1MB Frameless Spindle Motor

Project Planning Manual

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The purpose of this documentation This documentation:
- serves to introduce frameless spindle motors,
- describes the structural integration of the frameless spindle motor into the motor spindle,
- describes how the frameless spindle motor influences spindle construction, and,
- offers instructions and guidelines on storage, handling, mounting and installation of rotor and stator.

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1. The 1MB frameless spindle motor

Applications

1MB frameless spindle motors are used as direct drives in motor spindles. The motor spindle acquires a high degree of rigidity by placing the motor between the main spindle bearings. This means that in lathes, for example, only one drive is needed for main spindle and C-axis operation.

Motor spindles are used for lathing, milling and grinding operations in machine tools, transfer facilities, finishing centers and other special machinery.

Figure 1.1 shows the parts of an AC main spindle drive with frameless spindle motor.

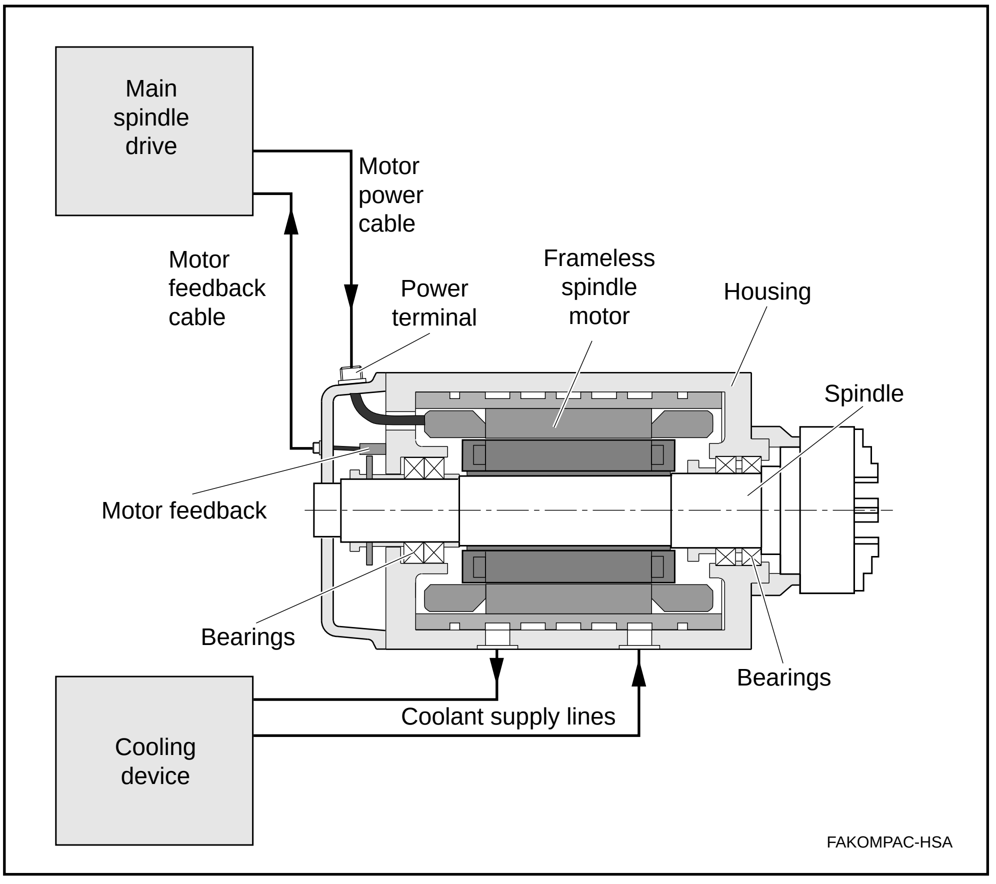


Figure 1.1: Parts of the AC main spindle drive with frameless spindle motor

Motor spindle

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

Determining which type of bearing and which type of lubrication are to be used, and the extent of bearing stress all depend upon how the motor spindle is used, and is the responsibility of the manufacturer of the spindle.

How the frameless spindle motor influences the contruction of the motor spindle is described in this document.

Motor feedback

The motor feedback measures rotor position and signals it to the drive for the purpose of controlling RPM and spindle position. It is integrated into the motor spindle as an independent sub-assembly.

Drive

Together with an INDRAMAT main spindle drive, the motor spindle offers mechanical power and torque as outlined in the characteristics curves of the motor-drive combination. See documentation "AC main spindle drives with controlled 1MB frameless spindle motors, selection guides", doc. no. 209-0042-4118.

Figure 1.2 depicts typical characteristics curves.

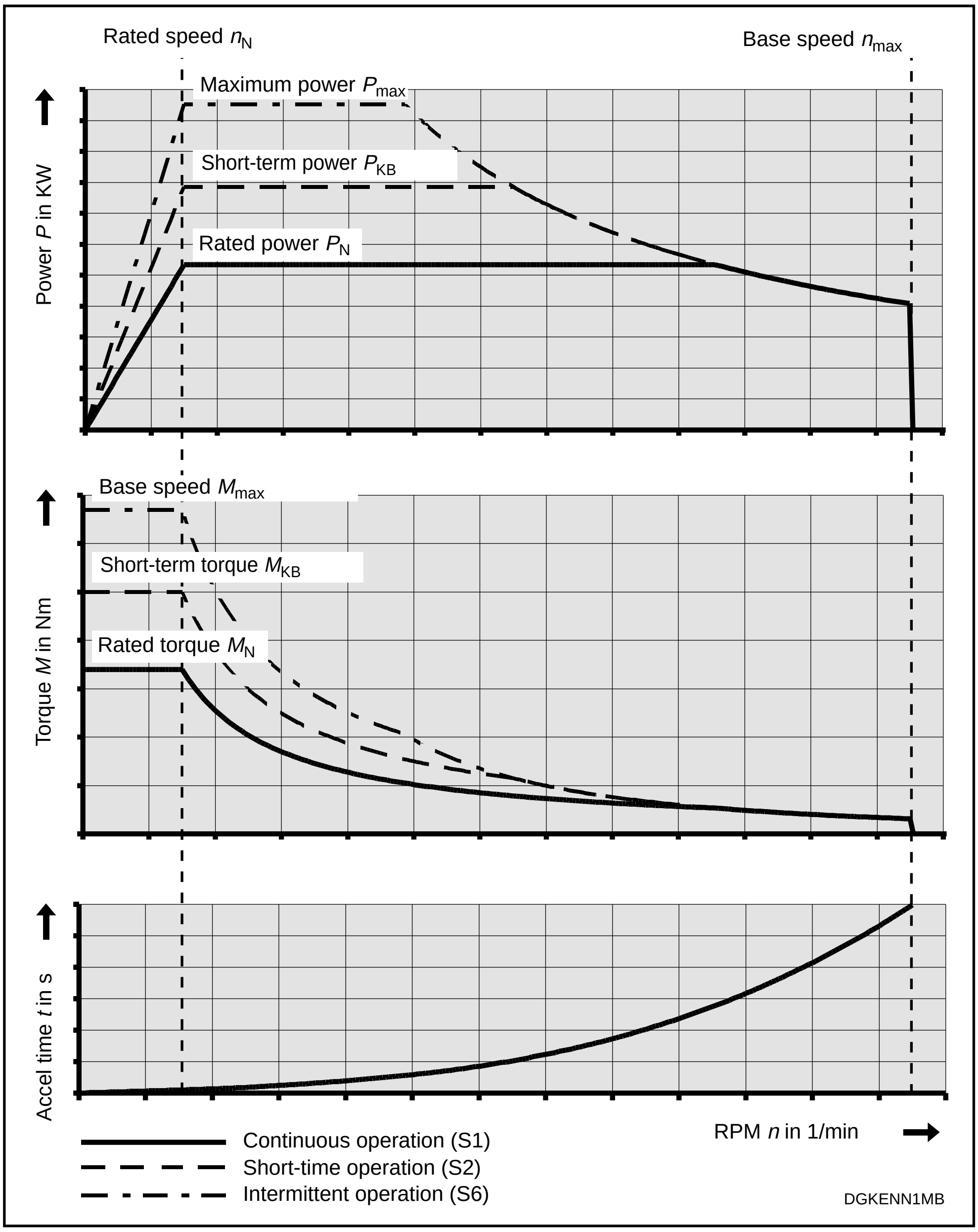


Figure 1.2: Typical characteristics curves of a 1MB frameless spindle motor

Cooling

The frameless spindle motor has a high power density because of the liquid-cooled stator. The coolant absorbs the dissipated heat of the stator and most of the heat dissipated by the rotor. The dissipated heat is then transferred in the cooler to a primary heat-exchanging unit.

Power ratings and size

The power ratings of the frameless spindle motor are dependent upon its size. This is depicted in Figure 1.3. The figure demonstrates that high power ratings can be achieved with a small size.

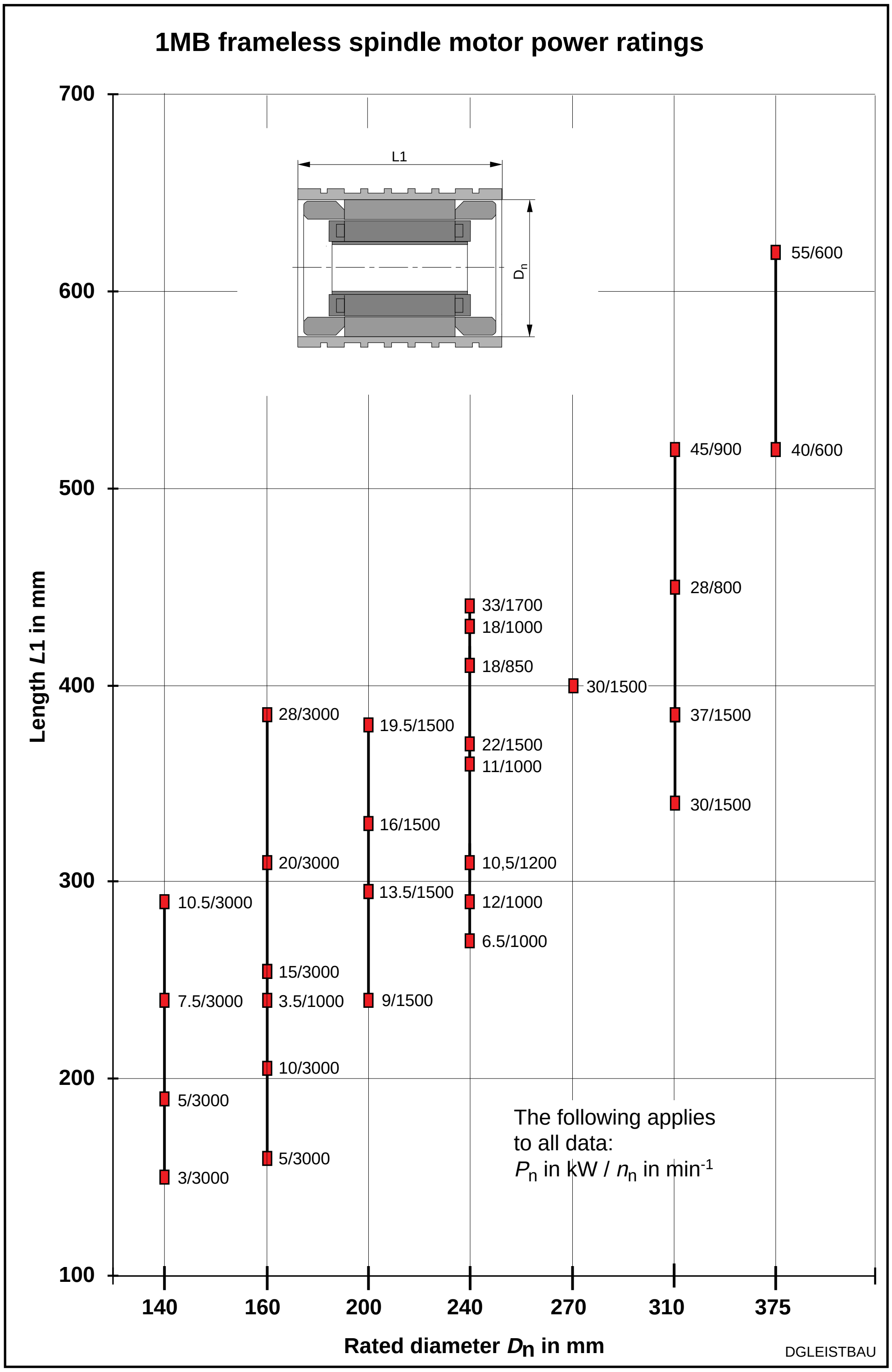


Figure 1.3: Power ratings and size

Design

The frameless spindle motors are liquid-cooled threephase asynchronous motors with cage rotors. They consist of a stator with cooling jacket and a rotor with step interference fit. The motor size is named after the outside diameter, D_n, of the laminated core.

There is a spiral groove on the cooling jacket. The coolant is conducted over it between spindle housing and cooling jacket.

The step interference fit on the rotor is a friction-locked interference fit. It makes it possible to easily mount or dismount the rotor. Step interference fits cause no tension which could interfere with the running smoothness of the spindle. They also increase the rigidity of the spindle.

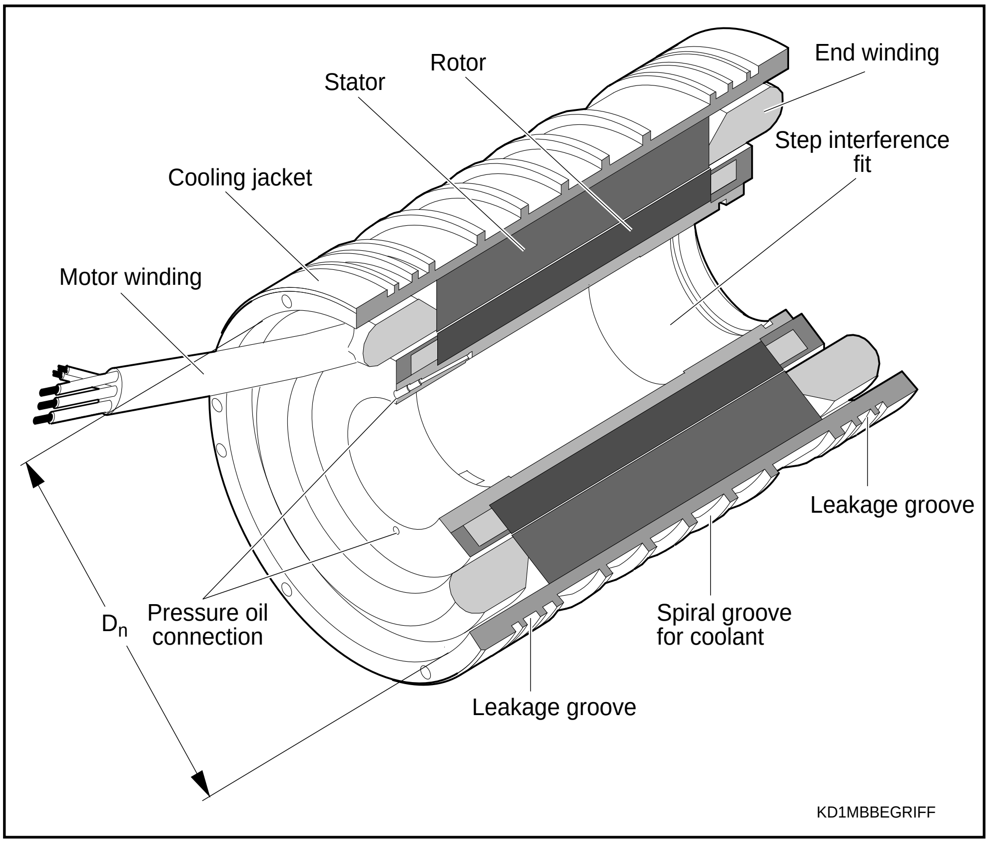


Figure 1.4: Allocation of terms on a frameless spindle motor

2. Technical information

2.1 Mounting the rotor - basic principle

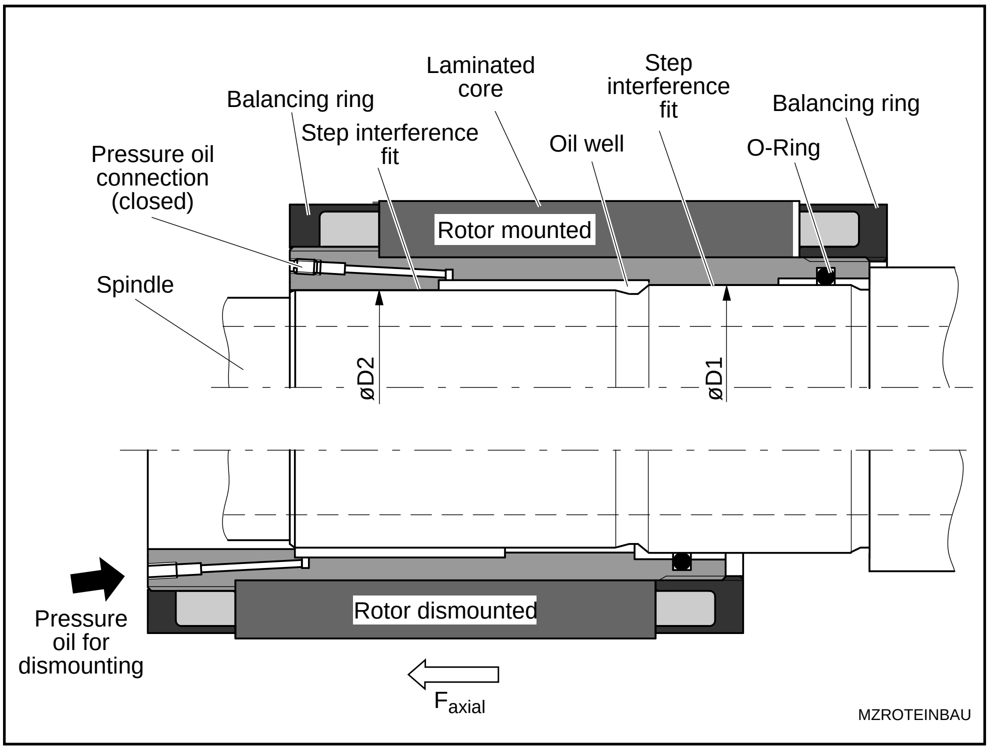


Figure 2.1: Mounting the rotor, and operating principle of the step interference fit

Rotor

The rotor consists of a sleeve and a laminated core with balancing rings located on the front. The spindle has two fitting surfaces arranged next to each other. These have slightly graduated diameters (ø D1 > ø D2). Rotor und spindle are frictionally engaged by the step interference fit. The graduated fitting surfaces align the mounted rotor to the spindle. They are needed so that the rotor can be dismounted without damage.

The spindle construction with respect to the step interference fit must correspond to the guidelines outlined in "Technical Data - constructing the motor spindle".

The rotor is mounted by shrinkfitting it onto the spindle. The oil under pressure process is used when dismounting.

Mounting/Dismounting

The rotor is heated up to approximately 200 °C prior to mounting. The material expansion means that fittings expand to fit diameters D1and D2. Rotor and spindle can be joined without force of pressure. The rotor can be dressed to its final dimensions once it has cooled down.

Oil under pressure is injected into the step interference fit for dismounting. This creates an axial force with which the rotor can slide off the spindle as soon as there is a separating oil film between the fitting surfaces to separate them. The step interference fit starts to loosen at diameter D1 first. The O-ring keeps the oil from running out.

The steps for mounting and dismounting are outined in detail in Section 14 of this documentation (Mounting Guidelines).

Balancing

After mounting, the rotor is balanced to the necessary vibration severity grade (DIN VDE 0530, section 14). Threaded pins are radially screwed into the circumference of the balancing ring to achieve equilibrium of the rotor. The threaded pins are additionally bonded into place. No material may be removed from the balancing ring.

2.2. Mounting the stator - basic principle

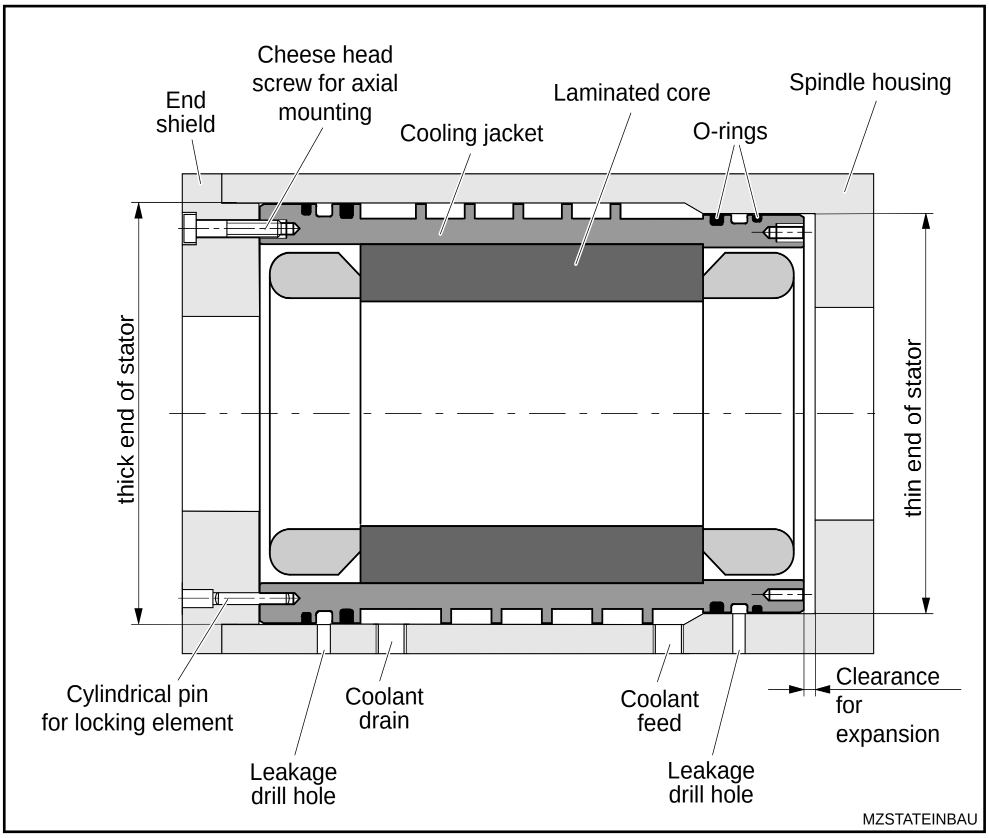


Figure 2.2: Mounting the stator

Stator

The stator is made up of a laminated core with end windings located on the front, and the cooling jacket. The outside diameter of the cooling jacket is stepped. As a result, the ends of the stator are called thick and thin stator ends.

Construct the mounting drill hole in the spindle housing as per the data in the section entitled "Technical Data - Constructing the Motor Spindle".

Securing the stator

The stator is axially mounted in the motor spindle at either the thick or thin end of the stator. It must be secured against movement. Windings for axial mounting and drill holes for cylindrical pins (not with 1MB 140) are fixed to the front as protection against torsion.

There must be a clearance between stator and spindle housing of at least 1mm on the end opposite the stator end. The stator can thus expand in length. This expansion of length is caused by the stator heating up while the motor spindle is operating.

The stator is light in weight and small in size. It, therefore, does not achieve its final flexural strength until it has been built into the spindle housing.

Cooling

The spiralled slot worked into the cooling jacket creates a cooling channel together with the spindle housing. This channel is sealed at both ends with an O-ring. There is a wraparound leakage groove between the O-rings. A hole must be drilled at the lowest point of the spindle housing for any leaking coolant to be able to run off.

The cooling jacket is made of aluminum and is protected against corrosion by a hard coat surface. The spindle housing must also protected against corrosion. A suitable coolant or coolant additive can be used for this purpose.

For additional information on dimensions and selecting the proper cooling mode, see "Liquid cooling of INDRAMAT drives; dimensioning, selection", doc. no. 209-0042-4123.

Electrical connections

The power terminal is brought out through one of the end windings of the stators. There is also at least one NTC thermistor in this end winding. It measures the winding temperature through the drive.

The power terminal and the NTC thermistor are conducted together as a motor winding through a tube. Depending upon how it is ordered, the motor winding can be located at either the thick or thin end of the stator.

When bringing the cable through the spindle housing, note the following:

- the bending radius of the motor winding must not be less than outlined (see section "Technical data"), and,
- the edges of the drill hole in the spindle housing must be rounded off.

2.3. Motor feedback

The drive must be able to detect spindle position in order to control spindle speed or when positioning the spindle. The motor feedback is used for this purpose.

The high-resolution main spindle position encoder from INDRAMAT functions as a motor feedback for frameless spindle motors. It is made up of a measuring wheel and a non-contact sensor. The measuring wheel is mounted on the spindle, the sensor on the spindle housing.

There are three measuring wheel sizes available for the different frameless spindle motor sizes.

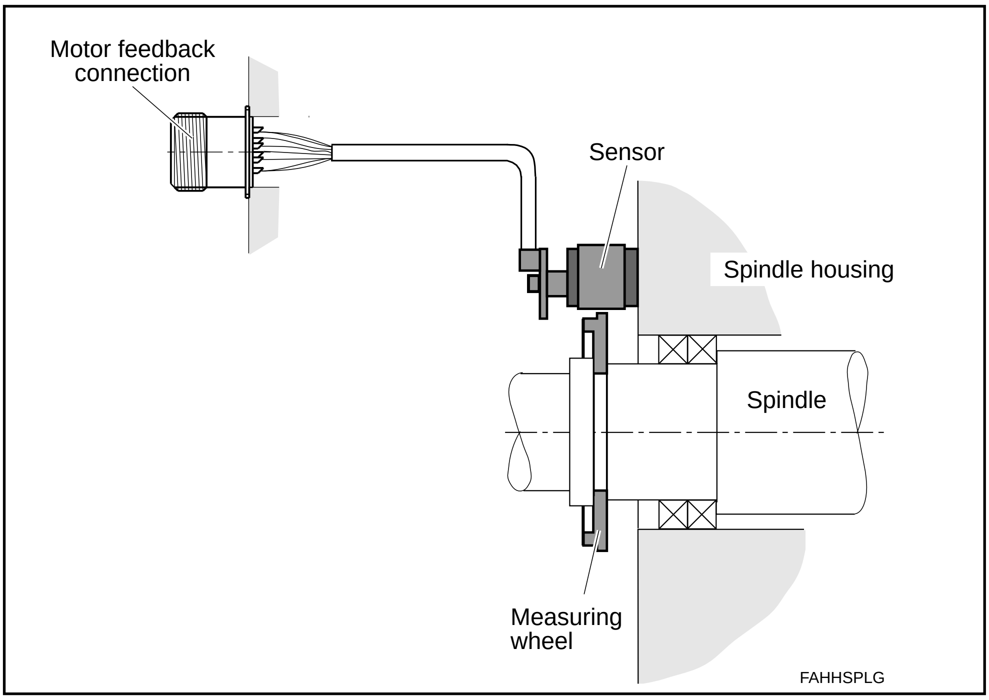


Figure 2.3: High-resolution main spindle position encoder

The area of the main spindle position encoder on the motor spindle must have a protection category of IP 54 as per DIN VDE 0530, section 5 .

For further information on features and integration of the position encoder into the motor spindle, see document: "High-resolution main spindle position encoder; Project planning manual", doc. no.: 209-0042-4119.

2.4. Precision

The precision of a motor spindle depends on its mechanical design and the control technology.

Mechanical design

The degree of motor spindle precision which can be achieved is affected by the rigidity of the housing, bearings and spindle as well as by its operating precision. The operating precision in both axial and radial directions is dependent on the lay-out of the bearings and the accuracy of this lay-out. These demands are met by an appropriate spindle construction.

Control technique

The operating precision of the spindle depends upon the control quality of the drive systems motor, motor feedback and drive. The rotational position accuracy of the spindle is determined by how accurately the drive can read the spindle position and the absolute position accuracy of the motor feedback.

- The drive reads the spindle position signal received from the high-resolution main spindle position encoder with an accuracy of up to 1/4000000 th of a revolution.
- The size of the measuring wheel and the accuracy with which it is mounted determine the precision with which the absolute position can be measured.

For further information see "High-resolution main spindle position encoder; Project planning manual", doc. no.: 209-0042-4119.

The position accuracy of the spindle, so important to C-axis operation, depends upon the resolution of spindle position and the type and resolution of the velocity command value. The velocity command value from the NC control unit can be transmitted to the drive in three different ways:

- analog, +/- 10V maximum
- digital, 16 bit parallel
- SERCOS-interface

One performance feature of these three modes of velocity command value entry is a very broad RPM range -- from minimum RPM, 0.0005 rpm, to maximum RPM.

Analog, +/- 10V maximum
This interface is equipped with two differential inputs. The resolution can be set with parameters.

Digital, 16 bit parallel
Guarantees high command value accuracy with small command values and long transmission paths.

SERCOS-interface
The fiber optics cable interface, SERCOS interface, offers the most powerful mode of command value entry. It transmits, in addition to the command value (position, RPM or torque command values), the actual values and drive diagnostics.

For further information, see "AC main spindle drives with a controlled asynchronous motor or a frameless spindle motor; applications", doc. no.: 209-0041-4109.

2.5. Heat dissipation of the frameless spindle motor

The heat dissipated by the frameless spindle motor in the motor spindle is primarily eliminated by a liquid coolant. The end shields and the rotating spindle also help dissipate heat.

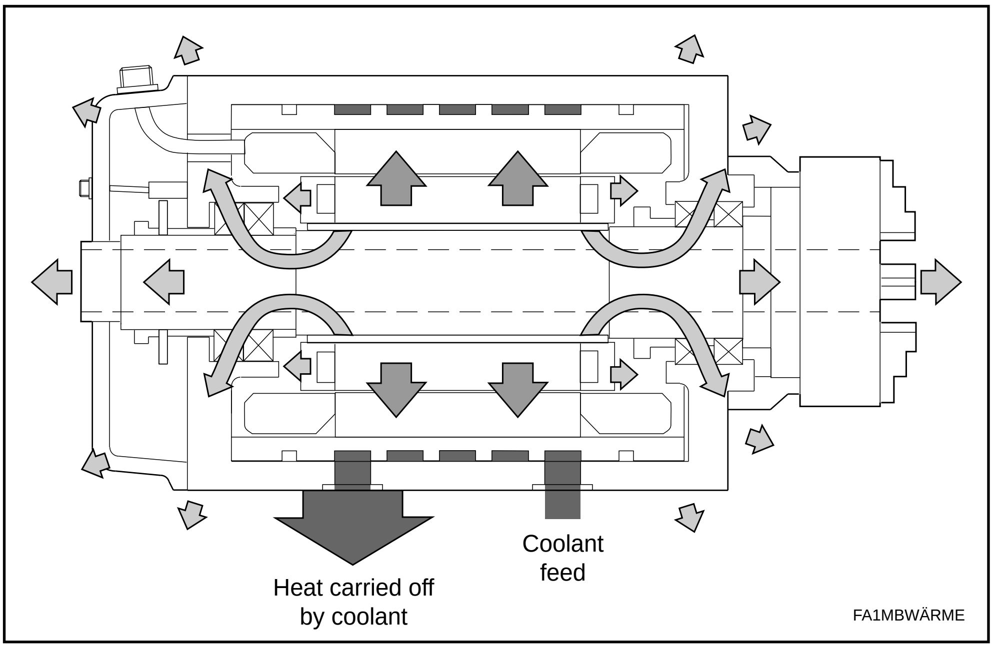


Figure 2.4: Heat flow in the motor spindle caused by the frameless spindle motor

2.5.1 Heat dissipation of the stator

Cooling

The frameless spindle motor has been designed in such a way that most of the heat is produced by the stator. The coolant flowing around the cooling jacket of the stator very effectively absorbs this heat. In addition, the coolant also maintains uniform temperature in the spindle housing.

The dimensions for a liquid cooling system can be found in the technical data of the relevant frameless spindle motor. The document "Liquid cooling in INDRAMAT drives; dimensioning, selection guides", doc. no.: 209-0042-4123, offers detailed information on dimensioning and the selection of an appropriate cooling system.

2.5.2 Heat dissipation of the rotor

Approximately one third of the heat dissipated by the frameless spindle motor is produced in the rotor. Most of this heat is transferred to the stator via an air gap. A small portion of the heat is dissipated over the spindle, bearings and the end shield. The extent of this heat flow is dependent upon the type and the volume of the materials over which the heat flows.

The increase in bearing temperature caused by the heat transfer depends upon

- the rate of utilization of the motor (heat entry), and,
- the mechanical construction (heat transfer).

Temperature distribution depends on the conditions and can be determined. A heat transfer calculation, the FEM method (finite element calculation), is used.

Calculating heat transfer - example

The amount of heat transferred by a motor spindle with a 1MB 310D frameless spindle motor was calculated below. The curve of the temperature with nominal power output for a spindle with drill hole was calculated.

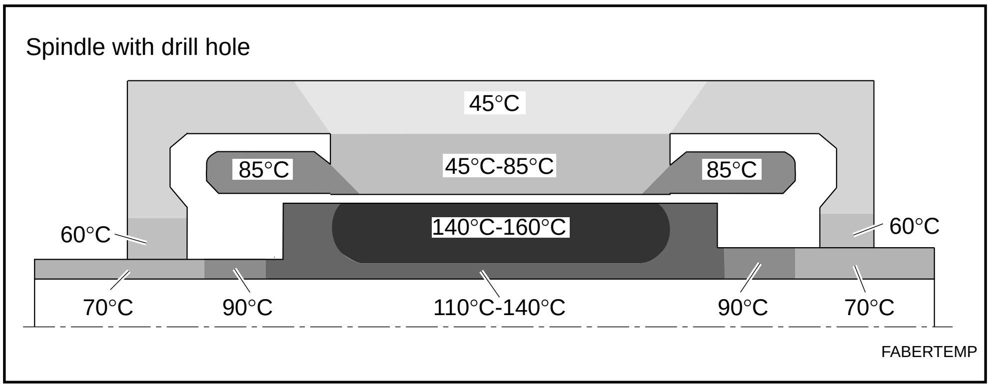


Figure 2.5: An example of a calculated temperature curve

The temperature curve is individual for every spindle and motor type. The temperature curve depicted in Figure 2.5 should not be generally applied. It only serves as an example for similar designs!

By taking specific structural measures, it is further possible to keep heat away from the bearings. Figure 2.6 depicts an example of such a structural change. Liquid-cooled cuffs are used. These bring about additional cooling by being close to rotor and spindle. Depending upon the fluid circulation system of the motor spindle, be sure there is no drop in pressure or flow of coolant!

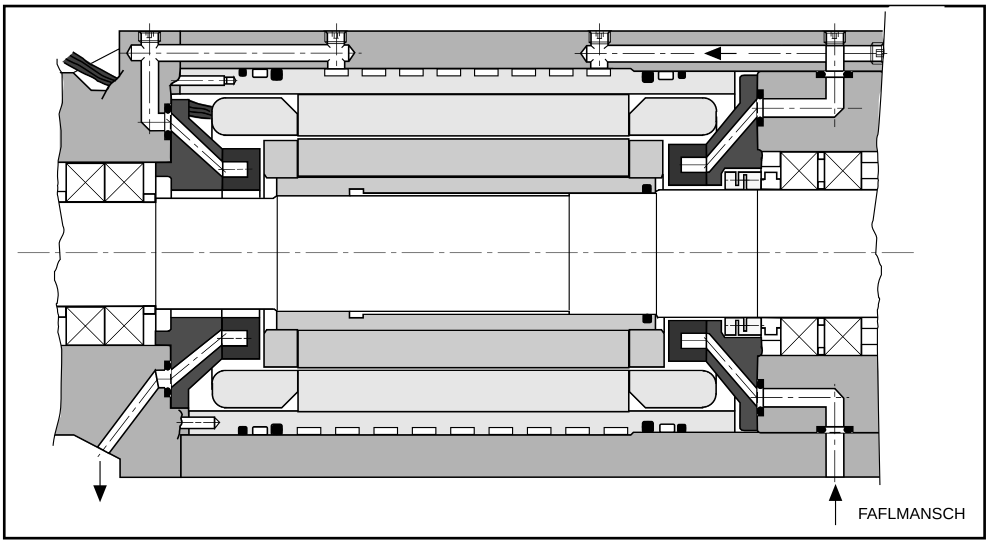


Figure 2.6: Liquid-cooled cuffs mounted close to the rotor

Temperature gradient in the spindle bearing

The fittings and tolerances make it possible to radially pre-stress the bearings for the shaft seat and drill hole of the housing.

A temperature gradient between the inside and outside ring of the spindle bearing increases this pre-stressing because of the varying degrees of thermal expansion. This increases frictional losses which additionally heats up the bearings. An overheating of the spindle bearings can cause damage.

When designing the motor spindle it is, therefore, also necessary to note a small temperature difference in the spindle bearing.

Alternatively, structural changes can additionally transfer heat to the outside ring of the bearing.

Cooling rings, as depicted in Figure 2.7, transfer some of the heat produced by the rotor directly to the end shield. This heats up the outside ring of the bearings and the temperature gradient drops.

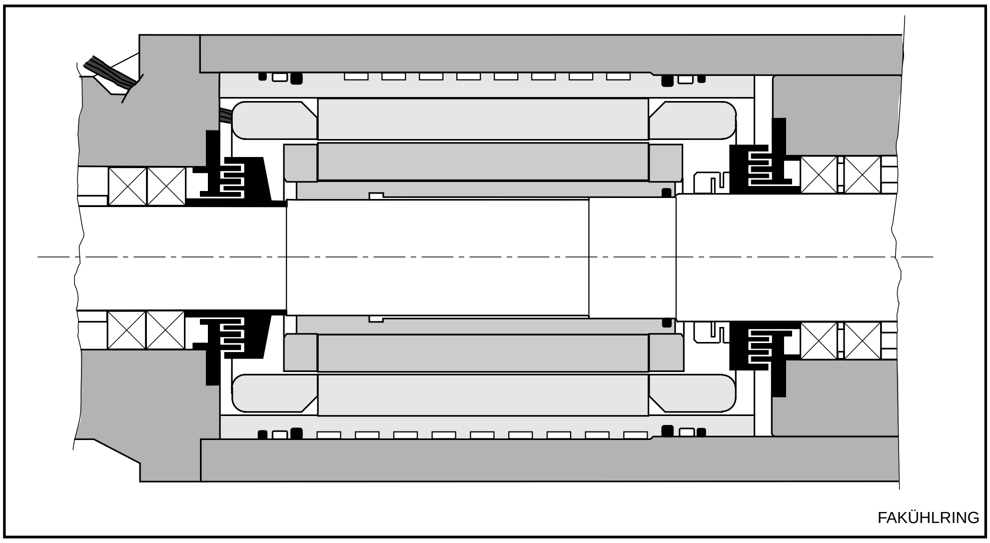


Figure 2.7: Cooling rings mounted close to the rotor

2.6. Electrical connections

The terminal diagram depicted in Figure 2.8 is schematic. It is the checklist for all the electrical connections needed to operate the motor spindle with a 1MB motor.

The electrical connections of INDRAMAT main spindle drives have been standardized to restrict the variety.

The following electrical connections are on the motor spindle with frameless spindle motor:

- power terminals with NTC thermistor connections of the motor
- ground terminals
- motor feedback connections

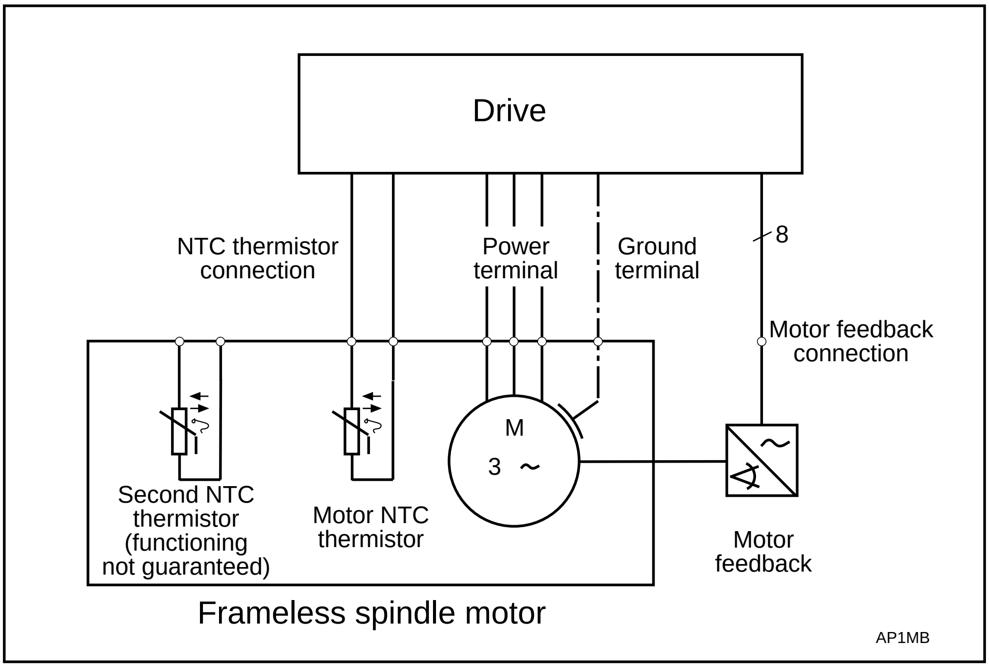


Figure 2.8: A schematic terminal diagram of frameless spindle motors

2.6.1 Ground terminals

The 1MB motor is grounded on the drive via the motor power cable. The ground terminal on the stator of the motor spindle must be laid out as shown in the dimensional sheet. See section "Technical data" of the relevant frameless spindle motor.

The diameter of the ground terminal line corresponds to the minimum conductor diameter of the relevant 1MB motor as listed in the "Technical data".

2.6.2 Power terminal

The power terminals of the frameless spindle motor can be:

- terminal connections (junction box), or,
- plug-in connections (flange socket).

The motor winding of the stator is 1.5 meters long. This winding is enclosed in a protective tubing and is made up of three power conductors -- six power conductors in a motor with selectable windings -- and two wire pairs for the NTC thermistor in the end winding.

Power conductor in the motor winding

The diameters of the power conductors of the motor winding depend on the rated current of the motor. Diameters of 10, 16, 25 or 35 mm^2 are available.The diameter of the wire pair for the motor NTC thermistor connection is 1.5mm^2.

The motor winding is connected inside the motor. The insulation of the motor winding is, therefore, designed for temperatures higher than those found in the motor power cable (connection between motor spindle and drive). The minimum core diameter of the motor power cable listed in the section "Technical data" is generally different from the diameter of the power conductor of the motor winding.

Bending radius of the motor winding

The bending radii of the motor winding are listed in the dimensional data of the relevant frameless spindle motor (see "Technical data").

Terminal connections

A junction box with terminal connections is used to connect the motor winding of the stator to the motor power cable. The junction box is mounted to the spindle housing. It must be equipped with a three or six pin terminal board for the power terminal, and a terminal strip with four clamping points for the NTC thermistor (see Figure 2.9). The standards as depicted in Figure 2.10 must be maintained for the terminal connections to be properly implemented!

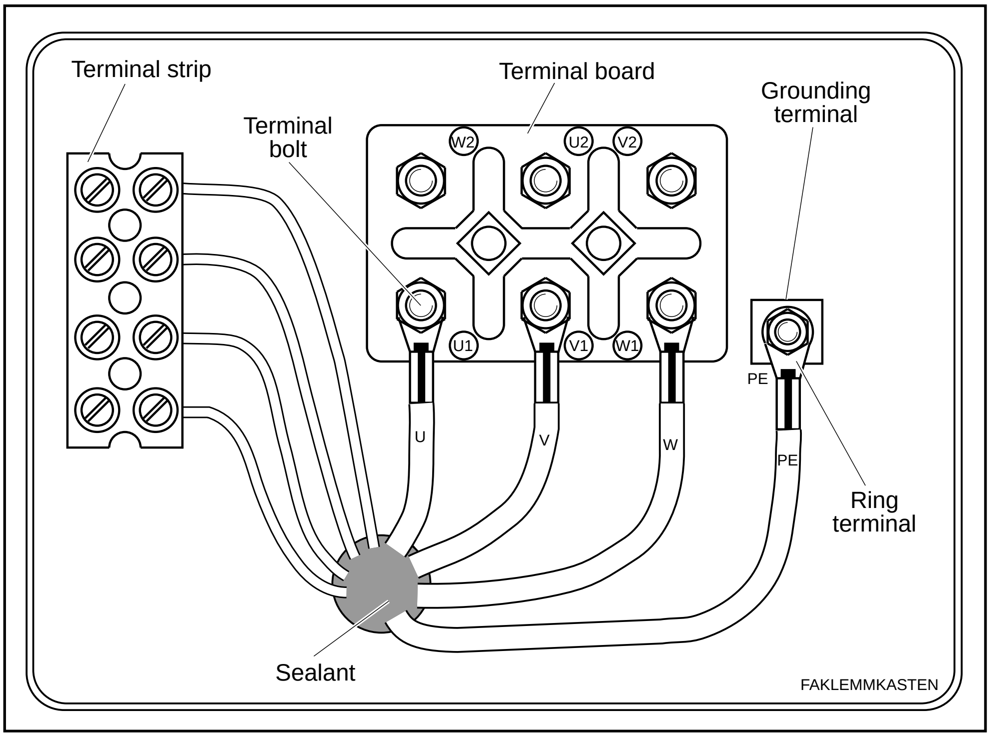


Figure 2.9: Example of a junction box (open, looking into it)

	Standard	Reference to terminal connection
terminal board	DIN 46 294	maximum rated voltage of AC 660 V
terminal strip	DIN VDE 0110	maximum rated voltage of AC 380 V
assembly bolt	DIN 46 200	determining bolt diameter
ring terminal	DIN 46 237	power conductor of the motor winding
ferrules	DIN 46 228, section 3	NTC thermistor cond. of the motor winding
protection category	DIN VDE 0530, sect. 5	minimum protection category of IP 54
designation of connection	EN 60 445 DIN VDE 0530, sect. 8	see Figure 2.9

Figure 2.10: Terminal connection standards

The lowest protection category of the junction box may be IP 54, laid out as per DIN VDE 0530, section 5. There must also be seals between the spindle housing and junction box, as well as at the lid of the junction box (Figure 2.11). The cable duct from spindle housing to junction box must be sealed with sealant (Figure 2.9). Do not use screws!

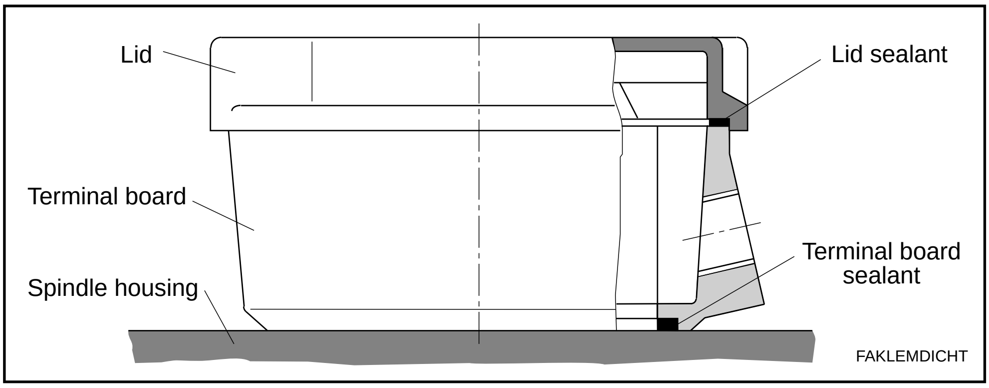


Figure 2.11: Seals at the junction box

The assembly bolts of the terminal boards are laid out for the rated current of a 1MB motor as per DIN 46 200 (see Figure 2.12). Rated current data are found in section "Technical data" of the relevant frameless spindle motor.

Rated current up to /A	**Bolt** 1) windings *d*	material	**Hexagon screw** 1) 2)	**Disc for connecting ring** 1) 2)
10	M 3.5	CuZn37 F45	DIN 439 - AM 3.5 - brass	DIN 125 - 3.7 - brass
16	M 4		DIN 439 - AM 4 - brass	DIN 125 - 4.3 - brass
25	M 5		DIN 439 - AM 5 - brass	DIN 125 - 5.3 - brass
63	M 6		DIN 439 - BM 6 - brass	DIN 125 - 6.4 - brass
100	M 8		DIN 439 - BM 8 - brass	DIN 125 - 8.4 - brass
160	M 10		DIN 934 - M 10 - brass	-
250	M 12		DIN 934 - M 12 - brass	-

1) Materials at least electrically and mechanically comparable are also permissible.

2) Other seats and discs used for mounting may be made of steel. Caution: heat is created by eddy currents.

Figure 2.12: Current load of the assembly bolts as per DIN 46 200

INDRAMAT does not supply the individual parts of the terminal connections. Figure 2.13 lists possible suppliers for junction boxes, terminal boards and terminal strips.

Part	Supplier
Junction boxes	KIENLE & SPIESS GmbH 74343 Sachsenheim
Terminal boards	REKOFA WENZEL GmbH & CoKG 53474 Bad Neuenahr-Ahrweiler
Terminal strips	WIELAND, ELEKTROINDUSTRIE GmbH 96045 Bamberg

Figure 2.13: Recommended suppliers

Plug-in connections

The motor winding of the stator is connected to the motor power cable via a flange socket if plug-in connectors are used.

The conductors of the power terminal and the wire pair of the motor NTC thermistor are soldered to the back side of the flange socket. The flange socket is screwed onto the spindle housing from outside.

