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Synchronous MBS Kit Spindle Motors

Project Planning

DOK-MOTOR*-MBS********-PRJ1-EN-P

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Indramat

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The purpose of the document

This document ...

- familiarizes the potential user with MBS kit spindle motors
- describes the instllation of the kit spindle motor into the motor spindle
- explains the effects that the kit spindle motor has on the spindle construction in general
- offers instructions on storage, handling, mounting and installing the motor and stator

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Phone 09352/40-0 • Tx 689421 • Fax 09352/40-4885

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Contents

1 Introducing the MBS Kit Spindle Motor

1.1 MBS Main Spindle Drive

MBS kit spindle motors are used as direct drives in motor spindles. The arrangement of the motor between the main spindle bearings lends the motor extreme rigidity. This means, for example, that in grinding machines, main spindle and C-axis operations are implemented with but one drive.

Motor spindles are used for lathing, milling and grinding processes in machine tools, transfer streets, machining centers and special machines.

Fig. 1.1 shows components of an MBS kit spindle main drive.

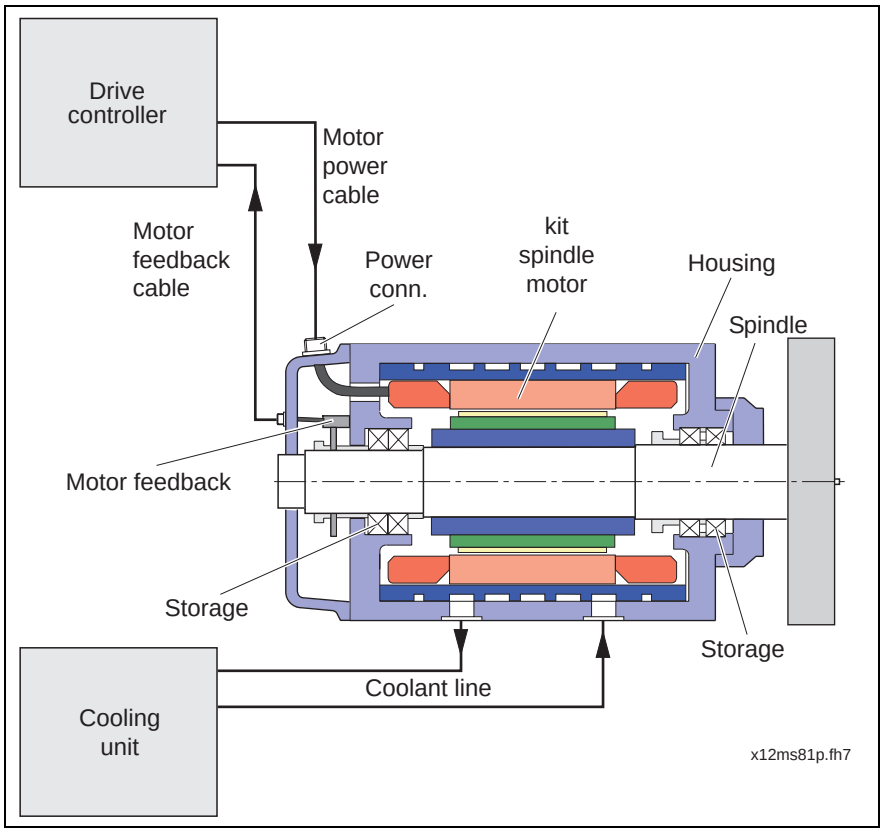


Fig. 1-1: Components of an MBS main spindle drive

Motor spindle

The motor spindle is made up of a spindle with housing, bearings, kit spindle motor with cooling option and the motor feedback.

Determining the type of bearings, lubricant and the extent of bearing input tension depends on how the motor spindle is used. The spindle builder bears this responsibility.

How a spindle motor affects the construction of the motor spindle is described in this document.

Motor feedback

The motor feedback measures rotor position and transmits it to the controller in order to regulate speed and spindle position. It is integrated into the motor spindle as a self-sufficient module.

Structure

MBS kit main spindle motors are liquid-cooled, permanent-magnet excited synchronous motors. They are made up of a stator with cooling

jacket and a rotor with step compression joint (the rotor can be axially clamped as an alternative). Motor size is fixed according to the outside diameter, D_n, of the stator jacket.

There is a helical groove on the cooling jacket that conducts the coolant between the spindle house and the cooling jacket.

The step compression joint on the rotor is a non-positive compression joint that makes it possible to easily mount and remove the rotor. Step compression joints do not cause any stress that could negatively effect the running accuracy of the spindle. They also increase the stiffness of the spindle.

With axial clamping, the rotor is centered on the spindle with a clearance, then pressed against the spindle shoulder via a terminal board using a tension screw. This makes it easy to mount and remove, if necessary. Maximum speed must be limited to 2500 min^{-1} as higher speeds cause a slight elongation between rotor and spindle housing which, in turn, can lead to an unbalanced state.

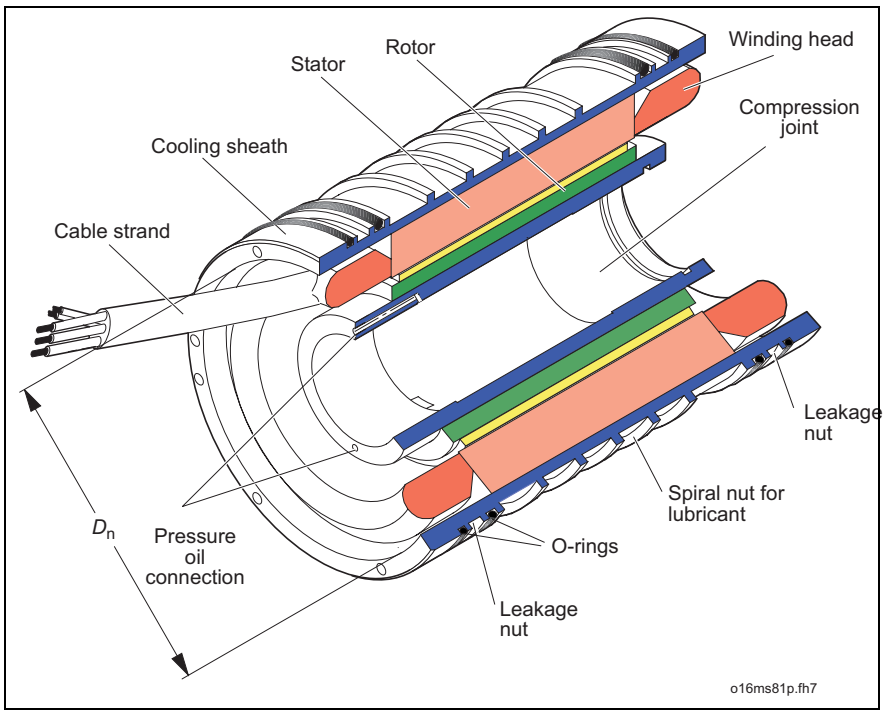


Fig. 1-2:Synchronous kit spindle motors with allocation of terms

1.2 MBS Servo Drive

MBS kit servo motors are different from the MBS kit main spindle motors as:

- their cooling mode is natural convection,
- they have low end speeds and
- their rotor inside diameters are larger.

The following figure illustrates the components of an MBS kit servo drive.

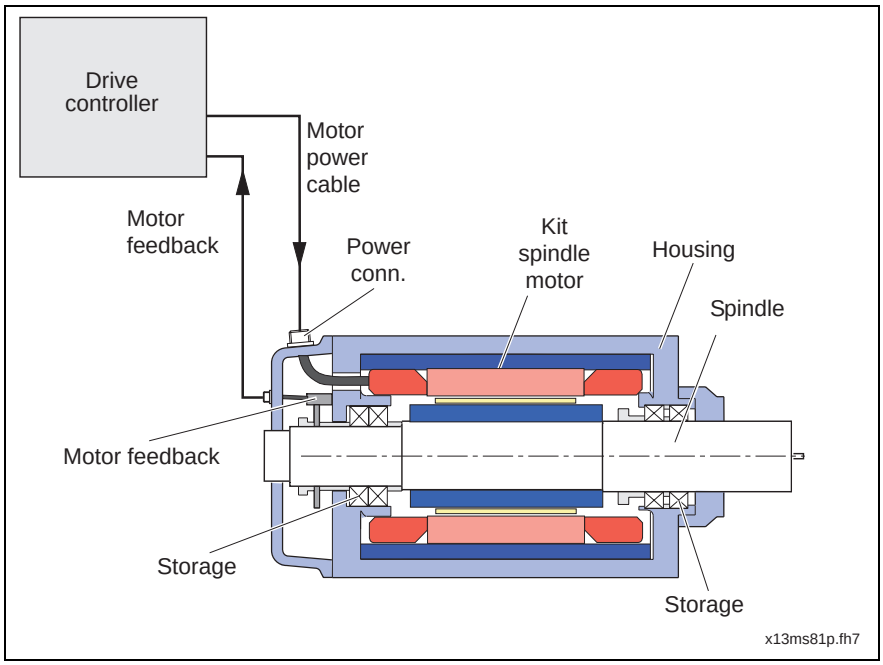


Fig. 1-3: Components of an MBS kit servo drive

Motor spindle

The motor spindle is made up a spindle with housing, bearings, kit spindle motor and motor feedback.

What type of bearings, lubricant and the extent of bearing input tension are used depends on how the motor spindle is used and is the responsiblity of the spindle builder.

Motor feedback

The motor feedback measures rotor position and transmits it to the controller to regulate speed and spindle position. It is integrated into the motor as a self-sufficient module.

Structure

An MBS kit servo spindle motor is a permanent-magnet excited synchronous motor. Thermoconduction and natural convection remove all heat. Spindle mounting must assure thermoconduction.

The rotor of the servo spindle motor must be connected non-positively with the spindle with either, as is the case with main spindles, a step compression joint or an „axial clamp“. (See section 1.1 MBS Main Spindle Drive)

2 Technical Details

2.1 The Basic Principle of Rotor Mounting

The rotor is made up of a sleeve to which magnets have been glued on the outside. The sleeve drill hole has two slightly graduated diameters. These fitting surfaces center the mounted rotor against the spindle. The rotor centering construction must comply with the instructions specified in the section „Technical data - motor spindle construction“.

There are two ways to mount the rotor to the spindle:

1. Shrink the rotor onto the spindle

- Shrink the rotor onto the spindle
- Shrink the rotor onto the reduction sleeve

2. Clamp the rotor axially

2.1.1 Mounting the rotor by shrinking it onto the spindle, removing the rotor using an oil under pressure process

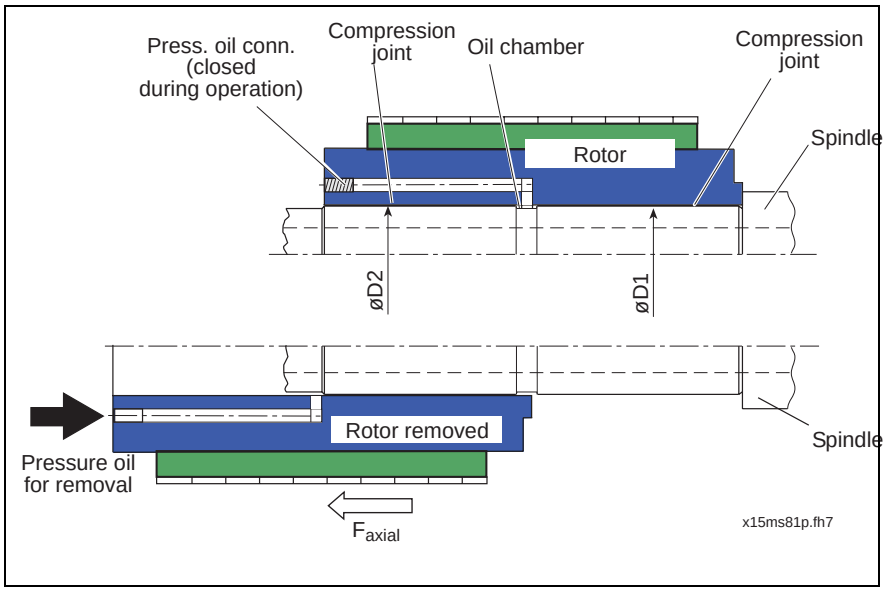


Fig. 2-1: Rotor mounting and step compression joint

Rotor mounting by shrinking

Before mounting it, the rotor is heated up to 130°C but no more than 140°C.

Note: Maximum temperature may not be exceeded! The temperature in the cabinet may not exceed 140°C.

Due to material expansion, the fittings at diameter D1 and D2 expand. Rotor and spindle can be joined without the use of pressure.

Removal with the oil under pressure process

Oil under pressure is forced into the step comression joint. This generates an axial force that makes the rotor slip off of the spindle once an oil film has sufficiently built up between the fitting surfaces.

The steps for mounting and removal are specified in section 2 „Technical Details".

After mounting, the rotor is balanced to the required vibration grade (DIN VDE 0530 Section 14). To compensate the weight of the rotor at both rotor ends, axial tapped pins are screwed in and then secured with a bonding agent (see 8.4 „Securing the screws with LOCTITE“).

Mounting in this way means that the motor spindle is securely centered on the spindle in every operating state.

The maximum speeds apply as outlined in section 2, subsection „Technical Details“.

2.1.2 Rotor Mounting on Reduction Sleeve

Regardless of its size, each rotor can only be delivered with one inside diameter, namely, the biggest one possible. If a smaller diameter is needed, then the rotor can be shrunk onto a reduction sleeve.

Note: Indramat does not supply reduction sleeves.

The reduction sleeve onto which the rotor is shrunk can then, in turn, be shrunk onto the spindle or axially clamped.

Fig. 2-2: Rotor mounting to reduction sleeves

2.1.3 Rotor Mounting by „Axially Clamping“ to the Spindle

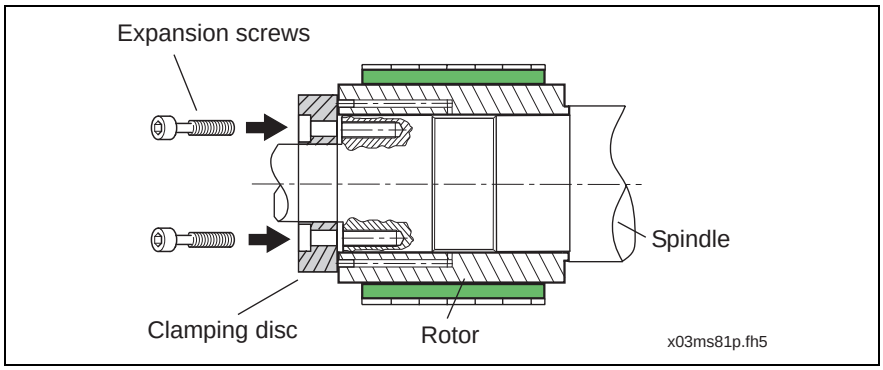


Fig. 2-3:Rotor mounting with „axial clamping“

The rotor is center on the spindle with clearance and then pressed against the spindle shoulder via a terminal board using a tension screw, thus clamping it axially.

The tension screws must compensate the change in length between rotor and spindle caused by the temperature difference between rotor and spindle equal to max. 20°C when the motor is in operation.

Tension screws and terminal boards must be ordered separately and are the responsibility of the spindle builder.

There are holes for the screws on the front of the rotor.

Balancing the rotor

After mounting, the rotor is balanced to the required vibration grade (DIN VDE 0530 Section 14). To compensate the weight of the rotor at both rotor ends, axial tapped pins are screwed in and then secured with a bonding agent (see 8.4 „Securing the screws with LOCTITE“).

Note:	The clamping disc must be ordered separately.

Note:	Maximum speed with „axial clamping" is limited to 2500 min^{-1}.

Due to the temperature difference between rotor and spindle as well as the centrifugal force, minimal displacemenet between rotor and spindle axis can occur at higher speeds (>2500 min^{-1}). This could increase the imbalanced mass to an unacceptable extent.

The rotor may not be mounted to the spindle in any other way!

2.2 Stator Mounting Principle

Stator

The stator is made up of a cooling jacket and a core assembly with winding overhang arranged on the front. The outside of the jacket is stepped. The ends of the stator are therefore generally identified as the thick and thin stator end.

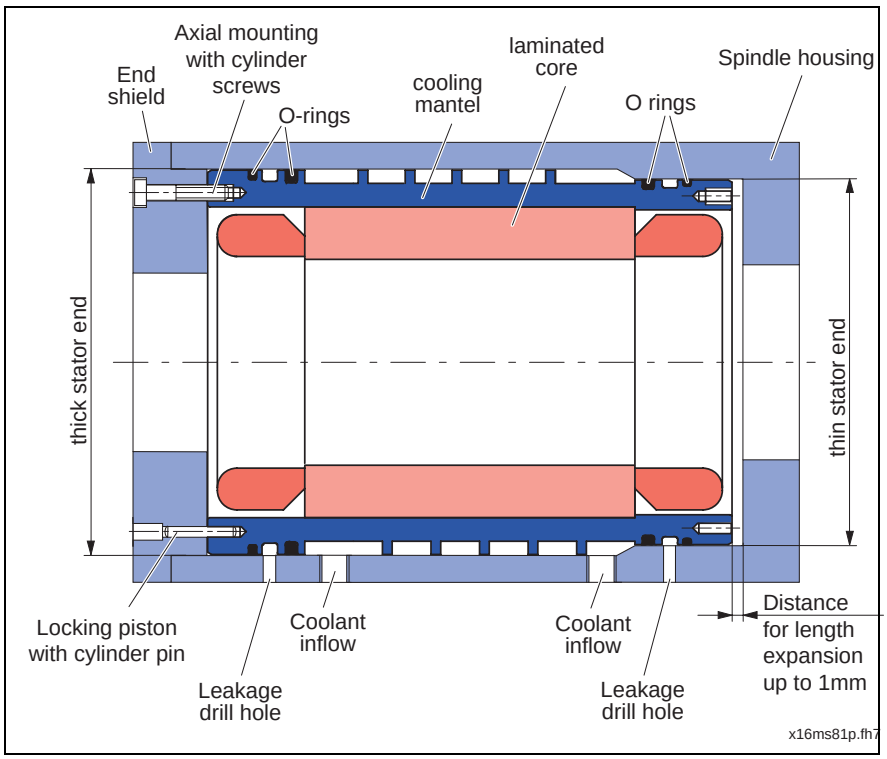


Fig. 2-4: Stator mounting principle

The mounting drill hole in the spindle housing must be constructed as per „Technical data - construction the motor spindle“.

Mounting the stator

The stator is axially fixed and secured against twisting at either the thick or thin end within the motor spindle. For this purpose, there are windings on the front for axial mounting and drill holes for cylinder pins to prevent twisting.

There is a clearance between stator and spindle housing of at least 1 mm at the opposite stator end. This makes it possible for the stator to expand. This expansion results from the heat generated by the stator while the motor spindle is running.

The layout of the stator accommodates light weight and little volume. Its final flexural strength is not achieved until it is mounted into the spindle housing.

Cooling with „natural convection“

When cooling with natural convection, the heat generated in rotor and stator is conducted over the end shields, the turning spindle and the stator housing.

Liquid cooling

The coiled groove worked into the cooling jacket creates a channel with the spindle housing. This is sealed on both ends by two O-rings. There is a drainage groove between the O-rings. The drainage of the coolant is ensured by a drain hole at the lowest point of the spindle housing.

The cooling jacket is made of aluminum. The spindle housing must be protected against corrosion. A suitable coolant or additive can be used for this purpose.

For further information on dimensioning and selecting a coolant, see the document „Liquid cooling of INDRAMAT drive components; Dimensioning and Selecting“, doc. no. 209-0042-4123.

Electrical connections

The power connection is conducted through one of the end windings of the stator. At least one PTC resistor is in the end winding to measure the winding temperature through the controller.

The power connection and the PTC resistor connection are conducted together as one cable core within a hose The cable core can, depending on how ordered, be situated at either the thick or thin stator end.

When conducting the cable through the spindle housing, please note that

- the bend radius specified for the cable strand may not be exceeded (see section „Technical data“),
- the edges of the drill holes on the spindle housing must be smoothed or protected with a plastic sleeve.

2.3 Motor Feedback

To control spindle speed, and when positioning the spindle, it is necessary for the controller to be able to evaluate spindle position. A motor feedback is needed for this.

Note: The builder of the machine or installation decides which feedback is used. Compatibility to Indramat drive controllers must be checked. Consult your local sales representative or office.

2.4 Electrical Connections

The connection diagram in Fig. 2.5 is schematic. It is a checklist for all connections needed to operate the motor spindle with a 1MB motor.

The electrical connections of INDRAMAT main spindle drives are standardized in an effort to keep the variety of cables to a minimum.

There are the following electrical connections on a motor spindle with kit spindle motor:

- power connections with PTC resistor of the motor
- ground connections
- motor feedback connections

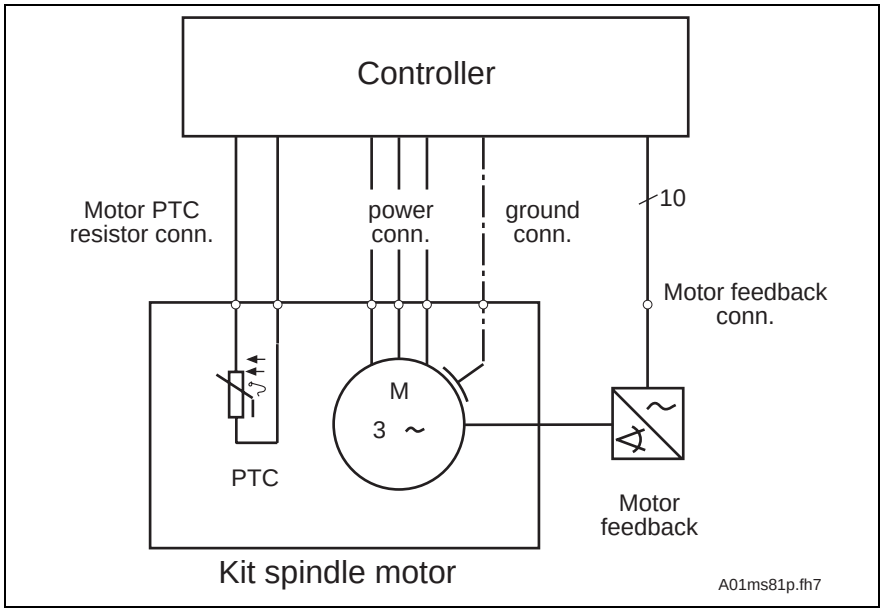


Fig. 2-5: Schematic connection diagram for kit spindle motors

2.4.1 Ground Connections

An MBS motor is grounded via the motor power cable on the controller. The ground connection on the stator of the motor spindle must comply with the specifications of the dimension sheet. See section „Technical data“ of the relevant kit spindle motor.

The cross section of the ground wire corresponds to the minimum core cross section as specified in the section „Technical data“ of the relevant MBS motor.

2.4.2 Power Connections

The power connection of the kit spindle motor implements

- a terminal connection (terminal box).

The stator has a 1.5 meter long cable. This cable has a protective covering and is made up a power core, protective conductor and a wire pair for the PTC resistor in the winding overhang.

Power cores cross sections

The cross sections of the power cores of the cable strand depend on the nominal motor current. The cross section of the line pair for connecting the PTC resistor of the motor equals 0.5 mm^2.

The cable strand is a motor-internal connection. The insulation of the strand is thus designed to take temperatures higher than that of the motor power cable (connection between motor spindle and controller). The data in section „Technical data“ on the minimum core cross section of the motor power cable therefore generally deviate from the cross sections of the power cores of the cable strand.

Bend radius of the cable strand

The allowable bend radius of the cable strand is specified in the dimension sheet of the relevant kit spindle motor in section „Technical data“.

Terminal connection

In terminal connections, the cable strand of the stator is connected with the motor power cable in the terminal box. The terminal box is mounted to the spindle housing or within its proximity. There must be a three or six pin terminal strip for the power connections and a terminal strip with two terminal points for the PTC resistor connection in the box (Fig. 2-6). The standard cables also contain two additional strands for the optional brake control. These are generally not required. To avoid interference during operation, it is advisable to route these cores in the terminal box on a terminal strip. To maintain all the standards applicable to the terminal connections, see Fig. 2-7.

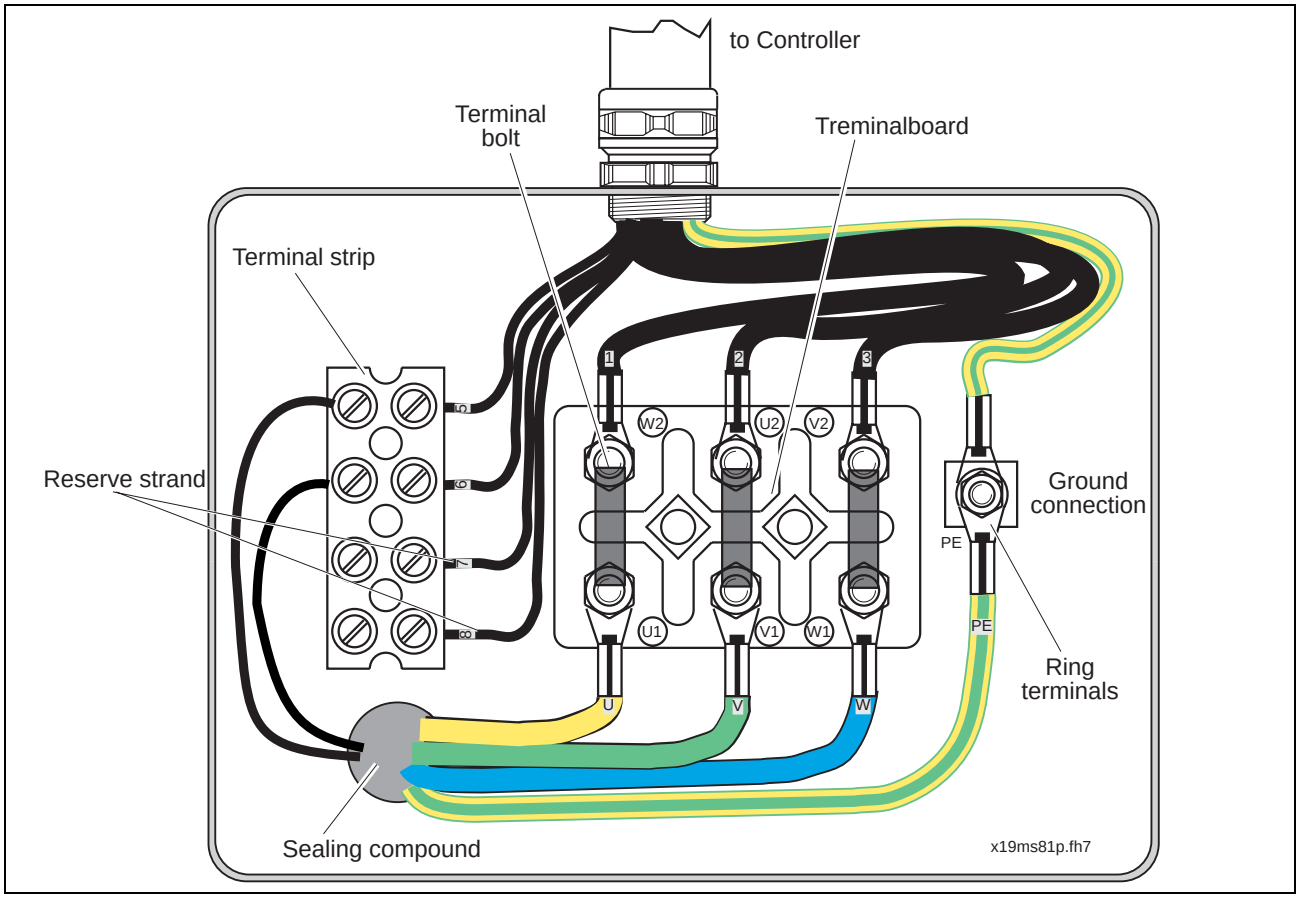


Fig. 2-6: An example of a terminal box (looking down, box open)

	Standard	Terminal connection
Terminal panel	DIN 46 294	maximum nominal voltage AC 660V
Terminal strip	DIN VDE 0110	maximum nominal voltage AC 380V
Mounting bolts	DIN 46 200	determining bolt diameter
Ring terminals	DIN 46 237	power core of the cable strand
Ferrules	DIN 46 228 Section 3	PTC resistor core of the cable strand
Protection category	DIN VDE 0530 Section 5	minimum category IP54
Connection designation	EN 60 445 DIN VDE 0530 Section 8	(see Fig. 2-7)

Fig. 2-7: Terminal connection standards

The terminal box must have a minimum protection category of IP 54 as specified in DIN VDE 0530 Section 5. There must be seals between spindle housing and terminal box as well as the terminal box lid (Fig. 2-8:). The cable leadthrough of the individual strands from spindle housing to terminal box are sealed with sealing material (Fig. 2-7: Terminal connection standards). Cable screws may only be used with connections to the drive controller.

