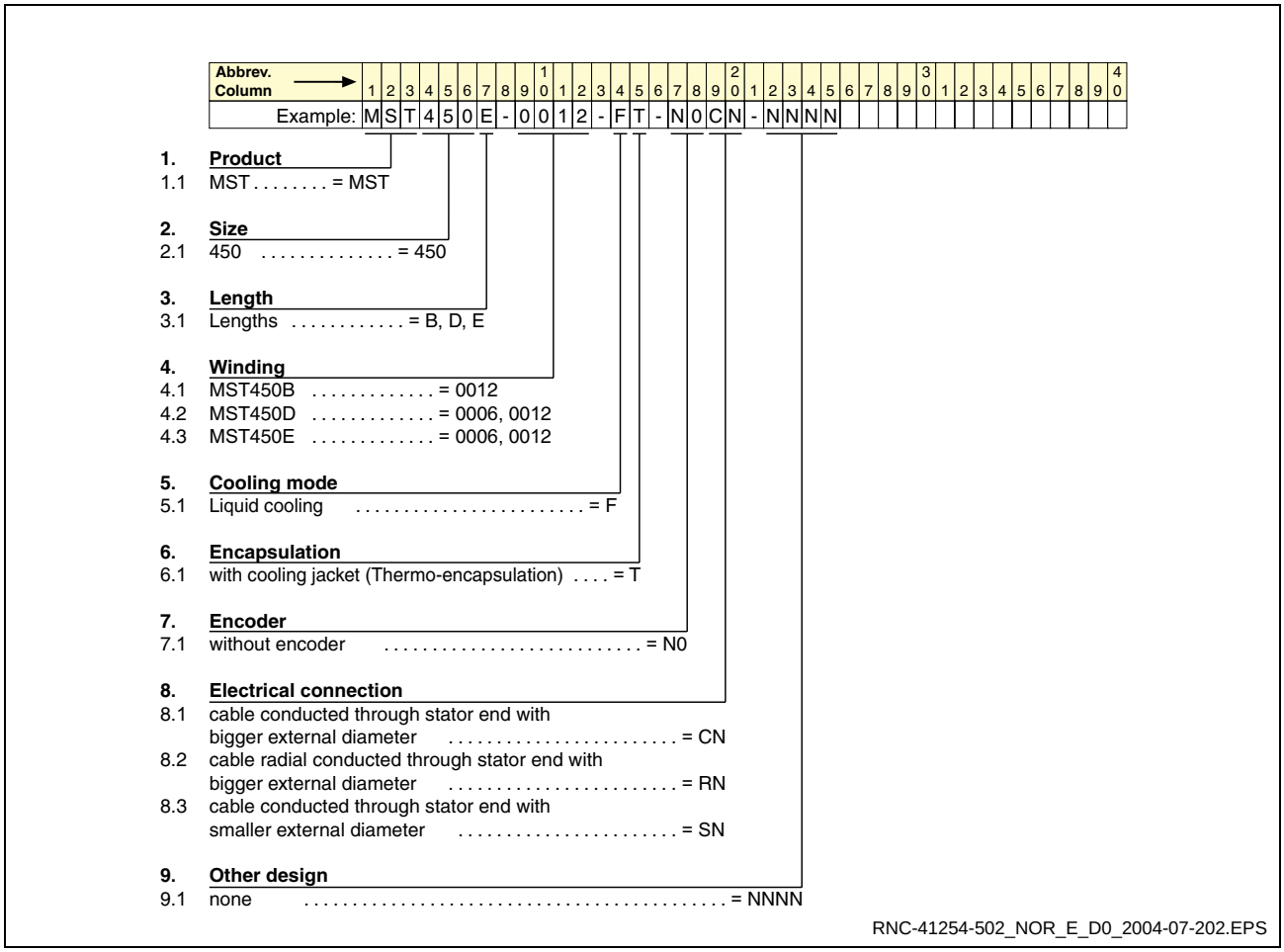


Fig. 6-12: Type code Stator MST450

6.8 Size 530

Rotor MRT530

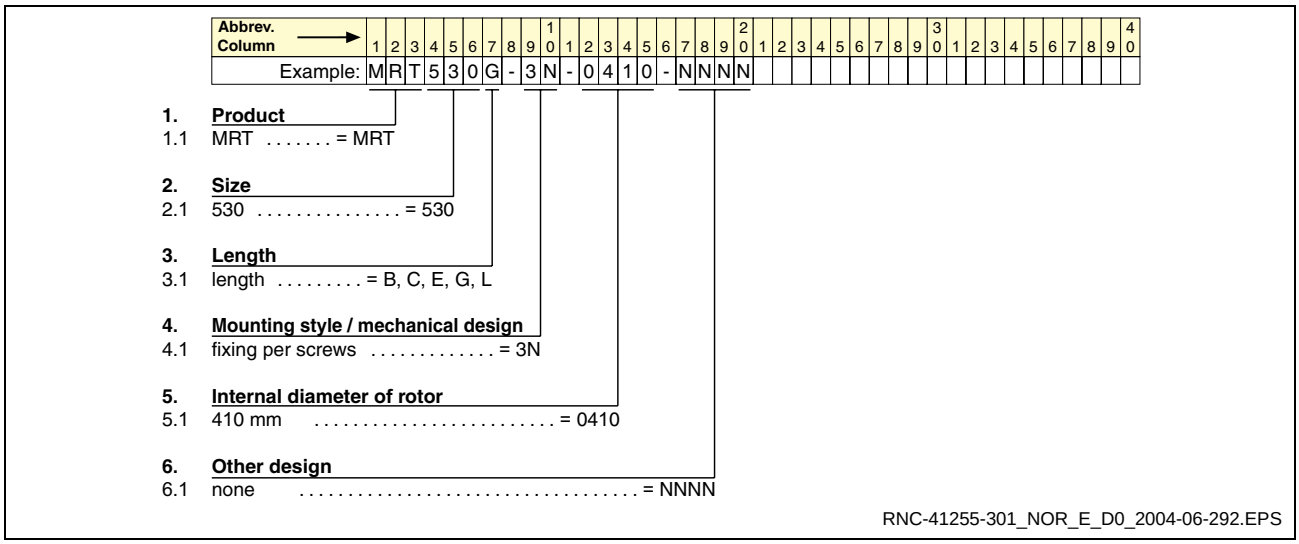


Fig. 6-13: Type code Rotor MRT530

Stator MST530

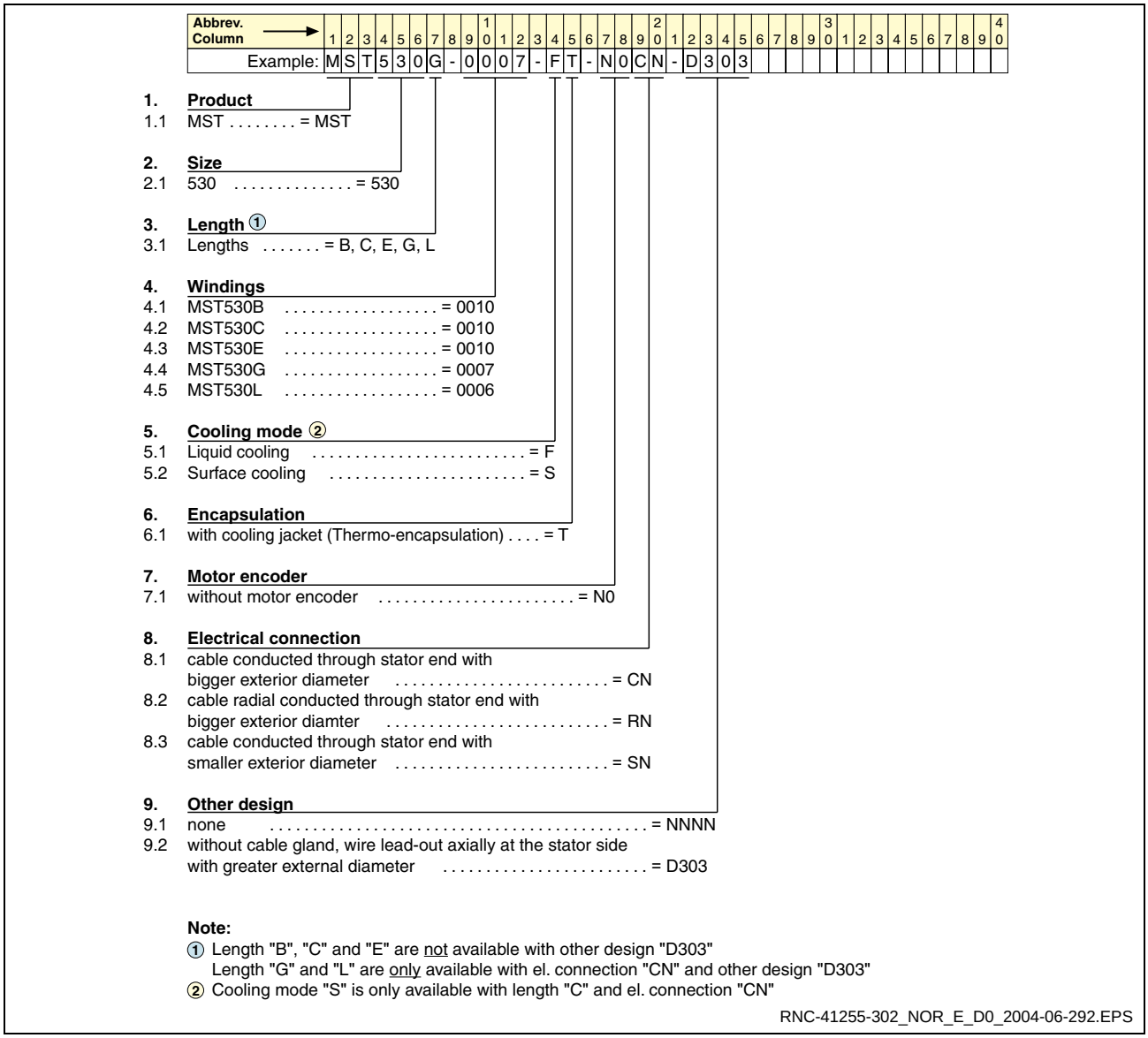


Fig. 6-14: Type code Stator MRT530

7 Accessories

7.1 Mounting Ring

To simplify the handling, transport and mounting of Rexroth IndraDyn T synchronous torque motors, a mounting fixture should be made by the machine manufacturer according to his own specifications. This can significantly simplify work, especially for the sizes 450 and 530. The required dimension information is shown at the end of this chapter.

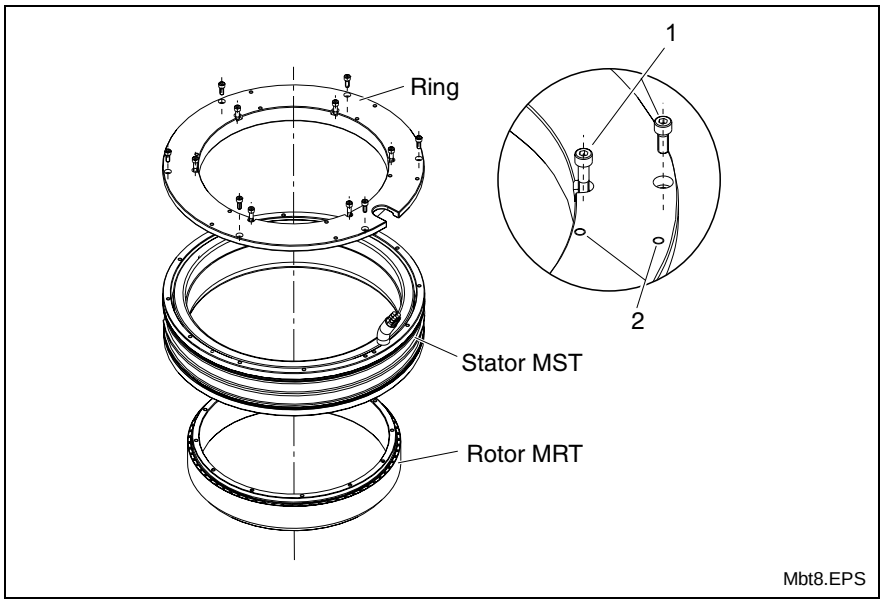
By specifying his own construction, the machine manufacturer can optimally take into account constructional details and special work flows on his machine during assembly, commissioning and servicing.

For sizes 450 and 530, Rexroth can provide mounting rings upon request at additional cost. The stator and rotor are then delivered in a pre-assembled condition if they are ordered in this manner.

Note:

- Special constructional features of the machine or special designs cannot be taken into account in the Rexroth mounting rings.
- The Rexroth mounting ring is only to be used as an assembly or application tool and must be removed before the motor is commissioned electrically.
- Heed the safety notes regarding handling of magnetic parts.

Construction



(1): Fastening bolts for attaching the mounting ring
(2): Threaded holes for insertion of ring bolts to assist in lifting

Fig. 7-1: Mounting ring for the IndraDyn T MST/MRT

Order

The mounting rings for IndraDyn T motors are allocated according to the stator that is used.

Depending on the requirements,

- an unassembled mounting ring (see Fig. 7-2) or
- a pre-assembled mounting ring (see Fig. 7-3)

can be ordered.

Unassembled mounting ring

Mounting ring	MNR	For stator
RING-MOUNTING M01-MBT450	R911296650	MST450.-....-FT-N0CN-NNNN
RING-MOUNTING M02-MBT450	R911298824	MST450.-....-FT-N0SN-NNNN
RING-MOUNTING M01-MBT530	R911294612	MST530.-....-FT-N0CN-NNNN
RING-MOUNTING M02-MBT530	R911295876	MST530.-....-FT-N0SN-NNNN
RING-MOUNTING M03-MBT530	R911296195	MST530.-....-ST-N0CN-NNNN

Fig. 7-2: MBT – unassembled mounting ring

Pre-assembled mounting ring

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
SUP-M02-MBT530	R911296537	MST530.-...-FT-N0SN-NNNN
SUP-M03-MBT530	R911296538	MST530.-...-ST-N0CN-NNNN

Fig. 7-1: MBT – pre-assembled mounting ring

Handling

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

Therefore, please heed the following procedure:

Ordering

You will find a special text in the quote of Bosch Rexroth, you may copy this into your purchase order. Herewith, the assignment of stator type and installation ring can be traced during order processing. The fixed buy-back price for the mounting ring is already stipulated in the quote.

Waybill

Upon delivery of a mounting ring, a “SUP-MBT waybill” including further information is in the packing unit. Please keep it for the eventually return of the mounting ring.

Reconsignment

1. Contact the Rexroth branch which supplied you and ask for a return number (RGA number).
2. Fill out the data on the backof the waybill completely.
3. Send the undamaged goods together with the waybill – no postage required – to the destination.

Note: Return the goods back only according to Incoterm clause **DDU**. Other Incoterms will not be accepted.

4. A credit note for the fixed value for the undamaged and reusable mounting rings will be remitted to your customer account after receipt. You can query your Bosch Rexroth sales office about the fixed values of your credit notes.

For high-volume production, it is advisable to store a sufficient amount of mounting rings at the facility where the motors are being installed. As a result, service and installation work can be done more quickly. In such cases, keep the waybill in a safe place in case the goods need to be returned at a later time.

Dimension Sheet for Mounting Ring in SUP-M01-MBT450

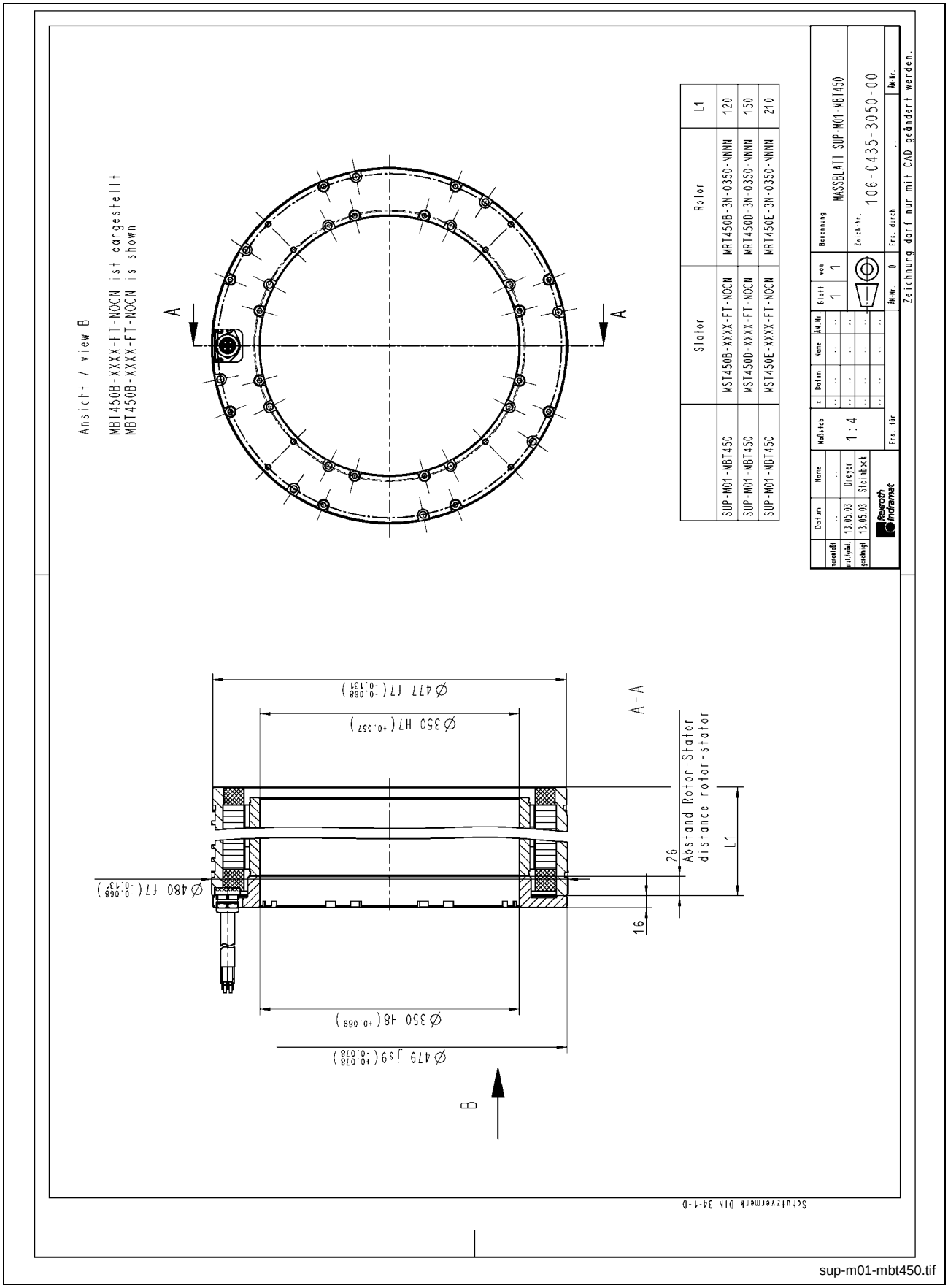
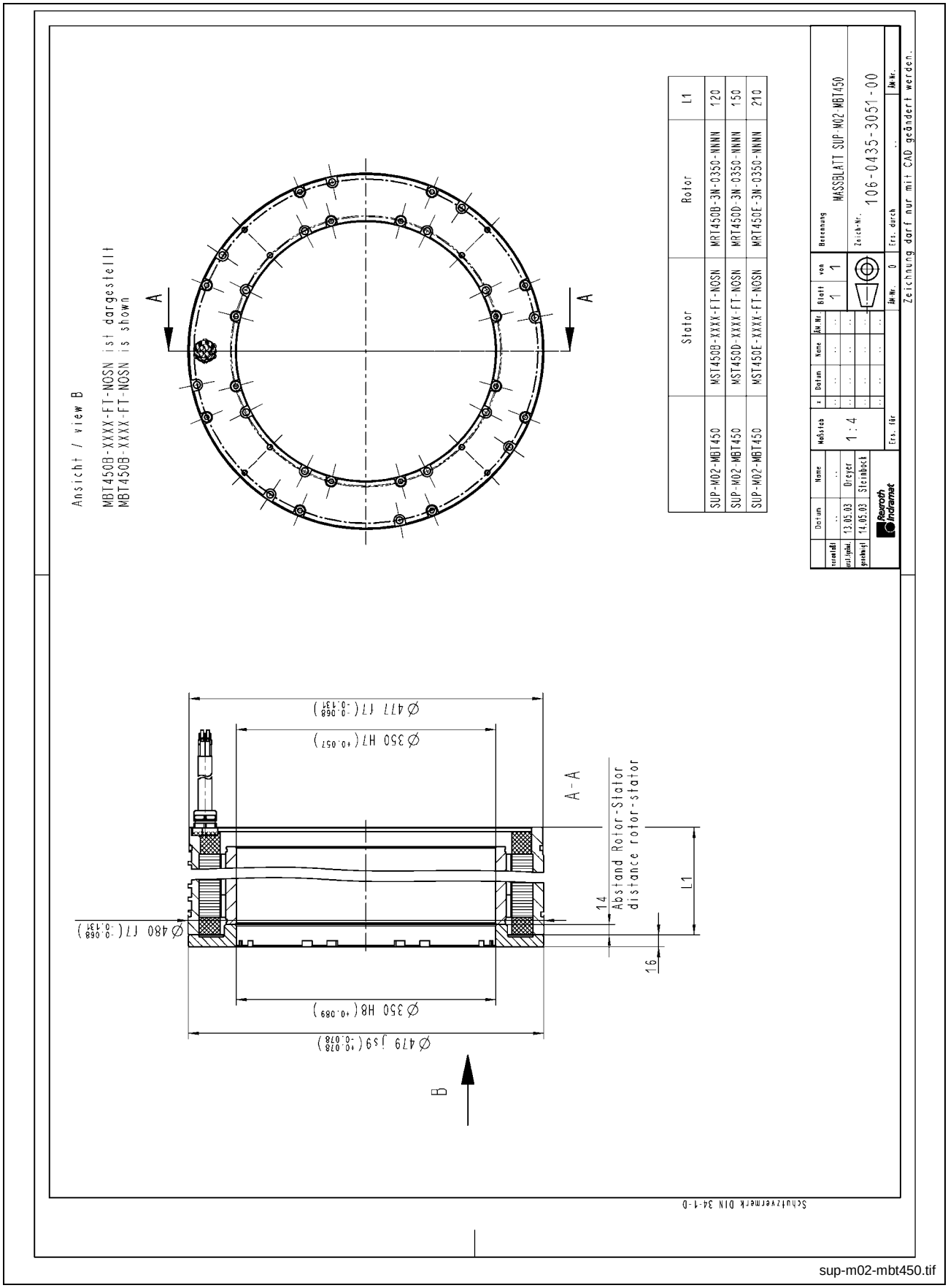