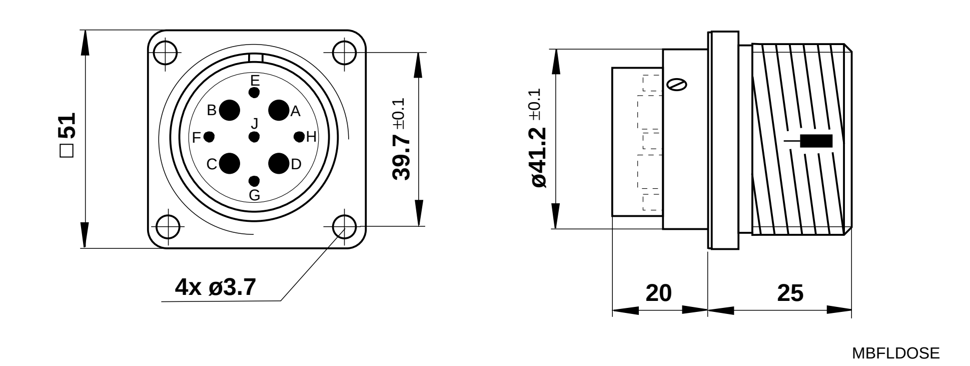


Figure 2.14: Flange socket IN192/25L from INDRAMAT

The flange socket depicted in Figure 2.14, with type designation IN192/25L, can be purchased from INDRAMAT. It is suitable for a conductor diameter of up to 25 mm^2. Use terminal connections for greater conductor diameters.

Motor winding leadthroughs should be constructed in such a way that the motor spindle can be taken apart without unsoldering the motor winding from the flange socket!

2.7. Standards and guidelines

The following standards are referenced in this document. These standards should be followed and applied.

Standard	No.	Sect.	Edition	Title
DIN	34		10/77	Copyright to protect documentation.
DIN	509		08/66	Undercuts.
DIN	580		03/72	Ring bolts.
DIN	912		12/83	Socket head cap screw, modified, ISO 4762.
DIN	913		12/80	Hex-socket set screw, modified, ISO 4026.
DIN	2999	1	07/83	British Standard brass head for threaded pipe and fittings, cylindrical internal screw thread and coniform outside thread, thread sizes.
DIN	6325		10/71	Straight pin (replaced by DIN EN 28 734).
DIN	42 961		06/80	Rating plate for electrical machinery, version.
DIN	46 200		07/77	Current-conducting assembly bolts upto 1600 A. Design and allocation of current sizes.
DIN	46 294		04/85	Rectangular terminal board with six assembly bolts.
DIN EN	28 734		10/92	Straight pins.
DIN EN	60 445		09/91	Designating the connections of electrical equipment and certain conductors, general rules for an alphanumeric labelling system.
DIN VDE	0110	2	01/89	Coordinating insulation for electrical equipment in low-voltage plants, measuring air and leakage paths.
DIN VDE	0530	1	07/91	Rotating electrical machinery; measuring data and operating modes.
DIN VDE	0530	5	04/88	Rotating electrical machinery; criteria for the protection categories with housing as the guideline for rotating machinery.
DIN VDE	0530	8	07/87	Rotating electrical machinery; designation of connections and rotational direction.

Figure 2.15: The standards referenced.

The following standards and regulations must also be taken into consideration during mounting, construction and documentation of a motor spindle (list is incomplete):

Standard	No.	Sect.	Edition	Title
DIN	46 228	3	08/92	Ferrules, tubing form without plastic sleeve.
DIN	46 237		07/70	Ring terminals for solderless connections, insulated, for copper conductor.
DIN VDE	0100	410	11/83	Construction of high-voltage facilities with rated voltages of up to 1000 V, protective measures; protection against dangerous shock currents.
DIN VDE	0530	14	02/93	Rotating electrical machinery; mechanical vibrations of some machines with an axis height of 56 mm and higher; measurements, evaluations and limit values of the severity grades.

Regulation	Title
89/336/EWG	Electromagnetic compatibility - EU guidelines with their national interpretation through the EMC law dated 9 November 1992
	Accident prevention guidelines:
VBG 1	General rules and regulations.
VBG 4	Electrical plants and operating equipment.
VBG 5	Power-driven machinery.

Figure 2.16: Additional standards and regulations

3. 1MB 140 - technical data

3.1. Frameless spindle motor

Rated data

Designation	Symbol	Unit	1MB 140			
Motor length			B	D	F	H
Type of winding			4B		4A	4B
Rated power [1]	P_n	kW	3.7	(5.0)	7.5	10.5
Rated torque [1]	M_n	Nm	7	(16)	24	34
Rated RPM [1]	n_n	min^{-1}	5000	3000		
Rated voltage [2]	U_{neff}	V	220		380	
Rated current	I_n	A	25	(34)	43	58
Minimum diameter for INDRAMAT cables	A	mm^2	4	(6)	10	16
Inductance [3]	L	mH	2.85		1.83	1.58
Maximum RPM	n_{max}	min^{-1}	28,000			
Rotor moment of inertia	J_m	kgm^2	0.0044	0.0061	0.0082	0.0103
Weight: Rotor	m	kg	3.3	4.5	6.1	7.3
Weight: Stator	m	kg	5.3	8.2	11.8	15.5
Insulation category DIN VDE 0530, section 1			F			
Technical data for liquid cooling mode:						
Rated power loss	P_{Vn}	kW	1.0	(1.6)	2.4	3.2
Coolant temeprature at entry	ϑ_{ein}	°C	10° to 40°			
Coolant temperature increase with P_{Vn} [4]	$\Delta\vartheta_n$	K	10			
Ambient temperature		°C	5° to 45°			
Minimum required coolant flow with $\Delta\vartheta_n$ [4]	Q_n	l/min	1.4	(2.3)	3.4	4.6
Pressure drop with Q_n [4]	Δp_n	bar	0.1			
Maximum system pressure	p_{max}	bar	3			
Volume in coolant channel	V	l	0.2	0.3	0.4	0,6

Cooling jacket material: Aluminum, hard coat surface
O-ring: Viton

1) Data relates to S1 operation of the motor on KDA/TDA drive (U_{neff} = 220V) or RAC (U_{neff} = 380V). The S1 data of other motor-drive combinations can be derived from the relevant characteristics curves.

2) The motors are not suited for direct mains connection.

3) Inductance of the mounted motor spindle at 20°C, measured between the power conductors with $f_{\sim}$ = 1 kHz.

4) Data relates to water-based coolant. Should other coolants be used (e.g., oil), recalculate data or see flow diagram.

Preliminary data indicated with ( ).

Figure 3.1: 1MB 140 frameless spindle motor - rated data

3.2. Dimensional data

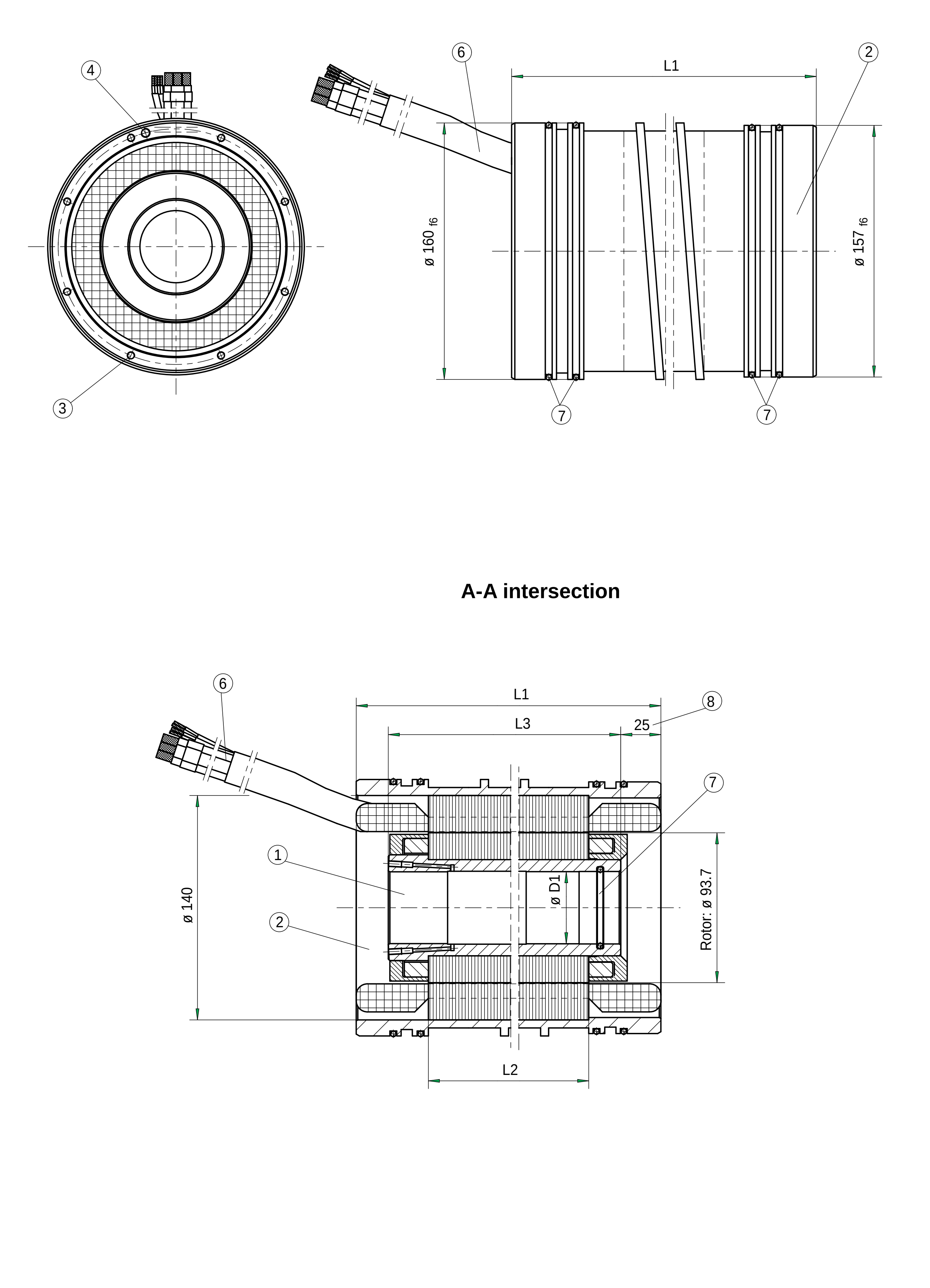
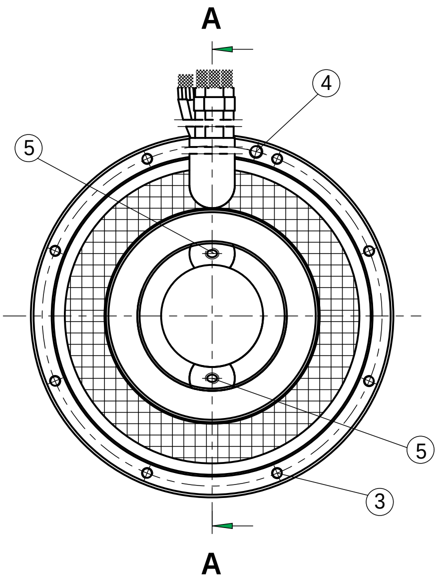


Figure 3.2: 1MB 140 frameless spindle motor - dimensional data (part 1)



1 Rotor 1MR 140...

2 Stator 1MS 140...

3 8x M5 thread for axial mounting to spindle housing

4 M6 thread for mounting to ground terminal line

5 pressure oil connection to release step interference fit

6 motor winding with 1500 mm length

7 O-ring made of Viton

8 Positional dimension of rotor to stator

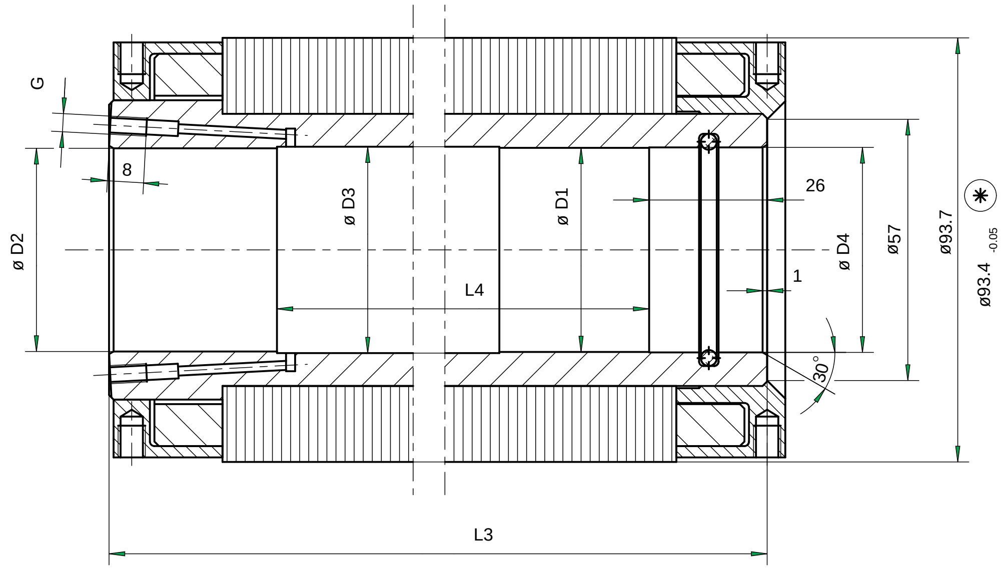
Type \ Dim.	ø D 1 H6	L 1	L 2	L 3
1 MB 140 B	45	150	60	105
1 MB 140 D		190	100	145
1 MB 140 F		240	150	195
1 MB 140 H		290	200	245

Quellverweis: 106-0243-3020-00

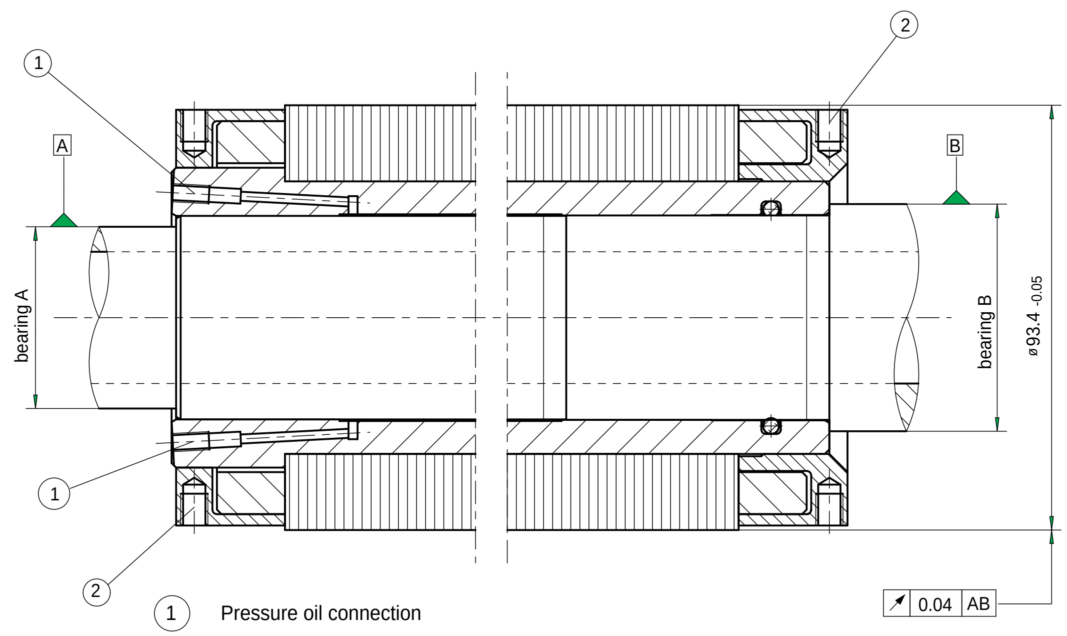
Figure 3.2: 1MB 140 frameless spindle motor - dimensional data (part 2)

3.3. Motor spindle construction

Rotor 1 MR 140... (condition at delivery) ✳



Rotor mounted to spindle (completely dressed) ✳



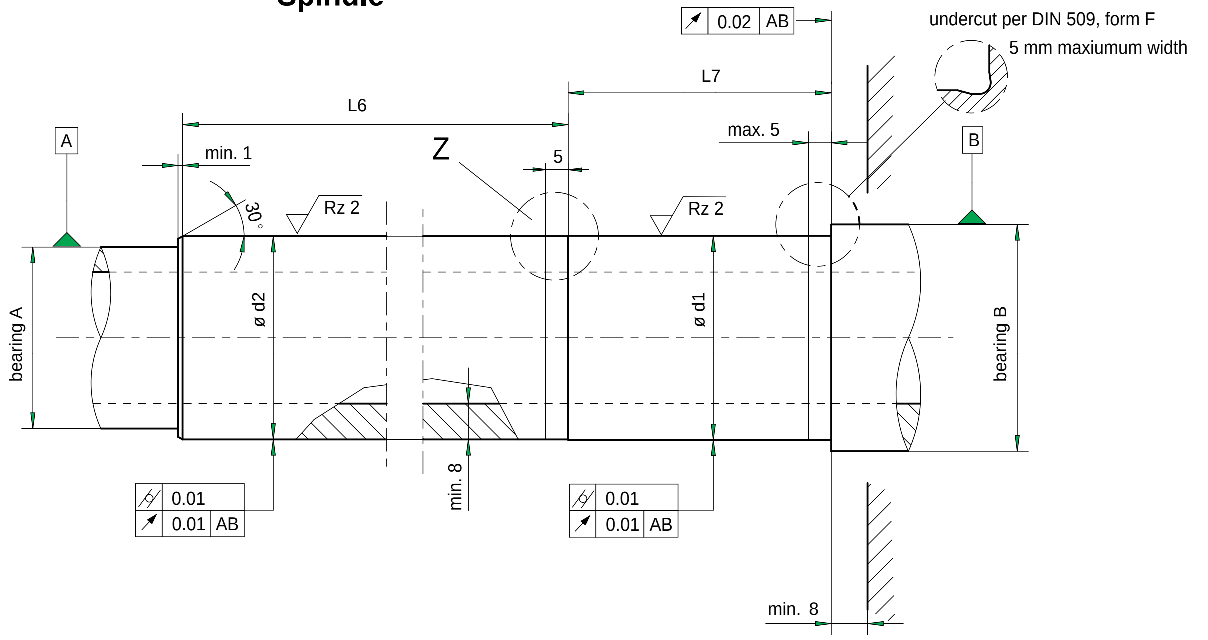
(1) Pressure oil connection
closed with threaded pin as per DIN 913 after rotor is mounted
secure threaded pins by bonding with LOCTITE 620

(2) Balancing ring with M5 or M6 thread
threaded pins per DIN 913 for equilibrium when balancing
secure threaded pins by bonding with LOCTITE 620

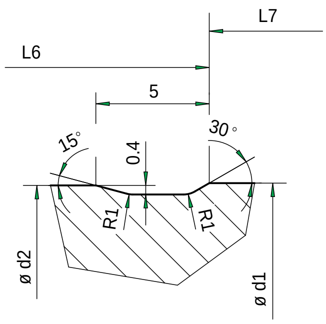
Threaded pins for (1) (2) included in delivery.

Figure 3.3: 1MR 140 rotor - dimensional data (part 1)

Spindle



Detail Z



✳ Note! Product change:

In the future, the rotors will be delivered "complete dressed"!

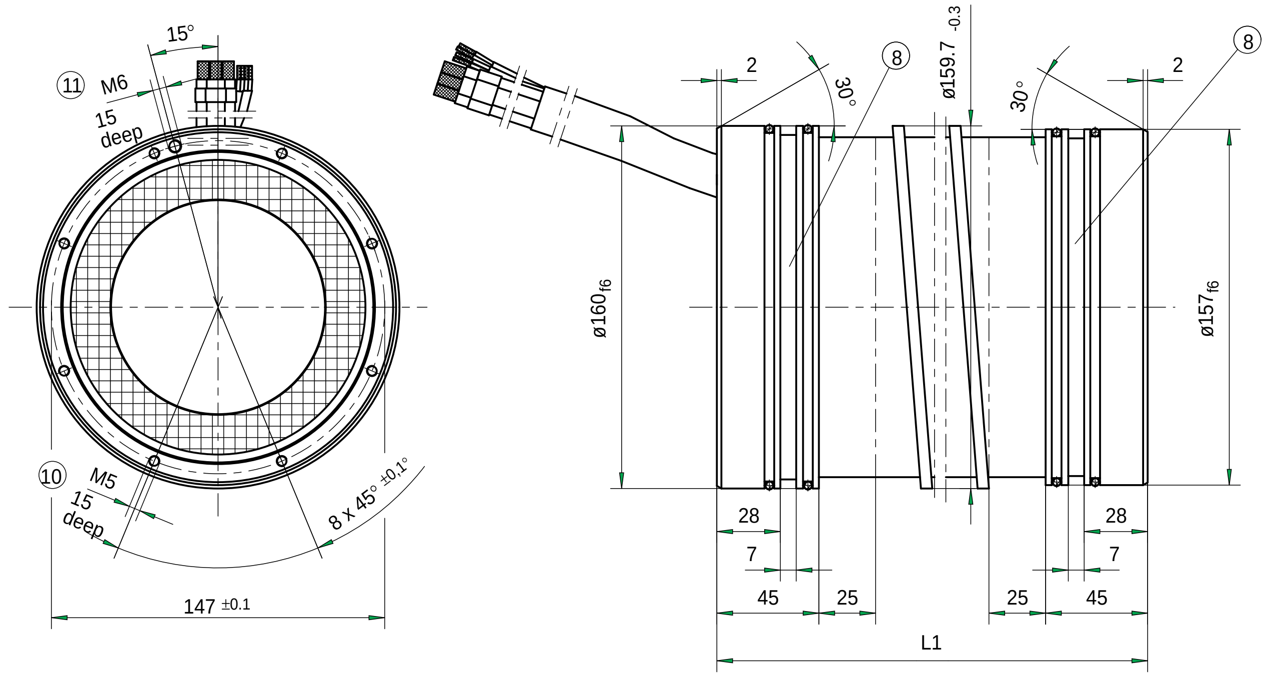
The dimension indicated with ✳ then applies.

Type \ Dim.	Rotor L3	Rotor L4	Rotor G	Rotor ø D1 ^{H6}	Rotor ø D2 ^{H6}	Rotor ø D3	Rotor ø D4	Spindle L6 $_{-0.5}$	Spindle L7 $_{-0.5}$	Spindle ød1 $_{s6}$	Spindle ød2 $_{t6}$
1 MR 140 B-A045	105	42	M4x0.5	45	44.8	45.5	45.2	45	58	45	44.8
1 MR 140 D-A045	145	82						85			
1 MR 140 F-A045	195	132						135			
1 MR 140 H-A045	245	182						185			

Fit	Dim.
45 $_{s6}$	+0.059 +0.043
45 ^{H6}	+0.016 0
44.8 $_{t6}$	+0.070 +0.054
44.8 ^{H6}	+0.016 0

Quellverweis: 106-0243-2021-00

Figure 3.3: 1MR 140 rotor - dimensional data (part 2)



Mounting drill hole:
with axial mounting of the stator to end shield

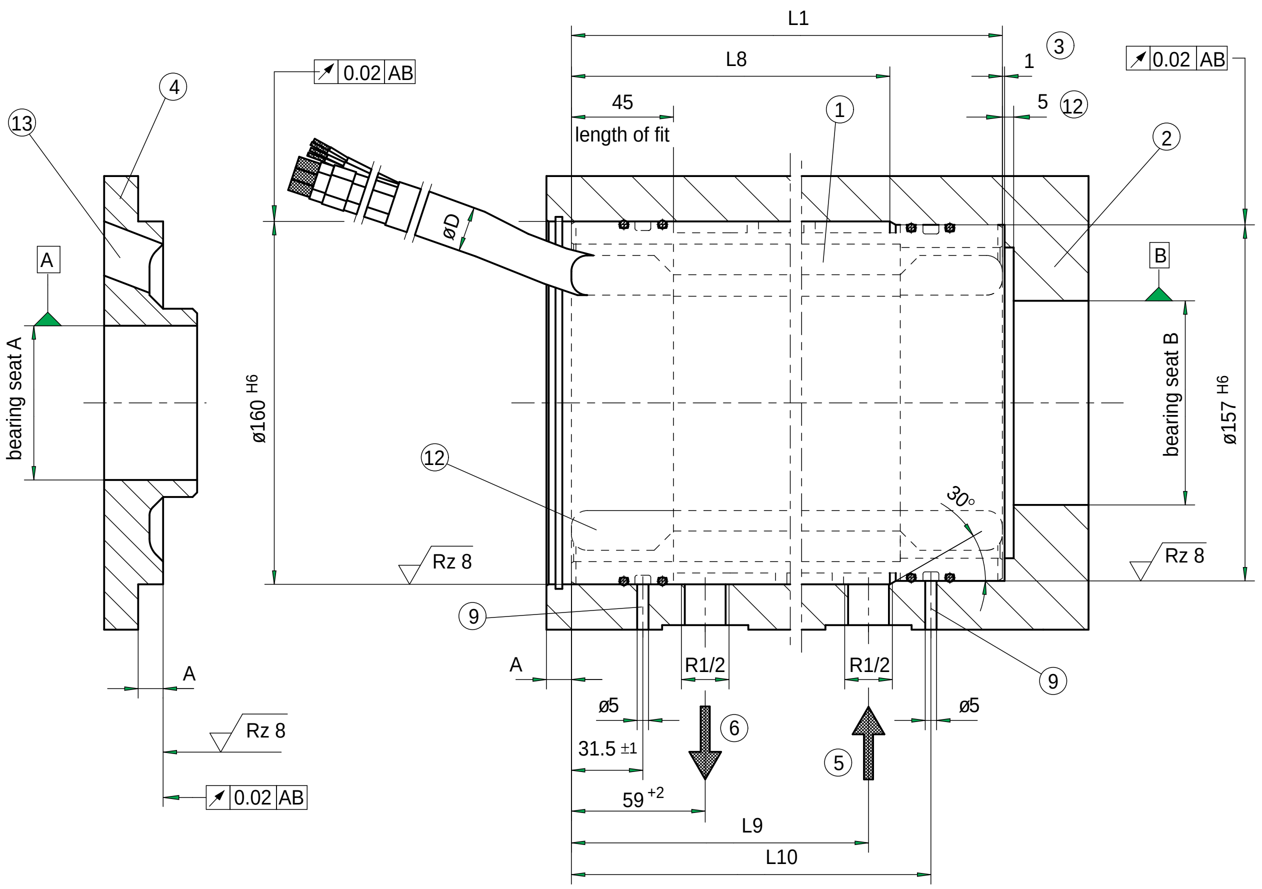
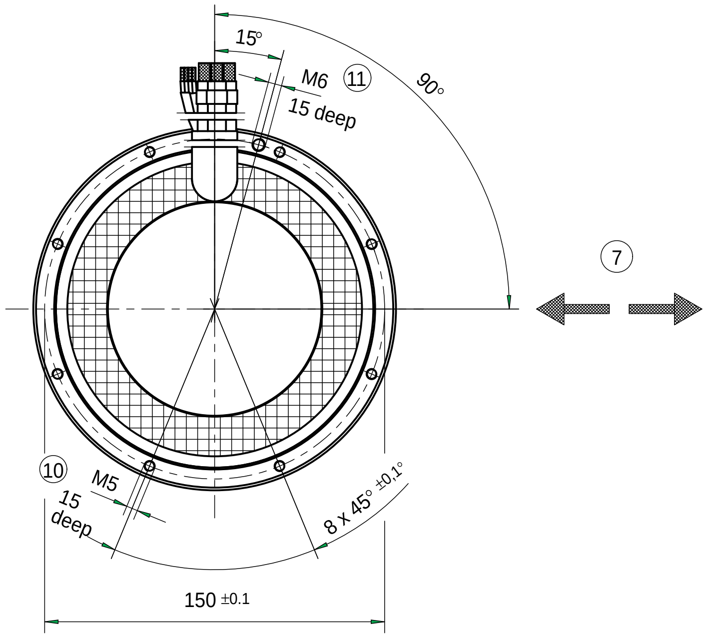


Figure 3.4: 1MS 140 stator - dimensional data (part 1)



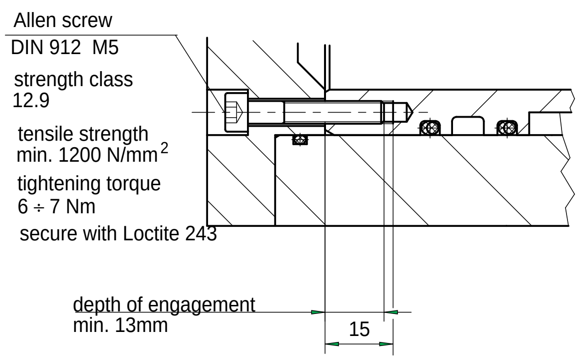
1. Stator 1 MS 140...
2. Spindle housing
3. Minimum clearance for expansion
4. End shield
5. Coolant feed thread per DIN 2999
   with 1 MS 140 D/F/H position anywhere on circumference
6. Coolant feed thread per DIN 2999
   with 1 MS 140 D/F/H position anywhere on circumference
7. Coolant feed and drain, with 1 MS 140 B
   only these positions to motor winding possible
8. Leakage groove
9. Leakage drill hole

(10) (11) on either stator end

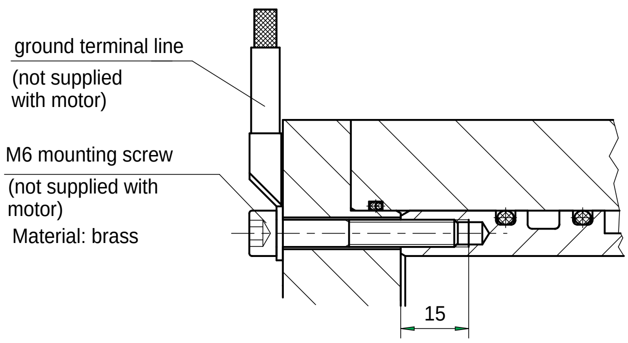
12. End winding
    Minimum 5 mm clearance to housing
13. Cable leadthrough with rounded edges

Dim. / Type	L1	L8 $^{+1}$	L9 $_{-2}$	L10 ±1	motor winding	
					øD	**bend radius**
1 MS 140 B-4B	150	101	91	118.5	20	70
1 MS 140 D-4B	190	141	131	158.5		
1 MS 140 F-4A	240	191	181	208.5		
1 MS 140 H-4B	290	241	231	258.5	22	90

(10) Axial mounting to end shield



(11) Ground terminal line connection



Quellverweis: 106-0243-2022-00

Figure 3.4: 1MS 140 stator - dimensional data (part 2)

3.4. 1MB 140 - type codes

Type codes: Example: 1MB 140 B-4A-A 045 A 1

1. Designation:	1MB
2. Motor size:	140
3. Motor length:	B, D, F, H
4. Type of winding:	
1MB 140B	4B
1MB 140D	4B
1MB 140F	4A
1MB 140H	4B
5. Type of rotor:	
with step interference fit	A
6. Inside diameter of rotor:	
45 mm	045
7. Type of stator:	
with aluminum cooling jacket	A
8. Electrical connection:	
conductor on thick stator end/1.5m	1
conductor on thin stator end /1.5m	2

Quellverweis: INN 06.40

Figure 3.5: 1MB 140 frameless spindle motor - type codes

Type codes: Example: 1MR 140 B-A 045

1. Designation:	1MR
2. Motor size:	140
3. Motor length:	B, D, F, H
4. Type of rotor:	
with step interference fit	A
5. Inside diameter of rotor:	
45 mm	045

Quellverweis: INN 06.42

Figure 3.6: 1MR 140 rotor - type codes

Type codes: Example: 1MS 140 B-4A-A 1

1. Designation:	1MS
2. Motor size:	140
3. Motor length:	B, D, F, H
4. Type of winding:	
1MB 140B	4B
1MB 140D	4B
1MB 140F	4A
1MB 140H	4B
5. Type of stator:	
with aluminum cooling jacket	A
6. Electrical connection:	
conductor on thick stator end/1.5m	1
conductor on thin stator end /1.5m	2

Quellverweis: INN 06.41

Figure 3.7: 1MS 140 stator - type codes

4. 1MB 160 - technical data

4.1. Frameless spindle motor

Rated data

Designation	Symbol	Unit	1MB 160						
Motor length			B	D	E	F		H	N
Type of winding			4A		4B	4A	4B	4A	
Rated power [1]	P_n	kW	5	10	3.5	15		(20)	(28)
Rated torque [1]	M_n	Nm	16	32	33	48		(64)	89
Rated RPM [1]	n_n	min^{-1}	3000		1000	3000			
Rated voltage [2]	U_{neff}	V	220				380		
Rated current	I_n	A	36	48	19	74	45	(58)	(75)
Minimum conductor dia. for INDRAMAT cables	A	mm^2	6	10	2.5	25	10	(16)	(25)
Inductance [3]	L	mH	1.31	1.17	8.0	0.72	2.01		
Maximum RPM	n_{max}	min^{-1}	20,000						
Rotor moment of inertia	J_m	kgm^2	0.0084	0.0121	0.0149	0.0161		0.0201	0.0267
Weight: Rotor	m	kg	5.3	7.3	9.4	10.2		9.8	12.7
Weight: Stator	m	kg	6.8	11.1	14.4	15.8		21.0	28.1
Insulation classification DIN VDE 0530, section 1			F						
Technical data of liquid cooling mode:									
Rated power loss	P_{Vn}	kW	1.2	1.8	2.1	3.0		(3.8)	4.8
Coolant temperature at entry	ϑ_{ein}	°C	10° to 40°						
Coolant temperature increase with P_{Vn} [4]	$\Delta\vartheta_n$	K	10						
Ambient temperature		°C	5° to 45°						
Minimum required coolant flow with $\Delta\vartheta_n$ [4]	Q_n	l/min	1.7	2.6	3.0	4.3		(5.4)	6.9
Pressure drop with Q_n [4]	Δp_n	bar	0.1					0.2	0.3
Maximum system pressure	p_{max}	bar	3						
Volume in coolant channel	V	l	0.2	0.3	0.5			0.7	0.9

Cooling jacket material: Aluminum, hard coat surface
O-ring: Viton

[1] Data relates to S1 operation of a motor on KDA/TDA drive (U_{neff} = 220V) or RAC (U_{neff} = 380V). The S1 data of other motor-drive combinations can be derived from the relevant characteristics curves.

[2] The motors are not suited for direct mains connection.

[3] Inductance of the mounted motor spindle at 20°C, measured between the power conductors with $f_\sim$ = 1 kHz.

[4] Data relates to water-based coolant. Should other coolants be used (e.g., oil), recalculate data or see flow diagram.

Preliminary data indicated with ( ).

Figure 4.1: 1MB 160 frameless spindle motor - rated data

4.2. Dimensional data

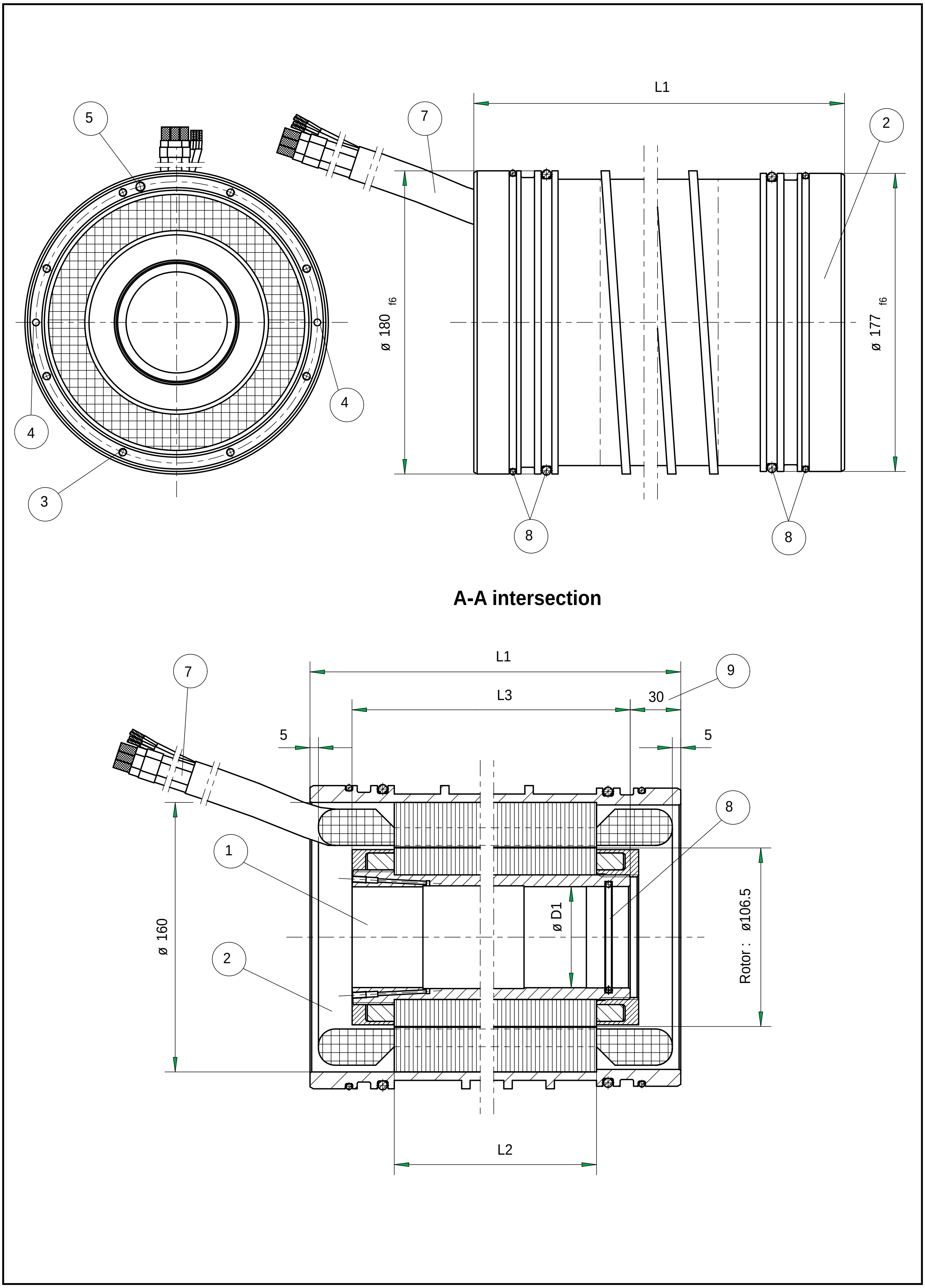
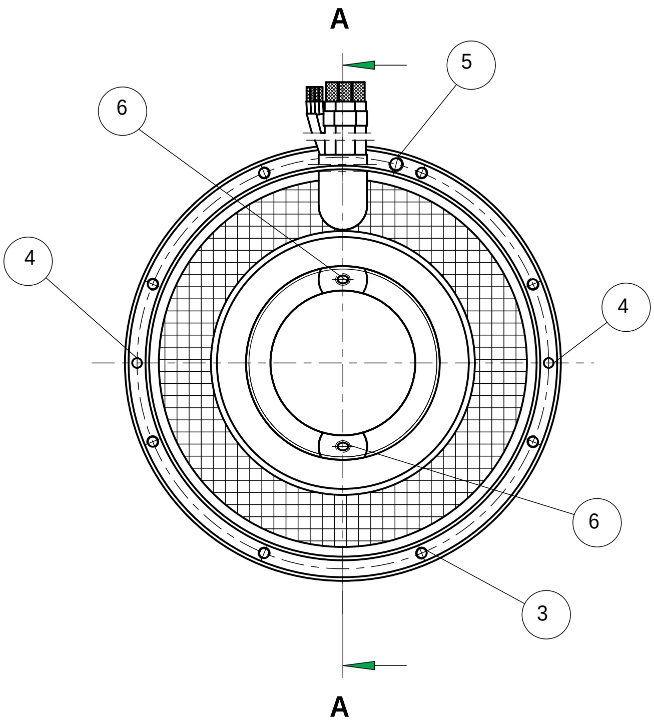


Figure 4.2: 1MB 160 frameless spindle motor - dimensional data (part 1)



(1) Rotor 1MR 160...

(2) Stator 1MS 160...

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

(4) drill diameter 4 for cylindrical pins to secure against rotational movements of spindle housing

(5) M6 thread for mounting to ground terminal line

(6) pressure oil connection to release step interference fit

(7) motor winding with 1500 mm length

(8) O-ring made of Viton

(9) Positional dimension of rotor to stator

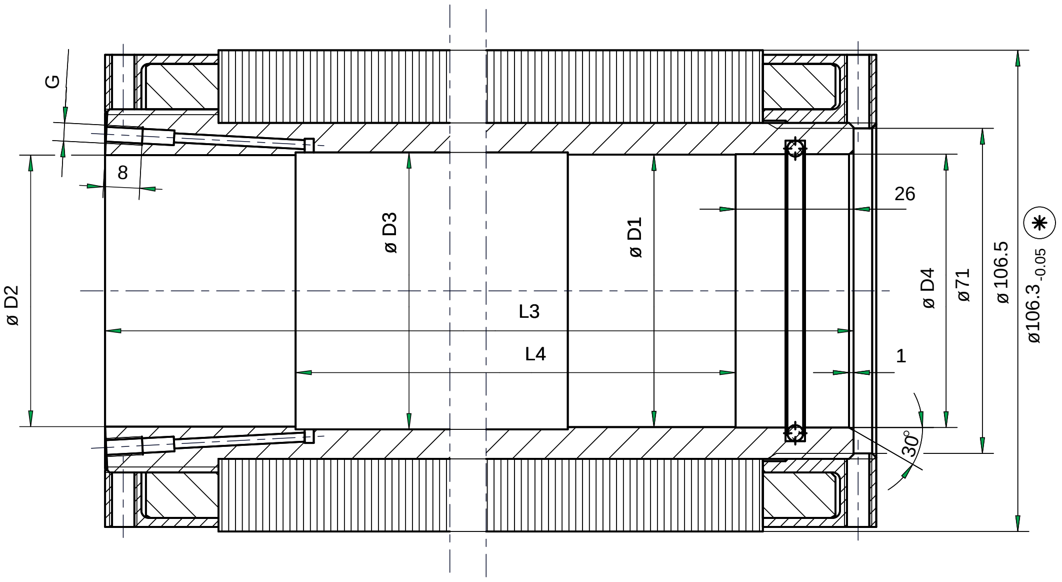
<table>
<tr><th>Dim.
Type</th><th colspan="4">ø D 1 H6</th><th>L 1</th><th>L 2</th><th>L 3</th></tr>
<tr><td>1 MB 160 B</td><td rowspan="4">40</td><td rowspan="4">45</td><td rowspan="4">55</td><td rowspan="4">60</td><td>160</td><td>60</td><td>105</td></tr>
<tr><td>1 MB 160 D</td><td>205</td><td>105</td><td>150</td></tr>
<tr><td>1 MB 160 E</td><td>240</td><td>140</td><td>185</td></tr>
<tr><td>1 MB 160 F</td><td>255</td><td>155</td><td>200</td></tr>
<tr><td>1 MB 160 H</td><td colspan="4" rowspan="2">60</td><td>310</td><td>210</td><td>255</td></tr>
<tr><td>1 MB 160 N</td><td>385</td><td>285</td><td>330</td></tr>
</table>

Quellverweis: 106-0192-3020-00

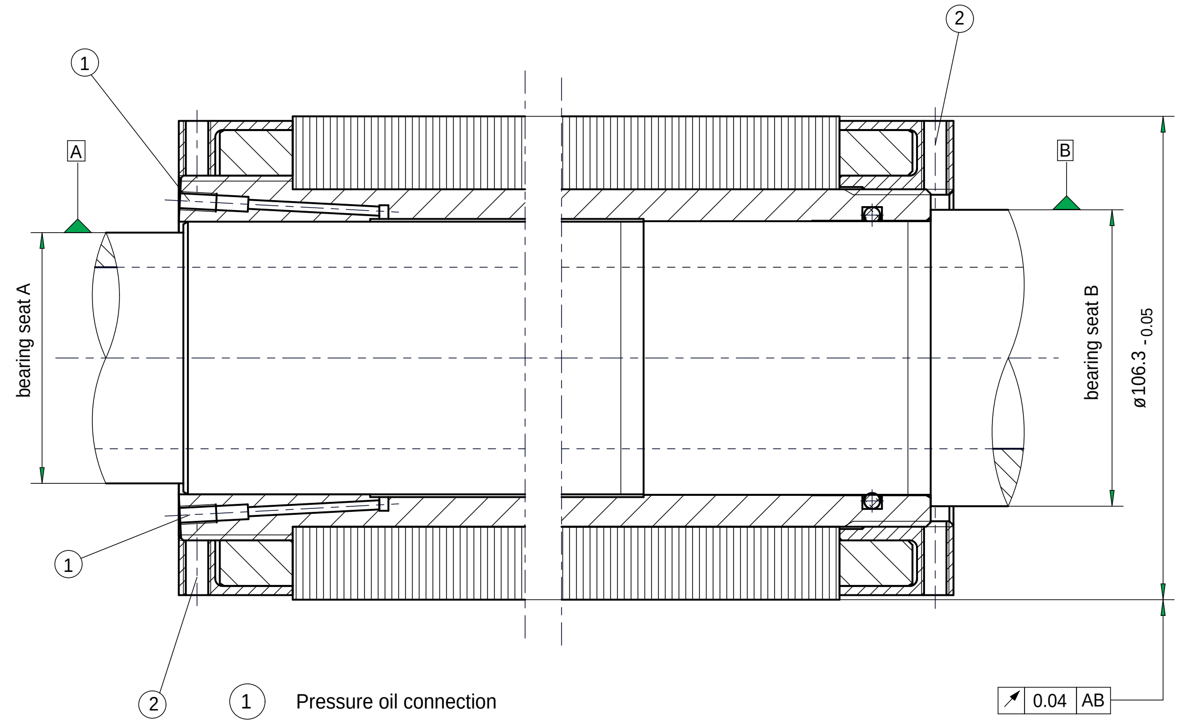
Figure 4.2: 1MB 160 frameless spindle motor - dimensional data (part 2)

4.3. Motor spindle construction

Rotor 1 MR 160... (condition at delivery) ✱



Rotor mounted to spindle (final dressing) ✱



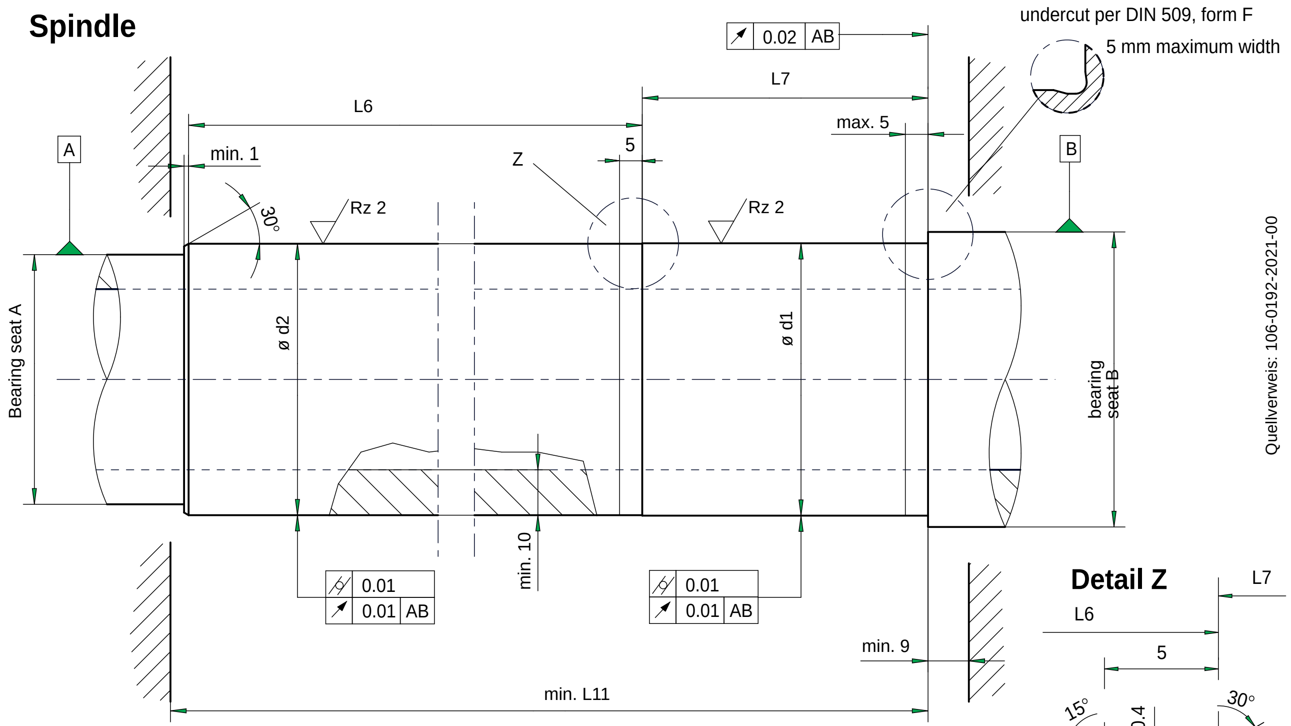
① Pressure oil connection
Sealed with threaded pins as per DIN 913 after rotor is mounted
Secure the threaded pins by bonding with LOCTITE 620

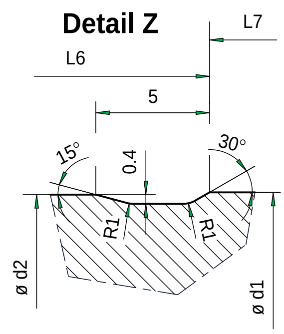
② Balancing ring with M6 thread
Threaded pins per DIN 913 for equilibrium when balancing
Secure the threaded pins by bonding with LOCTITE 620

Threaded pins ① ② are included in delivery.