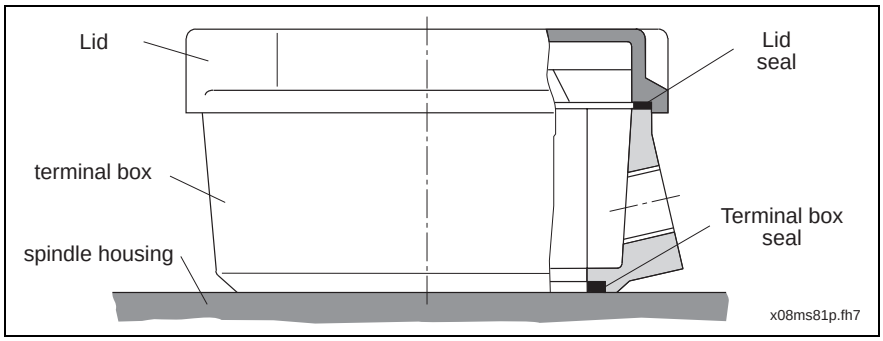


Fig. 2-8: Seals on the terminal box

The mounting bolts of the terminal boards meet DIN 46 200 demands in terms of the nominal current for the MBS motors (see Fig. 2-9). Data on the nominal current are in section „Technical data“ of the relevant kit spindle motors.

Nominal curent	Bolts		Hexagonal groove	Washer for eye connection [1) 2)]
up to /A	winding d	material		
10	M 3.5	CuZn37 F45	DIN 439 -AM 3.5 - Ms	DIN 125 - 3.7 - Ms
16	M 4		DIN 439 -AM 4 - Ms	DIN 125 - 4.3 - Ms
25	M 5		DIN 439 - AM 5 - Ms	DIN 125 - 5.3 - Ms
63	M 6		DIN 439 - BM 6 - Ms	DIN 125 - 6.4 - Ms
100	M 8		DIN 439 - BM 8 - Ms	DIN 125 - 8.4 - Ms
160	M 10		DIN 934 - M10 - Ms	---
250	M 12		DIN 934 - M12 - Ms	---

1) Materials of equal electrical and mechanical value may also be used.

2) Additional grooves and washers may be made of steel. Note the heating up caused by eddy currents.

Fig. 2-9: Current load of the mounting bolts as per DIN 46 200

The individual components of the terminal connections are not available through INDRAMAT. For terminal box, board and strip suppliers, see below.

Components	Supplier
Terminal box	Kinle & Spiess GmbH 74343 Sachsenheim
Terminal board	REKOFA WENZEL GmbH &CoKG 53474 Bad Neuenahr-Ahrweiler
Terminal strip	WIELAND, ELEKTROINDUSTRIE GmbH 96045 Bamberg

Fig. 2-10: Possible suppliers

2.5 Standards and Regulations

The following standards are quoted in this document. These must be complied with and used.

Standard	No.	Sect.	Edition	Title
DIN	34		01.98	Protection notes on limiting use of documentation
DIN	509		06.98	Relief groove
DIN	580		03.72	Ring screws
DIN	913		12.80	Winding pin with hexagon socket, ISO
DIN	2999	1	07.83	Whithworth tubular windings for tubular pipes and fittings, c y-lindrical internal thread and conical external thread, winding dimension
DIN	42 961		06.80	Name plate for electrical machines, design
DIN	46 200		07.77	current-conductive connecting bolts up to 1600A. Layout and allocation of current rates.
DIN	46 294		04.85	Square terminal board with six mounting bolts.
DIN EN	60 445		09.91	Designation of the electrical connections of equipment and specific conductors, general rules for an alpha-numeric coding system.
DIN EN ISO	4762		02.98	cylinder screw with hexagon socket, ISO 4762 modified
DIN EN ISO	8734		10.92	hardened cylinder pin (ISO8734: 1967) German version of 1992
DIN VDE	0110	1	04.97	Insulation coordination for electrical equipment in extra-low voltage installations, measuring air and creepage distance.
DIN VDE	0530	1	07.91	Rotating electrical machines, measuring data and operation modes
DIN VDE	0530	5	04.88	Rotating electrical machines, breakdown of protection categorie of housing for rotating machines
DIN VDE	0530	8	07.87	Rotating electrical machines, terminal designations and rotational direction.

Fig. 2-11:Quoted standards

The construction, mounting and documentation of a motor spindle in terms of standards and regulations must be complied with (List may be not complete).

Standard	No.	Sect.	Edition	Title
DIN	46 228	3	08.92	Ferrules, raw form without plastic sleeve
DIN	46 237		07.70	Ring terminals for no-solder connections, insulated for copper conductor
DIN VDE	0100	410	11.83	construction of high-voltage facilities with nominal voltages up to 1000V, safety measures, protection against dangerou body currents
DIN EN	60034	14	09.97	running electrical machines, section 14; mechanical vibrations of specific machines with an axis height of 56 mm and higher, measurements, evaluation and limit values of the vibrations.

Regulation	Title
89/336/EWG	Electromagnetic compatibility, EU guidelines with national interpretations of EMC law dated 9 November 1992
	Accident prevention
VBG 1	General regulations
VGB 4	Electrical machines and equipment
VGB 5	Power-driven equipment

Fig. 2-12: Additional standards and regulations

3 Safety Instructions for Electrical Drives

3.1 Introduction

These instructions must be read and understood before the equipment is used in order to minimize the risk of personal injury and / or property damage. Follow these safety instructions at all times.

Do not attempt to install, use or service this equipment without first reading all documentation provided with the product. Please read and understand these safety instructions, and all user documentation of the equipment, prior to working with the equipment at any time. You must contact your local Indramat representative if you cannot locate the user documentation for your equipment. A listing of Indramat offices is supplied in the back of this manual. Request that your representative send this documentation immediately to the person or persons responsible for the safe operation of this equipment.

If the product is resold, rented and/or otherwise transferred or passed on to others, then these safety instructions must accompany it.

WARNING

Improper use of this equipment, failure to follow the attached safety instructions, or tampering with the product, including disabling of a or several safety devices, may result in bodily injury, severe electrical shock, death, or property damage!

3.2 Hazards with improper use

DANGER

High voltage and high discharge current!

Danger to life, risk of severe electrical shock and risk of injury!

DANGER

Dangerous movements!

Danger to life and risk of injury or equipment damage by unintentional motor movements!

WARNING

High electrical voltages due to incorrect connections!

Danger to life, severe electrical shock and serious bodily injury!

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 incorrect handling!

Bodily injury caused by crushing, shearing, cutting and thrusting movements!

CAUTION

Risk of injury due to incorrect handling of batteries!

3.3 General

- INDRAMAT GmbH is not liable for damages resulting from failure to observe the warnings given in these instructions.
- Operating, maintenance and safety instructions in the local language or English must be ordered and received before initial start-up, if the instructions in the language provided are not understood perfectly.
- 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.
- Trained and qualified personnel in electrical equipment:

  Only trained and qualified personnel may work on this equipment or within its proximity. Personnel are qualified if they have sufficient knowledge of the assembly, installation, and operation of the product as well as an understanding of all warnings and precautionary measures noted in these instructions.

  Furthermore, they should be trained, instructed, and qualified to switch electrical circuits and equipment on and off, to ground them, and to mark them according to the requirements of safe work practices and common sense. They must have adequate safety equipment and be trained in first aid.
- Use only spare parts approved by the manufacturer.
- All safety regulations and requirements for the specific application must be followed as practiced in the country of use.
- The equipment is designed for installation on commercial machinery.
- Start-up is only permitted once it is sure that the machine in which the product is installed complies with the requirements of national safety regulations and safety specifications of the application.

  European countries: see Directive 89/392/EEC (Machine Guideline).
- 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 INDRAMAT document "EMC in Drive and Control Systems“.

  The machine builder is responsible for compliance with the limiting values as prescribed in the national regulations and specific EMC regulations for the application.

  European countries: see Directive 89/336/EEC (EMC Guideline).

  U.S.A.: See National Electrical Codes (NEC), National Electrical Manufacturers Association (NEMA), and local building codes. The user of this equipment must consult the above noted items at all times.
- Technical data, connections, and operational conditions are specified in the product documentation and must be followed.

3.4 Protection against contact with electrical parts and not grounded enclosures

Note: This section pertains to equipment and drive components with voltages over 50 Volts.

Touching live parts with potentials of 50 volts and higher applied to them or touching not grounded enclosures can be dangerous and cause severe electrical shock. In order for electrical equipment to be operated, certain parts must have dangerous voltages applied to them.

DANGER

High Voltage!
Danger to life, severe electrical shock and risk of injury!

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

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

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

⇒ At no time may electrical equipment be operated if the ground wire is not permanently connected, even for brief measurements or tests.

⇒ Before beginning any work, disconnect mains or the voltage source from the equipment. Lock the equipment against being switched on while work is being performed.

⇒ Wait five (5) minutes after switching off power to allow capacitors to discharge before beginning work. Measure the voltage on the capacitors before beginning 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.

⇒ Before switching the equipment on, install those covers and guards provided with the equipment to prevent contact with live parts. Before operating, cover and guard live parts properly so they cannot be touched.

⇒ A residual-current-operated protective device (r.c.d.) must not be used on an AC drive! Indirect contact must be prevented by other means, for example, by an overcurrent protective device.

European countries: according to EN 50178/ 1994.

⇒ Electrical components with exposed live parts must be installed in a control cabinet to prevent direct contact.

European countries: according to EN 50178/ 1994.

U.S.A: See National Electrical Codes (NEC), National Electrical Manufacturers Association (NEMA), and local building codes. The user of this equipment must consult the above noted items at all times.

DANGER

High housing voltage! High leakage current!
Danger to life and limb, danger of injury from electric shock!

⇒ Prior to powering up, connect the electrical equipment, the housing of all electrical units and motors to the protective conductor at the grounding points or ground them. This applies even to brief tests.

⇒ The protective conductor of the electrical equipment and units must always be connected to the supply network. Leakage current exceeds 3.5 mA.

⇒ Use at least a 10 mm^2 copper conductor cross section for this protective connection over its entire course!

⇒ Prior to startups, even for brief tests, always connect the protective conductor or connect with ground wire. High voltage levels can occur on the housing that could lead to severe electrical shock and personal injury.

European countries: EN 50178 / 1994, section 5.3.2.3.

USA: See National Electrical Codes (NEC), National Electrical Manufacturers Association (NEMA), and local building codes. The user of this equipment must consult the above noted items at all times.

3.5 Protection by protective low voltage (PELV) against electrical shock

All connections and terminals with voltages ranging between 5 and 50 volts on INDRAMAT products are protective low voltages designed in accordance with the following standards on contact safety:

- International: IEC 364-4-411.1.5
- EU countries: see EN 50178/1994, section 5.2.8.1.

WARNING

High electrical voltages due to incorrect connections!
Danger to life, severe electrical shock and/or serious bodily injury!

⇒ Only that equipment or those electrical components and cables may be connected to all terminals and clamps with 0 to 50 volts that are of the protective low voltage type (PELV = Protective Extra Low Voltage).

⇒ Only connect those voltages and electrical circuits that are safely isolated. Safe isolation is achieved, for example, with an isolating transformer, an optoelectronic coupler or when battery-operated.

3.6 Protection against dangerous movements

Dangerous movements can be caused when units have bad interfaces or motors are connected incorrectly.

There are various causes of dangerous movements:

- Improper or incorrect wiring or cable connections
- equipment is operated incorrectly
- probe parameters or encoder parameters are set incorrectly
- malfunctioning components
- errors in software or firmware

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

Although the monitoring circuits in the drive components make improper operation almost impossible, personnel safety requires that proper safety precautions be taken to minimize the risk of personal injury and/or property damage. This means that unexpected motion must be anticipated since safety monitoring built into the equipment might be defeated by incorrect wiring or other faults.

DANGER

Dangerous movements!
Danger to life and risk of injury or equipment damage!

⇒ In the drive component monitoring units, every effort is made to avoid the possibility of faulty operation in connected drives. Unintended machine motion or other malfunction is possible if monitoring units are disabled, bypassed or not activated.

⇒ Safe requirements of each individual drive application must be considered on a case-by-case basis by users and machine builders.

Avoiding accidents, personal injury and/or property damage:

⇒ Keep free and clear of the machine's range of motion and moving parts. Prevent people from accidentally entering the machine's range of movement:
- use protective fences
- use protective railings
- install protective coverings
- install light curtains / barriers

⇒ Fences should be strong enough to withstand maximum possible momentum.

⇒ Mount the Emergency Stop (E-stop) switch in the immediate reach of the operator. Verify that the emergency stop works before startup. Do not operate the machine if it is not working.

⇒ Isolate the drive power connection by means of an emergency stop circuit or use a start inhibit system to prevent unintentional start-up.

⇒ Make sure that the drives are brought to standstill before accessing or entering the danger zone.

⇒ Disconnect electrical power to the equipment using a master lock-out and secure against reconnection for:
- maintenance and repair work
- cleaning of equipment
- long periods of discontinued equipment use

⇒ Avoid operating high-frequency, remote control, and radio equipment near equipment electronics and supply leads. If use of such equipment cannot be avoided, verify the system and the plant for possible malfunctions at all possible positions of normal use before the first start-up. If necessary, perform a special Electromagnetic Compatibility (EMC) test on the plant.

3.7 Protection when Handling and Mounting MBS Rotors

Synchronous kit motor rotors generate considerable static magnetic fields due to the glued on permanent magnets.

Danger

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

⇒ Persons with pacemakers and metal implants are not permitted to have access to 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, repaired or mounted.

⇒ If it is necessary for a person with a pacemaker to enter into such an area, then a physician must be consulted prior to doing so.

⇒ Persons with metal implants or hearing aids must take care prior to entering into areas described above. It is assumed that metal implants or hearing aids will be affected by such areas: A physician must be consulted prior to working in and/or entering such areas.

CAUTION

Danger of pinching fingers and hands due to the attractive force of the magnets!

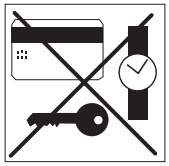
Strong magnetic fields due to permanent magnets of the rotors!

⇒ Only handle when wearing protective gloves.

CAUTION

Sensitive parts can be damaged or destroyed!

Strong magnetic fields due to permanent magnets of the rotors!



⇒ Watches, credit cards, any types of cards with magnetic strips as well as ferromagnetic metal sections such as iron, nickel, cobalt must be kept away from permanent magnets.

4 Ambient Conditions

Maximum Installation Elevation and Ambient Temperatures

Nominal data

The specified power data of the motors applies to

- ambient temperatures of 0º to +45º C
- installation elevations of 0 to 1000 m above sea level

Exceeding nominal data

If the motors are used in areas in which these values would be exceeded then the "Load factors" must be taken into account. This derates the power data.

⇒ In cases such as these, check whether the power data still suffice for your application. To determine the load factors, see Fig. 4-1. Values higher than those illustrates for both temperature and installation elevations are not allowed!

Note: Motor damage and forfeiture of guarantee!

Motors operated outside of the specified range could be damaged. Doing so would also mean that the guarantee is forfeited. Therefore, please note the following instructions.

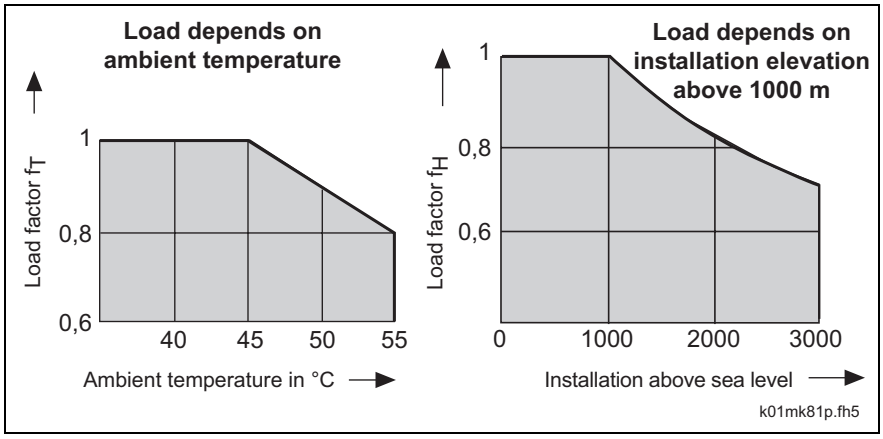


Fig. 4-1: Load factor as dependent on ambient temperatures and installation elevation

If **either** ambient temperature **or** installation elevation lie above nominal data range, then

⇒ multiply the torque data specified in the selection data with the low factor which has been determined, then

⇒ make sure that your application does not exceed the reduced torque.

If **both** the ambient temperature **and** installation elevation lie above the nominal data, then

⇒ mulitply the determined load factors f_T and f_H;

⇒ then multiply that value with the motor torque data specified in the selection list.

⇒ Now make sure that the reduced torque is not exceeded by your application.

5 MBS200 Main spindle drives

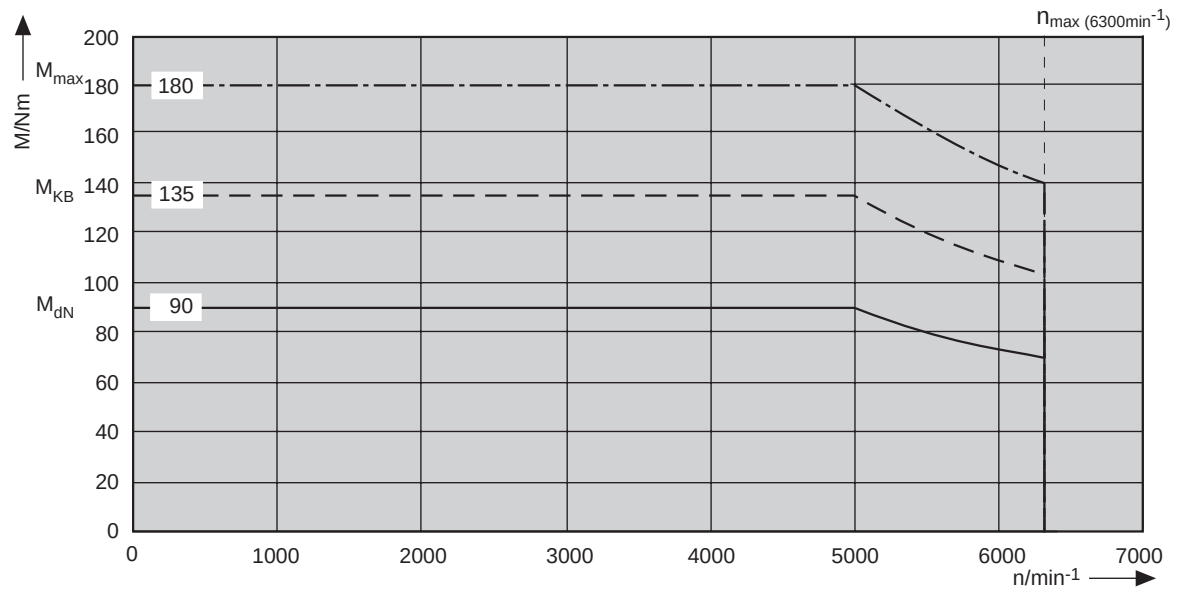
5.1 Technical data

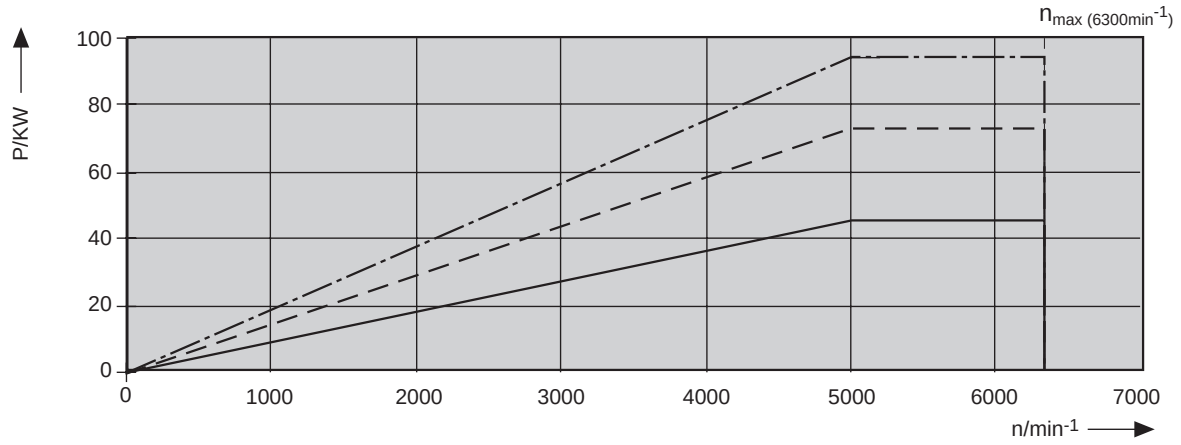
Designation		Symbol	Unit	Data	
Motor type				MBS200B-050	MBS200C-050
Motor nominal speed [1) 5)]		n	min^{-1}	5200	5200
Allowable maximum speed					
Mounting	„Shrinking“	n_{max}	min^{-1}	6300	6300
	„axially clamped“	n_{max}	min^{-1}	2500	2500
Continuous torque at standstill		M_{dN}	Nm	90	115
Continuous current at standstill		I_{dN}	A	128	150
Minimum cross section for INDRAMAT cable [7)]		A	mm^2	1 x 25 or 2 x 10	1 x 35 or 2 x16
Minimum cross section for standard PVC cable [8)]		A	mm^2	1 x 50 or 2 x 16	2 x 25
Theoretical maximum torque [2)]		M_{max}	Nm	180	180
Usable peak current		I_{max}	A	245	240
Rotor moment of inertia		J_M	kgm^2	300×10^{-4}	325×10^{-4}
Torque constant at 20°C		K_m	Nm/A	0.73	0.785
Voltage constant at 20°C [4)]		K_{eff}	V	66.4	71.4
Windings resistance at 20°C		R_A	Ohm	0.06	0.07
Windings inductance		L_A	mH	0.46	0.55
Thermal time constant		T_{th}	min	120	120
Weight	Rotor	m_M	kg	12.0	14.5
	Stator	m_M	kg	17.0	20.0
Allowable ambient temperature		T_{um}	°C	0 to +40	
Allowable storage and transport temperature		T_L	°C	-20 to +80	
Maximum installation elevation [3)]			m	1000 above sea level	
Insulation classification				F	
Technical data about liquid cooling					
Nominal power loss		P_{Vn}	kW	1.5	2.5
Coolant temperature at entry		ϑ_{ein}	°C	10 to 40	
Coolant temperature at P_{Vn} [6)]		$\Delta\vartheta_n$	K	10	
Ambient temperature		T	°C	5 to 45	
Required coolant flowthrough at $\Delta\vartheta_n$ [6)]		Q_n	l/min	10	10
Pressure drop at Q_n [6)]		Δp_n	bar	0.1	0.1
Maximum system pressure		p_{max}	bar	5	5
Volume in coolant channel		V	l	0.4	0.5

1) Depends on torque requirements of application. For standard applications see n_{max} in the selection lists for the motor/controller combination. For other applications determine usable speed using required torque specified in speed/torque characteristics.
2) Achievable maximum torque depends on drive controller. **Only those** in the selection lists for the motor/controller combination specified maximum torques M_{max} are binding.
3) Installation heights over 1000m are possible with reduced data; see section 4.
4) at 1000 min^{-1} .
5) if mounted „axially clamped“ then speed must be limited to 2500 min^{-1}.
6) Data based on water as coolant. If any other type is used, e.g., oil, then recompute data or locate values in the flowthrough chart.
7) Line diameter per DIN EN 60204, routing B2 and conversion factor for INDRAMAT cable at ambient temperature 40°C.
8) Line cross section per DIN EN 60204, routing B2 and ambient temperature 40°C.

Fig. 5-1: Technical data MBS200B-050 / MBS200C-050

Characteristics of MBS200B-050





—·- -	M_{max}	Corresponds to the theoretically possible maximum torque of the motor. The drive controller can limit it.
— —	M_{KB}	S6- Intermittent operating curve at 44% ON time of the motor (per DIN VDE 0530, edition datet 07/1991).
——	M_{dN}	S1- continous operating curve of the motor (per DIN VDE 0530, edition dated 07/1991).

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Fig. 5-2: Characteristics of MBS200B-050

Characteristics of MBS200C-050

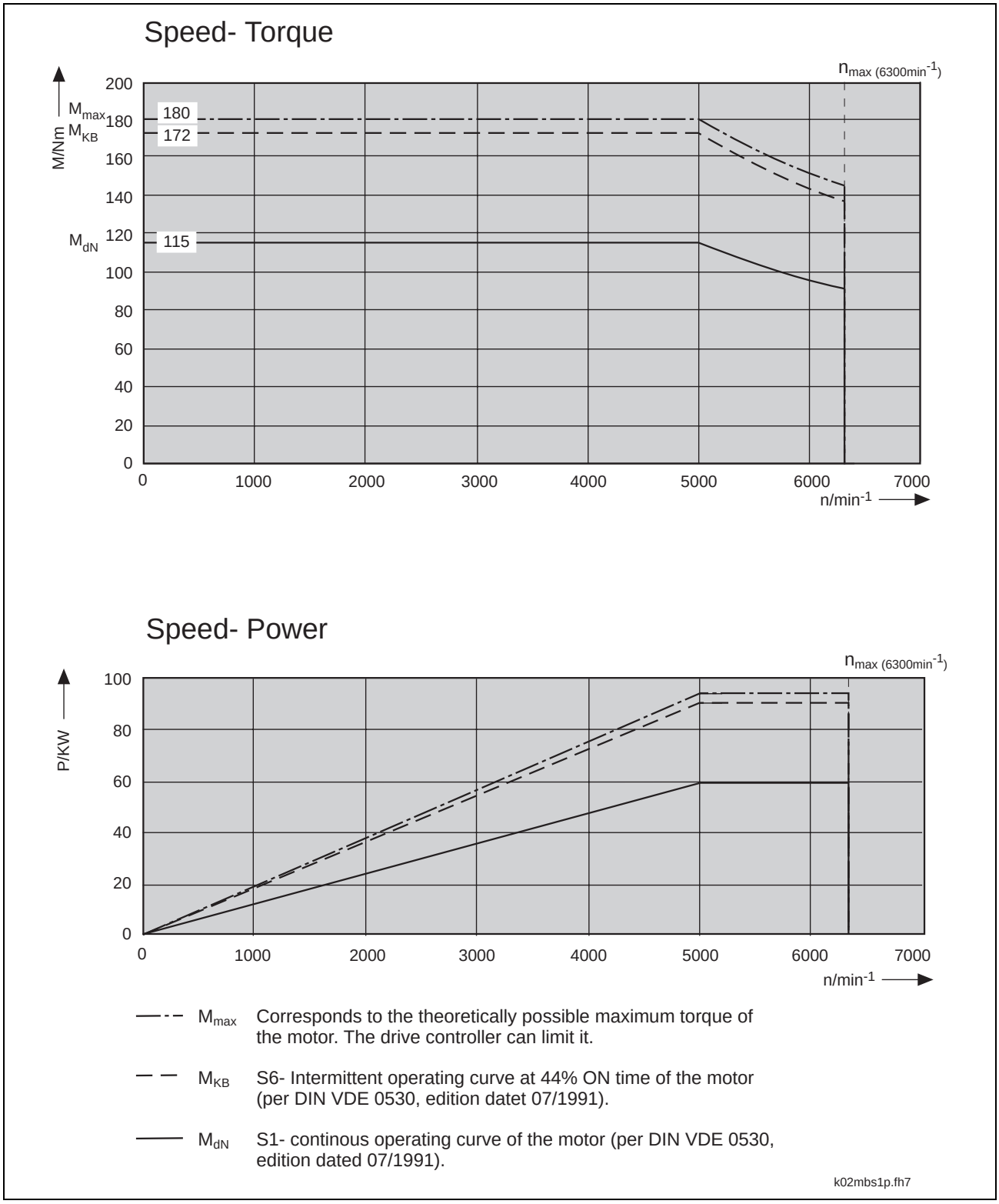
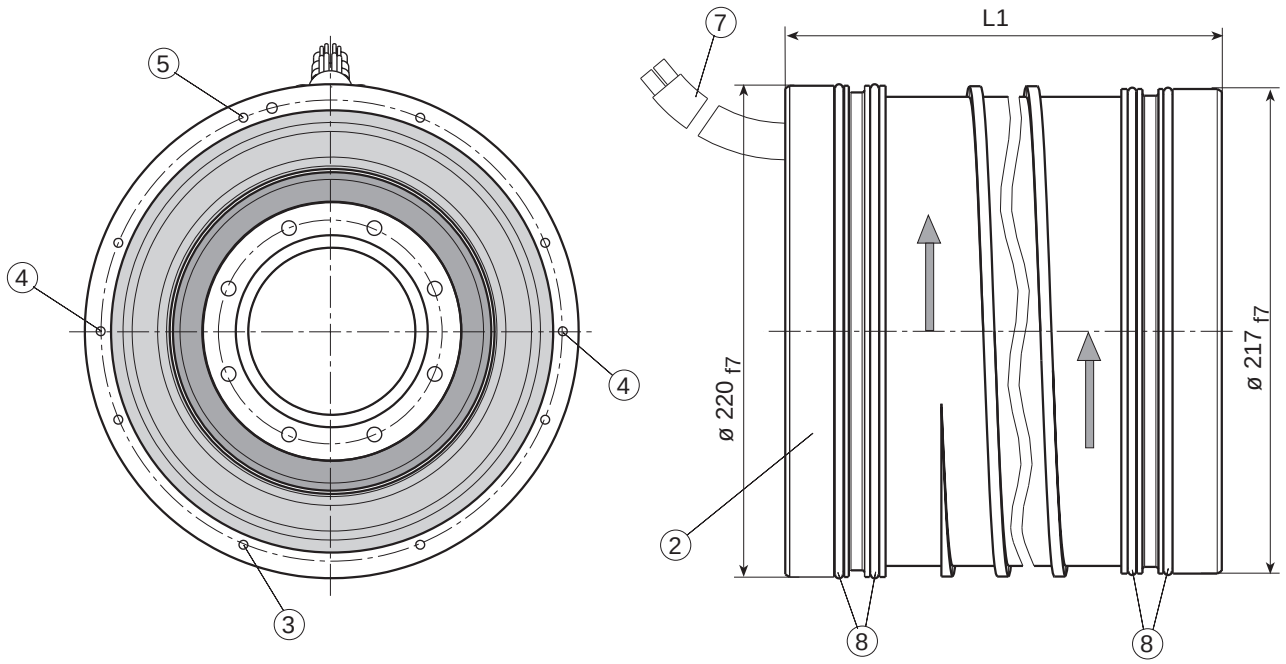
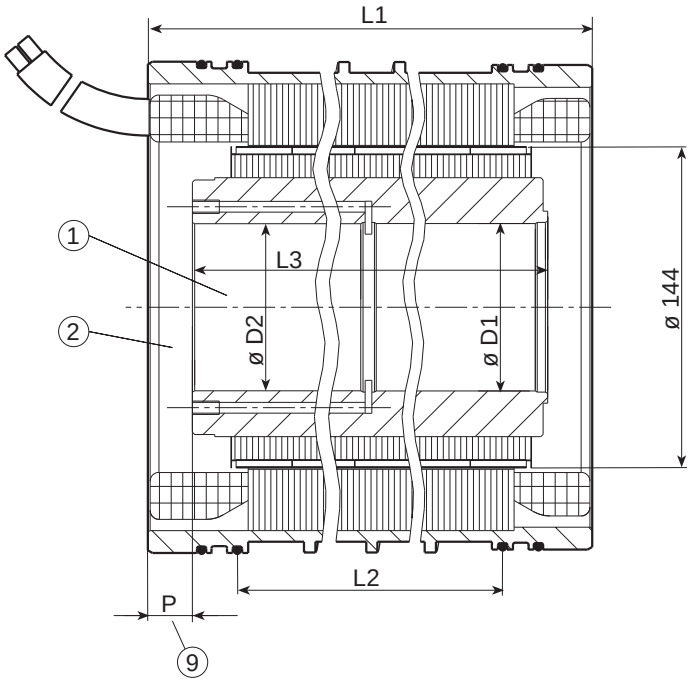