Fig. 7-2: Dimension sheet for mounting ring in SUP-M01-MBT450

Dimension Sheet for Mounting Ring in SUP-M02-MBT450



sup-m02-mbt450.tif

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

Dimension Sheet for Mounting Ring in SUP-M01-MBT530

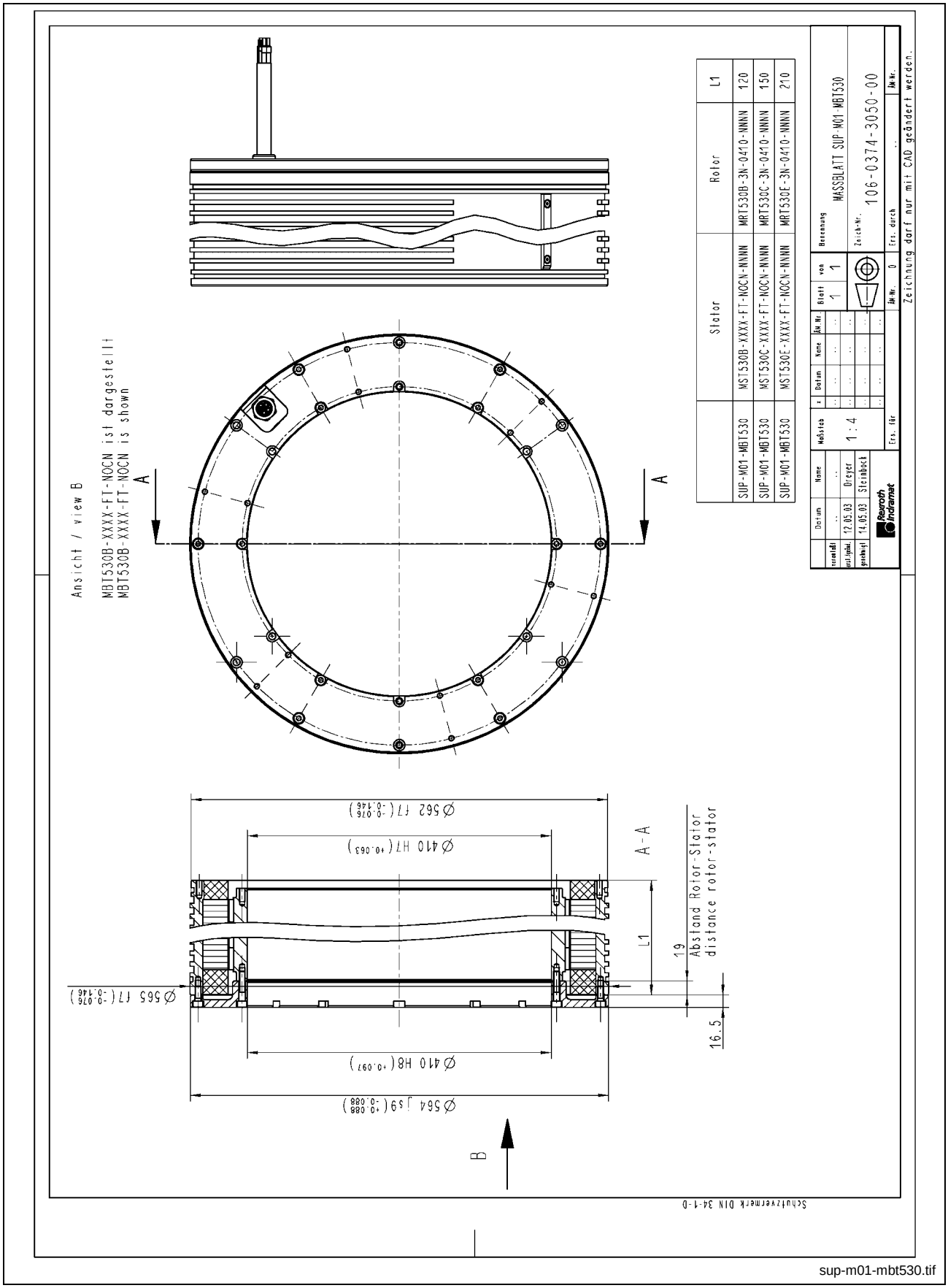
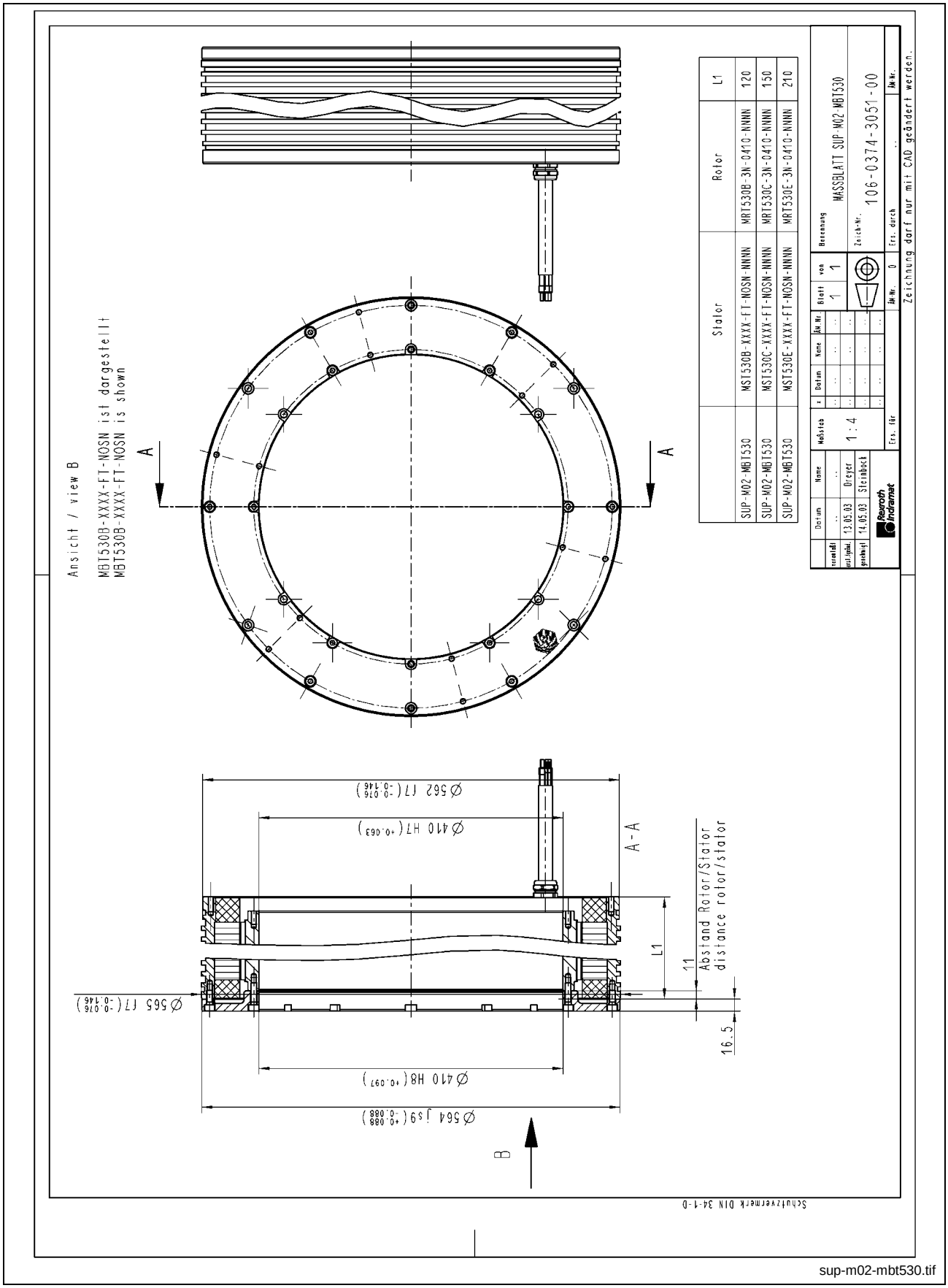


Fig. 7-4: Dimension sheet for mounting ring in SUP-M01-MBT530

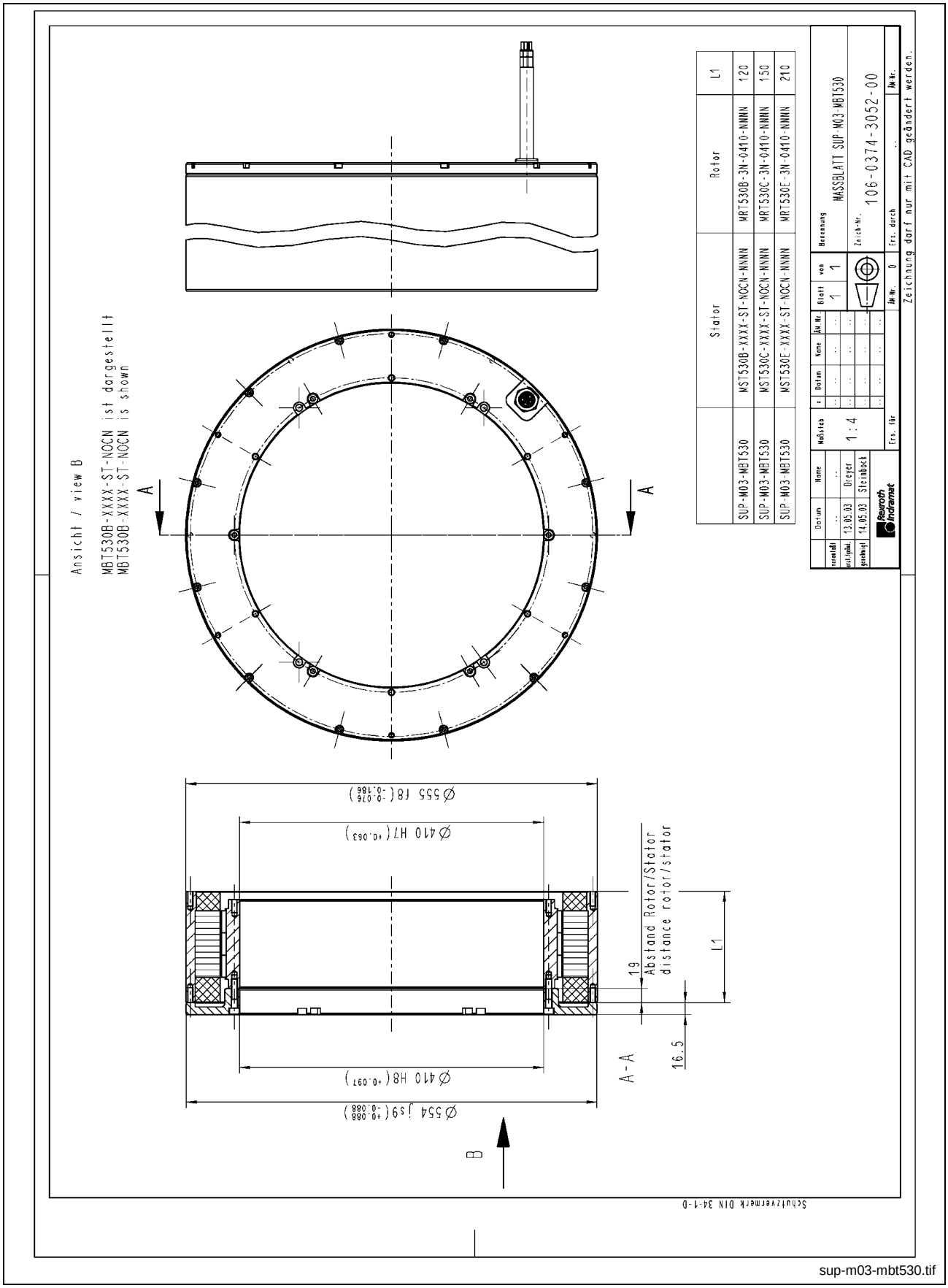
Dimension Sheet for Mounting Ring in SUP-M02-MBT530



sup-m02-mbt530.tif

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

Dimension Sheet for Mounting Ring in SUP-M03-MBT530



sup-m03-mbt530.tif

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

8 Connection Techniques

8.1 Notes

CAUTION

Destruction of the motors by direct connection to the 50/60Hz mains network (three-wire or single-phase mains)!

⇒ The motors described here may be operated only with suitable drive control devices, with variable output voltage and frequency (converter mode), as specified by Rexroth.

Bosch Rexroth offers a wide range of ready-made cables, which are optimally adapted to our products and different demands, for connecting IndraDyn T motors.

Note:

- **Note that self-assembled cables or cable systems from other manufacturers may not fulfill these criteria.**
- **Thus Bosch Rexroth shall not be held responsible for damages resulting from their use.**
- The chosen connection must be suitable for the applied intermediate circuit voltage.
- The design of the power cable also depends on the control device used. Please observe the documentation of the drive device.

You can find additional information ...

- on selecting power and encoder cables for IndraDyn T motors in the Documentation “Rexroth Connection Cables”, MNR. R911282688
- for assembling **cables and plugs**, as well as technical data, in the documentation "Rexroth Connection Techniques, Assembling and Tools...", MNR. R911286117.
- for **connection and dimensioning** of cooling systems for IndraDyn T motors in the documentation "Liquid Cooling of Rexroth Drive Components", MNR. R911265836.
- for "**electromagnetic compatibility** (EMC) for drive and control systems" in the documentation of the same name, MNR. R911259814.

8.2 Connection Cables

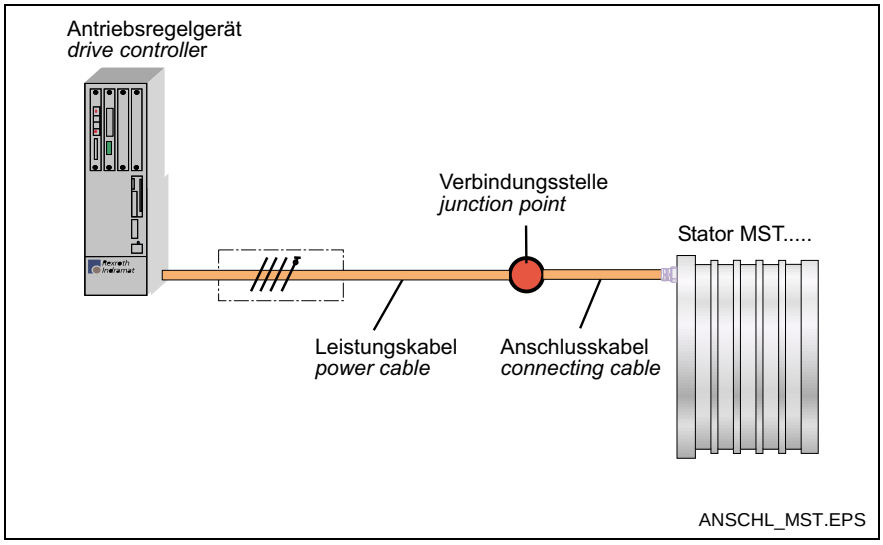


Fig. 8-1: IndraDyn T connection diagram

In the standard design, the stators are electrically connected using an

- approx. 2m-long connection cable with wire end ferrules.

Stators with type key option “Other design ...D30x” are supplied with an

- approx. 2m-long single wires with wire end ferrules.
- approx. 1.5m-long single wires for MST210 in design “...D301”.

The connection cable is guided on the stator side with either the larger or smaller external diameter.

The following overview provides the technical data of these connection cables for the individual stator sizes.

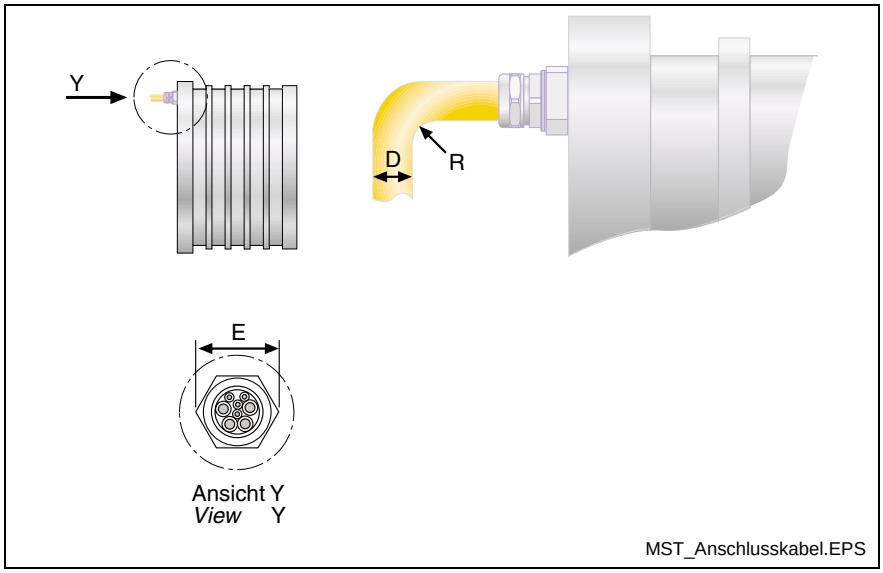


Fig. 8-2: Connection cable on stator

Stator	Connection cable	Connection wire cross-section	Control wire cross-section	Width across corners [E] for PG threads	Diameter [D] +/- 1mm	Permitted bending radius [R]
MST130x-...NS-..	Single wires	1.5mm²	1.0mm²	- / -	15mm	10
MST130x-...-FT-.. MST210R-xxxx	INK678 + L17YC11Y	1.5mm² - / -	- / - 1.0mm²	23mm 16mm	10.5mm 6mm	for fixed installations: 6 x D; for flexible installations: 10 x D
MST160x-xxxx MST210A-0027 MST210C-0027 MST290B-0018 MST290D-0002	INK602	2.5mm²	1.0mm²	34mm	14.8mm	
MST210C-0050 MST210E-0027 MST290D-0018 MST290E-0004 MST360B-0018 MST360D-0012 MST360D-0018	INK603	4.0mm²	1.0/ 1.5mm²	34mm	16.3mm	
MST210D-0070 MST290E-0018 MST450B-0012 MST450D-0006 MST450D-0012 MST450E-0006 MST530B-0010 MST530C-0010	INK604	6.0mm²	1.0/ 1.5mm²	34mm	18.5mm	
MST360E-0018 MST450E-0012 MST530E-0010	INK605	10.0mm²	1.5mm²	40mm	22.2mm	
MST530G-0006 MST530G-0007 MST530L-0006 MST530L-0007	Single wires	2x16.0mm² per phase	1.5mm²	- / -	2 x 9mm	90mm

Fig. 8-3: Connection cables for IndraDyn T stators

The wire designation on the connection cable depends on the selected stator design and is made as follows:

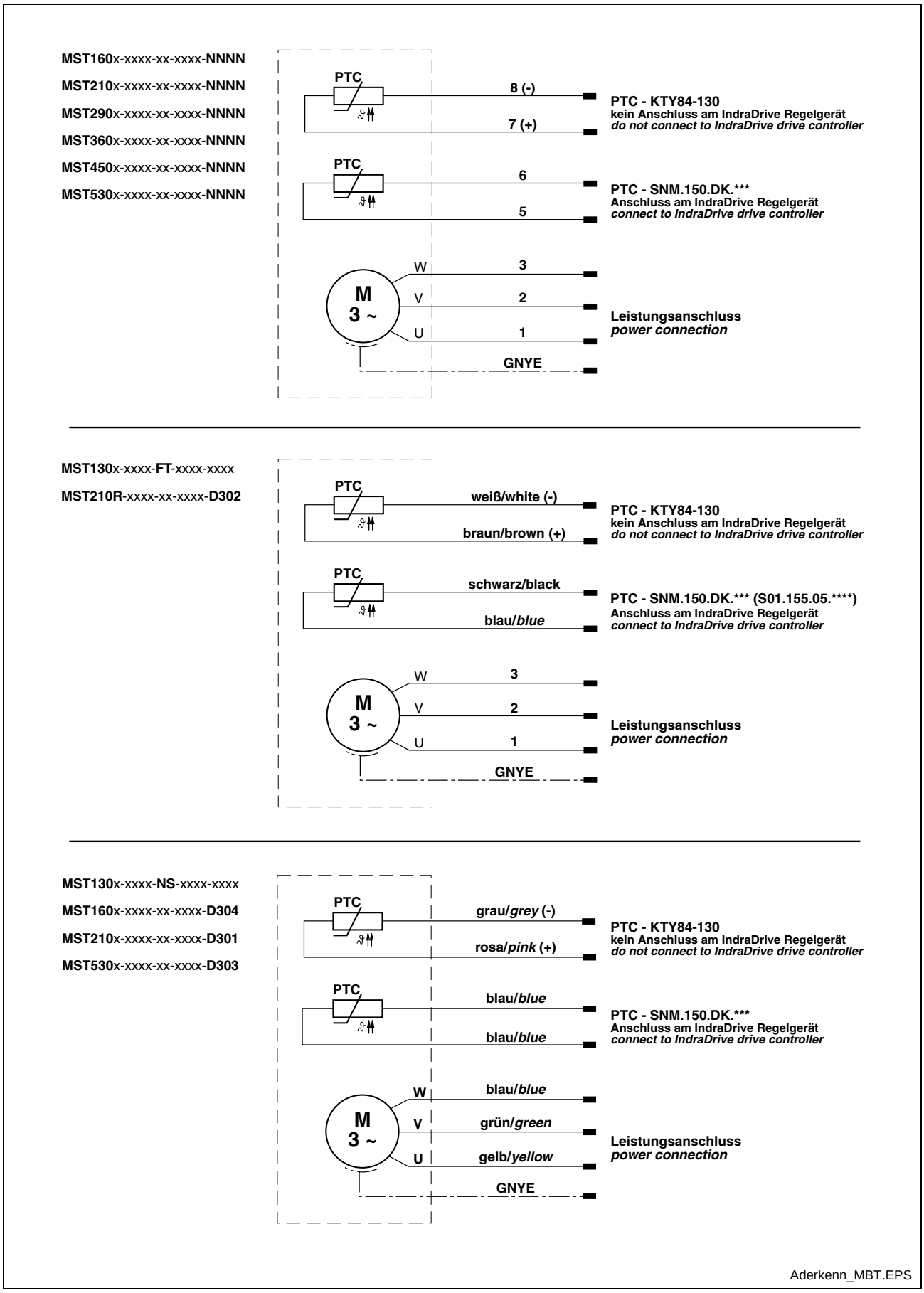


Fig. 8-4: Wire designations for IndraDyn T stators

Before connecting the motor, the following steps must be carried out by the machine manufacturer:

1. Decide on the type of connection (**terminal box** or **coupling and connector)** as well as procurement of the required components.
2. Shorten the power cable to the desired length (only if required).
3. If the Rexroth connection technique is used: create the motor-side connection according to the documentation "Rexroth Connection Cables", MNR. R911282688.
4. Attaching the coupling and the cable harness to the machine.

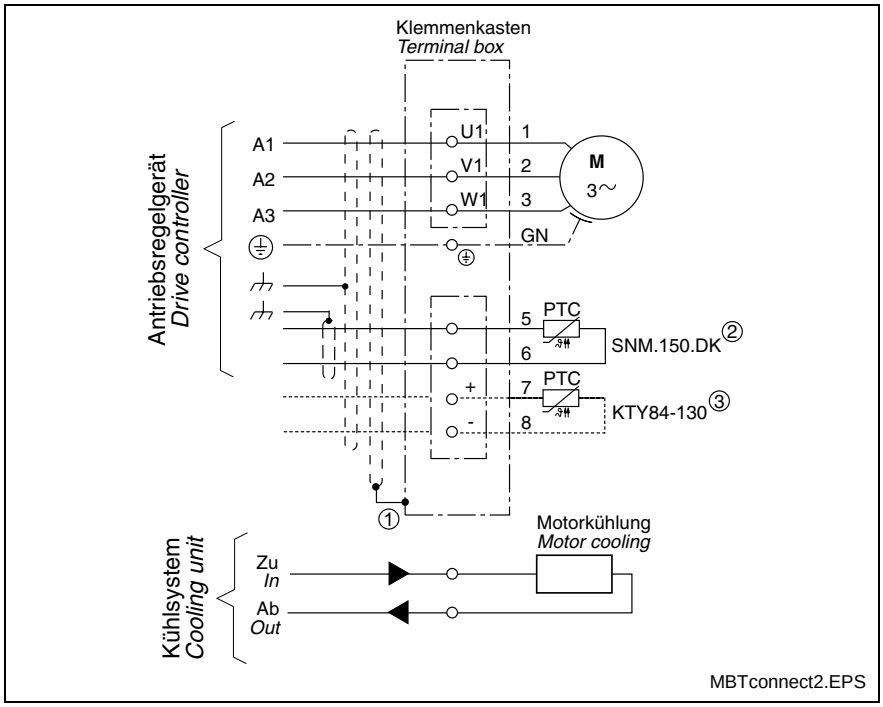
Note: Pinching and constant movement of the connection cable or of the wires on the point of exit can cause breakage of the cable or other irreparable damage.

- Minimum bending radius for fixed installation: **R = 6 x D**
- Minimum bending radius for flexible installation: **R = 10 x D**

The following points must be heeded in particular for the creation and installation of connections:

- Carefully execute the shield connection to maintain the EMC guidelines.
- Carefully execute the screw and connector connections to maintain the proper degree of IP protection.
- The power cables for connection to the drive or control unit are not contained in the scope of delivery of the motor and must be ordered separately.
- Do not open or loosen the factory-attached and assembled PG screws. The internal shield connection could be damaged or become ineffective.
- The coolants, lubricants and fuels used on the machine are not permitted to damage the cables either chemically or structurally.

8.3 Connection with Terminal Box



(1) Shield connection via cable clamping of the cable strain relief within the PG thread.

(2): Connect temperature sensor SNM.150.DK (for protecting the motor) to the drive controller.

(3): Use temperature sensor KTY84-130 only for external temperature measurement.

Fig. 8-5: Sample connection using a terminal box

Terminal Box

The components for the connection with terminal box are not available from Bosch Rexroth. Some possible suppliers are:

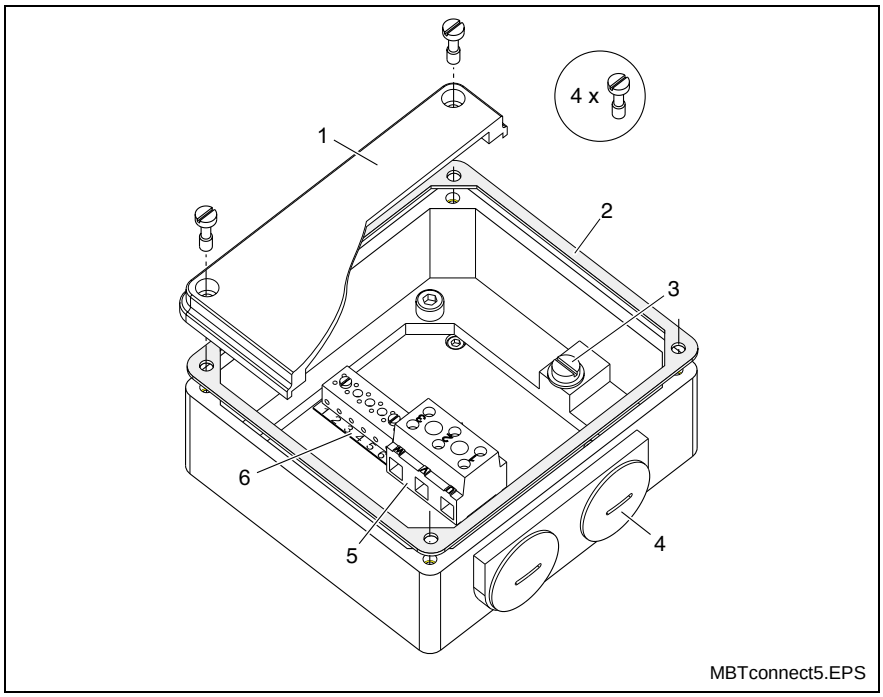
Components	Supplier
Terminal box	**KIENLE & SPIESS** Stanz- und Druckgießwerk GmbH Bahnhofstraße 23 74343 Sachsenheim, Germany Phone: +49 (0) 71 47 29 - 0 Fax: +49 (0) 71 47 29 - 1488 Internet www.kienle-spiess.de
Terminal board	**REKOFA WENZEL** GmbH & Co. KG Walporzheimer Strasse 100 53474 Bad Neuenahr-Ahrweiler, 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

Fig. 8-6: Terminal box suppliers

Pay attention to the following when selecting the components:

- The components must be suited for the currents and voltages of the chosen drive system, especially for high intermediate circuit voltages up to 750 V_{DC}.
- Heed the required diameter and end thread of the PG thread.
- Impermeability of the housing. Minimum protection class IP65 recommended.