Figure 4.3: 1MR 160 rotor - dimensional data (part 1)

Spindle





Note! Product change:

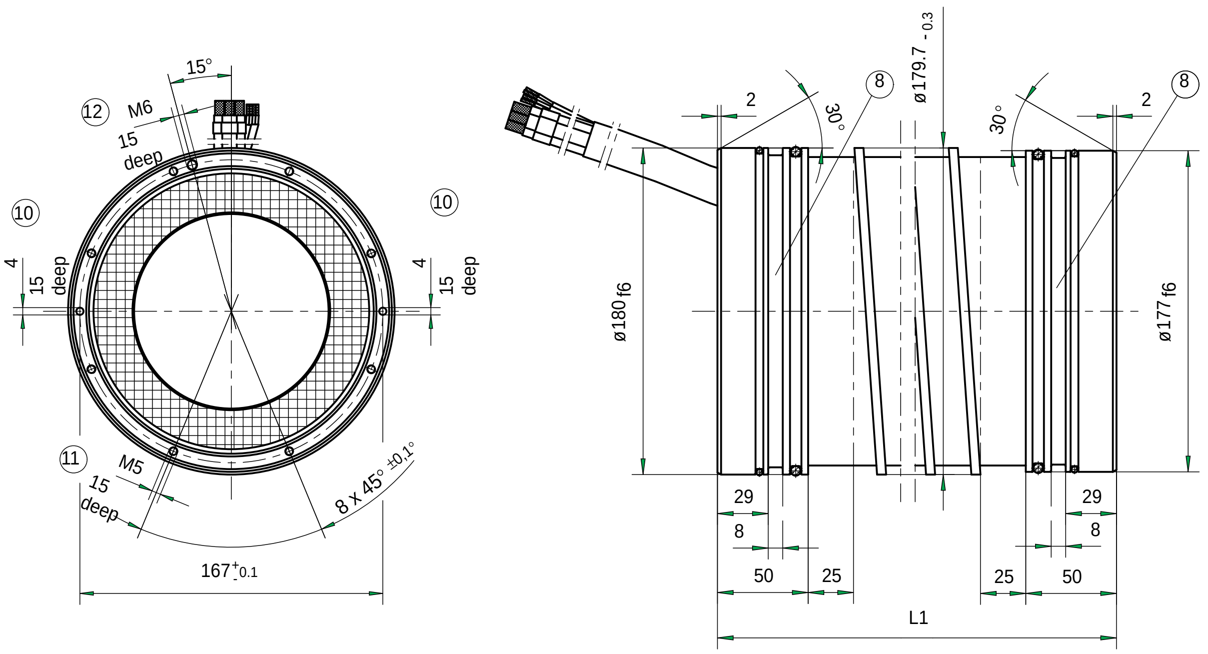
In the future, the rotors will be supplied "final dressed"!

The dimension applies indicated with a ✳

Type / Dim.	Rotor L3	Rotor L4	Rotor G	Rotor ø D1 H6	Rotor ø D2 H6	Rotor ø D3	Rotor ø D4	Spindle L6 -0.5	Spindle L7 -0.5	Spindle ød1 s6	Spindle ød2 t6	Spindle L11
1 MR 160 B-A040	105	42	M6	40	39.8	41	40.2	45	58	40	39.8	min. 107
1 MR 160 D-A040	150	82						85	63			min. 152
1 MR 160 E-A040	185	117						120				min. 187
1 MR 160 F-A040	200	132						135				min. 202
1 MR 160 B-A045	105	42		45	44.8	46	45.2	45	58	45	44.8	min. 107
1 MR 160 D-A045	150	82						85	63			min. 152
1 MR 160 E-A045	185	117						120				min. 187
1 MR 160 F-A045	200	132						135				min. 202
1 MR 160 B-A055	105	42	M4x0.5	55	54.8	56	55.2	45	58	55	54.8	min. 107
1 MR 160 D-A055	150	82						85	63			min. 152
1 MR 160 E-A055	185	117						120				min. 187
1 MR 160 F-A055	200	132						135				min. 202
1 MR 160 B-A060	105	42		60	59.8	61	60.2	45	58	60	59.8	min. 107
1 MR 160 D-A060	150	82						85	63			min. 152
1 MR 160 E-A060	185	117						120				min. 187
1 MR 160 F-A060	200	132						135				min. 202
1 MR 160 H-A060	255	187						190				min. 257
1 MR 160 N-A060	330	262						265				min. 332
1 MR 160 B-A061	105	42		60.3	60.1	61	60.5	45	58	60.3	60.1	min. 107
1 MR 160 D-A061	150	82						85	63			min. 152
1 MR 160 E-A061	185	117						120				min. 187
1 MR 160 F-A061	200	132						135				min. 202
1 MR 160 H-A061	255	187						190				min. 257
1 MR 160 N-A061	330	262						265				min. 332

Fit	Dim.
60.3 s6	+0.072 / +0.053
60.3 H6	+0.019 / 0
60.1 t6	+0.085 / +0.066
60.1 H6	+0.019 / 0
60 s6	+0.072 / +0.053
60 H6	+0.019 / 0
59.8 t6	+0.085 / +0.066
59.8 H6	+0.019 / 0
55 s6	+0.072 / +0.053
55 H6	+0.019 / 0
54.8 t6	+0.085 / +0.066
54.8 H6	+0.019 / 0
45 s6	+0.059 / +0.043
45 H6	+0.016 / 0
44.8 t6	+0.070 / +0.054
44.8 H6	+0.016 / 0
40 s6	+0.059 / +0.043
40 H6	+0.016 / 0
39.8 t6	+0.064 / +0.048
39.8 H6	+0.016 / 0

Figure 4.3: 1MR 160 rotor - dimensional data (part 2)



Mounting drill hole :

for axial mounting of the stator to end shield

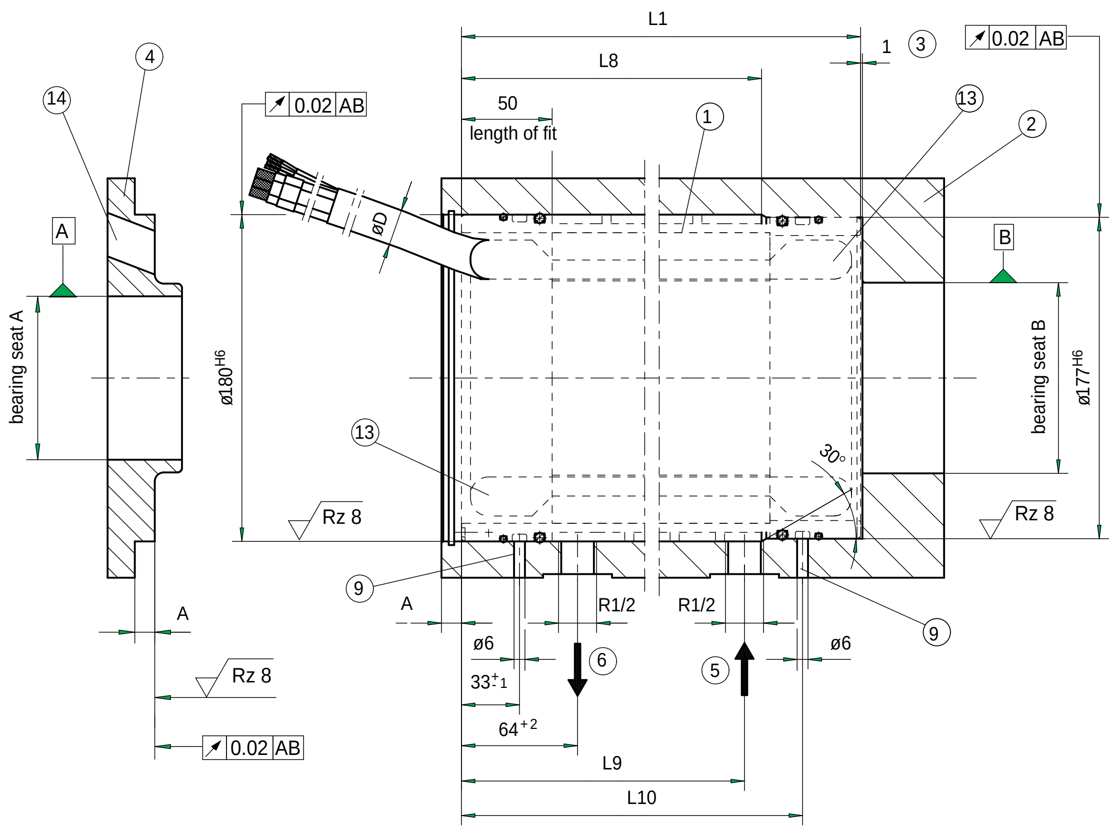
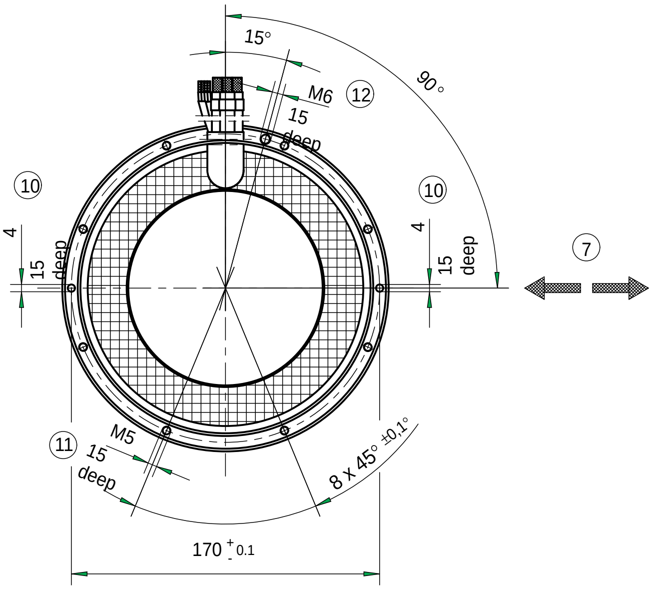


Figure 4.4: 1MS 160 stator - dimensional data (part 1)



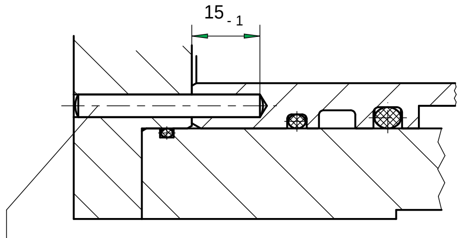
1. Stator 1 MS 160...
2. Spindle housing
3. Minimum clearance for expansion
4. End shield
5. Coolant feed thread as per DIN 2999 with 1 MS 160 D/E/F/H/N position anywhere on circumference
6. Coolant drain thread as per DIN 2999 with1 MS 160 D/E/F/H/N position anywhere
7. Coolant flow and drain, for 1 MS 160 B only possible in these positions to motor cable
8. Leakage groove
9. Leckage drill hole

(10) (11) (12) on either stator end

13. End winding clearance to housing is at least 5 mm
14. Cable leadthrough with rounded edges

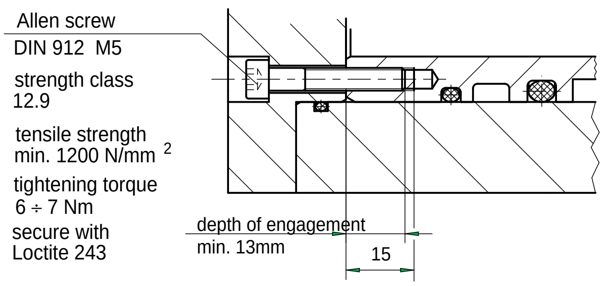
Dim. / Type	L1	L8 $^{+1}$	L9 $_{-2}$	L10 ± 1	motor winding øD	motor winding bend radius
1 MS 160 B-4A	160	106	96	127	20	70
1 MS 160 D-4A	205	151	141	172		
1 MS 160 E-4B	240	186	176	207		
1 MS 160 F-4A	255	201	191	222	22	90
1 MS 160 F-4B					20	70
1 MS 160 H-4A	310	256	246	277		
1 MS 160 N-4A	385	331	321	352	22	90

(10) Securing against rotations on end shield

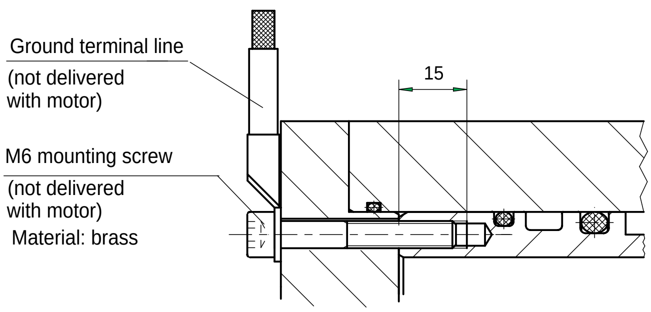


Cylindrical pin DIN 6325 ø5 m6
Material: tensile strength min. 600 N/mm²
hardened, hardness 60 ± 2 HRC

(11) Axial mounting to end shield



(12) Attachment of ground terminal connection



Quellverweis: 106-0192-2022-00

Figure 4.4: 1MS 160 stator - dimensional data (part 2)

4.4. 1MB 160 - type codes

Type codes: Example: 1MB 160 F-4A-A 060 A 1

1.	Designation:	1MB
2.	Motor size:	160
3.	Motor length:	B, D, E, F, H, N
4.	Type of winding:	
	1MB 160B	4A
	1MB 160D	4A
	1MB 160E	4B
	1MB 160F	4A, 4B
	1MB 160H	4A
	1MB 160N	4A
5.	Type of rotor:	
	with step inteference fit	A
6.	Inside rotor diameter:	
	40 mm	040
	45 mm	045
	55 mm	055
	60 mm	060
7.	Type of stator:	
	with aluminum cooling jacket	A
8.	Electrical connections:	
	conductor on thick end of stator/1.5m	1
	conductor on thin end of stator /1.5m	2

Quellverweis: INN 06.40

Figure 4.5: 1MB 160 frameless spindle motor - type codes

Type codes: Example: 1MR 160 F-A 060

1.	Designation:	1MR
2.	Motor size:	160
3.	Motor length:	B, D, E, F, H, N
4.	Type of rotor:	
	with step inteference fit	A
5.	Inside rotor diameter:	
	40 mm	040
	45 mm	045
	55 mm	055
	60 mm	060

Quellverweis: INN 06.42

Figure 4.6: 1MR 160 rotor - type codes

Type codes: Example: 1MS 160 F-4A-A 1

1.	Designation:	1MS
2.	Motor size:	160
3.	Motor length:	B, D, E, F, H, N
4.	Type of winding:	
	1MB 160B	4A
	1MB 160D	4A
	1MB 160E	4B
	1MB 160F	4A, 4B
	1MB 160H	4A
	1MB 160N	4A
5.	Type of stator:	
	with aluminum cooling jacket	A
6.	Electrical connection:	
	conductor on thick end of stator/1.5m	1
	conductor on thin end of stator /1.5m	2

Quellverweis: INN 06.41

Figure 4.7: 1MS 160 stator - type codes

5. 1MB 200 - technical data

5.1. Frameless spindle motor

Designation	Symbol	Unit	1MB 200						
Motor length			C	D				E	H
Type of winding			4A	4E	4B	4C	4D	4B	
Rated power [1]	P_n	kW	9	13.5		31.0	22.3	16.0	19.5
Rated torque [1]	M_n	Nm	57	85		59	85	102	124
Rated RPM [1]	n_n	min^{-1}	1500			5000	2500	1500	
Rated voltage [2]	U_{neff}	V	220		380				
Rated current	I_n	A	50	84	48	75	59	43	68
Minimum diameter for INDRAMAT cables	A	mm^2	10	25	10	16	16	10	16
Inductance [3]	L	mH	1.87	0.90	2.75	0.79	1.78	3.50	1.65
Maximum RPM	n_{max}	min^{-1}	18,000						
Rotor moment of inertia	J_m	kgm^2	0.041	0.052				0.059	0.069
Weight: Rotor	m	kg	15	19				22	26
Weight: Stator	m	kg	21	29				34	41
Insulation classification DIN VDE 0530, section1			F						
Technical data of liquid cooling mode:									
Rated power loss	P_{Vn}	kW	2.0	2.7					3.8
Coolant temperature at entry	ϑ_{ein}	°C	10° to 40°						
Coolant temperature increase with P_{Vn} [4]	$\Delta\vartheta_n$	K	10						
Ambient temperature		°C	5° to 45°						
Minimum required coolant flow with $\Delta\vartheta_n$ [4]	Q_n	l/min	2.9	3.9					5.4
Pressure drop with Q_n [4]	Δp_n	bar	0.1						0.2
Maximum system pressure	p_{max}	bar	3						
Volume in coolant channel	V	l	0.6	0.8				0.9	1.1

Cooling jacket material: Aluminum, hard coat surface
O-ring: Viton

[1] Data relates to S1 operation of a motor on KDA/TDA drive (U_{neff} = 220V) or RAC (U_{neff} = 380V). The S1 data of other motor-drive combinations can be derived from the relevant characteristics curves.

[2] The motors are not suited for direct mains connection.

[3] Inductance of the mounted motor spindle at 20° C., measured between the power conductors with $f_\sim$ = 1 kHz.

[4] Data relates to water-based coolant. Should other coolants be used (e.g., oil), recalculate data or see flow diagram.

Figure 5.1: 1MB 200 frameless spindle motor - rated data

5.2. Dimensional data

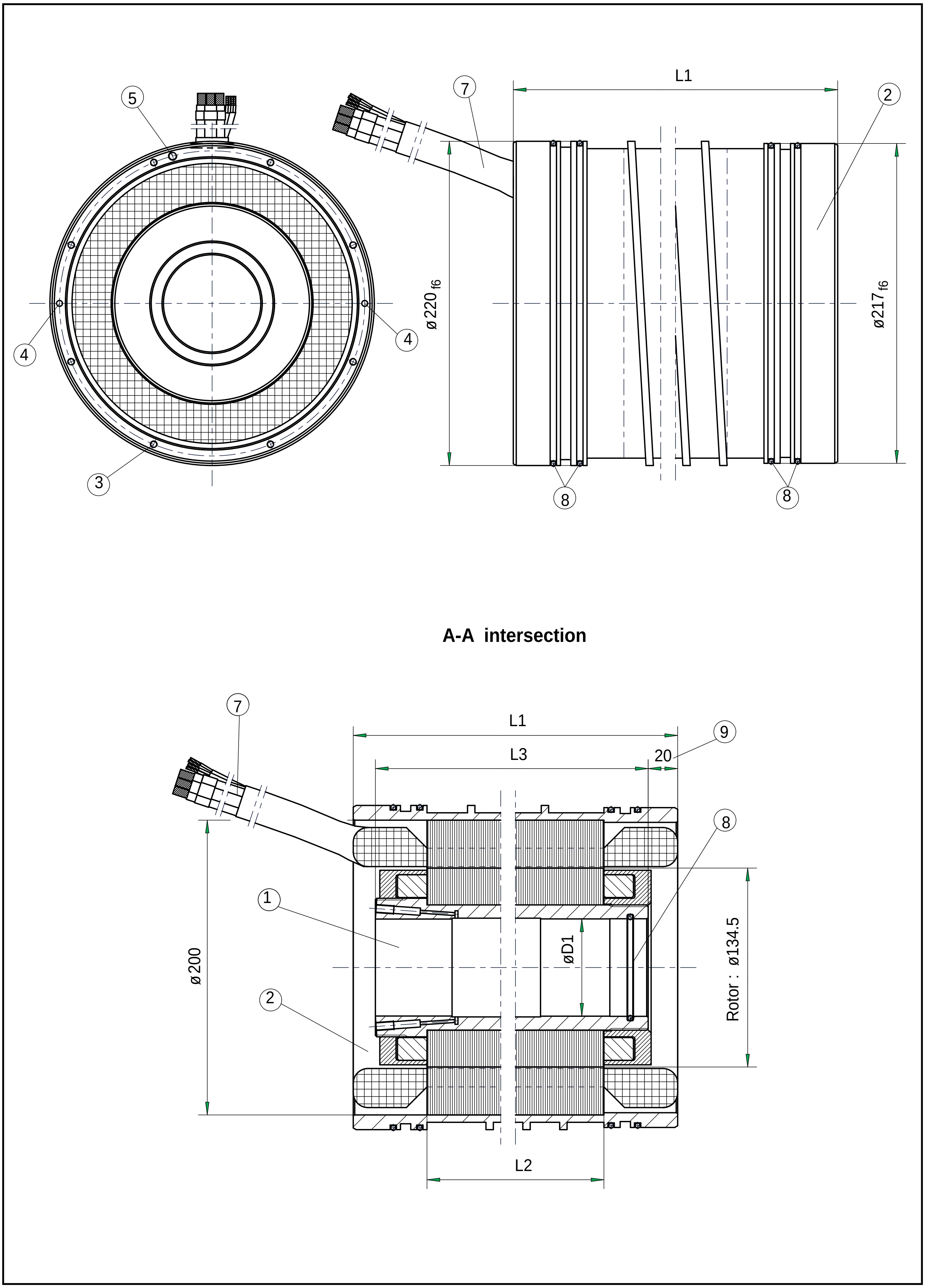
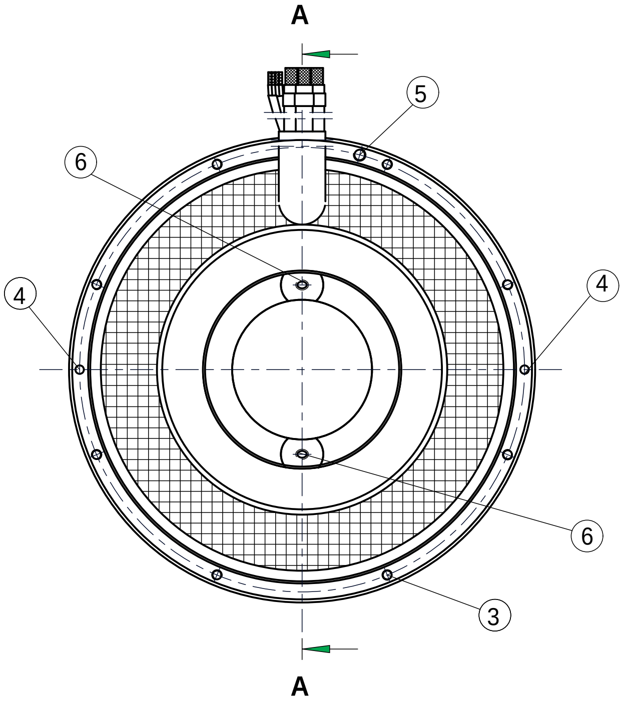


Figure 5.2: 1MB 200 frameless spindle motor - dimensional data (part 1)



1. Rotor 1MR 200...
2. Stator 1MS 200...
3. 8x M5 thread for axial mounting to spindle housing
4. ø4 drill hole for cylindrical pins to secure against rotations with respect to spindle housing
5. M6 thread for mounting to ground terminal connection
6. pressure oil connection to release step interference fit
7. 1500 mm long motor winding
8. O-ring made of viton
9. Positional dimension of rotor to stator

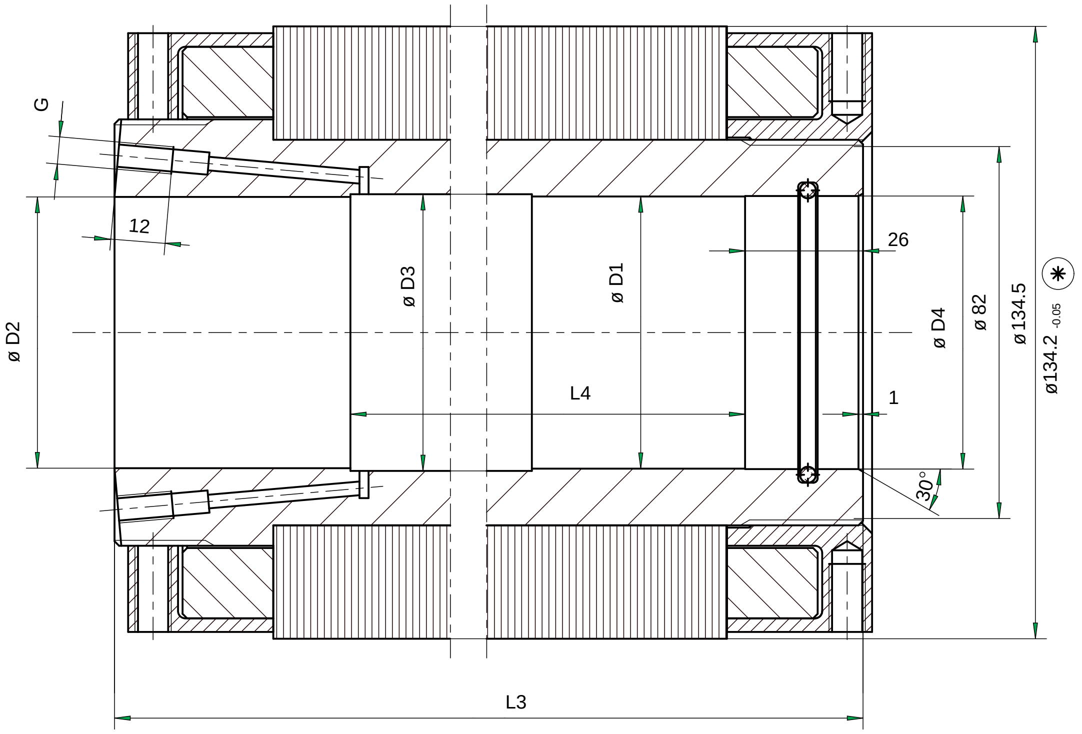
Dim. / Type	ø D 1 H6		L 1	L 2	L 3
1 MB 200 C	60	66	240	140	205
1 MB 200 D			295	195	260
1 MB 200 E			330	230	295
1 MB 200 H			380	280	345

Quellverweis: 106-0200-3020-00

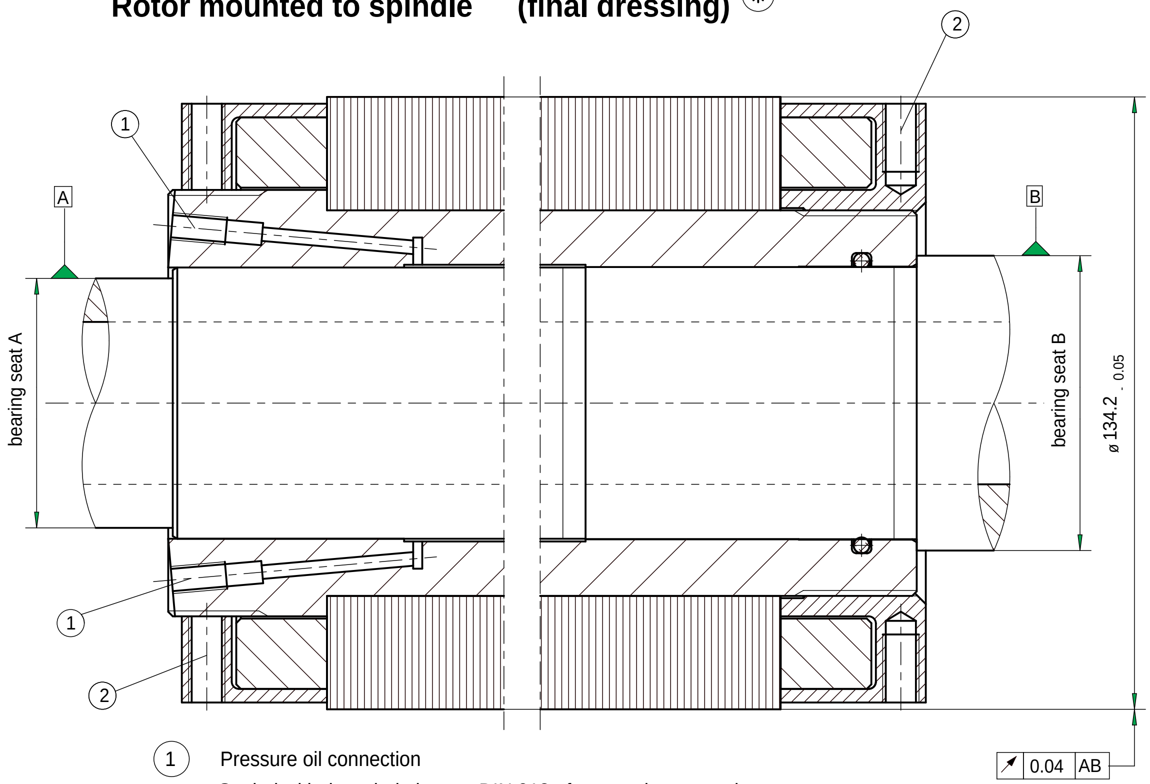
Figure 5.2: 1MB 200 frameless spindle motor - dimensional data (part 2)

5.3. Motor spindle construction

Rotor 1 MR 200... (condition at delivery) ✳



Rotor mounted to spindle (final dressing) ✳



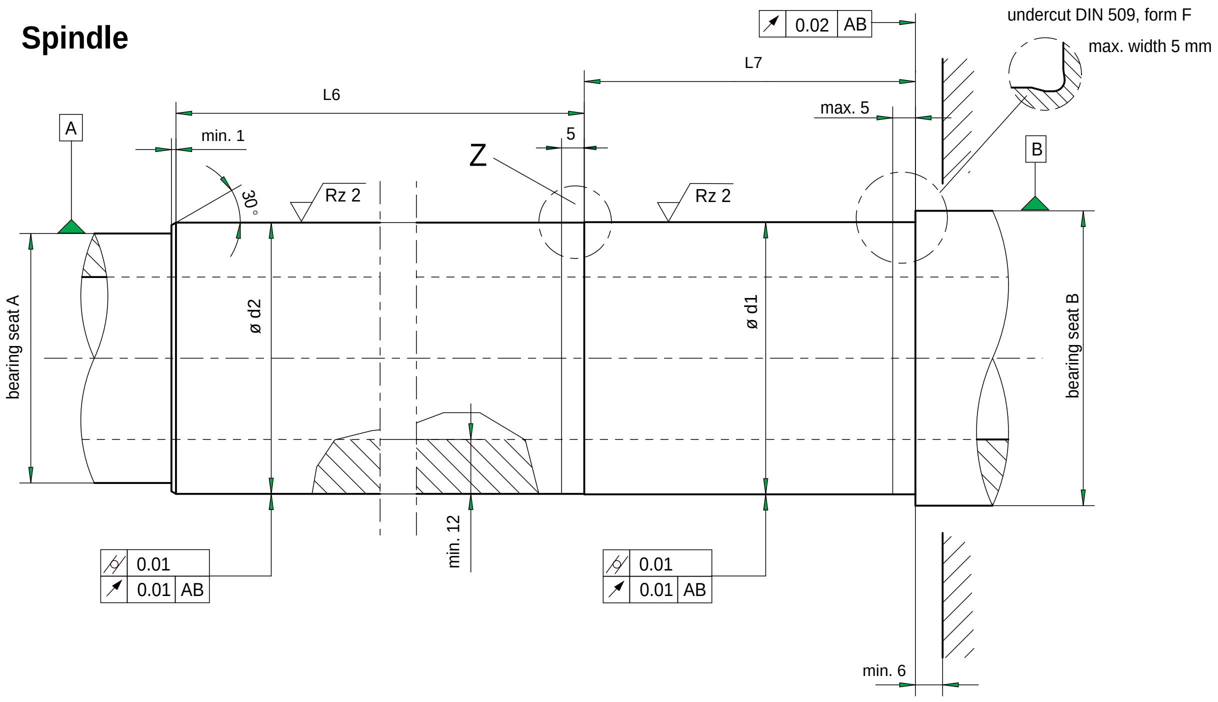
(1) Pressure oil connection
Sealed with threaded pins per DIN 913 after rotor is mounted
Secure the threaded pins by bonding with LOCTITE 620

(2) Balancing ring with M6 or M8 thread
Threaded pins per DIN 913 for equilibrium when balancing
Secure the threaded pins by bonding with LOCTITE 620

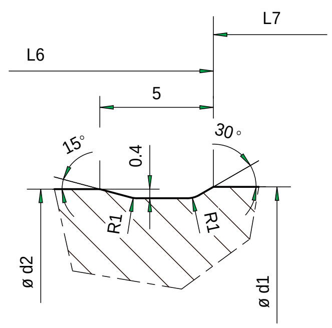
Threaded pins (1) (2) are part of general delivery.

Figure 5.3: 1MR 200 rotor - dimensional data (part 1)

Spindle



Detail Z



(✳) Note! Product change:

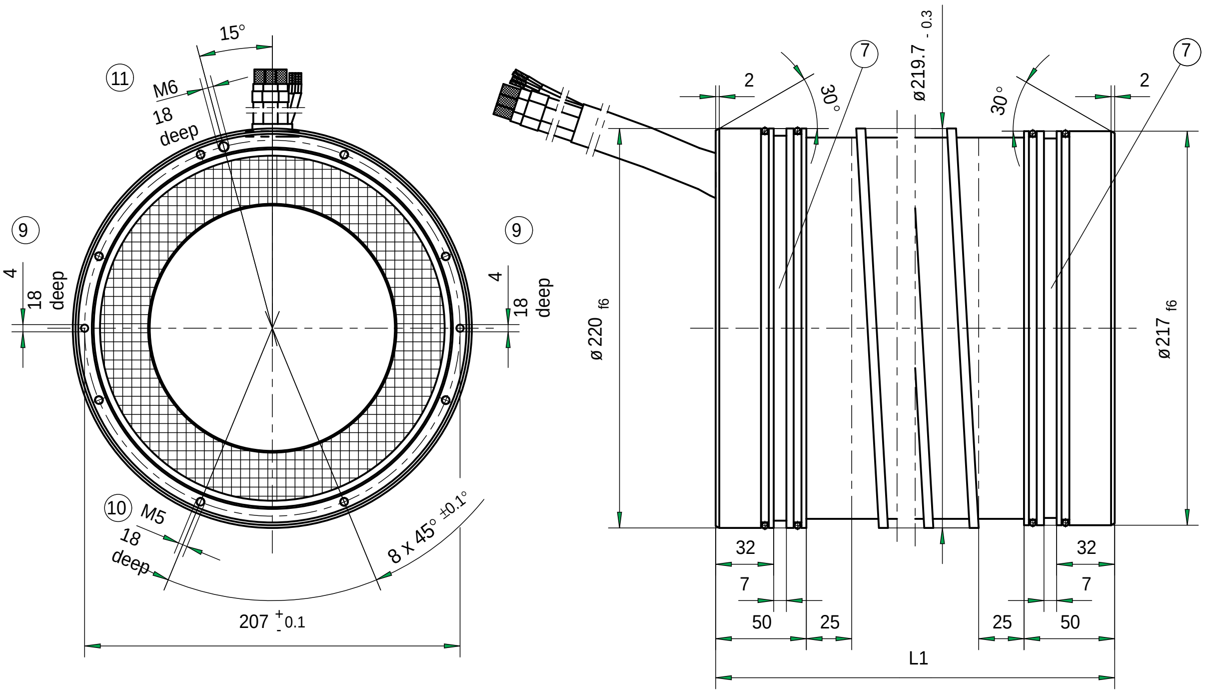
In the future, the rotors will be supplied "final dressed"!
The dimension applies indicated with a (✳)

Type \ Dim.	Rotor L3	Rotor L4	Rotor G	Rotor ø D1 H6	Rotor ø D2 H6	Rotor ø D3	Rotor ø D4	Spindle L6 -0.5	Spindle L7 -0.5	Spindle ød1 s6	Spindle ød2 t6
1 MR 200 C-A060	205	127	M6	60	59.8	61	60.2	130	73	60	59.8
1 MR 200 D-A060	260	182						185			
1 MR 200 E-A060	295	217						220			
1 MR 200 H-A060	345	267						270			
1 MR 200 C-A066	205	127		66	65.8	67	66.2	130		66	65.8
1 MR 200 D-A066	260	182						185			
1 MR 200 E-A066	295	217						220			
1 MR 200 H-A066	345	267						270			

Fit	Dim.
66 s6	+0.078 / +0.059
66 H6	+0.019 / 0
65.8 t6	+0.094 / +0.075
65.8 H6	+0.019 / 0
60 s6	+0.072 / +0.053
60 H6	+0.019 / 0
59.8 t6	+0.085 / +0.066
59.8 H6	+0.019 / 0

Quellverweis: 106-0200-2021-00

Figure 5.3: 1MR 200 rotor - dimensional data (part 2)



Mounting drill hole:

for axial mounting of the stator to the end shield

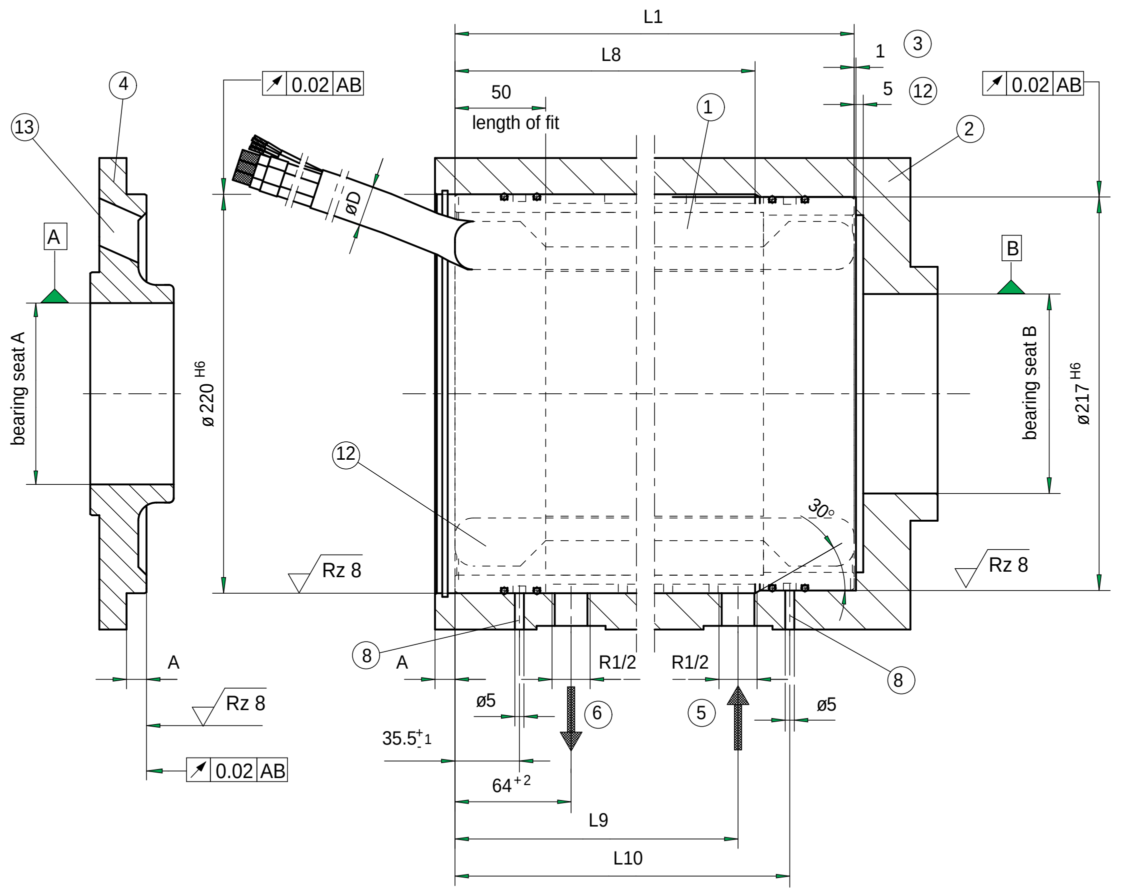
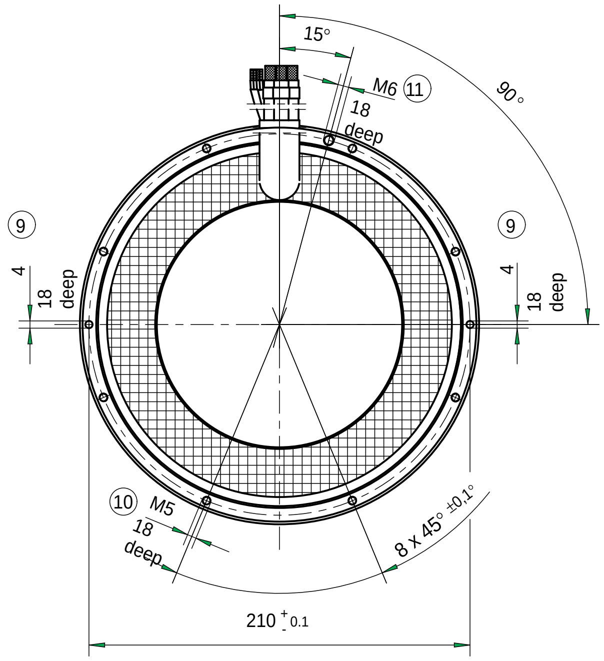


Figure 5.4: 1MS 200 stator - dimensional data (part 1)



(1) Stator 1 MS 200...

(2) Spindle housing

(3) Minimum clearance for expansion

(4) end shield

(5) coolant feed per DIN 2999
positioned anywhere on circumference

(6) coolant thread as per DIN 2999
anywhere on circumference

(7) Leakage groove

(8) Leakage drill hole

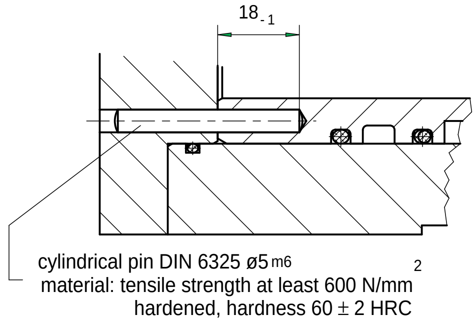
(9) (10) (11) on either stator end

(12) end winding
clearance to housing at least 5 mm

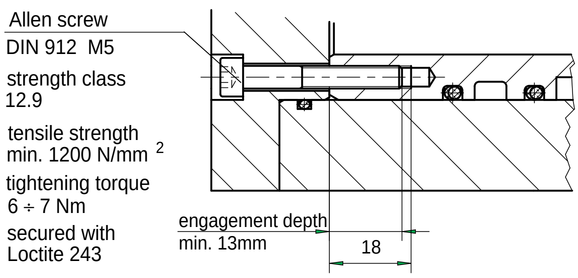
(13) cable leadthrough with rounded edges

Dim. / Type	L1	L8 +1	L9 -2	L10 ± 1	motor winding øD	motor winding bend radius
1 MS 200 C-4A	240	186	176	204.5	20	70
1 MS 200 D-4B	295	241	231	259.5	22	90
1 MS 200 D-4C						
1 MS 200 D-4D						
1 MS 200 D-4E						
1 MS 200 E-4B	330	276	266	294.5		
1 MS 200 H-4B	380	326	316	344.5		

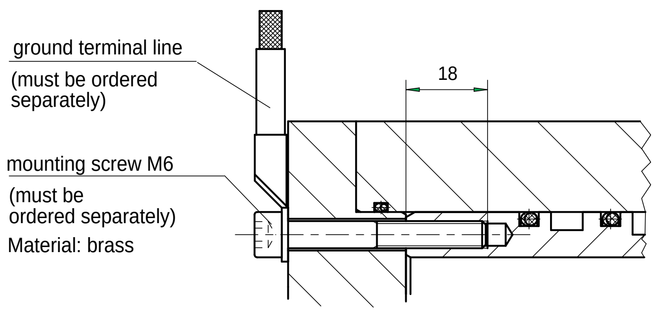
(9) Secure against movements on end shield



(10) Axial mounting on end shield



(11) Attachment of ground terminal connection



Quellverweis: 106-0200-2022-00

Figure 5.4: 1MS 200 stator - dimensional data (part 2)

5.4. 1MB 200 - type codes

Type codes: Example: **1MB 200 D-4D-A 060 A 1**

1. Designation:	1MB
2. Motor size:	200
3. Motor length:	C, D, E, H
4. Type of winding:	
1MB 200C	4A
1MB 200D	4C, 4D, 4E
1MB 200E	4B
1MB 200H	4B
5. Type of rotor:	
with step inteference fit	A
6. Inside rotor diameter:	
60 mm	060
66 mm	066
7. Type of stator:	
with aluminum cooling jacket	A
8. Electrical connections:	
conductor on thick end of stator/1.5m	1
conductor on thin end of stator /1.5m	2

Quellverweis: INN 06.40

Figure 5.5: 1MB 200 frameless spindle motor - type codes

Type codes: Example: **1MR 200 D-A 060**

1. Designation:	1MR
2. Motor size:	200
3. Motor length:	C, D, E, H
4. Type of rotor:	
with step interference fit	A
5. Inside rotor diameter:	
60 mm	060
66 mm	066

Quellverweis: INN 06.42

Figure 5.6: 1MR 200 rotor - type codes

Type codes: Example: **1MS 200 D-4D-A 1**

1. Designation:	1MS
2. Motor size:	200
3. Motor length:	C, D, E, H
4. Type of winding:	
1MB 200C	4A
1MB 200D	4C, 4D, 4E
1MB 200E	4B
1MB 200H	4B
5. Type of stator:	
with aluminum cooling jacket	A
6. Electrical connections:	
conductor on thick end of stator/1.5m	1
conductor on thin end of stator /1.5m	2

Quellverweis: INN 06.41

Figure 5.7: 1MS 200 stator - type codes

6. 1MB 240 - technical data

6.1. Frameless spindle motor

Rated data

Designation	Symbol	Unit	1MB 240				
Motor length			B	D	F	H	
Type of winding			4A				4B
Rated power 1)	P_n	kW	6.5	10.5	13	18	
Rated torque 1)	M_n	Nm	62	84	123	169	
Rated RPM 1)	n_n	min^{-1}	1000	1200	1000		
Rated voltage 2)	U_{neff}	V	220				380
Rated current	I_n	A	46	49	74	86	56
Minimum conductor dia. for INDRAMAT cables	A	mm^2	10		25		16
Inductance 3)	L	mH	1.66	1.77	1.29	1.18	2.75
Maximum RPM	n_{max}	min^{-1}	11000				
Rotor moment of inertia	J_m	kgm^2	0.078	0.097	0.120	0.153	
Weight: Rotor	m	kg	19	23	29	37	
Weight: Stator	m	kg	29	37	48	62	
Insulation classification DIN VDE 0530. section 1			F				
Technical data liquid cooling mode:							
Rated power dissipation	P_{Vn}	kW	1.8		2.9	3.5	
Coolant temperature at entry	ϑ_{ein}	°C	10° to 40°				
Coolant temperature increase with P_{Vn} 4)	$\Delta\vartheta_n$	K	10				
Ambient temperature		°C	5° to 45°				
Minimum required coolant flow with $\Delta\vartheta_n$ 4)	Q_n	l/min	2.6		4.2	5.0	
Pressure drop with Q_n 4)	Δp_n	bar	0.1			0.2	
Maximum system pressure	p_{max}	bar	3				
Volume of coolant channel	V	l	0.6	0.8	1.0	1.4	

Cooling jacket material: Aluminum, hard coat surface
O-ring: Viton

1) Data relates to S1 operation of a motor on KDA/TDA drive (U_{neff} = 220V) or RAC (U_{neff} = 380V). The S1 data of other motor-drive combinations can be derived from the relevant characteristics curves.

2) The motors are not suited for direct mains connection.

3) Inductance of the mounted motor spindle at 20°C, measured between the power conductors with $f_\sim$ = 1 kHz.

4) Data relates to water-based coolant. Should other coolants be used (e.g., oil), recalculate data or see flow diagram.