Fig. 5-3: Characeristics of MBS200C-050

5.2 Dimensional data



cut A-A



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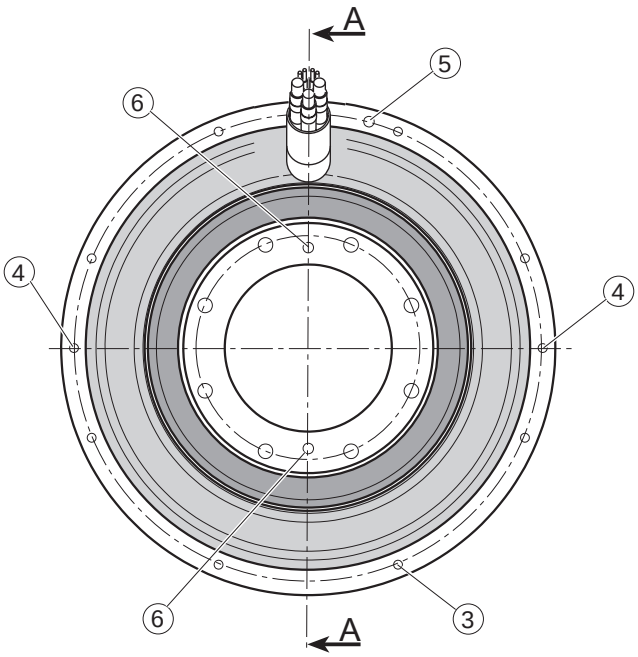


(1) Rotor MRS200B-B075
MRS200C-B075

(2) Stator MSS200B-050-A1
MSS200C-050-A1

(3) 8x M5 threads for axial mounting to spindle housing

(4) drill ø4 for cylinder pin to secure in housing

(5) thread M6 to mount ground connection line

(6) Pressure oil connection for compression joint

(7) cable strand 1500 mm long

(8) O-ring made of Viton

(9) Rotor/stator positions

Table

Dim. / Type	øD1 H6	øD2 H6	L1	L2	L3	P
MRS200B-B075 with MSS200B-B050	75	74,8	195	115	155	20
MRS200C-B075 with MSS200C-B050	75	74,8	235	155	180	30

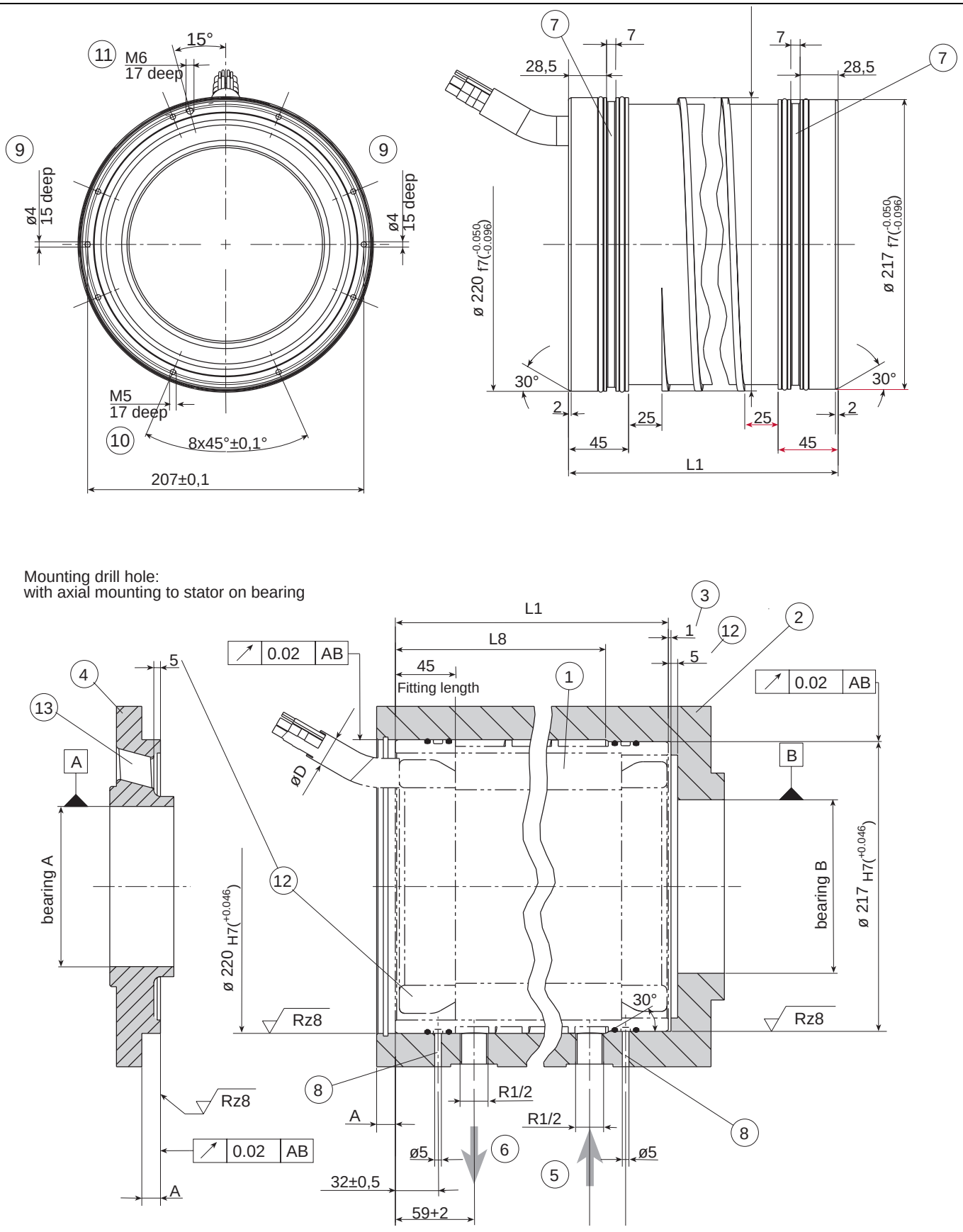
75 H6	+0.019 0
74.8 H6	+0.019 0
220 f7	-0.050 -0.096
217 f7	-0.050 -0.096
Fit	Dim

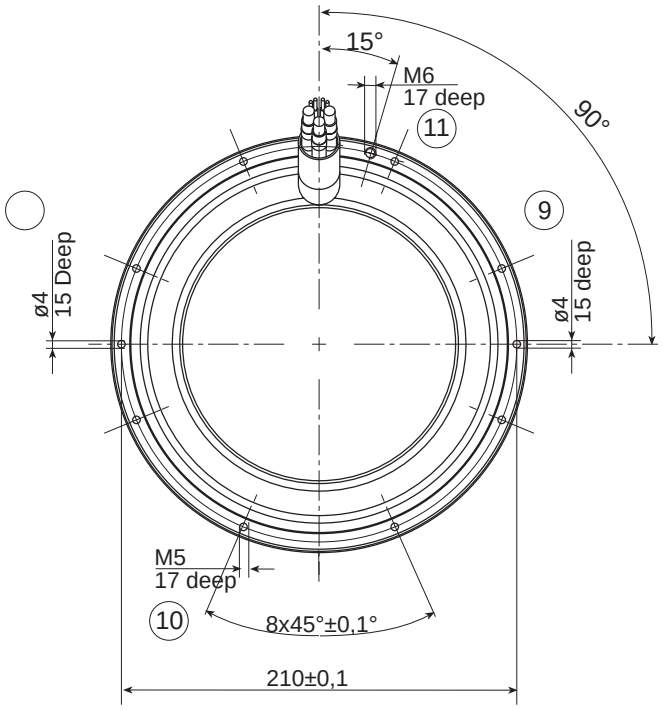
Quellvenweis: 106-0302-3001-00-C

m04msx1p.fh7

Fig. 5-4: Dimensions of stator MSS200B/C-B075 with rotor MRS200B/C-B075

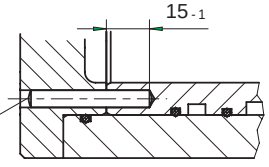
5.3 Dimensional data for mounting stator





1. Stator MSS200B-050 / MSS200C-050
2. Spindle housing
3. Minimum clearance for expansion
4. End plate
5. Coolant inlet seal DIN 2999 on circumference
6. coolant effluent pin DIN 2999 on circumference
7. Leakage nut
8. Leakage drill hole
9. 10. 11. At one of either stator ends
12. Winding head distance to housing min. 5 mm
13. Cable leadthrough with rounded edges

9 Locking piston on end shield



cylinder pin DIN 6325 ø5 m6
Material: strain strength min. 600N/mm²
hardness 60 ±2 HRC

10 Axial mounting to end shield

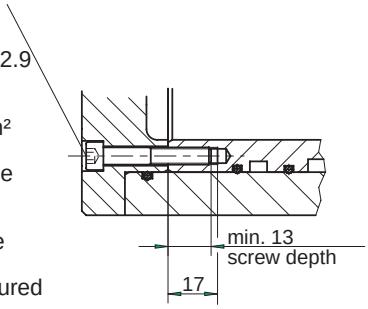
cylinder screw
DIN 912 M5

Strength class 12.9

Strain strength
min. 1200 N/mm²

Tightening torque
6 - 7 Nm

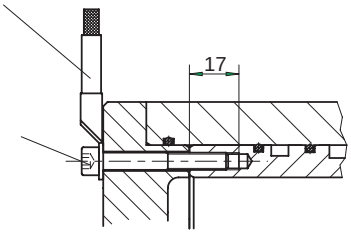
fixed with Loctite
243
bonded and secured



11 Ground connection line mounting

Grounding line
(must be ordered
separately)

Mounting screw M6
(must be ordered
separately)
Material: brass



Table

Type \ Dim.	L1	L8 +1	L9 -2	L10 ±0,5	Cable strand	
					øD	Bend radius
MSS200B-050	195	146	136	163	22	90
MSS200C-050	235	186	176	203	22	90

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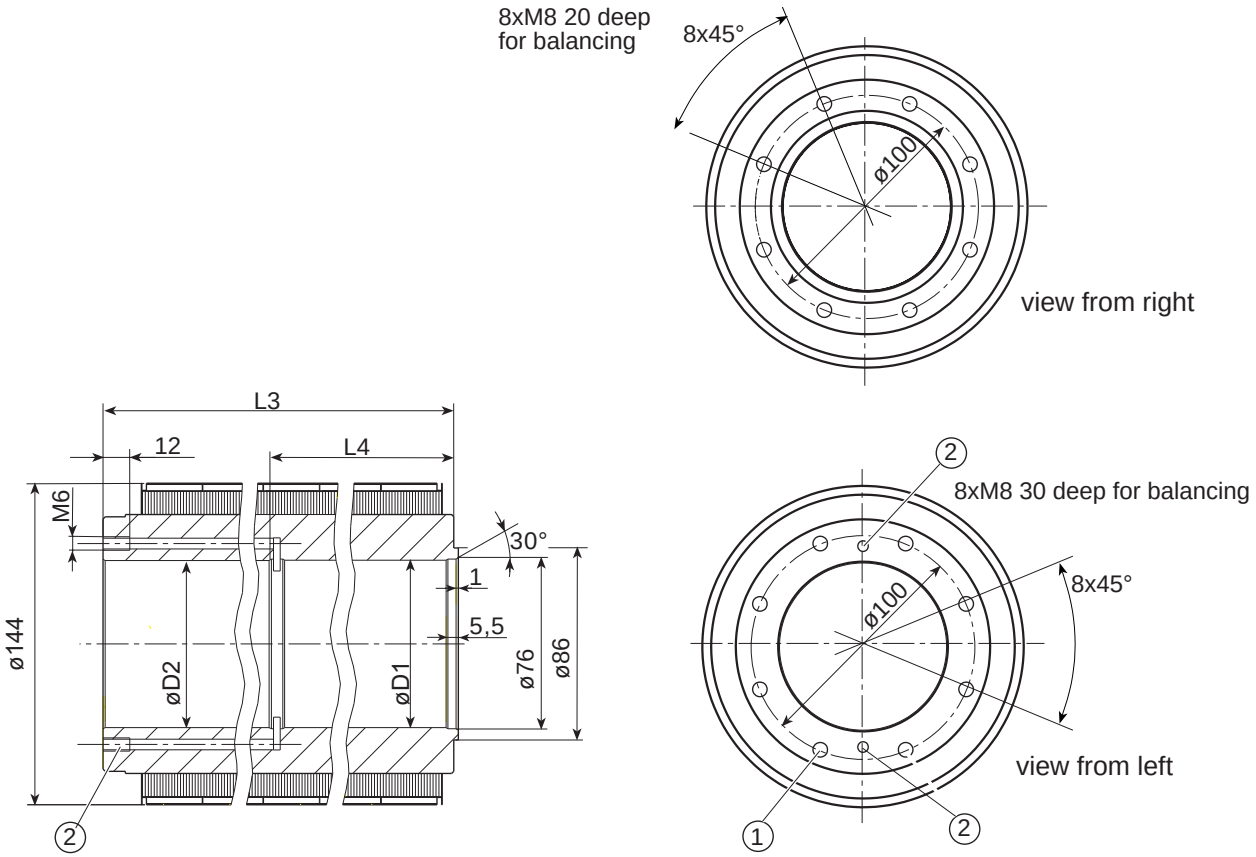
Fig. 5-5: Dimensions for mounting stator MSS200B/C-050

5.4 Dimensional data of rotor



① threaded balancing drill hole M8
weight compensation when balancing with threaded pin DIN 913
secure threaded pin with Loctite 620

② Pressure oil connection
closed with threaded pin DIN 913 after mounting rotor
secure threaded pin with Loctite 620

Table

Type \ Dim.	øD1 H6	øD2 H6	L3	L4
MRS200B-B075	75	74,8	155	82,5
MRS200C-B075	75	74,8	180	95

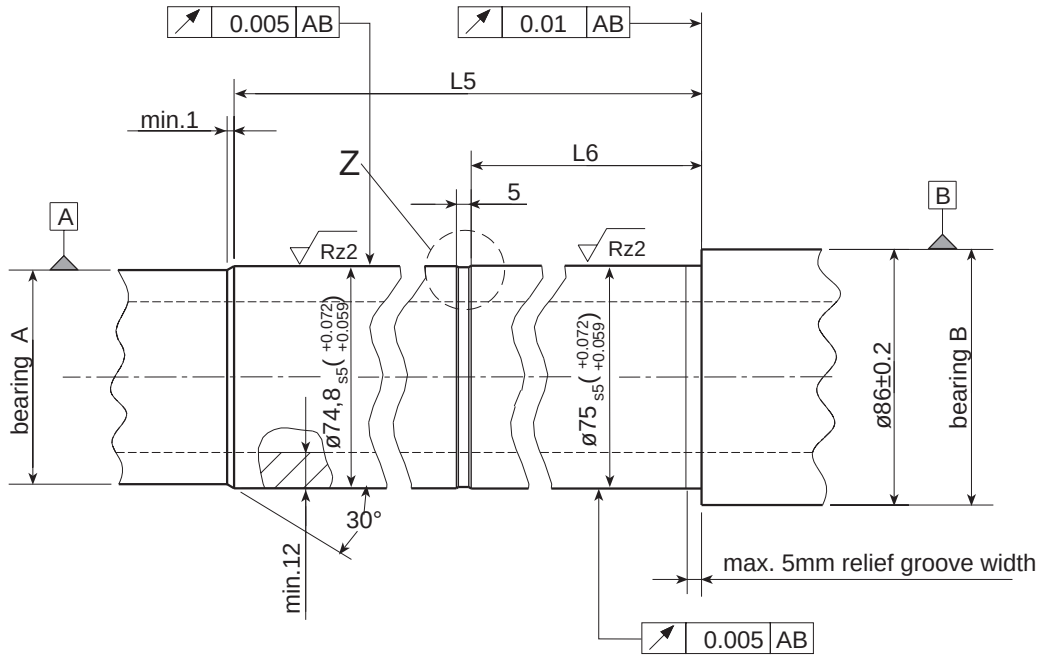
75 H6	+0.019 0
74.8 H6	+0.019 0
Fit	Dim

Quellverweis: 106-0302-3011-01

m05msx1p.fh7

Fig. 5-6:Dimensions of rotor MRS200B/C-B075

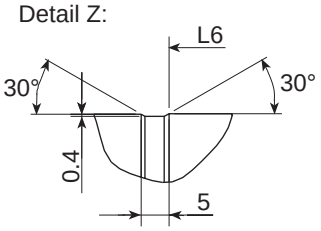
5.5 Dimensional data of spindle („Shrink“ mounting)



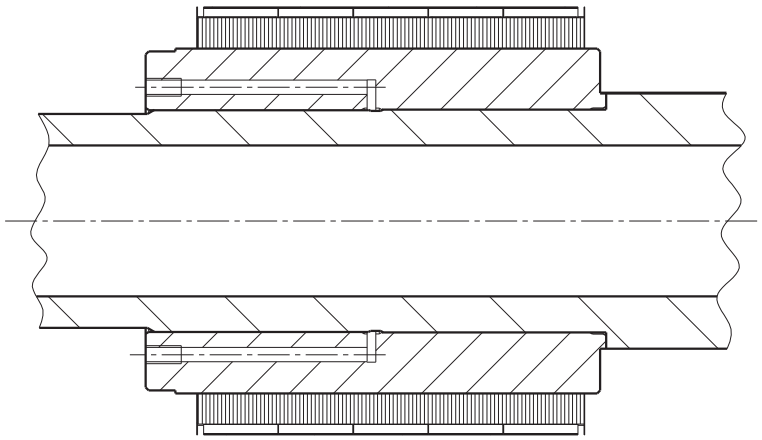
Table

Type \ Dim.	L5	L6
MRS200B-B075	$152^{+0,3}$	$75^{+0,3}$
MRS200C-B075	$177^{+0,3}$	$87,5^{+0,3}$

Detail Z:



Rotor shrunk onto spindle

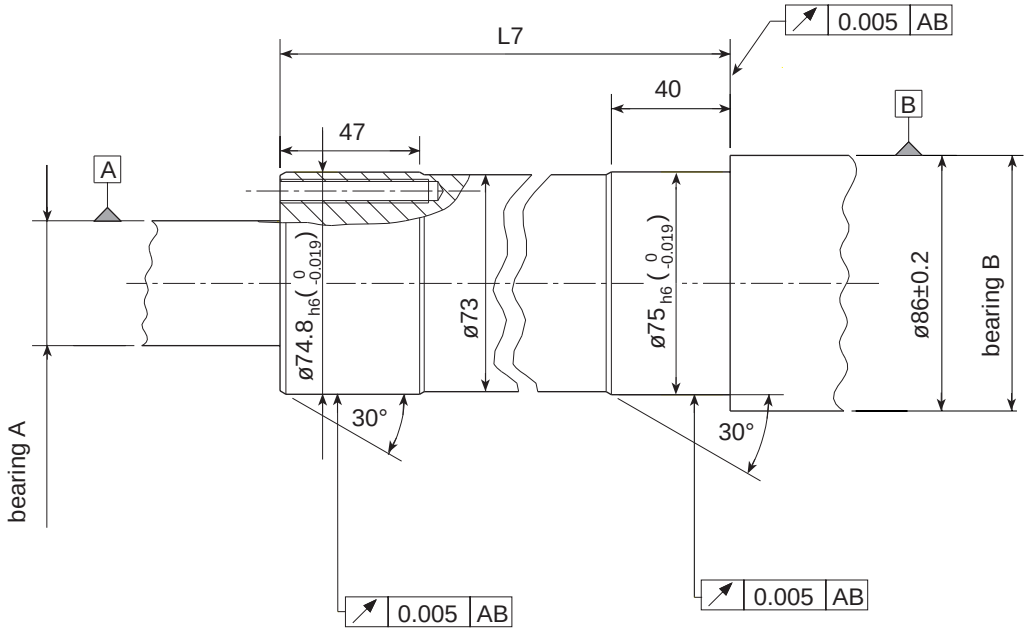


Quellverweis: 106-0302-3011-01

m06msx1p.fh7

Fig. 5-7: Spindle for rotor MRS200B/C-B075 („Shrink" mounting)

5.6 Dimensional data of spindle („Axially clamped“ mounting)

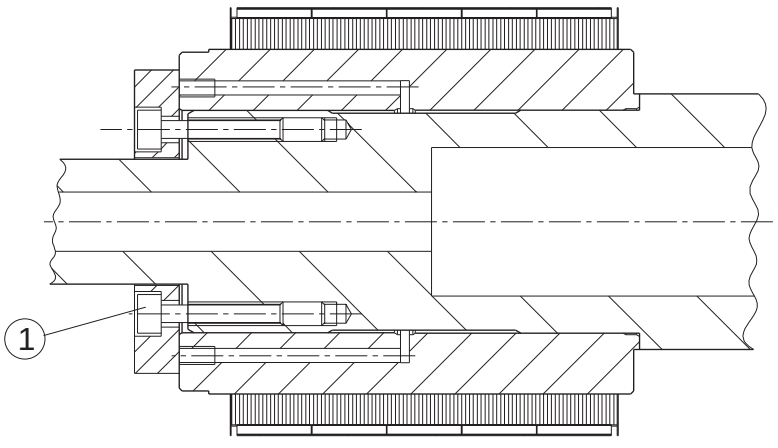


Table

Type \ Dim.	L7
MRS200B-B075	152
MRS200C-B075	177

Note: Maximum speed n_{max} with "axial clamping" equals 2500 min-1

Rotor "axially clamped" to spindle



(1) Use expansion screws between rotor and spindle due to length compensation! The user must size the rotor clamping screws!