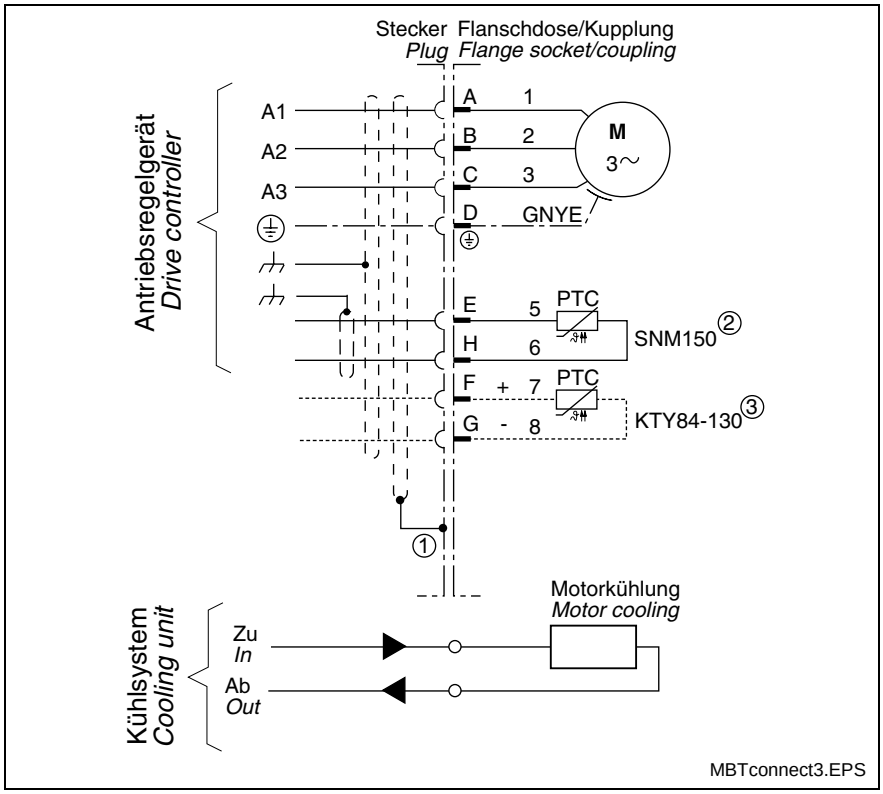
A complete terminal box consists, for example, of the following components:



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

Fig. 8-7: Terminal box

8.4 Connection with Coupling



(1) Shield connection via cable clamping of the cable strain relief within the PG thread.

(2): Connect temperature sensor SNM.150.DK (for protecting the motor) to the drive controller.

(3): Use temperature sensor KTY84-130 only for external temperature measurement

Fig. 8-8: Sample coupling connection

Coupling and Connector

Choose the coupling with the corresponding connector and the necessary connecting diameter according to the motor data sheet.

Order designation: INS0382/**LXX** or INS0482/**LXX**

- ../**L** = Solder version (contact pin with solder contact)
- ../..**XX** = Connection diameter (e.g. 6 mm² = **06**)

The coupling and connector to connect IndraDyn T motors have a bayonet socket and are not in the scope of delivery.

Note:

- When assembling the connection with crimp contacts, special tools are necessary.
- For more information about **creating** cables and connectors as well as technical data, see the documentation “Rexroth Connection Cables” MNR. R911282688.
- INS0482 connectors are only suitable for a cross-sectional diameters up to 10 mm².

Handling

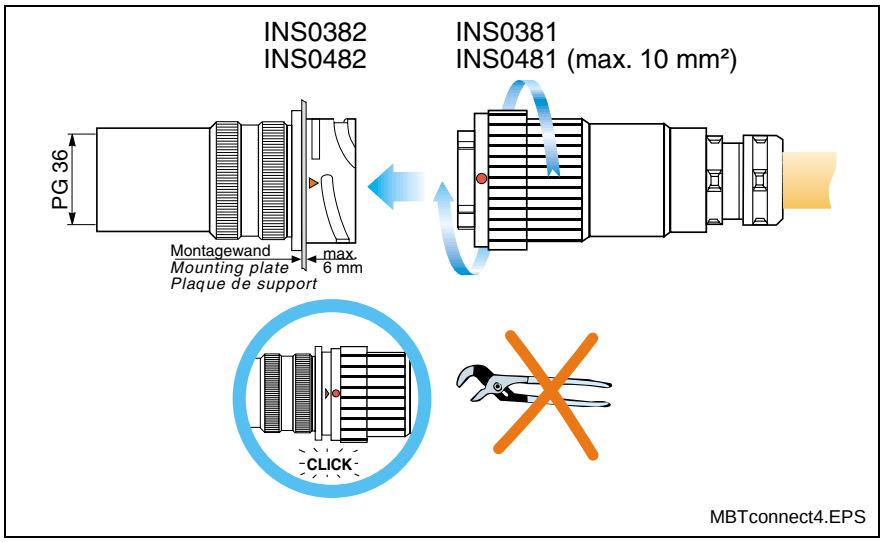


Fig. 8-9: IndraDyn T power connector

1. Insert the plug into the connector; pay attention to the coding.
2. Manually tighten the bayonet socket until it audibly locks in.
3. The red marks on the flange socket and the plug should be aligned when the bayonet connection is locked in.

8.5 Sensors

Encoder

An encoder and encoder connection components are not in the scope of delivery of the motor. Choose the components according to the requirements of the machine.

The encoder attachment and the rotation direction of the motor must be parameterized when the drive controller is commissioned. To do this, heed the functional descriptions for the drive controller as well as the definitions in chapter 9.8 “Drive Side and Rotation Direction”.

You can find information about encoder manufacturers in chapter 9.9 “External Components”.

Note:

The cables for connecting the motor encoder and the device control must have a compatible plug on the motor side. When using components of different manufacturers, always ensure that the connection system is compatible.

Temperature Sensors

To ensure a reliable motor protection, the temperature sensor SNM.150.DK must be connected to the drive controller. The connection is made according to the diagram in Figs. 8-5 or 8-8. For further notes regarding the temperature sensors, please refer to Chapter 9.6, "Motor Temperature Monitor”.

8.6 Motor Cooling

Synchronous IndraDyn T motors are supplied as kit motors without a motor housing for installation in the machine. The selection and dimensioning of the connection system is to be carried out by the machine manufacturer. For further notes regarding motor cooling, please refer to chapter 9.5, Motor Cooling, and chapter 9.6, Motor Temperature Monitoring.

⇒ Note the motor data in this documentation, as well as the general details for **dimensioning** cooling systems in the documentation “Liquid Cooling of Rexroth Drive Components...”, MNR. R911265836.

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

⇒ Note that intake and outflow are possible only in the position shown in the dimension sheet.

The assignment of intake and outflow has no influence on the performance data of the motor. For standardization and easy handling, an arrangement that has been proven once should be decided upon and maintained.

Operating Pressure

The maximum coolant supply pressure of **3 bar** applies to all IndraDyn T motors. This is measured directly at the coolant connection of the motor.

Please observe that additional threads or branch connections in the cooling circuit can reduce the flow and supply pressure of the coolant.

⇒ Select generously dimensioned connection threads and hose diameters.

9 Application Notes

9.1 Conditions for Use

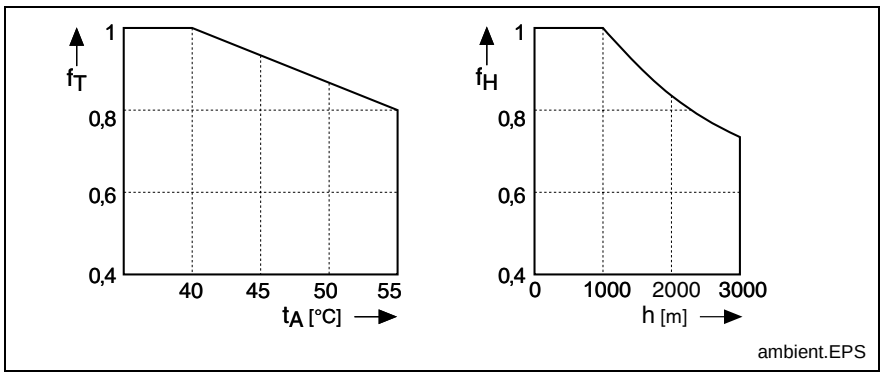
Setup Elevation and Ambient Temperature

The performance data specified for the drive system apply in the following conditions:

ambient temperature of 0º to + 40º C

setup elevation of 0 m to 1,000 m above sea level.

If you want to use the drive systems in areas with values beyond these ranges, the performance data are reduced according to the following figure.



(1): Utilization depending on the ambient temperature
(2): Utilization depending on the setup elevation
f_T: Temperature utilization factor
t_A: Ambient temperature in degrees Celsius
f_H: Height utilization factor
h: Setup elevation in meters

Fig. 9-1: Utilization factors

Notes: The details for the utilization depending on the setup elevation and ambient temperature do not apply to the defined liquid coolant on the motor, but rather to the entire drive system, consisting of the motor, drive controller and mains supply.

9.2 Ambient Conditions

According to DIN EN 60721-3-3, Tab. 6, 1994 edition, IndraDyn T motors can be operated in stationary weather-protected locations under the following conditions:

Ambient Mechanical Conditions

Vibrations / sine-shaped oscillations

Direction	Maximum permissible vibration load (10-2000 Hz)
axial	10 m/s²
radial	30 m/s²

Fig. 9-2: Maximum values for sine-shaped vibrations

Shocks/jolts

Motor frame size	Maximum permitted shock load (6ms)	
	axial	radial
130	100 m/s²	100 m/s²
160		
210		
290		
360		
450		
530		

Fig. 9-3: Maximum values for shock load

⇒ Ensure that the maximum values for storage, transport and operation of motors as specified in Figs. 9-4 and 9-5 are not exceeded.

The construction and effectiveness of shock-absorbing or shock-decoupling attachments depends on the application and must be tested using measurements. This does not lie within the area of responsibility of the motor manufacturer. Modifications of the motor construction result in nullification of the warranty.

Ambient Climatic Conditions

Humidity/temperature

Ambient climatic conditions are defined into different classes according to DIN EN 60721-3-3, Table 1. They are based on observations made over long periods of time throughout the world and take into account all influencing quantities that could have an effect, such as the air temperature and humidity.

Based on this table, Rexroth recommends class 3K4 for continuous use of the motors.

This class is excerpted in the following table.

Environmental factor	Unit	Class 3K4
Low air temperature	°C	+5 [1])
High air temperature	°C	+40
Low rel. air humidity	%	5
High rel. air humidity	%	95
Low absolute air humidity	g/m³	1
High absolute air humidity	g/m³	29
Speed of temperature change	°C/min	0.5
[1]) Rexroth permits 0°C as the lowest air temperature.		

Fig. 9-4: Classification of climatic environmental conditions according to DIN EN 60721-3-3, Table 1

9.3 International Protection Class

The degree of protection is defined by the abbreviation IP (International Protection) and two reference numbers specifying the degree of protection. The first reference number describes the degree of protection against contact and penetration of foreign bodies; the second reference number describes the degree of protection against water.

Protection class **IP00** according to IEC 60529:1989 + A1: 2000 applies for the stator and rotor of the IndraDyn T series. The applicability for certain conditions of the IndraDyn T motors must be checked carefully.

Heed the following list (without any guarantee for completeness).

Difficulties

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

Possible influences

- Chemical or electro-chemical interaction with subsequent corrosion or decomposition of motor parts.
- Damage of the winding insulation and irreparable damage of the motor.

Possible countermeasures

- Plan suitable covers or seals to protect the motor.
- Use only cooling lubricants and other materials that have no aggressive or decomposing effect on the motor parts.
- Do not clean with high pressures, steam or jets of water.

The machine manufacturer is responsible for the testing and execution of suitable measures.

9.4 Compatibility

All Bosch Rexroth control and drive devices are developed and tested according to the state of the art.

However, since it is impossible to follow the continuing further development of every material with which our controls and drives could come into contact (e.g. lubricants on tool machines), reactions with the materials that we use cannot be ruled out in every case.

For this reason, you will have to carry out a test for compatibility among new lubricants, detergents, etc. and our housing and device materials.

9.5 Motor Cooling System

The heat of the transformed motor power loss P_V is dissipated using the cooling system. IndraDyn T motors may be operated only if the supply of coolant is ensured. The cooling system must be rated by the machine manufacturer in such a way that all requirements regarding flow, pressure, purity, temperature gradient etc. are maintained in every operating state.

CAUTION

Impairment or loss of motor, machine or cooling system!

⇒ It is essential that you take into account the motor data and the explanations and conceptions of the cooling systems in the documentation "Liquid Cooling, Dimensioning, Selection", MNR. R911265836.

⇒ Heed the manufacturer's instructions when constructing and operating cooling systems.

⇒ Do not use any lubricants or cutting materials from operating processes.

⇒ Avoid pollution of the coolant as well as changes of the chemical consistency and of the pH value.

Coolants

All information and technical data are based on water as the coolant. If other coolants are used, these data no longer apply and must be recalculated.

Cooling with flowing tap water is not recommended. Calcareous tap water can cause deposits and damage the motor and the cooling system.

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

IndraDyn T motors can be damaged irreparably by using aggressive coolants, additives and lubricants.

⇒ Use systems with a closed circulation and a fine filter ≤ 100 µm.

⇒ Avoid pollution of the coolant as well as changes of the chemical consistency and of the pH value.

⇒ Heed the environmental protection and waste disposal instructions at the place of installation when selecting the coolant.

Rexroth can give no general statements or investigations regarding the applicability of process-related coolants or operating conditions.

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

Aqueous Solution

Aqueous solutions ensure reliable corrosion protection without significant changes of the physical property of the water. The recommended additives contain no materials harmful to water.

Emulsion with Corrosion Protection

Corrosion protection oils for coolant systems 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 duct against corrosion and cavitation. An oil content of 0.5 - 2 volume percent has proven itself.

If the corrosion protection oil is responsible for not only corrosion protection but also for lubricating the coolant pump, an oil content of 5 volume percent is necessary.

⇒ Heed the instructions of the pumping manufacturer!

Description	Manufacturers in Germany
1-3% solutions	
Aquaplus 22	Petrofer, Hildesheim
Varidos 1+1	Schilling Chemie, Freiburg
33% solutions	
Glycoshell	Deutsche Shell Chemie GmbH, Eschborn
Tyfocor L	Tyforop Chemie GmbH, Hamburg
OZO antifreeze	Deutsche Total GmbH, Düsseldorf
Aral cooler antifreeze A	ARAL AG, Bochum
BP antifrost X 2270 A	Deutsche BP AG, Hamburg
Emulsifiable mineral oil concentrate	
Shell Donax CC (WGK: 3)	Shell, Hamburg

Fig. 9-5: Recommended coolant additives

Used Materials

In IndraDyn T motors, the coolant comes into contact with the following materials:

- AlSi5Mg (cooling jacket)
- Fluoric-rubber FPM (O-ring)

Coolant Inlet Temperature

IndraDyn T motors are designed according to DIN EN 60034-1 for operation with a coolant temperature between +10 and +40°C. This temperature range must be strictly observed. At higher coolant temperatures, the reduction of the available torque is increased. Because of high coolant temperature gradients, lower temperatures can lead to destruction of the motor.

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

Setting of the inlet temperature

Observe the permitted temperature range and heed the existing ambient temperature when setting the coolant inlet temperature. The lower limit of the recommended coolant inlet temperature can be limited compared to the existing ambient temperature. To avoid condensation, a value of max. 5°C below the existing ambient temperature is permitted as the lowest temperature to be set.

Example 1:

Specified temperature range: +10 - +40°C

Ambient temperature: +23°C

Set coolant inlet temperature: +18 - +40°C

Example 2:

Specified temperature range: +10 - +40°C

Ambient temperature: +32°C

Set coolant inlet temperature: +27 - +40°C

Note: The coolant inlet temperature must be set in a temperature range of +10°C - +40°C and may be only max. 5°C under the existing ambient temperature to avoid condensation.

Operation without Liquid Coolant

Theoretically, operation of IndraDyn T motors without any liquid coolant is possible.

Therefore, please heed the following notes and restrictions:

- Only the motors of size 130 "Cooling type **N**" (natural convection) and size 530C “Cooling type **S**“ (surface ventilation) have been released for operation without liquid cooling.
- Without liquid cooling, only significantly reduced performance data are available. Except for MST130, these are not listed in this documentation.
- **Operation without liquid coolant is permissible only with an application test and explicit permission by Bosch Rexroth. This mode of operation is not proper without such a test and permission; it violates any kind of guarantee.**

If required, please contact the responsible Bosch Rexroth branch. You can find the addresses in the Appendix.

Rotor Temperature

The maximum permitted rotor temperature when operating the motor is +100°C. If this temperature must be exceeded, e.g. if parts attached to the rotor lead to heating of the motor, the user must provide additional cooling of these parts.

9.6 Motor Temperature Overview

CAUTION

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

⇒ The PTC sensors are not safety devices and are not suited for integration in safety systems to protect persons or machines.

⇒ The PTC sensors are neither designed nor suitable for acquisition of the housing, rotor or bearing temperature. Additional requirements of the temperature monitor must be implemented by the machine manufacturer.

⇒ The motor is protected from a thermal load only if temperature sensor SNM.150.DK is connected to the drive control device.

Stators of synchronous-torque motors type IndraDyn T are standardized with integrated temperature sensors to protect the motor. Every motor phase contains one of three serially switched ceramic PTCs, so that thermal control of the motor in every operation phase is ensured. These thermistors (in the following: thermistor motor protection) have a switching character (see Fig. 9-7) and are evaluated on all Rexroth control devices.

Furthermore, all stators are fitted with an additional temperature sensor for temperature measurement. This sensor (in the following: sensor temperature measurement has a nearly linear characteristic curve (see Fig. 9-9).

Temperature sensor motor protection

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

Fig. 9-6: Temperature sensor motor protection

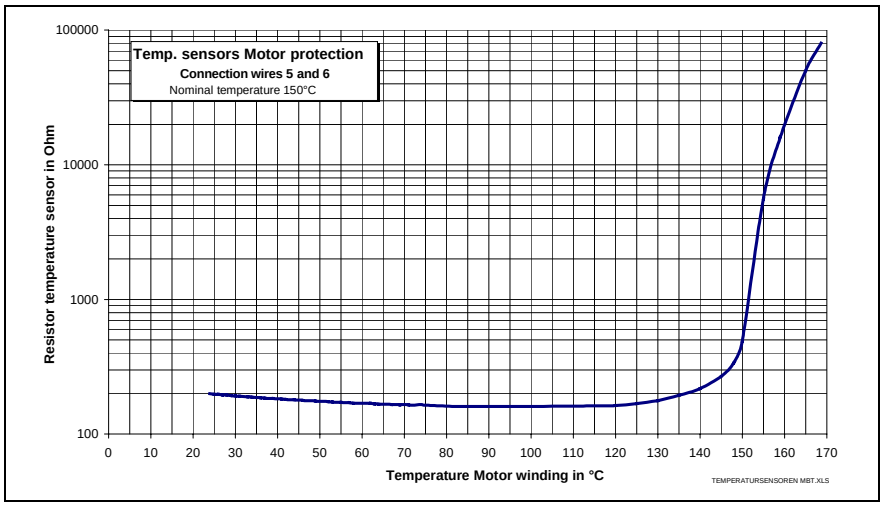


Fig. 9-7: Characteristic of motor protection temperature sensors (PTC)

External sensor temperature measurement

Type	KTY84-130
Resistor at 25°C	577 Ohm
Resistor at 100°C	1000 Ohm
Continuous current at 100°C	2 mA

Fig. 9-8: External sensor temperature measurement

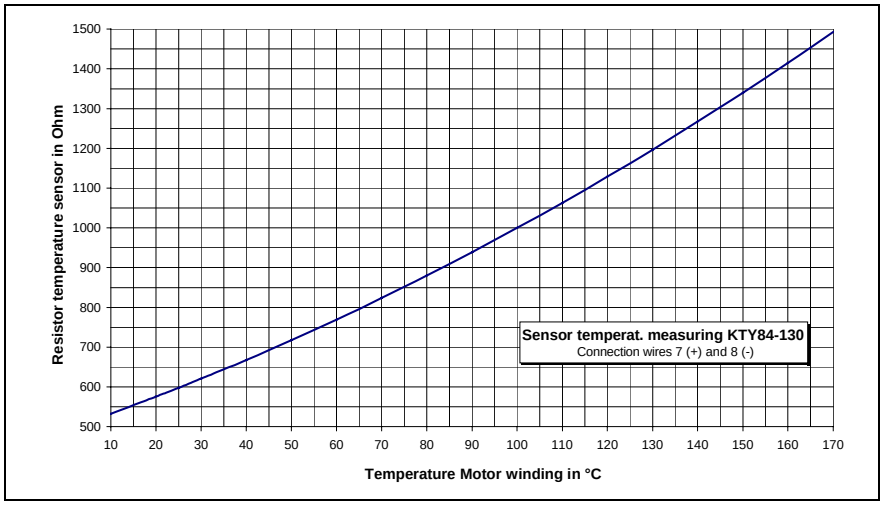


Fig. 9-9: Characteristic of temperature measurement sensor KTY84-130 (PTC)

A polynomial of degree 3 is sufficient for describing the resistance characteristic of the sensor used for temperature measurement (KTY84-130). In the following, this is specified for determining a temperature from a given resistance and vice-versa.

Temperature depending on resistance

$$T_w = A \cdot R_{KTY}^{\ 3} + B \cdot R_{KTY}^{\ 2} + C \cdot R_{KTY} + D$$

T_w: Winding temperature of the motor in °C
R_{KTY}: Resistance of the temperature sensor in Ohm
A: $3.039 \cdot 10^{-8}$
B: $-1.44 \cdot 10^{-4}$
C: 0.358
D: -143.78

Fig. 9-10: Polynomial used for determining the temperature with a known sensor resistance (KTY84)

Resistance depending on temperature

$$R_{KTY} = A \cdot T_w^{\ 3} + B \cdot T_w^{\ 2} + C \cdot T_w + D$$

T_w: Winding temperature of the motor in °C
R_{KTY}: Resistance of the temperature sensor in Ohms
A: $1.065 \cdot 10^{-6}$
B: 0.011
C: 3.93
D: 492.78

Fig. 9-11: Polynomial used for determining the sensor resistance (KTY84) with a known temperature

Note: Note the correct polarity when using the sensor for temperature measurement.

You can find further details on connecting the temperature sensors in chapter 8, “Connection Techniques”.

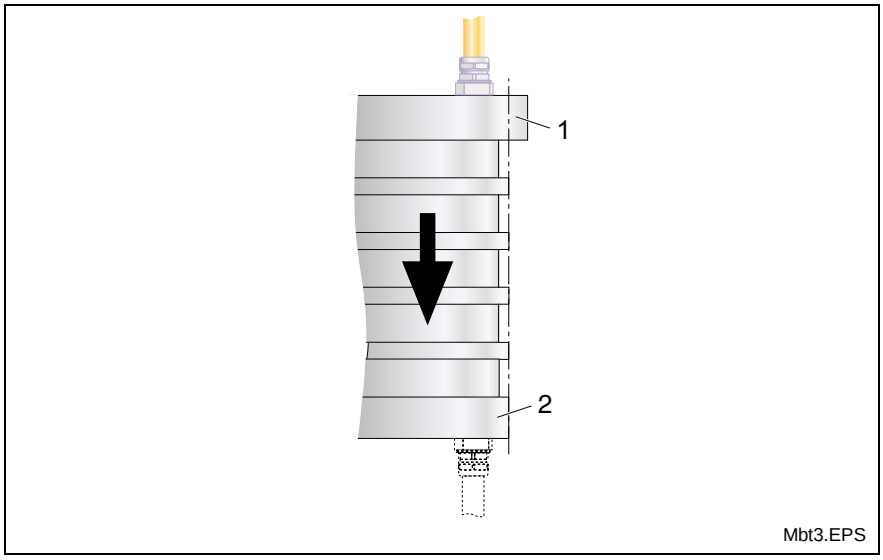
9.7 Fastening

Stator

The stator is fastened to one of the two stator ends using screwed connections. In no case may both ends be screwed on. Depending on the stator type selected, the stator ends may have different diameters, simplifying assembly (see Fig. 9-2).

When planning the installation, note the selected output direction of the power cable as well as the information in the dimension sheets, especially

- the number and type of fastening holes,
- the torque,
- and the depth of thread.