Figure 6.1: 1MB 240 frameless spindle motor - rated data

6.2. Dimensional data

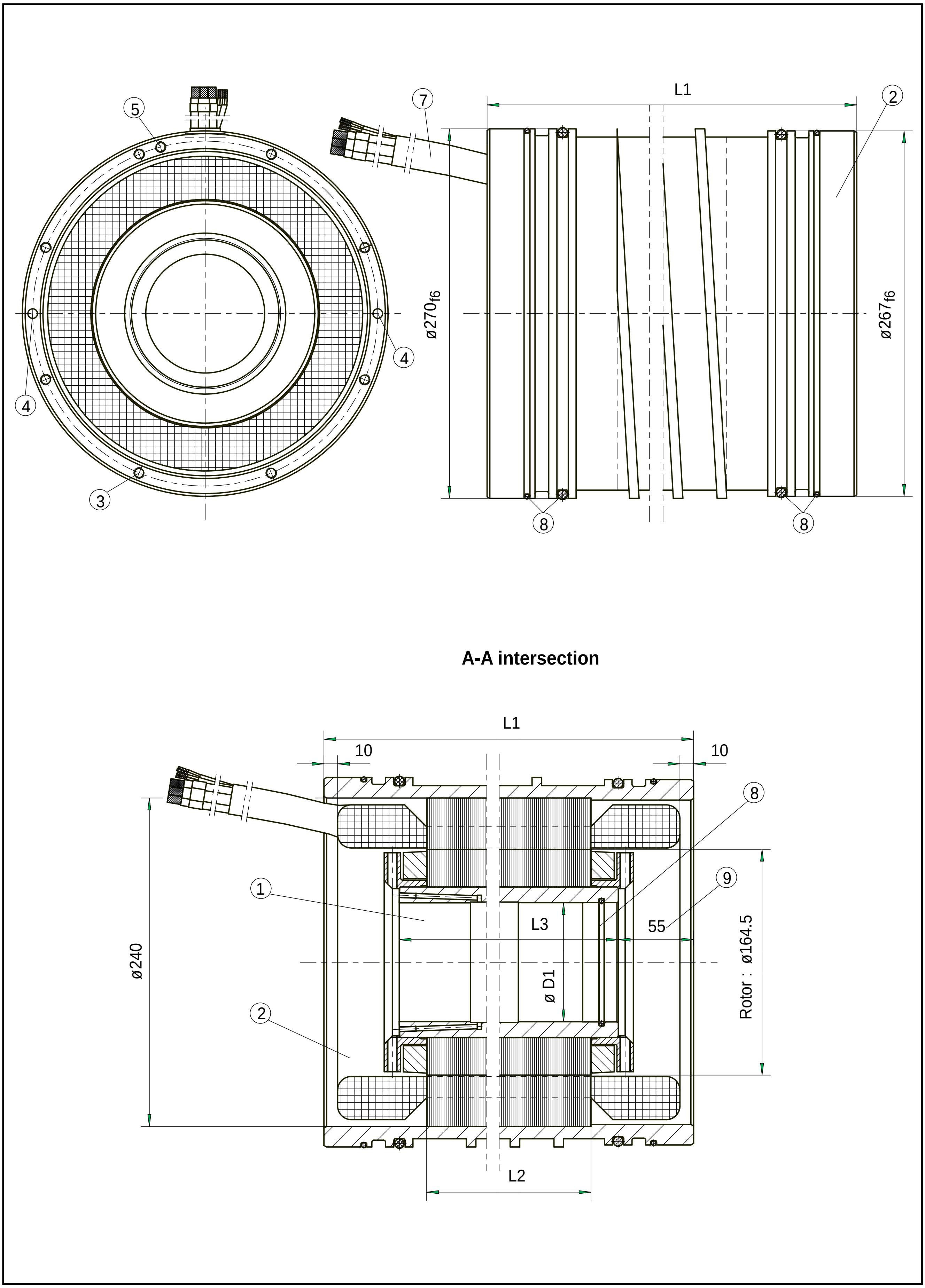
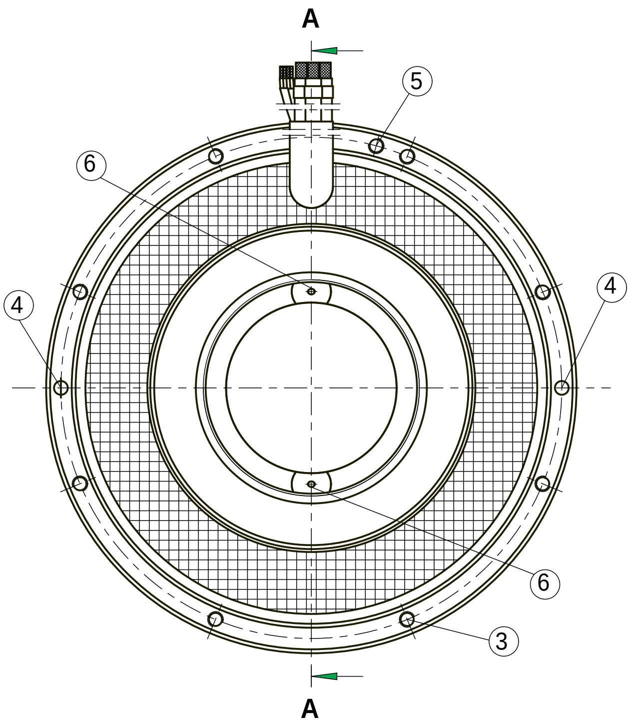


Figure 6.2: 1MB 240 frameless spindle motor - dimensional data (part 1)



1 Rotor 1MR 240...

2 Stator 1MS 240...

3 8x M8 thread for axial mounting to spindle housing

4 ø7 drill hole for cylindrical pins to secure against rotational motions with respect to spindle housing

5 M8 thread for mounting of ground terminal line

6 pressure oil connection to release step interference fit

7 motor winding length 1500 mm

8 O-ring made of Viton

9 Positional dimension of rotor to stator

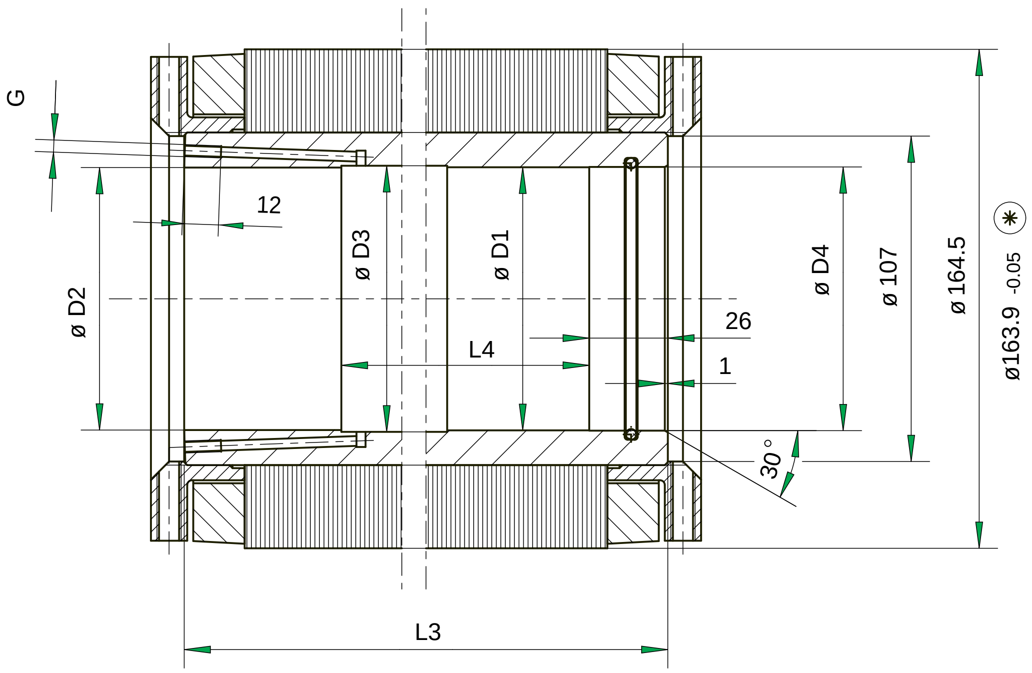
<table>
<tr><th>Dim. / Type</th><th colspan="2">ø D 1 H6</th><th>L 1</th><th>L 2</th><th>L 3</th></tr>
<tr><td>1 MB 240 B</td><td rowspan="4">7 2</td><td rowspan="4">8 7</td><td>2 7 0</td><td>1 2 0</td><td>1 6 0</td></tr>
<tr><td>1 MB 240 D</td><td>3 1 0</td><td>1 6 0</td><td>2 0 0</td></tr>
<tr><td>1 MB 240 F</td><td>3 6 0</td><td>2 1 0</td><td>2 5 0</td></tr>
<tr><td>1 MB 240 H</td><td>4 3 0</td><td>2 8 0</td><td>3 2 0</td></tr>
</table>

Quellverweis: 106-0179-3020-00

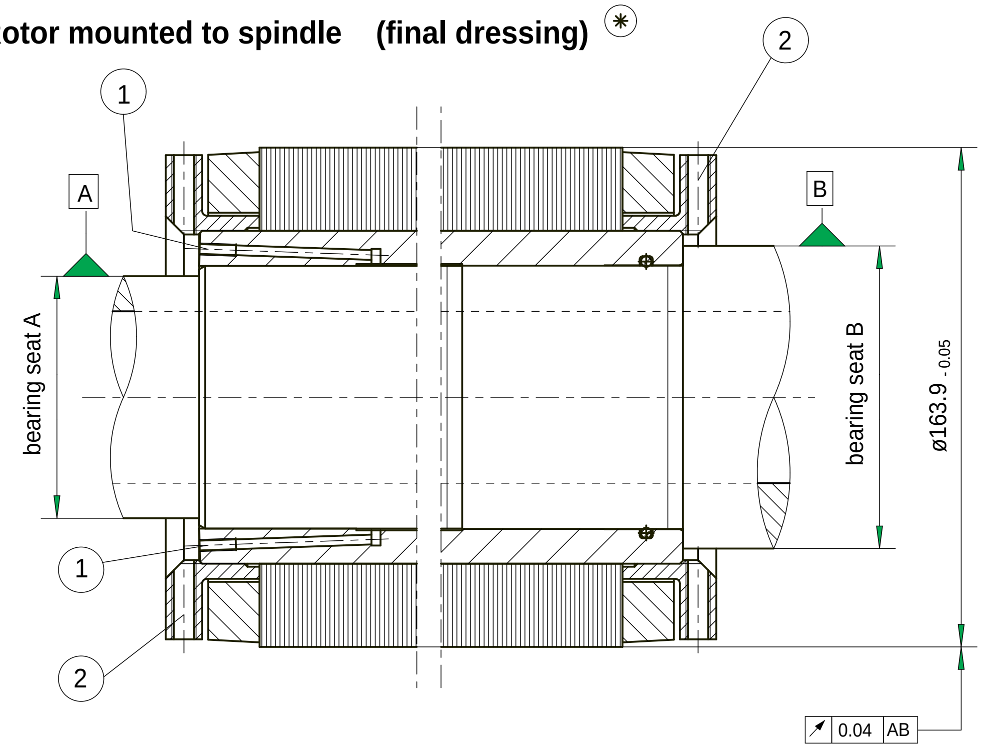
Figure 6.2: 1MB 240 frameless spindle motor - dimensional data (part 2)

6.3 Motor spindle construction

Rotor 1 MR 240... (condition at delivery) ✳



Rotor mounted to spindle (final dressing) ✳



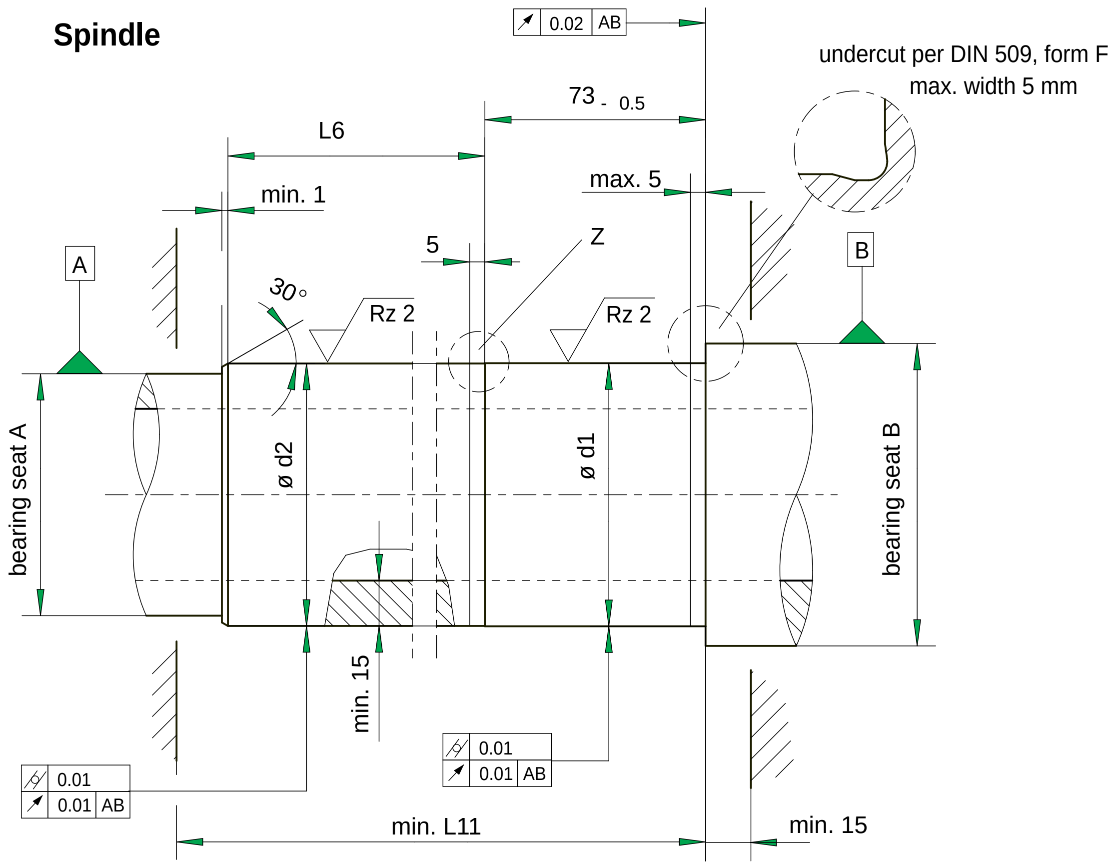
① Pressure oil connection
Sealed with threaded pins DIN 913 after rotor is mounted
Secure the threaded pins by bonding with LOCTITE 620

② Balancing ring with M8 thread
Threaded pins per DIN 913 for equilibrium when balancing
Secure the threaded pins by bonding with LOCTITE 620

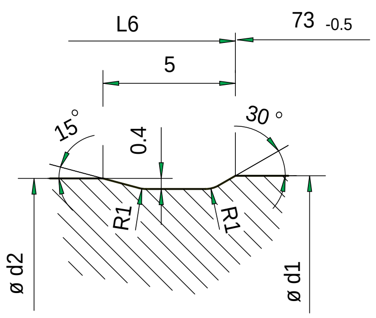
Threaded pins for ① ② are supplied with general delivery.

Figure 6.3: 1MR 240 rotor - dimensional data (part 1)

Spindle



Detail Z



✳ **Note! Product change:**

In the future, the rotors will be supplied "final dressed"!

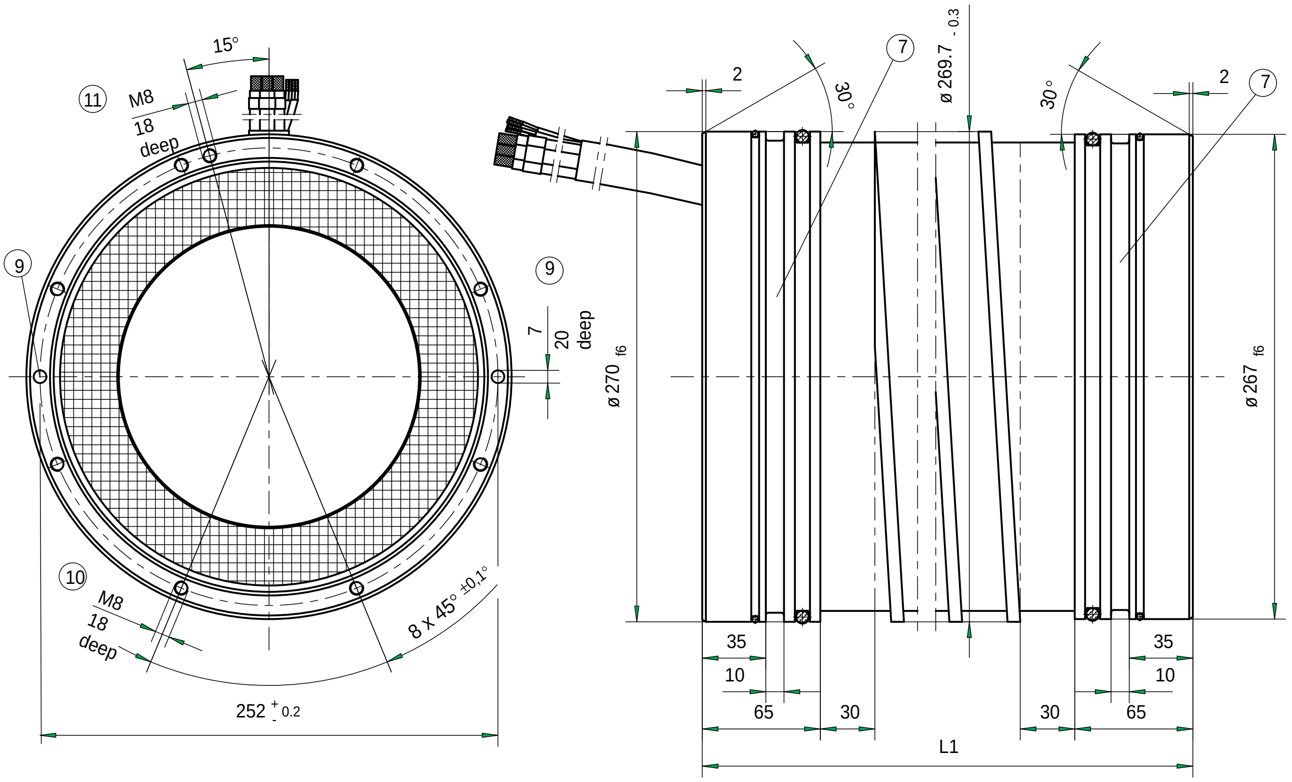
The dimension applies indicated with a ✳

Type \ Dim.	Rotor							Spindle			
	L3	**L4**	**G**	**ø D1 H6**	**ø D2 H6**	**ø D3**	**ø D4**	**L6 -0.5**	**ød1 s6**	**ød2 t6**	**L11**
1 MR 240 B-A072	160	82	M6	72	71.8	73	72.2	85	72	71.8	175
1 MR 240 D-A072	200	122						125			215
1 MR 240 F-A072	250	172						175			265
1 MR 240 H-A072	320	242						245			335
1 MR 240 B-A087	160	82	M4x0.5	87	86.8	88	87.2	85	87	86.8	175
1 MR 240 D-A087	200	122						125			215
1 MR 240 F-A087	250	172						175			265
1 MR 240 H-A087	320	242						245			335

87 s6	+0.093 +0.071
87 H6	+0.022 0
86.8 t6	+0.113 +0.091
86.8 H6	+0.022 0
72 s6	+0.078 +0.059
72 H6	+0.019 0
71.8 t6	+0.094 +0.075
71.8 H6	+0.019 0
Fit	**Dim.**

Quellverweis: 106-0179-3021-00

Figure 6.3: 1MR 240 rotor - dimensional data (part 2)



Mounting drill hole:

for axial mounting of the stator to the end shield

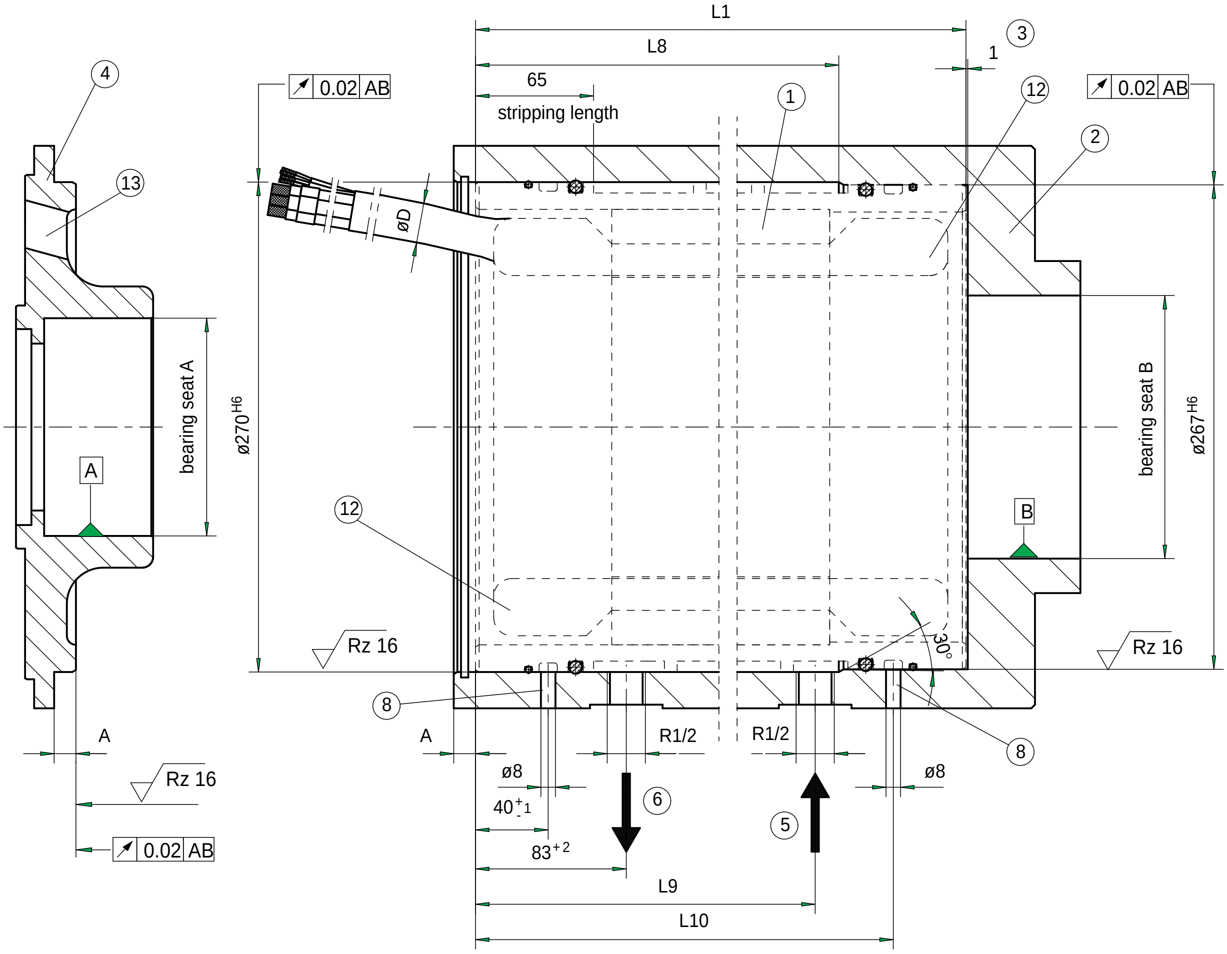
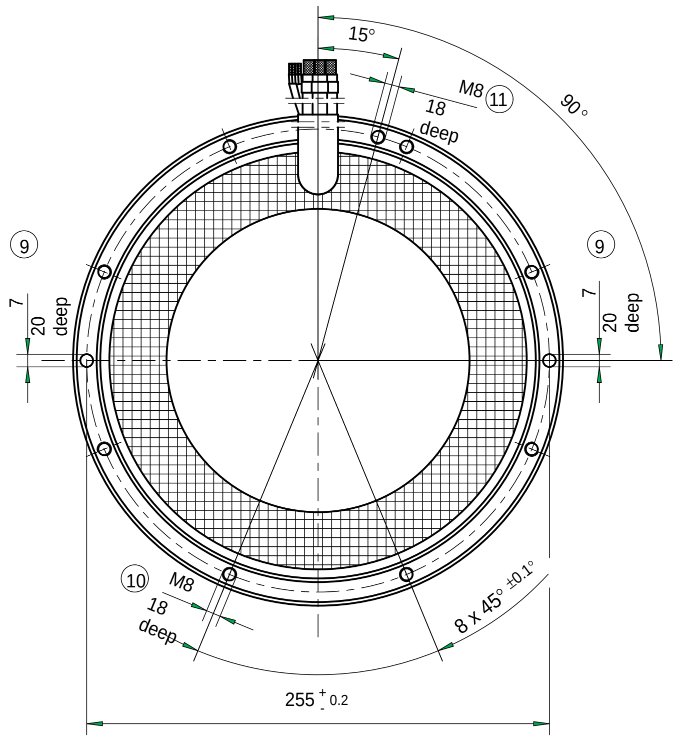


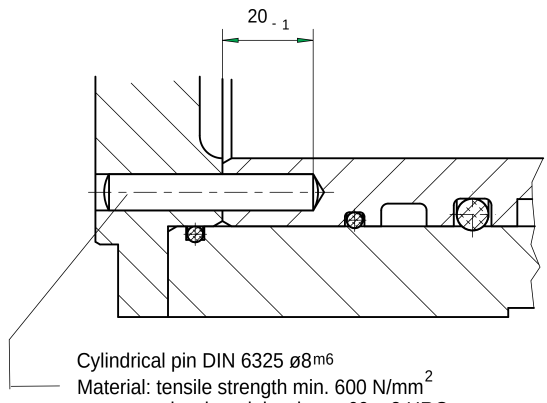
Figure 6.4: 1MS 240 stator - dimensional data (part 1)



1 Stator 1 MS 240...
2 Spindle housing
3 Minimum clearance for expansion
4 end shield
5 Coolant flow thread as per DIN 2999 anywhere on circumference
6 Coolant drain flow as per DIN 2999 anywhere on circumference
7 Leakage groove
8 Leakage drill hole
9 10 11 on either stator end
12 End winding
Minimum clearance to housing 5 mm
13 Cable leadthrough with rounded edges

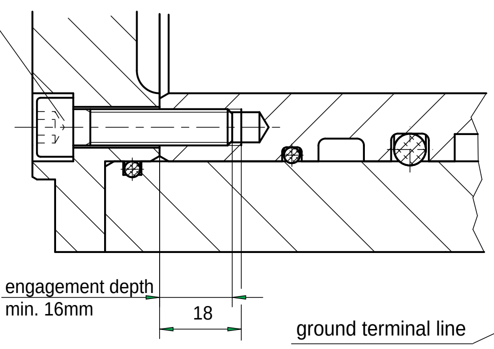
Type \ Dim.	L1	L8 +1	L9 -2	L10 ±1	motor winding	
					øD	bend radius
1 MS 240 B-4A	270	201	187	230	20	70
1 MS 240 D-4A	310	241	227	270		
1 MS 240 F-4A	360	291	277	320	22	90
1 MS 240 H-4A	430	361	347	390		
1 MS 240 H-4B						

9 Secure against movements on shield end

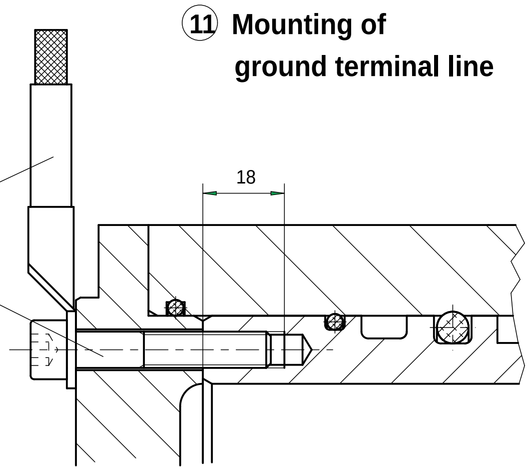


Cylindrical pin DIN 6325 ø8m6
Material: tensile strength min. 600 N/mm^2
hardened, hardness 60 ± 2 HRC

10 Axial mounting to end shield



11 Mounting of ground terminal line



Quellverweis: 106-0179-2022-00

Figure 6.4: 1MS 240 stator - dimensional data (part 2)

6.4. 1MB 240 - type codes

Type codes: Example: 1MB 240 F-4A-A 072 A 1

1.	Name:	1MB
2.	Motor size:	240
3.	Motor length:	B, D, F, H
4.	Type of winding:	
	1MB 240B	4A
	1MB 240D	4A
	1MB 240F	4A
	1MB 240H	4A, 4B
5.	Type of rotor:	
	with step interference fit	A
6.	Inside rotor diameter:	
	72 mm	072
	87 mm	087
7.	Type of stator:	
	with aluminum cooling jacket	A
8.	Electrical connections:	
	Conductor on thick end of stator/1.5m	1
	Conductor on thin end of stator /1.5m	2

Quellverweis: INN 06.40

Figure 6.5: 1MB 240 frameless spindle motor - type codes

Type codes: Example: 1MR 240 F-A 072

1.	Name:	1MR
2.	Motor size:	240
3.	Motor length:	B, D, F, H
4.	Type of rotor:	
	with step interference fit	A
5.	Inside rotor diameter:	
	72 mm	072
	87 mm	087

Quellverweis: INN 06.42

Figure 6.6: 1MR 240 rotor - type codes

Type codes: Example: 1MS 240 F-4A-A 1

1.	Name:	1MS
2.	Motor size:	240
3.	Motor length:	B, D, F, H
4.	Type of winding:	
	1MB 240B	4A
	1MB 240D	4A
	1MB 240F	4A
	1MB 240H	4A, 4B
5.	Type of stator:	
	with aluminum cooling jacket	A
6.	Electrical connections:	
	Conductor on thick end of stator/1.5m	1
	Conductor on thin end of stator /1.5m	2

Quellverweis: INN 06.41

Figure 6.7: 1MS 240 stator - type codes

7. 1MB 241- technical data

7.1. Frameless spindle motor

Rated data

Designation	Symbol	Unit	1MB 241			
Motor length			D	H		
Type of winding			6A	6C	6D	
Rated power [1)]	P_n	kW	12	18		
Rated torque [1)]	M_n	Nm	112	202		
Rated RPM [1)]	n_n	min^{-1}	1000	850		
Rated voltage [2)]	U_{neff}	V	220		380	
Rated current	I_n	A	62	84	60	
Minimum conductor dia. for INDRAMAT cables	A	mm^2	10	25	16	
Inductance [3)]	L	mH	1.42	1.00	2.12	
Maximum RPM	n_{max}	min^{-1}	9,000			
Rotor moment of inertia	J_m	kgm^2	0.135	0.214		
Weight: Rotor	m	kg	24	39		
Weight: Stator	m	kg	38	63		
Insulation classification DIN VDE 0530 section 1			F			
Technical data liquid cooling mode:						
Rated power dissipation	P_{Vn}	kW	2.0	3.0		
Coolant temperature at entry	ϑ_{ein}	°C	10° to 40°			
Coolant temperature increase with P_{Vn} [4)]	$\Delta\vartheta_n$	K	10			
Ambient temperature		°C	5° to 45°			
Minimum required coolant flow with $\Delta\vartheta_n$ [4)]	Q_n	l/min	2.9	4.3		
Pressure drop with Q_n [4)]	Δp_n	bar	0.1			
Maximum system pressure	p_{max}	bar	3			
Volume of coolant channel	V	l	0.8	1.4		

Cooling jacket material: Aluminum, hard coat surface
O-ring: Viton

1) Data relates to S1 operation of a motor on KDA/TDA drive (U_{neff} = 220V) or RAC (U_{neff} = 380V). The S1 data of other motor-drive combinations can be derived from the relevant characteristics curves.

2) The motors are not suited for direct mains connection.

3) Inductance of the mounted motor spindle at 20°C, measured between the power conductors with $f_\sim$ = 1 kHz.

4) Data relates to water-based coolant. Should other coolants be used (e.g., oil), recalculate data or see flow diagram.

Figure 7.1: 1MB 241 frameless spindle motor - rated data

7.2. Dimensional data

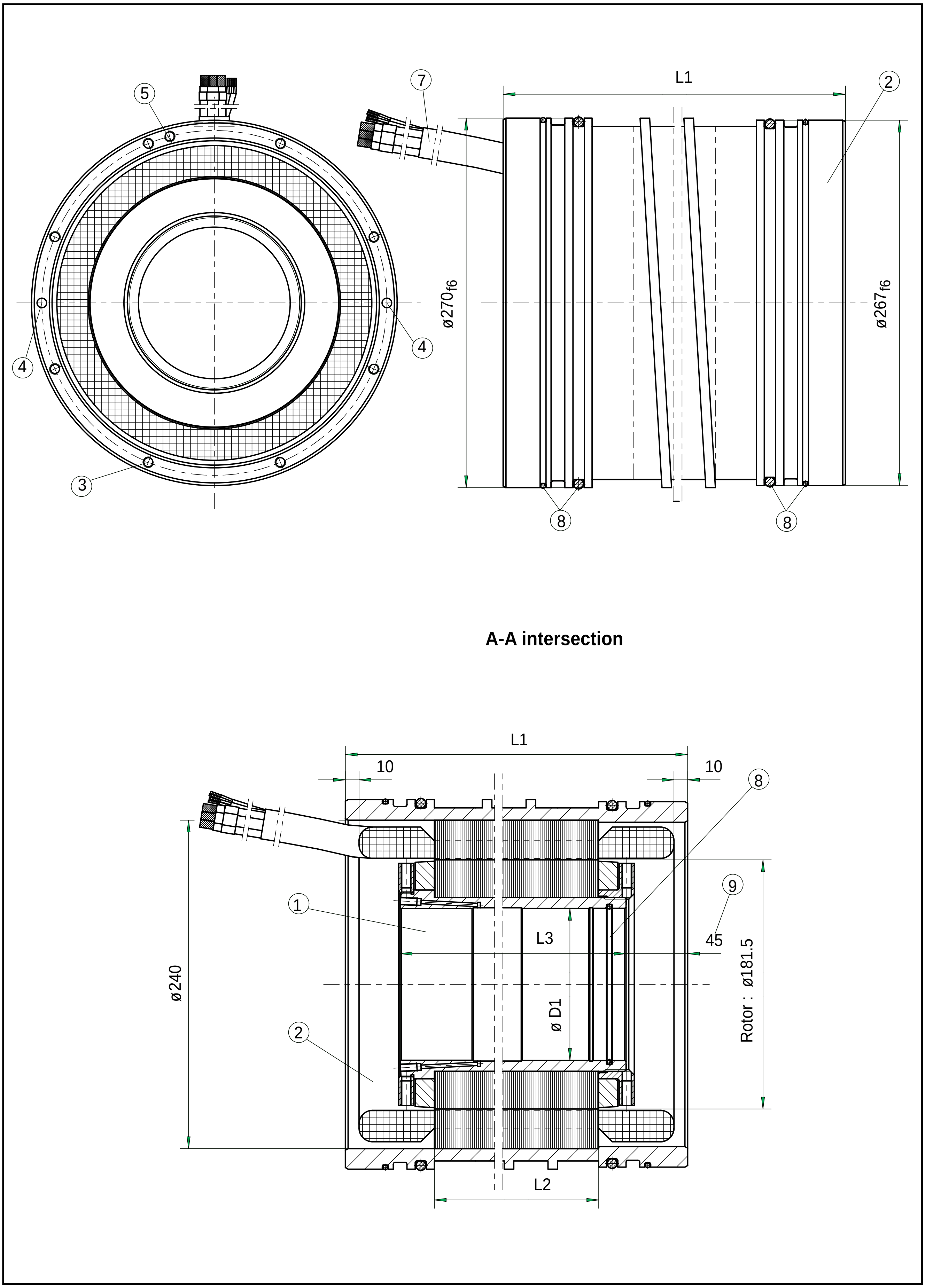
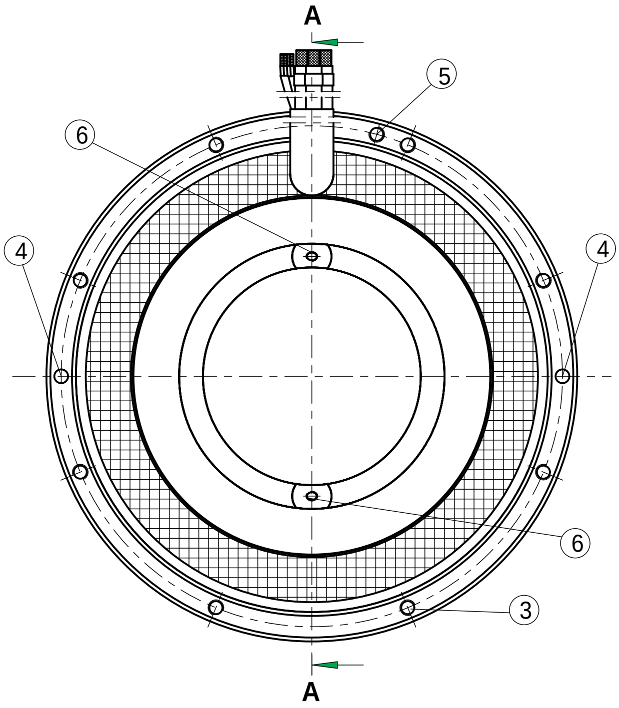


Figure 7.2: 1MB 241 frameless spindle motor - dimensional data (part 1)



1 Rotor 1MR 241...

2 Stator 1MS 241...

3 8x M8 thread for axial mounting to spindle housing

4 ø7 drill hole for cylindrical pin for securing against movements with respect to spindle housing

5 M8 thread for mounting the ground terminal connection

6 Pressure oil connection for step interference fit

7 motor winding length 1500 mm

8 O-ring made of Viton

9 Positional dimension of rotor to stator

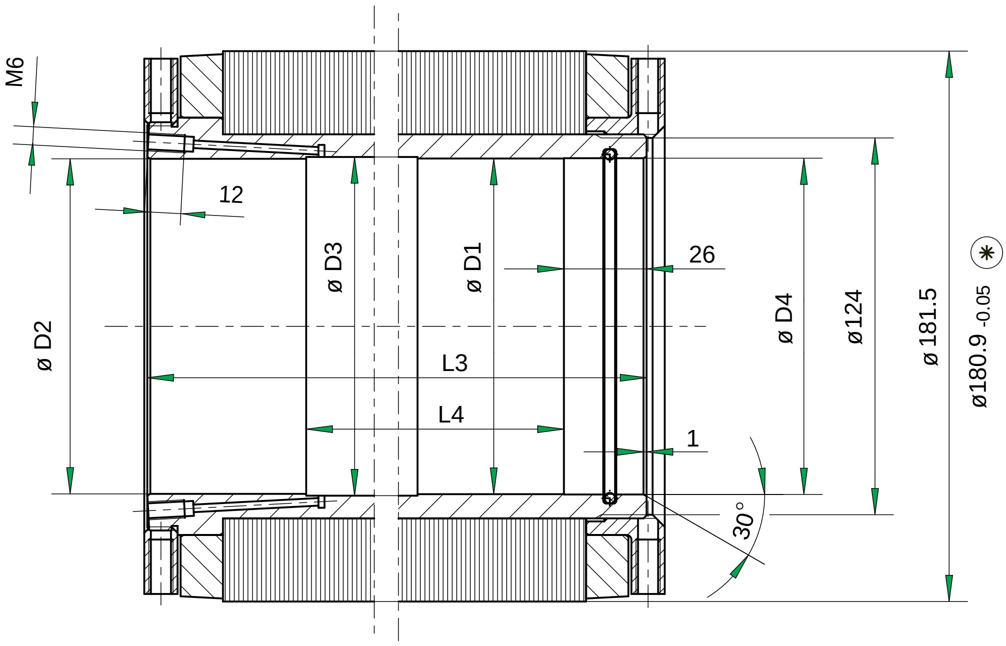
Type \ Dim.	ø D 1 H6		L 1	L 2	L 3
1 MB 241 D	98	111	290	160	205
1 MB 241 H			410	280	325

Quellverweis: 106-0193-3020-00

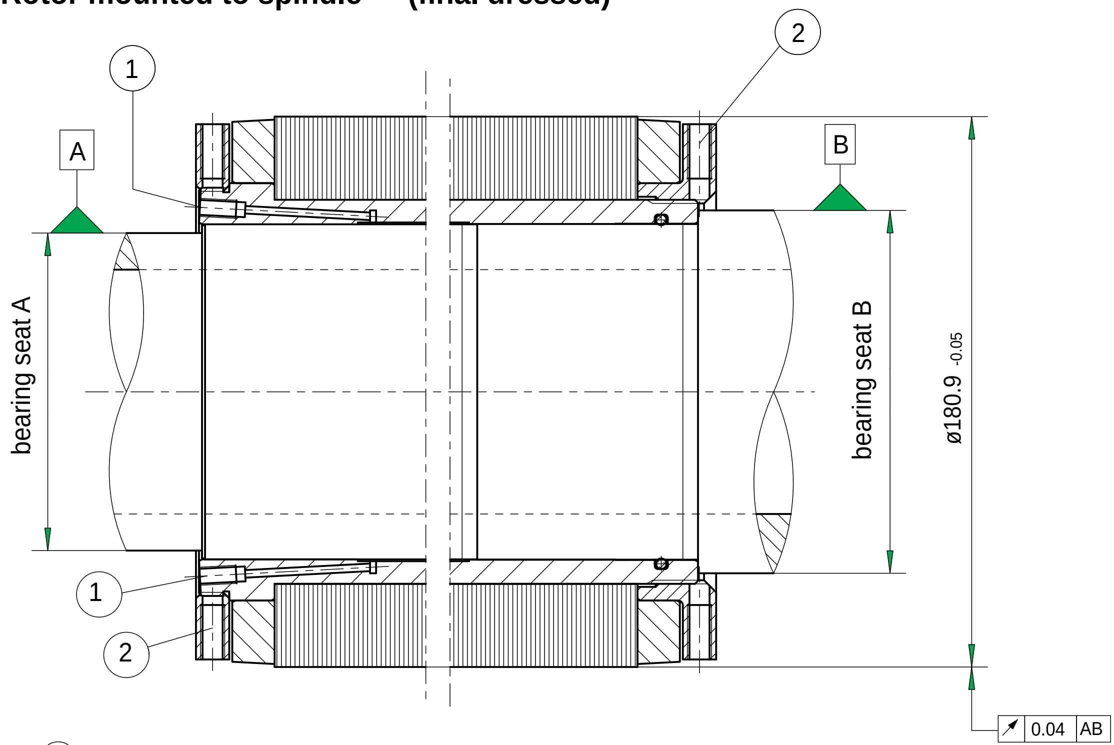
Figure 7.2: 1MB 241 frameless spindle motor - dimensional data (part 2)

7.3. Motor spindle construction

Rotor 1 MR 241... (condition at delivery) ✳



Rotor mounted to spindle (final dressed) ✳



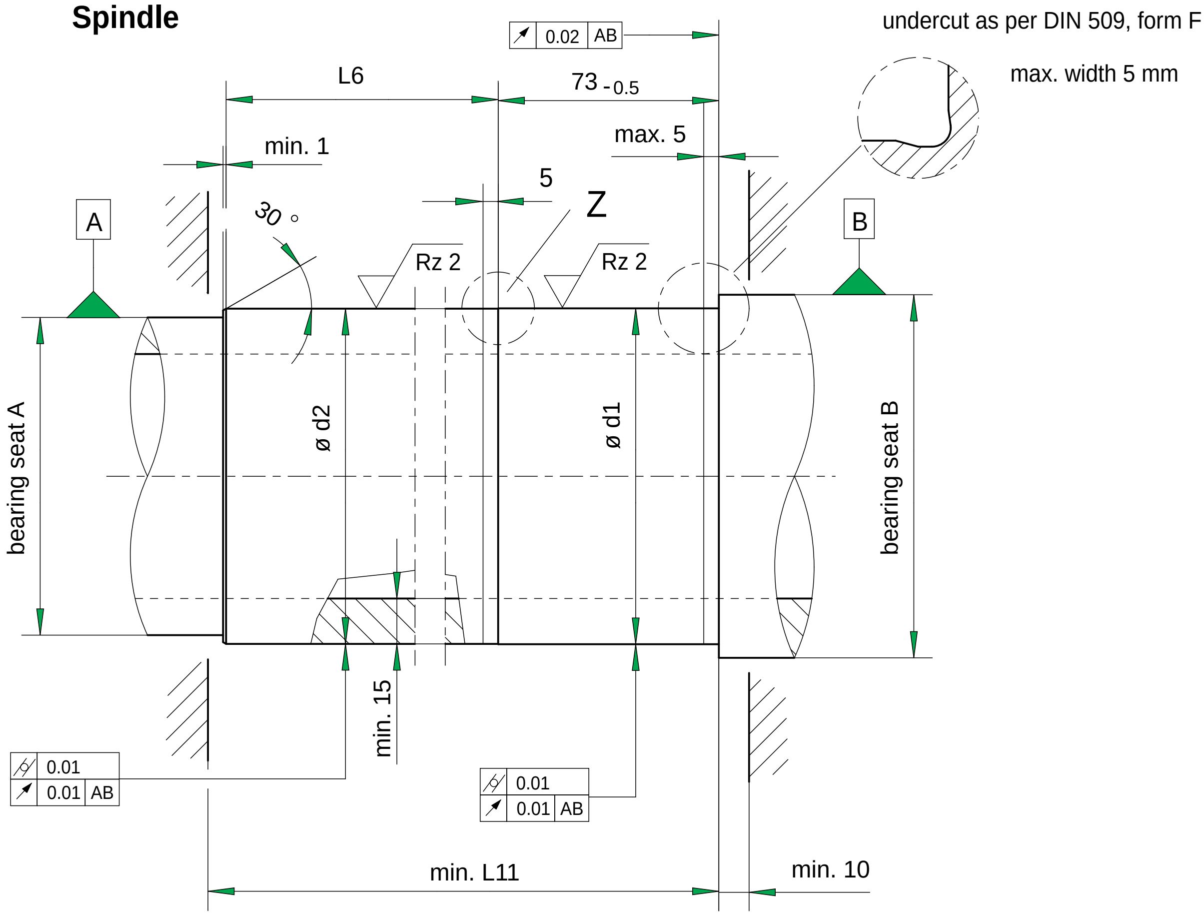
(1) Pressure oil connection
Sealed with threaded pin per DIN 913 after rotor is mounted
Secure threaded pins by bonding with LOCTITE 620

(2) Balancing ring with M8 thread
Threaded pins per DIN 913 for equilibrium when balancing
Secure the threaded pins by bonding with LOCTITE 620

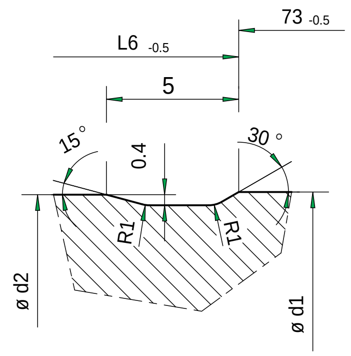
Gewindestifte für (1) (2)
sind im Lieferumfang enthalten

Figure 7.3: 1MR 241 rotor - dimensional data (part 1)

Spindle



Detail Z



✳ **Note! Product change:**

In the future, the rotors will be supplied "final dressed"!