Quellverweis: 106-0302-3011-01

m07msx1p.fh7

Fig. 5-8: Spindle for rotor MRS200B/C-B075 (Mounting „axially clamped“)

5.7 Type Codes

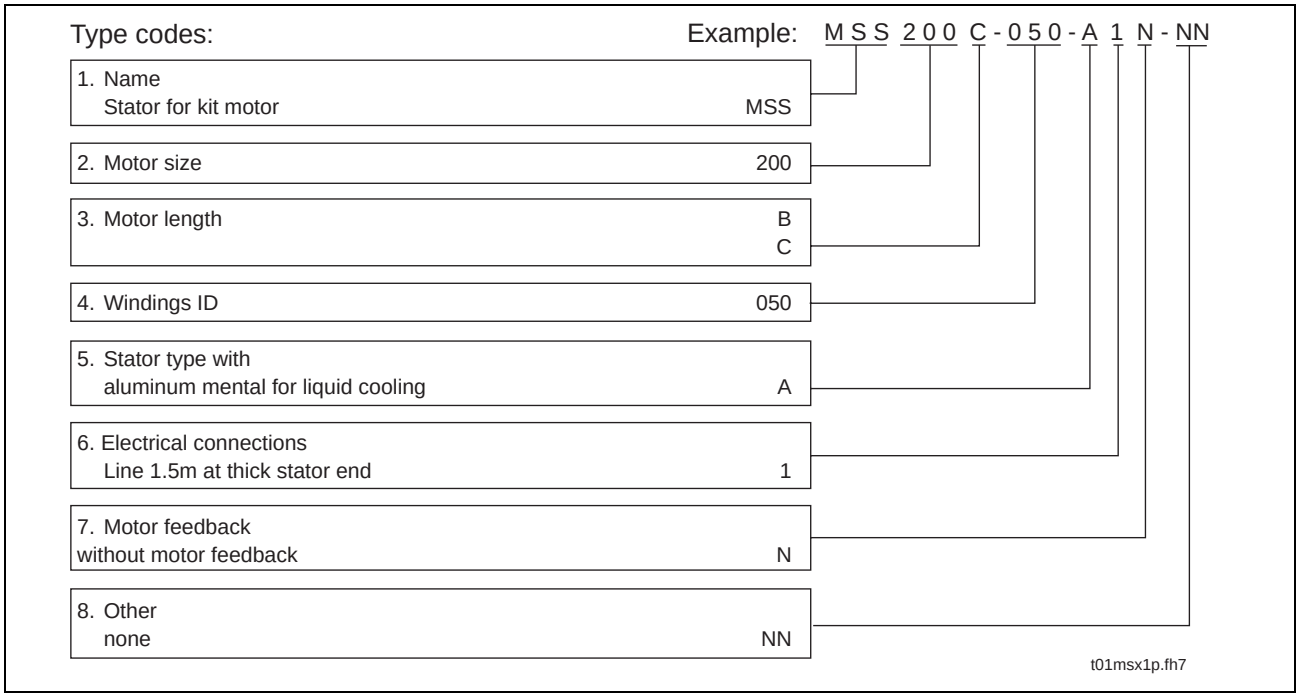


Fig. 5-9: Type codes of a MBS main spindle motor (Stator)

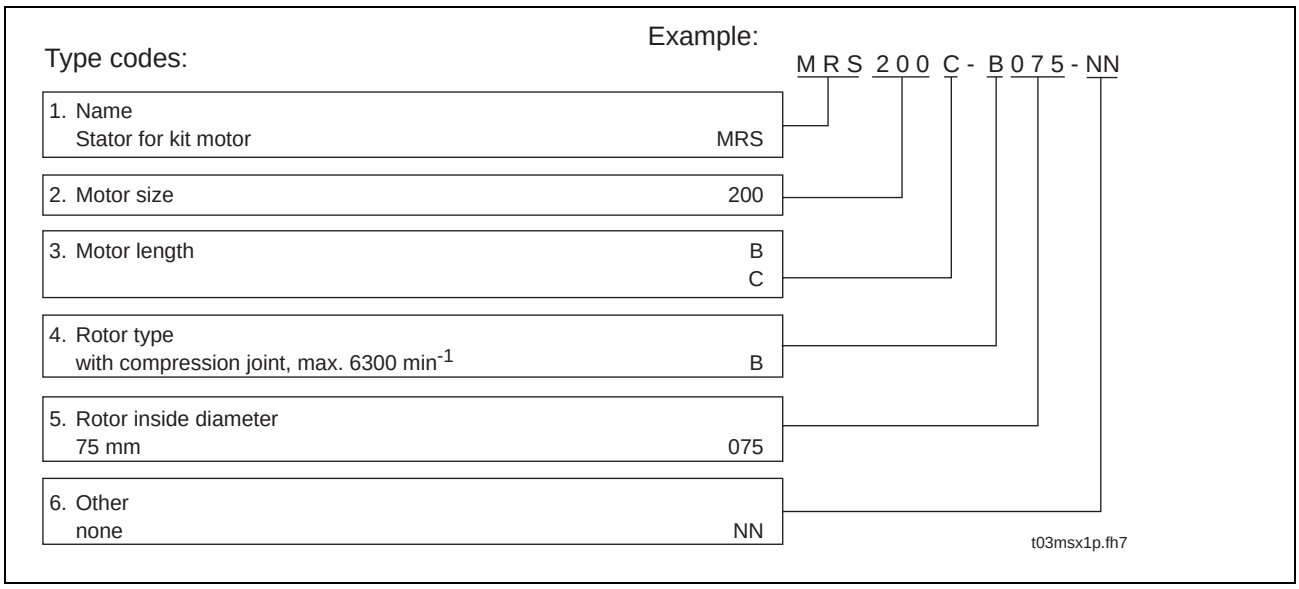


Fig. 5-10: Type codes of a MBS main spindle motor (Rotor)

6 MBS200 Servo Drive

6.1 Technical data

Designation		Symbol	Unit	Data
Motor type				MBS200B-008
Motor nominal speed [1]		n	min^{-1}	800
Allowable maximum speed				
Mounting	„Shrinking“	n_{max}	min^{-1}	1200
	„axially clamped“	n_{max}	min^{-1}	1200
Continuous torque at standstill		M_{dN}	Nm	65
Continuous current at standstill		I_{dN}	A	17.0
Minimum cross section for INDRAMAT cable [5]		A	mm^2	1.0
Minimum cross section for standard PVC cable [6]		A	mm^2	1.5
Theoretical maximum torque [2]		M_{max}	Nm	160
Usable peak current		I_{max}	A	42.5
Rotor moment of inertia		J_M	kgm^2	$300x10^{-4}$
Torque constant at 20°C		K_m	Nm/A	4.0
Voltage constant at 20°C [4]		K_{eff}	V	363
Windings resistance at 20°C		R_A	Ohm	2.1
Windings inductance		L_A	mH	16.0
Thermal time constant		T_{th}	min	120
Weight	Rotor	m_M	kg	7.5
	Stator	m_M	kg	16.0
Allowable ambient temperature		T_{um}	°C	0 to +40
zul. Storages- und Transport-temperatur		T_L	°C	-20 to +80
Maximum installation elevation [3]			m	1000 above sea level
Insulation classification				F

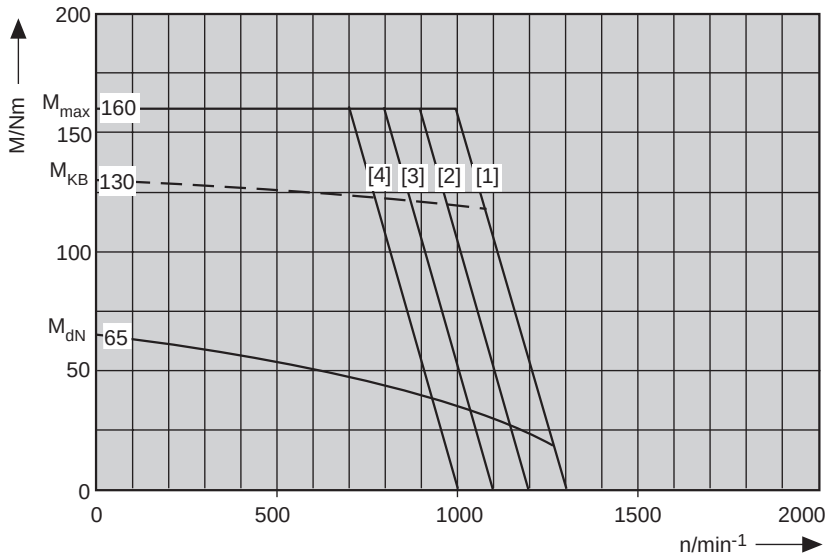
1) Depends on torque requirements of application. For standard applications see n_{max} in the selection lists for the motor/controller combination. For other applications determine usable speed using required torque specified in speed/torque characteristics.
2) Achievable maximum torque depends on drive controller. **Only those** in the selection lists for the motor/controller combination specified maximum torques M_{max} are binding.
3) Installation heights over 1000m are possible with reduced data; see section 4.
4) at 1000 min^{-1} .
5) Line diameter per DIN EN 60204, routing B2 and conversion factor for INDRAMAT cable at ambient temperature 40°C.
6) Line cross section per DIN EN 60204, routing B2 and ambient temperature 40°C.

Fig. 6-1: Technical data MBS200B-008

Mounting effects

Note: The actually available continnous torques at standstill depend on how the unit was mechanically mounted into the machine. Heat dissipation is individual to each spindle construction and motor type. The torques specified in the Technical Data can vary.

Characteristics of MBS200C-050



M_{max} Corresponds to the theoretically possible maximum torque of the motor. The drive controller can limit it.

M_{KB} S6- Intermittent operating curve at 44% ON time of the motor (per DIN VDE 0530, edition datet 07/1991).

M_{dN} S1- continous operating curve of the motor (per DIN VDE 0530, edition dated 07/1991).

Characteristics [1] to [4]

[1] HDS or HDD on power supply units HVR

[2] HDS or HDD on power supply units HVE with a main connection to 3x AC 480V

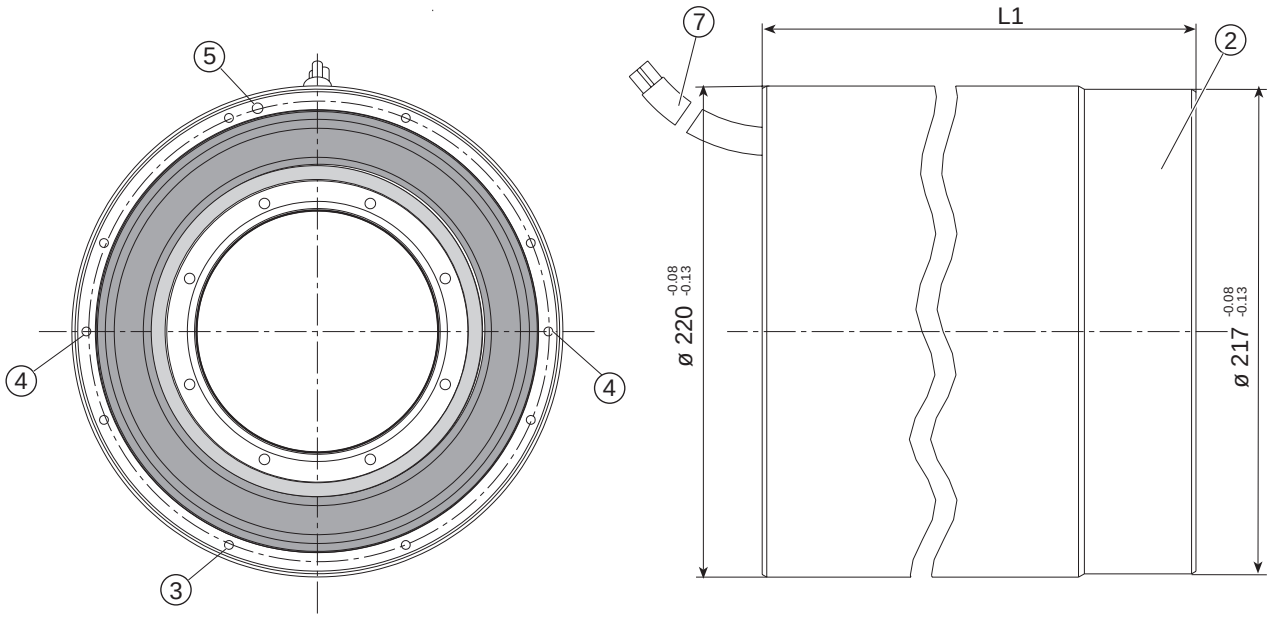
[3] HDS or HDD on power supply units HVE with a main connection to 3x AC 440V

[4] HDS or HDD on power supply units HVE with a main connection to 3x AC 400V -or- DKR with a main connection to 3x AC 400V

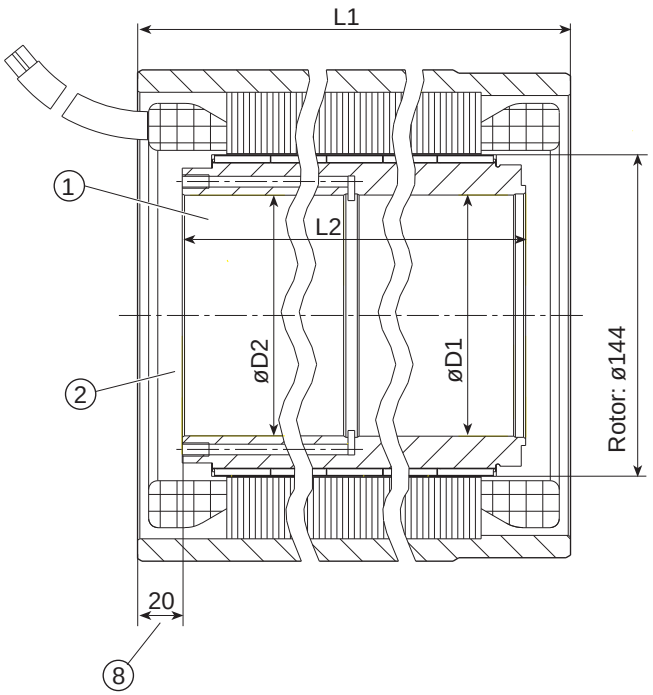
k01mbs1p.fh7

Fig. 6-2: Characteristics MBS200B-008

6.2 Dimensional data



cut A-A



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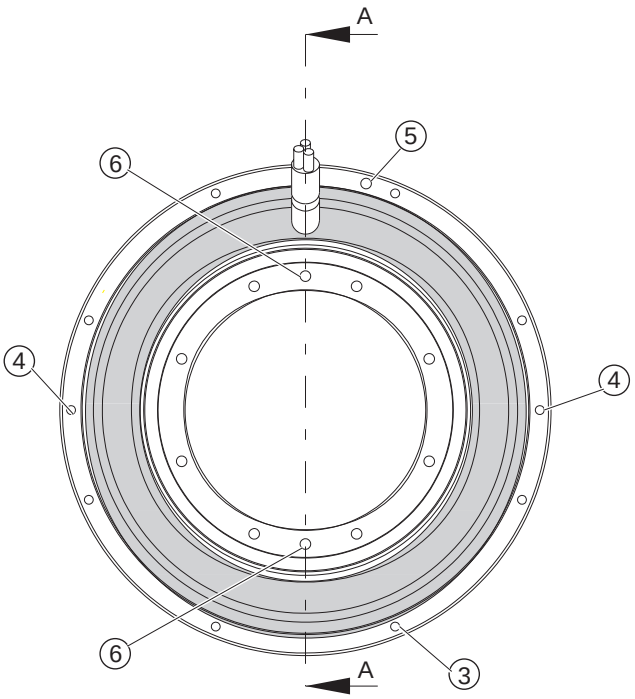


1. Rotor MRS200B-A108
2. Stator MSS200B-008-B1
3. 8x thread M5 for axial mounting to spindle housing
4. drill ø4 for cylinder pin to secure it in terms of - spindle housing
5. thread M6 to mount ground connection
6. pressure oil connection compression joint
7. cable strand 1500 mm long
8. rotor/stator positions

Table

Type \ Dim.	∅D1^{H6}	∅D2^{H6}	L1	L2
MRS200B-A108 with MSS200B-008	108	107.8	195	155

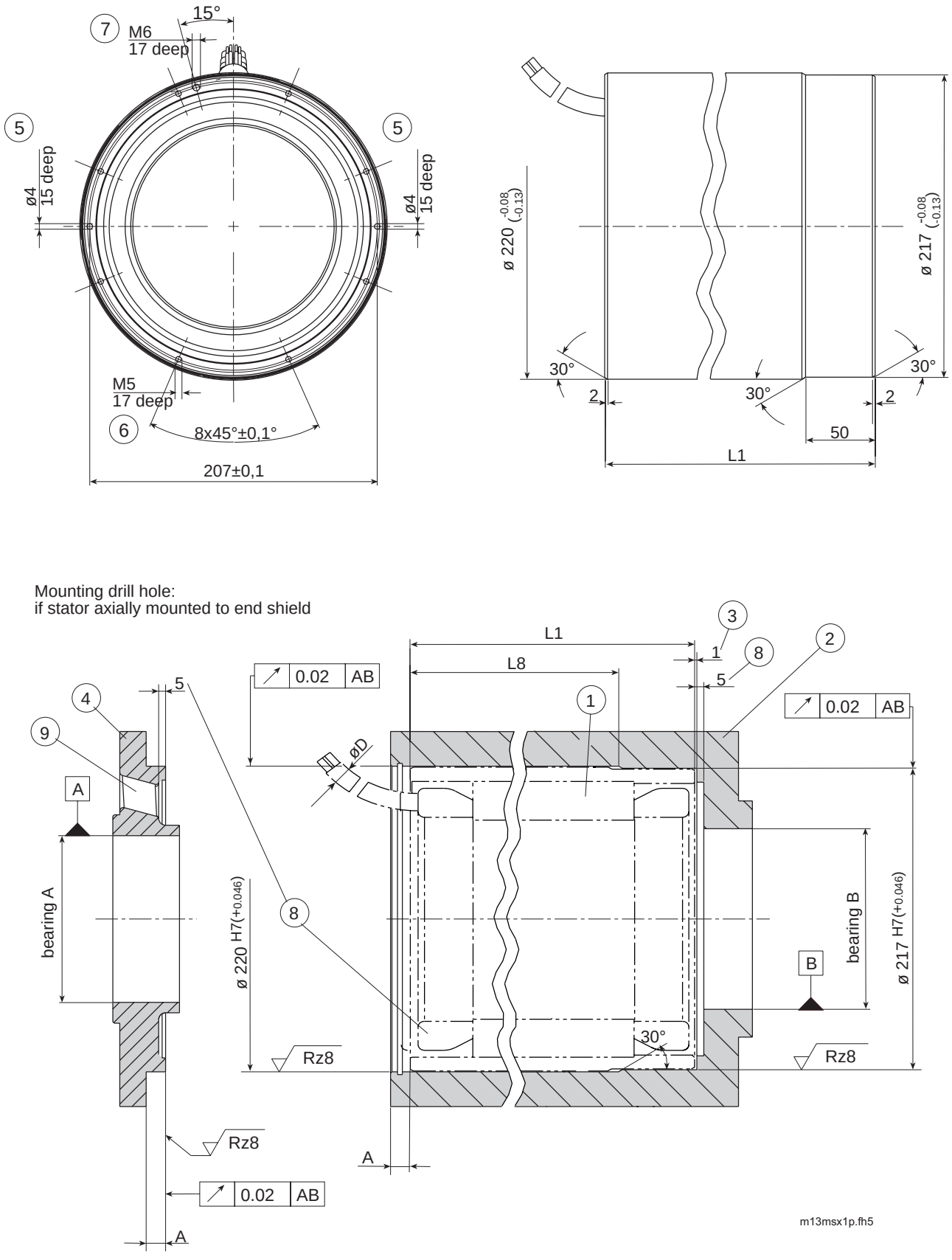
108 ^{H6}	$^{+0.022}_{0}$
107.8 ^{H6}	$^{+0.022}_{0}$
Fit	Dim

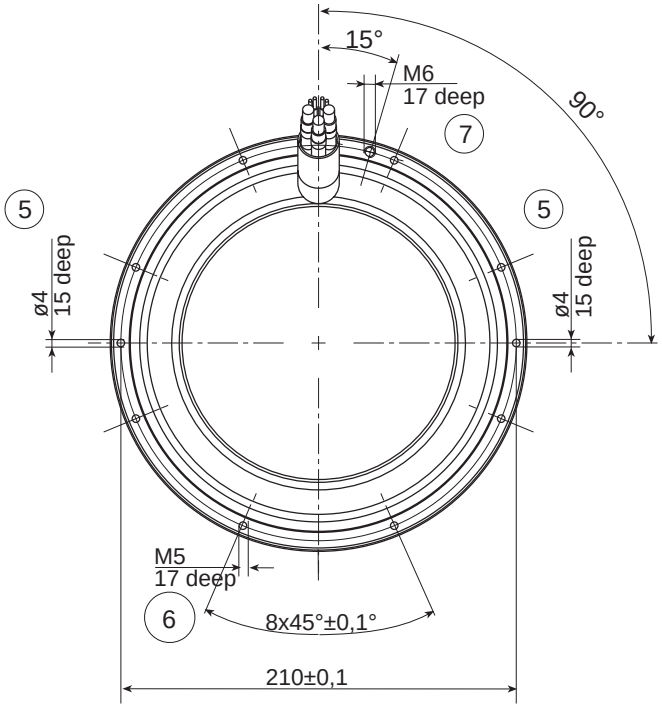
Quellverweis: 106-0302-302-04

m02msx1p.fh7

Fig. 6-3: Dimensions of stator MSS200B-008 with rotor MRS200B-A108

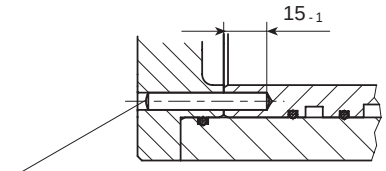
6.3 Dimensional data for mounting stator





1. Stator MSS200B-008
2. Spindle housing
3. Minimum clearance for expansions
4. End shield
5. 6. 7. on either stator end
8. Winding head
   distance to housing min. 5 mm
9. Cable leadthrough with rounded edges

5 Locking piston on end shield



Cylinder pin DIN 6325 ø5 m6
Material: strain strength min. 600N/mm²
hardness 60 ±2 HRC

6 Axial mounting to end shield

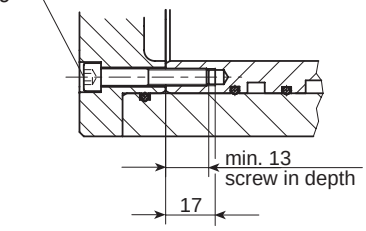
cylinder screw
DIN 912 M5

strength class 12.9

strain strength
min. 1200 N/mm²

tightening torque
6 - 7 Nm

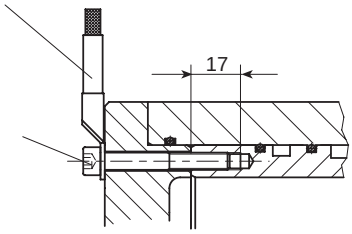
with Loctite 243
bonded and
secured



7 Ground line connection

Ground line
(must be ordered
separately)

Mounting screw M6
(must be ordered
separately)
Made of brass



Dimension table

Type \ Dim.	L1	L8 ±1	Cable strand	
			øD	Bend radius
MSS200B-008	195	150	16	60

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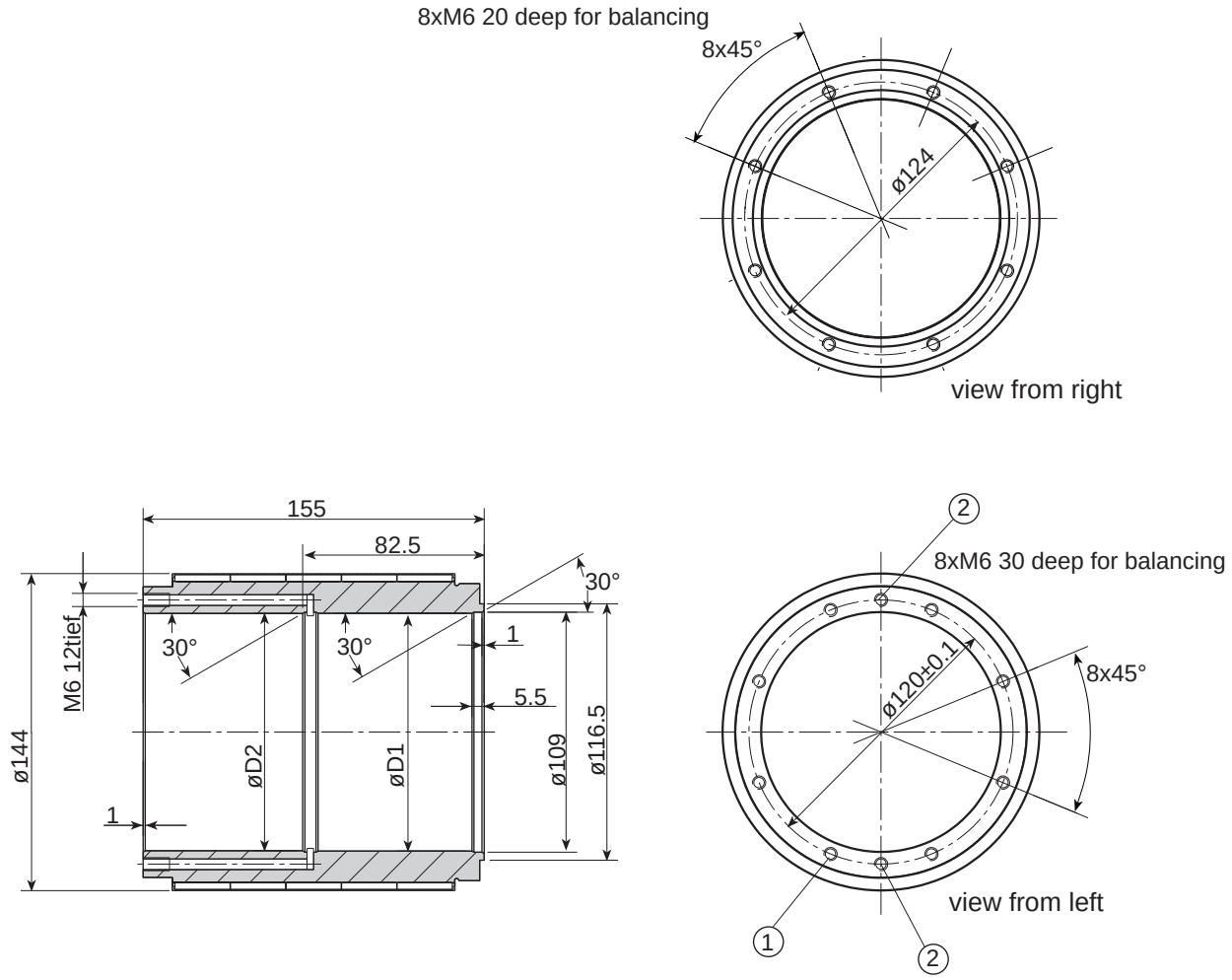
Fig. 6-4: Dimensions of stator MSS200B-008

6.4 Dimensional data for mounting rotor



① balancing drill hole with M8
weight compensastion when balancing threaded pins DIN 913
secure threaded pins with Loctite 620

② Pressure oil connection
sealed with threaded pins DIN 913 after mounting rotor
secure threaded pin by gluing with Loctite 620

Table

Type \ Dim.	øD1 H6	øD2 H6
MRS200B-A108	108	107.8

108 H6	+0.022 0
107.8 H6	+0.022 0
Fit	Dim.

m08msx1p.fh7

Quellverweis: 106-0302-3010-02

Fig. 6-5: Dimensions of rotor MRS200B-A108

6.5 Dimensional data of spindle („Shrink" mounting)

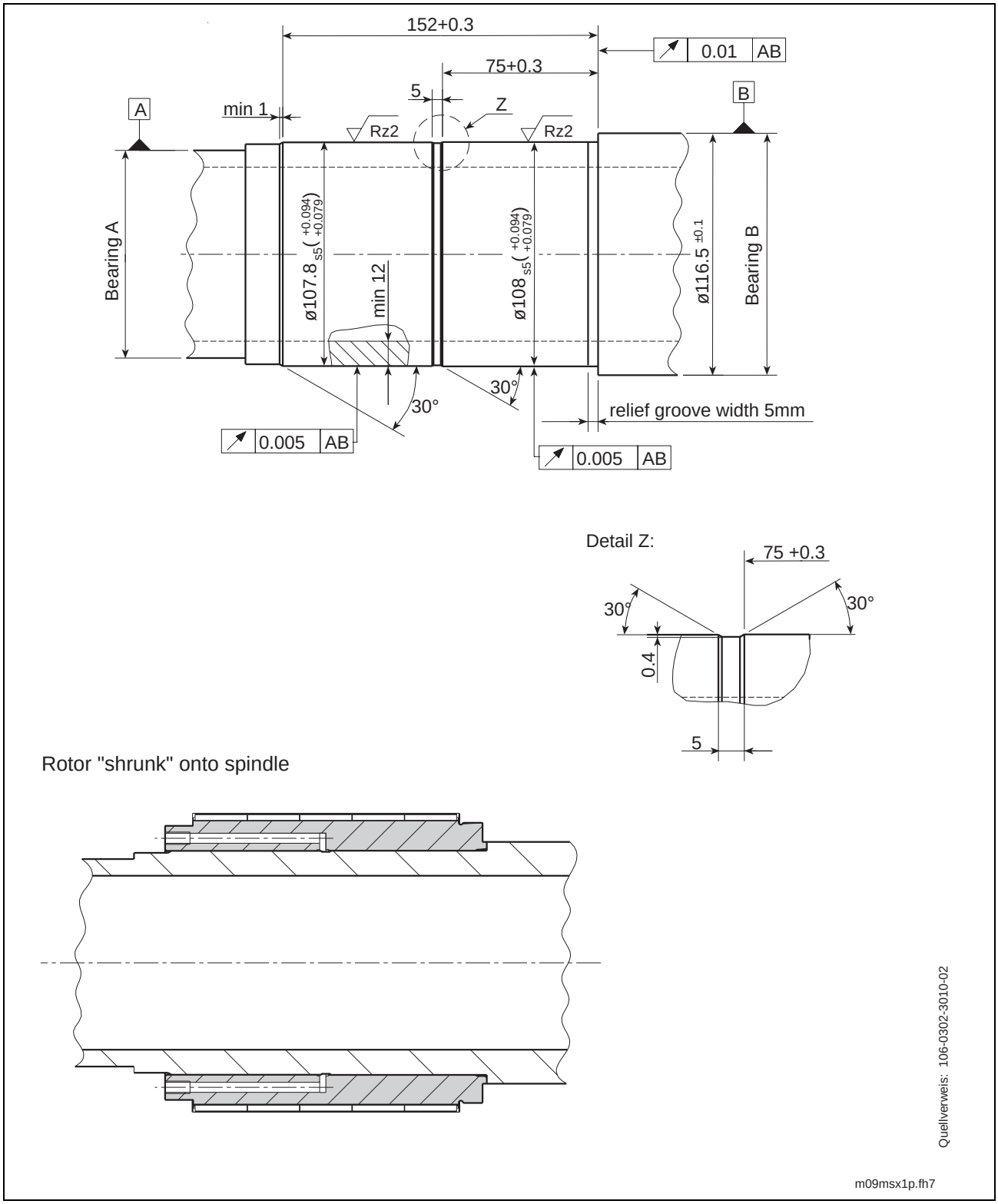
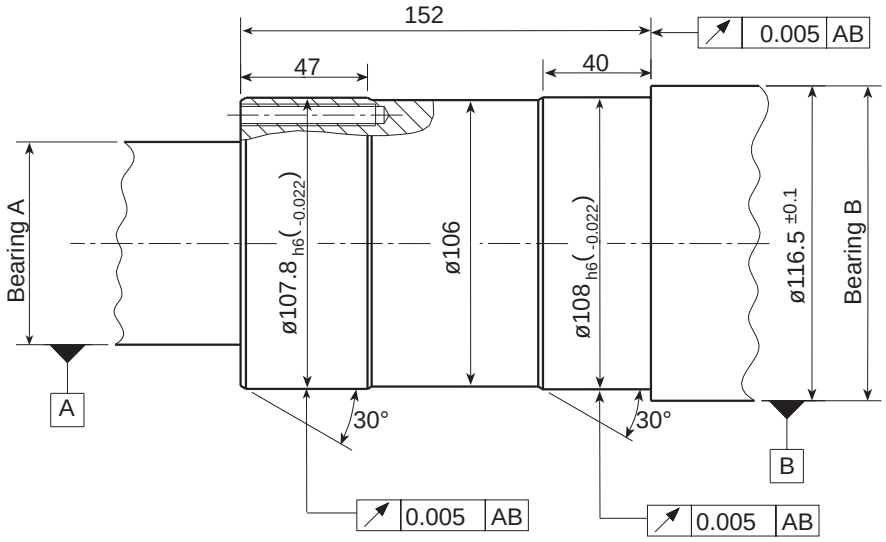
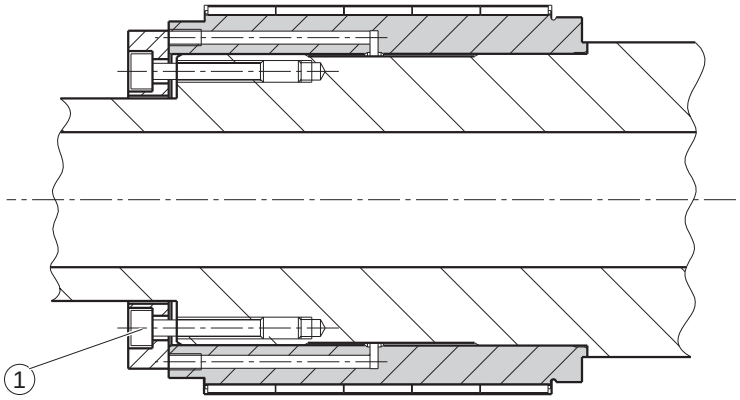


Fig. 6-6: Spindle for rotor MRS200B-A1008 („Shrink" mounting)

6.6 Dimensional data of spindle („Axially clamped" mounting)



Rotor "axially clamped" onto spindle



(1) Use expansion screws due to axial length compensation between rotor and spindle. The user must size the rotor mounting screws!