(1): Side with larger outer diameter (exaggerated view)
(2): Side with smaller outer diameter

Fig. 9-12: Example of IndraDyn T stator mounting

Note:

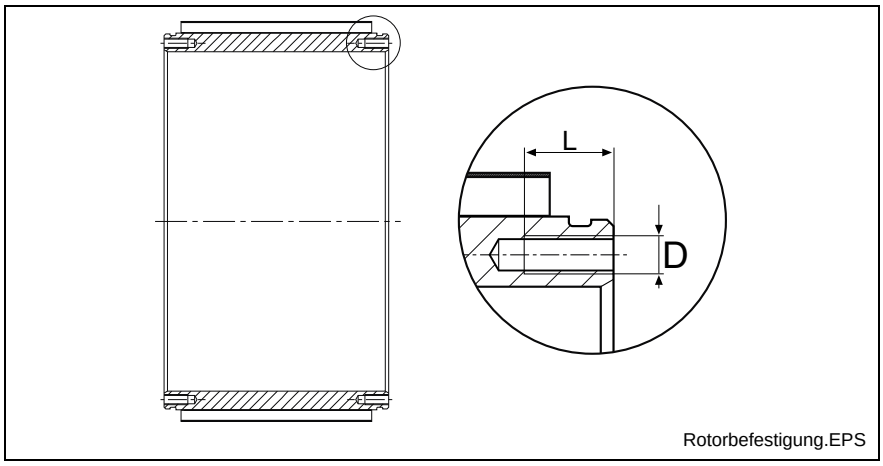
- The necessary screw length depends on the machine construction.
- In no case may both stators ends be screwed on.
- The screwed connections must be able to take up both the force due to the weight of the motor and the forces acting during operation.
- Notice the minimum depth of thread for screwed connections on stator type MST.

Rotor

The rotor is connected on the machine by screws.

During installation, note the information in the dimension sheets regarding

- the number and type of fastening holes,
- the torque,
- and the depth of thread.



(L): Depth of thread
(D): Thread diameter

Fig. 9-13: IndraDyn T rotor fastening

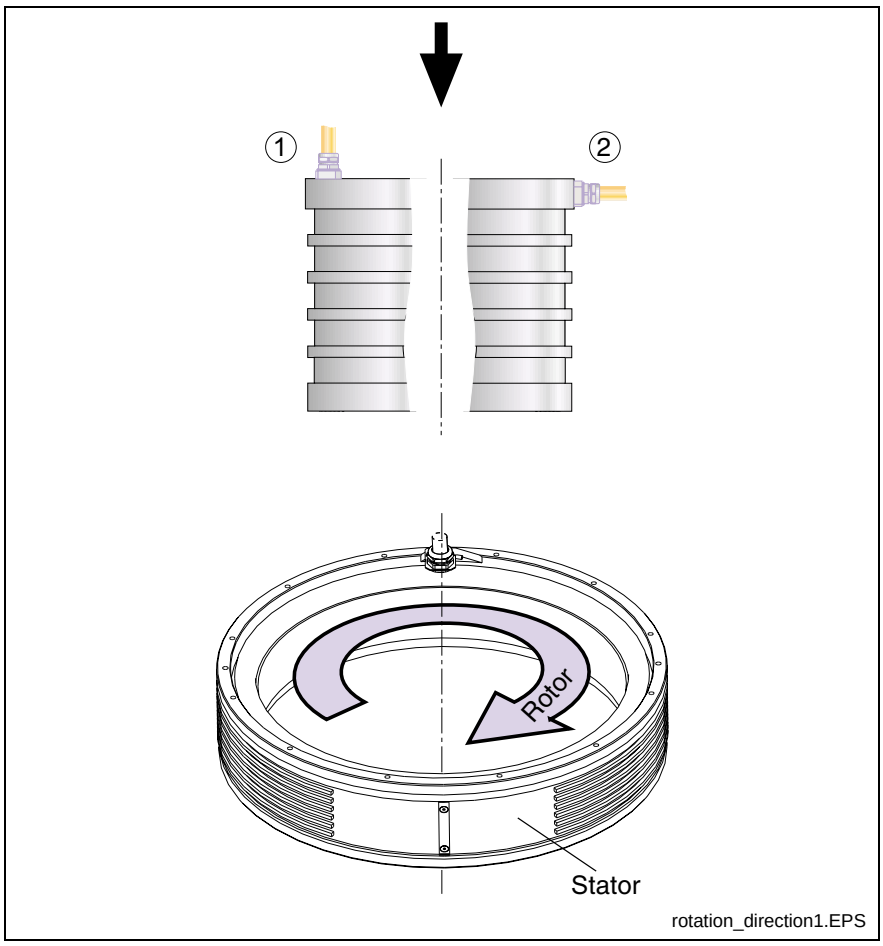
Note:

- The necessary screw length depends on the machine construction.
- The screwed connections must be able to take up both the force due to the weight of the motor and the forces acting during operation.
- Note the minimum depth of thread for screwed connections on rotor MRT.

9.8 Rotor Direction of Rotation

The rotation direction of the rotor on an IndraDyn T motor can be specified using the exit side of the power cable on the stator. The rotor must rotate in the clockwise direction when the exit side of the power cable is viewed.

The following figure clarifies the relationship.



(1): Axial power connection
(2): Radial power connection

Fig. 9-14: Rotor rotation direction with view of the cable exit side on the stator

9.9 Foreign Components

he bearing and the motor encoder do not belong to the scope of delivery of the IndraDyn T motor. The selection of the needed components depends on the requirements of the application or machine.

You can find further information regarding encoder systems, encoder signals and corresponding interface connections in the documentation of the control parts, DOK-INDRV*-CSH********-PR0x-EN-P, MNR R911295011.

Note: IndraDyn T motors can be operated together with Rexroth drive families DIAX04 and ECODRIVE03 only with an absolute measuring system. All current DIAX04 and ECODRIVE03 firmware can be used for this purpose.

A combination of an incremental measuring system and IndraDyn T motors cannot be used for DIAX04 and ECODRIVE03! Such applications are not supported!

Using the new IndraDrive drive generation, IndraDyn T motors can be combined with both incremental and absolute measuring systems!

Suppliers for encoder and bearing systems are

Component	Supplier
ER.... angle measuring instruments	**DR. JOHANNES HEIDENHAIN GmbH** Dr.-Johannes-Heidenhain-Str. 5 83301 Traunreut, Germany Tel.: +49 (0) 86 69 31 - 0 Fax: +49 (0) 86 69 50 61 Internet: www.heidenhain.de
RESR angle measuring systems	**RENISHAW GmbH** Karl-Benz-Strasse 12 72124 Pliezhausen Tel.: +49 (0) 71 27 / 98 10 Fax: +49 (0) 71 27 / 88 23 7 Internet: www.renishaw.com
YRT... bearings	**INA-SCHAEFFLER KG** Industriestrasse 1-3 91074 Herzogenaurach, Germany Tel.: +49 (0) 91 32 / 82 - 0 Fax: +49 (0) 91 32 / 82 - 49 33 Internet: www.ina.de

Fig. 9-15: Motor encoder / bearing suppliers

10 Handling and Transport

10.1 Supplied Condition

IndraDyn T motors are delivered in wooden crates. Packing units on pallets are secured by retaining straps.

CAUTION

Injuries due to uncontrolled movement of the retaining straps when cutting!

⇒ Maintain a sufficient distance and carefully cut the retaining straps.

Upon delivery, the stator and rotor of size 450 and 530 are connected with an mounting ring. During transport and storage, the mounting ring must remain on the motor.

⇒ Remove the mounting ring only after finishing and testing the assembly.

⇒ Use the mounting ring for securing the device during disassembly and return shipment.

MST stators with design "...-ST-..." are protected by corrosion protection wax RIVOLTA K.S.P. 317. The corrosion protection must be kept for transport and storage.

The contact surfaces of these stators must be cleaned with a suitable cleanser before mounting (e.g. RIVOLTA A.C.S.3).

Factory Inspection

All IndraDyn T motors undergo the following tests, among others, at the factory:

- High-voltage test according to EN 60034-1 (= VDE 0530-1).
- Insulation resistance according to EN 60204-1/1.92, Section 20.3.
- Geometric measurement of all mounting sizes.

Inspection by Customer

Since all IndraDyn T motors undergo a standardized inspection procedure, high-voltage tests on the customer side are not required. Motors and components could be damaged if they undergo several high-voltage tests.

CAUTION

Destruction of motor components by improperly executed high-voltage test! Invalidation of warranty!

⇒ Avoid repeated inspections.

⇒ Observe the regulations of EN 60034-1 (= VDE 0530-1).

Scope of Delivery

The total scope of delivery can be seen in the delivery note or the waybill. The content, however, can consist of several packages. Each individual package can be identified using the shipment label attached to the outside.

An individual type label with the device designation and technical details as well as a supply note with information for handling is provided in the packaging for both stator and rotor.

For motors with an optional mounting ring, an additional supply note with further information is attached.

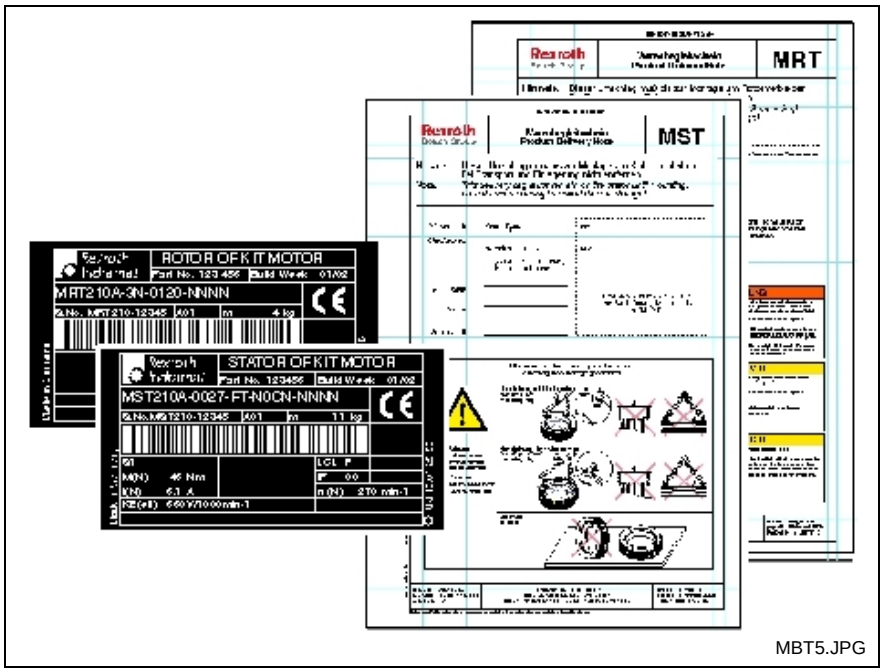


Fig. 10-1: Scope of delivery

⇒ After receiving the goods, compare the ordered and the supplied type. Submit claims concerning deviations immediately.

⇒ Control the received scope of delivery for its completeness.

10.2 Transport and Storage

Also observe the notes regarding storage and transport on the packages.

WARNING

The rotor is magnetic! Risk of injury and crimping danger by magnetic forces!

⇒ Eliminate movable metal objects or secure against movement.

⇒ Carefully handle magnetic parts.

CAUTION

Damages or injuries and invalidation of the warranty due to improper handling! Heavy!

- ⇒ **Strictly observe all security and warning notices (see Chapter 3)!**
- ⇒ Protect the products from dampness and corrosion.
- ⇒ Avoid mechanical stressing, jolts, throwing, tipping or dropping of the products.
- ⇒ Use only suitable lifting equipment.
- ⇒ Never pick up a motor on the connectors, cables or connection thread.
- ⇒ Use suitable protective equipment and protective clothing during transport.
- ⇒ **Transport** the motors horizontally in a dry, low-vibration, dust-free and corrosion-protected state. Permitted temperature range **-20° C to +80° C**.
- ⇒ **Store** the motors horizontally in a dry, vibration-free, dust-free and corrosion-protected location. Permitted temperature range: **0° C to +45° C**.

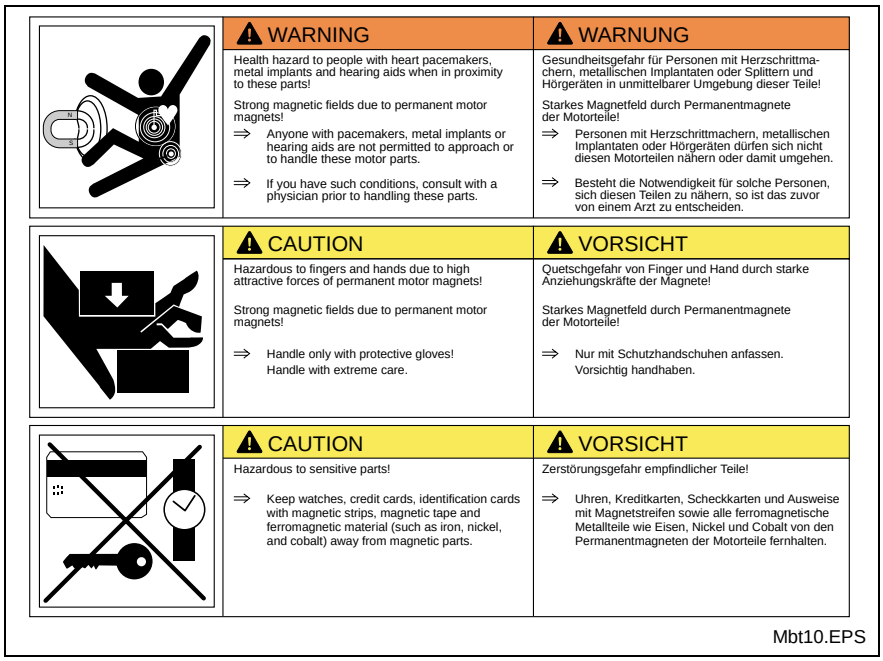
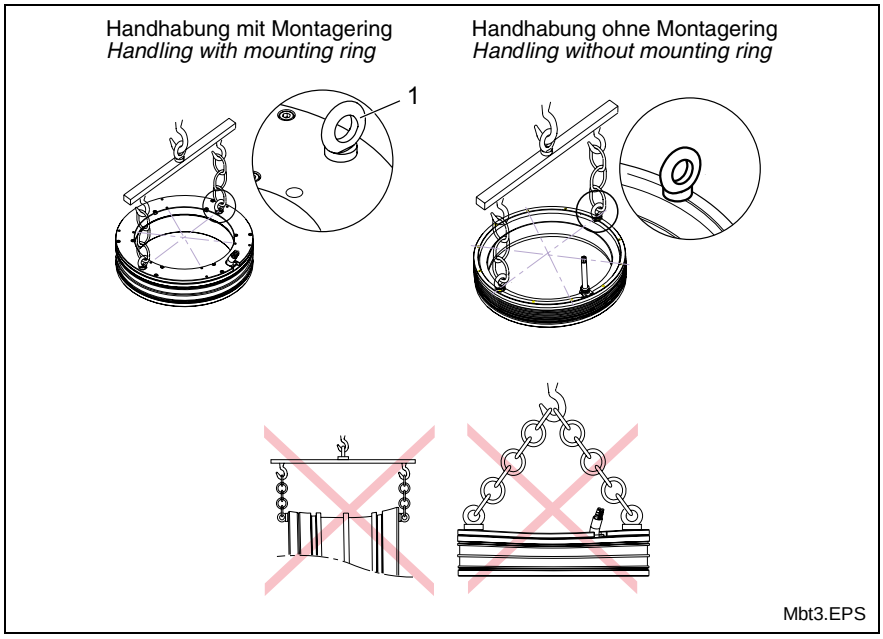


Fig. 10-2: Warning sign on and within packaging

The self-sticking warning label according to Fig. 10-2 (approx. dimensions: 110 mm x 150 mm) can be ordered from Rexroth (MNR R911278745).

Transport



(1): Ring screw for transport (according to DIN 580)

Fig. 10-3: IndraDyn T transport

Note:

- Use ring screws for transport only in opposite holes. Use only suitable lifting equipment.
- Place the motor only in the horizontal position on a clean, level base.
- If the fittings on the cooling jacket are damaged, the stator becomes useless.

Storage

Store the motor only according to the following figure.

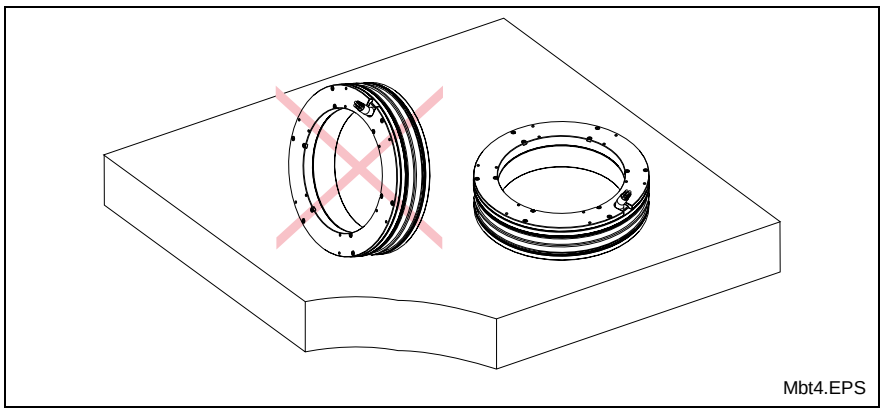


Fig. 10-4: IndraDyn T storage

Note:

- Place the motor only in the horizontal position on a clean, level base.
- Before you store or ship the parts, remove the remaining coolant and other pollution.
- Use the transport crate to store the motor over a longer time and to protect it against damage and pollution.

11 Installation

11.1 Safety

WARNING

Injuries due to live parts! Lifting of heavy loads! Danger of damage!

⇒ Carry out all working steps especially carefully. In this way, you minimize 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 by the loom of cables.

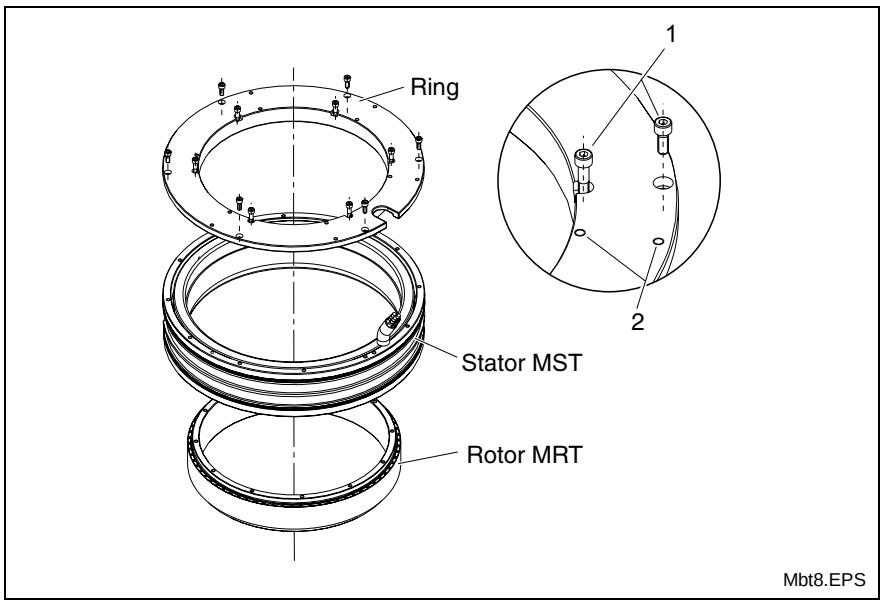
⇒ Install the motors only when they are de-energized and not connected electrically.

⇒ Observe the notes regarding safety and handling notes in previous chapters.

The number and sequence of the steps here described can be affected by the characteristics of the machine construction and deviate from the schematical procedure. The following description is provided only for orientation. Only the assembly instructions of the machine manufacturer are binding.

11.2 Mounting Ring

Upon delivery, the stator and rotor of IndraDyn T motors of size 450 and 530 are optionally connected with a mounting ring The following figure shows the construction.



(1): Fastening screw of the mounting ring
(2): Hole for ring screws

Fig. 11-1: IndraDyn T mounting ring

11.3 Mechanical Installation

WARNING

The rotor is magnetic! Risk of injury and crimping danger by magnetic forces!

⇒ Eliminate movable metal objects or secure against movement.

⇒ Carefully handle magnetic parts.

⇒ Wear protective clothing and use mounting tools.

The following mounting instructions describe a nonbinding, schematic construction without considering the constructive specialty of the machine; they serve only for general orientation.

The machine manufacturer must take into account the special character of his construction and must work out special mounting instructions. Only the assembly instructions of the machine manufacturer are binding.

Note: During assembly, avoid pinching or sticking of the stator and damage to the motor-side centering unit or to the system-side insertion fitting.

Avoid strain, pinching or other damage to the cable.

All screwed connections must be secured using LOCTITE 243 screw fastener. LOCTITE 243 – without an activator and at room temperature – becomes hand-tight within about 15-30 minutes. The final strength is reached after about 12 hours.

Note: The description of the motors with sizes 210R, 530G and 530L is provided in the Appendix (see Chapter 15).

Preparation

Initial state: The motor lies flat on a clean, level base.

1. Check whether the components are damaged. Defective components may not be mounted.
2. Hold tools, auxiliary material, measuring and test equipment ready and make sure that assembly can be carried out in a clean, dry and dust-free environment.
3. Check all components and mounting areas, holes and threads, as well as the O-ring nuts on the stator, whether they are clean and free of burrs. Everything must be **clean, stainless and completely free of burrs**. Clean and debur such areas if necessary.
4. Before assembly, clean the contact surface of the stators with design "..-ST-..." using a suitable cleanser (e.g. RIVOLTA A.C.S.3).
5. Grease the O-rings with an ordinary lubricant grease and mount the O-rings in the stator grooves. Avoid twisting and soiling of the O-rings.
6. Screw the ring screws required for transport into the opposite threads. Check the machine construction whether longer ring screws with a spacer sleeve are required.

Attend to cleanliness during all working steps!

When inserting the rotor into the stator, pay attention to the radial and axial forces resulting from the magnetic force.

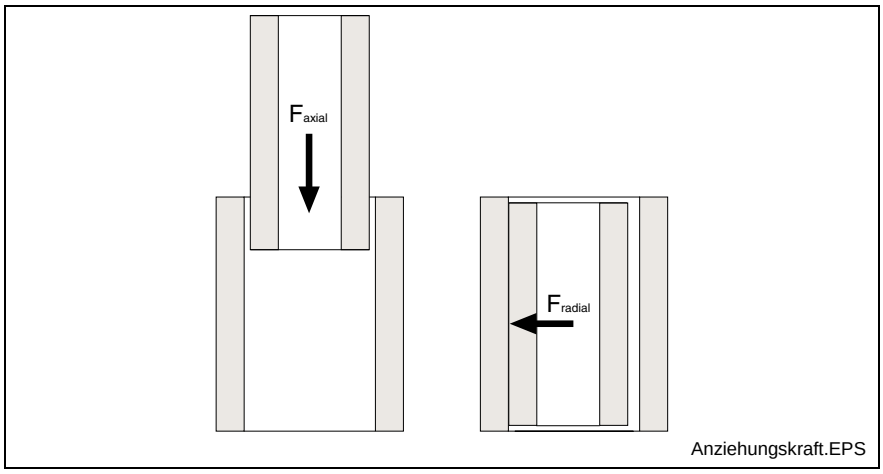


Fig. 11-2: Attractive forces during assembly

Rotor size MRT....		F_{axial} [N]	F_{radial} [N]
130	A	105	120
	C		361
	E		602
	G		843
160	A	143	410
	C		819
	E		1229
210	A	192	330
	C		824
	D		1154
	E		1649
	R		714
290	B	289	995
	D		1493
	E		2489
360	B	370	1273
	D		1909
	E		3182
450	B	479	1651
	D		2476
	E		4127
530	B	564	1940
	C		2911
	E		4851
	G		9702
	L		14553

Fig. 11-3: Magnetic forces of attraction during assembly

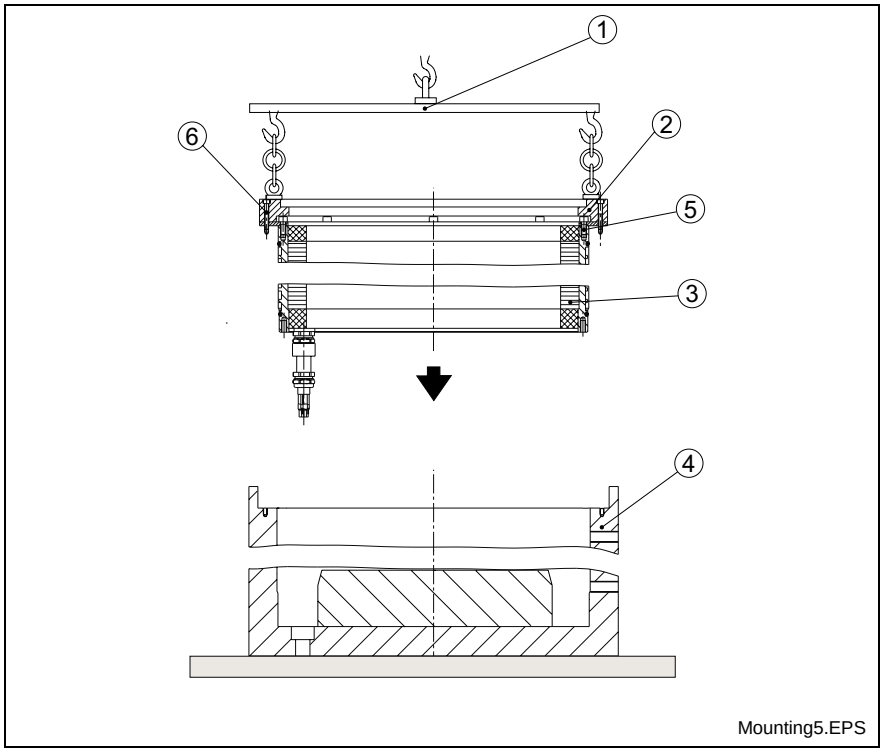
Assembly without Mounting Ring

The following figures show the general mounting procedure. Note the special mounting instructions of the machine manufacturer. All the screwed connections shown below must be secured using Loctite 243.