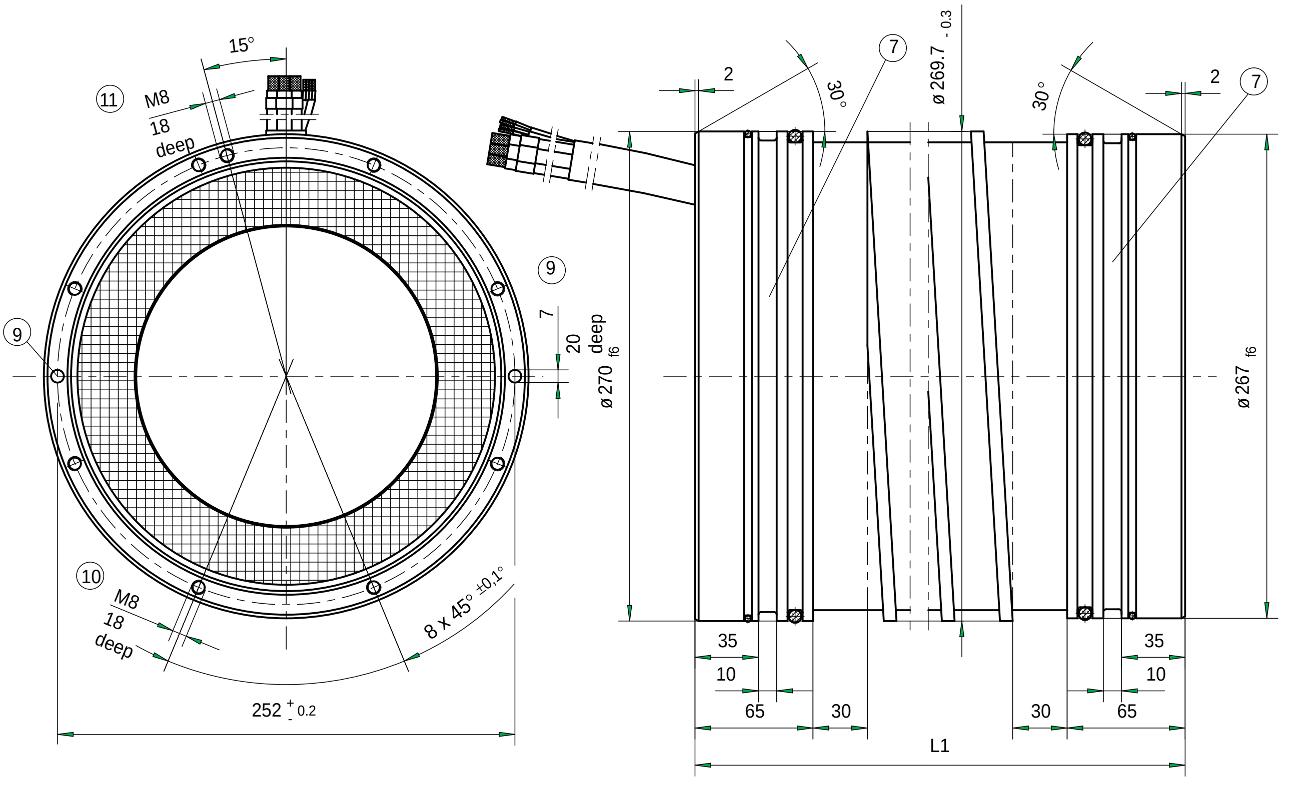
The dimension applies indicated with a ✳

Fit	Dim.
111 s6	+0.101 +0.079
111 H6	+0.022 0
110.8 t6	+0.126 +0.104
110.8 H6	+0.022 0
98 s6	+0.093 +0.071
98 H6	+0.022 0
97.8 t6	+0.113 +0.091
97.8 H6	+0.022 0

Dim. / Type	Rotor						Spindle			
	L3	L4	ø D1 H6	ø D2 H6	ø D3	ø D4	L6 -0.5	ød1 s6	ød2 t6	L11
1 MR 241 D-A098	205	127	98	97.8	99	98.2	130	98	97.8	209
1 MR 241 H-A098	325	247					250			329
1 MR 241 D-A111	205	127	111	110.8	112	111.2	130	111	110.8	209
1 MR 241 H-A111	325	247					250			329

Quellverweis: 106-0193-3021-00

Figure 7.3: 1MR 241 rotor - dimensional data (part 2)



Mounting drill hole:

for axial mounting of the stator to the end shield

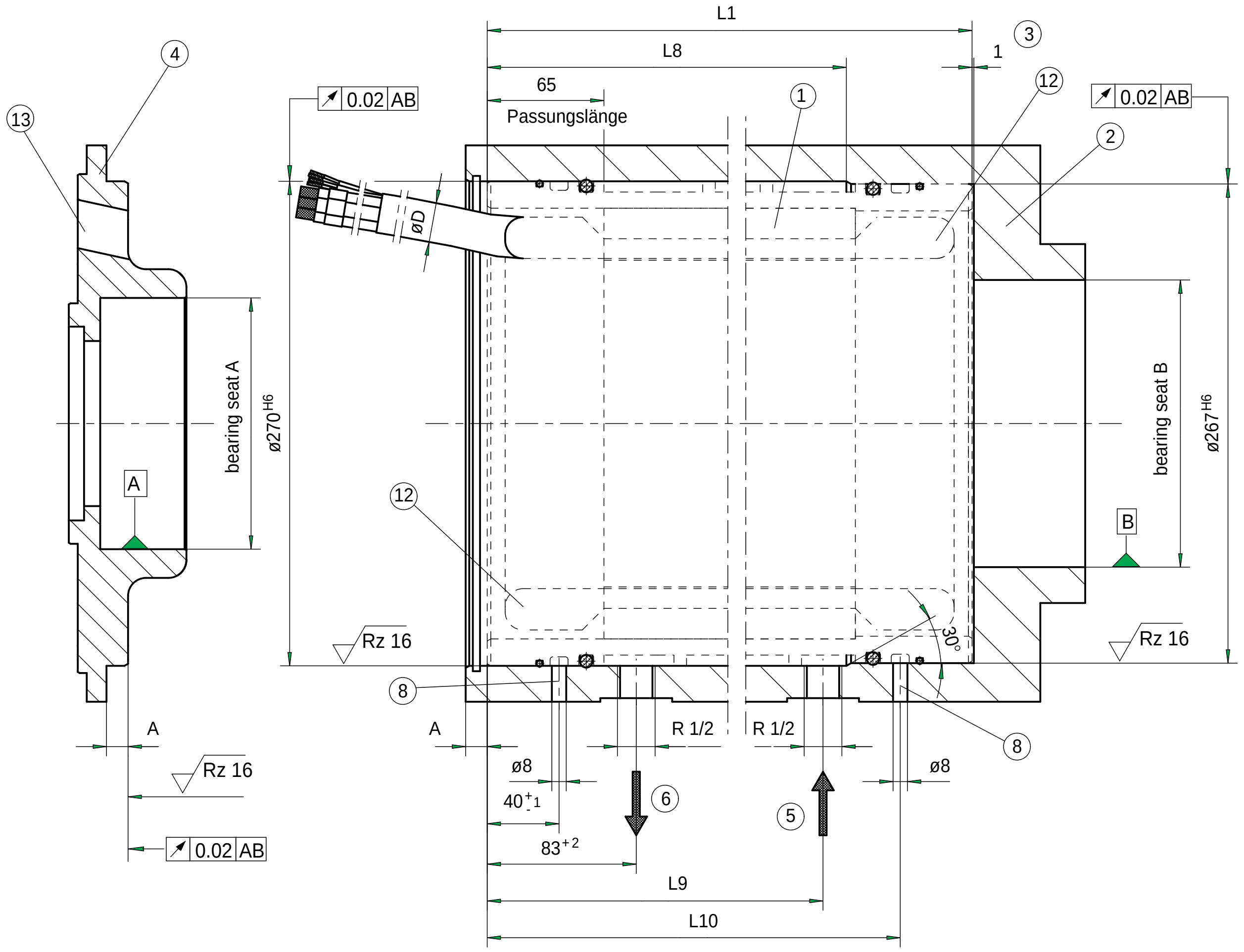
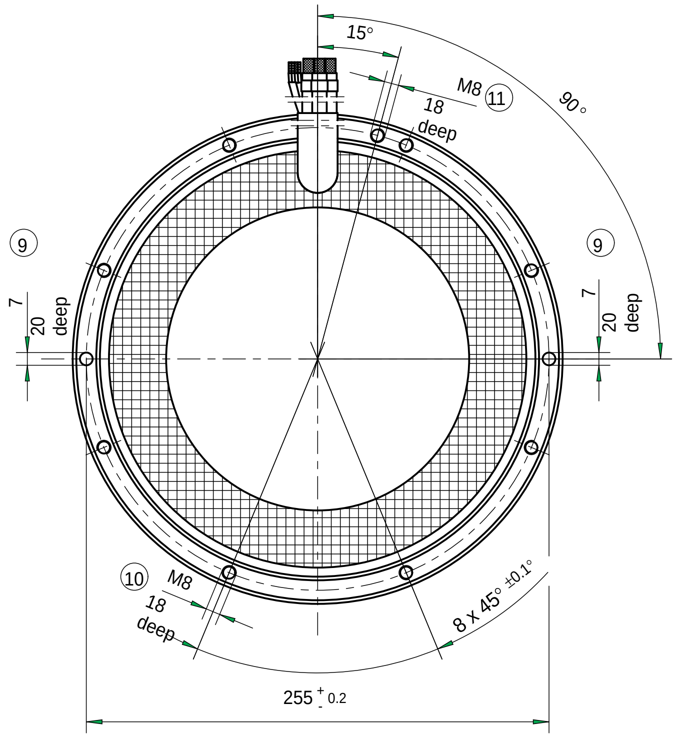


Figure 7.4: 1MS 241 stator - dimensional data (part 1)



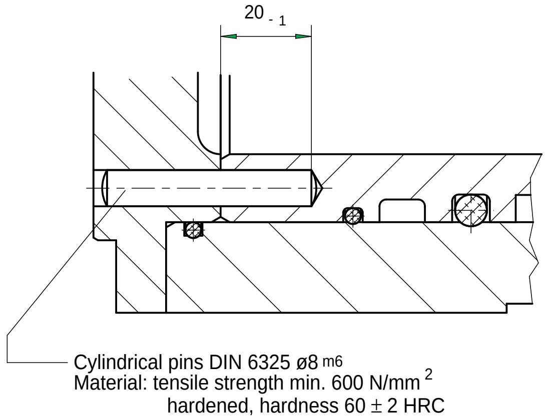
1. Stator 1 MS 241...
2. Spindle housing
3. Minimum clearance for expansion
4. End shield
5. Coolant feed thread per DIN 2999 anywhere on circumference
6. Coolant drain thread as per DIN 2999 anywhere on circumference
7. Leakage groove
8. Leakage drill hole

(9) (10) (11) on either end of stator

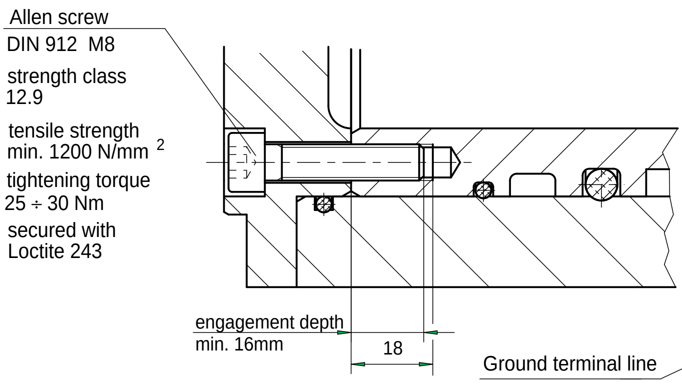
12. End winding
    Minimum clearance to housing at least 5 mm
13. Cable leadthrough with rounded edges

Dim. / Type	L1	L8 +1	L9 -2	L10 +/- 1	motor winding øD	motor winding bend radius
1 MS 241 D-6A	290	221	207	250	20	70
1 MS 241 H-6C	410	341	327	370	22	90
1 MS 241 H-6D						

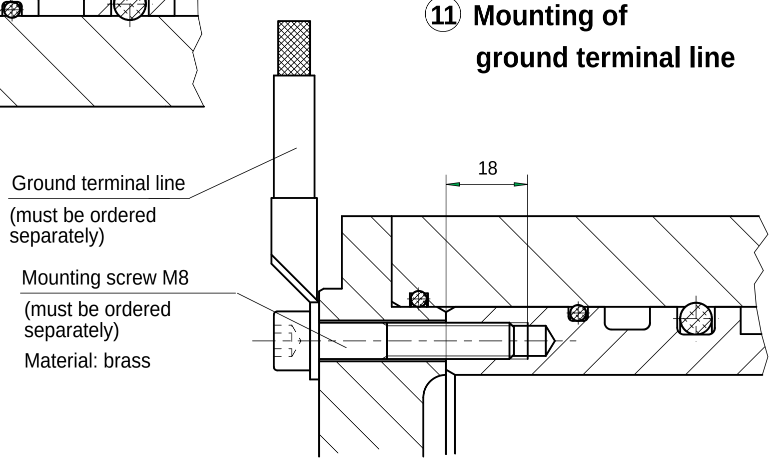
(9) Secure against movements on end shield



(10) Axial mounting to end shield



(11) Mounting of ground terminal line



Quellverweis: 106-0193-2022-00

Figure 7.4: 1MS 241 stator - dimensional data (part 2)

7.4. 1MB 241 - type codes

Type codes: Example: 1MB 241 H-6C-A 111 A 1

1.	Name:	1MB
2.	Motor size:	241
3.	Motor length:	D, H
4.	Type of winding: 1MB 241D 1MB 241H	 6A 6C, 6D
5.	Type of rotor: with step interference fit	 A
6.	Inside rotor diameter: 98 mm 111 mm	 098 111
7.	Type of stator: with aluminum cooling jacket	 A
8.	Electrical connections: Conductor on thick end of stator/1.5m Conductor on thin end of stator /1.5m	 1 2

Quellverweis: INN 06.40

Figure 7.5: 1MB 241 frameless spindle motor - type codes

Type codes: Example: 1MR 241 H-A 111

1.	Name:	1MR
2.	Motor size:	241
3.	Motor length:	D, H
4.	Type of rotor: with step interference fit	 A
5.	Inside rotor diameter: 98 mm 111 mm	 098 111

Quellverweis: INN 06.42

Figure 7.6: 1MR 241 rotor - type codes

Type codes: Example: 1MS 241 H-6C-A 1

1.	Name:	1MS
2.	Motor size:	241
3.	Motor length:	D, H
4.	Type of winding: 1MB 241D 1MB 241H	 6A 6C, 6D
5.	Type of stator: with aluminum cooling jacket	 A
6.	Electrical connections: Conductor on thick end of stator/1.5m Conductor on thin end of stator /1.5m	 1 2

Quellverweis: INN 06.41

Figure 7.7: 1MS 241 stator - type codes

8. 1MB 242 - technical data

8.1. Frameless spindle motor

Rated data

Designation	Symbol	Unit	1MB 242			
Motor length			N			
Type of winding			4B			
Rated power [1)]	P_n	kW	33			
Rated torque [1)]	M_n	Nm	185			
Rated RPM [1)]	n_n	min^{-1}	1700			
Rated voltage [2)]	U_{neff}	V	380			
Rated current	I_n	A	98			
Minimum conductor dia. for INDRAMAT cables	A	mm^2	35			
Inductance [3)]	L	mH	1.29			
Maximum RPM	n_{max}	min^{-1}	16,000			
Rotor moment of inertia	J_m	kgm^2	0.135			
Weight: Rotor Stator	m m	kg kg	37 81			
Insulation classification DIN VDE 0530, section 1			F			
Technical data liquid cooling mode:						
Rated power dissipation	P_{Vn}	kW	3.0			
Coolant temperature at entry	ϑ_{ein}	°C	10° to 40°			
Coolant temperature-increase with P_{Vn} [4)]	$\Delta\vartheta_n$	K	10			
Ambient temperature		°C	5° to 45°			
Minimum required coolant flow with $\Delta\vartheta_n$ [4)]	Q_n	l/min	4.3			
Pressure drop with Q_n [4)]	Δp_n	bar	0.1			
Maximum system pressure	p_{max}	bar	3			
Volume of coolant channel	V	l	1.6			

Cooling jacket material: Aluminum, hard coat surface
O-ring: Viton

1) Data relates to S1 operation of a motor on KDA/TDA drive (U_{neff} = 220V) or RAC (U_{neff} = 380V). The S1 data of other motor-drive combinations can be derived from the relevant characteristics curves.

2) The motors are not suited for direct mains connection.

3) Inductance of the mounted motor spindle at 20°C, measured between the power conductors with $f_\sim$ = 1 kHz.

4) Data relates to water-based coolant. Should other coolants be used (e.g., oil), recalculate data or see flow diagram.

Figure 8.1: 1MB 242 frameless spindle motor - rated data

8.2. Dimensional data

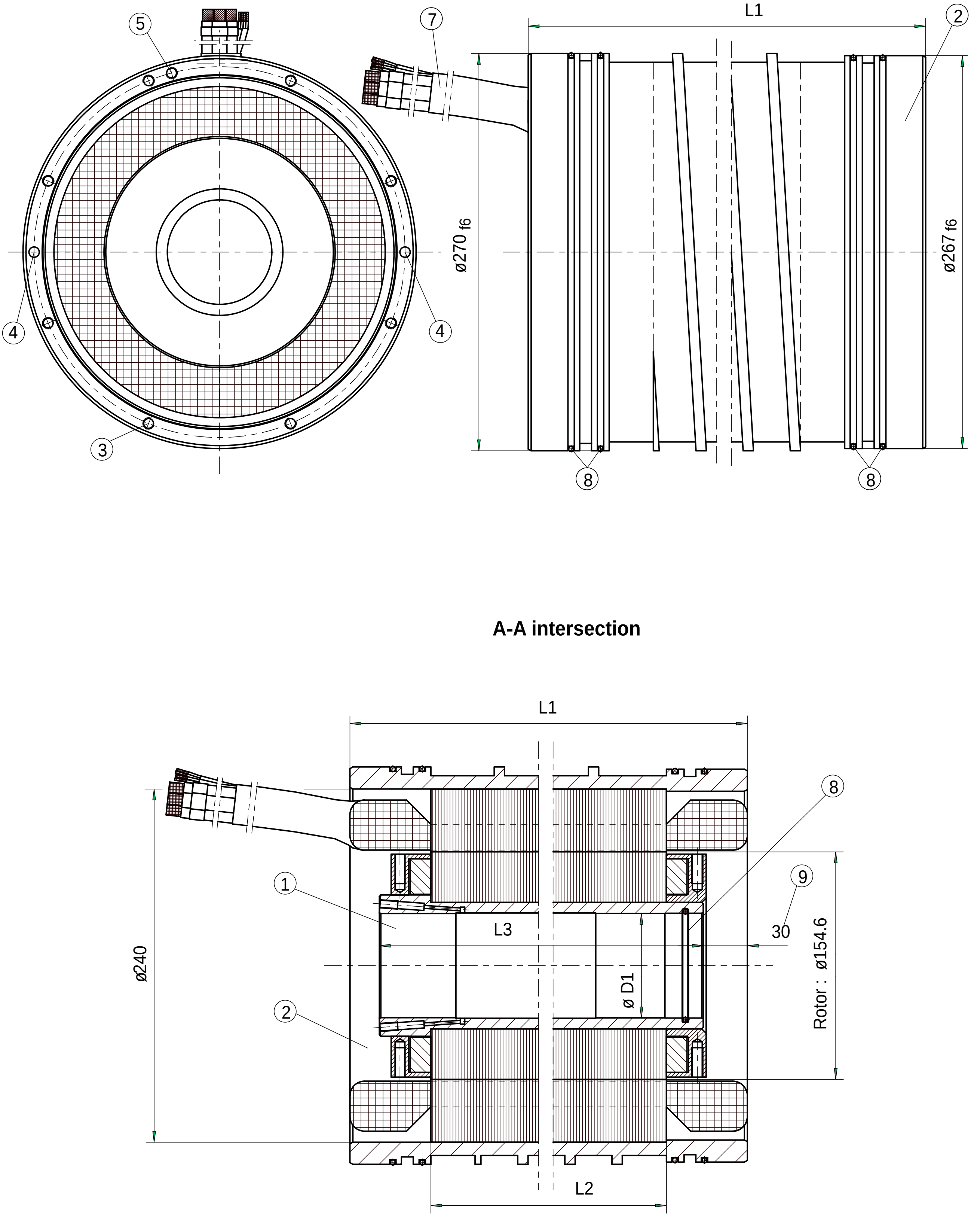
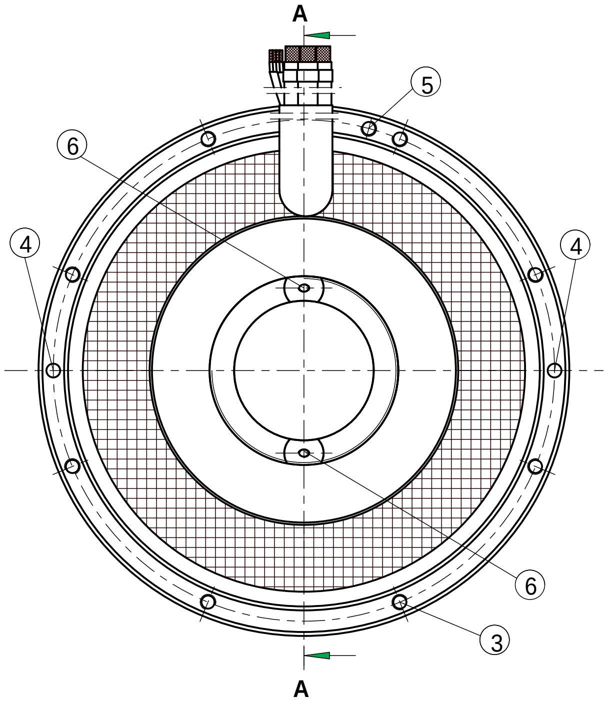


Figure 8.2: 1MB 242 frameless spindle motor - dimensional data (part 1)



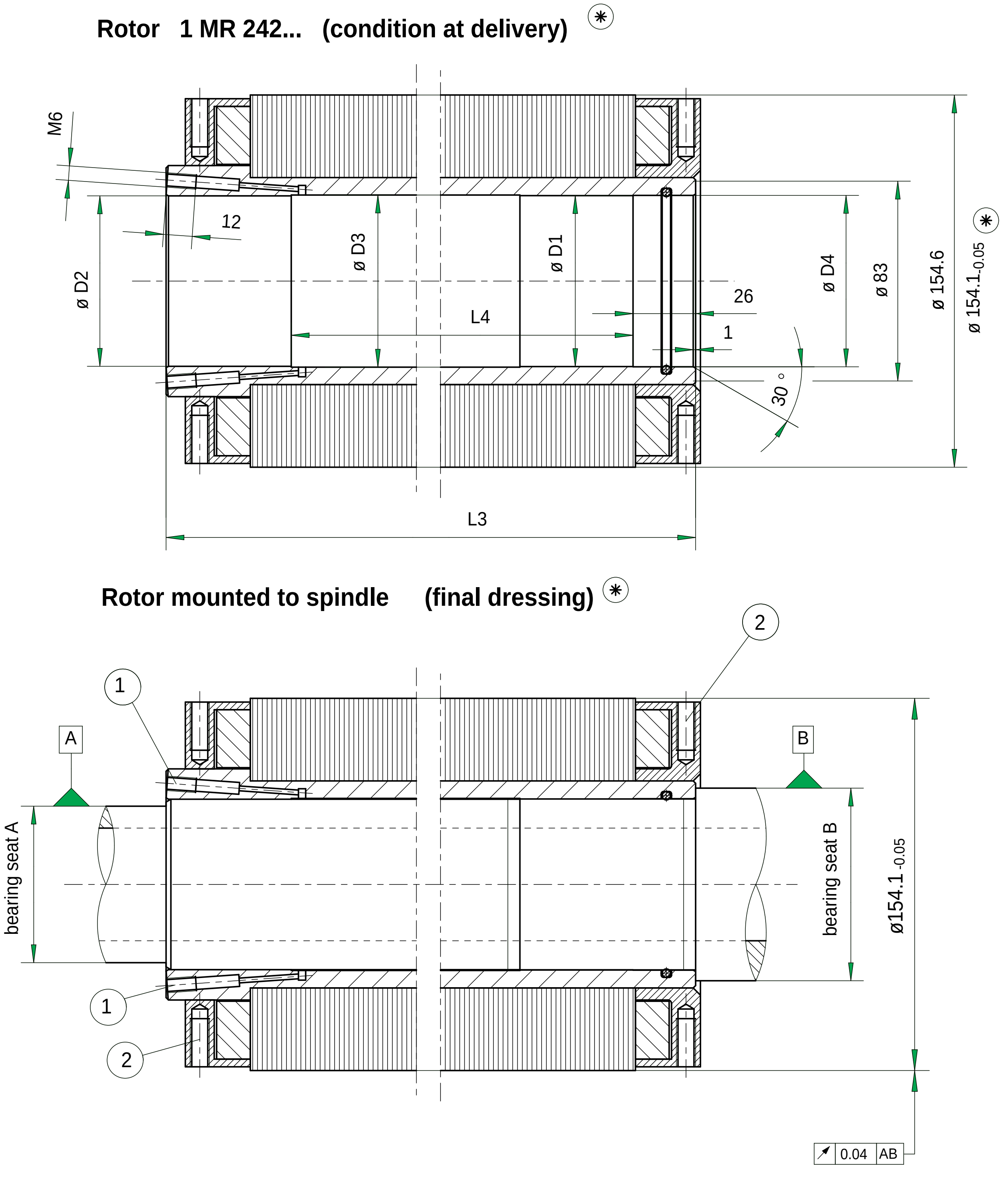
1. Rotor 1MR 242...
2. Stator 1MS 242...
3. 8x M8 thread for axial mounting to spindle housing
4. ø7 drill hole for cylindrical pins for securing against movements with respect to spindle housing
5. M8 thread for mounting ground terminal
6. Pressure oil connection step interference fit
7. motor winding 1500 mm long
8. O-ring made of Viton
9. Positional dimension of rotor to stator

Dim. / Type	ø D 1 ^{H6}	L 1	L 2	L 3
1 MB 242 N	71	440	330	390

Quellverweis: 106-0194-3020-00

Figure 8.2: 1MB 242 frameless spindle motor - dimensional data (part 2)

8.3. Motor spindle construction

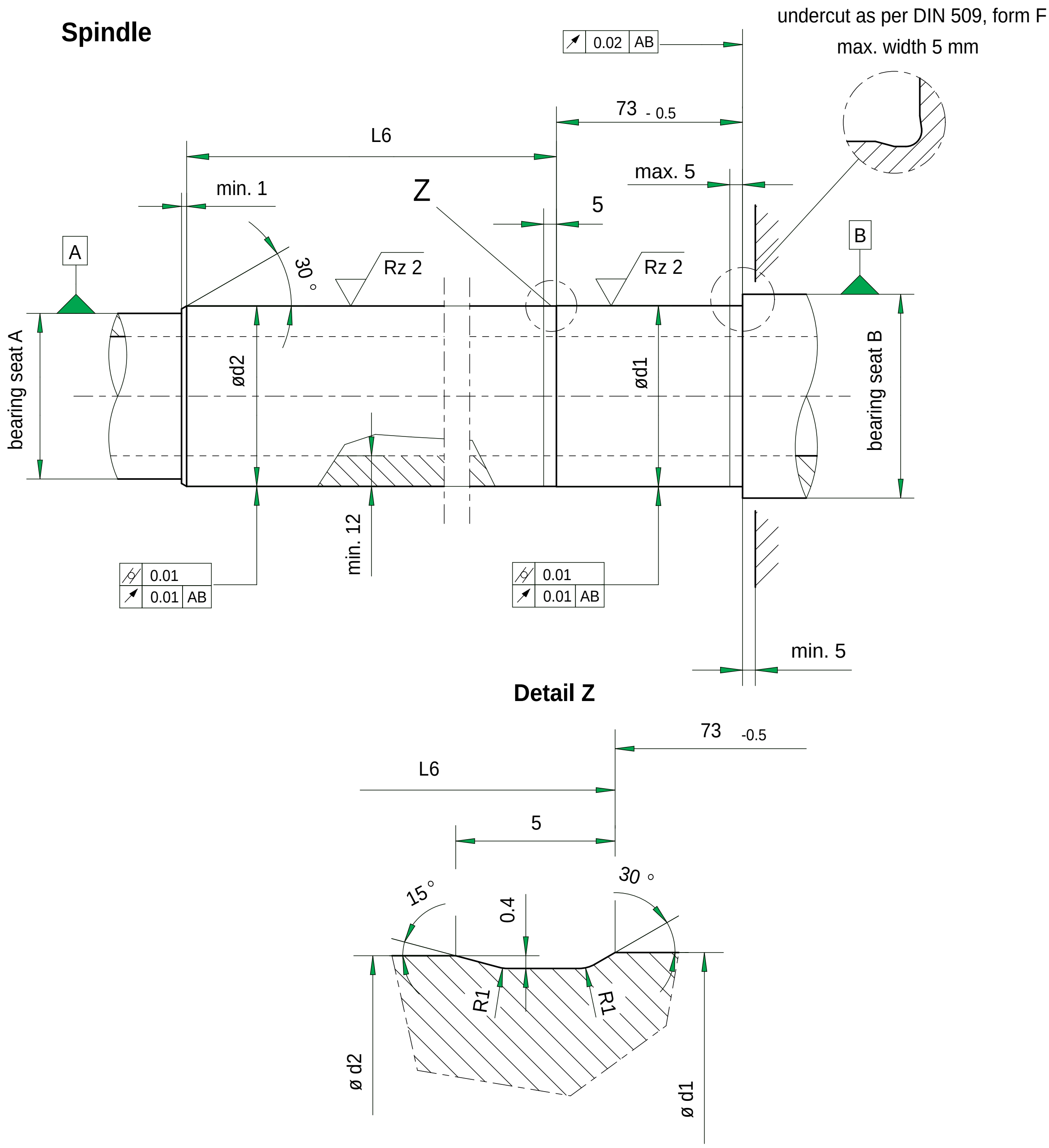


1 Pressure oil connection
Sealed with threaded pins per DIN 913 after rotor is mounted
Secure the threaded pins by bonding with LOCTITE 620

2 Balance ring with M6 or M8 thread
Threaded pins per DIN 913 for equilibrium when balancing
Secure the threaded pins by bonding with LOCTITE 620

Threaded pins for 1 2 are general part of order.

Figure 8.3: 1MR 242 rotor - dimensional data (part 1)



✳ Note! Product change:

In the future, the rotors will be supplied "final dressed"!

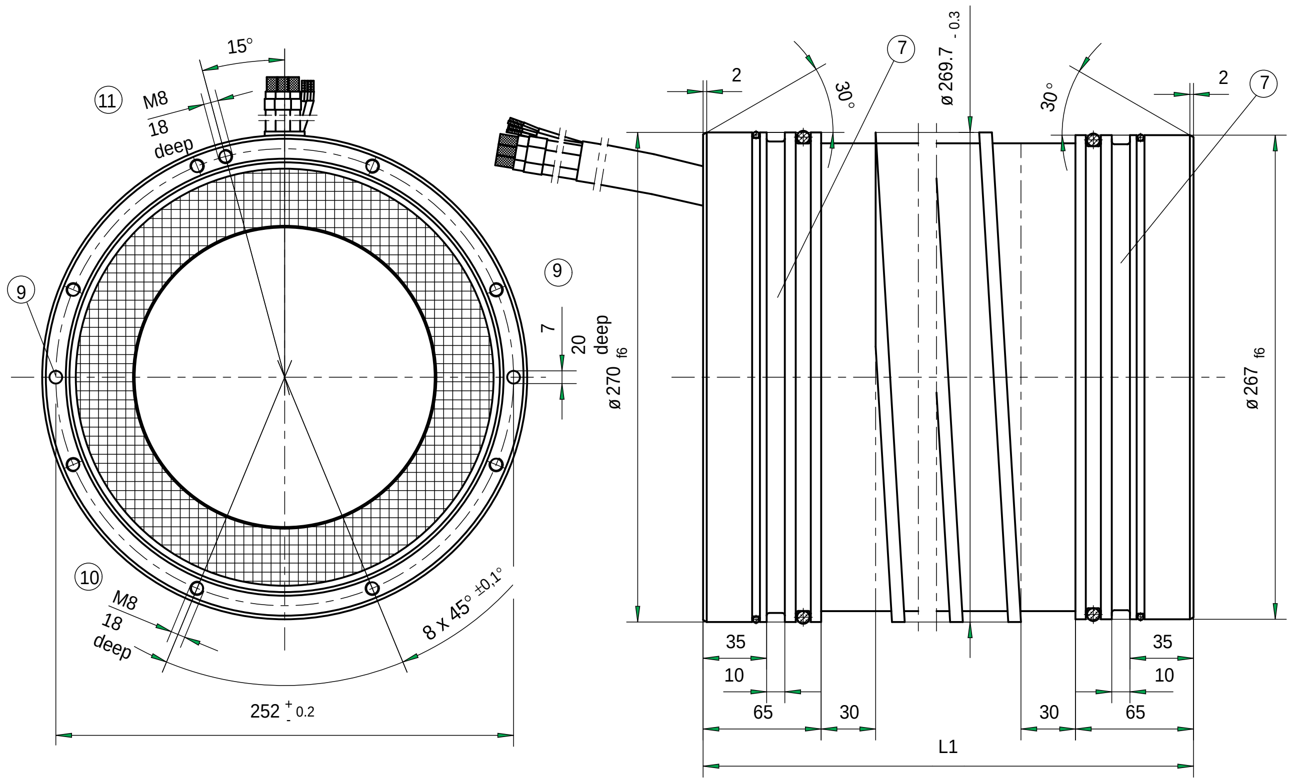
The dimension applies indicated with a ✳

Fit	Dim.
71 s6	+0.078 +0.059
71 H6	+0.019 0
70.8 t6	+0.094 +0.075
70.8 H6	+0.019 0

Type / Dim.	Rotor						Spindle		
	L3	L4	ø D1 H6	ø D2 H6	ø D3	ø D4	L6 -0.5	ød1 s6	ød2 t6
1 MR 242 N-A071	390	312	71	70.8	72	71.2	315	71	70.8

Quellverweis: 106-0194-3021-00

Figure 8.3: 1MR 242 rotor - dimensional data (part 2)



Mounting drill hole:

for axial mounting of the stator to the end shield

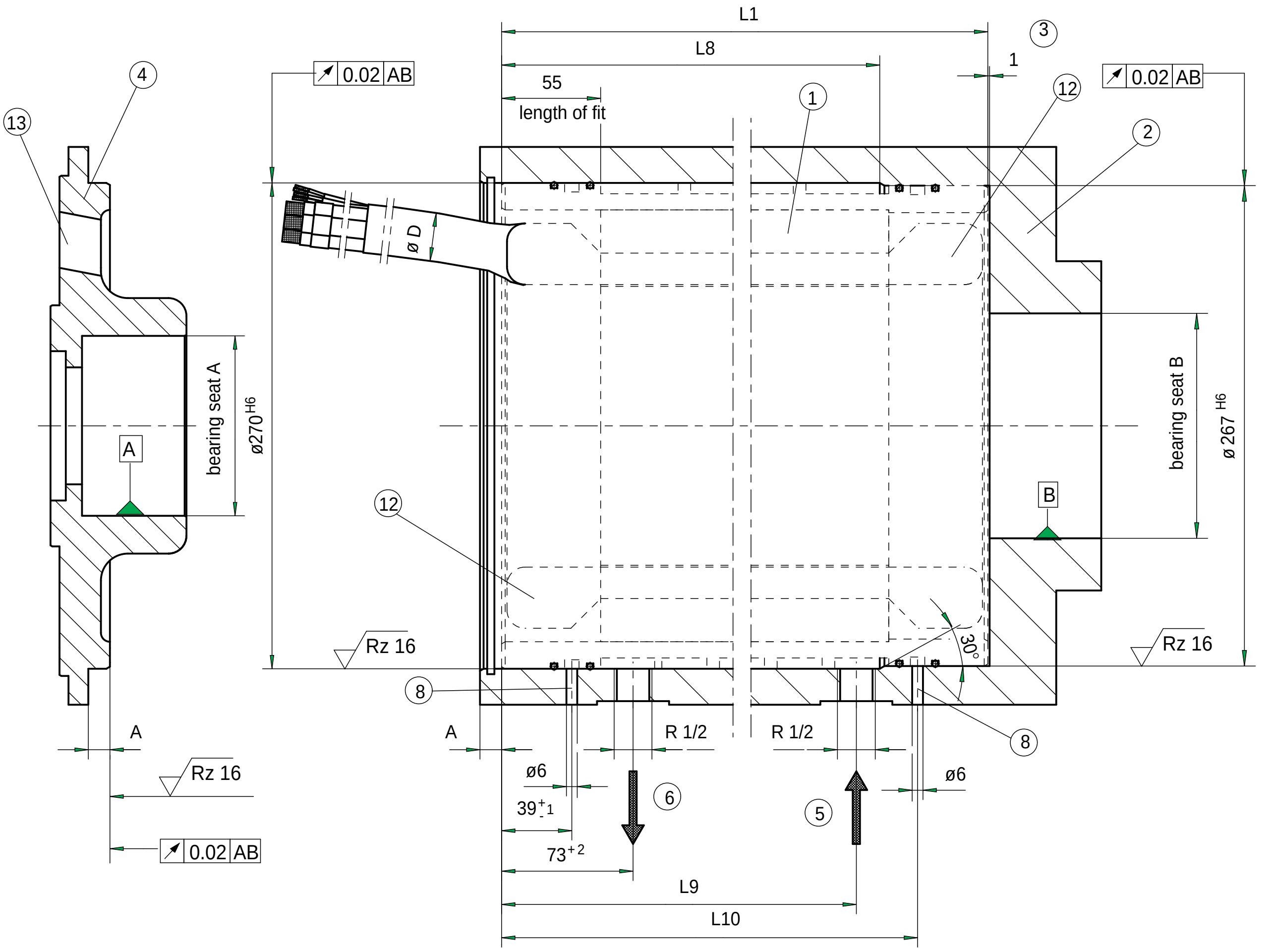
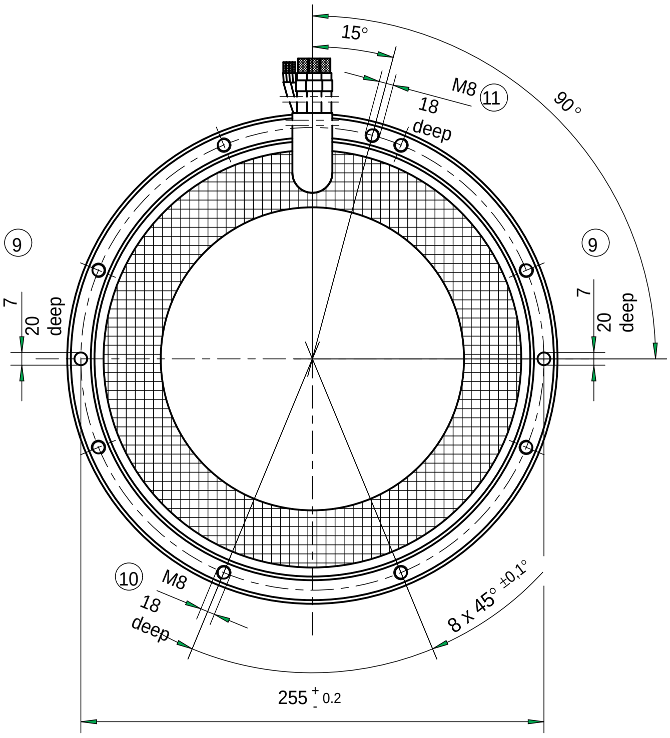


Figure 8.4: 1MS 242 stator - dimensional data (part 1)



(1) Stator 1 MS 242...

(2) Spindle housing

(3) Minimum clearance for expansion

(4) end shield

(5) Coolant feed thread DIN 2999 anywhere on circumference

(6) Coolant drain thread DIN 2999 anywhere on circumference

(7) Leakage groove

(8) Leakage drill hole

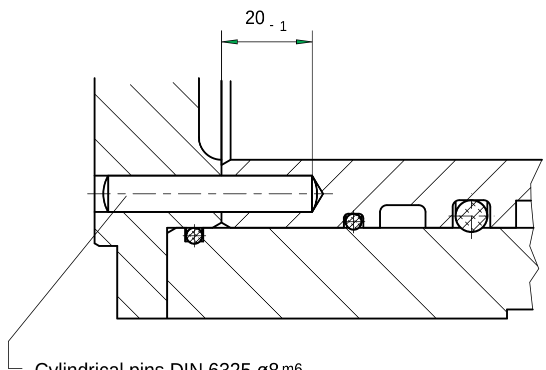
(9) (10) (11) on either end of stator

(12) End winding
Minimum clearance of 5 mm to housing

(13) Cable leadthrough with rounded edges

Type \ Dim.	L1	L8 +1	L9 -2	L10 ± 1	motor winding øD	motor winding bend radius
1 MS 242 N-4B	440	381	367	401	27	110

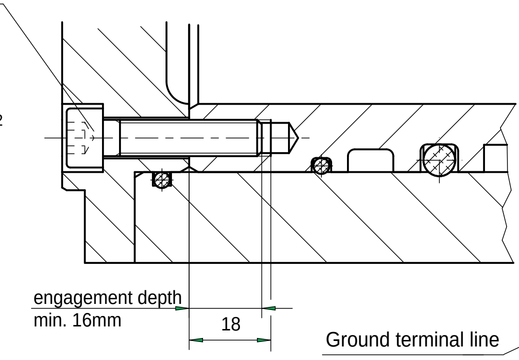
(9) Secure against movements on end shield



Cylindrical pins DIN 6325 ø8 m6
Material: Tensile strength min. 600 N/mm²
hardened, hardness 60 ± 2 HRC

(10) Axial mounting to end shield

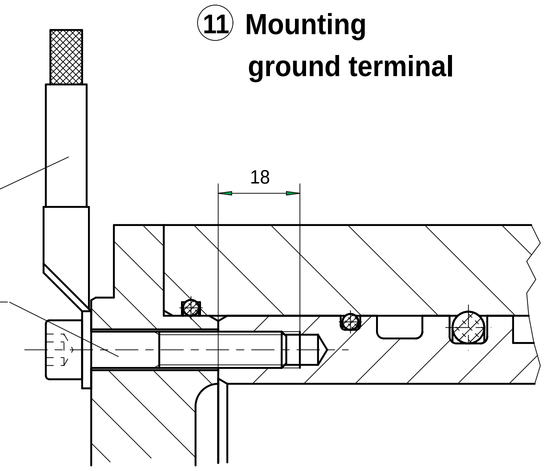
Allen screw
DIN 912 M8
strength class 12.9
tensile strength min. 1200 N/mm 2
tightening torque 25 ÷ 30 Nm
secure with Loctite 243



(11) Mounting ground terminal

Ground terminal line
(must be ordered separately)

Mounting screw M8
(must be ordered separately)
Material: brass



Quellverweis: 106-0194-2022-00

Figure 8.4: 1MS 242 stator - dimensional data (part 2)

8.4. 1MB 242 - type codes

Type codes: Example: 1MB 242 N-4B-A 071 A 1

1.	Name:	1MB
2.	Motor size:	242
3.	Motor length:	N
4.	Type of winding: 1MB 242N	4B
5.	Type of rotor: with step interference fit	A
6.	Inside rotor diameter: 71 mm	071
7.	Type of stator: with aluminum cooling jacket	A
8.	Electrical connections: Conductor on thick end of stator/1.5m Conductor on thin end of stator /1.5m	 1 2

Quellverweis: INN 06.40

Figure 8.5: Frameless spindle motor 1MB 242 - type codes

Type codes: Example: 1MR 242 N-A 071

1.	Name:	1MR
2.	Motor size:	242
3.	Motor length:	N
4.	Type of rotor: with step interference fit	A
5.	Inside rotor diameter: 71 mm	071

Quellverweis: INN 06.42

Figure 8.6: Rotor 1MR 242 - type codes

Type codes: Example: 1MS 242 N-4B-A 1

1.	Name:	1MS
2.	Motor size:	242
3.	Motor length:	N
4.	Type of winding: 1MB 241D	4B
5.	Type of stator: with aluminum cooling jacket	A
6.	Electrical connections: Conductor on thick end of stator/1.5m Conductor on thin end of stator /1.5m	 1 2

Quellverweis: INN 06.41

Figure 8.7: Stator 1MS 242 - type codes

9. 1MB 270 - technical data

9.1. Frameless spindle motor

Rated data

Designation		Symbol	Unit	1MB 270			
Motor length				C			
Type of winding				4B			
Rated power	1)	P_n	kW	30			
Rated torque	1)	M_n	Nm	190			
Rated RPM	1)	n_n	min^{-1}	1500			
Rated voltage	2)	U_{neff}	V	380			
Rated current		I_n	A	96			
Minimum conductor dia. for INDRAMAT cables		A	mm^2	35			
Inductance	3)	L	mH	1.25			
Maximum RPM		n_{max}	min^{-1}	12,000			
Rotor moment of inertia		J_m	kgm^2	0.258			
Weight: Rotor Stator		m m	kg kg	52 82			
Insulation classification DIN VDE 0530, section 1				F			
Technical data liquid cooling mode:							
Rated power dissipation		P_{Vn}	kW	3.6			
Coolant temperature at entry		ϑ_{ein}	°C	10° to 40°			
Coolant temperature-increase with P_{Vn}	4)	$\Delta\vartheta_n$	K	10			
Ambient temperature			°C	5° to 45°			
Minimum required coolant flow with $\Delta\vartheta_n$	4)	Q_n	l/min	5.2			
Pressure drop with Q_n	4)	Δp_n	bar	0.2			
Maximum system pressure		p_{max}	bar	3			
Volume of coolant channel		V	l	1.5			

Cooling jacket material: Aluminum, hard coat surface
O-ring: Viton

1) Data relates to S1 operation of a motor on KDA/TDA drive (U_{neff} = 220V) or RAC (U_{neff} = 380V). The S1 data of other motor-drive combinations can be derived from the relevant characteristics curves.

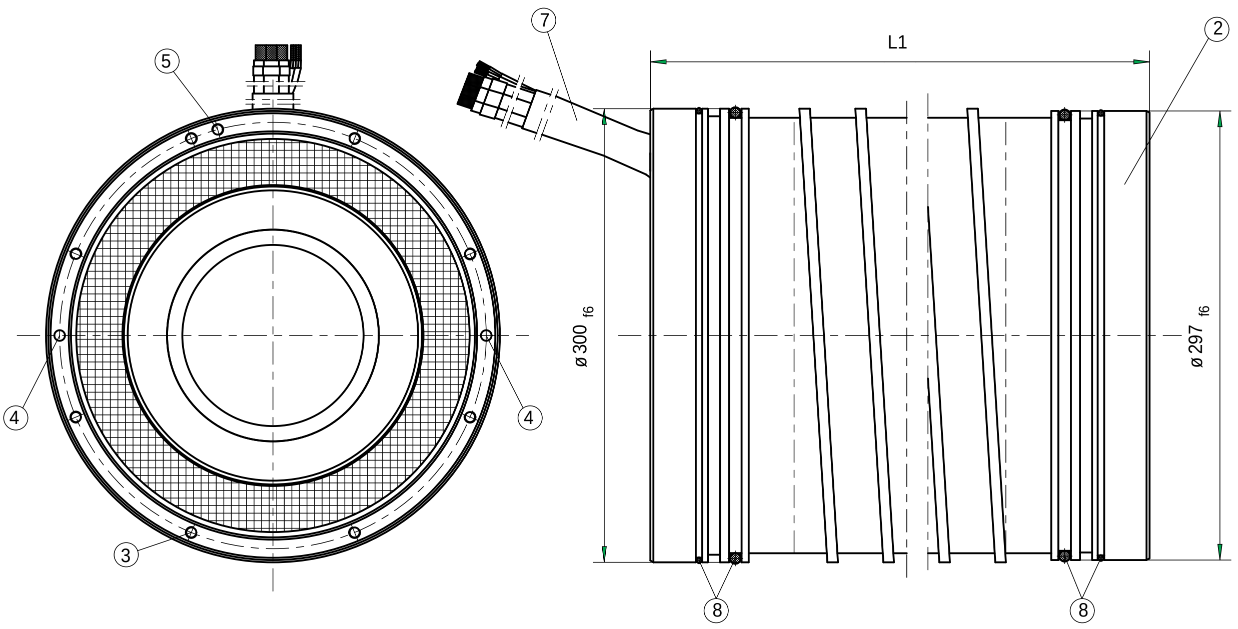
2) The motors are not suited for direct mains connection.

3) Inductance of the mounted motor spindle at 20°C, measured between the power conductors with $f_{\sim}$ = 1 kHz.

4) Data relates to water-based coolant. Should other coolants be used (e.g., oil), recalculate data or see flow diagram.