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Quellverweis: 106-0302-3010-02

Fig. 6-7: Spindle for rotor MRS200B-A1008 („Axially clamped" mounting)

6.7 Type Codes

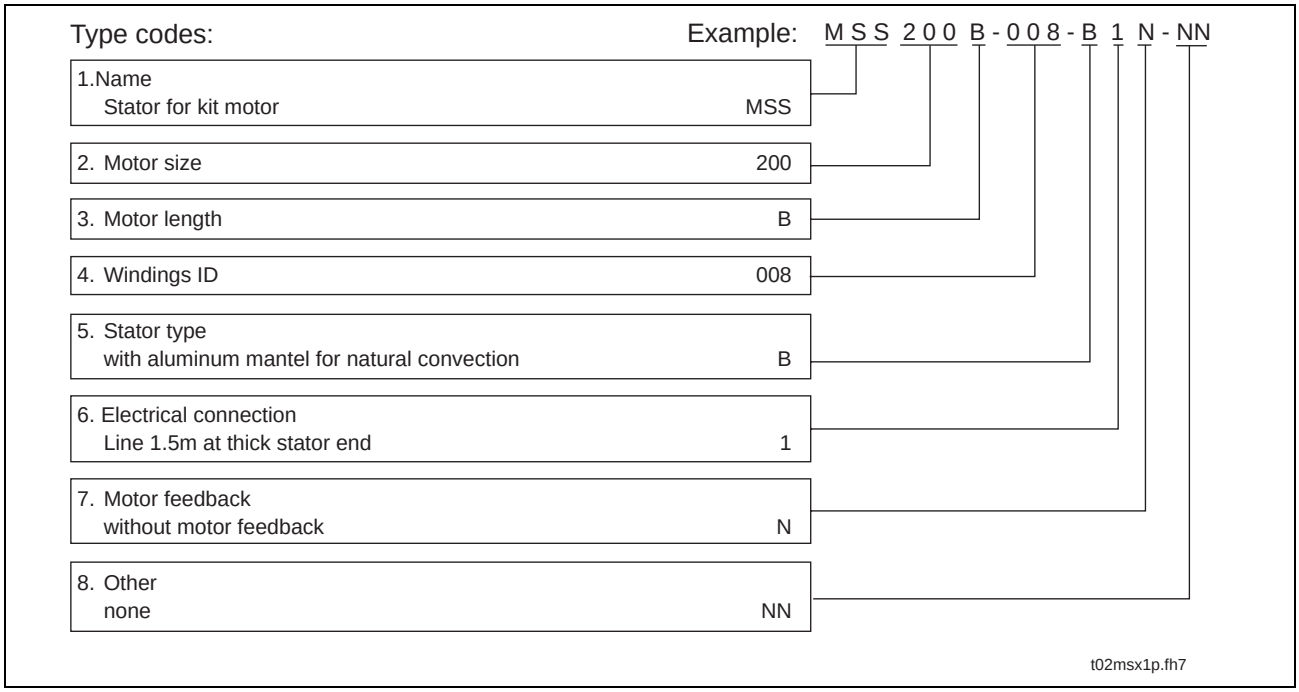


Fig. 6-8: Type codes of an MBS servo motor (Stator)

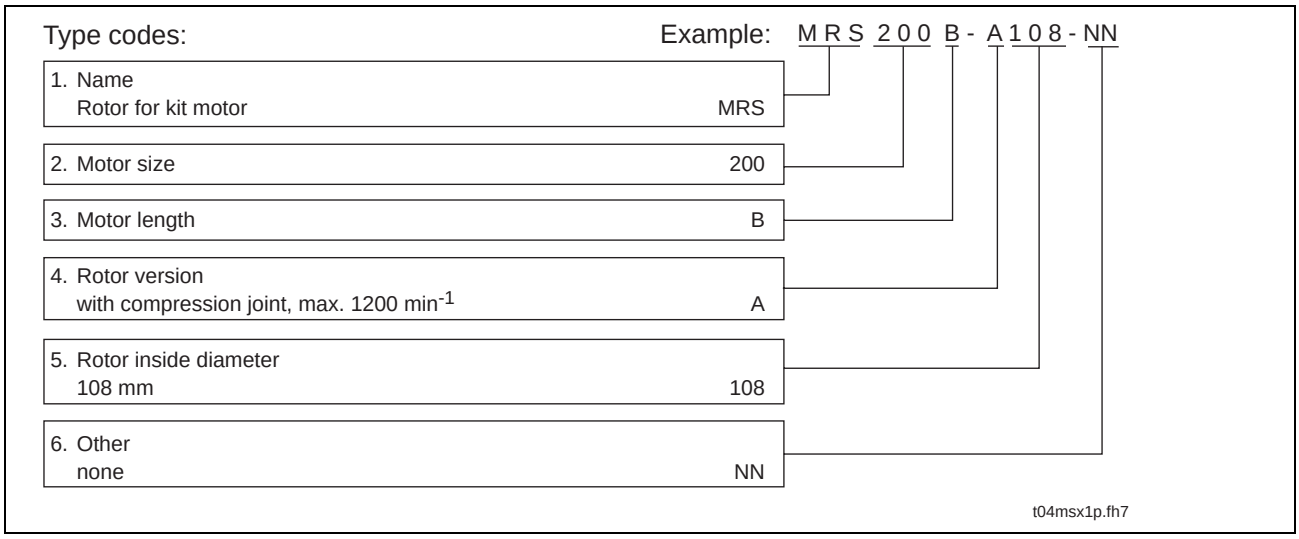


Fig. 6-9: Type codes of an MBS servo motor (Rotor)

7 Electrical Connections

7.1 Terminal Diagram DKR

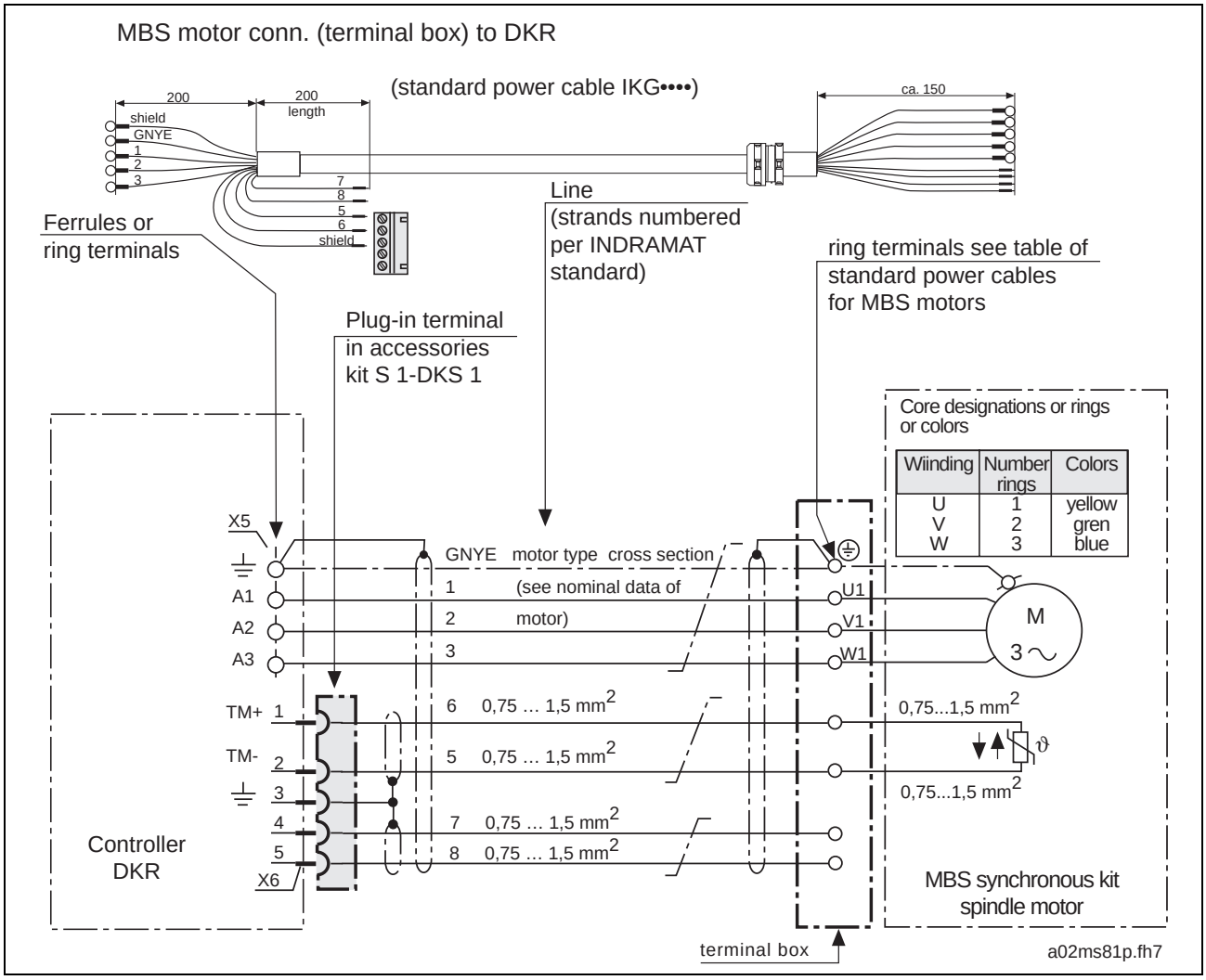
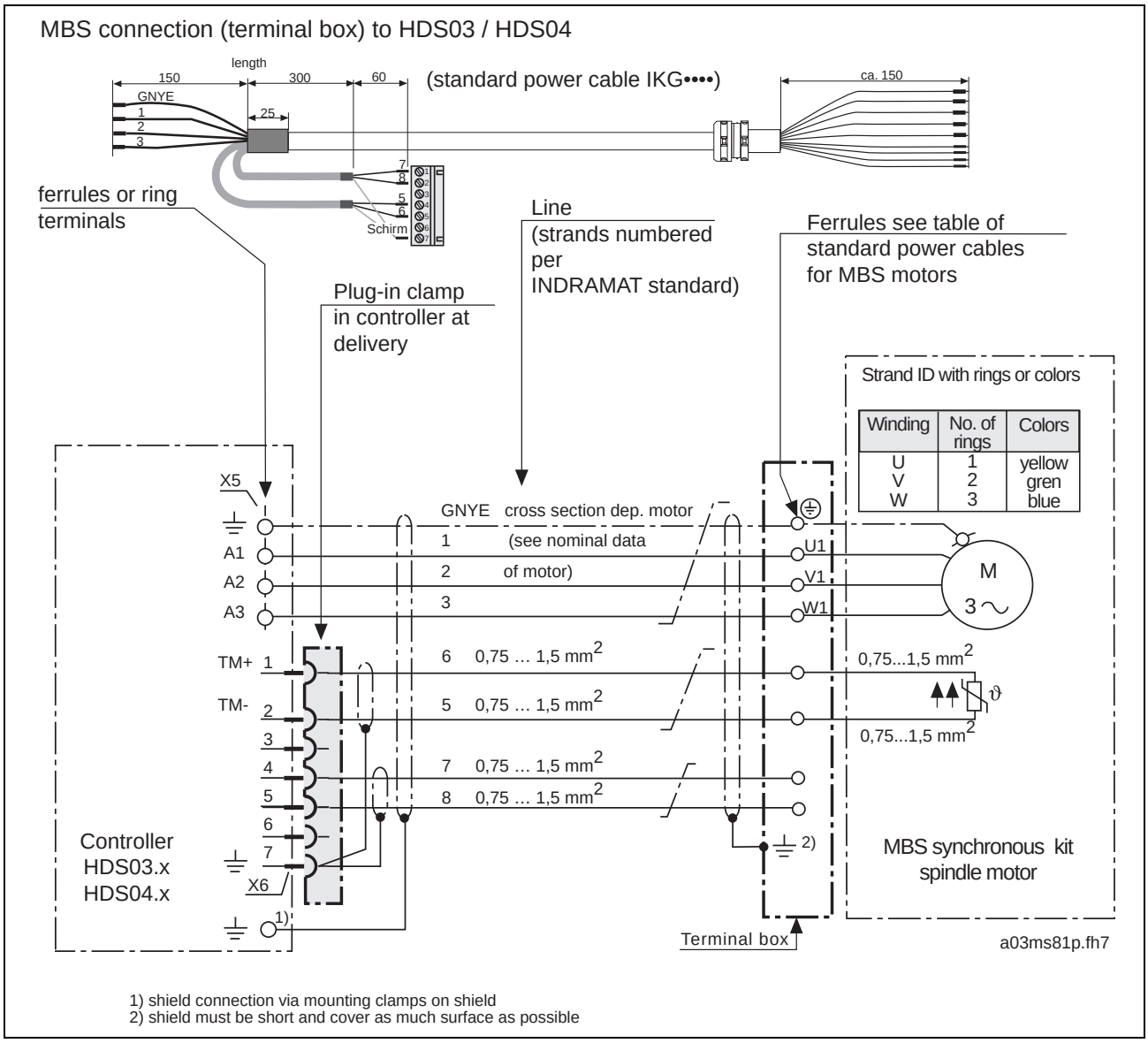


Fig. 7-1: Terminal diagram of an MBS motor connected to a DKR drive

7.2 Terminal Diagram HDD/HDS



1) shield connection via mounting clamps on shield
2) shield must be short and cover as much surface as possible

Fig. 7-2: Terminal diagram of an MBS motor connected to HDS03/HDS04 drives

7.3 Connecting Cables

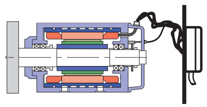
Technical data of the power and feedback cables

Technical data of the power and feedback cables to connect MBS motors

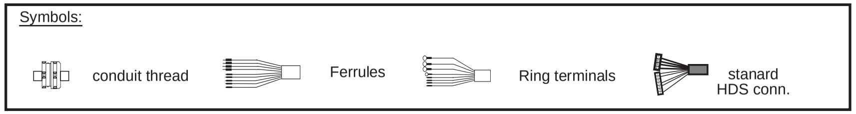
Name	Unit	Data						
		IKG	IKG	IKG	IKG	IKG	IKG	IKS
Type designation of standard cables IKG... or IKS...		4041	4078	4178	4198	0175	0138	4374 4375 4376 4377
type designations of cable (standard) INK...		0653	0602	0605	0606	0607	0667	0448
Power or supply strand cross section	mm²	4 x 1.0	4 x 2.5	4 x 10	4 x 16	4 x 25	4 x 35	2 x 0.5
Control strand cross section (holding brake, temperture sensor or control voltage)	mm²	2 x (2 x 0.75)	2 x (2 x 1.0)	(2 x 1.0) + (2 x 1.5)	2 x (2 x 1.5)	2 x (2 x 1.5)	2 x (2 x 1.5)	4 x (2 x 0.25)
Diameter	mm	12.0 ±0.5	15.0 ±0.8	22.5 ±1.0	27.6 ±0.8	30.4 ±0.8	32.4 ±0.8	8.8 ±0.3
Minimum bend radius with fixed routing with flexible routing (≥ 2 000 000 bends)	mm mm	75 125	95 160	170 230	190 280	210 300	230 320	45 90
Specific cable weight	kg/m	0.25	0.59	1.10	1.40	1.73	2.40	0.10
Protection with proper mounting of the plug-in connections		IP 65						
Chemical features		absolute resistance to mineral oils and greases hydrolysis resistance, silicone and halogen free						
Allowable ambient temperature for storage	ºC	-30 to +80						
Allowable ambient temperature for operations	ºC	-30 to +40						
Cable surface		Poor adhesion, prevents sticking in drag chains						

Fig. 7-3: Technical data of power and feedback cables for MBS motors

The line cross sections depend on the motor. These are listed in the relevant data.



Motor	Controller connection	Line cross section A [mm²]	Standard cable for direct connections	Parts for standard cables for direct connection: on the motor	Parts for standard cables for direct connection: Line flex./extr. flex.	Parts for standard cables for direct connection: controller	Standard cable for intermediate clamping to terminal strip: on the motor flex./extr. flex.	Standard cable for intermediate clamping to terminal strip: on the controller flex./extr. flex.
	HDS 3.x HDS 4.x			For...		For...		
MBS200B-008		1.0	IKG4041 (PG21)	ferrules	INK0653	plug-in clamps (HDS3.x/HDS4.x)	*)	*)
		2.5	IKG4078 (PG21)	ferrules	INK0602	plug-in clamps (HDS3.x/HDS4.x)	*)	*)
	DKR4			For...		Für...		
MBS200B-050		25	IKG0175/ (PG 48)	..studs M12 ⏚ M12	INK0607	.. screws M12 (DKR4)	*)	*)
MBS200C-050		35	IKG0183 (PG 48)	..studs M12 ⏚ M12	INK0667	...screws M12 (DKR4)	*)	*)
	DKR4			For...		Für...		
MBS200B-050		10	2 x IKG4178 (PG29)	ferrules	2 x INK0605	...screws M12 (DKR4)	*)	*)
MBS200C-050		16	2 x IKG4198 (PG36)	ferrules	2 x INK0606	...screws M12 (DKR4)	*)	*)



*) Available. Query with type designation at INDRAMAT, Dept. ECM4

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Fig. 7-4: Standard motor power cables for MBS motors

8 Mounting Instructions

8.1 General Information

These mounting guidelines describe how

- the rotor is mounted to the spindle,
- the rotor is removed from the spindle,
- the stator is installed in the spindle housing and electrically connected,
- to electrically check the motor spindle,
- to remove the stator from the spindle housing.

Carefully performing the work steps described here guarantees:

- the faultless and safe mounting and removal of components and sections and
- the faultless functioning of the kit spindle motor.

Safety notes

The safety guidelines specified in 3 of this document must be complied with. They help prevent accidents and prevent damage to materials that could be caused by improper handling.

Additionally, special safety notes are outlined in the guidelines. They occur there where extreme caution must be used. General safety guidelines affecting mounting are outlined in section 3.3

The safety guidelines are emphasized with the following symbol.

CAUTION

DANGER, WARNING, CAUTION

⇒ Disregarding these safety guidelines can cause personnel injury and extensive property damage!

Liability

The procedures for mounting and removing sections is always basically the same. It can be different depending on the construction of the spindle and spindle housing. These mounting guidelines only offer a basis and must be adapted to the requirements at hand. Compliance with the mounting guidelines of the builder of spindle and spindle housing is mandatory and takes precedence over the procedure described here.

The diagram below offers an overview of the individual steps involved.

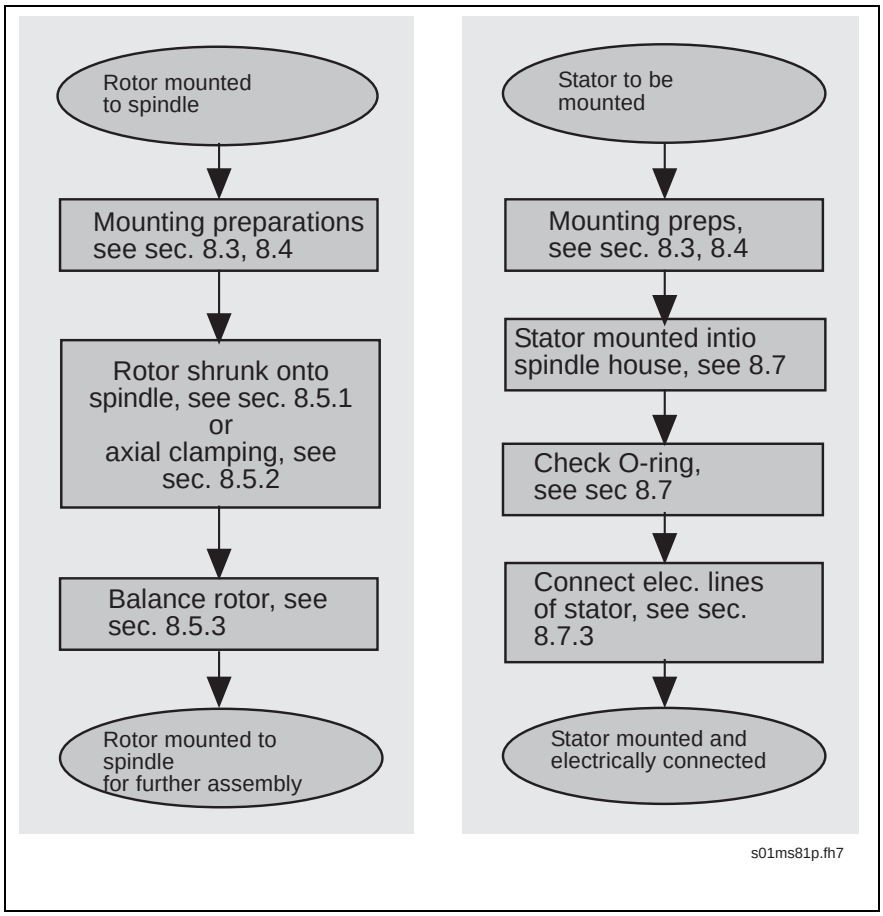

Fig. 8-1: Steps for mounting and removing rotor and stator

8.2 General Safety Guidelines

This section outlines general safety guidelines which must mandatorily be complied with.

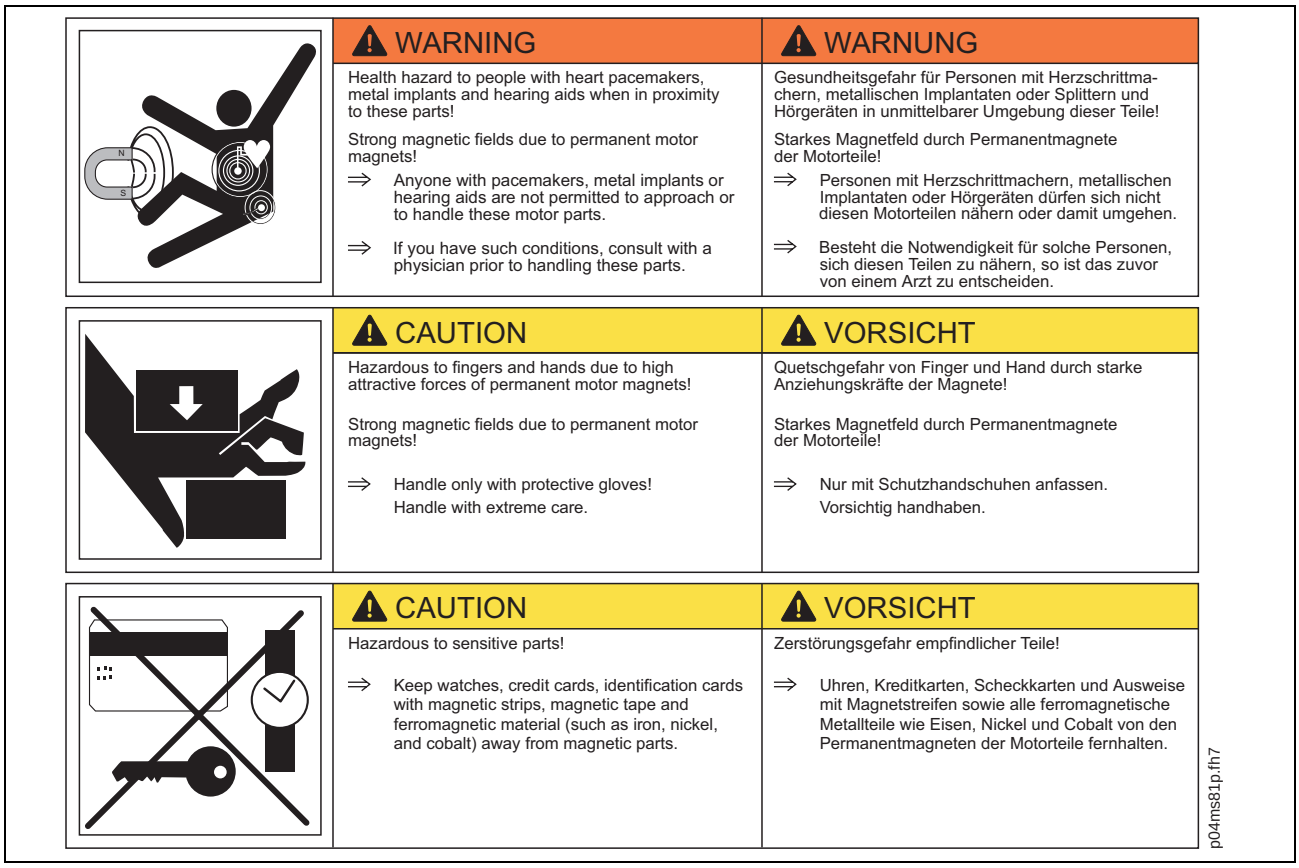

Fig. 8-2: Warning instructions with a strong magnetic field

Oil pump

Use only manually-operated oil pumps when removing the rotor from the spindle. These guarantee that the oil pressure will immediately drop below 0 bar in the event of leaks in the step compression joint, threaded end or in the pump line system. The oil pump must additionally be outfitted with a pressure reflief device for safety reasons, to keep the oil pressure from rising above 1500 bar.

Securing the threaded pins

To keep the threaded pins inserted into the rotor from loosening during operations and endangering man and machine, they must be additionally secured. The pins are thus bonded with LOCTITE-620. For an outline of the bonding instructions, see Section 8.4

Accident prevention

Safety clothing must be worn while mounting. There is the particular hazard of a burn when shrinking the rotor onto the spindle. Heat-resistance clothing must be worn.

Accident prevention guidelines as stated in „Electrical machines and equipment“ (VBG 4) must be complied with. Before starting, ensure that electrical machines and equipment are shut off and that power cannot be switched while personnel is working. Electrical or suitable supervisory personnel must first check machines and equipment prior to starting up to ensure that such are in good working order.

The user is responsible for the correct grounding of installation and machinery. To prevent accidents from contact with live sections, safety measures must be taken against direct and indirect contact. Corresponding notes are outined in DIN VDE 0100, Section 410.

Transport and handlng

Transport and handling guidelines (Section 9: „Storage, handling, transport“) must be complied with.

8.3 Aids for Mounting and Removal

Tools and devices	Mount rotor to spindle	Remove rotor from spindle	Mount stator	Elec. check motor spindle	Remove stator
crane (as per component weight)	X	X	X		X
lifting device (as per component weight); see sec. 15	X	X	X		X
Device for accepting the rotor 1)	X				
Warming cabinet (130 ... 140 °C)	X				
Balancing machine	X				
Holding device to fix spindle rotor 1)	(X)				
Compressed air device	(X)				
Oil pump (hand operated, max. 1500 bar) with accessories1)	(X)	X			
End device 1)		X			
Drill device			X		
Water pump to check seal (to 6 bar)			X		
Ohm meter				X	
Inductance measuring device				X	
High voltage device				X	
Torque key to 35 Nm			X		
Convention tools and cleaning machines	X	X	X		X
Withdrawing screw (as per rotor diameter)		X			
Aids					
LOCTITE 243			X		
LOCTITE 620	X				
LOCTITE quick cleaner 7061	X		X		
LOCTITE activator 7649	X		X		
Mineral oil: viscosity 300 mm2/s at 20 °C	(X)				
Mineral oil: viscosity 900 mm2/s at 20 °C		X			
Oil, conventional, for lubrication	X				
Grase, conventional	X		X		
Petroleum jelly			X		
Coolant		X			

1) See notes on next page
(X) Only with mounting problems

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Fig. 8-3: Aids

Note: Only use proper and suitable tools and devices!