Initial state: The rotor and stator lie on a clean, level surface. All previously described steps have been carried out.

Mount the motor according to the following schematic procedure.

1. Screw the stator flange (2) onto the stator (3) using a torque wrench and the screws (5).
2. With a suitable tool (1), guide the stator into the machine housing (4) so that it is centered and then push the stator into its final position so that it is aligned properly.



(1): Lifting gear
(2): Stator flange
(3): Stator
(4): Machine housing
(5): Fastening screws for stator flange
(6): Fastening screws for stator flange - machine housing

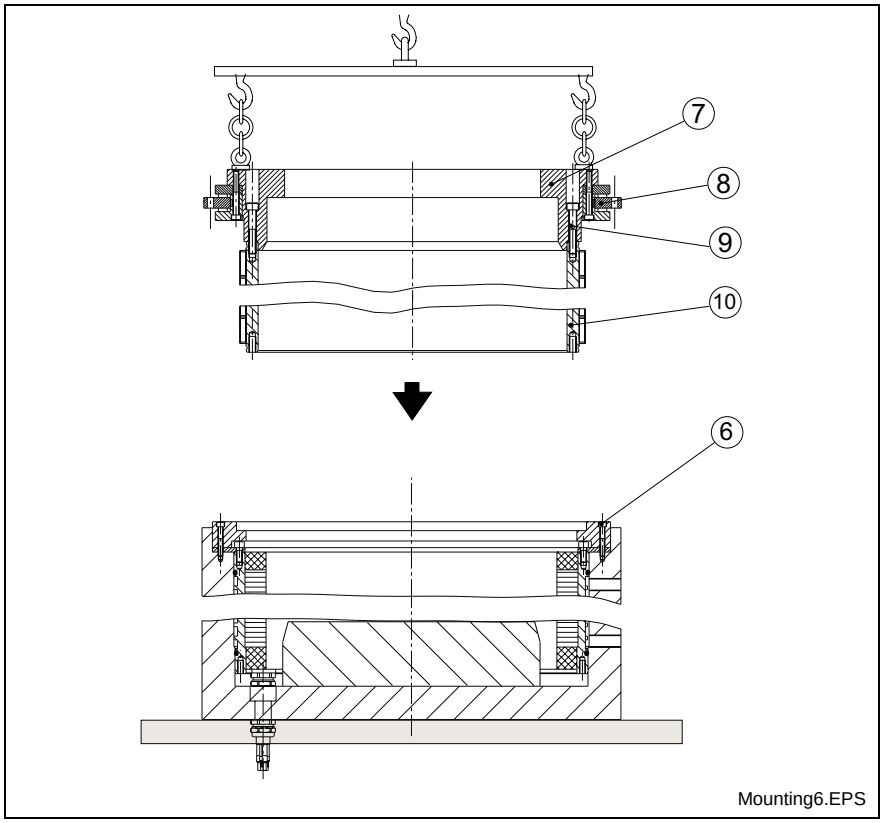
Fig. 11-4: IndraDyn T stator installation

3. Screw the stator flange onto the machine frame using a torque wrench and the screws (6).
4. Screw the rotor flange (7) onto the rotor (10) using a torque wrench and the screws (9).
5. Attach the bearing (8) to the rotor flange.
6. Secure the machine housing with the stator against lifting from the surface.
7. Guide the rotor package into the stator up to its final position so that it is centered.

WARNING

Injuries/damage

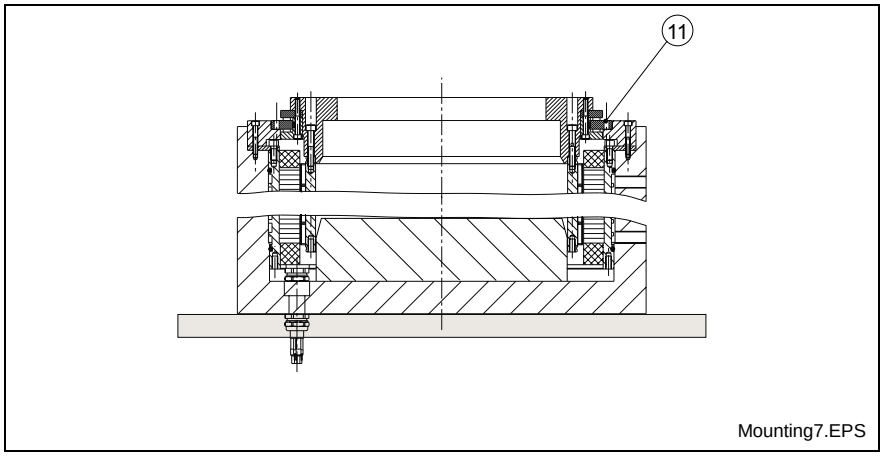
⇒ Due to the permanent magnets on the rotor and the resulting magnetic forces, the rotor is suddenly pulled into the stator.



(6): Fastening screws for stator flange - machine housing
(7): Rotor flange
(8): Axial-radial bearing
(9): Rotor fastening screws
(10): Rotor

Fig. 11-5: IndraDyn T rotor installation

8. Screw the bearing ring onto the stator flange using a torque wrench and the screws (11).



(11): Bearing fastening screws

Fig. 11-6: IndraDyn T installation

9. Screw the stator flange onto the machine housing using a torque wrench and the screws (6).
10. Check the accuracy and stability of all mounted parts and mechanical connections.

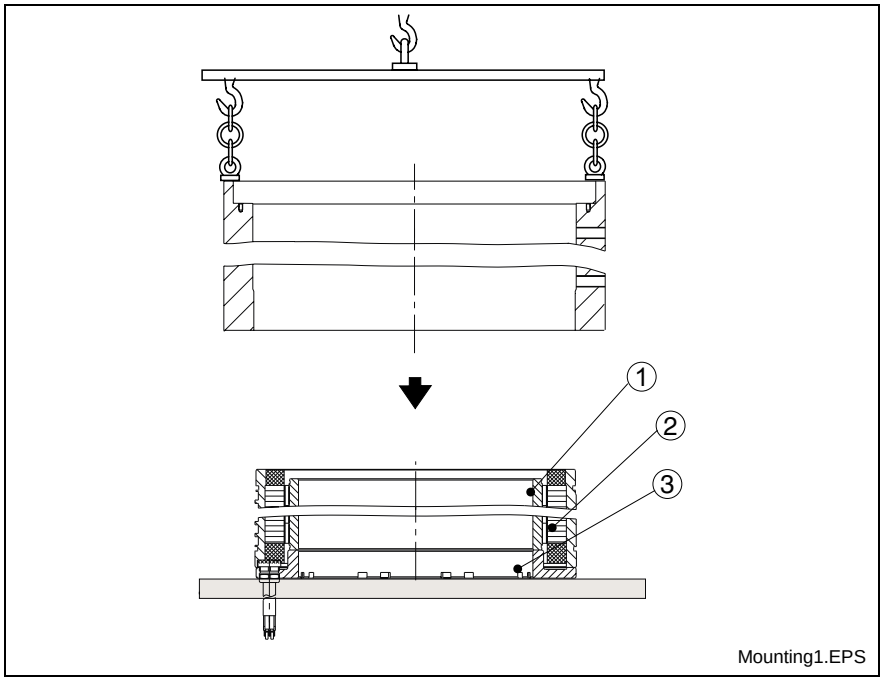
After proper mechanical assembly, continue with the other connections.

Assembly with Mounting Ring (Optional)

The following figure shows the general mounting procedure. Note the special mounting instructions of the machine manufacturer. All the screwed connections shown below must be secured using Loctite 243.

Mount the motor according to the following schematic procedure.

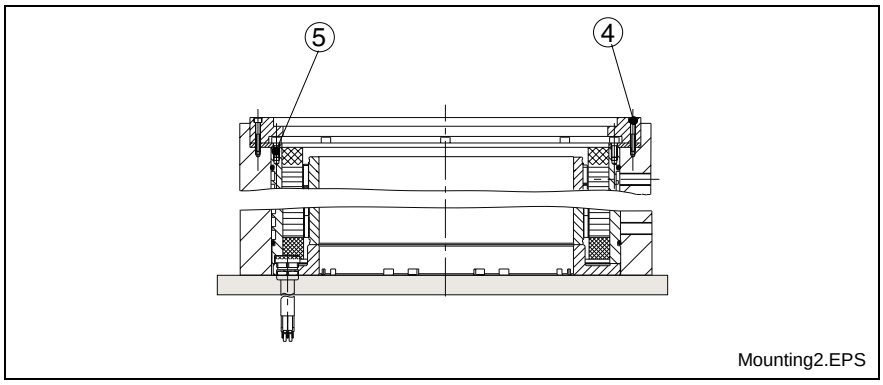
1. Guide the machine housing over the stator-rotor package up to its final position so that it is centered. Ensure that the stator centering unit guides the motor sufficiently and that it aligns properly.



(1): Rotor
(2): Stator
(3): Mounting ring

Fig. 11-7: Assembling the stator-rotor package

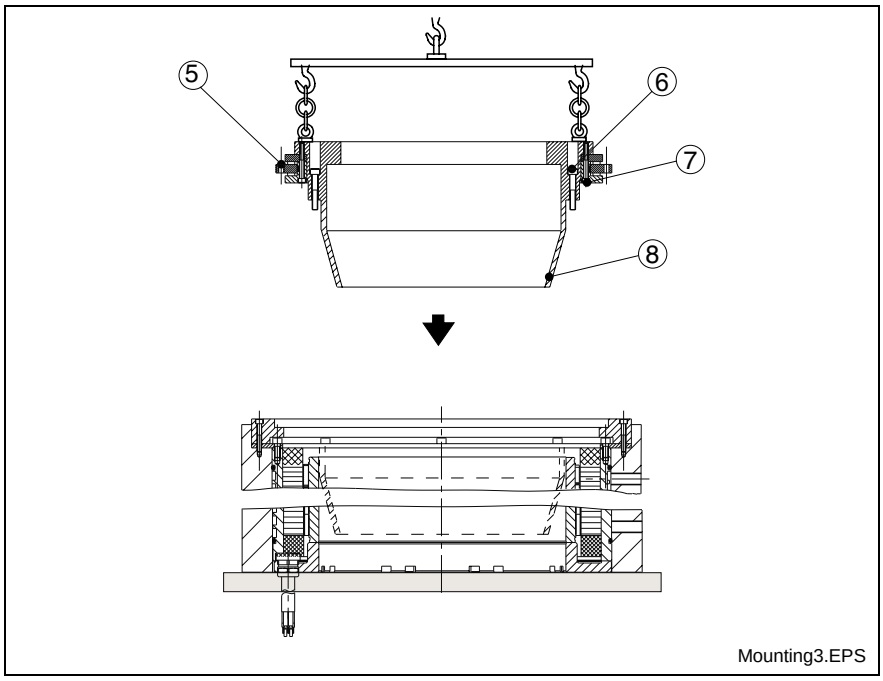
2. Attach the stator flange and screw it onto the stator and the machine housing using a torque wrench and the screws (4) and (5).



(4): Fastening screws for stator flange - machine housing
(5): Fastening screws for stator flange - stator

Fig. 11-8: Assembly of the stator flange

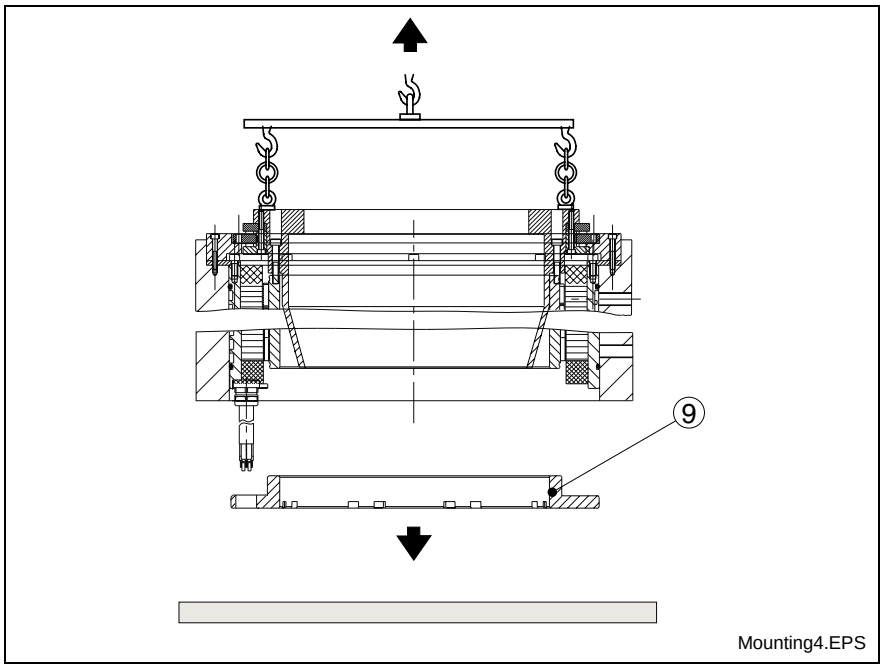
3. Screw the bearing ring onto the rotor flange using a torque wrench and the screws (7).
4. Lower the rotor flange, with the attached bearing, into the rotor until the centering unit (8) takes hold of the rotor flange in the rotor hole.
5. Loosen the fastening screws of the mounting ring on the stator (**not on the rotor**), but do not remove them.



(5): Bearing ring fastening holes
(6): Rotor flange fastening screws
(7): Rotor - bearing ring fastening screws
(8): Centering unit

Fig. 11-9: Attaching the rotor flange to the bearing

6. Lower the rotor flange, with the attached bearing, over the rotor down to the final position so that it is centered. Screw the rotor flange onto the rotor using a torque wrench and the screws (6).
7. Screw the bearing ring onto the stator flange using a torque wrench and the screws (5).
8. Loosen all the fastening screws on the mounting ring (9) and remove the mounting ring.



(9): Mounting ring

Fig. 11-10: Removing the mounting ring

9. Check the accuracy and stability of all mounted parts and mechanical connections.

After proper mechanical assembly, continue with the other connections.

11.4 Electrical Connection

Electrically connect the motor according to the terminal diagram and the instructions in chapter 8 “Connection Techniques”. Observe the notes in the supplementary documentation.

Note:

- In the case of self-made cables, pay attention that the design and installation are EMC-compatible.
- Pay attention to the fastenings of the connectors and cables to the cable strain relief that may be needed.
- The terminal diagrams of the product documentation are used to generate the system circuit diagrams. Solely the system circuit diagrams of the machine manufacturer are decisive for connecting the drive components to the machine.

11.5 Coolant Connection

Connect the coolant supply for the motor according to chapter 8.6 “Motor cooling” and the connection diagrams of the machine manufacturer.

The entire coolant system must be checked for leaks and deaeration before the commissioning the machine. Therefore, note the instructions of the manufacturer.

Note:

- No force may affect the motor-side screws via the supply cables.
- The terminal diagrams of the product documentation are used to generate the system circuit diagrams. Solely the system circuit diagrams of the machine manufacturer are decisive for connecting the drive components to the machine. This also applies to the integration of systems for pressure reduction, flow and temperature control.
- Commissioning of the coolant system is not part of commissioning of the motor. Heed the notes of the machine and coolant system manufacturers.

12 Operating Torque Motors

12.1 General Notes Regarding Commissioning

CAUTION

Material damage due to errors in the controls of motors and moving elements! Unclear operating states and product data!

⇒ Do not carry out commissioning if connections, operating states or product data are unclear or faulty!

⇒ Do not carry out commissioning if the safety and monitoring equipment of the system is damaged or not in operation.

⇒ Damaged products may not be operated!

⇒ Contact Bosch Rexroth for missing information or support during commissioning.

The following commissioning notes refer to the motors as part of a drive system with a drive and control unit.

Preparation

1. Keep the documentation of all used products ready.
2. Log all measures taken in the commissioning log.
3. Check the products for damage.
4. Check all mechanical and electrical connections.
5. When installing and programming the machine, heed the allocation of the rotational directions of the motor and encoder.
6. Activate the safety and monitoring equipment of the system.

Execution

When all prerequisites have been fulfilled, proceed as follows:

1. Activate the external coolant system to supply the motor and check for proper operation. The motor coolant circulation system must be filled completely with coolant. Consider the notes of the manufacturer.
2. Carry out the commission of the drive system according to the instructions of the corresponding product documentation. You can find the corresponding information in the functional description of the drive controller.
3. Log all measures taken in the commissioning report.

Commissioning of drive controllers and the control unit may require additional steps. The inspection of the functioning and performance of the systems is not part of the commissioning of the motor; instead, it is carried out within the framework of the commissioning of the entire machine. Observe the information and regulations of the machine manufacturer.

12.2 Commissioning

The following points must be heeded especially during the commissioning of synchronous torque motors.

Parameter

IndraDyn T motors are frameless motors whose individual components – supplemented by an encoder system – are directly installed into the machine by the manufacturer. As a result of this, kit motors have no data memory to supply motor parameters or standard controller adjustment. At startup, all parameters must be manually entered or loaded into the drive. The DriveTop commissioning program makes all motor parameters of Bosch Rexroth available.

Encoder polarity

When viewing the A side, the encoder must show a positive nominal value for the clockwise rotation of the rotor. This connection must be established before commutation adjustment.

Commutation adjustment

For IndraDyn T motors, it is generally necessary to receive the position of the rotor compared to the stator immediately after startup or after a malfunction. This is called identification of pole position or commutation adjustment. The commutation adjustment process is the establishment of a position reference to the electrical or magnetic model of the motor. The commutation adjustment method depends on the encoder used.

Further applicable documents

Besides this documentation, the following additional documents are required to commission motors:

- Rexroth IndraDrive Description of Functions, MNR R911299225
- Rexroth IndraDrive Parameter Description, MNR R911297317
- Rexroth IndraDrive Troubleshooting, MNR R911297319

12.3 General Preconditions

The following preconditions must be provided for successful commissioning.

- Adherence to the safety regulations and notes.
- Check of electrical and mechanical components for safe functioning.
- Availability and supply of required tools.
- Adherence to the commissioning procedure described in the following.

Check of All Electrical and Mechanical Components

Carry out a check of all electrical and mechanical components before commissioning. Heed the following points in particular:

- Ensured safety of personnel and machine
- Proper installation of the motor
- Correct power connection of the motor
- Correct connection of the encoder system
- Functioning of available limit switch, door switch, etc.
- Proper functioning of the emergency stop chain.
- Machine construction (mechanical installation) in proper and complete condition.
- Correct connection and functioning of the motor cooling system.
- Proper connection and functioning of the drive control unit.

WARNING

Mortal danger, serious injury or damage due to failure or malfunction of mechanical or electrical components!

⇒ Troubleshoot mechanical or electrical components before continuing with commissioning.

WARNING

Risk of injury or mortal danger, as well as damage due to non-adherence to warnings and safety notes!

⇒ Heed the warning and safety notes.

⇒ Commissioning must to be carried out by skilled personnel

⇒ Heed the commissioning procedure described in the following.

Tools

DriveTop commissioning software

Commissioning can be carried out directly using an NC terminal or using special software. The DriveTop commissioning software permits menu-driven, custom-designed and motor-specific parameterizing and optimization.

PC

A normal Windows PC is required for commissioning using DriveTop.

Commissioning via NC

To commission using an NC control, access to all drive parameters and functions must be guaranteed.

Oscilloscope

An oscilloscope is needed for drive optimization. It serves to display the signals, which can be shown via the adjustable analog output of the drive controller. Viewable signals include nominal and actual values for the speed, position or voltage, position lag, intermediate circuit, etc.

Multimeter

During troubleshooting and the check of components, a multimeter which can measure voltages, currents and resistance can be helpful.

12.4 General Commissioning Procedure

The following flow chart shown the general commissioning procedure for synchronous kit motors of the IndraDyn T series. These points are explained in detail in the following chapters.

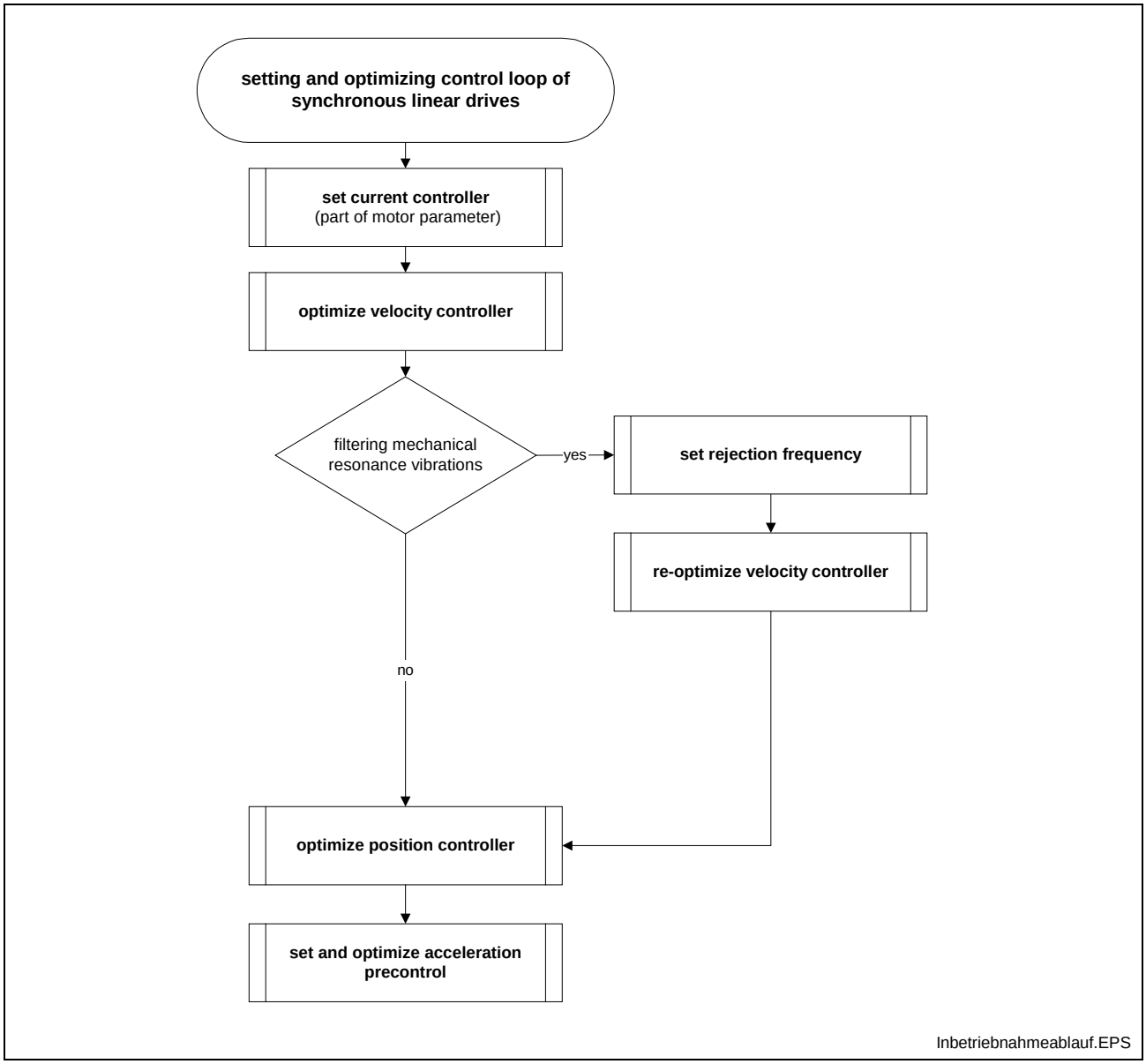


Fig. 12-1: General commissioning procedure for synchronous torque motors

12.5 Parameter Value Assignment

With DriveTop, entering or editing certain parameters and executing commands during the commissioning process is done inside menu-driven dialog boxes or in list representations. Optionally, this can also be performed via the control terminal.

Entering Motor Parameters

Note: The motor parameters are specified by Rexroth and must not be changed by the user. Commissioning is not possible if these parameters are not available. In this case, please contact with your Rexroth Sales and Service Facility.

WARNING

Injuries and mechanical damage if the motor is switched on immediately after the motor parameters have been entered! Entering the motor parameters does not make the motor operational!

⇒ Do not switch on the motor immediately after the motor parameters have been entered.

⇒ Enter the parameters for the encoder system.

⇒ Check and adjust the encoder polarity.

⇒ Perform the commutation setting.

The motor parameters should be entered in the following way:

- Use DriveTop to load all the motor parameters.

If the DriveTop commissioning software is not available,

- enter the individual parameters manually via the controller. You will receive a list with the required motor parameters from your responsible sales office.