Figure 9.1: 1MB 270 frameless spindle motor - rated data

9.2. Dimensional data



A-A intersection

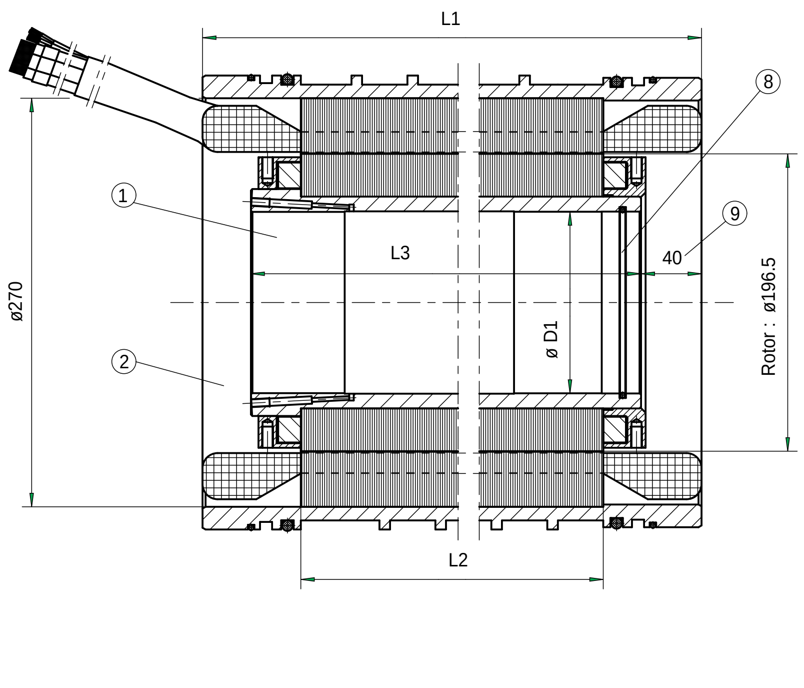
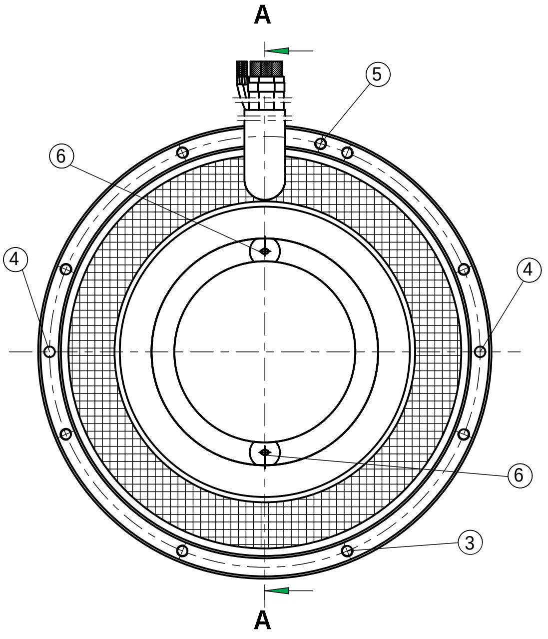


Figure 9.2: 1MB 270 frameless spindle motor - dimensional data (part 1)



1. Rotor 1MR 270...
2. Stator 1MS 270...
3. 8x M8 thread for axial mounting to spindle housing
4. ø7 drill hole for cylindrical pins for securing against movements with respec to the spindle housing
5. M8 thread for mounting the ground terminal
6. Pressure oil connection step interference fit
7. Motor winding length 1500 mm
8. O-ring made of Viton
9. Positional dimension of rotor to stator

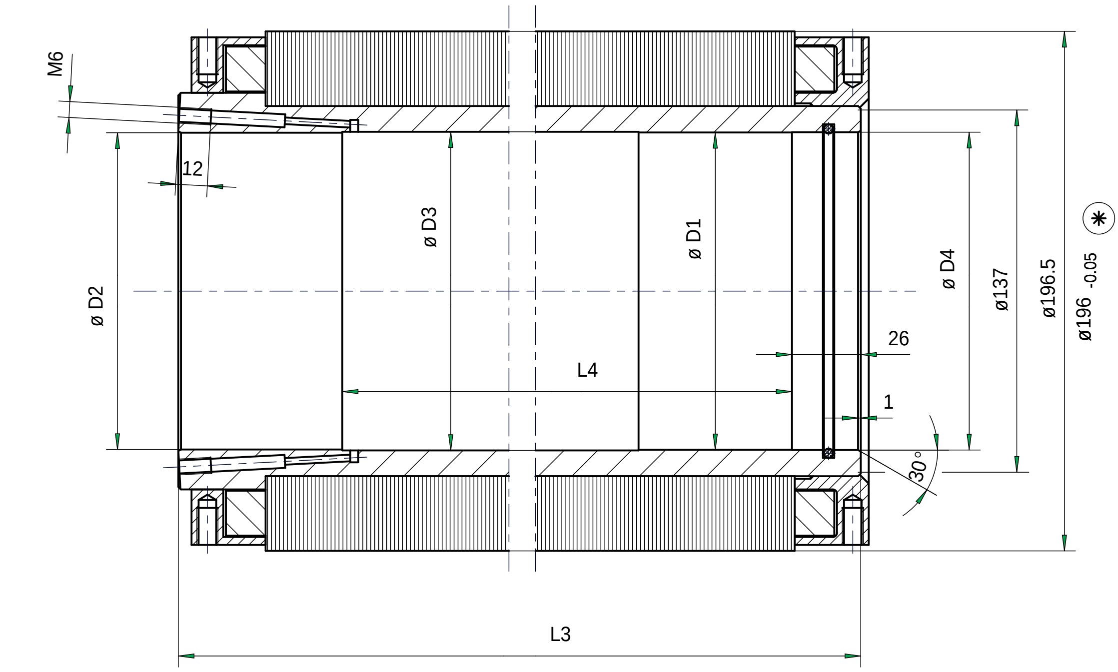
Dim. / Type	ø D 1 H6		L 1	L 2	L 3
1 MB 270 C	90	120	400	270	328

Quellverweis: 106-0259-3020-00

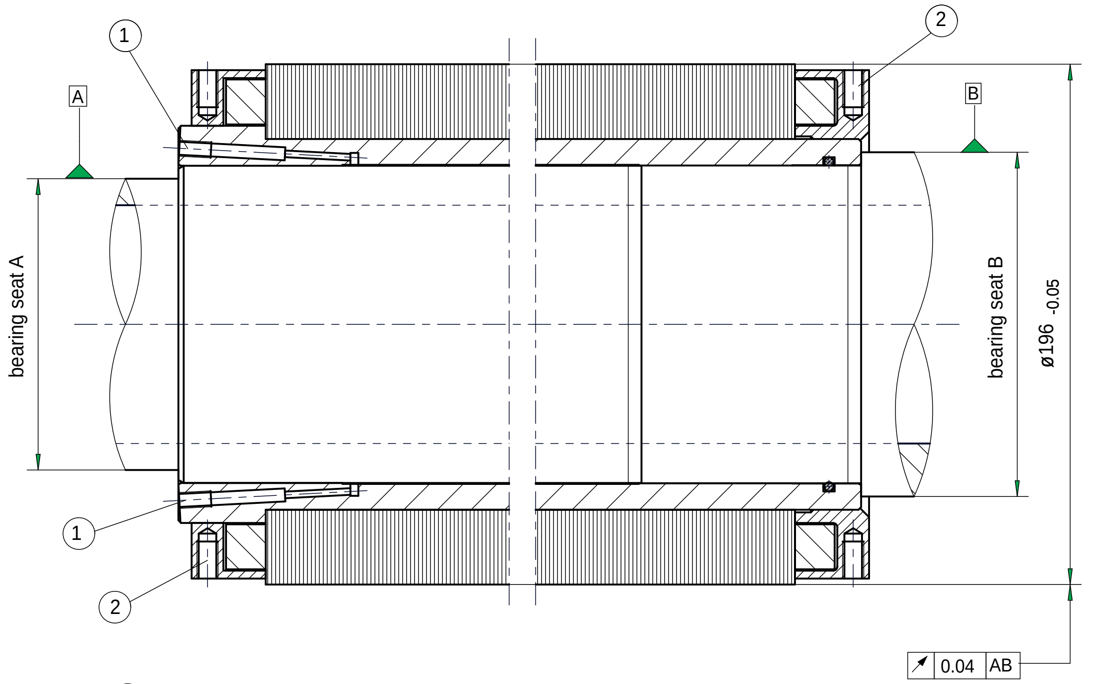
Figure 9.2: 1MB 270 frameless spindle motor - dimensional data (part 2)

9.3. Motor spindle construction

Rotor 1 MR 270... (condition at delivery) (✳)



Rotor mounted to spindle (final dressing) (✳)



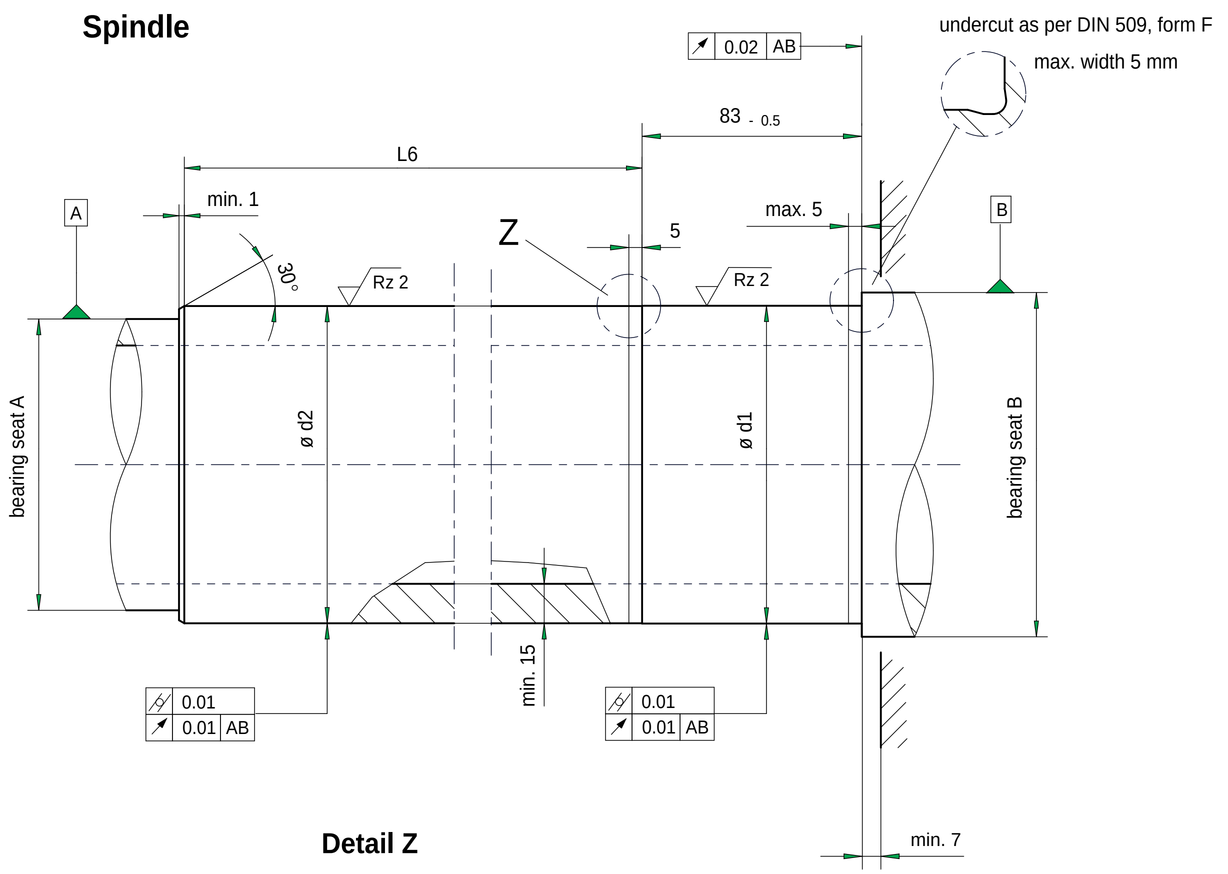
(1) Pressure oil connection
Sealed with threaded pins as per DIN 913 after mounting of rotor
Threaded pins bonded and secured with LOCTITE 620

(2) Balancing with M6 thread
Threaded pins as per DIN 913 for equilibrium when balancing
Threaded pins secured and bonded with LOCTITE 620

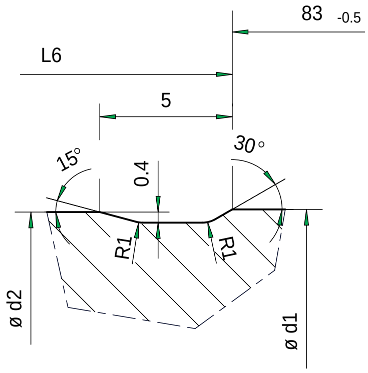
Threaded pins for (1) (2) are part of delivery.

Figure 9.3: 1MR 270 rotor - dimensional data (part 1)

Spindle



Detail Z



✳ Note! Product change:

In the future, the rotors will be supplied "final dressed"!

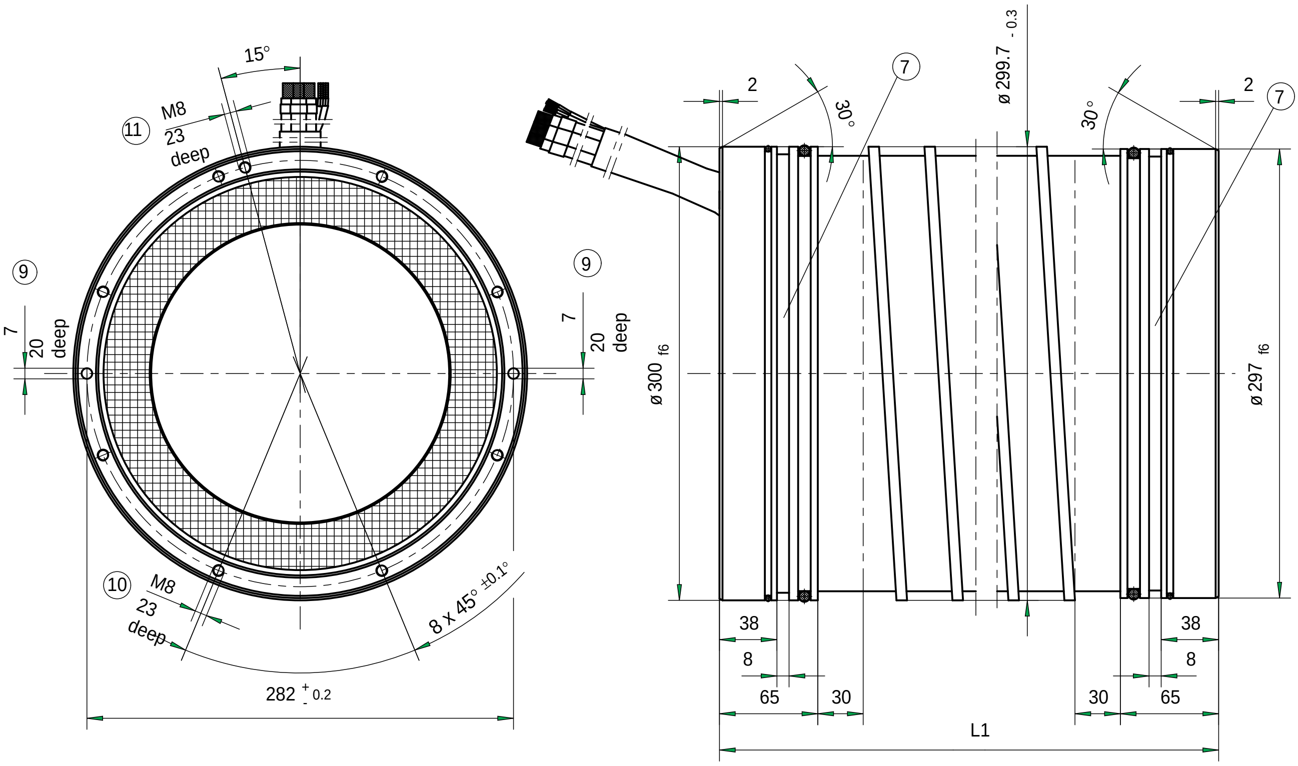
The dimension applies indicated with a ✳

Type \ Dim.	Rotor						Spindle		
	L3	L4	ø D1 H6	ø D2 H6	ø D3	ø D4	L6 -0.5	ød1 s6	ød2 t6
1 MR 270 C-A090	328	240	90	89.8	91	90.2	243	90	89.8
1 MR 270 C-A120	328	240	120	119.8	121	120.2	243	120	119.8

120 s6	+0.101 +0.079
120 H6	+0.022 0
119.8 t6	+0.126 +0.104
119.8 H6	+0.022 0
90 s6	+0.093 +0.071
90 H6	+0.022 0
89.8 t6	+0.113 +0.091
89.8 H6	+0.022 0
Fit	Dim.

Quellverweis: 106-0259-2021-00

Figure 9.3: 1MR 270 rotor - dimensional data (part 2)



Mounting drill hole:

for axial mounting of the stator to end shield

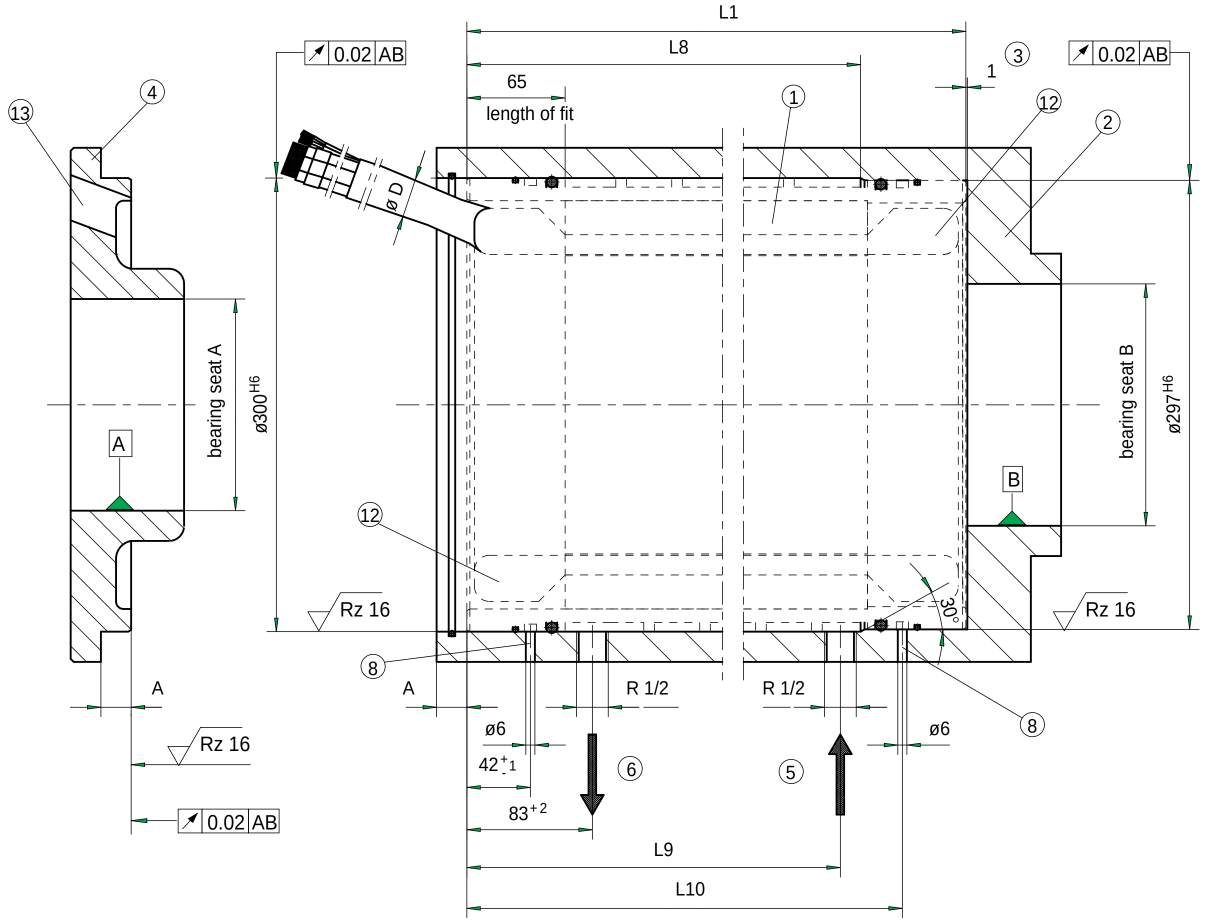
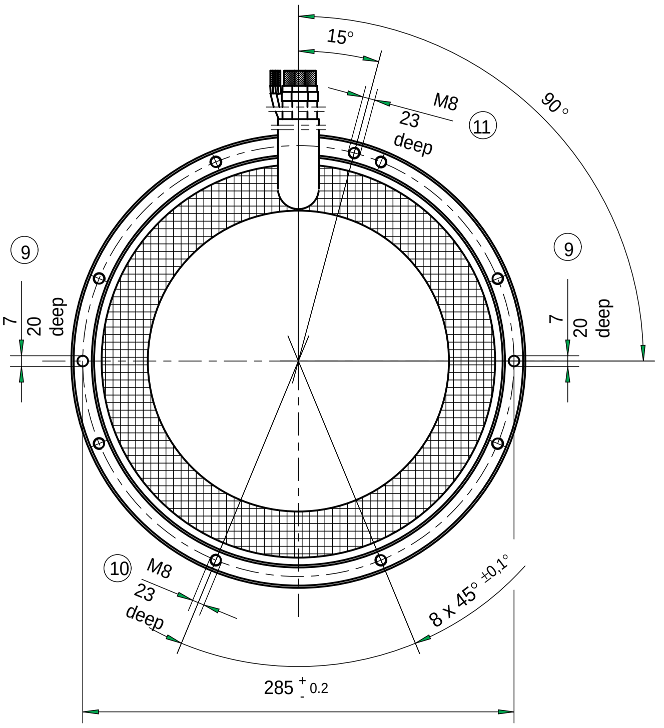


Figure 9.4: 1MS 270 stator - dimensional data (part 1)

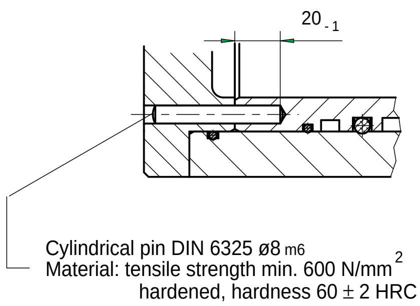


1. Stator 1 MS 270...
2. Spindle housing
3. Minimum clearance for expansion
4. End shield
5. Coolant feed thread as per DIN 2999 anywhere on circumference
6. Coolant drain thread as per DIN 2999 anywhere on circumference
7. Leakage groove
8. Leckage drill hole

(9) (10) (11) on either stator end

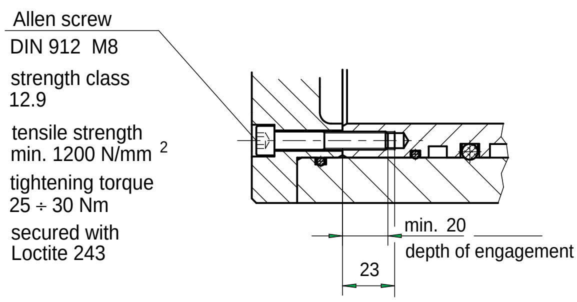
12. End winding
Clearance to housing min. 5 mm
13. Cable leadthrough with rounded edges

(9) Secure against movements on end shield

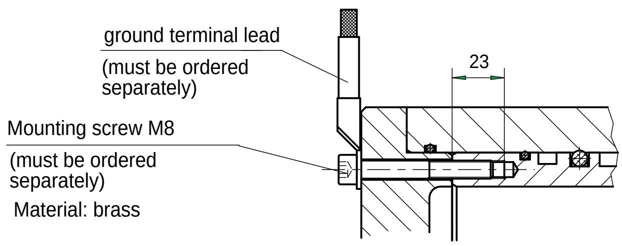


Dim. / Type	L1	L8 +1	L9 -2	L10 ± 1	motor winding øD	motor winding bend radius
1 MS 270 C-4B	400	331	317	358	27	110

(10) Axial mounting to end shield



(11) Mounting of ground terminal lead



Quellverweis: 106-0259-2022-00

Figure 9.4: 1MS 270 stator - dimensional data (part 2)

9.4. 1MB 270 - type codes

Type codes: Example: 1MB 270 C-4B-A 120 A 1

1.	Name:	1MB
2.	Motor size:	270
3.	Motor length:	C
4.	Type of winding: 1MB 270C	4B
5.	Type of rotor: with step interference fit	A
6.	Inside rotor diameter: 71 mm	120
7.	Type of stator: with aluminum cooling jacket	A
8.	Electrical connections: Conductor on thick end of stator/1.5m Conductor on thin end of stator /1.5m	 1 2

Quellverweis: INN 06.40

Figure 9.5: 1MB 270 frameless spindle motor - type codes

Type codes: Example: 1MR 270 C-A 120

1.	Name:	1MR
2.	Motor size:	270
3.	Motor length:	C
4.	Type of rotor: with step interference fit	A
5.	Inside rotor diameter: 120 mm	120

Quellverweis: INN 06.42

Figure 9.6: 1MR 270 rotor - type codes

Type codes: Example: 1MS 270 C-4B-A 1

1.	Name:	1MS
2.	Motor size:	270
3.	Motor length:	C
4.	Type of winding: 1MB 270C	4B
5.	Type of stator: with aluminum cooling jacket	A
6.	Electrical connections: Conductor on thick end of stator/1.5m Conductor on thin end of stator /1.5m	 1 2

Quellverweis: INN 06.41

Figure 9.7: 1MS 270 stator - type codes

10. 1MB 310 - technical data

10.1. Frameless spindle motor

Rated data

Designation	Symbol	Unit	1MB 310				
Motor length			B			D	F
Type of winding			6B	6D	6E	6B	
Rated power [1]	P_n	kW	27	19	12	28	45
Rated torque [1]	M_n	Nm	260			340	480
Rated RPM [1]	n_n	min^{-1}	1000	700	440	800	900
Rated voltage [2]	U_{neff}	V	380		220	380	
Rated current	I_n	A	79	61	82	80	111
Minimum conductor dia. for INDRAMAT cables	A	mm^2	25	16	25		35
Inductance [3]	L	mH	1.71	1.39	2.90	1.85	1.39
Maximum RPM	n_{max}	min^{-1}	8,000				
Rotor moment of inertia	J_m	kgm^2	0.477			0.595	0.723
Weight: Rotor	m	kg	65			80	97
Weight: Stator	m	kg	84			108	133
Insulation classification DIN VDE 0530, section 1			F				
Technical data liquid cooling mode:							
Rated power dissipation	P_{Vn}	kW	3.5			3.8	5.5
Coolant temperature at entry	ϑ_{ein}	°C	10° to 40°				
Coolant temperature-increase with P_{Vn} [4]	$\Delta\vartheta_n$	K	10				
Ambient temperature		°C	5° to 45°				
Minimum required coolant flow with $\Delta\vartheta_n$ [4]	Q_n	l/min	5.0			5.4	7.9
Pressure drop with Q_n [4]	Δp_n	bar	0.2				0.3
Maximum system pressure	p_{max}	bar	3				
Volume of coolant channel	V	l	1.4			1.8	2.2

Cooling jacket material: Aluminum, hard coat surface
O-ring: Viton

[1] Data relates to S1 operation of a motor on KDA/TDA drive (U_{neff} = 220V) or RAC (U_{neff} = 380V). The S1 data of other motor-drive combinations can be derived from the relevant characteristics curves.

[2] The motors are not suited for direct mains connection.

[3] Inductance of the mounted motor spindle at 20°C, measured between the power conductors with $f_\sim$ = 1 kHz.

[4] Data relates to water-based coolant. Should other coolants be used (e.g., oil), recalculate data or see flow diagram.

Figure 10.1: 1MB 310 frameless spindle motor - rated data

10.2. Dimensional data

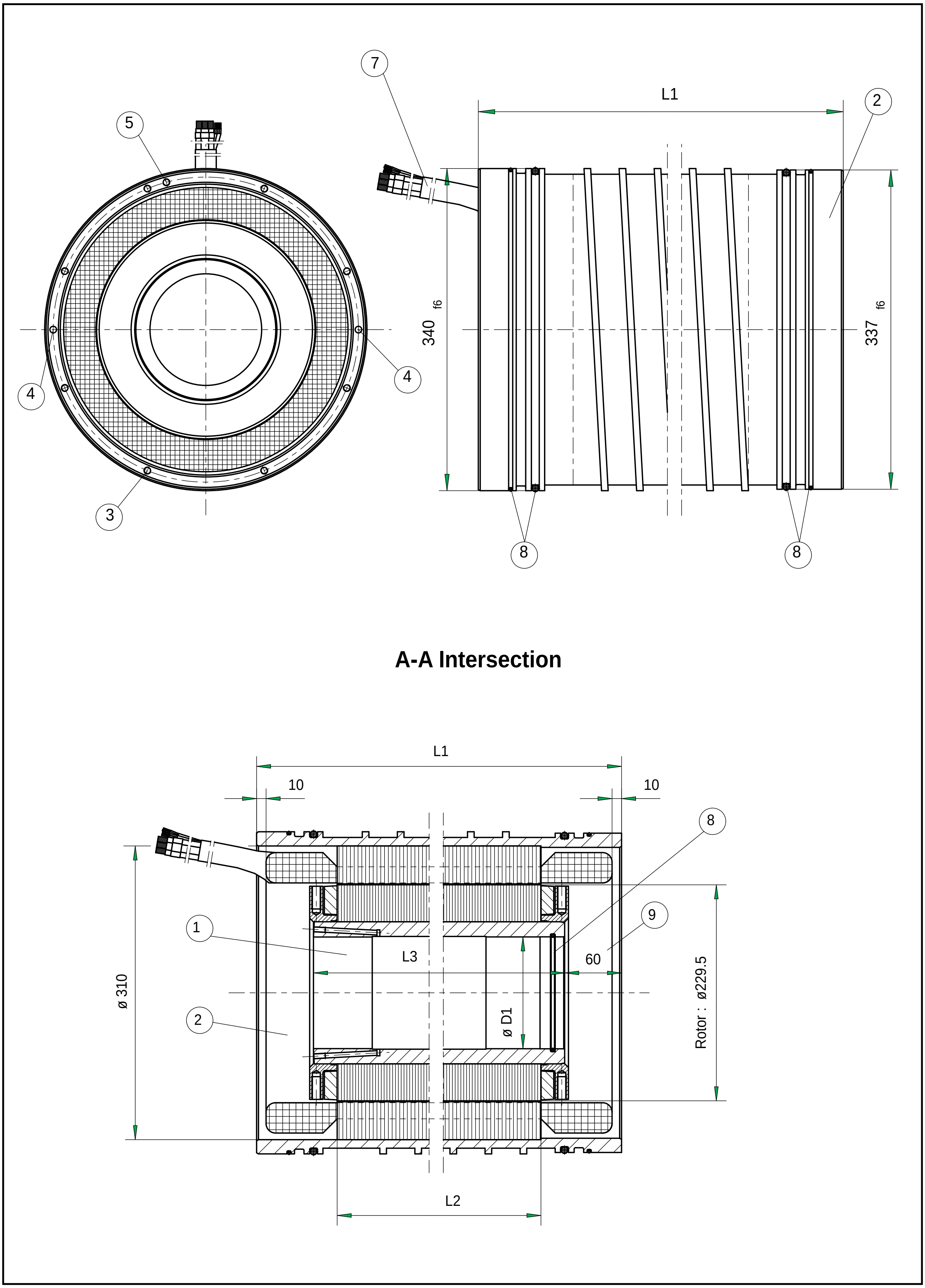
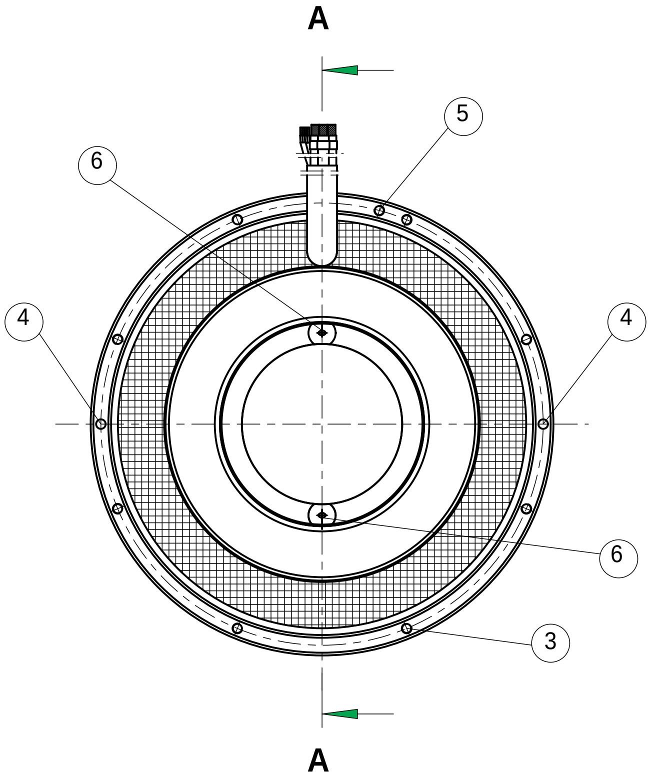


Figure 10.2: 1MB 310 frameless spindle motor - dimensional data (part 1)



1. Rotor 1MR 310...
2. Stator 1MS 310...
3. 8x M8 thread for axial mounting on spindle housing
4. ø7 drill hole for cylindrical pins for securing against movements with respect to spindle housing
5. M8 thread for mounting the ground terminal lead
6. Pressure oil connection step interference fit
7. Motor winding 1500 mm long
8. O-ring made of Viton
9. Positional dimension of rotor to stator

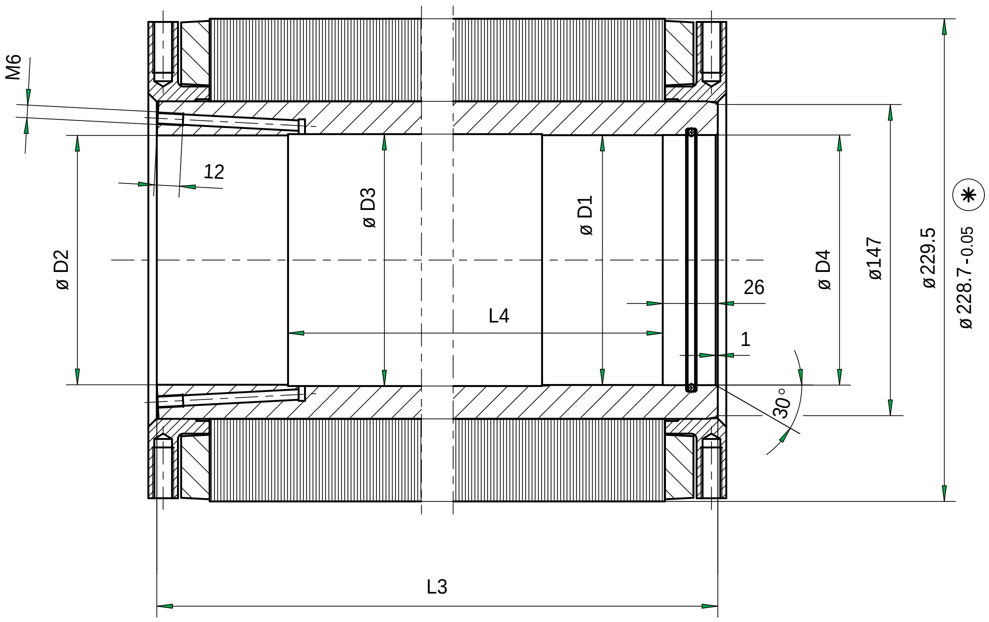
Type \ Dim.	ø D 1 H6						L 1	L 2	L 3
1 MB 310 B	94	108	112	118	120	125	385	215	265
1 MB 310 D							450	280	330
1 MB 310 F							520	350	400

Quellverweis: 106-0180-3020-00

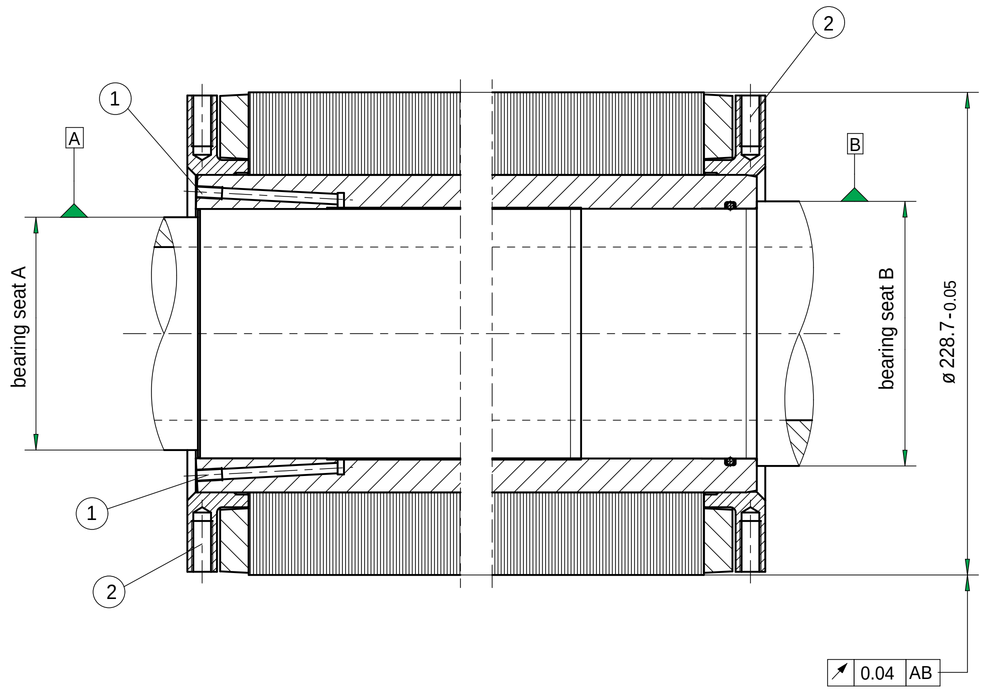
Figure 10.2: 1MB 310 frameless spindle motor - dimensional data (part 2)

10.3. Motor spindle construction

Rotor 1 MR 310... (condition at delivery) ✳



Rotor mounted to spindle (final dressing) ✳



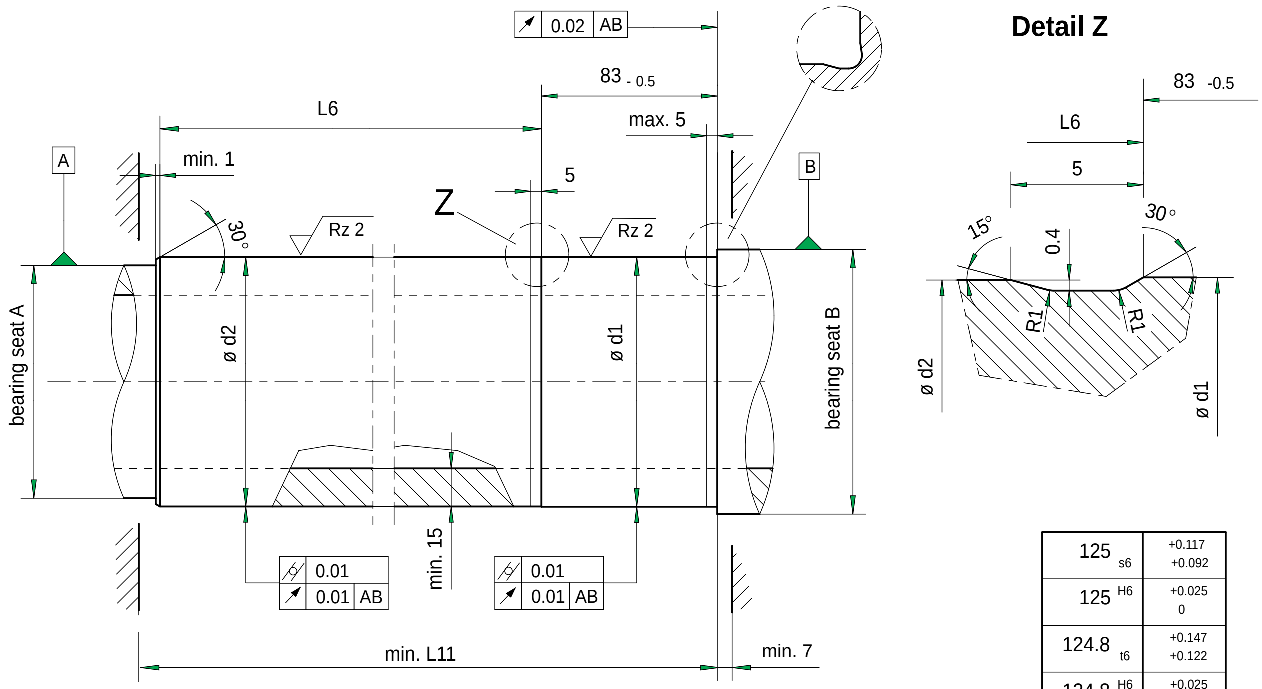
(1) Pressure oil connection
Sealed with threaded pins as per DIN 913 after mounting of rotor
Threaded pins secured and bonded with LOCTITE 620

(2) Balancing ring with M10 thread
Threaded pins per DIN 913 for equilibrium when balancing
Threaded pins secured and bonded with LOCTITE 620

Threaded pins for (1) (2) are part of delivery.

Figure 10.3: 1MR 310 rotor - dimensional data (part 1)

Spindle



Note! Product change:

In the future, the rotors will be supplied "final dressed"!

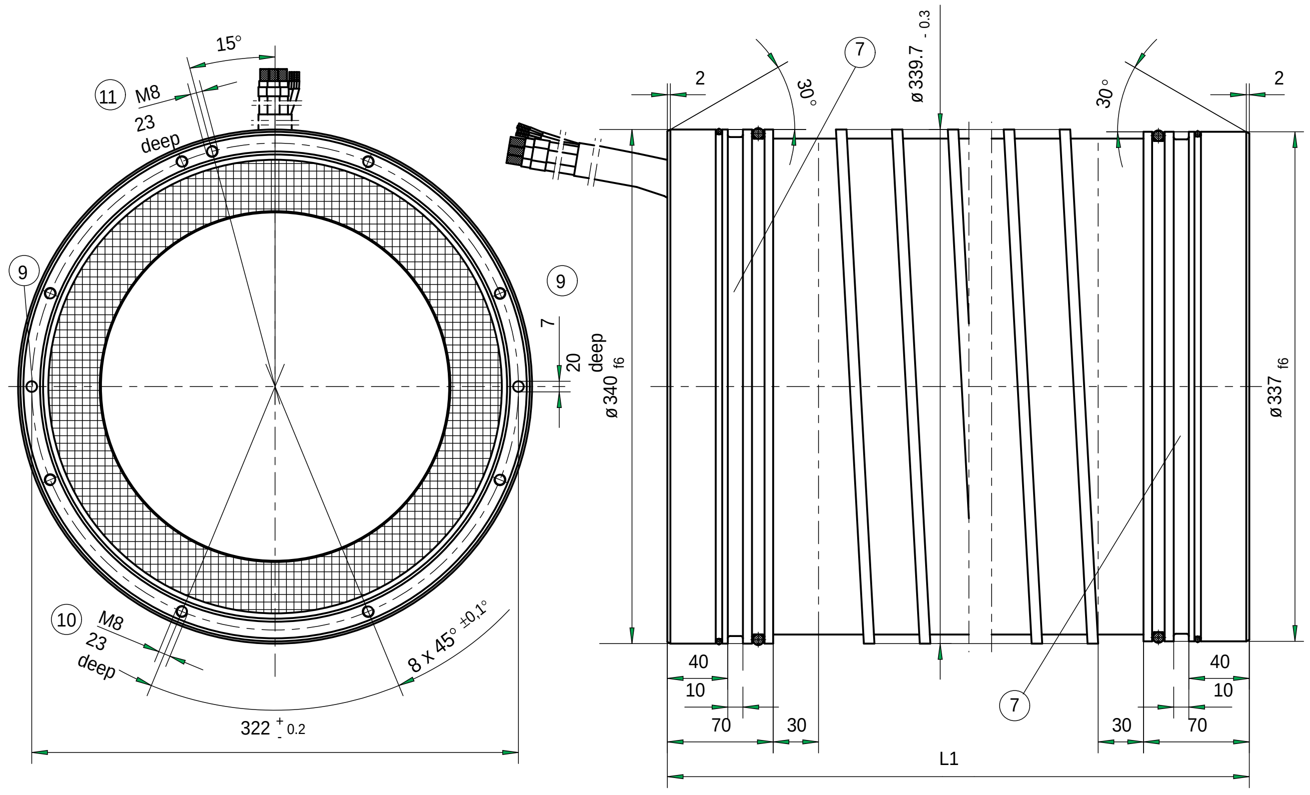
The dimension applies indicated with a ✳

Type \ Dim.	Rotor L3	Rotor L4	ø D1 H6	ø D2 H6	ø D3	ø D4	Spindle L6 -0.5	ød1 s6	ød2 t6	L11
1 MR 310 B-A094	265	177					180			273
1 MR 310 D-A094	330	242	94	93.8	95	94.2	245	94	93.8	338
1 MR 310 F-A094	400	312					315			408
1 MR 310 B-A108	265	177					180			273
1 MR 310 D-A108	330	242	108	107.8	109	108.2	245	108	107.8	338
1 MR 310 F-A108	400	312					315			408
1 MR 310 B-A112	265	177					180			273
1 MR 310 D-A112	330	242	112	111.8	113	112.2	245	112	111.8	338
1 MR 310 F-A112	400	312					315			408
1 MR 310 B-A118	265	177					180			273
1 MR 310 D-A118	330	242	118	117.8	119	118.2	245	118	117.8	338
1 MR 310 F-A118	400	312					315			408
1 MR 310 B-A120	265	177					180			273
1 MR 310 D-A120	330	242	120	119.8	121	120.2	245	120	119.8	338
1 MR 310 F-A120	400	312					315			408
1 MR 310 B-A125	265	177					180			273
1 MR 310 D-A125	330	242	125	124.8	126	125.2	245	125	124.8	338
1 MR 310 F-A125	400	312					315			408

Fit	Dim.
125 s6	+0.117 / +0.092
125 H6	+0.025 / 0
124.8 t6	+0.147 / +0.122
124.8 H6	+0.025 / 0
120 s6	+0.101 / +0.079
120 H6	+0.022 / 0
119.8 t6	+0.126 / +0.104
119.8 H6	+0.022 / 0
118 s6	+0.101 / +0.079
118 H6	+0.022 / 0
117.8 t6	+0.126 / +0.104
117.8 H6	+0.022 / 0
112 s6	+0.101 / +0.079
112 H6	+0.022 / 0
111.8 t6	+0.126 / +0.104
111.8 H6	+0.022 / 0
108 s6	+0.101 / +0.079
108 H6	+0.022 / 0
107.8 t6	+0.126 / +0.104
107.8 H6	+0.022 / 0
94 s6	+0.093 / +0.071
94 H6	+0.022 / 0
93.8 t6	+0.113 / +0.091
93.8 H6	+0.022 / 0

Quellverweis: 106-0180-2021-00

Figure 10.3: 1MR 310 rotor - dimensional data (part 2)



Mounting drill hole:

for axial mounting of the stator to the end shield

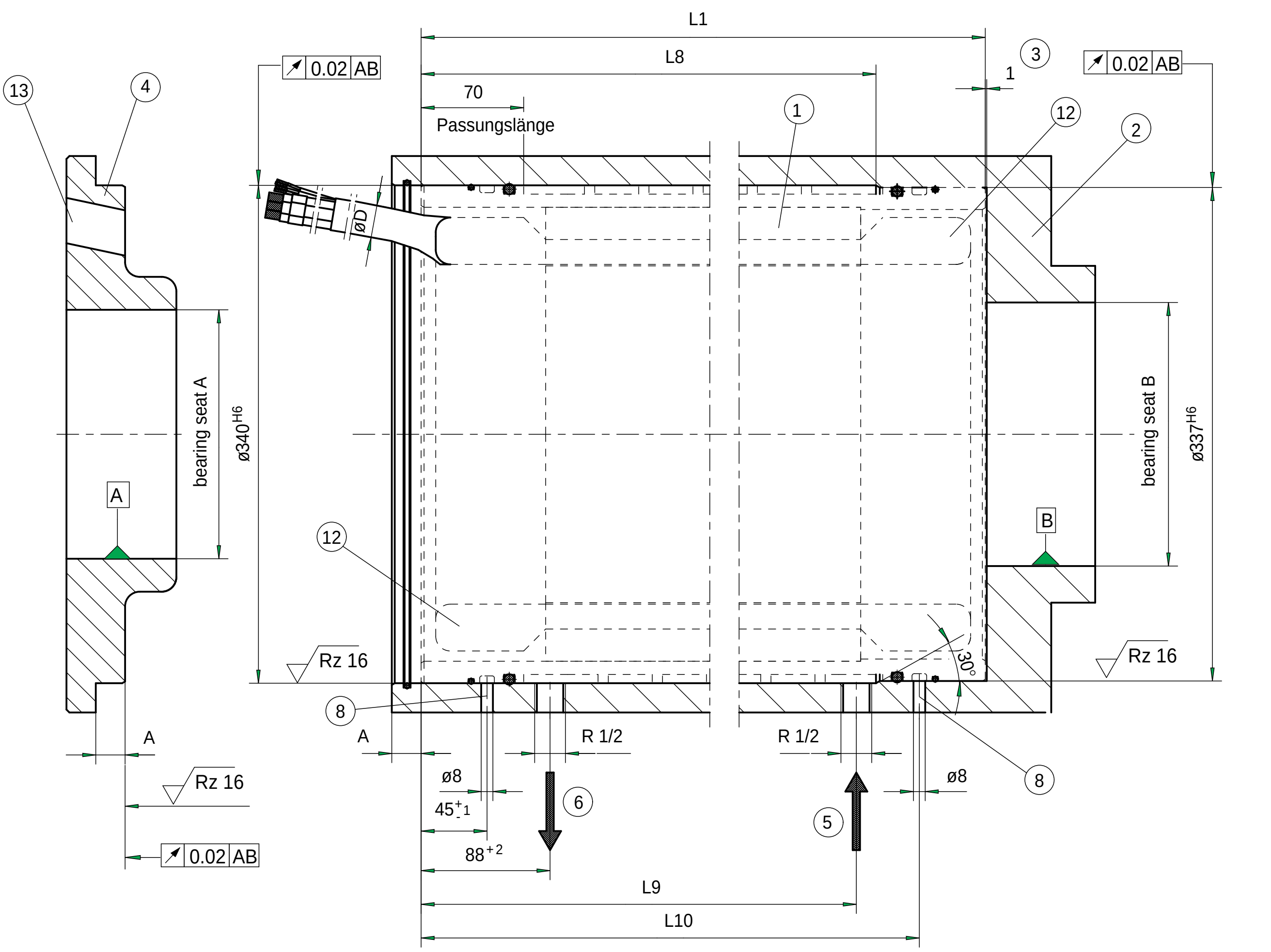
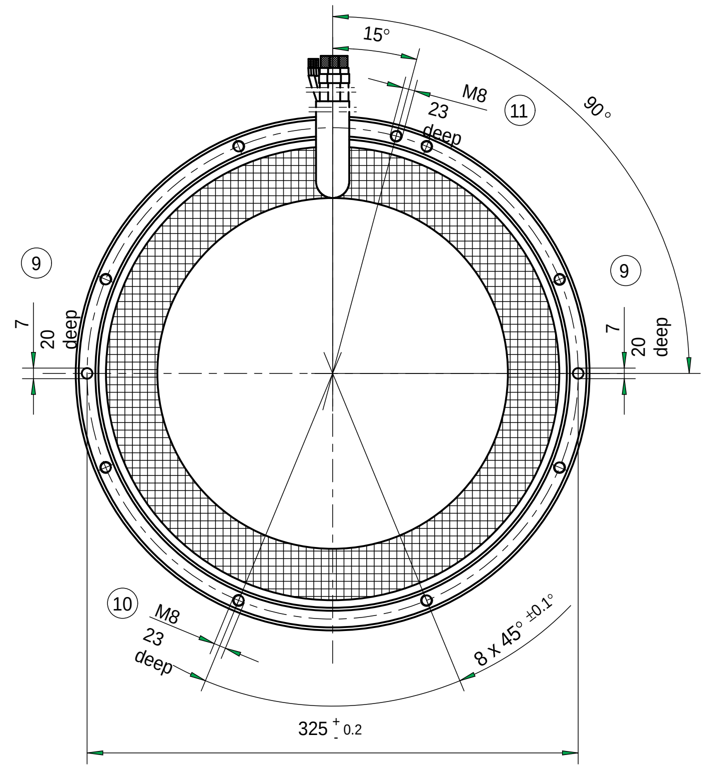


Figure 10.4: 1MS 310 stator - dimensional data (part 1)



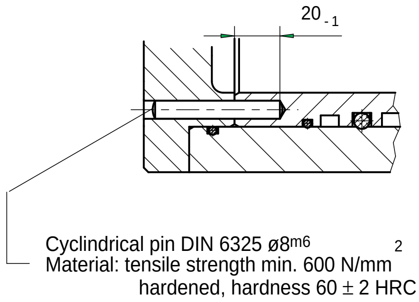
1. Stator 1 MS 310...
2. Spindle housing
3. Minimum clearance for expansion
4. End shield
5. Coolant feed thread as per DIN 2999 anywhere on circumference
6. Coolant drain thread as per DIN 2999 anywhere on circumference
7. Leakage groove
8. Leakage drill hole

(9) (10) (11) on either stator end

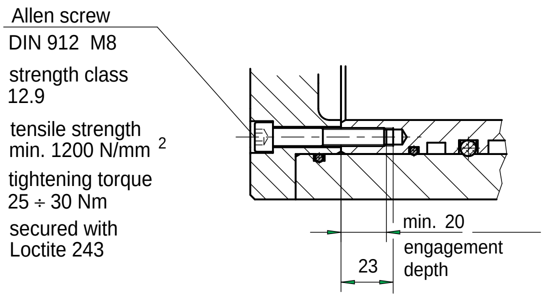
12. End winding
    Clearance to housing min. 5 mm
13. cable leadthrough with rounded edges

Type \ Dim.	L1	L8 +1	L9 -2	L10 ± 1	Motor winding øD	Motor winding bend radius
1 MS 310 B-6B						
1 MS 310 B-6D	385	311	297	340	22	90
1 MS 310 B-6E						
1 MS 310 D-6B	450	376	362	405		
1 MS 310 F-6B	520	346	432	475	27	110

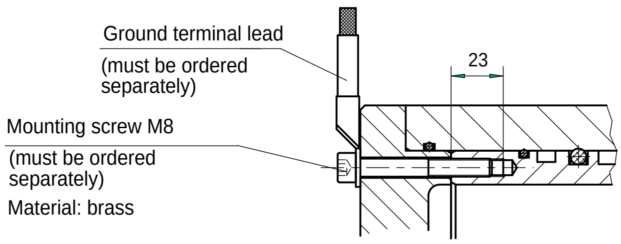
(9) Secure against movements on end shield



(10) Axial mounting to the end shield



(11) Mounting ground terminal lead



Quellverweis: 106-0180-2022-00

Figure 10.4: 1MS 310 stator - dimensional data (part 2)

10.4. 1MB 310 - type codes

Type codes: Example: 1MB 310 D-6B-A 094 A 1

1.	Name:	1MB
2.	Motor size:	310
3.	Motor length:	B, D, F
4.	Type of winding:	
	1MB 310B	6B, 6D, 6E
	1MB 310D	6B
	1MB 310F	6B
5.	Type of rotor:	
	with step interference fit	A
6.	Inside rotor diameter:	
	94 mm	094
	108 mm	108
	112 mm	112
	118 mm	118
	120 mm	120
	125 mm	125
7.	Type of stator:	
	with aluminum cooling jacket	A
8.	Electrical connections:	
	Conductor on thick end of stator/1.5m	1
	Conductor on thin end of stator /1.5m	2

Quellverweis: INN 06.40

Figure 10.5: 1MB 310 frameless spindle motor - type codes

Type codes: Example: 1MR 310 D-A 094

1.	Name:	1MR
2.	Motor size:	310
3.	Motor length:	B, D, F
4.	Type of rotor:	
	with step interference fit	A
5.	Inside rotor diameter:	
	94 mm	094
	108 mm	108
	112 mm	112
	118 mm	118
	120 mm	120
	125 mm	125

Quellverweis: INN 06.42

Figure 10.6: 1MR 310 rotor - type codes

Type codes: Example: 1MS 310 D-6B-A 1

1.	Name:	1MS
2.	Motor size:	310
3.	Motor length:	B, D, F
4.	Type of winding:	
	1MB 310B	6B, 6D, 6E
	1MB 310D	6B
	1MB 310F	6B
5.	Type of stator:	
	with aluminum cooling jacket	A
6.	Electrical connections:	
	Conductor on thick end of stator/1.5m	1
	Conductor on thin end of stator /1.5m	2

Quellverweis: INN 06.41

Figure 10.7: 1MS 310 stator - type codes

11. 1MB 312 - technical data

11.1. Frameless spindle motor

Rated data

Designation	Symbol	Unit	1MB 312			
Motor length			B	C		
Type of winding			4A		4C	
Rated power [1]	P_n	kW	30	37	25/14	
Rated torque [1]	M_n	Nm	190	238		
Rated RPM [1]	n_n	min^{-1}	1500		1000/580	
Rated voltage [2]	U_{neff}	V	380			
Rated current	I_n	A	78	98	105/61	
Minimum conductor dia. for INDRAMAT cables	A	mm^2	25	35	35/16	
Inductance [3]	L	mH	1.70	1.40	1.53	
Maximum RPM	n_{max}	min^{-1}	12,000			
Rotor moment of inertia	J_m	kgm^2	0.277	0.331		
Weight: Rotor	m	kg	50	60		
Weight: Stator	m	kg	86	106		
Insulation classification DIN VDE 0530 Sect. 1			F			
Technical data liquid cooling mode:						
Rated power dissipation	P_{Vn}	kW	2.8	3.5 (Δ)		
Coolant temperature at entry	ϑ_{ein}	°C	10° to 40°			
Coolant temperature-increase with P_{Vn} [4]	$\Delta\vartheta_n$	K	10			
Ambient temperature		°C	5° to 45°			
Minimum required coolant flow with $\Delta\vartheta_n$ [4]	Q_n	l/min	4.0	5.0		
Pressure drop with Q_n [4]	Δp_n	bar	0.1	0.2		
Maximum system pressure	p_{max}	bar	3			
Volume of coolant channel	V	l	1.1	1.4		

Cooling jacket material: Aluminum, hard coat surface
O-ring: Viton

1) Data relates to S1 operation of a motor on KDA/TDA drive (U_{neff} = 220V) or RAC (U_{neff} = 380V). The S1 data of other motor-drive combinations can be derived from the relevant characteristics curves.