Explanations

Device for taking up the rotor

This device must be heat-resistant up to at least 140°C and be able to carry the weight of rotor and spindle. It must also offer the rotor a level and horizontal base. An example is illustrated below.

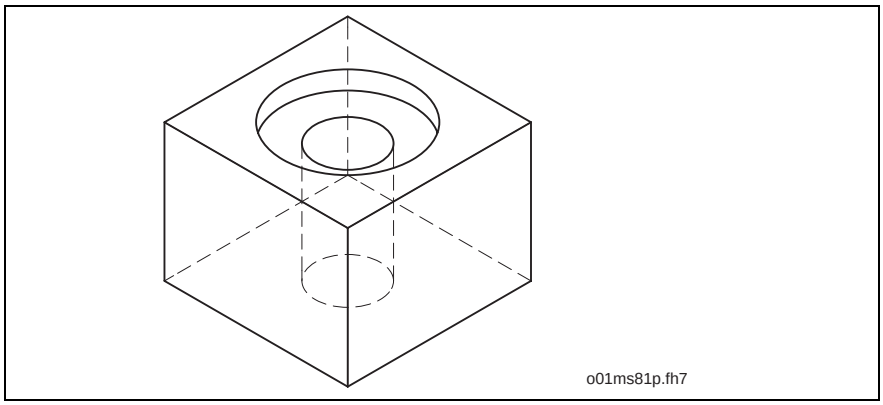


Fig. 8-4: The principle of a device to incorporate the rotor

Manually-Operated Oil Pump and Accessories

Oil pressure: 1500 bar with overpressure prevention device, threaded ends of the high-pressure hose: M6 (see „Dimensional data “).

Oil pumps and accessories are generally available from the manufacturers of rolling bearings.

Work holding device for fixing spindle/rotor

If the spindle is deformed after the rotor is shrunk on, then a work holding device is needed to correct this. This device must firmly fix the rotor onto the spindle to prevent any axial motion of the rotor. An illustration can be found in Fig. 8-10.

Stop device

When removing the rotor from the spindle it can happen that the rotor suddenly slips off of it. A stop device must therefore be mounted to the spindle. An illustration of such can be seen in Fig. 8-17. The mounting dimensions for the stop must be complied with(see Fig. 8-18).

8.4 Securing the screws with LOCTITE

General information

LOCTITE is a plastic bonding agent which goes on in liquid form. It remains fluid until there is contact with oxygen. Not until the section is mounted does it change from a fluid to a solid state. This chemical conversion is catalyzed by air and the metal contact. A form-fitting connection is the end result and is both shock and vibration proof.

The drying time drops if Activator 7649 is used.

LOCTITE 620 is heat-resistant up to 200 °C, LOCTITE 243 up to 150 °C.

Bonding

Procedure:

⇒ Tapped hole and screw or threaded pins must be absolutely free of chips and dirt.

⇒ Clean tapped hole and screw/threaded pin stift with LOCTITE cleaner 7061, removing oil, grease and dirt. Threads must be free of all rust. If necessary re-shave threads.

WARNING

Danger to the health of persons with heart pacemakers, metal implants or metal splinters and hearing aids when near these parts!

Strong magnetic fields caused by permanent magnets of the rotors!

⇒ Persons with heart pacemakers, metal implants or hearing aids should not go near this section of the motor or handle it.

⇒ If individuals with these problems have to go near these parts, then a physician should be consulted.

Danger of pinching fingers and hands due to the strong attractive force of the magnets!

Strong magnetic field of permanent magnets of the rotors!

⇒ Wear gloves when handling
Handle carefully.

⇒ Remove movable metal parts or secure against all movement.

⇒ Handle carefully: when handling the rotor make sure the area is clean.

Danger of damaging sensitive parts!

Strong magnetic fields caused by the permanent magnets of the motor!

⇒ Watches, credit cards and cards of any kind with magnetic strips as well as all ferromagnetic metal parts such as iron, nickel and cobalt must be kept away from permanent magnets.

Note: All chips and dirt **must be removed** from the rotor! **Note!** The rotor is magnetic. When handling, make sure that the area is clean. Metal chips or dirt not removed could damge the rotor and stator.

⇒ Spray LOCTITE activator into drill holes, permit to dry.

⇒ Spray LOCTITE over the entire length of the thread in a fine and even manner.

⇒ Screw in suitable screws/threaded pin.

⇒ Permit bond to dry. Drying time is specified in Fig. 8-5.

Securing screwed connections with LOCTITE in the tapped blind holes:

The bonding agent must be applied into the tapped hole not on the screw. This keeps the compressed air from pressing the bonding agent out when the screw or pin is screwed in.

Bonder	Dry	Solid without activator	Solid with activator
LOCTITE 243	≈ 12 h	15 to 30 min.	10 to 20 min.
LOCTITE 620	≈ 24 h	1 to 2 h	15 to 30 min
Note: All data refer to drying times at room temperature. Additional heat decreases drying times accordingly.			

Fig. 8-5: Drying times of LOCTITE

Dissolving the bond

The bond can be dissolved by simply screwing the screw out or pulling the pin out in the usual fashion.

LOCTITE 620 has a a release torque of 20-45 Nm, LOCTITE 243 of 14-34 Nm (per DIN 54 454). **Do not heat up** the connection with hot air to reduce the release torque.

Note: The bond of the rotor magnets is only guaranteed up to a maximum temperature of 140°C. Heating up the screw connections with a hot air gun to reduce the release torque can cause the rotor magnets to drop off. Conventional hot air guns reach a temperature exceeding 140°C.

Once the screw or pin is removed, the rests of the bonding agent must be removed from the hole, for example, the thread can be machined.

8.5 Mounting the Rotor to the Spindle

The rotor can be mounted in two different ways. Both are described extensively below.

- shrinking rotor onto spindle 1st mounting mode, see section 7.5.1.)
- axially clamping rotor (2nd mounting mode see section 7.5.2)

When mounting „axially clamped" note that maximum speeds must be reduced.

WARNING

Danger to the health of individuals with heart pacemaker, metal implants or splinters and hearing aids exists when in close proximity to these parts!

Strong magnetic field due to permanent magnets of the rotor!

⇒ Individuals with heart packemakers, metal implants or hearing aids may not come close to these motor parts or handle them.

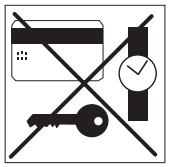
⇒ If these individuals have to do so, then a physician should be consulted before hand.

Strong magnetic field of permanent magnets of the rotors!

⇒ Wear gloves when handling
Handle carefully.

⇒ Remove movable metal parts or secure against all movement.

⇒ Handle carefully: when handling the rotor make sure the area is clean.



Danger of damaging sensitive parts!

Strong magnetic fields caused by the permanent magnets of the motor!

⇒ Watches, credit cards and cards of any kind with magnetic strips as well as all ferromagnetic metal parts such as iron, nickel and cobalt must be kept away from permanent magnets.

Note: **Rotor is magnetic!**

Magnets are glued onto the outside of the rotor. These are mechanically sensitive to shocks and concussions.
Therefore:
- handle the rotor carefully
- not do hit with hammer, refrain from any other kind of concussive activity.

Parts / what is included when the rotor is delivered

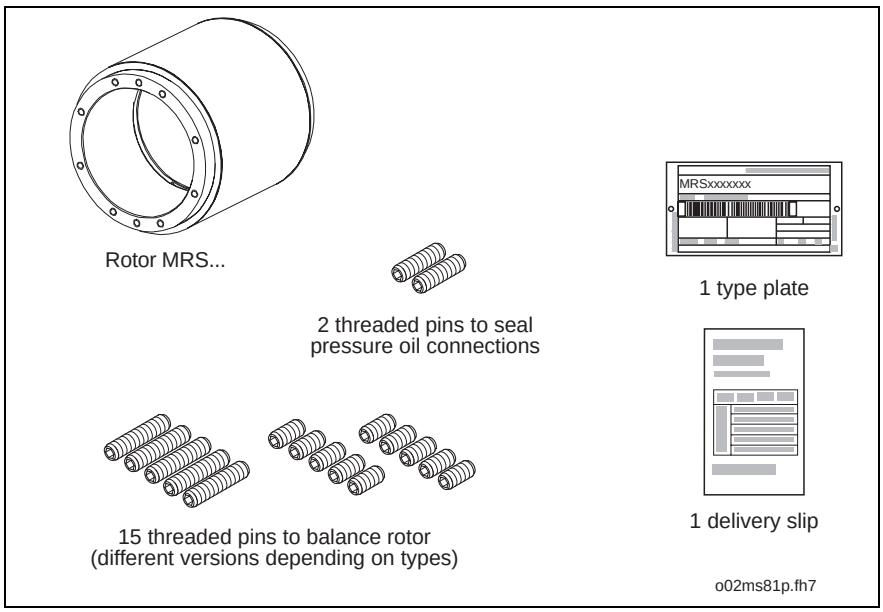


Fig. 8-6: What is included in the delivery of the rotor

Prior to mounting

Mounting should take place in a dry and dust-free environment. The following steps should be taken before doing so:

⇒ Check whether all the parts that should have been delivered, have been delivered.

⇒ Check the rotor visually for any damage.

⇒ Mount the type plate in a visible spot on the spindle housing.

⇒ Check beveling and edges at the press seat of the spindle that they are burr free. Remove such, if necessary.

⇒ Clean inside and outside diameters of rotor, oil connections and pressure at at the spindle for dirt, dust, metal chips and so on.

⇒ Oil pressure seats ød1 and ød2 at the spindle.

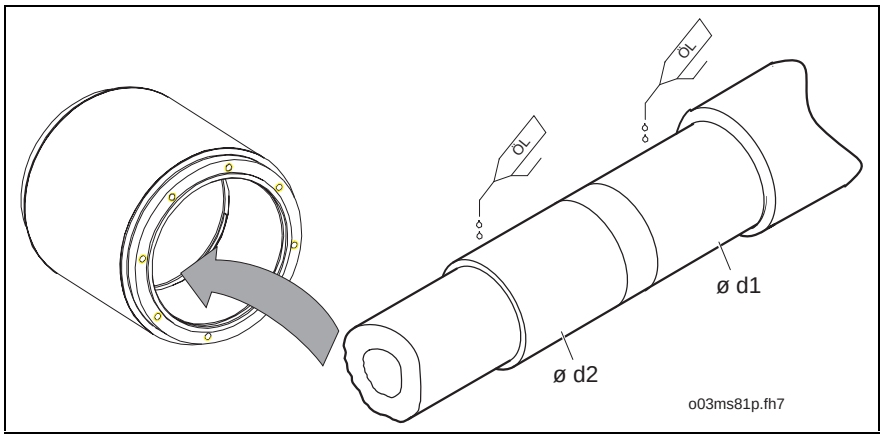


Fig. 8-7:Preparing rotor and spindle for mounting

⇒ Prepare work holding device of the rotor so that the rotor is supported in a vertical manner to accept the spindle.

8.5.1 Shrinking Rotor onto Spindle (1st mounting mode)

The rotor must be heated up in a warming cabinet before it can be shrunk onto the spindle.

Maximum 140°C in the warming cabinet

The warming cabinet may not exceed 140°C. Ensure that it does not!

Note !

Note: **Rotor damage and forfeiture of guarantee !!!**

Temperatures higher than 140°C can dissolve the bonded connections of the rotor magnets. The rotor is destroyed. The guarantee is forfeited. Note the following instructions.

⇒ Heat up rotor in warming cabinet to at least 130°C. but not higher than 140°C.

Note: If the rotor is not heated up to at least 130°C, then the spindle will get stuck when the rotor is shrunk on before the end position is reached!

WARNING

Hot sections with temperatures higher than 100°C

Severe burns can result if these sections are touched.

⇒ Wear heat-resistant clothing!

⇒ Wear safety gloves!

⇒ Place rotor into the prepared device. The largest diameter D1 must be situated at the top! (see Fig. 8-8)

⇒ Pick spindle up and quickly glide it into the rotor.

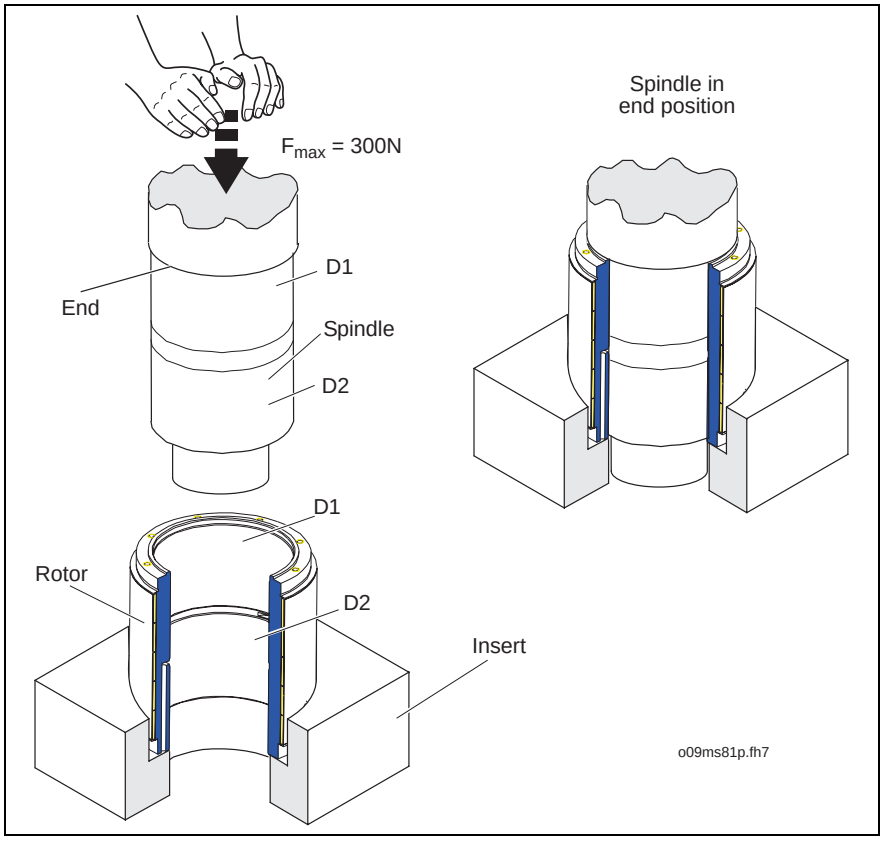


Fig. 8-8: Joining rotor and spindle

Generally, the spindle glides without additional force into its intended end position (stop at spindle). If it does not glide into such with its own weight,

then it can be pressed into it using an extrinsic force of maximum 300 N (body pressure of the person mounting).

⇒ Rotor and spindle must now cool to room temperature.

Check whether the rotor is properly shrunk onto the spindle.

⇒ Visually check whether the spindle is seated at the stop of the rotor.

⇒ Check the smooth running of the spindle.

⇒ Determine whether the spindle runs as smoothly now as it did prior to shrinking.

If it does not, then the spindle is slightly deformed. This deformation is caused by the stress created while cooling off in the step compression joint.

Note: If the spindle is not in the end position, then it must be renewed and reshrunk (see „2.1.1 Mounting the rotor by shrinking it onto the spindle, removing the rotor using an oil under pressure process“, page 2-1, error 1). If the necessary concentric accuracy has not been achieved, then all deformations of the spindle have to be corrected by „swimming“ (see 2.1.2 Rotor Mounting on Reduction Sleeve“, page 2-2, error 2).

⇒ Seal pressure oil connections in the rotor with the threaded pins suppliled. Note: insert threaded pins completely and secure against twisting by using LOCITE 620. For bonding guidelines, see section Securing the screws with LOCTITE. The threaded pins must be bonded so that the connections are completely protected against the oil pressure.

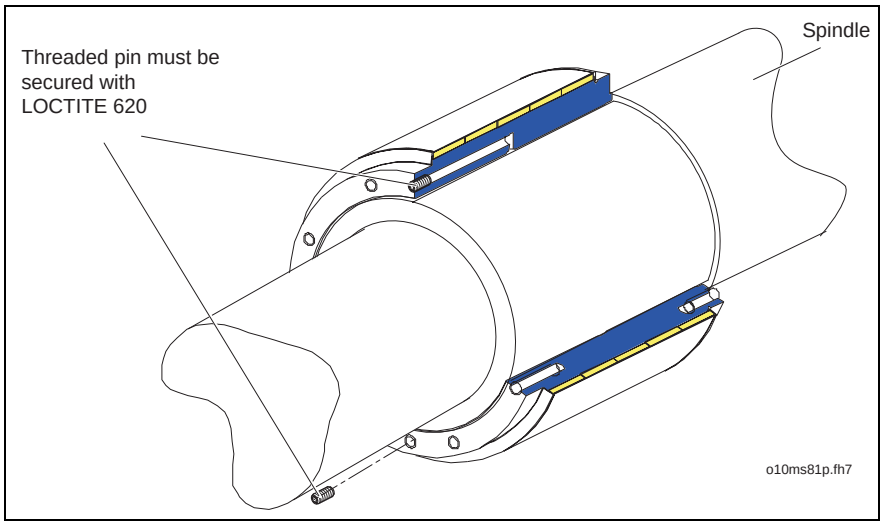


Fig. 8-9: Sealing the pressure oil connections

What to do with mounting errors

Fault 1 **Spindle remains stuck while shrinking prior to reaching end position in rotor.**

Procedure:

⇒ Let rotor and spindle cool off.

⇒ Seal one of the two pressure oil connections on the rotor with a threaded pin. Insert pin completely and secure with Loctite 620. For bonding guidelines, see section 8.4. The threaded pin must be bonded to seal the connection completely against oil pressure.

⇒ Press rotor off of spindle using the pressure oil process (Procedure described in section 8.5.)

⇒ Check the tolerances of the pressure fittings.

⇒ If necessary, remove burrs from inside diameter of rotor and pressure fittings ∅d1 and ∅d2 of the spindle.

Note: Spindle and rotor must be absolutely burr free!

⇒ Re-shrink rotor onto spindle.

Fault 2 **The spindle was deformed while being shrunk onto rotor.**

The shrinking process can generate stress in the step compression joint. These can cause micrometric deformations in the spindle. By pressing pressure oil into the joint can these stresses be relieved and the deformations of the spindle undone.

Procedure:

⇒ Permit rotor and spindle to cool.

⇒ Seal one of the two pressure oil connections on the rotor with a threaded pin. Insert pin completely and secure with Loctite 620. For bonding guidelines, see section 8.4. The threaded pin must be bonded to seal the connection completely against oil pressure.

⇒ Hold rotor and spindle with suitable mounting tools together in such a way that the rotor is firmly held in its position onto the spindle.

Note: The rotor may **not** shift axially on the spindle while the pressure oil is being pressed in.

⇒ Mount oil pump.

⇒ Use oil with a viscosity of 300 mm²/s at 20°C. This ensures that the oil will quickly and completely drain off after „swimming“ the rotor.

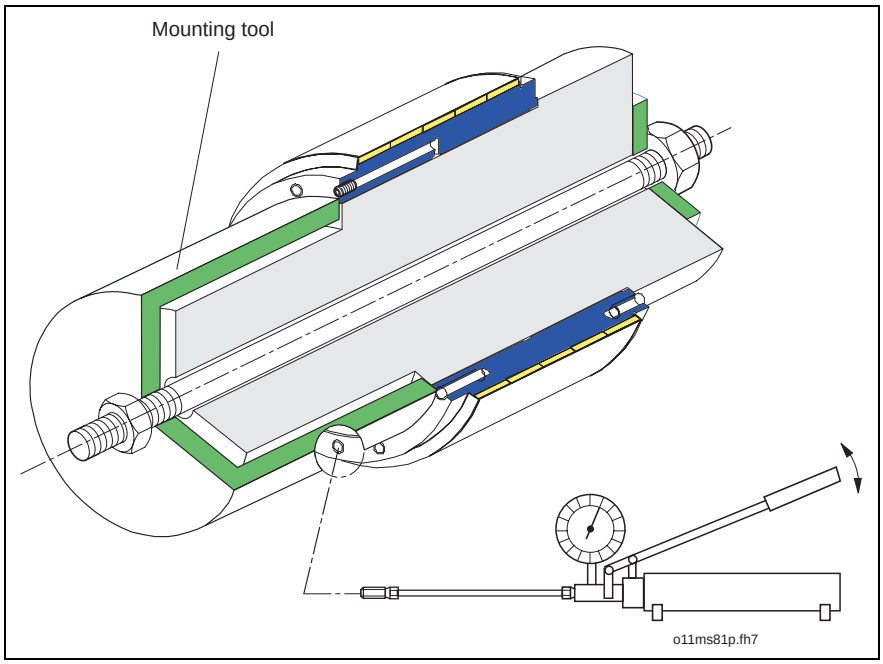


Fig. 8-10: Swimming the rotor

⇒ Pump oil into the step compression joint.

Note: Oil will leak! Oil collective tray must be held ready!

⇒ Slowly increase oil pressure until the oil emerges from an interference interface on the front.

An oil film builds between rotor and spindle that keeps the two apart. This „swimming“ of the rotor on the spindle releases the stress caused during shrinking.

⇒ There may be no pressure on oil pump, feed lines or compression joint.

⇒ Open both pressure oil connections.

⇒ Bring spindle with holding device into vertical position and press oil out of compression joint with air pressure (see Fig. 8-11: Removing air with oil pressure)

⇒ Let oil run completely out of the compression joint.

Note: Do not apply a full load to the compression joint for the next 24 hours.

⇒ Tighten both pressure oil connections using the tapped pins supplied and then seal with LOCTITE 620 (see sealing guidelines, section: 8.4).

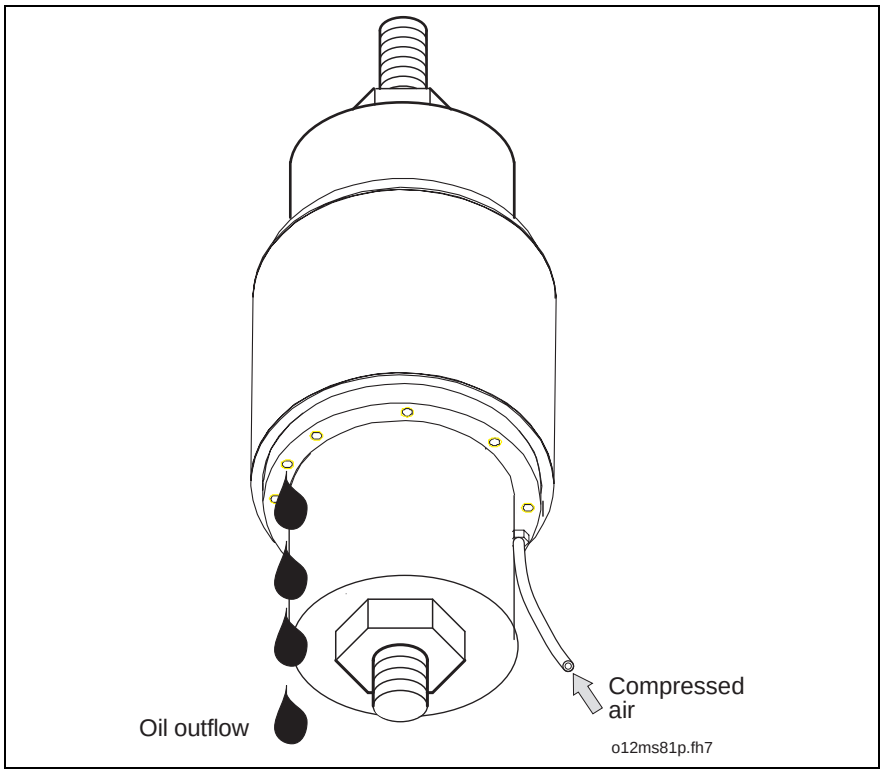


Fig. 8-11: Removing air with oil pressure

8.5.2 Axially Clamping the Rotor (2nd mounting mode)

The rotor is „axially clamped“ between a clamping disc and the spindle. INDRAMAT does not supply the clamping disc.

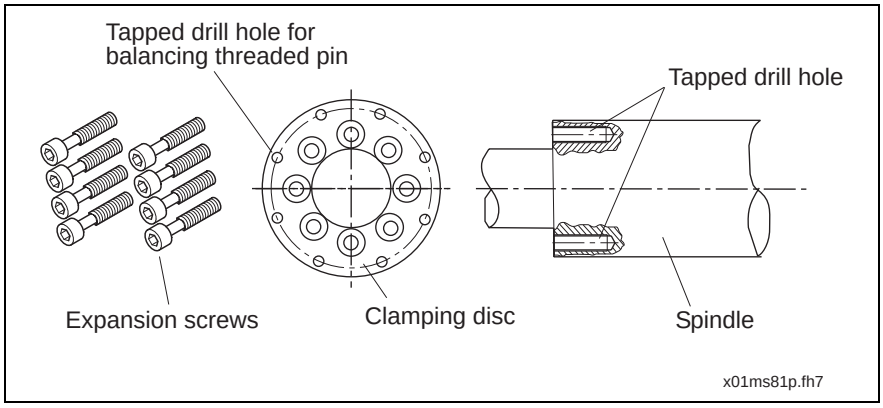


Fig. 8-12: Individual sections - axially clamping the rotor

The parts must look like those illustrated above.

The clamping disc must have tapped holes in an axial direction around its circumference in which the threaded pins are inserted for balancing.

Note: Due to axial expansion in length between rotor and spindle, expansion screws must be used for spindle and clamping disc.

Note: The user is responsible for dimensioning the rotor mounting screw!

The following graphic illustrates how to bring rotor and spindle together using the „axial clamping“ principle.

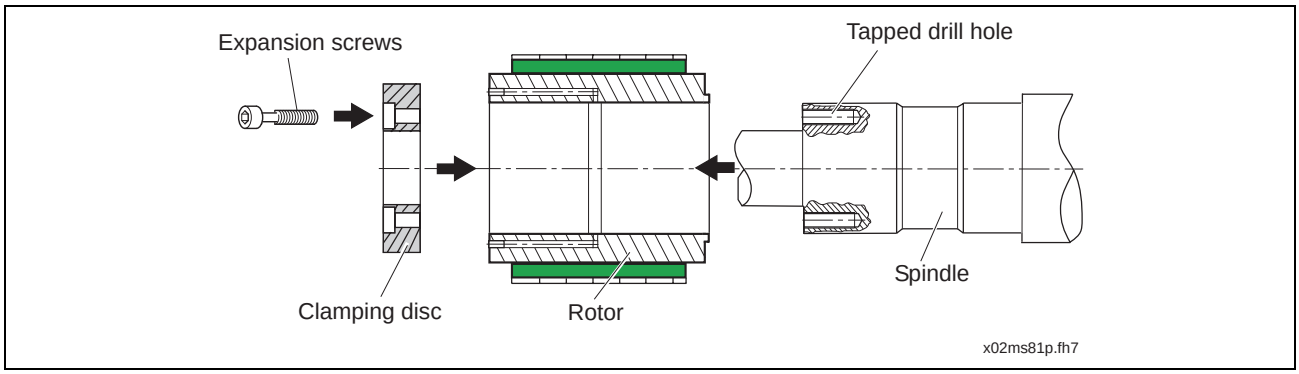


Fig. 8-13: Axially clamping rotor and spindle (mounting type no. 2)

Suitable mounting aids for mounting rotor and combining spindle and rotor must be placed ready prior to each operation.

Note: **Rotor is magnetic!**

Magnets have been glued onto the outside of the rotor.
These are mechanically sensitive to shocks and hammering.
So:
- handle rotor with care
- no shocks, do not hammer

WARNING

Danger to the health of individuals with heart pacemaker, metal implants or splinters and hearing aids exists when in close proximity to these parts!

Strong magnetic field due to permanent magnets of the rotor!

⇒ Individuals with heart packemakers, metal implants or hearing aids may not come close to these motor parts or handle them.

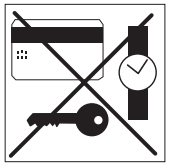
⇒ If these individuals have to do so, then a physician should be consulted before hand.

Strong magnetic field of permanent magnets of the rotors!

⇒ Wear gloves when handling
Handle carefully.

⇒ Remove movable metal parts or secure against all movement.

⇒ Handle carefully: when handling the rotor make sure the area is clean.