Motor parameters

SercosID	Motor parameters
P-0-0004	Velocity loop smoothing time constant
P-0-0018	Number of pole pairs/pole pair distance
P-0-0045	Control word of current controller
P-0-0051	Torque/force constant
P-0-0512	Temperature sensor
P-0-0533	Voltage loop proportional gain
P-0-0534	Voltage loop integral action time
P-0-0535	Motor voltage at no load
P-0-0536	Maximum motor voltage

P-0-4005	Flux-generating current, limit value
P-0-4014	Type of construction of motor
P-0-4016	Direct-axis inductance of motor
P-0-4017	Quadrature-axis inductance of motor
P-0-4034	Thermal time constant of winding
P-0-4035	Thermal time constant of motor
P-0-4036	Rated motor speed
P-0-4037	Thermal short-time overload of winding
P-0-4048	Stator resistance
S-0-0100	Velocity loop proportional gain
S-0-0101	Velocity loop integral action time
S-0-0106	Current loop proportional gain 1
S-0-0107	Current loop integral action time 1
S-0-0109	Motor peak current
S-0-0111	Motor current at standstill
S-0-0113	Maximum motor speed
S-0-0201	Motor warning temperature
S-0-0204	Motor shutdown temperature

Fig. 12-2: IndraDyn T motor parameters

Input of the Parameters of the Encoder System

Encoder type

The encoder type must be defined. Parameter P-0-0074 is used to do this.

Encoder type	P-0-0074
Incremental encoder, e.g. Lenord&Bauer gear-wheel encoder	2
Absolute encoder, e.g. Rexroth DSF or Rexroth HSF Encoder	1

Fig. 12-3: Encoder type definition

Signal period

Encoder systems for IndraDyn T motors generate and interpret **sinusoid** signals. The sine signal period must be entered in parameter S-0-0116, sensor 1 resolution.

The required data are made available by the encoder manufacturer.

Input of Drive Limitations and Application-Related Parameters

Drive limitations

The possible selectable drive limitations include:

- Current limitation
- Torque limitation
- Speed limitation
- Travel range limits

Application-related parameters

The application-related drive parameters include, for example, the parameters of the drive fault reaction.

Note: For detailed descriptions, refer to the documentation: “IndraDrive Description of Functions”, MNR R911299224.

12.6 Determining the Polarity of the Encoder System

In order to avoid direct feedback in the velocity control loop, the effective direction of the motor force and the count direction of the encoder system must be the same.

WARNING

Different effective directions of motor torque and count direction of the encoder system cause uncontrolled movements of the motor upon power-up!

⇒ Ensure that uncontrolled movements do not occur.

⇒ Effective direction of motor torque = count direction of encoder system.

Make sure that the following parameters according to Fig. 12-4 are adjusted before the encoder polarity test.

ID number	Description	Value
S-0-0085	Torque/force polarity parameter	0000000000000000
S-0-0043	Velocity polarity parameter	0000000000000000
S-0-0055	Position polarities	0000000000000000

Fig. 12-4: Table of polarity parameters

The encoder polarity is selected via parameter

S-0-0277, position feedback type 1 (bit 3)

Position, velocity and force data must not be inverted when the encoder system count direction is set:

S-0-0085, Torque/force polarity parameter	0000000000000000
S-0-0043, Velocity polarity parameter	0000000000000000
S-0-0055, Position polarities	0000000000000000

Note: After adjusting the polarity of the encoder, it must be ensured that the encoder supplies positive signals for clockwise motor rotation and negative signals for counterclockwise motor rotation.

12.7 Commutation Adjustment

DANGER

Malfunctions due to the activation of motors and moving elements!
Commutation adjustment must always be performed in the following cases:

- ⇒ Initial commissioning
- ⇒ Modification of the mechanical attachment of the encoder system
- ⇒ Exchange of the encoder system
- ⇒ Modification of the mechanical attachment of the stator and/or rotor.

WARNING

Malfunction and/or uncontrolled motor movement due to error in commutation adjustment!

- ⇒ Effective direction of motor torque = count direction of encoder system
- ⇒ Adhere to the described setting procedures
- ⇒ Correct motor and encoder parameterization
- ⇒ Expedient parameter values must be assigned for current and velocity control loop
- ⇒ Correct connection of motor power cable
- ⇒ Protection against uncontrolled movements

Setting the correct commutation angle is a prerequisite for maximum and constant torque development of the synchronous torque motor.

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 must be assigned correctly. See also Chapter 8, “Electrical Connection”.

Adjustment procedure

Different commutation adjustment procedures have been implemented in the firmware. The selection must be done via parameter P-0-0522. The following figure gives an overview of the relationship between the encoder system used and the procedure to be used.

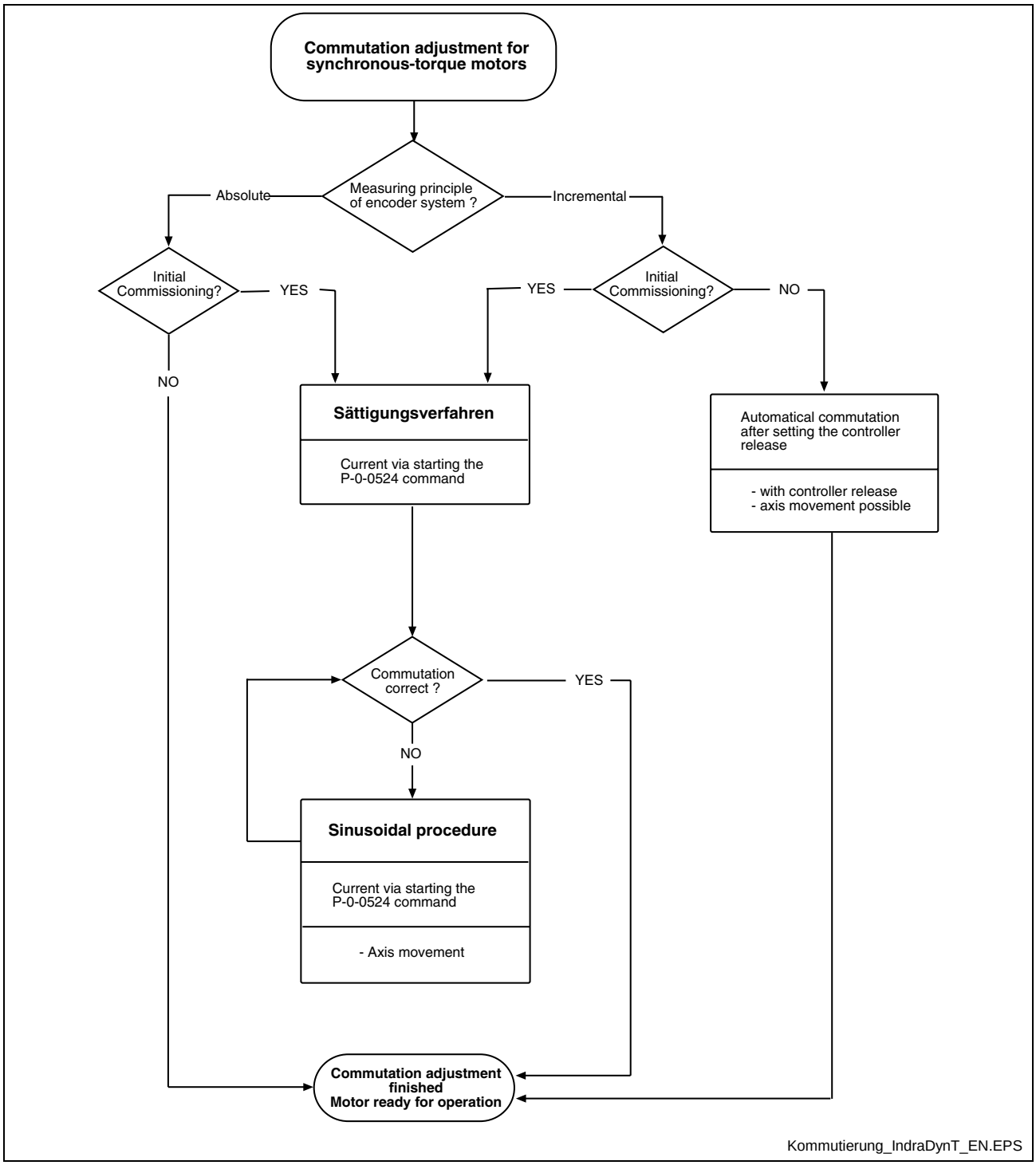


Fig. 12-5: Commutation adjustment method for synchronous torque motors

Note: A detailed description of the particular procedures is given in the firmware description for Rexroth IndraDrive drive devices, MNR R911299225.

12.8 Setting and Optimizing the Control Loop

General Sequence

The control loop settings in a digital drive controller are significant to the characteristics of the servo axis. The control loop structure consists of a cascaded position, velocity and current controller. The corresponding mode defines the active controllers.

Note: Defining the control loop settings requires the corresponding expertise.

Fig. 12-6: Setting and optimizing the control loop of frameless synchronous torque motors

Note: Use the functional description of the drive controller for more additional information.

Filtering mechanical resonance vibrations

Digital drives from Rexroth are able to provide narrow-band suppression of vibrations that are produced due to the power train between the motor and the mechanical axis system. This results in increased drive dynamics with good stability.

The position or velocity feedback in the closed control circuit excites the mechanical system to perform mechanical oscillations. This behavior, known as “two-mass vibration”, is mainly in the frequency range between 400 and 800 Hz. It depends on the rigidity of the mechanical system and the spatial expansion of the system.

In most cases, this “two-mass vibration” has a clear resonance frequency that can selectively be suppressed by a cutoff filter in the drive.

Suppressing the mechanical resonance frequency may improve the dynamic properties of the velocity control loop and of the position control loop compared with closed-loop operation without the cutoff filter.

This leads to an increased profile accuracy and to smaller cycle times for positioning processes at a sufficient distance from the stability limit.

The cutoff frequency and bandwidth of the filter can be selected. The highest attenuation takes effect on the cutoff frequency. The bandwidth defines the frequency range at which the attenuation is less than -3dB. A higher bandwidth leads to less attenuation of the cutoff frequency!

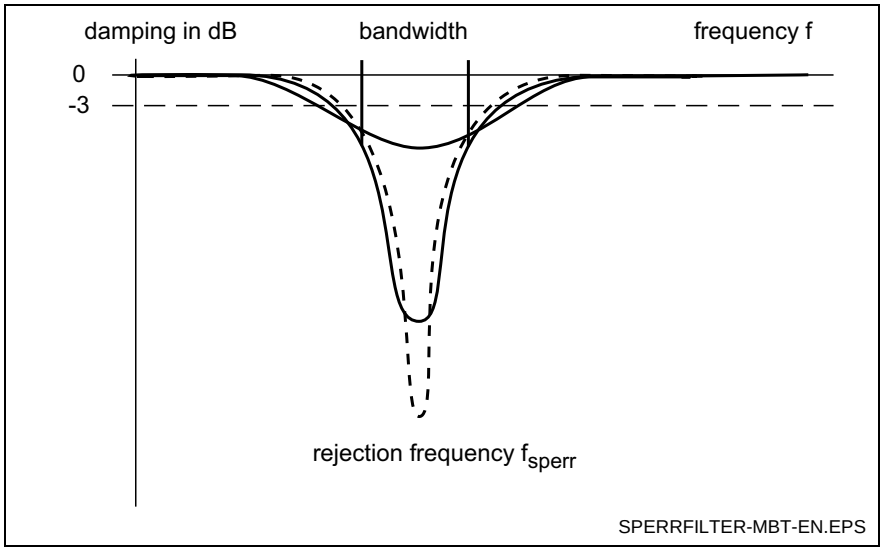


Fig. 12-7: Amplitude response of cutoff filter depending on bandwidth, qualitative

12.9 Deactivation

In the case of malfunctions, maintenance measures or to deactivate the motors, proceed as follows:

1. Observe the instructions of the machine documentation.
2. Use the machine-side control commands to bring the drive to a controlled standstill.
3. Switch off the power and control voltage of the drive device.
4. Switch off the master 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 for the discharge time of the electrical systems to elapse; then disconnect all electrical connections, if necessary. Protect all electrical cables and contacts against contact with other electrically conducting parts.
7. Document all executed measures in the commissioning report and the machine maintenance plan.

12.10 Dismantling

DANGER

Fatal injury due to errors in activating motors and working on moving elements!

⇒ Do not work on unsecured, operating machines.

⇒ Secure the machine against accidental movements and against unauthorized operation.

⇒ Before dismantling, secure the motor and power supply against falling or movements before disconnecting the mechanical connections.

1. Observe the instructions of the machine documentation.
2. Please heed the safety notes and carry out all steps as described in the above instructions in the "Deactivation" section.
3. Before dismantling, secure the motor and power supply against falling or movements before disconnecting the mechanical connections.
4. Empty the coolant duct of the motor and dismantle the motor from the machine. Store the motor properly!
5. Document all executed measures in the commissioning report and the machine maintenance plan.

12.11 Maintenance

Synchronous motors of the IndraDyn T series operate maintenance-free within the given operating conditions. However, operation under unfavorable conditions can lead to limitations in availability.

⇒ Increase availability with regular preventive maintenance measures. Heed the information in the maintenance schedule of the machine manufacturer and the service measures described below.

⇒ Log all maintenance measures in the machine maintenance plan.

Measures

DANGER

Danger of injury due to moving elements!
Danger of injury due to hot surfaces!

⇒ Do not carry out any maintenance measures when the machine is running.

⇒ During maintenance work, secure the system against restarting and unauthorized use.

⇒ Do not work on hot surfaces.

Bosch Rexroth recommends the following maintenance measures, based on the maintenance plan of the machine manufacturer:

Measure	Interval
Check the function of the coolant system.	According to the guidelines in the machine maintenance plan, but at least every 1000 operating hours.
Check the mechanical and electrical connections.	According to the guidelines in the machine maintenance plan, but at least every 1000 operating hours.
Check the machine for smooth running, vibrations and bearing noises.	According to the guidelines 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.

Fig. 12-8: IndraDyn T maintenance measures

Coolant Supply

It may become necessary to dismantle the coolant supply for maintenance measure or troubleshooting.

⇒ This work must be carried out only by skilled personnel.

⇒ Do not carry out any maintenance measures when the machine is running. Please observe the safety notes.

⇒ Protect open supply cables and connections against penetration of pollution.

12.12 Troubleshooting

DANGER

Danger of injury due to moving elements!
Danger of injury due to hot surfaces!

⇒ Do not carry out any maintenance measures when the machine is running.

⇒ Switch off the control device and the machine and await the discharging time of the electric systems

⇒ During maintenance work, secure the system against restarting and unauthorized use.

⇒ Do not work on hot surfaces.

WARNING

The rotor is magnetic! Risk of injury and danger of squeezing by magnetic forces!

⇒ Eliminate movable metal objects or secure them against movement.

⇒ Carefully handle magnetic parts.

⇒ Wear protective clothing and use mounting tools.

Possible causes for the malfunctioning of IndraDyn T motors can be limited to the following areas:

- Motor cooling circuit and temperature variation
- Internal temperature sensor
- Mechanical damage of the motor
- Mechanical connection to machine

The encoder and the temperature sensor are controlled by the drive-controller or control unit and are displayed according to the diagnosis. Observe the notes in the corresponding documentation.

Some sample faults are shown below, along with potential causes. This list does not lay claim to completeness.

Excess Temperature of Motor Housing

Status The housing temperature of the motor climbs to unusually high values.

CAUTION

Damage of motor or machine by restarting after increased motor temperature!

⇒ Liquid-cooled motors should not be restarted immediately after failure of the coolant system and an increased motor temperature or supplied with cold coolant . Danger of damage!

⇒ Wait before restarting until the motor temperature has dropped to 40° C.

Possible causes

1. Malfunction in the coolant system.
2. Original operating cycle has been changed.
3. Original motor parameters have been changed.
4. Motor bearings worn or defective.

Measures

1. Check the coolant system. Clean or rinse the cooling circuit if required. Contact the machine manufacturer if the coolant system malfunctions.
2. Check the layout of the drive for changed requirements. If overloading occurs, stop operation. Danger of damage!
3. Reset to the original parameters. Check the layout of the drive in the case of changed requirements.
4. Contact the machine manufacturer.

High Motor Temperature Values, but Housing Temperature is Normal

Status The diagnostics system of the system shows unusually high values for the winding temperature via the display or control software. However, the motor housing has a normal temperature.

Possible causes

1. Wiring error or cable break in sensor cable.

Diagnostics system defective.

2. Winding temperature sensor malfunction (PTC).

Measures

1. Check the wiring and connection of the temperature sensor according to the terminal diagram.
2. Check the diagnostics system on the drive device or the control unit.
3. Check the resistance value of the temperature sensor using a multimeter.
   - Shut down the system and wait for the discharging time to elapse.
   - Disconnect the temperature sensor from the control device. Set the measuring instrument to resistance measurement and connect the wire pair with the measuring instrument (as a result, the sensor cable is also checked). Check the values according to the characteristic curve in chapter “Application Notes”.

Motor or Machine Generates Vibrations

Status

Audible or tactile vibrations occur on the motor or on the machine.

Possible causes

1. Driven machine elements are insufficiently coupled or damaged.

   Motor bearings worn or defective. Available bearing life time or grease lifetime elapsed.
2. Motor mount loose.
3. Drive system is instable from a control point of view.

Countermeasures

1. Contact the machine manufacturer.
2. Contact the machine manufacturer.
3. Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
4. Check parameters of the drive system (motor and encoder data). Observe the notes in the documentation for the drive controller.

Specified Position is not Attained

Status

The positioning command of the control unit is not precisely executed – or not at all. No malfunction display on the device controller or the control.

Possible causes

1. Wiring of encoder cable is incorrect or defective. Pin assignment (encoder signals) in cable or plug may be switched.

   Insufficient shielding of encoder cable against interference.
2. Incorrect encoder parameters set in drive controller.
3. Motor-machine connection loose.
4. Encoder defective.

Countermeasures

1. Check wiring according to terminal diagram and check state of cables for damage.
2. Check shielding; if necessary, increase effective contact surfaces of shielding.
3. Correct the parameters. Observe the commissioning log.
4. Check the mechanical connection. Do not continue to use damaged parts. Contact the machine manufacturer.
5. Change of encoder necessary. Contact the machine manufacturer.

Waste Disposal

Note: To simplify handling of the rotor during disposal, we recommend that the magnetic field / the permanent magnets on the rotor be neutralized. This is accomplished by heating the rotor in a heating furnace at no less than 265°C for at least 3 hours.

Manufacturing process

The manufacturing process of the products is executed in such a manner that energy and raw materials are optimized; in addition the process permits recycling and the utilization of incidental waste.

Bosch Rexroth regularly tries to replace polluted raw materials and supplies by environmentally friendly alternatives.

Application

Bosch Rexroth products do not contain any kind of dangerous substances which could be released with proper use. Normally, no negative influences for the environment can be assumed .

Forbidden substances

We guarantee that our products include no substances according to chemical ban regulations. Furthermore, our products are free of mercury, asbestos, PCBs and chlorinated hydrocarbons.

Material composition

Basically, our motors contain

- steel
- aluminum
- copper
- brass
- magnetic materials
- electronic components and modules

Recycling

Most of the products can be recycled due to the high metal proportion. To reach optimum metal recovery, disassembly into individual components is necessary.

The metals also contain electrical and electronical components that can be recycled using special separation processes. The hereby arising plastics could be thermally recycled.

Returns

The products manufactured by us can be returned to our premises for waste disposal at no charge. This is possible only if the product does not contain any disturbing adhesions such as oil, grease or other contamination.

Furthermore, it is not permitted that the product contains inappropriate foreign materials when it is returned.

The products must be delivered postage-free to the following address:

Bosch Rexroth AG
Electric Drives and Controls
Bürgermeister-Dr.-Nebel-Strasse 2
97816 Lohr am Main, Germany

Packaging

High-quality products need optimal packaging. The packaging material consists of paper, wood and polystyrene.

This can be recycled everywhere.

For ecological reasons, a return transport of the packaging should not take place.

13 Service & Support

13.1 Helpdesk

Unser Kundendienst-Helpdesk im Hauptwerk Lohr am Main steht Ihnen mit Rat und Tat zur Seite. Sie erreichen uns

Our service helpdesk at our headquarters in Lohr am Main, Germany can assist you in all kinds of inquiries. Contact us

- telefonisch - by phone: **+49 (0) 9352 40 50 60**
  über Service Call Entry Center Mo-Fr 07:00-18:00
  - via Service Call Entry Center Mo-Fr 7:00 am - 6:00 pm
- per Fax - by fax: **+49 (0) 9352 40 49 41**
- per e-Mail - by e-mail: **service.svc@boschrexroth.de**

13.2 Service-Hotline

Außerhalb der Helpdesk-Zeiten ist der Service direkt ansprechbar unter

After helpdesk hours, contact our service department directly at

+49 (0) 171 333 88 26

oder - or **+49 (0) 172 660 04 06**

13.3 Internet

Unter **www.boschrexroth.com** finden Sie ergänzende Hinweise zu Service, Reparatur und Training sowie die **aktuellen** Adressen *) unserer auf den folgenden Seiten aufgeführten Vertriebs- und Servicebüros.

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Außerhalb Deutschlands nehmen Sie bitte zuerst Kontakt mit unserem für Sie nächstgelegenen Ansprechpartner auf.

*) Die Angaben in der vorliegenden Dokumentation können seit Drucklegung überholt sein.

At **www.boschrexroth.com** you may find additional notes about service, repairs and training in the Internet, as well as the **actual** addresses *) of our sales- and service facilities figuring on the following pages.

- sales agencies
- offices providing service

Please contact our sales / service office in your area first.

*) Data in the present documentation may have become obsolete since printing.

13.4 Vor der Kontaktaufnahme... - Before contacting us...

Wir können Ihnen schnell und effizient helfen wenn Sie folgende Informationen bereithalten:

1. detaillierte Beschreibung der Störung und der Umstände.
2. Angaben auf dem Typenschild der betreffenden Produkte, insbesondere Typenschlüssel und Seriennummern.
3. Tel.-/Faxnummern und e-Mail-Adresse, unter denen Sie für Rückfragen zu erreichen sind.

For quick and efficient help, please have the following information ready:

1. Detailed description of the failure and circumstances.
2. Information on the type plate of the affected products, especially type codes and serial numbers.
3. Your phone/fax numbers and e-mail address, so we can contact you in case of questions.

13.5 Kundenbetreuungsstellen - Sales & Service Facilities

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Südamerika – South America

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14 Appendix for Motor Size 210R

14.1 General

To improve the clarity of this documentation, this chapter describes special IndraDyn T motor characteristics that vary from the standard size and model for size and design:

- **MST210R**-xxxx-FT-N0CN-**D302**
- **MST210R**-xxxx-FT-N0CN-**T302**

in conjunction with rotor:

- **MRT210R**-3N-**0130**

The rotor in design MRT210R-3N-0130 has been designed to be part of the spindle. Its mechanical characteristics thus differ significantly from the standard design of rotors for IndraDyn T motors.

Note: Note that, due to the construction of the rotor as a part of the spindle and the resulting increased shape and position tolerances, this rotor design is not suitable for highly precise applications.

The construction of the rotor as a part of the spindle is shown schematically below; the special feature for cooling the stators is also described. Detailed information and notes can be provided by the machine manufacturer only after the entire system has been designed.

14.2 Dimension Sheet, MBT210R

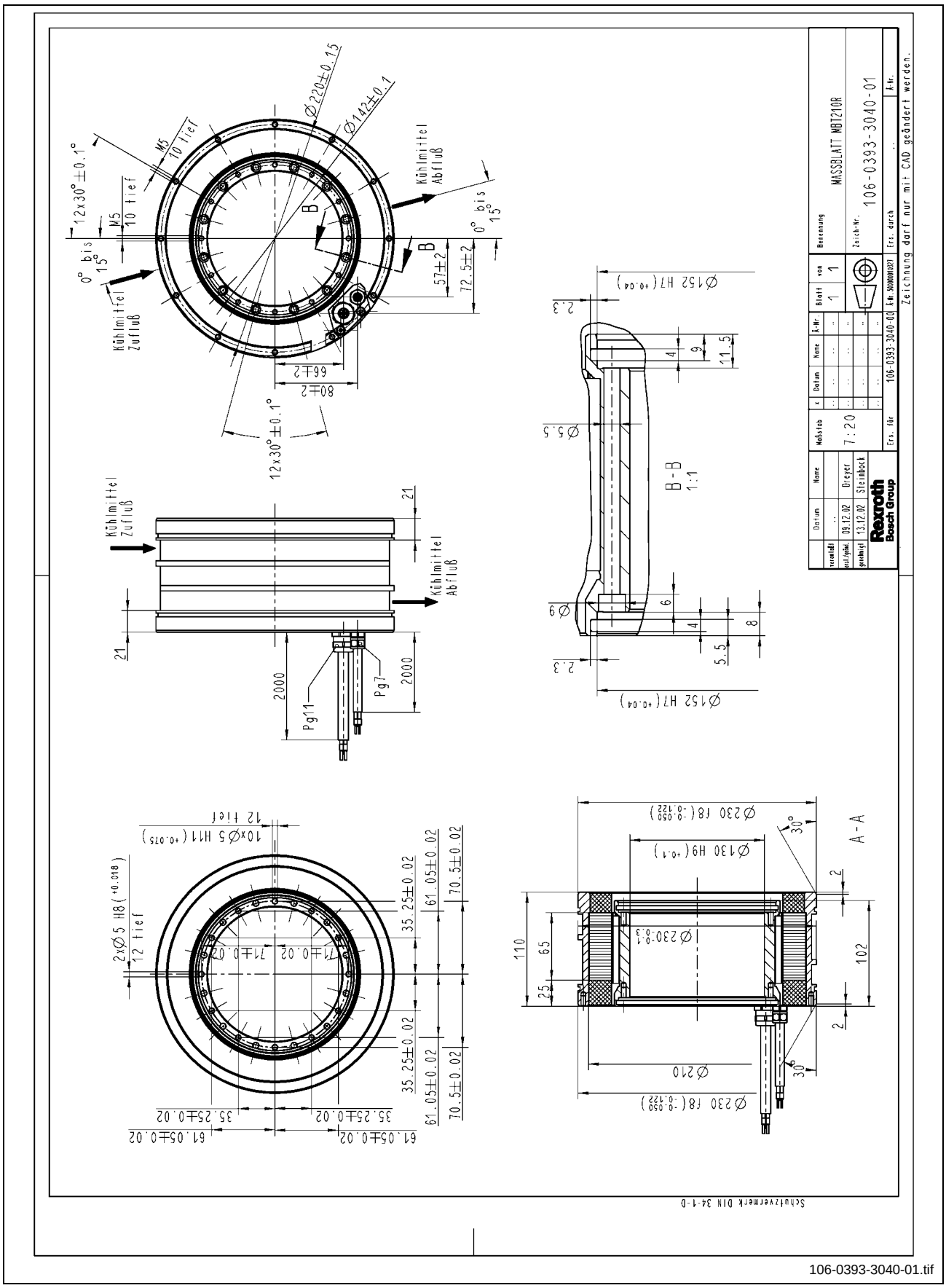


Fig. 14-1: Dimension sheet, MBT210R

14.3 Installation

Mechanical Installation

Safety

When installing the motor, heed the general notes regarding safety in chapter 3 “Notes Regarding Safety” as well as the special notes regarding safety for installation in chapter 12 “Installation“.