2) The motors are not suited for direct mains connection.

3) Inductance of the mounted motor spindle at 20°C, measured between the power conductors with $f_\sim$ = 1 kHz.

4) Data relates to water-based coolant. Should other coolants be used (e.g., oil), recalculate data or see flow diagram.

Figure 11.1: 1MB 312 frameless spindle motor - rated data

11.2. Dimensional data

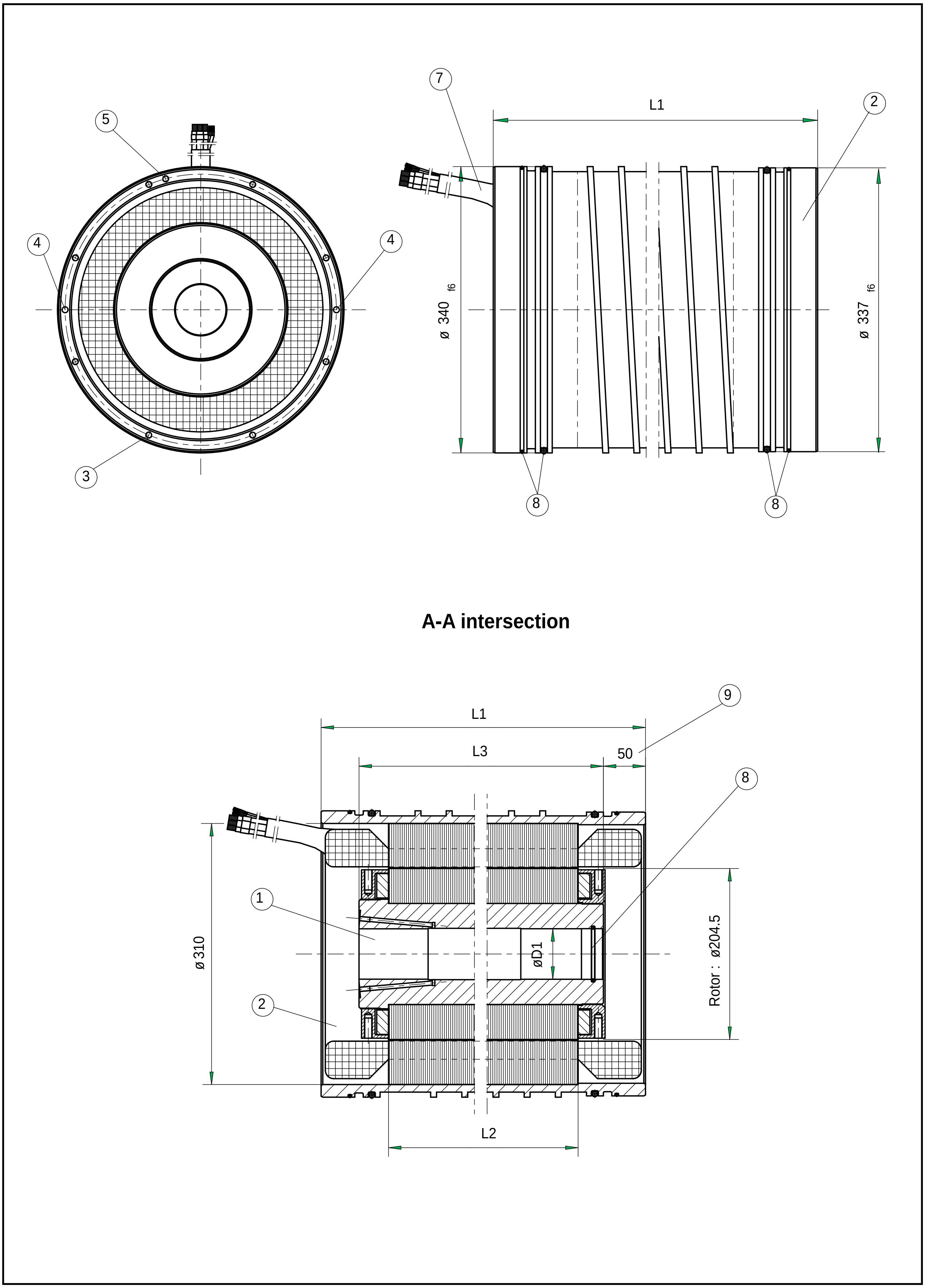
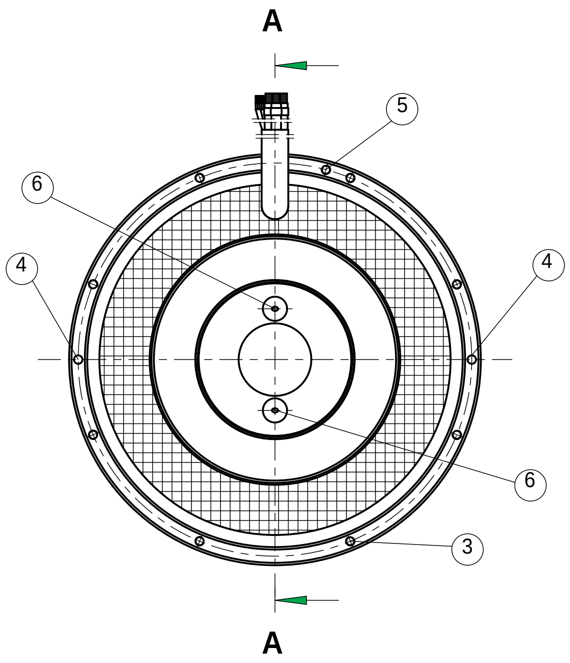


Figure 11.2: 1MB 312 frameless spindle motor- dimensional data (part 1)



1 Rotor 1MR 312...

2 Stator 1MS 312...

3 8x M8 thread for axial mounting to spindle housing

4 ø7 drill hole for cylindrical pin to secure against movements with respect to the spindle housing

5 M8 thread for mounting the ground terminal lead

6 Pressure oil connection step interference fit

7 Motor winding 1500 mm long

8 O-ring made of Viton

9 Positional dimension of rotor to stator

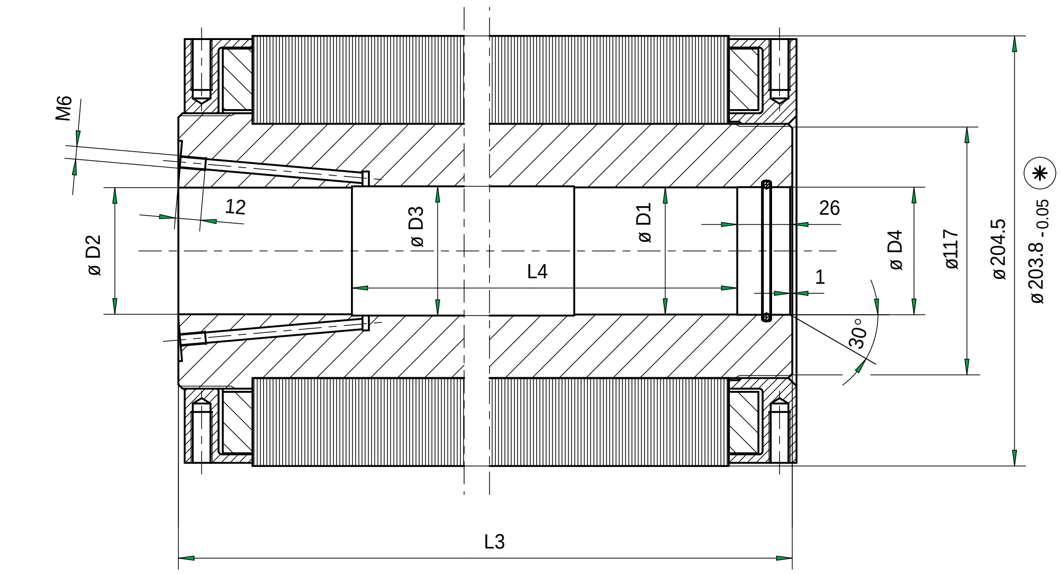
Type \ Dim.	ø D 1 H6	L 1	L 2	L 3
1 MB 312 B	6 0	3 4 0	1 8 0	2 4 5
1 MB 312 C		3 8 5	2 2 5	2 9 0

Quellverweis: 106-0196-3020-00

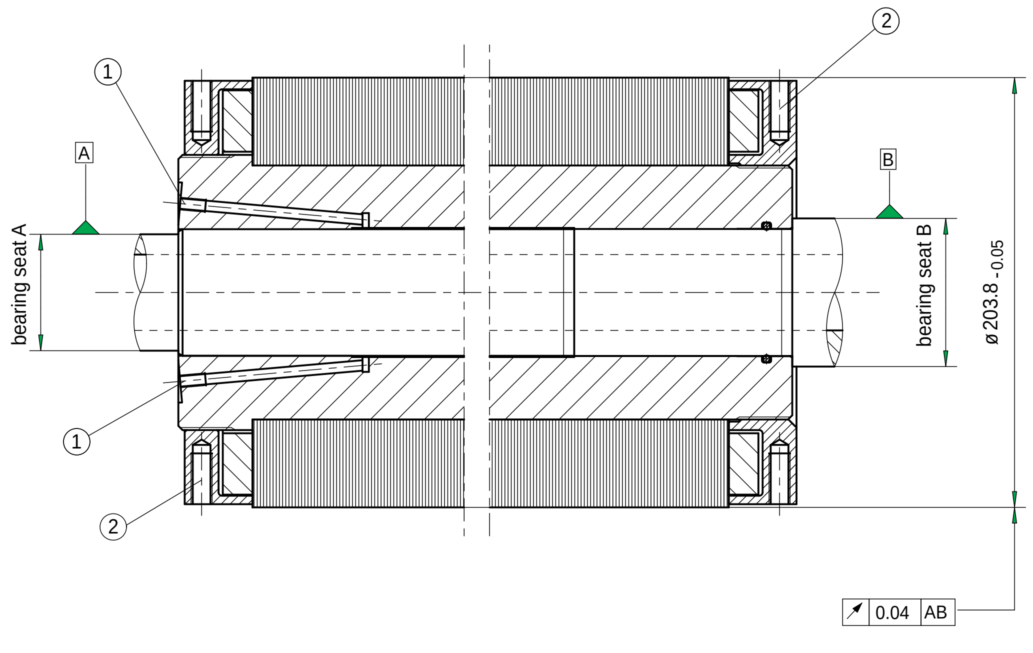
Figure 11.2: 1MB 312 frameless spindle motor- dimensional data (part 2)

11.3. Motor spindle construction

Rotor 1 MR 312... (condition at delivery) ✱



Rotor mounted to spindle (final dressing) ✱



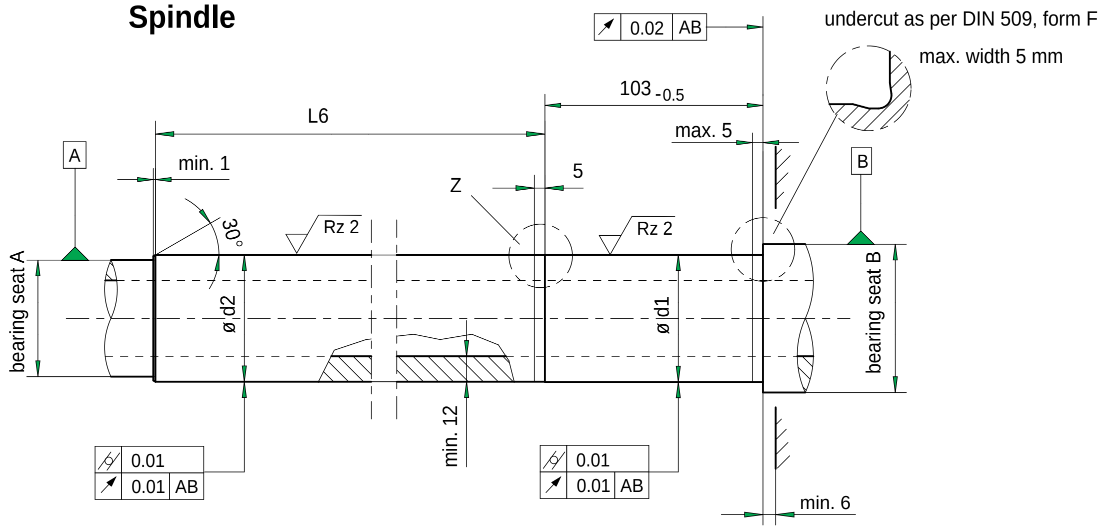
(1) Pressure oil connection
Sealed with threaded pins per DIN 913 after mounting of rotor
Threaded pins secured by bonding with LOCTITE 620

(2) Balancing ring with M10 thread
Threaded pins per DIN 913 for equilibrium when balancing
Threaded pins secured by bonding with LOCTITE 620

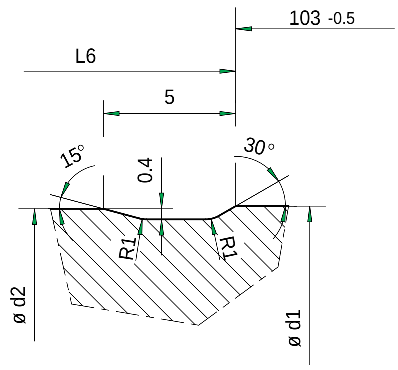
Threaded pins for (1) (2) are part of general delivery.

Figure 11.3: 1MR 312 rotor - dimensional data (part 1)

Spindle



Detail Z



✳ Note! Product change:

In the future, the rotors will be supplied "final dressed"!

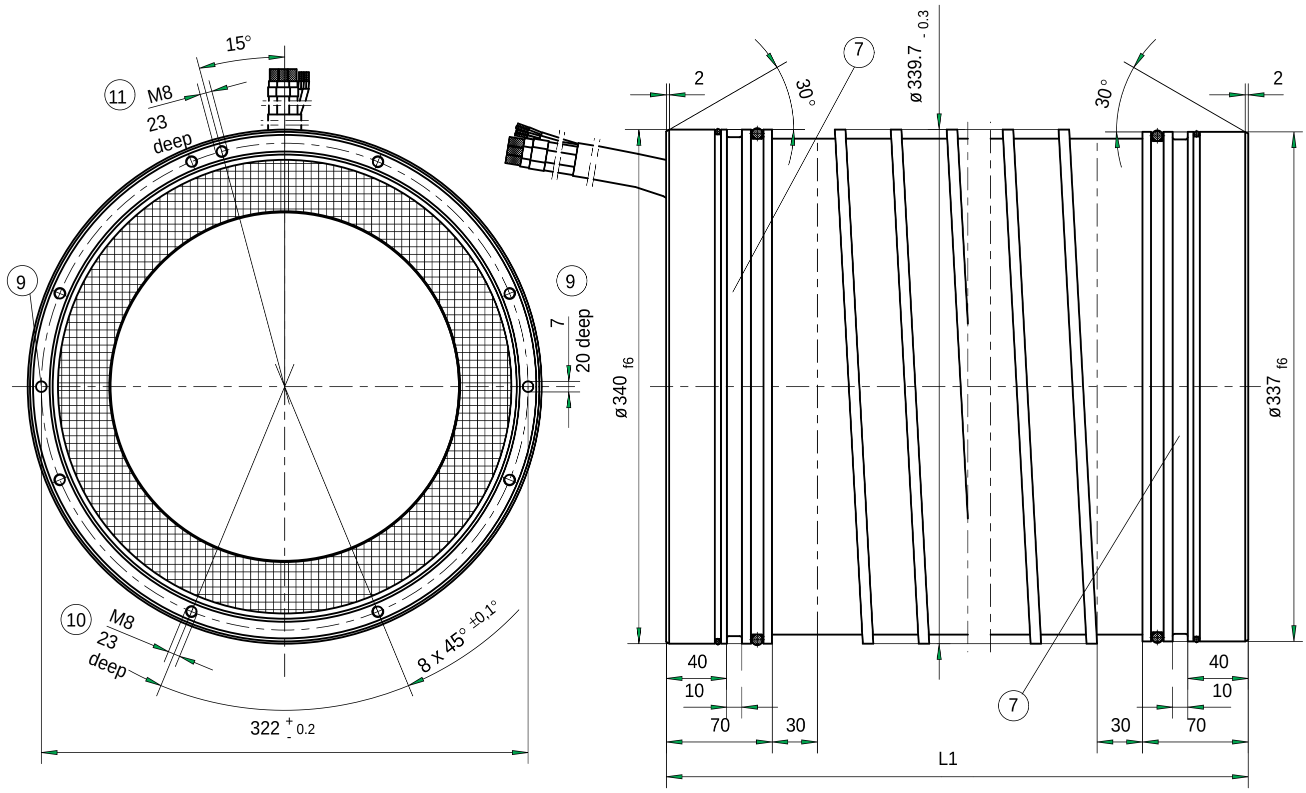
The dimension applies indicated with a ✳

Type \ Dim.	Rotor						Spindle		
	L3	L4	ø D1 H6	ø D2 H6	ø D3	ø D4	L6 -0.5	ød1 s6	ød2 t6
1 MR 312 B-A060	245	137	60	59.8	61	60.2	140	60	59.8
1 MR 312 C-A060	290	182					185		

Fit	Dim.
60 s6	+0.072 / +0.053
60 H6	+0.019 / 0
59.8 t6	+0.085 / +0.066
59.8 H6	+0.019 / 0

Quellverweis: 106-0196-2021-00

Figure 11.3: 1MR 312 rotor - dimensional data (part 2)



Mounting drill hole:

with axial mount of the stator to the end shield

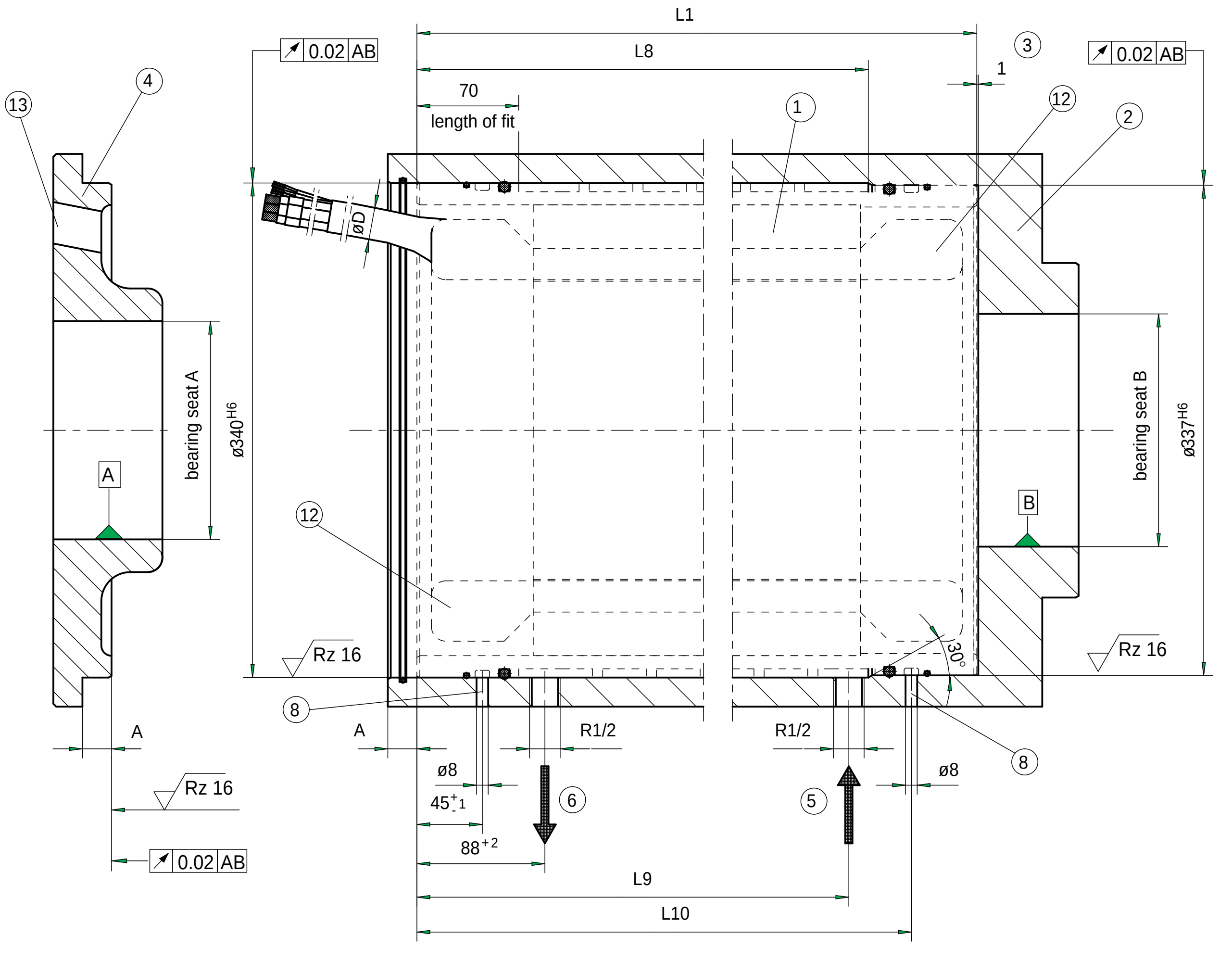
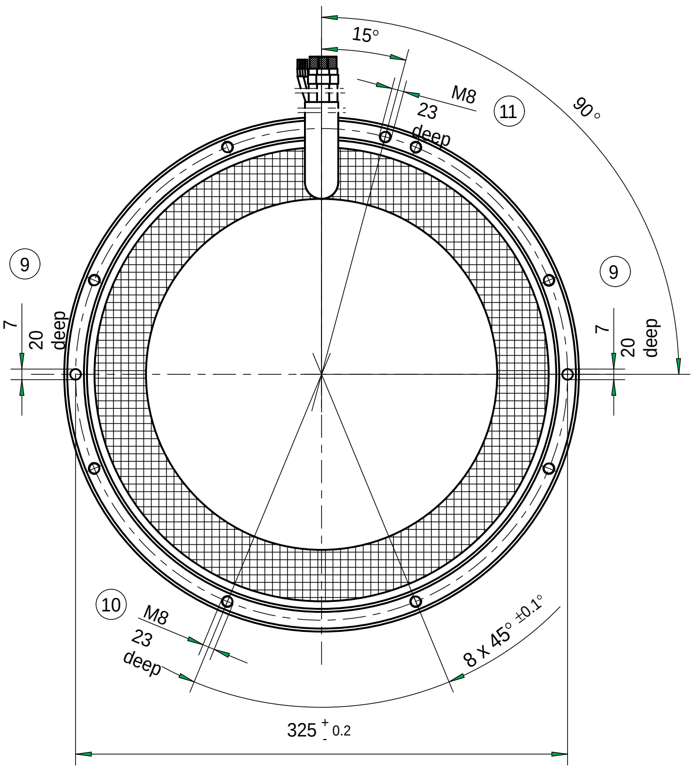
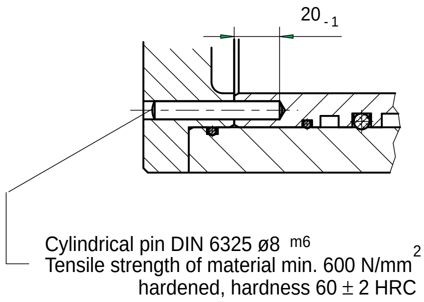


Figure 11.4: 1MS 312 stator - dimensional data (part 1)



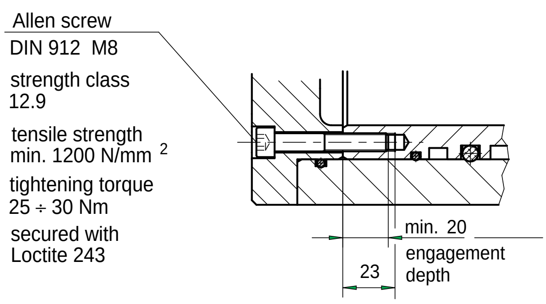
1 Stator 1 MS 312...
2 Spindle housing
3 Minimum clearance for expansion
4 End shield
5 Coolant feed thread as per DIN 2999 anywhere on circumference
6 Coolant feed thread as per DIN 2999 anywhere on circumference
7 Leakage groove
8 Leakage drill hole
9 10 11 on either end of stator
12 End winding Distance to housing min. 5 mm
13 Cable leadthrough with rounded edges

9 Secure against movements on end shield

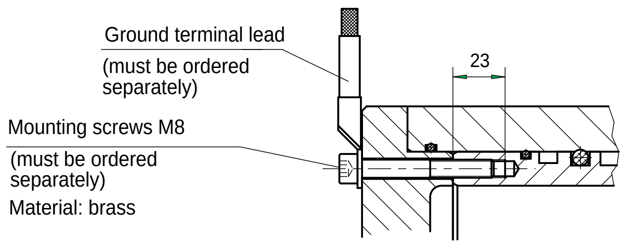


Type \ Dim.	L1	L8 +1	L9 -2	L10 ±1	motor winding øD	motor winding bend radius
1 MS 312 B-4A	340	266	252	295	22	90
1 MS 312 C-4A	385	311	297	340	27	110
1 MS 312 C-4C					22	90

10 Axial mounting to the end shield



11 Mounting ground terminal lead



Quellverweis: 106-0196-2022-00

Figure 11.4: 1MS 312 stator - dimensional data (part 2)

11.4. 1MB 312 - type codes

Type codes: Example: 1MB 312 B-4A-A 060 A 1

1.	Name:	1MB
2.	Motor size:	312
3.	Motor length:	B, C
4.	Type of winding: 1MB 312B 1MB 312C	 4A 4A, 4C
5.	Type of rotor: with step interference fit	 A
6.	Inside rotor diameter: 60 mm	 060
7.	Type of stator: with aluminum cooling jacket	 A
8.	Electrical connections: Conductor on thick end of stator/1.5m Conductor on thin end of stator /1.5m	 1 2

Quellverweis: INN 06.40

Figure 11.5: 1MB 312 frameless spindle motor - type codes

Type codes: Example: 1MR 312 B-A 060

1.	Name:	1MR
2.	Motor size:	312
3.	Motor length:	B, C
4.	Type of rotor: with step interference fit	 A
5.	Inside rotor diameter: 60 mm	 060

Quellverweis: INN 06.42

Figure 11.6: 1MR 312 rotor - type codes

Type codes: Example: 1MS 312 B-4A-A 1

1.	Name:	1MS
2.	Motor size:	312
3.	Motor length:	B, C
4.	Type of winding: 1MB 312B 1MB 312C	 4A 4A, 4C
5.	Type of stator: with aluminum cooling jacket	 A
6.	Electrical connections: Conductor on thick end of stator/1.5m Conductor on thin end of stator /1.5m	 1 2

Quellverweis: INN 06.41

Figure 11.7: 1MS 312 stator - type codes

12. 1MB 375 - technical data

12.1. Frameless spindle motor

Rated data

Designation	Symbol	Unit	1MB 375			
Motor length			B	D		
Type of winding			6B		6D	
Rated power [1]	P_n	kW	40	55	27.5	
Rated torque [1]	M_n	Nm	636	875		
Rated RPM [1]	n_n	min^{-1}	600		300	
Rated voltage [2]	U_{neff}	V	380			
Rated current	I_n	A	(120)	(150)	94	
Minimum conductor dia. for INDRAMAT cables	A	mm^2	(2x16)	(2x25)	35	
Inductance [3]	L	mH			(3.3)	
Maximum RPM	n_{max}	min^{-1}	6,000			
Rotor moment of inertia	J_m	kgm^2	1.39	1.73		
Weight: Rotor	m	kg	106	132		
Weight: Stator	m	kg	162	205		
Insulation classification DIN VDE 0530, section 1			F			
Technical data liquid cooling mode:						
Rated power dissipation	P_{Vn}	kW	5.1	6.5		
Coolant temperature at entry	ϑ_{ein}	°C	10° to 40°			
Coolant temperature increase with P_{Vn} [4]	$\Delta\vartheta_n$	K	10			
Ambient temperature		°C	5° to 45°			
Minimum required coolant flow with $\Delta\vartheta_n$ [4]	Q_n	l/min	7.3	9.3		
Pressure drop with Q_n [4]	Δp_n	bar	0.3	0.5		
Maximum system pressure	p_{max}	bar	3			
Volume of coolant channel	V	l	2.7	3.5		

Cooling jacket material: Aluminum, hard coat surface
O-ring: Viton

[1] Data relates to S1 operation of a motor on KDA/TDA drive (U_{neff} = 220V) or RAC (U_{neff} = 380V). The S1 data of other motor-drive combinations can be derived from the relevant characteristics curves.

[2] The motors are not suited for direct mains connection.

[3] Inductance of the mounted motor spindle at 20°C, measured between the power conductors with $f_\sim$ = 1 kHz.

[4] Data relates to water-based coolant. Should other coolants be used (e.g., oil), recalculate data or see flow diagram.

Preliminary values indicated with ( ).

Figure 12.1: 1MB 375 frameless spindle motor - rated data

12.2 Dimensional data

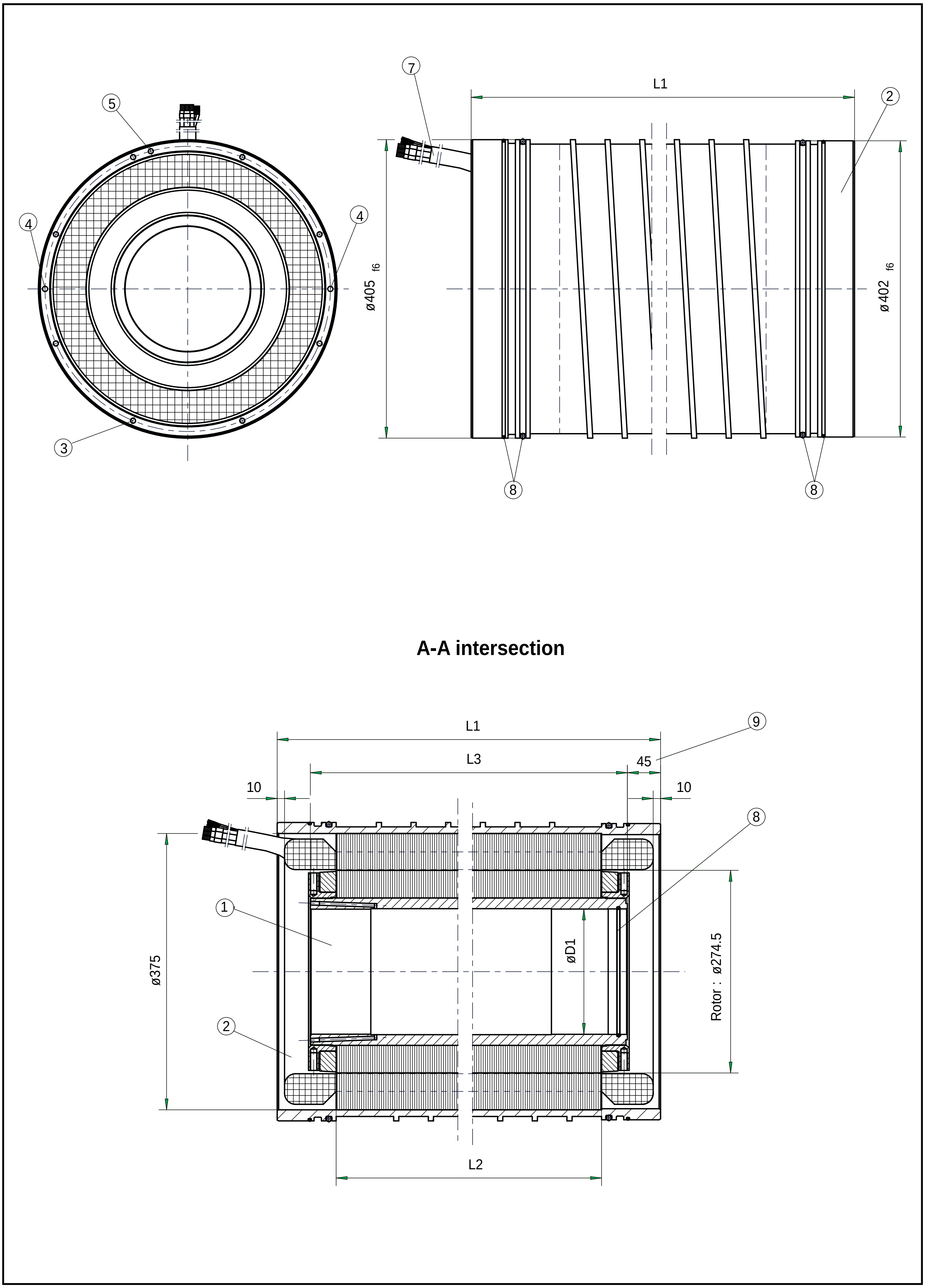
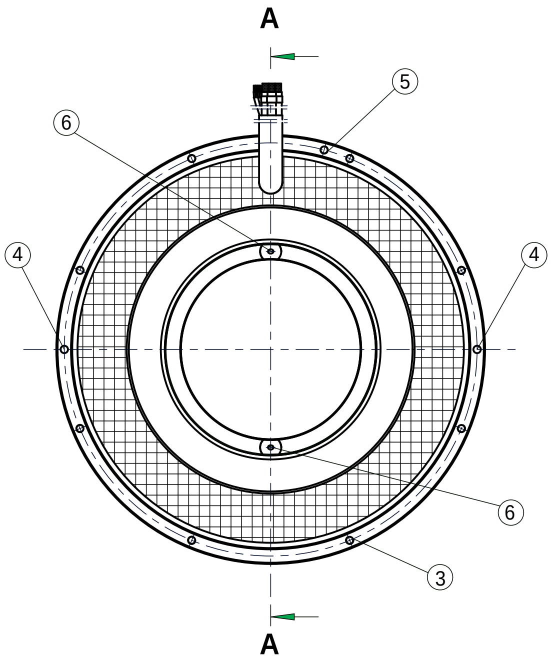


Figure 12.2: 1MB 375 frameless spindle motor - dimensional data (part 1)



1. Rotor 1MR 375...
2. Stator 1MS 375...
3. 8x M8 thread for axial mounting on the spindle housing
4. ø7 drill hole for cylindrical pin to secure against movements with respect to spindle housing
5. M8 thread for mounting the ground terminal lead
6. Pressure oil connection step interference fit
7. Motor winding 1500 mm long
8. O-ring made of Viton
9. Positional dimension of rotor to stator

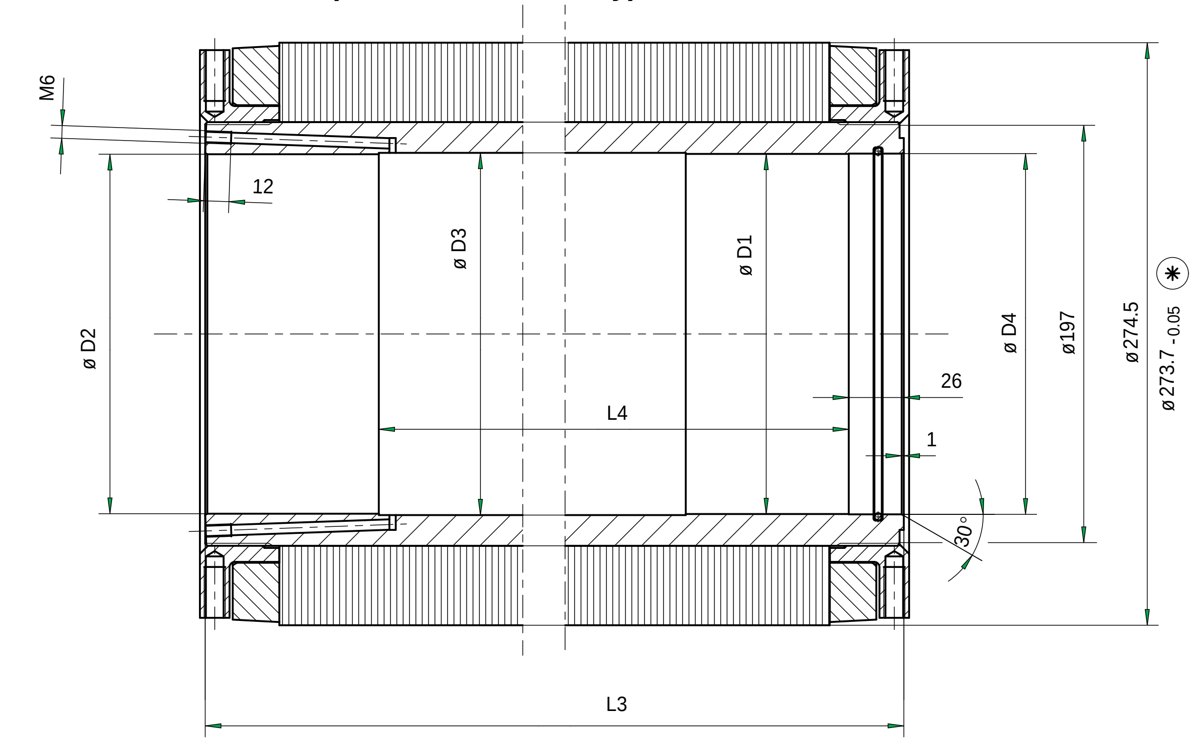
Dim. / Type	ø D 1 H6	L 1	L 2	L 3
1 MB 375 B	1 7 0	5 2 0	3 6 0	4 3 0
1 MB 375 D		6 2 0	4 6 0	5 3 0

Quellverweis: 106-0215-3020-00

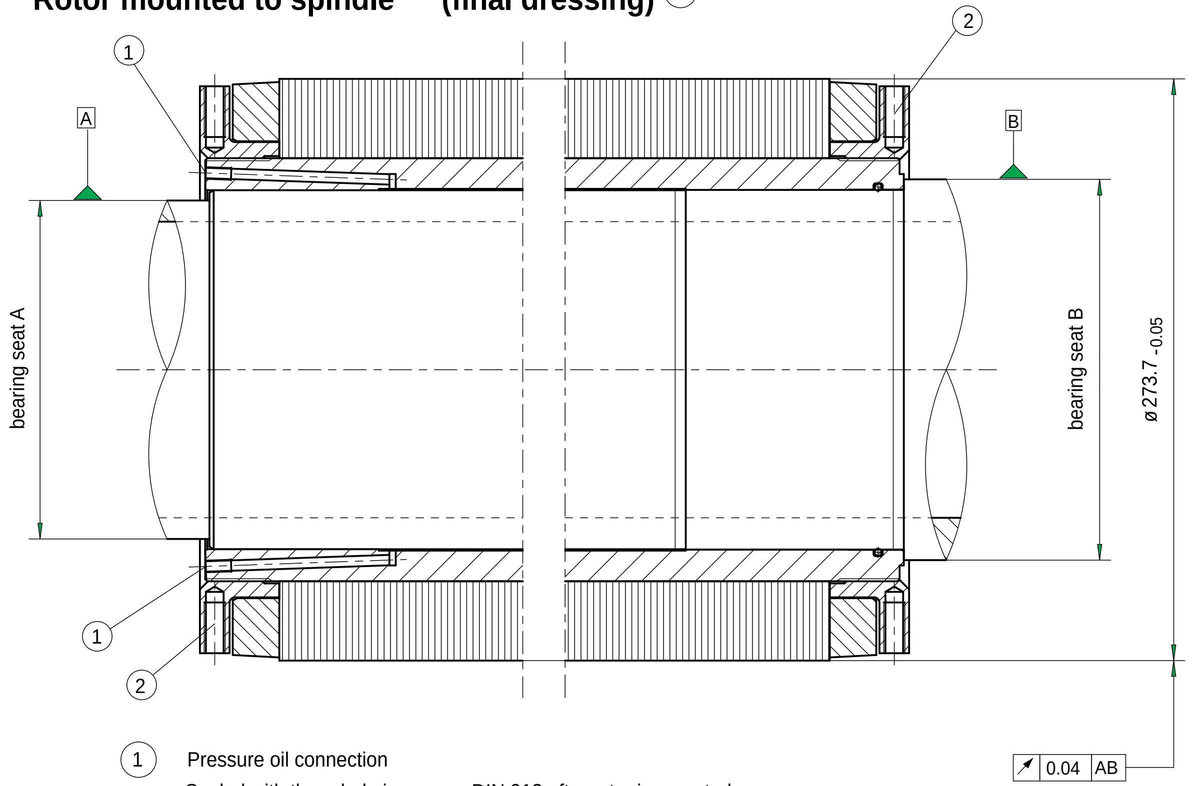
Figure 12.2: 1MB 375 frameless spindle motor - dimensional data (part 2)

12.3. Motor spindle construction

Rotor 1 MR 375... (condition at delivery) ✳



Rotor mounted to spindle (final dressing) ✳



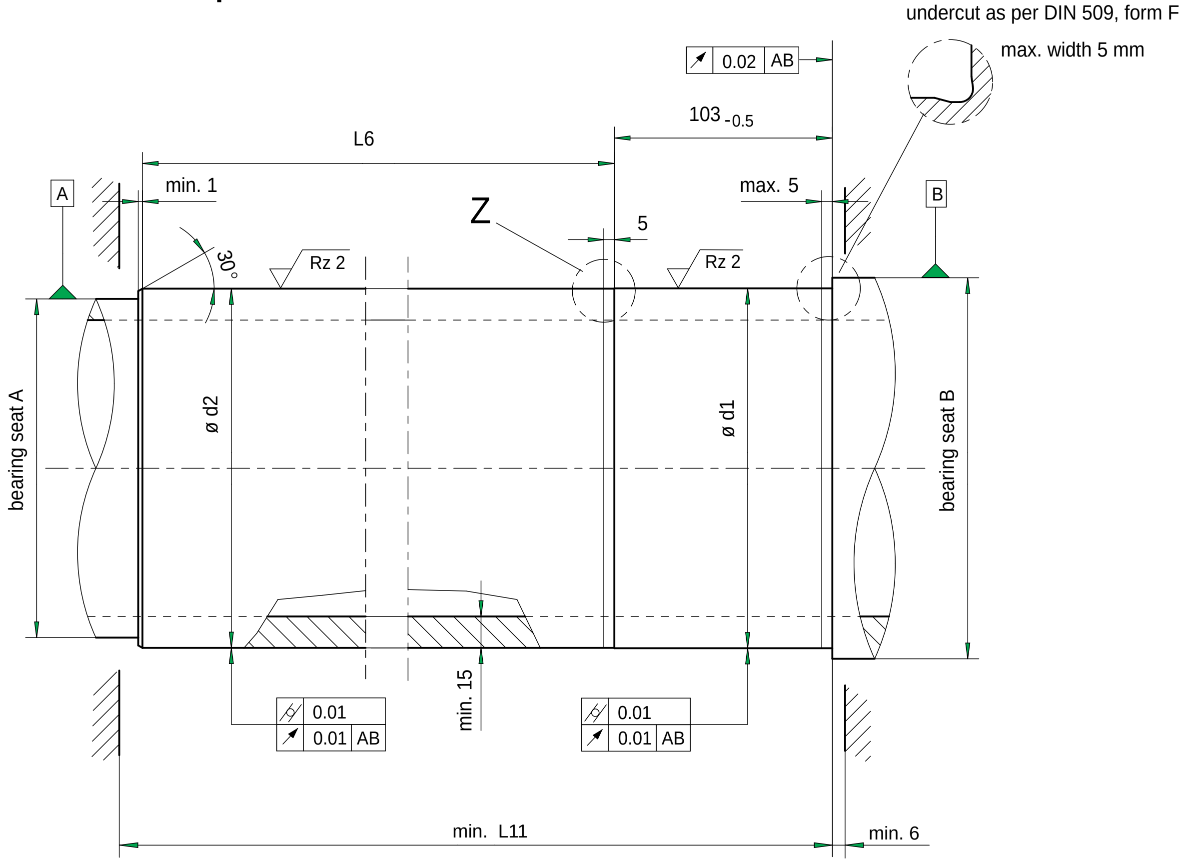
(1) Pressure oil connection
Sealed with threaded pins as per DIN 913 after rotor is mounted
Threaded pins secured by bonding with LOCTITE 620

(2) Balancing ring with M10 thread
Threaded pins per DIN 913 for equilibrium when balancing
Threaded pins secured by bonding with LOCTITE 620

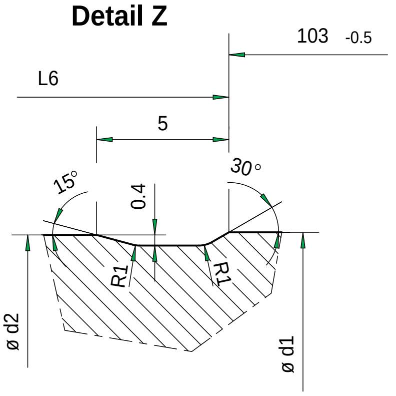
Threaded pins for (1) (2) are part of general delivery.