Danger of damaging sensitive parts!

Strong magnetic fields caused by the permanent magnets of the motor!

⇒ Watches, credit cards and cards of any kind with magnetic strips as well as all ferromagnetic metal parts such as iron, nickel and cobalt must be kept away from permanent magnets.

Procedure:

⇒ Insert spindle carefully into the rotor.

⇒ Fix spindle in rotor.

⇒ Set clamping disc into place and screw onto spindle with the expansion screws.

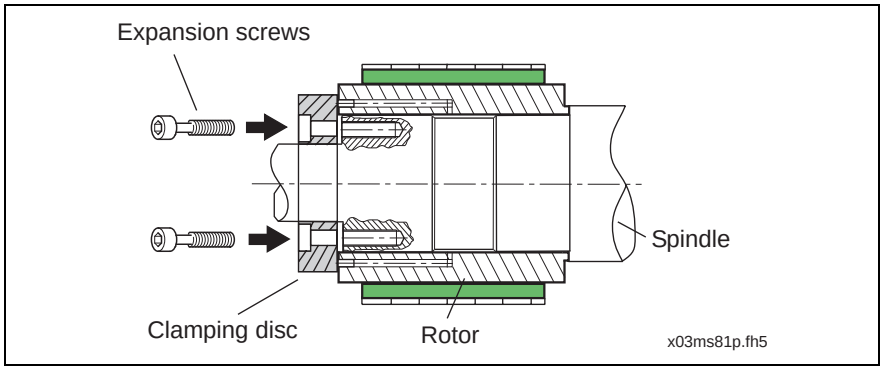


Fig. 8-14: Axially clamping rotor and spindle

8.5.3 Balancing the Rotor

To achieve the wanted vibration severity grade of the spindle it is necessary to balance rotor with spindle. There are tapped holes on the front of the rotor in axial direction. Screw in threaded pins as needed for balancing and secure with LOCTITE 620 (see bonding instructions, section 8.4). The threaded pins are supplied and illustrated in Fig. 8-16.

The needed vibration severity grade depends on the machining accuracy of the motor spindle and is defined by the motor spindle builder.

Note: Remove no material from rotor when balancing spindle!

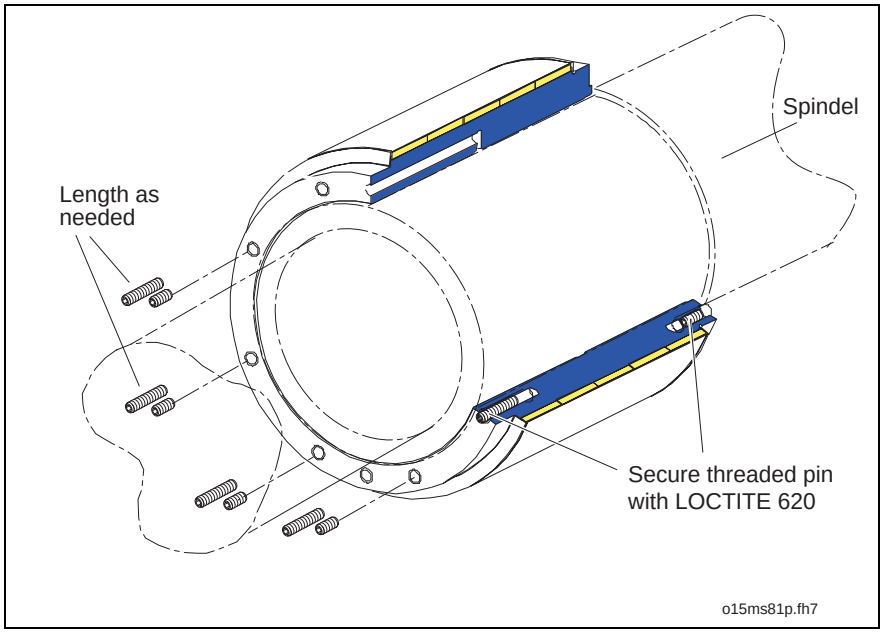


Fig. 8-15: Balancing by inserting threaded pins

Procedure:

⇒ Clean tapped holes of all dirt, metal chips or rust.

Note: Only absolutely clean and rust-free tapped holes can guarantee that the bonded surface will hold.

Use LOCTITE cleaner or re-shave tapped holes if necessary!

⇒ For balancing, insert threaded pins as needed in axial direction.

Note: Depending on mass compensation needed, several pins can be inserted into one hole.

It is necessary to insert all the way!

Secure threaded pins against becoming loose! Sealing them with LOCTITE 620 will prevent this, see section 8.4. Note drying times with activator! Activator does not have to be used.

Threaded pin per DIN 913	Number / MRS		Weight per pieces in g
	200x-A	200x-B	
M6x6	10	---	0,76
M6x12	5	---	1,81
M8x8	---	10	1,89
M8x16	---	5	4,41

Fig. 8-16: Overview of supplied pins

8.6 Removing Rotor from Spindle

It may be necessary, in the following cases to remove the rotor from the spindle:

- spindle damaged during storage
- rotor damage
- mounting error

8.6.1 Removing a Rotor that has been Shrunk On

Procedure:

⇒ Open a pressure oil connection.

The second connection must remain sealed. Seal with threaded pin, if necessary. Then seal with LOCTITE 620 completely, see Section Fig. 8-5. Glue the pin in in such a way that the connection is completely sealed against oil pressure.

⇒ Mount end stop (example: see Fig. 8-17). Mount as per (A) shown on table (see Fig. 8-18) of the end stop.

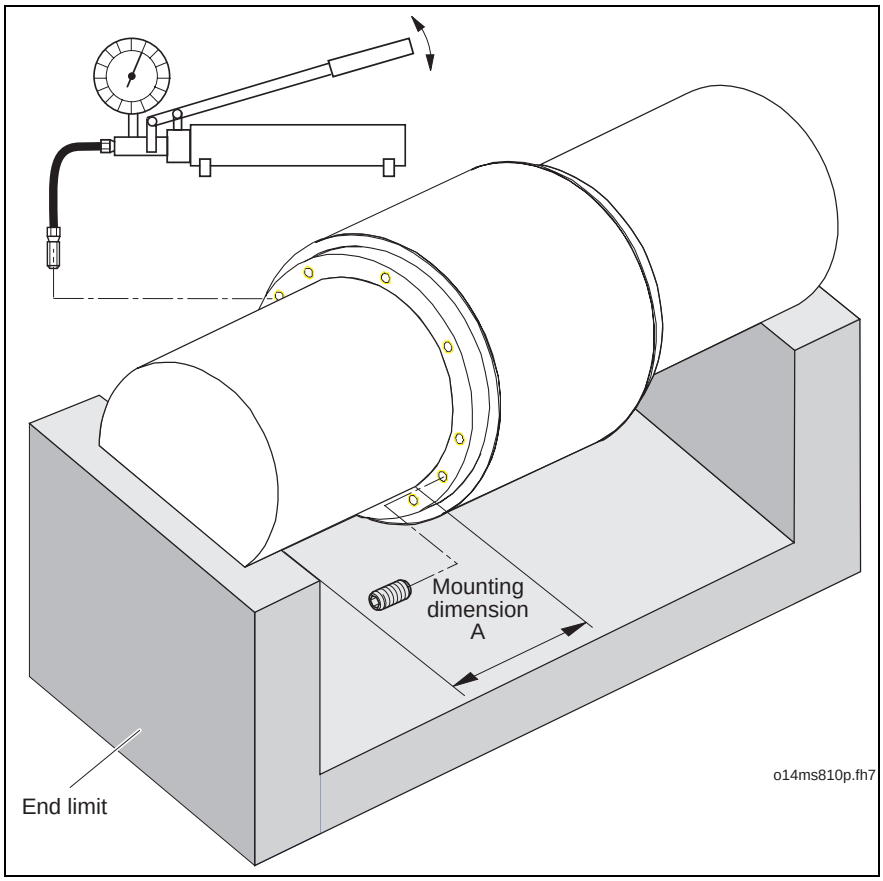


Fig. 8-17: Example of a stop for removal

Rotor	Dim. A in mm
MRS200B	100
MRS200C	110

Fig. 8-18: Mounting dimensions A for different types of rotors

⇒ Connect oil pump
Use oil with viscosity of 900mm²/s at 20°C!

WARNING

Sudden movement of the rotor.
Injury caused by the sudden sliding off of the rotor from the spindle while oil is being pressed into the compression joint.
⇒ Secure spindle before pumping oil in.

⇒ Pump oil into the step compression joint.

Note: Oil will leak! Oil collecting trough must be held ready!

⇒ Slowly increase oil pressure until the axial forces working in the compression joint permit the rotor to slip off of the spindle.
If oil leaks on the front of the compression joint and the rotor does not move off of the spindle, then pull the rotor off of the rotor sleeve with a withdrawing screw.

Note: The oil pressure must be retained during this action!

WARNING

Danger of pinching fingers and hands due to strong attractive force of magnets!

Strong magnetic field caused by permanent magnets of the rotor!

⇒ Handle only with gloves
CAUTION when handling.

⇒ Eliminate movable metal objects or secure against unwanted motions.

⇒ Careful handling: work on rotor only in a clean environment.

⇒ Mounting withdrawing screw as per illustration.

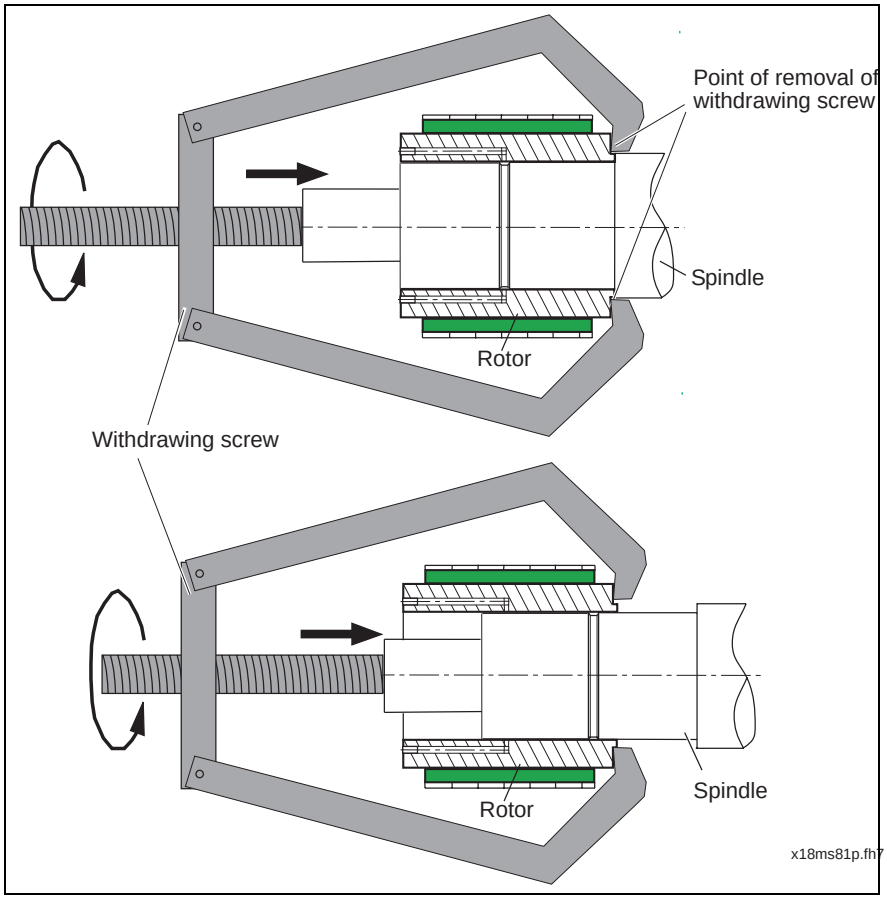


Fig. 8-19: Releasing rotor with from spindle with withdrawing screw

Do not hammer the rotor

Note: **Rotor damage and loss of guarantee!**

Handle rotor carefully! The magnets are glued onto the rotor and are sensitive to shocks and hammering.

For further procedures see section 8.5.1 “.

8.6.2 Removing an Axially-Clamped Rotor

Removing an axially-clamped rotor from the spindle occurs in reverse order to the mounting. See section 8.5.2 .

8.7 Mounting the Stator into the Spindle Housing

Parts / extent of delivery of stator

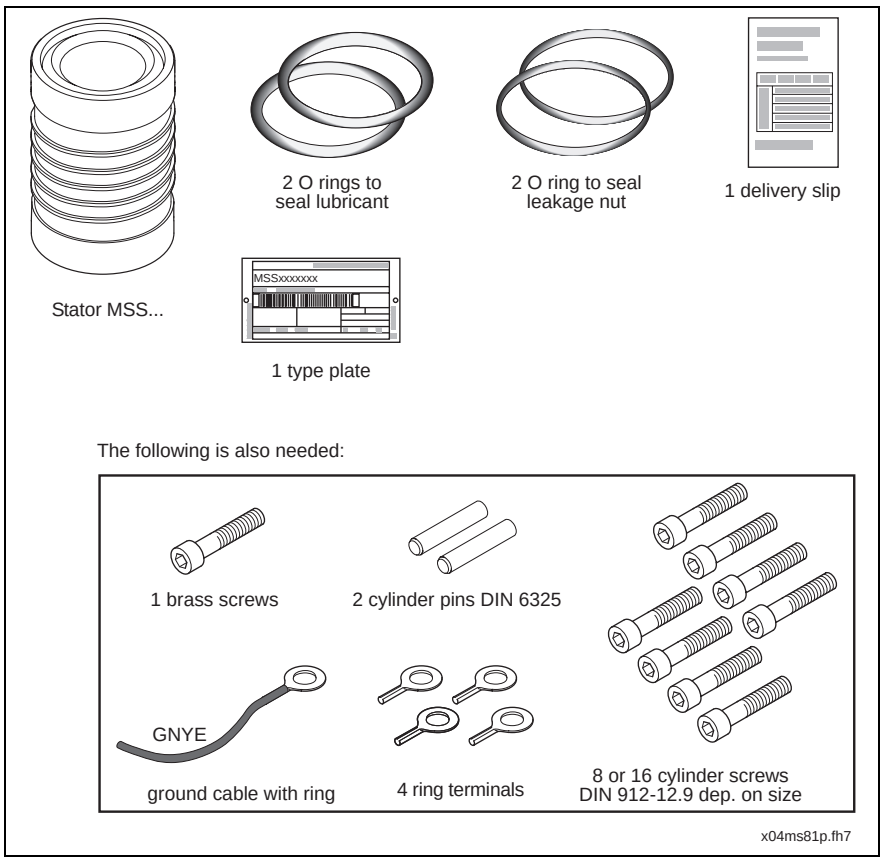


Fig. 8-20: Extent of delivery of stator and additional materials

Prior to mounting

Mounting should take place in a dry and dust-free environment. This necesitates the following preparatory measures:

⇒ Check whether everything has been delivered.

⇒ Have additional materials ready. The precise dimensions are specified in the constructional drawing.

⇒ Visually check stator for damages.

⇒ Visibly mount name plates on spindle housing.

⇒ Check that the holes in the spindle housing are free of burrs, clean, if necessary.

Note: The inside edges of the holes (connections for coolant and drainage holes) must be absolutely free of burrs so as not to damage the stator during mounting!

⇒ Clean O-ring grooves on stator of dirt, dust, metal chips, etc.

8.7.1 Mounting Stator for Liquid-Cooling into Spindle Housing

There are tapped holes on both sides of the front of the stator for mounting the stator.

Note: Mount on either thick or thin stator end, as desired, but not at both ends!

Note: The basic procedure for mounting the stator in the housing remains the same. There can be some deviation, depending on the construction of the spindle housing. The procedure for mounting the stator is described on the back of the end shield.

Procedure:

⇒ Grease O-rings.

⇒ Insert O-rings (position 1; per stator accessory list) in the inside grooves (coolant gasket). Do not twist O-rings in the process! Ensure that all surfaces are clean!

⇒ Insert O-rings (position 2; per stator acessory list) into the grooves further on the outside (drainage gaskets). Do not twist O-rings in the process! Ensure that all surfaces are clean!

Note: When inserting the O-rings, note that the drainage groove remains accessible!

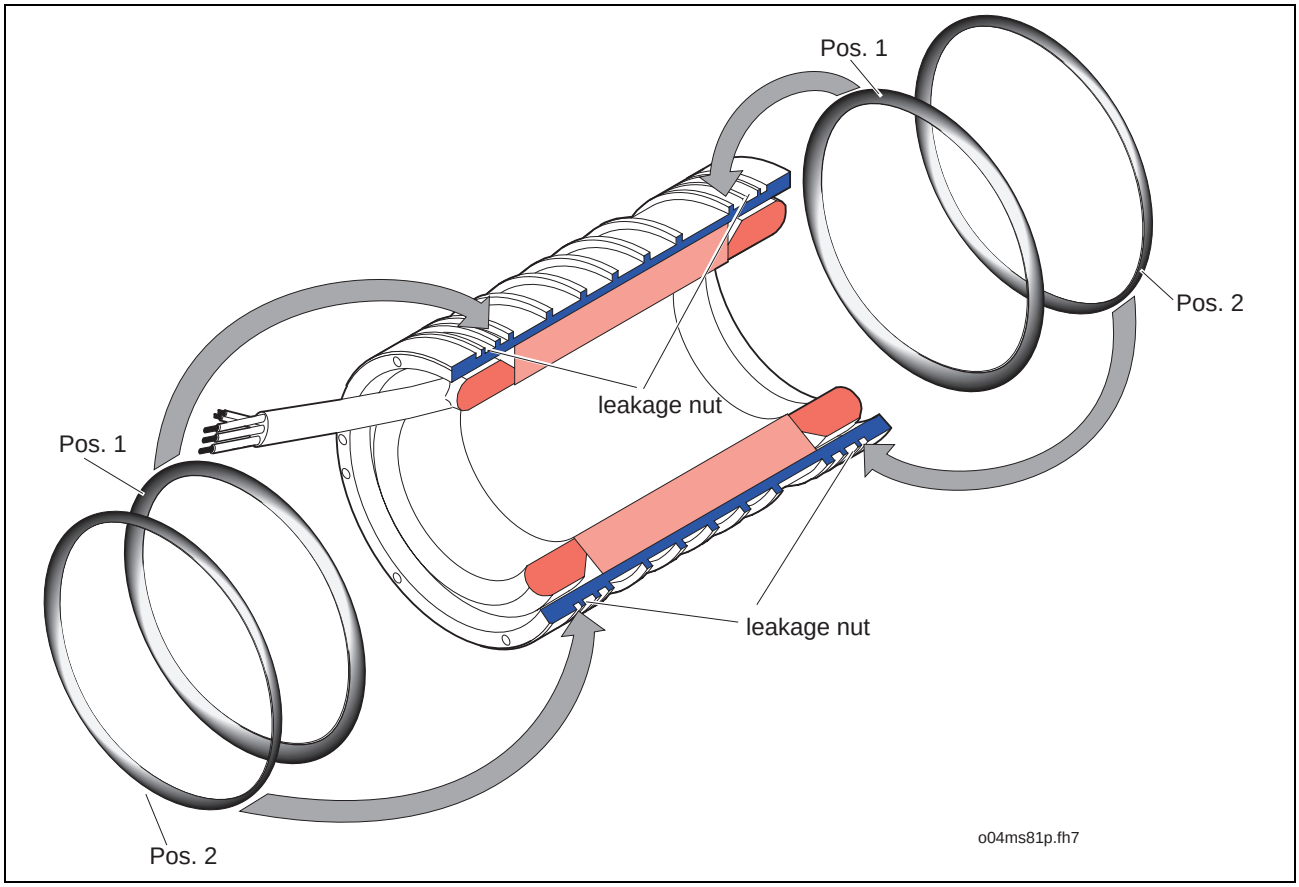


Fig. 8-21: Mounting O rings

Note: In some motors, the O-rings have the same size for both the drainage and coolant gaskets.

⇒ Slide stator centered into spindle housing. Use parallel chain or rope suspension tackle for lifting.

Note: Do not use cable strand as mounting aid, do not pull on it and manipulate it in any way!
Transport and handling instructions must be noted!

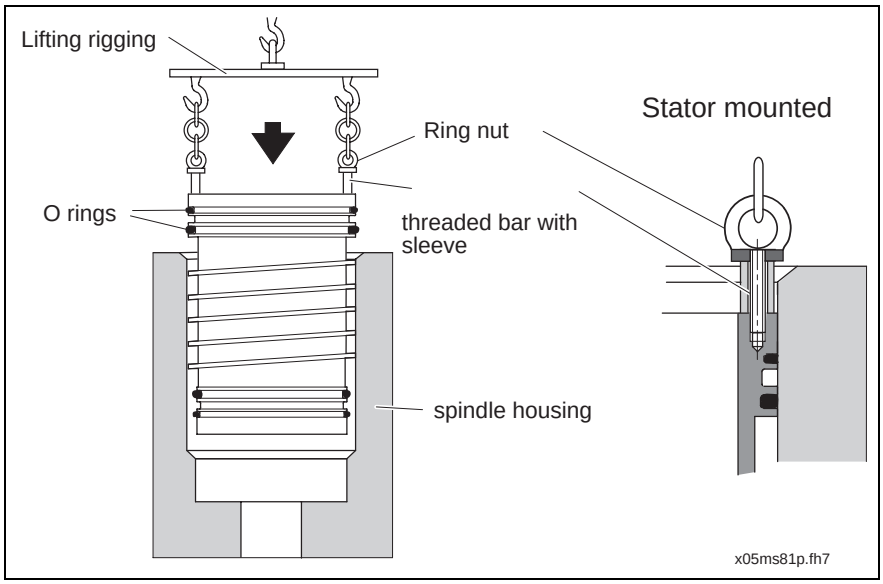


Fig. 8-22: Mounting the stator into spindle housing

⇒ Press stator into end position. Use suitable tools at all times, but especially if the mounting procedure is difficult.

⇒ Screw stator on front with name plate. Tighten screws evenly, using a torque key. Tightening torques are listed in the constructional diagrams.

⇒ Seal screws with LOCTITE 243, see Section 8.4 for instructions.

⇒ Pin stator to end shield.

The holes in the cooling jacket of the stator for the cylinder pins are predrilled. They must be drilled open to the dimensions specified on the constructional diagram.

Check imperviousness of O-rings

Once the stator is mounted, the imperviousness of the O-rings should be checked.

Procedure:

⇒ Fill coolant groove between cooling jacket and spindle housing with coolant.

⇒ Close any cooling connection in the spindle housing with a suitable screw.

⇒ Connect coolant pump with pressure gauge and controller to the second connection.

⇒ Stand spindle housing up so that the drainage holes are at the lowest point (at bottom).

⇒ Pump coolant in and slowly increase pressure from 0 to 6 bar.

⇒ Once 6 bar is reached, observe drainage for 10 minutes to see whether coolant is leaking.

Note: If coolant is leaking, then replace the O-rings! Locate cause of the defect in the O-rings and eliminate it!

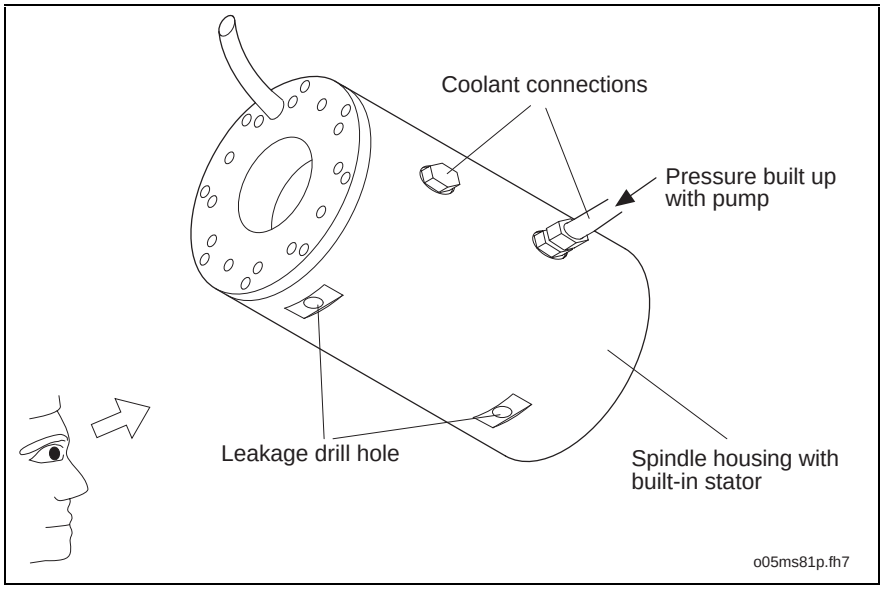


Fig. 8-23: Checking imperviousness of O rings

8.7.2 Mounting Stator for Natural Convection into Spindle Housing

To mount the stator in the spindle housing, there are tapped holes on the front of the stator on both sides.

Note: Mount at either thick or thin stator end, but not at both!

Note: Basic mounting procedures of the stator in the housing are always the same. There can be minor deviations depending on the construction of the spindle housing. The procedures for mounting the stator are described on the back end shield.

Procedure:

⇒ Glide stator centered into spindle housing. Use parallel chain or rope suspension tackle for mounting. (See Fig. Fig. 8-24).

Note: Do not use cable strand as mounting aid, do not pull on it and manipulate it in any way!
Transport and handling instructions must be noted!

WARNING

Danger of pinching fingers and hands due to strong attractive force of magnets!

Strong magnetic field caused by permanent magnets of the rotor!

⇒ Handle only with gloves
CAUTION when handling.

⇒ Eliminate movable metal objects or secure against unwanted motions.

⇒ Careful handling: work on rotor only in a clean environment.

Note: Due to the magnetic forces of the rotor magnets, the spindle house can be picked up during removal.

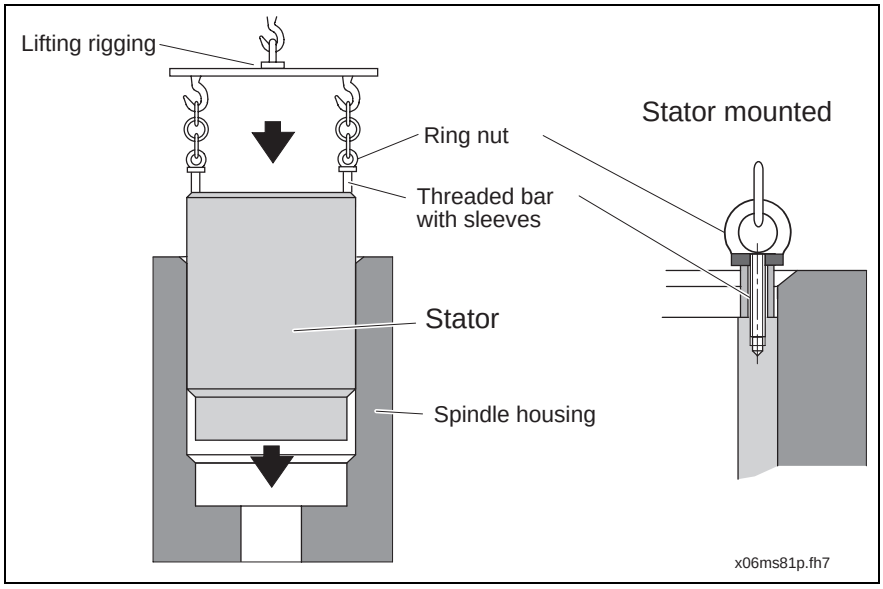


Fig. 8-24: Mounting the stator for natural convection into the spindle housing

⇒ Press stator into end position. Use suitable tools at all times, but especially if the mounting procedure is difficult.

⇒ Screw stator on front with name plate. Tighten screws evenly, using a torque key. Tightening torques are listed in the constructional diagrams.

⇒ Seal screws with LOCTITE 243, see Section 8.4 for instructions.

⇒ Pin stator to end shield.

The holes in the stator for the cylinder pins are pre-drilled. They must be drilled open to the dimensions specified on the constructional diagram.

8.7.3 Connecting the Electrical Stator Cables

A 1.5 meter long cable strand is attached to the stator at delivery. It is protected by a sleeve and is made up of:

- a power core (labelled U,V or W)
- and one (1) wire pair for the PTC resistor in the winding overhang.

Before connecting the PTC resistor, check that it is functioning properly. Measure its resistance with an ohm meter at room temperature. If the measurand lies between 60 and 750Ω, then the resistor is running and can be used.

⇒ Check PTC resistor. If the value measured ranges between 60 and 750 Ω, then the PTC resistor is functional and can be used.

All wires are connected inside a terminal box. The terminal box must be mounted directly to the spindle housing.

Note: When conducting the cable strand to the terminal box, note that the allowable bend radius of the cable strand is not exceeded!

The edges of the through holes may not be sharp!