The following mounting instructions describe a nonbinding, schematic construction without considering the constructive specialty of the machine; they serve only for general orientation.

The machine manufacturer must take into account the special characteristics of his construction and must work out a binding assembly plan.

Preparation

Initial state: The motor lies flat on a clean, level base.

1. Check whether the components are damaged. Defective components may not be mounted.
2. Hold tools, auxiliary material, measuring and test equipment ready and make sure that assembly can be carried out in a clean, dry and dust-free environment.
3. Check all components and mounting areas, holes and threads, as well as the O-ring nuts on the stator, whether they are clean and free of burrs. Everything must be **clean, stainless and completely free of burrs**. Clean and debur such areas if necessary.
4. Grease the O-rings with an ordinary lubricant grease and mount the O-rings in the stator grooves. Avoid twisting and soiling of the O-rings.
5. Screw the ring screws required for transport into the opposite threads. Check the machine construction whether longer ring screws with a spacer sleeve are required.

Attend to cleanliness during all working steps!

When inserting the rotor into the stator, pay attention to the radial and axial forces resulting from the magnetic force (see Fig. 11-3).

Assembly

Rotor MRT210R-3N-0130 has been designed to be part of the spindle and is fastened using screwed connections. In addition, cylindrical pins can be used on one side to help fasten the rotor.

You can find detailed information in the dimension sheet (Fig. 14-1).

During assembly, pay attention to the following

- the number and type of fastening and cylindrical pin holes,
- the torque,
- and the depth of thread.

Rotor MRT210R-3N-0130, assembled

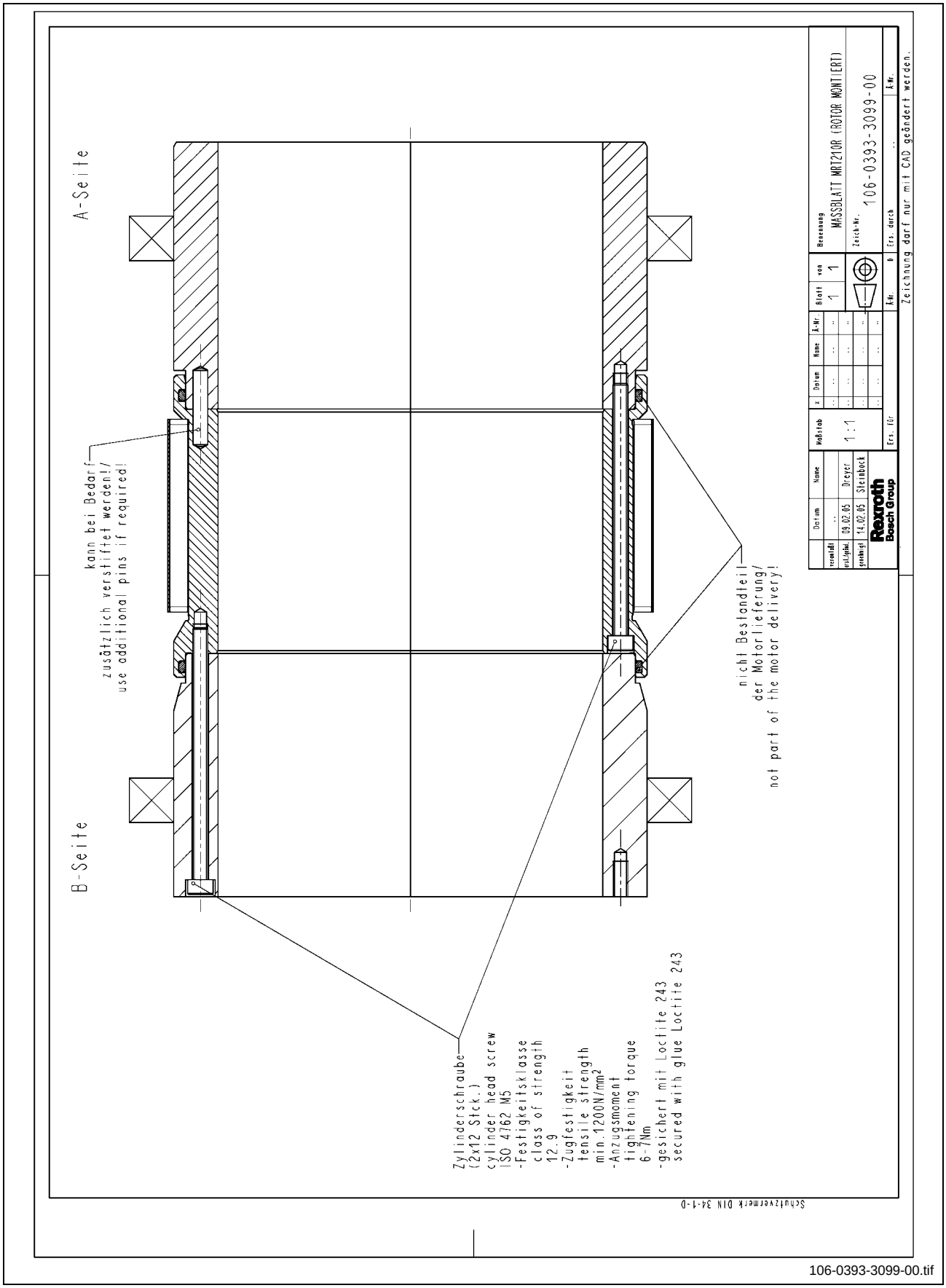


Fig. 14-2: Rotor MRT210R, assembled

Note:

- All the screwed connections shown below must be made using screws with a tensile strength of 12.9 and secured using Loctite 243.
- The necessary screw length depends on the machine construction.
- The screwed connections must be able to take up both the force due to the weight of the motor and the forces acting during operation.
- Observe the minimum depth of thread.

After proper mechanical assembly of the rotor and stator, make the other connections.

Electrical Connection

See Chapter 8, “Connection Techniques”.

Coolant Connection

The position of the coolant connections on stators

- **MST210R**-xxxx-FT-N0CN-**D302**
- **MST210R**-xxxx-FT-N0CN-**T302**

is 180° from that of the standard design of the motors.

Detailed information about the position of the coolant connections, as well as about the inflow and outflow of the coolant, can be found in the motor dimension sheet in Fig. 14.1.

Also observe the notes in Chapter 11.5, "Coolant Connection".

14.4 Accessories

For size 210R in the "Other design" D302 and T302, Rexroth can provide mounting rings upon request at additional cost.

Unassembled mounting ring

Mounting ring	MNR	for stator / rotor
RING-MOUNTING M04-MBT210	R911310058	MST210R-....-FT-N0CN-D302 MST210R-....-FT-N0CN-T302 MRT210R-3N-0130-M100

Fig. 14-3: Unassembled mounting ring for size 210R

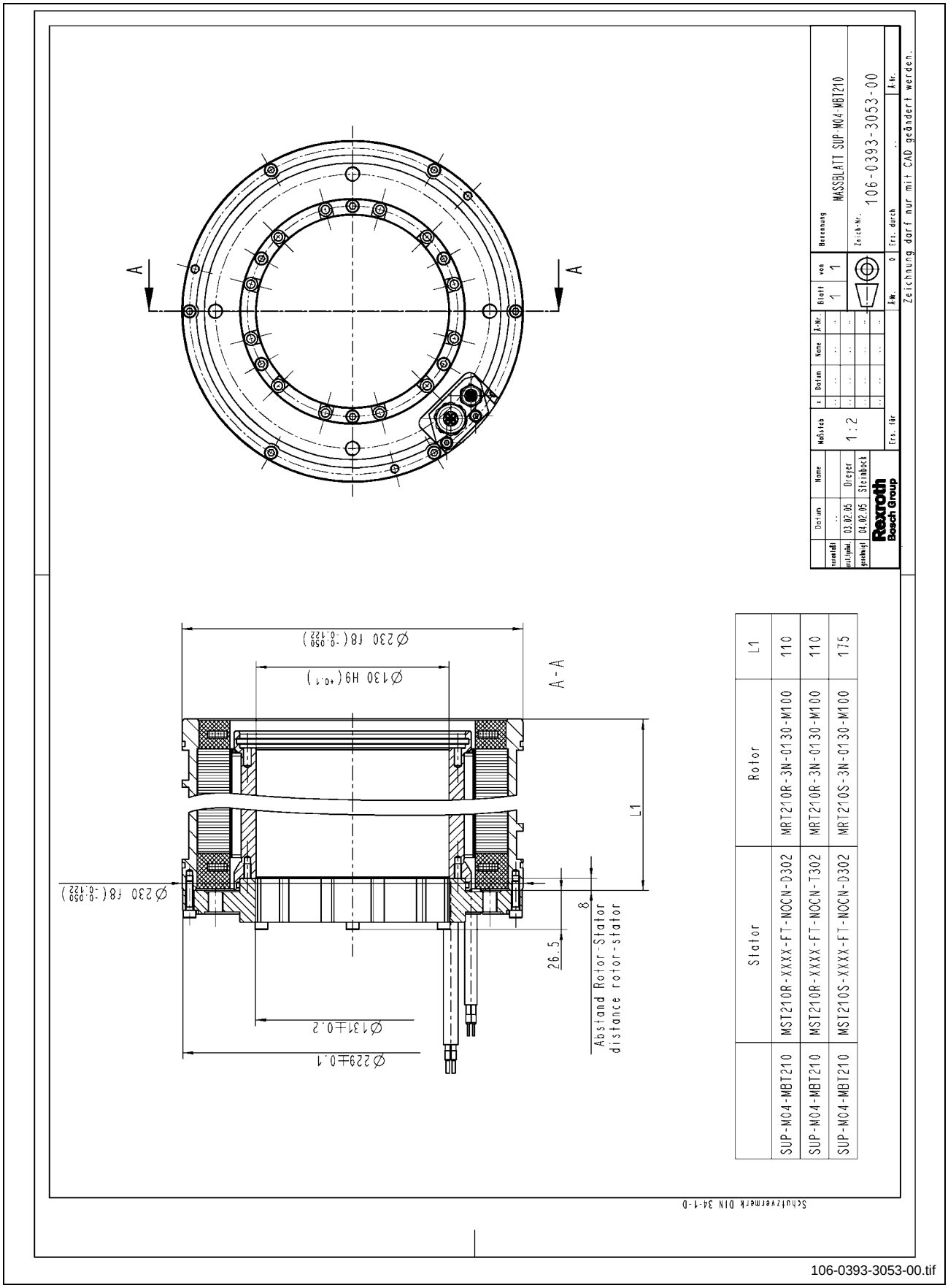
Assembled mounting ring

SUP designation	MNR	for stator / rotor
SUP-M04-MBT210	R911310057	MST210R-....-FT-N0CN-D302 MST210R-....-FT-N0CN-T302 MRT210R-3N-0130-M100

Fig. 14-4: Assembled mounting ring for size 210R

Note: Observe the notes regarding ordering, handling and goods return of the mounting rings in Chapter 7, "Accessories".

Dimension Sheet, SUP-M04-MBT210



	Stator	Rotor	L1
SUP-M04-MBT210	MST210R-XXXX-FT-NOCN-D302	MRT210R-3N-0130-M100	110
SUP-M04-MBT210	MST210R-XXXX-FT-NOCN-T302	MRT210R-3N-0130-M100	110
SUP-M04-MBT210	MST210S-XXXX-FT-NOCN-D302	MRT210S-3N-0130-M100	175

Fig. 14-5: Dimension sheet, SUP-M04-MBT210

15 Appendix for Motor Sizes 530G and 530L

15.1 General

Due to their design, IndraDyn T motors with the sizes 530G and 530L are especially suited to operating pressure rolls.

To improve the clarity of this document, this chapter (in addition to chapter 11 “Installation”) provides special notes regarding the assembly of these motors in size 530G and 530L.

The following mounting instructions describe a non-binding, schematic construction without considering the constructive specialty of the machine; they serve only for general orientation.

The machine manufacturer must consider the special character of his construction and must work out special mounting instructions. Only the mounting instructions of the machine manufacturer are binding.

All screwed connections must be secured using Loctite 243.

The installation dimension sheets provide additional notes and recommendations for the general assembly of the motors. For this reason, parts that are not included in the Bosch Rexroth scope of delivery are shown and are required; these must be provided and accordingly dimensioned by the user. These include:

- motor housing and terminal box
- motor encoder
- spacer sleeve (for rotor assembly)
- clamp collar and clamp plate (for rotor assembly)

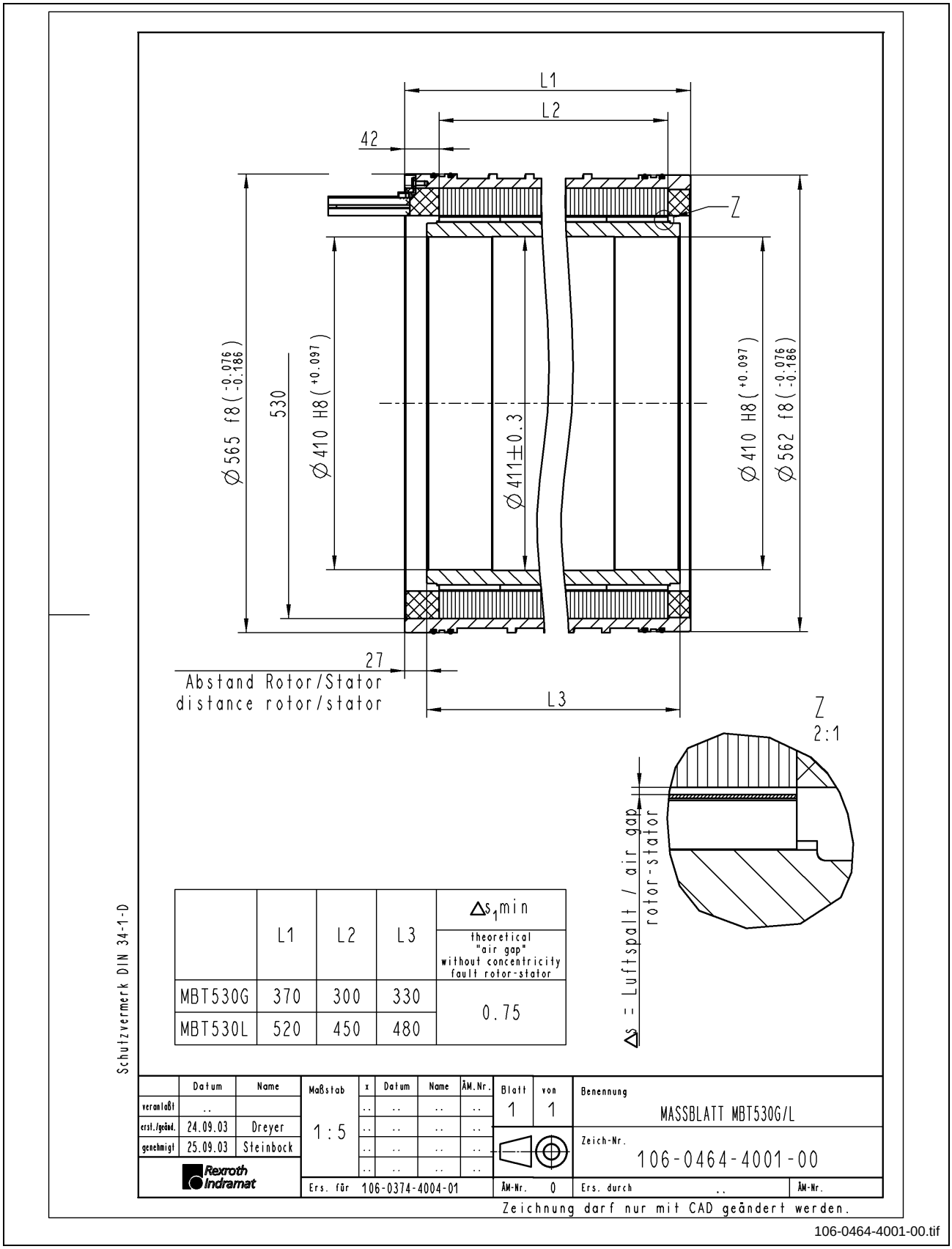
We recommend that you assemble the motor as follows:

1. Install the stator in the motor housing.
2. Connect the cable to the terminal box.
3. Fasten the stator, together with the housing, onto the machine.
4. Connect the rotor, together with the spacer sleeve, to the clamp plate.
5. Push the rotor, together with the spacer sleeve, onto the shaft end and fasten it using the clamp collar.
6. Attach the motor encoder.
7. Attach the housing lid and the encoder cover.
8. Make the electrical and cooling system connections.

The sequence of the illustrations in this chapter is as follows:

- Dimension sheet, motor MBT530G/L
- Dimension sheet, rotor MRT530G/L
- Dimension sheet, stator MBT530G/L
- Shaft dimensioning
- Installation dimension sheet, stator MBT530G/L, assembled (example)
- Installation dimension sheet, rotor MRT530G/L, assembled (example)
- Mounting tool for rotor (example)
- Installation dimension sheet, motor MBT530G/L, assembled (example)

15.2 Dimension Sheet, MBT530G / 530L



	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

Rexroth Indramat

Maßstab 1 : 5

Ers. für 106-0374-4004-01

Blatt 1 von 1

ÄM-Nr. 0

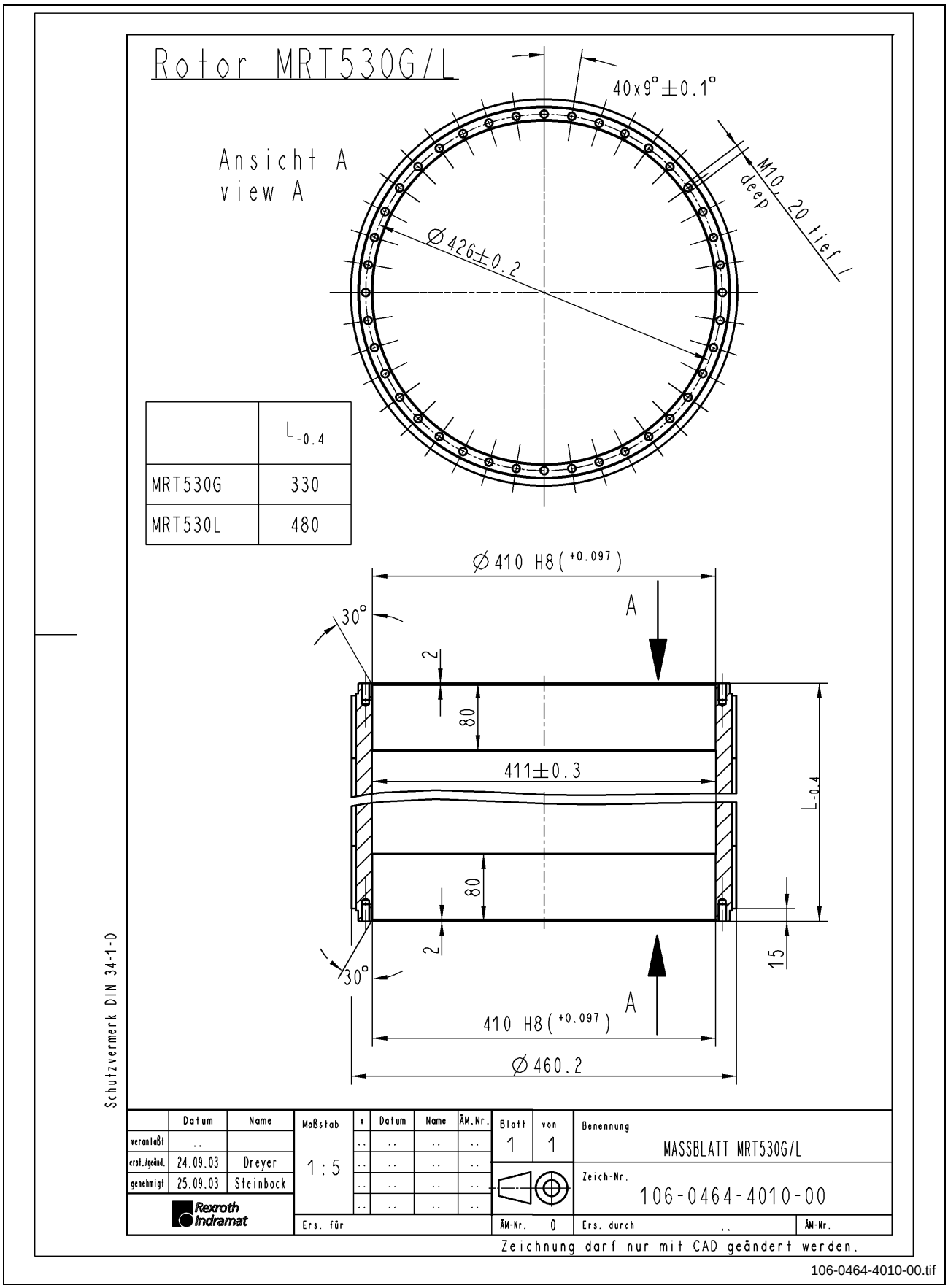
Benennung: MASSBLATT MBT530G/L

Zeich-Nr. 106-0464-4001-00

Ers. durch .. ÄM-Nr.

Fig. 15-1: Dimension sheet, MBT210R

Dimension Sheet, Rotor MRT530G / MRT530L



	$L_{-0.4}$
MRT530G	330
MRT530L	480

Fig. 15-2: Dimension sheet, rotor MRT530G / MRT530L

Dimension Sheet, Stator MST530G / MST530L

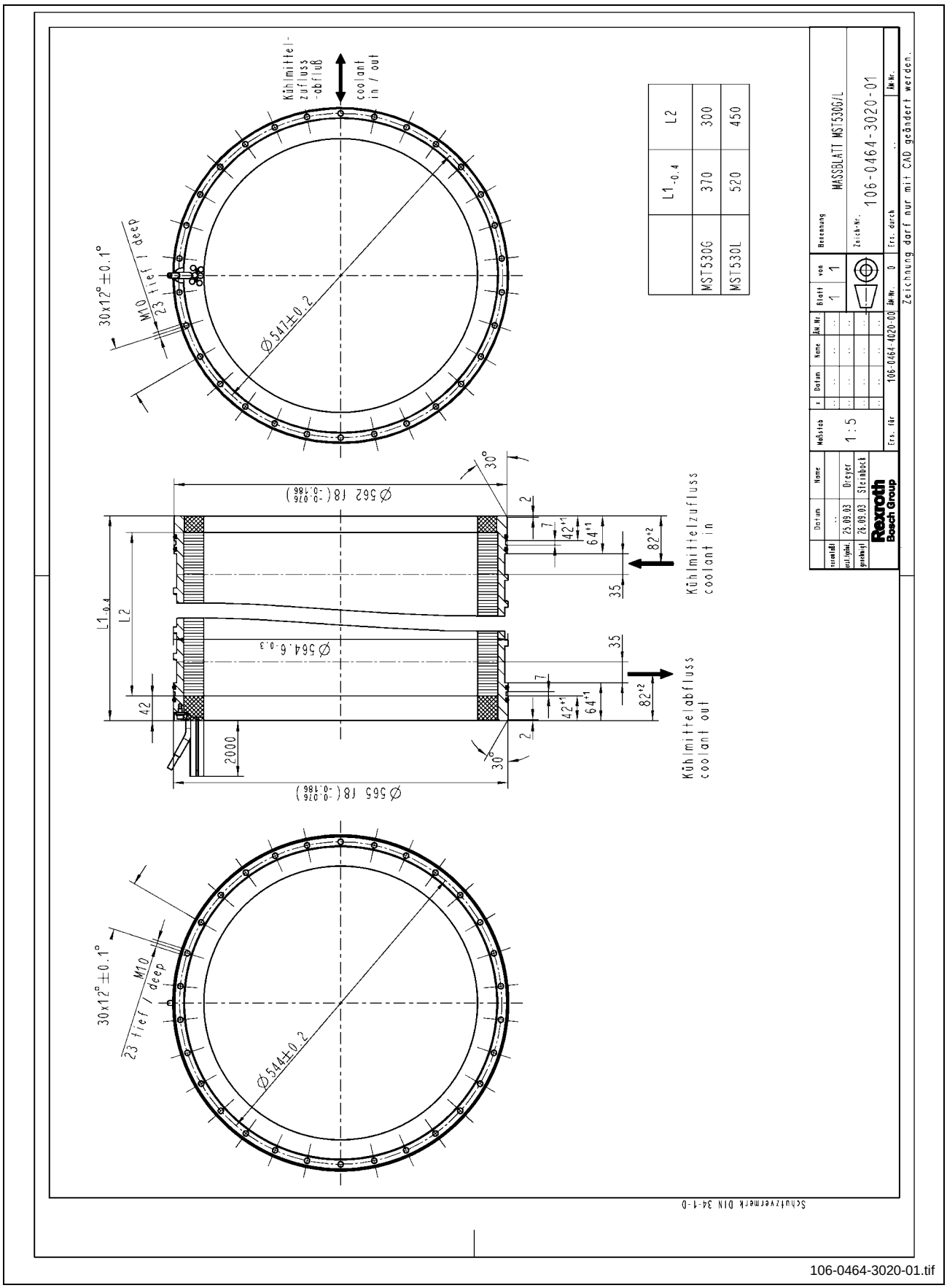


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Fig. 15-3: Dimension sheet, MST530G / MST530L

15.3 Shaft End Dimensioning

Due to installation tolerances on the system, it may not be possible to install the rotor co-axially in the stator. As a result, radial forces may occur in the motor during operation, also affecting the shaft end to which the rotor is attached.