The allowable bend radius depends on the diameter of the cable strand of the relevant motor type and is specified in the relevant dimensional sheets in this document.

Mount ground cable onto spindle housing

The grounding connection on the spindle housing must comply with the illustration as seen in Fig. 8-25: Grounding stator and spindle housing“. The stator is hereby grounded to the end shield via a screwed connection.

The minimum cross section depends on the relevant motor type. The relevant data is listed in section „Technical data“.

Note: The specified minimum cross section also applies to the grounding wire and must be complied with!

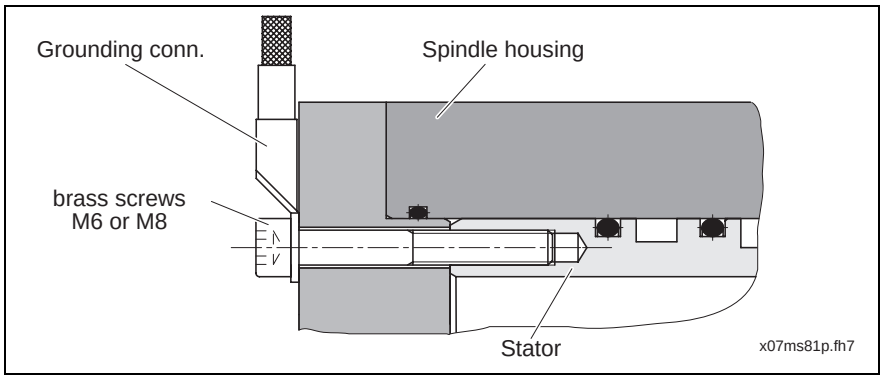


Fig. 8-25: Grounding stator and spindle housing

The ground connection with an M6 or M8 brass screw does not suffice. Therefore, back it up with an electrically-conductive connection between stator, spindle housing and end shield. If the electrically-conductive connection cannot be guaranteed, then contact the stator with a second brass screw.

Procedure:

⇒ Clean the area for the screw head. The metal surface must be blank so that both spindle housing and stator can be grounded.

⇒ Fasten ground cable with ring terminal to end shield with brass screw (M6 or M8, depending on type).

⇒ Apply petroleum jelly to connection to protect against corrosion.

Connecting cable in terminal box

Before connecting the cable strand cores in the terminal box, check the terminal box gaskets.

- There must be a terminal box and a lid gasket (see Fig. 8-26).
- Both the gaskets and their surfaces must be in perfect condition.

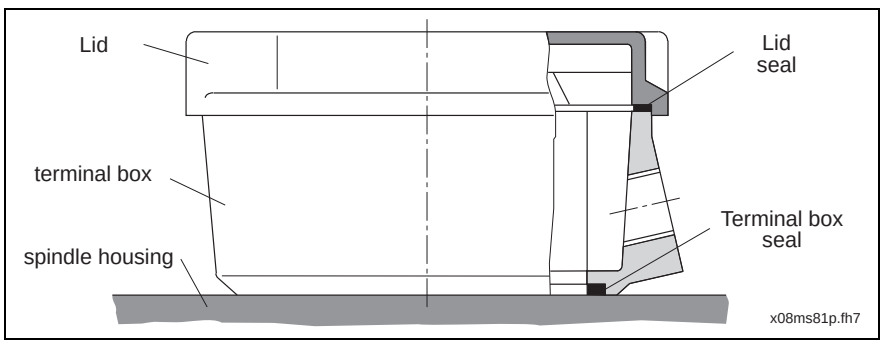


Fig. 8-26: Terminal box gaskets

Before connecting the cables in the terminal box, both the power connections and the ground connections must be equipped with ring terminals. The size of the terminals depends of the core diameter and the diameter of the stud bolts in the terminal box.

Note: The individual cores of the cable strand must be clearly labelled within the terminal box to avoid any confusion!

Fig. 8-26: Terminal box gaskets illustrates an example of how the individual points of connection within a terminal box are arranged.

The individual lines must be mounted as follows:

⇒ The ferrule of the ground connection must be screwed into its intended position.

⇒ The power connections must be screwed into place on the mounting bolts using attachment bolts (note tightening torque!). Connect them as specified in their designations:

- conductor U to bolt U1
- conductor V to bolt V1
- conductor W to bolt W1

Winding	M3.5	M4	M5	M6	M8	M10	M12
tightening torque in Nm	0.8	1.2	2.0	3.0	6.0	10.0	15.5

Fig. 8-27: Tightening torque for terminal board grooves per DIN 46 200

The PTC resistor is mounted ot the terminal strip.

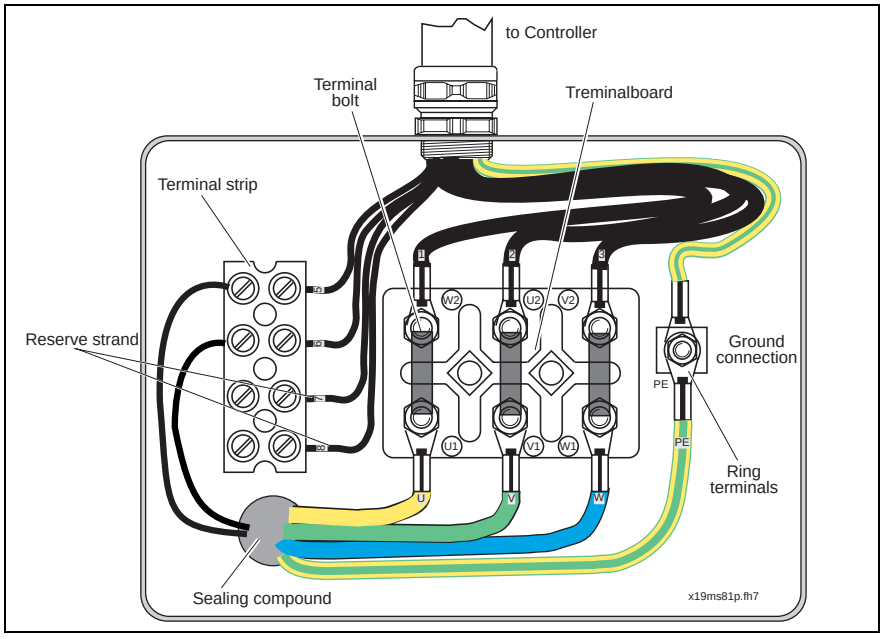


Fig. 8-28: Terminal box with terminal board and strip

Note: Other terminal box layouts require that all connections correspond, as specified, to the relevant construction diagrams.

After connecting the conductor in the terminal box, seal the through hole between terminal box and spindle housing with a moldable sealant.

8.8 Removing Stator from Spindle Housing

The stator must be removed if, for example:

- the winding is defect
- the PTC resistor is defect
- or the O-ring leaks

DANGER

High voltage !!!

Use extreme caution! Contact with live parts can be fatal!!

⇒ Make sure power is off and secured against being switched back on before work commences!

Procedure:

⇒ Release electrical connections
- power connection
- PTC resistor connection
- ground cable

⇒ release cap screw on end shield and remove

⇒ slowly remove end shield using appropriate tools

⇒ screw transport eyebolt into holes

Note: Do not pull or manipulate cable strand in any way to avoid damaging the stator! Follow transport and handling guidelines!

⇒ Slowly remove stator using a suitable lifting device (note the weight of the stator!).

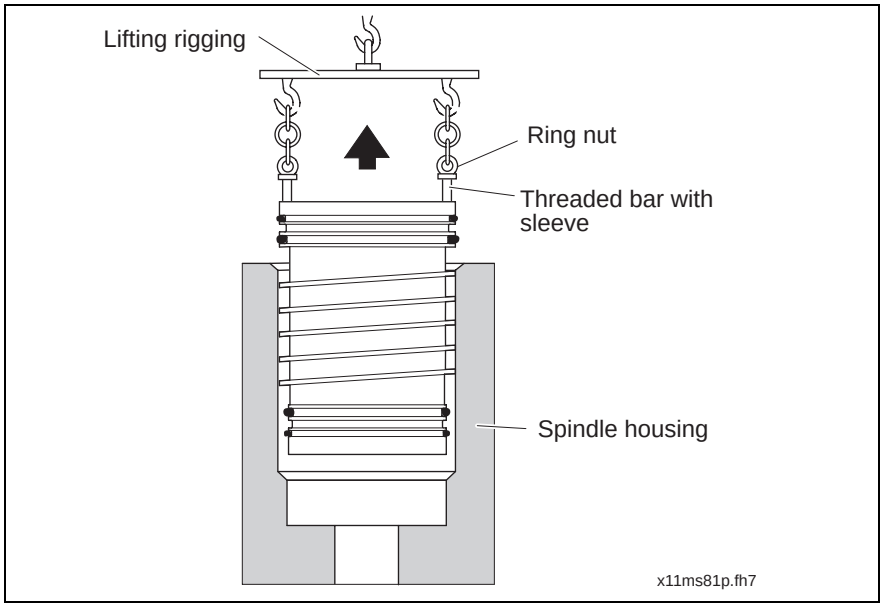


Fig. 8-29: Removing stator from spindle housing

8.9 Electrical Check - Motor Spindle

8.9.1 Conducting a Windings Check

Once the stator is mounted and the cores connected in the terminal box, it is necessary to run a windings check.

This check is conducted between the windings, housing and PTC resistor and checks insulation capacities.

The test voltage must be a sinusoidal a.c. voltage U_{eff} = 1500V.

Conduct the check as per DIN VDE 0530, section 1, para. 17.

Note: The windings check must be conducted by an electrician or under the supervision of such.

Check recommendations:

Take the following measurements and record them in the test protocol (see page 8-32):

1st High voltage test - winding

Procedure:

⇒ The winding ends must be connected to each other.

⇒ The PTC resistor must be shorted and connected to the housing, see Fig. 8-30: .

⇒ Test voltage U_{eff} = 1680 V (50/60 Hz) for five seconds and apply between the winding ends and the shorted PTC ends of the test specimen connected to the hosuing.

Note: Per DIN VDE 0530 Section 1 (07/91), subsection 17 a maximum test voltage of U_{eff} = 1500 V must be applied for further higher voltage MBS motor tests.

⇒ Measure leakage current.

The test is succesful if the leakage current equals ≤ 20 mA.

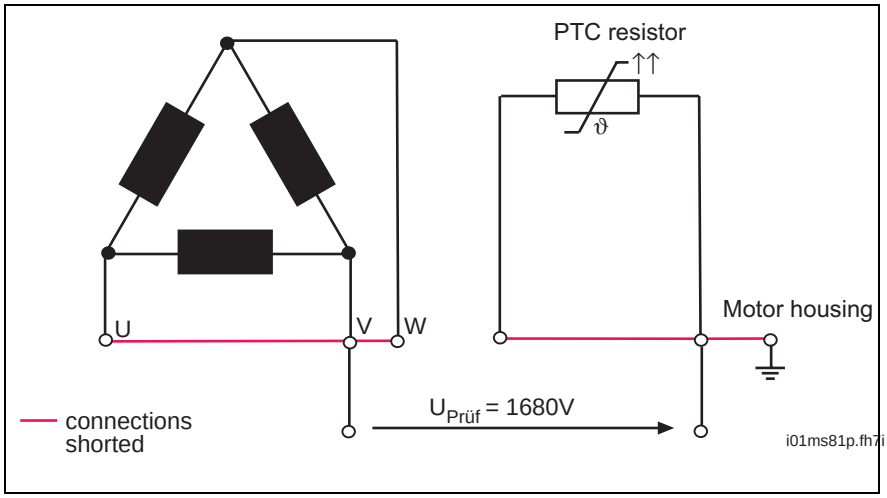


Fig. 8-30: High voltage test (circuit)

DANGER

Leakage current too high !!!

Use extreme caution! Contact with spindle housing can be fatal or cause extreme injury! Damage to machine possible!
If the leakage current is higher than the limit value, then the components are not sufficiently insulated.

⇒ Do not start-up the kit spindle motor, in this case!

⇒ Find and eliminate cause!!

2nd High voltage test - PTC resistor

Procedure:

⇒ Short the PTC resistor

⇒ Apply U_{eff} = 500 V (50/60 Hz) for five seconds between shorted PTC resistor ends and the housing of the test specimen.

⇒ Measure leakage current.
The test is succesful if the leakage current equals ≤ 10 mA.

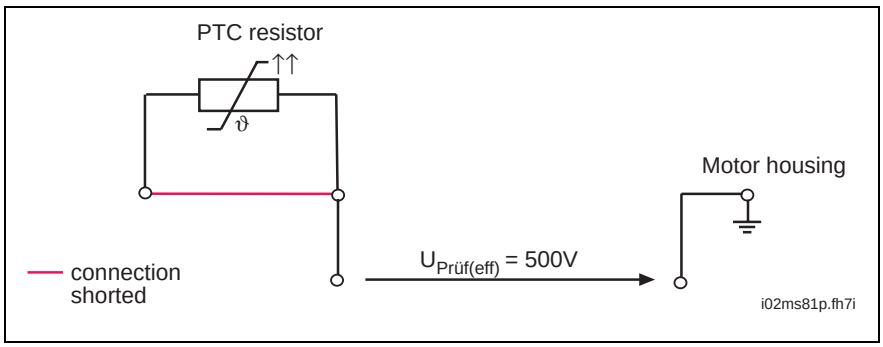


Fig. 8-31: High voltage test PTC resistor (circuit diagram)

DANGER

Leakage current too high !!!

Danger to life, danger of injury from electric shock upon contact with spindle housing. Machine damage possible!
If leakage current higher than set limit value, then the components are not sufficient insulated from each other.

⇒ Do not run the kit spindle motor!

⇒ Find and clear all faults!

3rd Inductance test

After mounting the entire motor spindle including terminal box the inductance values of the spindle motor must be checked. These are listed in the section „Technical data“ of the relevant MBS motor.

Pre-requisite: The following test conditions and materials must be maintained or must be handy.

Test conditions:

- the temperature of the motor spindle: approximately 20 °C
- spindle is standing still

Test materials:

- inductance measuring device with a measuring frequency of 1 kHz
- test guidelines

The measurements are tapped off between three power terminals or contacts (see test protocol; page 8-32).

Measurement from winding	U - V
Measurement from winding	V - W
Measurement from winding	W - U

⇒ Conduct the measurements at the three windings.
The values may not deviate by a maximum of ±10% from the inductance values specified in the technical data!

Causes for deviating measurement results:

- the rotor is defective
- rotor is turned by hand while the reading is being taken

4th PTC resistor measurement

Prerequisite: The following test conditions of test devices must be handy.

Test conditions:

- motor spindle temperature at about 20 °C
- spindle standing still

Prüfmittel:

- Ohm meter

The resistance readings are taken at the PTC resisstor connections

⇒ take the reading

8.9.2 Test Protocol of a motor spindle with MBS motor

Type designation of rotor and stator

Stator type: MSS __ __ __ __ - __ __ __ - __ __ __ - __ __ Serial no.: MSS __ __ __ - __ __ __ __ __ __	Manufac. date: _____
Rotor type: MRS __ __ __ __ - __ __ __ - __ __ __ - __ __ Serial no.: MRS __ __ __ - __ __ __ __ __ __	Manufac. date: _____

(Also see section: Identifying the merchandise)

1st High voltage test (winding) (see „8.9.1 Conducting a Windings Check“ page 8-29)

Run test as per section 8.9 (I_{leak} < 20mA)?

Test voltage: _____V

Test duration: _____sec.

Yes	No

2nd High voltage test (PTC resistor) (see „8.9.1 Conducting a Windings Check“ page 8-29)

Run test as per section 8.9 (I_{leak} < 10mA)?

Test voltage: _____V

Test duration: _____sec.

Yes	No

3rd Inductance test (see „8.9.1 Conducting a Windings Check“ page 8-29)

Temperature of motor spindle: _____°C

Measuring frequency: _____kHz

Inductance value per tech. data L_{TD}= _____mH

Reading				Test	$0.9 \cdot L_{TD} < L_{mess} < 1{,}1 \cdot L_{TD}$ _____mH < L_{mess} < _____mH
Inductance of	Symbol	Unit	Reading	passed	failed
Winding U-V	L_{mess1}	mH			
Winding V-W	L_{mess2}	mH			
Winding W-U	L_{mess3}	mH			

4th PTC resistor test (see „8.9.1 Conducting a Windings Check“ page 8-29)

Resistance reading between PTC resistor ends. The PTC resistor is in order if resistance ranges between the limits listed below at room temperature (20°C).

Criteria: $60\Omega < R_{20°C} < 750\Omega$

Comments: _____

_____

Loc. Date: _____ Name / Co.: _____

Fig. 8-32: Test protocol motor spindle (electrical)

9 Storage, Handling, Transport

9.1 General information

When selecting the transport and lifting devices, the varying weights and sizes of the individual designs must be taken into account.

The manually-transported models also necessitate the greatest care and transport and storage guidelines complied with.

9.2 Rotor

Storage

The rotor is packaged in a horizontal position and cushioned in form-fitting styrofoam. It must be stored dry, dust-free and shock proof. The permissible temperature range is: -25 °C up to + 50 °C. The rotor may be stored in either a horizontal or vertical position.

Lifting and transporting

When transporting, please note that the fittings on the inside of the rotor are not damaged. Damages here could eventually prevent the rotor from being removed from the spindle, if this should become necesary.

Note: The rotor may only be lifting and transported with the use of rigging made of plastic or with a special hook sheathed in plastic!

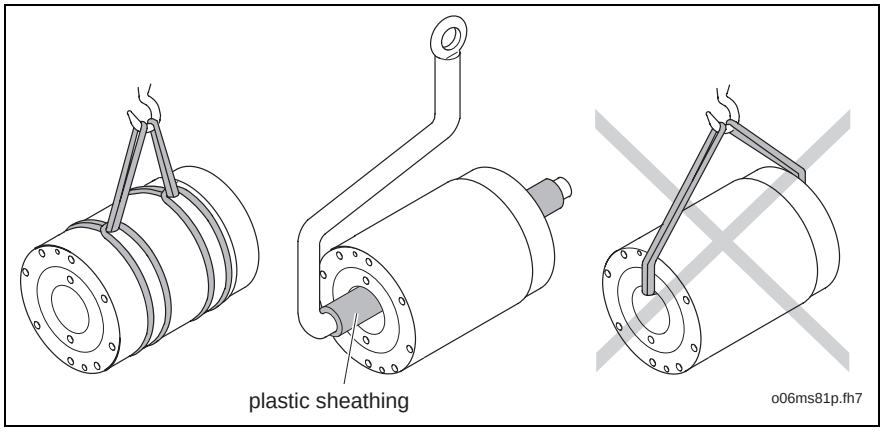


Fig. 9-1: Lifting the rotor with special rigging or hooks

9.3 Stator

Storage

The stator must be stored dust-free and shock resistant. Permissible temperature range: -25°C up to +50°C.

Note: The stator may only be stored in a vertical position!

It does not attain its final rigidity until it is mounted into the spindle housing. If stored horizontally, then the fittings on the cooling jacket could be damaged!

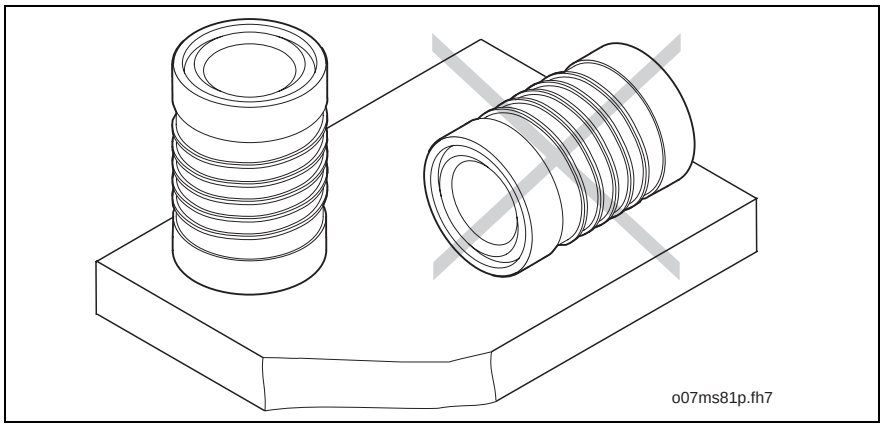


Fig. 9-2: Storage of stator

Lifting and transporting

Note: Lift and transport the stator only vertically before it is screwed together with the spindle housing! Use suitable parallel chain or rope suspension gear with suitable transport eyebolts!

This prevents a bending of the stator, damage to the fittings of the cooling jacket which would make the stator unfit for mounting. Ring screws are suitable as transport eyebolts as per DIN 580 (see Fig. 9-3)

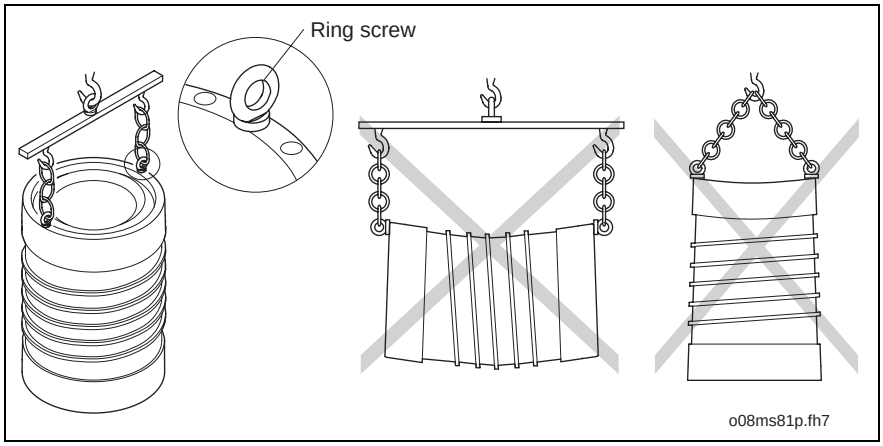


Fig. 9-3: Lifting and transporting the stator

10 Condition at Delivery

10.1 Delivery

The merchandise is delivered packed on a pallet or skeleton box. Rotor and stator are packed separately in form-fitting styrofoam sections to prevent mechanical damage that could result during transport if free movement were permitted.

There is an envelope on the carton. It contains the delivery slip.

Additional stickers on the package:

- one sticker with guidelines on handling and safe transport
- barcode sticker (number depends on contents) with information about:
  - customer
  - delivery slip number
  - consignment
  - shipping company

  (see auch section Storage, Handling, Transport, 9“)

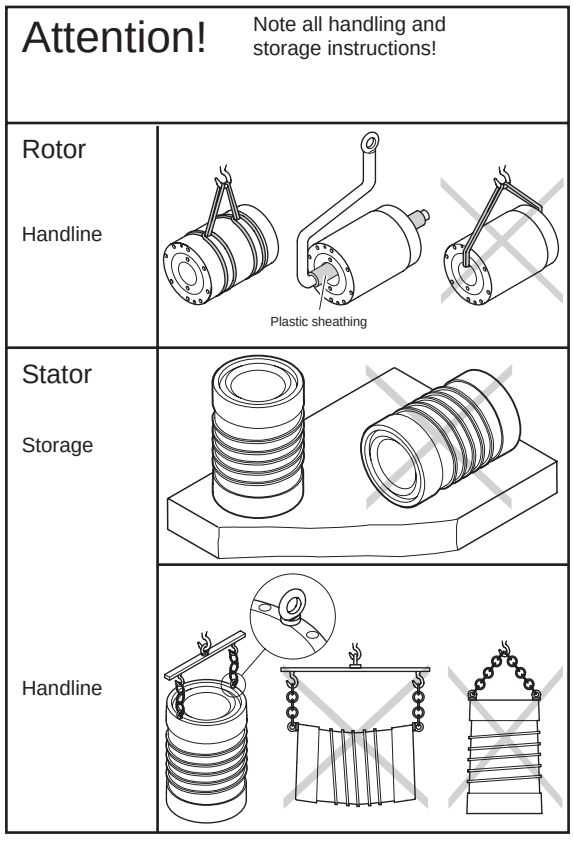


Fig. 10-1: Sticker on package: notes on handling and transport

There are no additional documents, unless specifically requested.

To remove the taut bands without injury or damage, carefully cut them open.

CAUTION

Use caution: Danger of uncontrolled movements of taut bands when released!

Mechanical injuries possible.

⇒ Release taut bands carefully!

⇒ Maintain sufficient clearance!

10.2 What is delivered

Rotor

There is an envelope attached to the rotor at the time of delivery.

The envelope must remain on the rotor until mounting! Do not remove if stored! This ensures that the accessories will not be lost.

The envelope contains:

- 1 delivery slip with accessories list
- 1 O-ring as per accessories list
- threaded pin for balancing as per accessories list
- threaded pin to close pressure oil connection as per accessories list
- type plate rotor

The delivery slip is visible on the top side of the envelope. It identifies handling guidelines and confirms the end control of the delivered rotor.

Stator

An envelope is mounted to the stator at delivery.

The envelope must remain on the stator until mounting! Do not remove if stored! This ensures that the accessories will not be lost.

The envelope contains:

- 1 delivery slip with accessories list
- 2 O rings for lubricant sealing as per accessories list
- 2 O rings for sealing the leakage nuts as per accessories list
- type plate for stator

The delivery slip is visible on the top of the envelope. It identifies handling guidelines and confirms the end control of the delivered rotor.

11 Identifying the merchandise

The merchandise is listed by name and order designation. There is only copy of it on which the entire delivery is listed. If the contents are distributed over more than one carton, then this is noted on the delivery or in the freight papers.

There is a barcode sticker on rotor and stator.

in preparation

Fig. 11-1: Barcode sticker (example)

The barcode sticker serves to identify the contents of the cartons and each is needed for order completion.

Rotor The rotor is delivered with name plate attached. When mounting the motor spindle attach it to the spindle housing

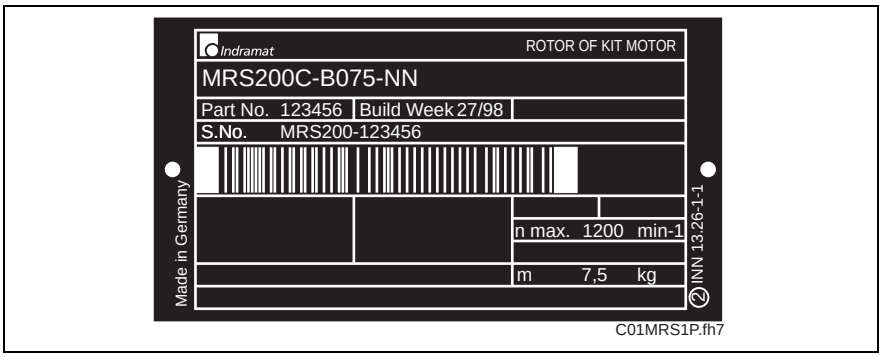


Fig. 11-2: Type plate rotor (example per DIN 42 961)

Stator The stator is delivered with name plate. When mounting the motor spindle attach it to the spindle housing.

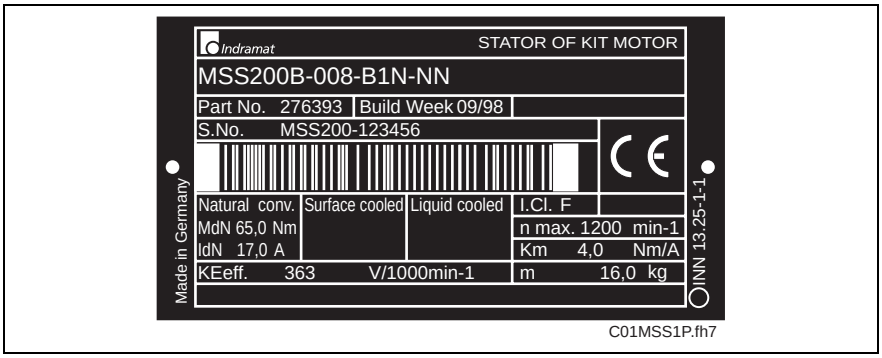


Fig. 11-3: Type plate of stator (example per DIN 42 961)

12 Index

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Austria ☐V/S ☒ Service

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Geschäftsbereich INDRAMAT
Industriepark 18
A - 4061 Pasching

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Telefax: +43 (0)7221/605-21

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Mannesmann Rexroth N.V.-S.A.
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DK-8900 Randers

Telefon: +45 (0)87/11 90 60
Telefax: +45 (0)87/11 90 61

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Finland ☒V/S ☐ Service

Rexroth Mecman OY
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Kruisbroeksestraat 1
P.O. Box 32
NL - 5281 RV Boxtel

Telefon: +31 (0)411/65 19 51
Telefax: +31 (0)411/65 14 83
e-mail: indramat@hydraudyne.nl

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Hydrocare B.V.
Kruisbroeksestraat 1
P.O. Box 32
NL - 5281 RV Boxtel

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Mannesmann Rexroth SA
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