To ensure sufficient rigidity of the drive system,

- the required minimum air gap after assembling the rotor and stator, and
- the resulting radial forces in operation (Fig. 15-4)

must be taken into account when dimensioning the required shaft diameter.

Therefore, the shaft diameter must be dimensioned in such a manner that the required air gap S2 (see dimension sheet in Fig. 15-9) after assembling the rotor and stator – taking into acount the bowing of the shaft – is not less than the minimum value anywhere.

Rotor size MRT....	**Rotor and stator, assembled min. air gap s_2** (see dim. sheet, Fig.15-9)	**$F_{radial\_operation}$ [N]**
530G	0.35mm	4,560
530L		6,840

Fig. 15-4: Radial forces acting in operation

Note: Dimension the shaft diameter in which the spacer sleeve for the rotor is to be inserted sufficiently to limit bowing.

Also heed the information regarding radial forces that can occur during assembly (Chapter 11.3 “Mechanical Installation”).

Shaft Dimensioning

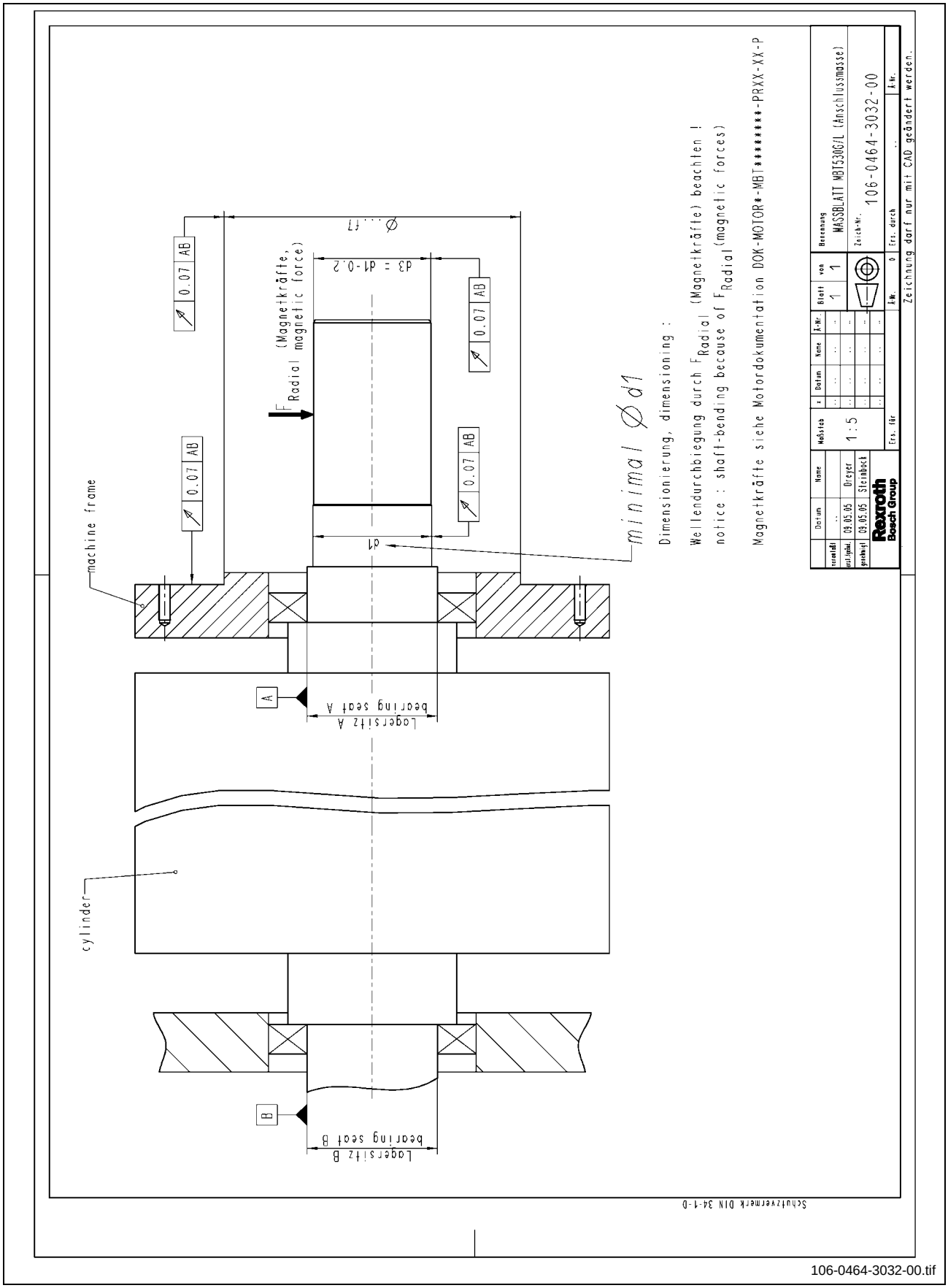

Fig. 15-5: Shaft dimensioning

15.4 Stator Assembly

Before the stator can be attached to the machine, it must be installed in a housing (see Fig. 15-6) prepared by the user. The housing is fastened on one of the two stator ends using the fastening holes provided for this purpose.

During installation, note the information in the dimension sheets (see Fig. 15-3) regarding.

- the number and type of fastening holes,
- the minimum depth of thread and tightening torque.

Note:

- The necessary screw length depends on the machine construction.
- The screwed connections must be able to take up both the force due to the weight of the motor and the forces acting during operation.

Attend to cleanliness during all working steps!

Preparation

Heed the notes regarding the preparation of assembly in Chapter 11.3 “Mechanical Installation”.

Assembly

1. Place the stator on a clean, level surface and insert lubricated o-rings. Lower the prepared housing over the stator – so that it is centered – and screw it onto the stator. (see Fig. 15-6)

Note: Avoid...

- misalignment or sticking when lowering the housing over the stator.
- damaging the motor-side centering unit or the insertion fitting in the housing.
- tension, pressure, deviating or other stress on the connection cable.

---

2. Turn the stator, together with the housing, 180° and attach the terminal box to the motor housing.
3. Connect the cable of the stator to the terminal box. See Chapter 8, “Connection Techniques”.
4. Fasten the stator, together with the housing, onto the machine. Center the housing over the centering unit provided for this purpose on the machine. (see Fig. 15-9)

Note: Avoid...

- misalignment or sticking when attaching the housing to the machine.
- damaging the centering unit on the housing and the machine.

Installation Dimension Sheet, MST530G / 530L

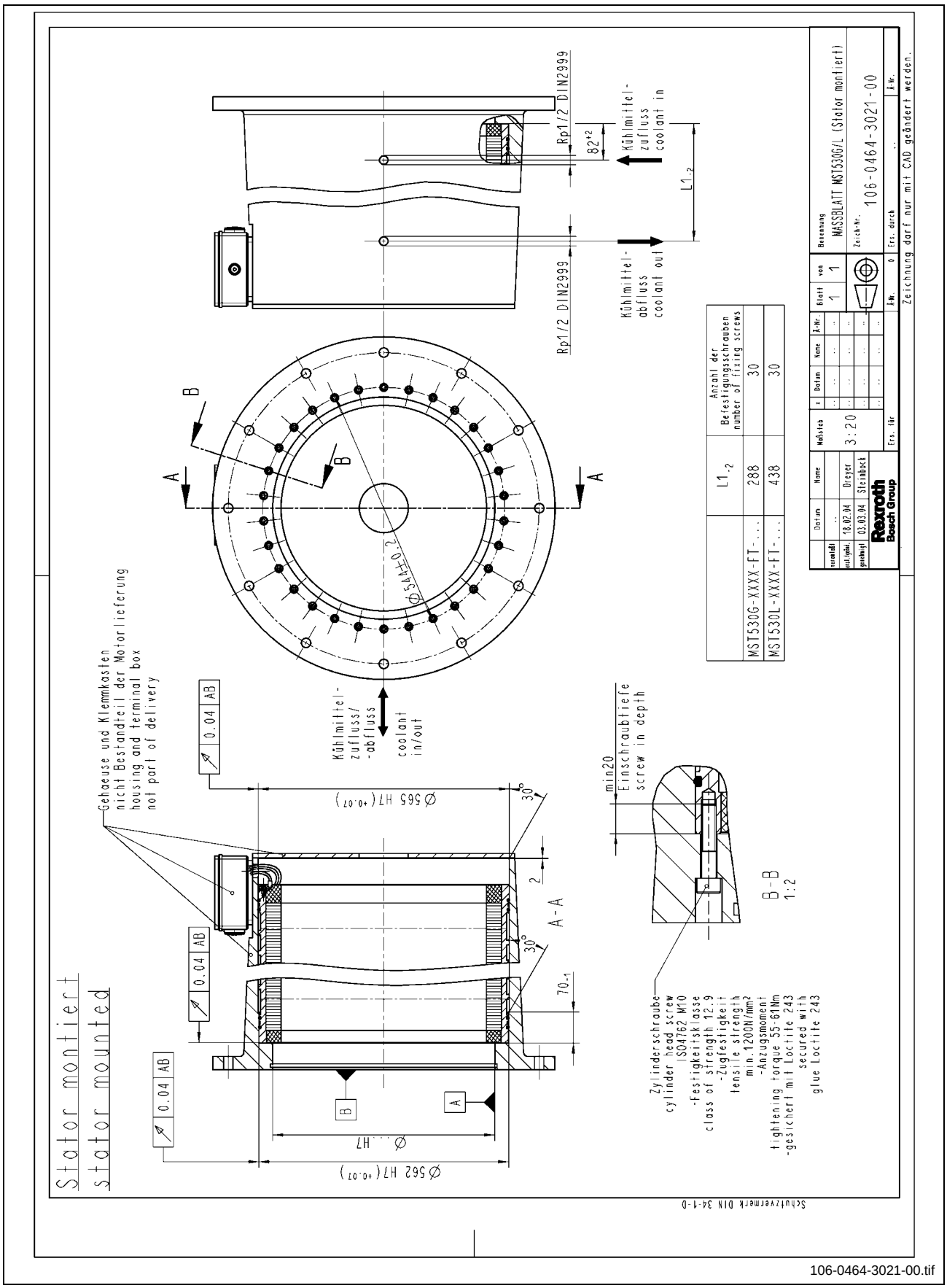

Fig. 15-6: Installation dimension sheet, MST530G/L

15.5 Assembly of the Rotor

WARNING

The rotor is magnetic! Risk of injury and crimping danger by magnetic forces!

⇒ Eliminate movable metal objects or secure them against movement.

⇒ Carefully handle magnetic parts.

⇒ Wear protective clothing and use mounting tools.

The rotor is guided into the rotor hole on a spacer sleeve using two insertion fittings and attached to a clamp plate. Then it must be guided – so that it is centered – over the shaft to be driven in the stator and fastened using a clamp collar.

During installation, note the information in the dimension sheets Figs. 15-2 and 15-7

- The number and type of fastening holes
- the minimum depth of thread and tightening torque.

Note:

- The necessary screw length depends on the machine construction.
- The screwed connections must be able to take up both the force due to the weight of the motor and the forces acting during operation.

Attend to cleanliness during all working steps!

Preparation

Heed the notes regarding the preparation of assembly in section 11.3 “Mechanical Installation“.

Assembly

1. Connect the rotor, together with the spacer sleeve, to a clamp plate. After attachment is complete, it must be ensured that both centering diameters of the rotor hole have been guided onto the spacer sleeve. (see Fig. 15-2)
2. Connect the rotor using a mounting tool to insert the rotor into the stator (see Fig. 15-8).
3. Using the mounting tool, push the rotor over the shaft end up to the end position. We recommend you to consider using a slide bearing (gunmetal bush, etc.) on one side of the shaft end, which allows axial length compensation due to the somewhat stronger heating of the rotor compared to the shaft during motor operation. (see Fig. 15-7)

WARNING

Injuries/damage due to strong magnetic forces!

⇒ Due to the permanent magnets on the rotor and the resulting magnetic forces, the rotor is suddenly pulled into the stator. Use suitable assembly tools.

4. Use a clamp collar to attach the spacer sleeve to the shaft end. The clamp collar provides the safe transmission of force from the motor to the shaft to be driven.

Installation Dimension Sheet, Rotor MRT530G / MRT530L

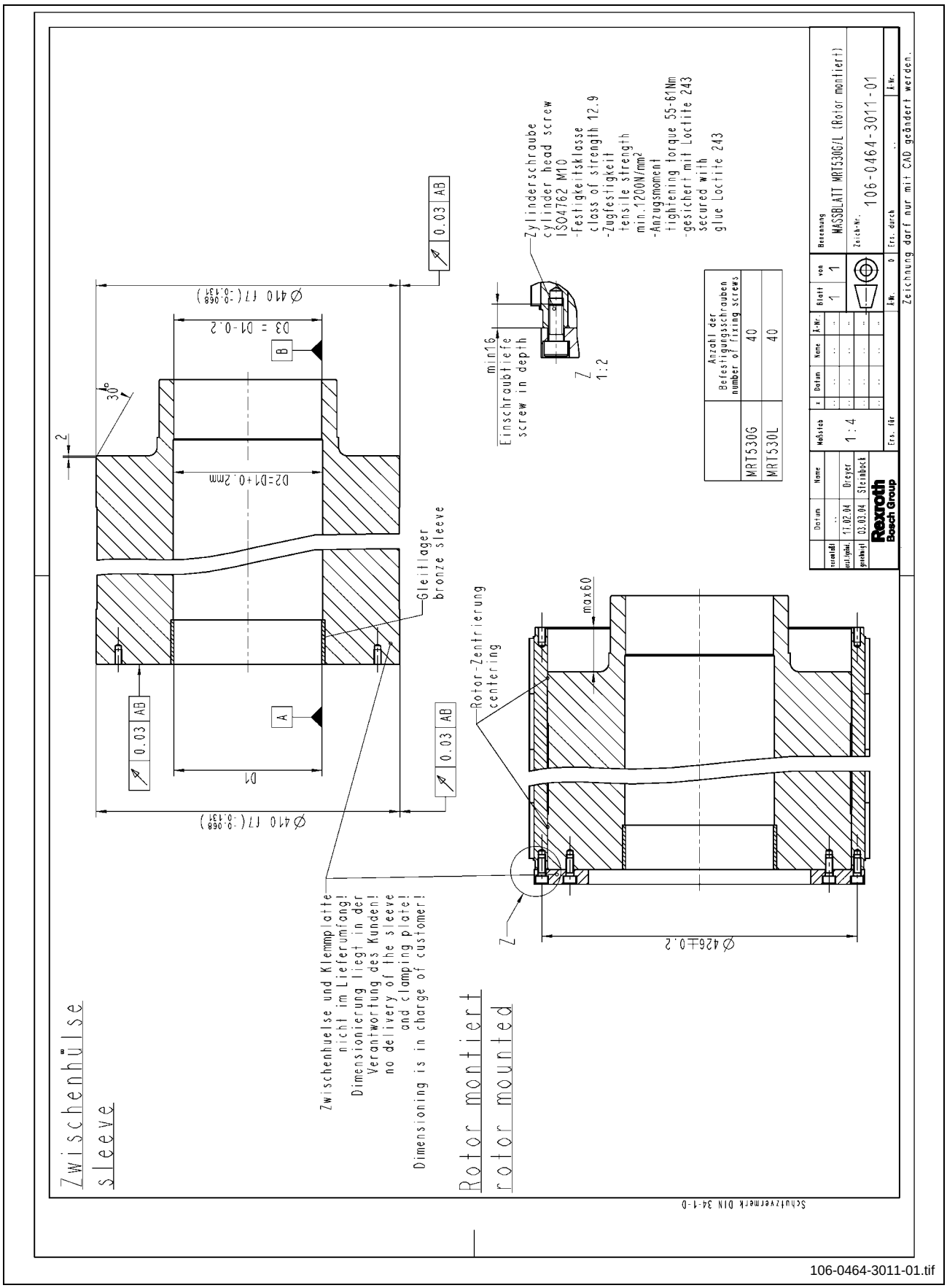

Fig. 15-7: Installation dimension sheet, MRT530G/L

Mounting Tool for Rotor (Example)

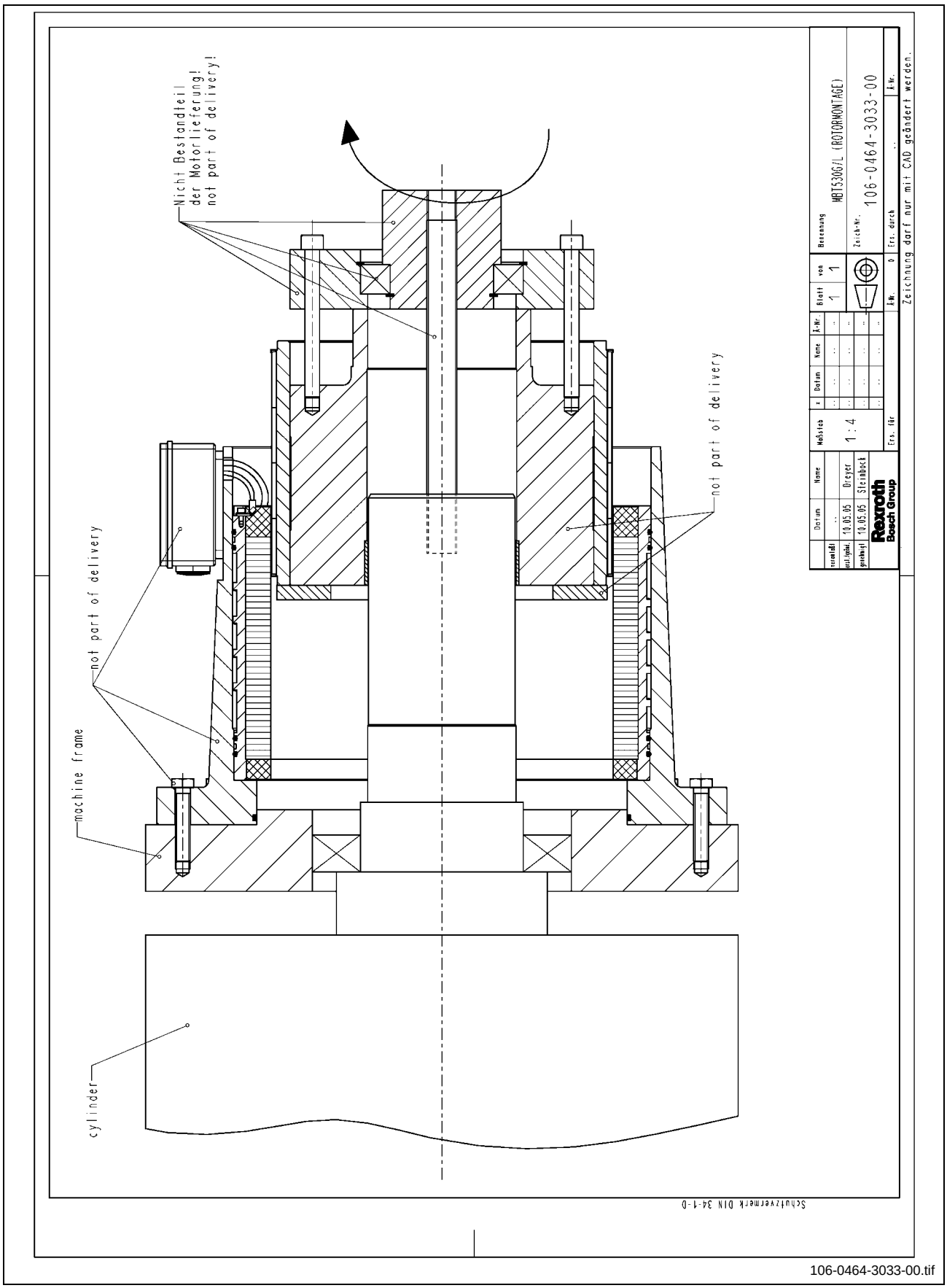

Fig. 15-8: Mounting tool for rotor (example)

15.6 Assembling the Motor Encoder and the Covers

After the stator has been attached to the machine and the rotor has been attached to the shaft, the encoder can be connected.

Note: The motor encoder is not in the scope of delivery for the motor; it must be provided by the user.

Carry out the following steps:

1. Attach the motor encoder to the shaft.
2. Close the motor housing and the encoder installation space with the covers provided.
3. Make the electrical connection according to section 11.4 and the coolant connection according to section 11.5.

Installation Dimension Sheet, MBT530G / 530L

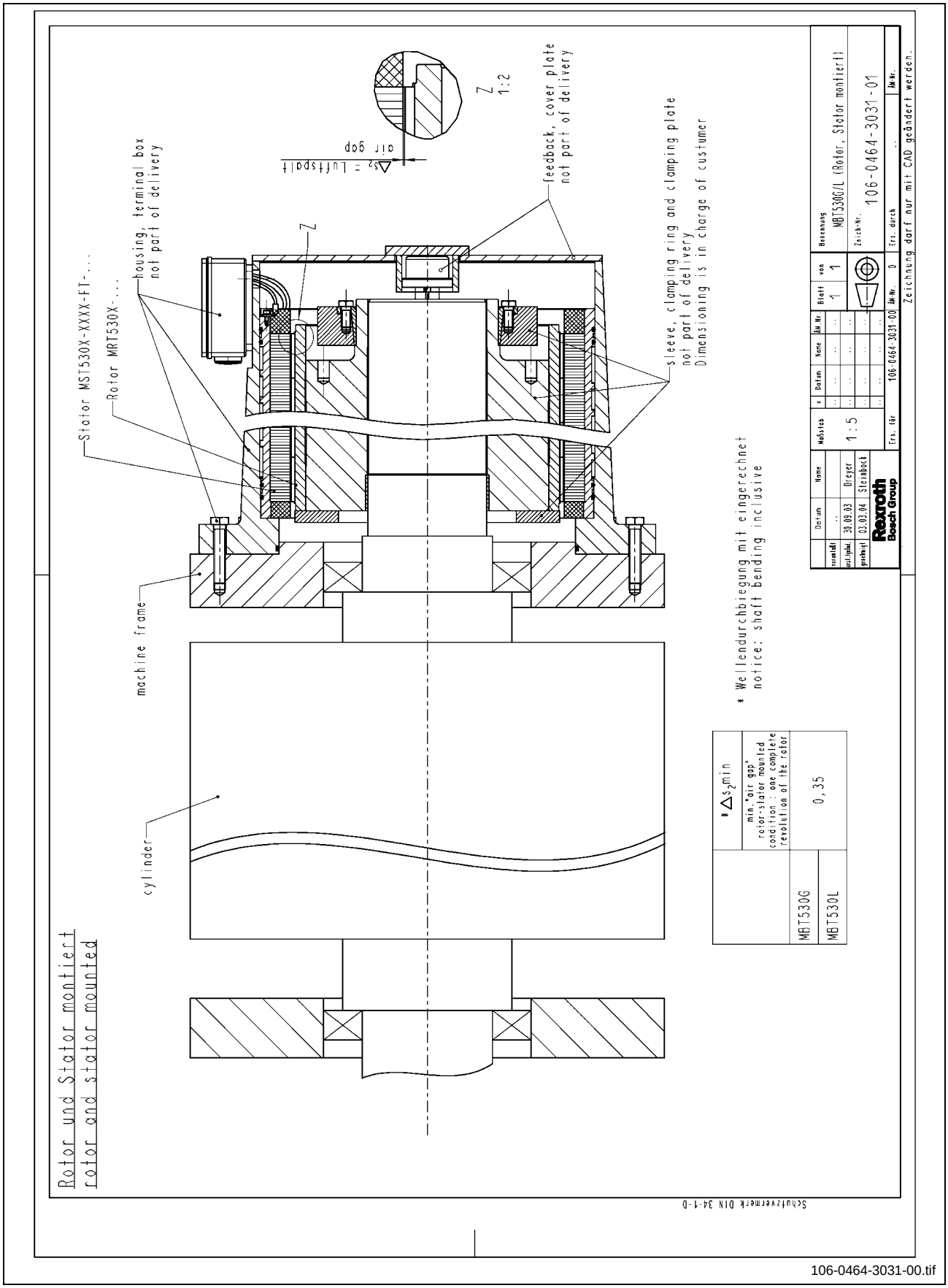

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Fig. 15-9: Installation dimension sheet, MBT530G/L

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