Figure 12.3: 1MR 375 rotor - dimensional data (part 1)

Spindle



Detail Z



(✳) Note! Product change:

In the future, the rotors will be supplied "final dressed"!

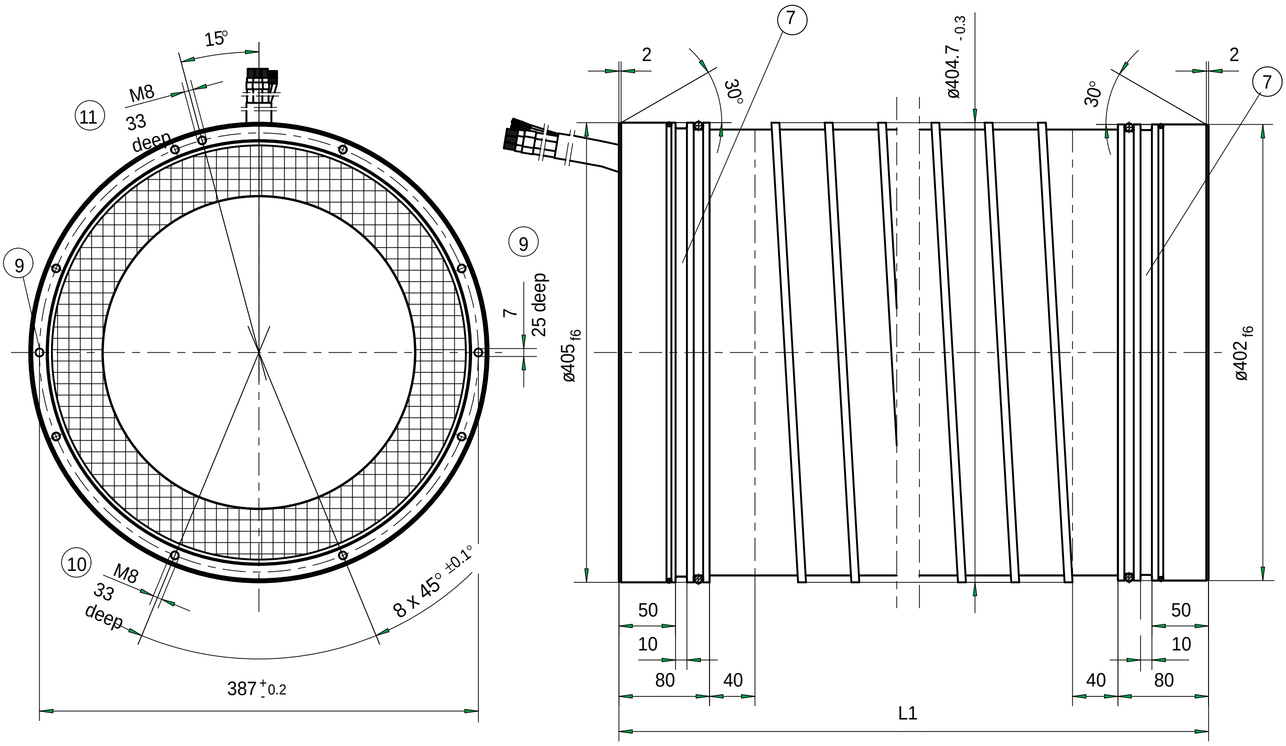
The dimension applies indicated with a (✳)

Type / Dim.	Rotor L3	Rotor L4	Rotor ø D1 H6	Rotor ø D2 H6	Rotor ø D3	Rotor ø D4	Spindle L6 -0.5	Spindle ød1 s6	Spindle ød2 t6	Spindle L11
1 MR 375 B-A170	430	322	170	169.7	171	170.2	325	170	169.7	437
1 MR 375 D-A170	530	422					425			537

Fit	Dim.
170 s6	+0.133 / +0.108
170 H6	+0.025 / 0
169.7 t6	+0.171 / +0.146
169.7 H6	+0.025 / 0

Quellverweis: 106-0215-2021-00

Figure 12.3: 1MR 375 rotor - dimensional data (part 2)



Mounting drill hole:

with axial mounting of the stator to end shield

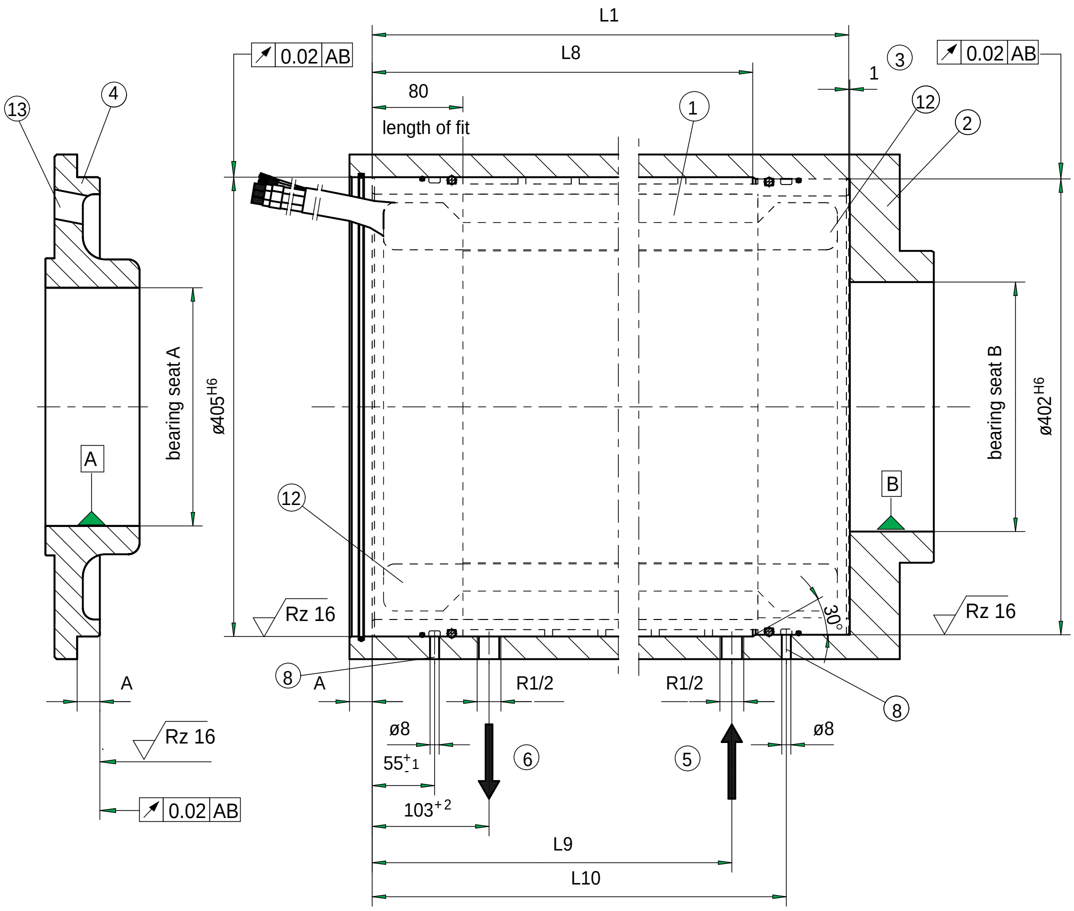
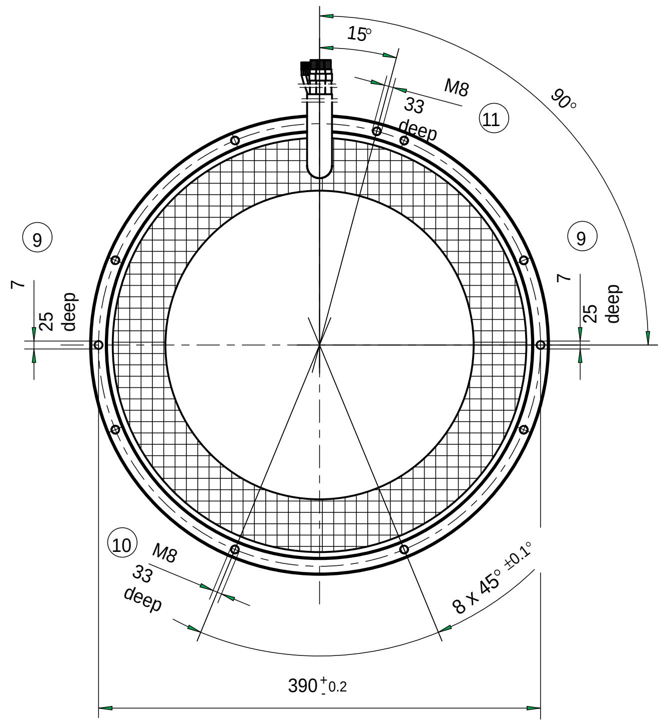


Figure 12.4: 1MS 375 stator - dimensional data (part 1)

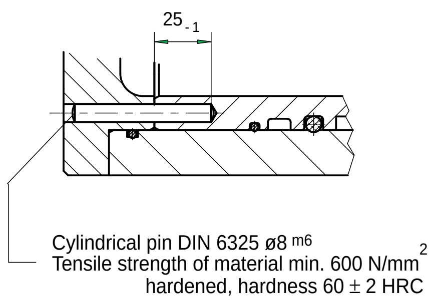


1. Stator 1 MS 375...
2. Spindle housing
3. Minimum clearance for expansion
4. End shield
5. Coolant feed thread as per DIN 2999 anywhere on circumference
6. Coolant drain thread as per DIN 2999 anywhere on circumference
7. Leakage groove
8. Leakage drill hole

(9) (10) (11) on either stator end

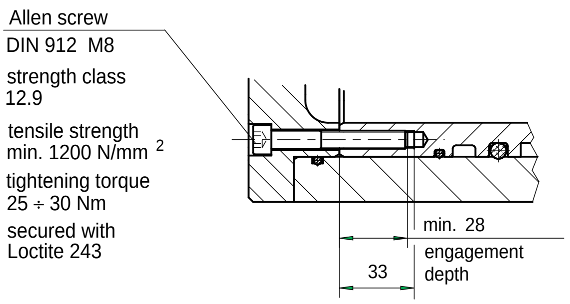
12. End winding minimum clearance to housing 5 mm
13. Cable leadthrough with rounded edges

(9) Secure against movements on end shield

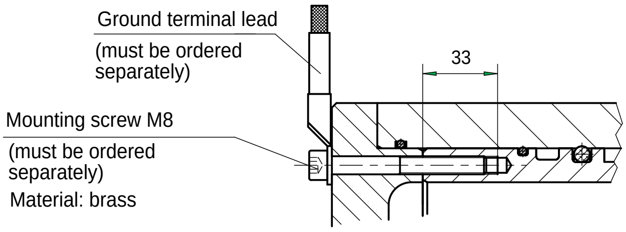


Type \ Dim.	L1	L8 +1	L9 -2	L10 ± 1	motor winding øD	motor winding bend radius
1 MS 375 B-6B	520	436	417	465	30	150
1 MS 375 D-6B	620	536	517	565		
1 MS 375 D-6D					27	110

(10) Axial mounting to end shield



(11) Mounting ground terminal lead



Quellverweis: 106-0215-2022-00

Figure 12.4: 1MS 375 stator - dimensional data (part 2)

12.4. 1MB 375 - type codes

Type codes: Example: **1MB 375 B-6B-A 170 A 1**

1.	Name:	1MB
2.	Motor size:	375
3.	Motor length:	B, D
4.	Type of winding:	
	1MB 375B	6B
	1MB 375D	6B, 6D
5.	Type of rotor:	
	with step interference fit	A
	with shrinkdown disc	S
6.	Inside rotor diameter:	
	125 mm	125 1)
	170 mm	170
7.	Type of stator:	
	with aluminum cooling jacket	A
8.	Electrical connections:	
	Conductor on thick end of stator/1.5m	1
	Conductor on thin end of stator /1.5m	2

1) Only with rotor type "shrinkdown disc".

Quellverweis: INN 06.40

Figure 12.5: 1MB 375 frameless spindle motor - type codes

Type codes: Example: **1MR 375 B-A 170**

1.	Name:	1MR
2.	Motor size:	375
3.	Motor length:	B, D
4.	Type of rotor:	
	with step interference fit	A
	with shrinkdown disc	S
5.	Inside rotor diameter:	
	125 mm	125 1)
	170 mm	170

1) Only with rotor type "shrinkdown disc".

Quellverweis: INN 06.42

Figure 12.6: 1MR 375 rotor - type codes

Type codes: Example: **1MS 375 B-6B-A 1**

1.	Name:	1MS
2.	Motor size:	375
3.	Motor length:	B, D
4.	Type of windings:	
	1MB 375B	6B
	1MB 375D	6B, 6D
5.	Type of stator:	
	with aluminum cooling jacket	A
6.	Electrical connections:	
	Conductor on thick end of stator/1.5m	1
	Conductor on thin end of stator /1.5m	2

Quellverweis: INN 06.41

Figure 12.7: 1MS 375 stator - type codes

13. Terminal Diagrams, Power Cables

13.1 Terminal diagrams for connection junction box

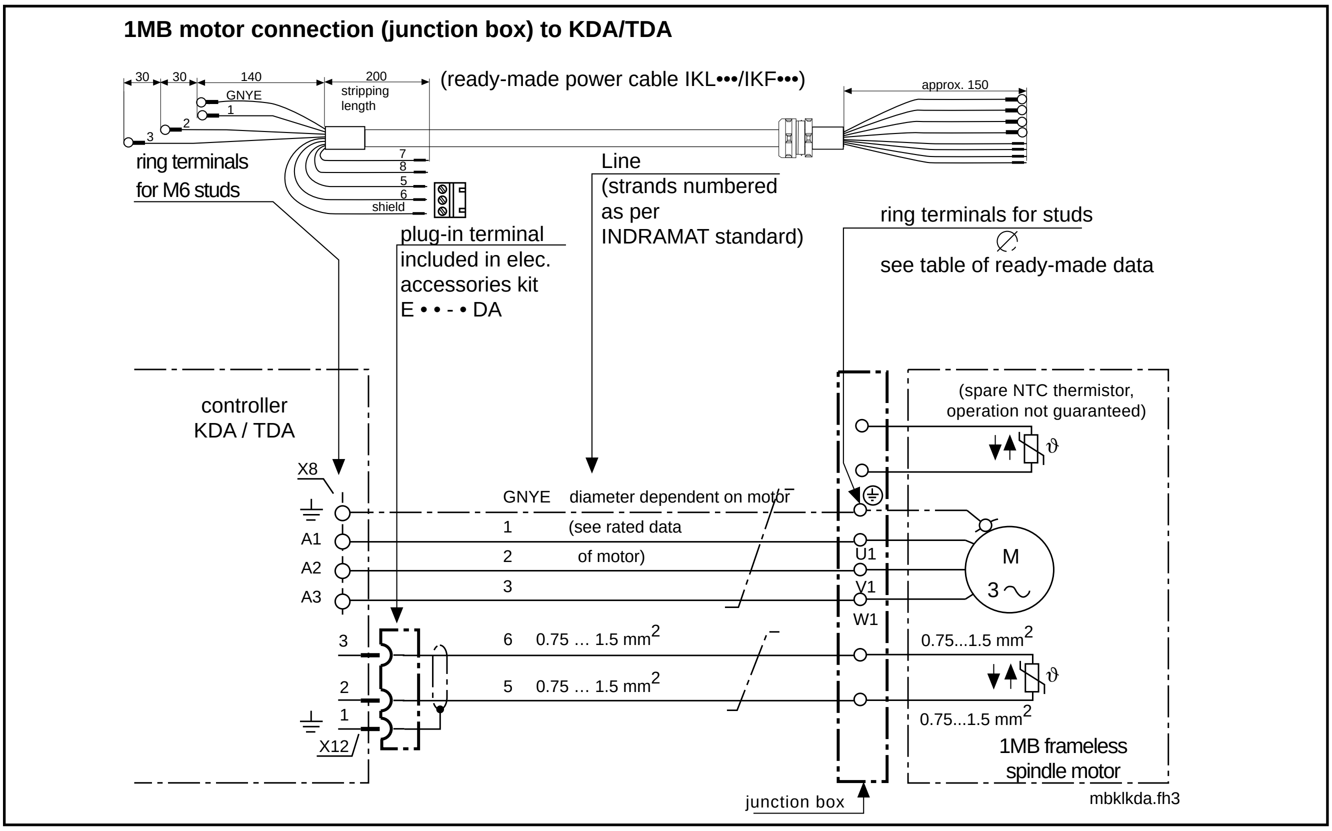


Figure 13.1: Connecting a 1MB to a KDA/TDA controller via a junction box

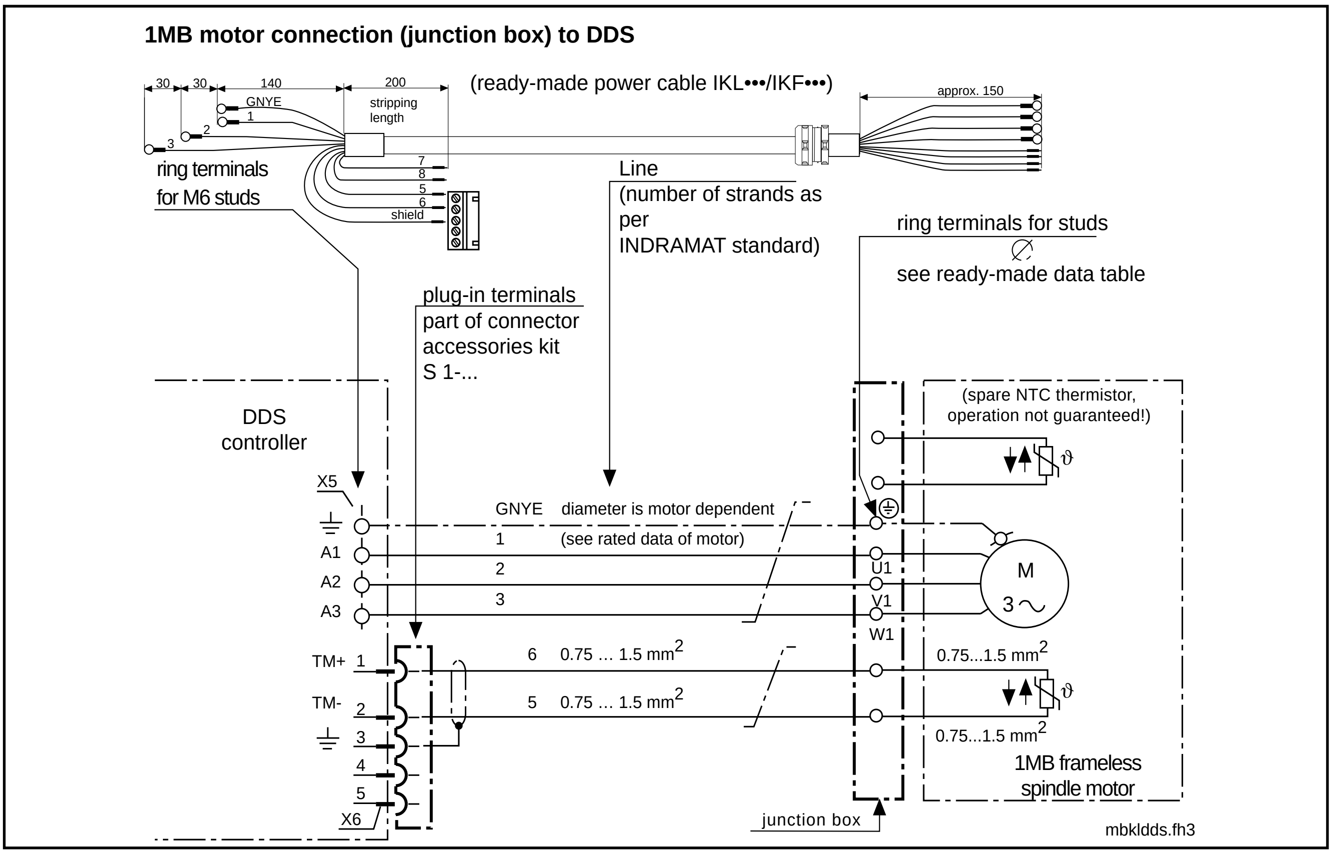


Figure 13.2: Connecting a 1MB to a DDS controller via a junction box

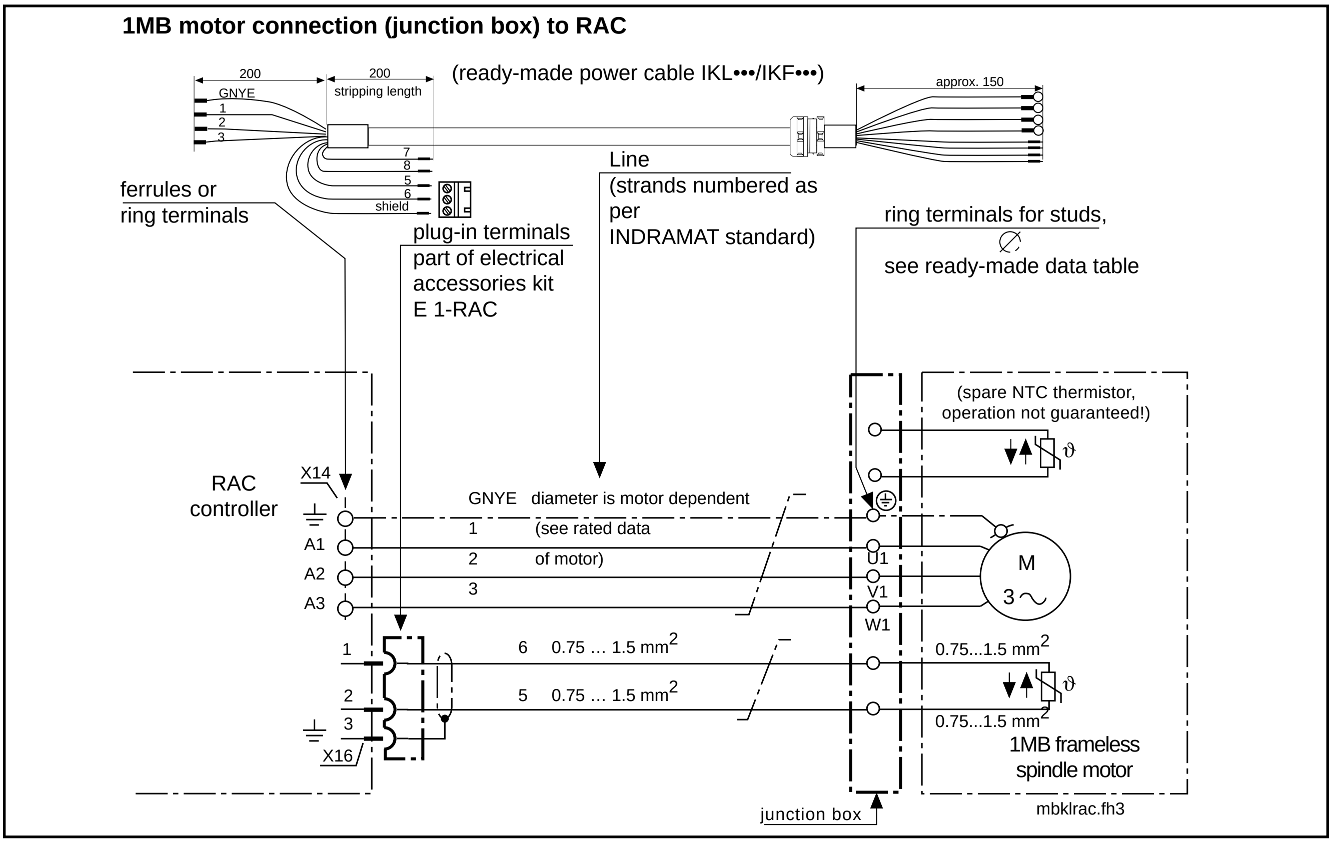


Figure 13.3: Connecting a 1MB to a RAC controller via a junction box

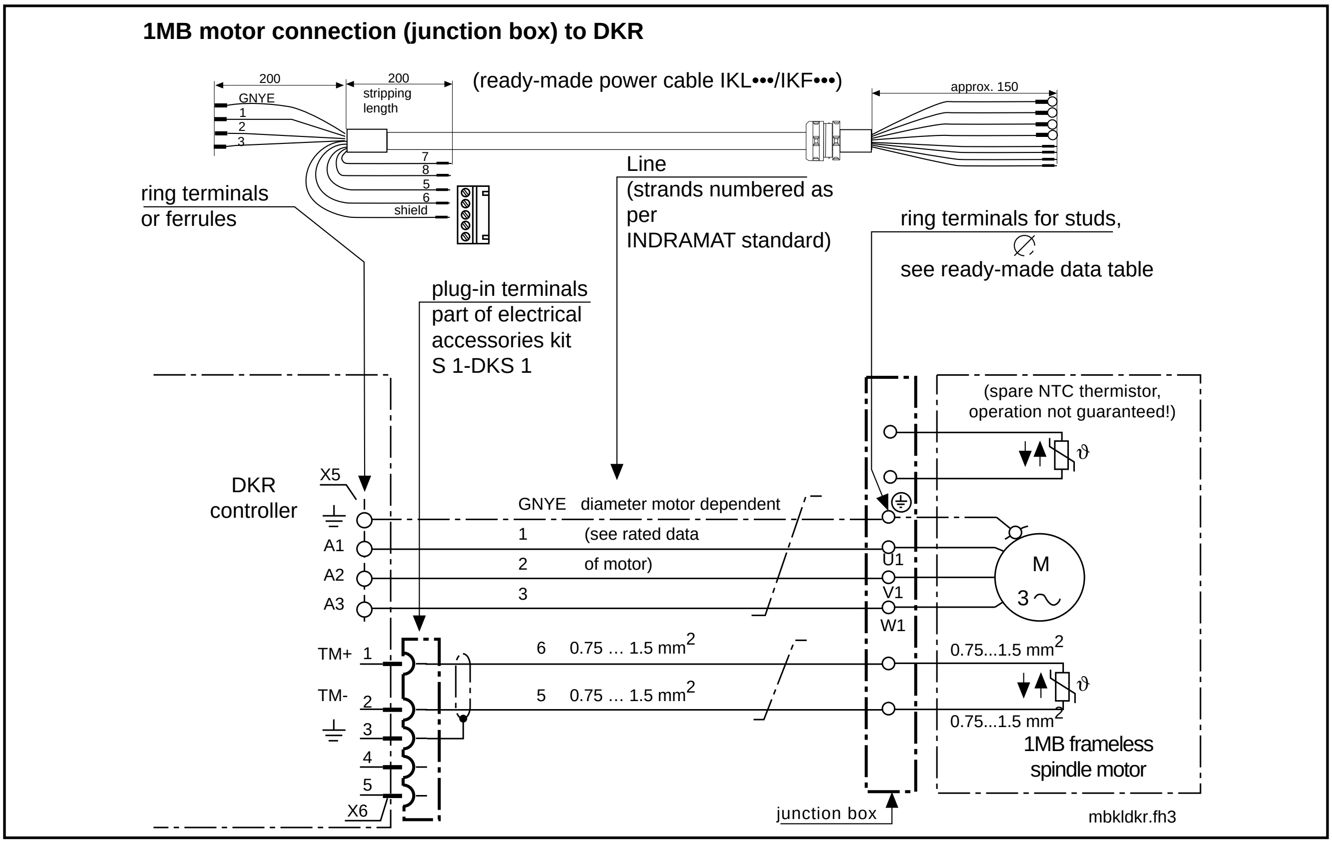


Figure 13.4: Connecting a 1MB to a DKR controller via a junction box

13.2 Terminal diagrams for connecting via a power plug-in connection

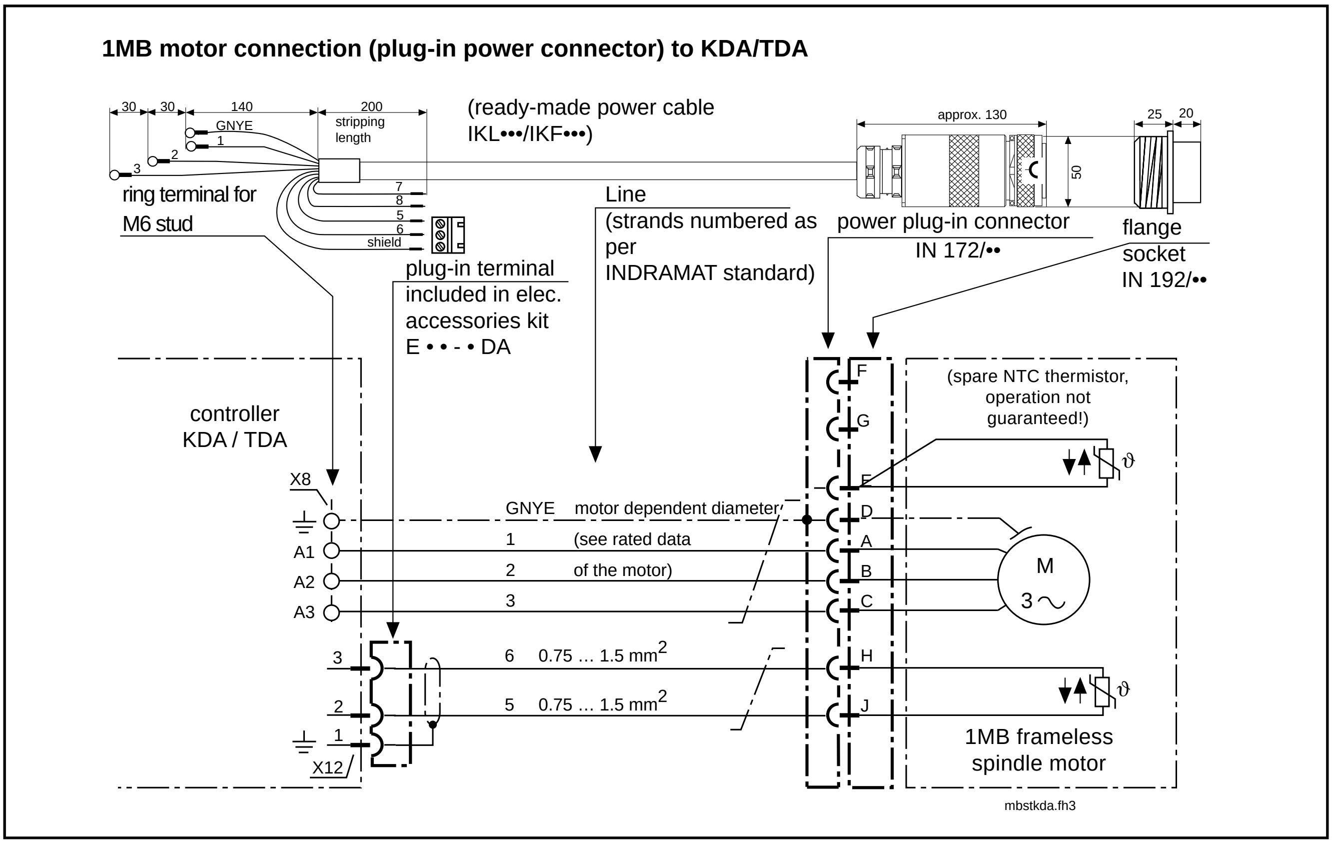


Figure 13.5: Connecting a 1MB to a KDA/TDA controller via a power plug-in connection

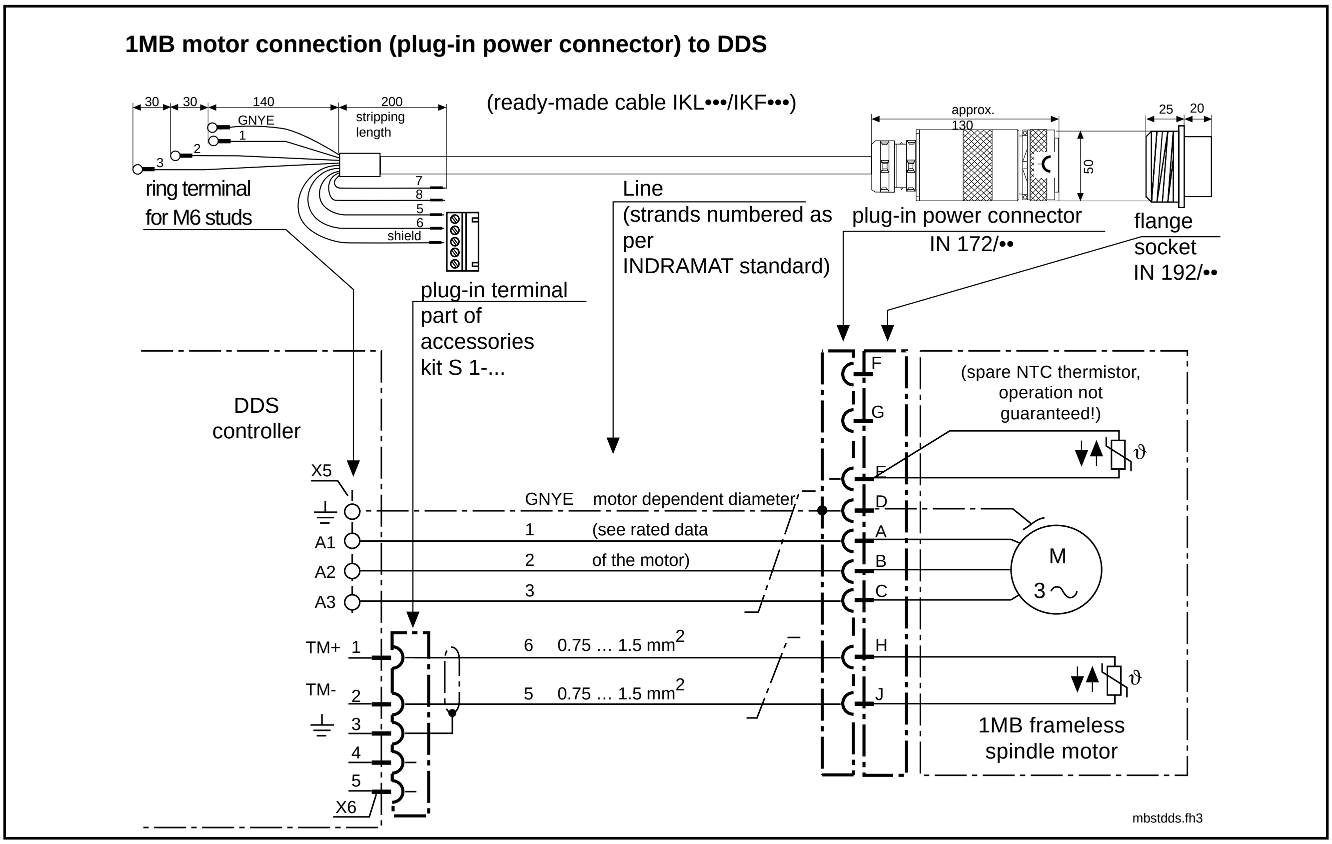


Figure 13.6: Connecting a 1MB to a DDS controller via a power plug-in connection

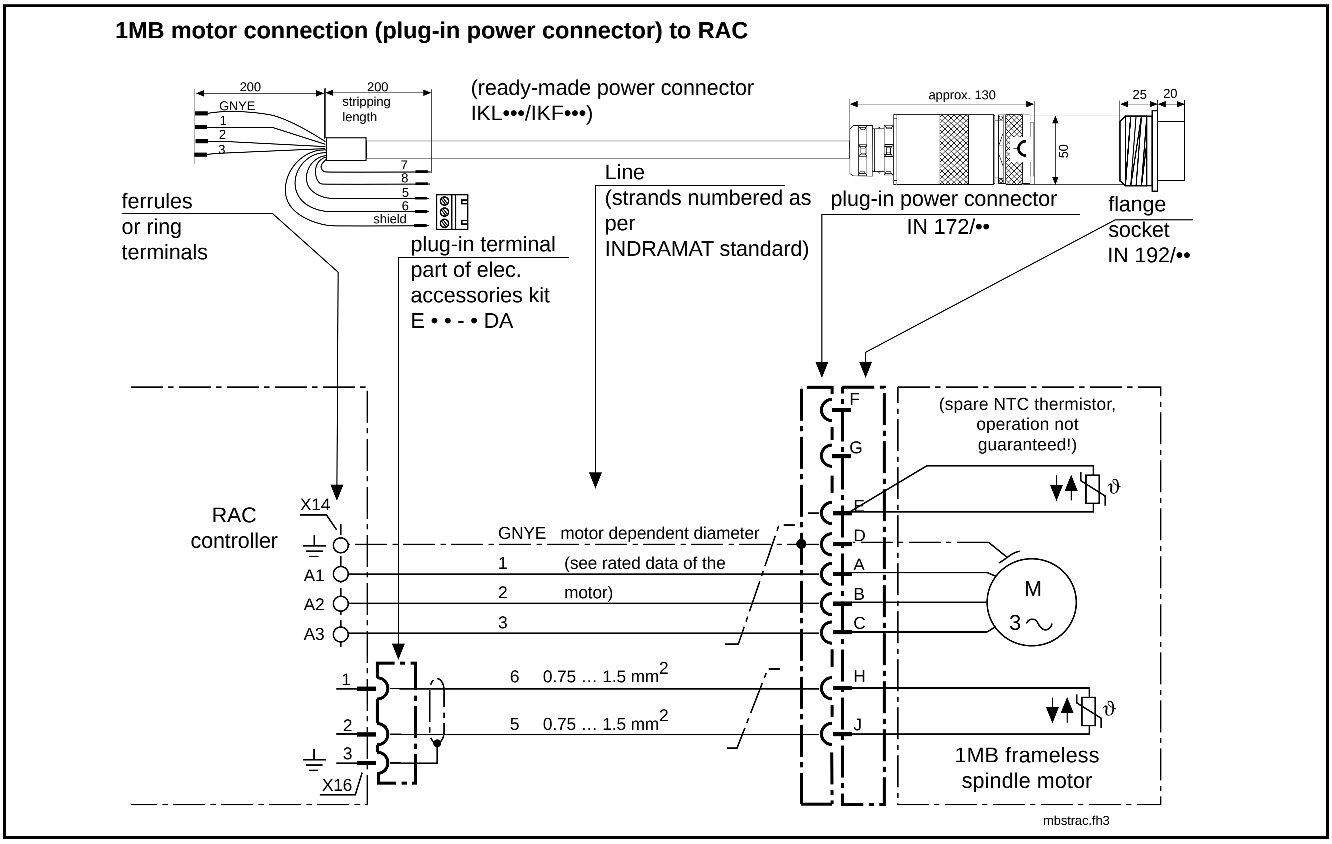


Figure 13.7: Connecting a 1MB to an RAC controller via a power plug-in connection

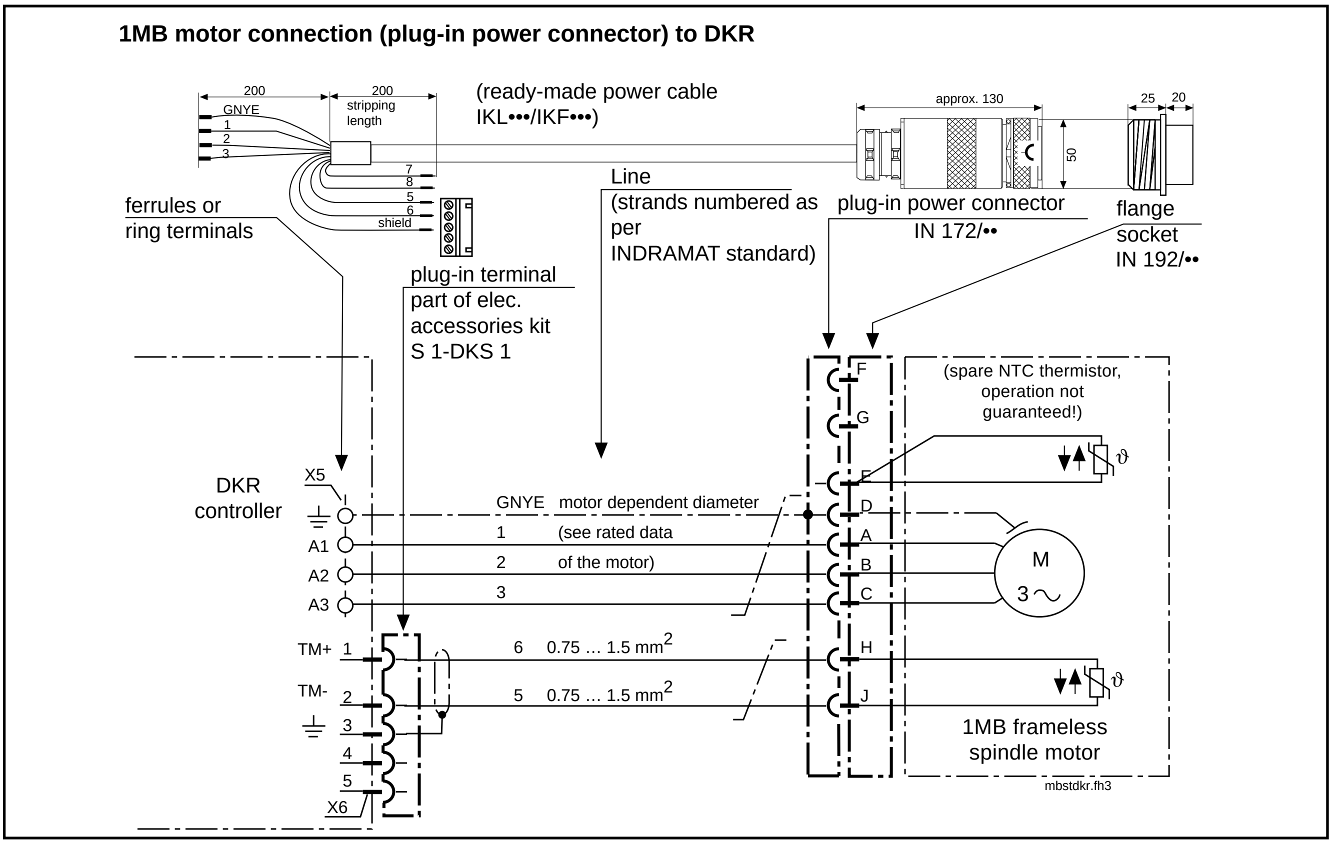
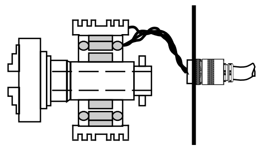


Figure 13.8: Connecting a 1MB to a DKR controller via a power plug-in connection

13.3 Power Cable Table

The required line diameters are motor-type dependent. The are listed in the relevant Technical Data.



	Line dia- meter A [mm²]	Ready-made cable for direct connection	Components of the ready-made cables for direct connection			Ready-made cables for intermediate clamping on terminal strip	
		flex./highly-flex.	on the motor	Line flex./highly-flex.	on the controller	on the motor flex./highly-flex.	on the controller flex./highly-flex.
For stud M6 on the controller					For...		
	4	IKL071/IKF071	INS172/25	INK203/INK403	... M6 stud (KDA/TDA/DDS)	IKL074/IKF074	not available
	6	IKL112/IKF112	INS172/06	INK204/INK404	... M6 stud (KDA/TDA/DDS)	IKL115/IKF115	not available
	10	IKL130/IKF130	INS172/10	INK205/INK405	... M6 stud (KDA/TDA/DDS)	IKL134/IKF134	not available
	16	IKL159/IKF159	INS172/16	INK206/INK406	... M6 stud (KDA/TDA/DDS)	IKL150/IKF150	not available
	25	IKL170/IKF170	INS172/25	INK207/INK407	... M6 stud (KDA/TDA/DDS)	IKL179/IKF179	not available
Terminal blocks on the controller					For...		
	6	IKL115/IKF115	INS172/06	INK204/INK404	... terminal block (RAC2/3, DKR2/3)	see other	not available
	10	IKL134/IKF134	INS172/10	INK205/INK405	... terminal block (RAC2/3, DKR2/3)	see other	not available
	16	IKL150/IKF150	INS172/16	INK206/INK406	... terminal block (RAC2/3, DKR2/3)	see other	not available
	25	IKL179/IKF179	INS172/25	INK207/INK407	... terminal block (RAC2/3, DKR2/3)	see other	not available

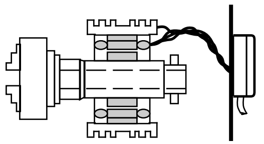
Symbols:

plug-in power connector (plug) — PG screw — ferrules — ring terminals

MBKAB01.FH3

Figure 13.9: Table of dimensions for power cables with plug-in connections

The required line diameters are motor-type dependent. They are listed in the relevant Technical Data.



	Line dia-meter A [mm^2]	Ready-made cable for direct connection	Components of the ready-made cables for direct connection: on the motor	Components of the ready-made cables for direct connection: Line flex./highly-flex.	Components of the ready-made cables for direct connection: on the controller	Ready-made cables for intermediate clamping on terminal strip: on the motor flex./highly-flex.	Ready-made cables for intermediate clamping on terminal strip: on the controller flex./highly-flex.
For M6 stud on the controller			For...		For...		
	10	IKL135/IKF135 (PG 29)	.. M6 stud ⏚ M8	INK205/INK405	.. M6 stud (KDA/TDA/DDS)	IKL136/IKF136	not available
	16	IKL157/IKF157 (PG 29)	.. M6 stud ⏚ M8	INK206/INK406	.. M6 stud (KDA/TDA/DDS)	IKL151/IKF151	not available
	25	IKL174/IKF174 (PG 29)	.. M8 stud ⏚ M8	INK207/INK407	.. M6 stud (KDA/TDA/DDS)	IKL172/IKF172	not available
Terminal blocks on the controller			For...		For...		
	6	IKL110/IKF110 (PG 29)	.. M6 stud ⏚ M8	INK204/INK404	... terminal block (RAC2/3, DKR2/3)	see other	not available
	10	IKL136/IKF136 (PG 29)	.. M6 stud ⏚ M8	INK205/INK405	... terminal block (RAC2/3, DKR2/3)	see other	not available
	16	IKL151/IKF151 (PG 29)	.. M8 stud ⏚ M8	INK206/INK406	... terminal block (RAC2/3, DKR2/3)	see other	not available
	25	IKL172/IKF172 (PG 36)	.. M8 stud ⏚ M8	INK207/INK407	... terminal block (RAC2/3, DKR2/3)	see other	not available
	35	IKL182/ *) (PG 42)	.. M10 stud ⏚ M10	INK267	... terminal block (RAC2/3, DKR2/3)	see other	not available
For M12 screws on the controller			For...		For...		
	50	IKL 191/ *) (PG 42)	.. M10 stud ⏚ M10	INK268/ *)	... M12 screws (RAC4, DKR4)	*)	not available
	2 x 25	2 x IKL 175/2 x IKF 175 (PG 48)	.. M12 stud ⏚ M12	2 x INK207/ 2 x INK407	... M12 screws (RAC4, DKR4)	*)	not available

Symbols: PG screw, ferrules, ring terminals

*) available, enquire using type designation by INDRAMAT, Dept. ENT

MBKAB02.FH3

Figure 13.10: Table of dimensions for power cables when connected via junction box

14. Mounting Guidelines

14.1. General information

These guidelines describe:

- how the rotor is mounted to the spindle,
- how the rotor should be removed from the spindle,
- how the stator is built into the spindle housing and electrically connected,
- how to check the motor spindle electrical connections, and,
- how to remove the stator from the spindle housing.

Carefully adhering to the steps described here will ensure:

- the faultless and safe mounting and removal of the parts and
- the proper functioning of the frameless spindle motor.

Warning and informational symbols

The instructions specified and explained in the safety guidelines must be adhered to. They help to prevent accidents and damage to materials resulting from improper handling.

Section 14.2 outlines general safety guidleines.

Additionally, there are special safety guidelines listed in the mounting guidelines. These will be found there where increased danger is given or could possibly occur.

The safety guidelines are emphasized with the use of the following symbols:

Symbol	Explanation
	**Warning! Area at Risk!** Disregarding this guideline may cause injury to personnel and extensive damage to materials.
	**Note! Important Information!** Disregarding this guideline can damage either the product or the area in which it is located.

Liability

The procedures for mounting and removing the various components is always the same. The procedure can vary, however, depending upon the structure of the spindle and its housing. These guidelines are, therefore, simply general in nature and must be adapted to suite the given demands. The mounting guidelines of the builder of the spindle and its housing are binding and have priority over the procedure described here.

Mounting steps

The procedures depicted below offer an overview of the individual steps.

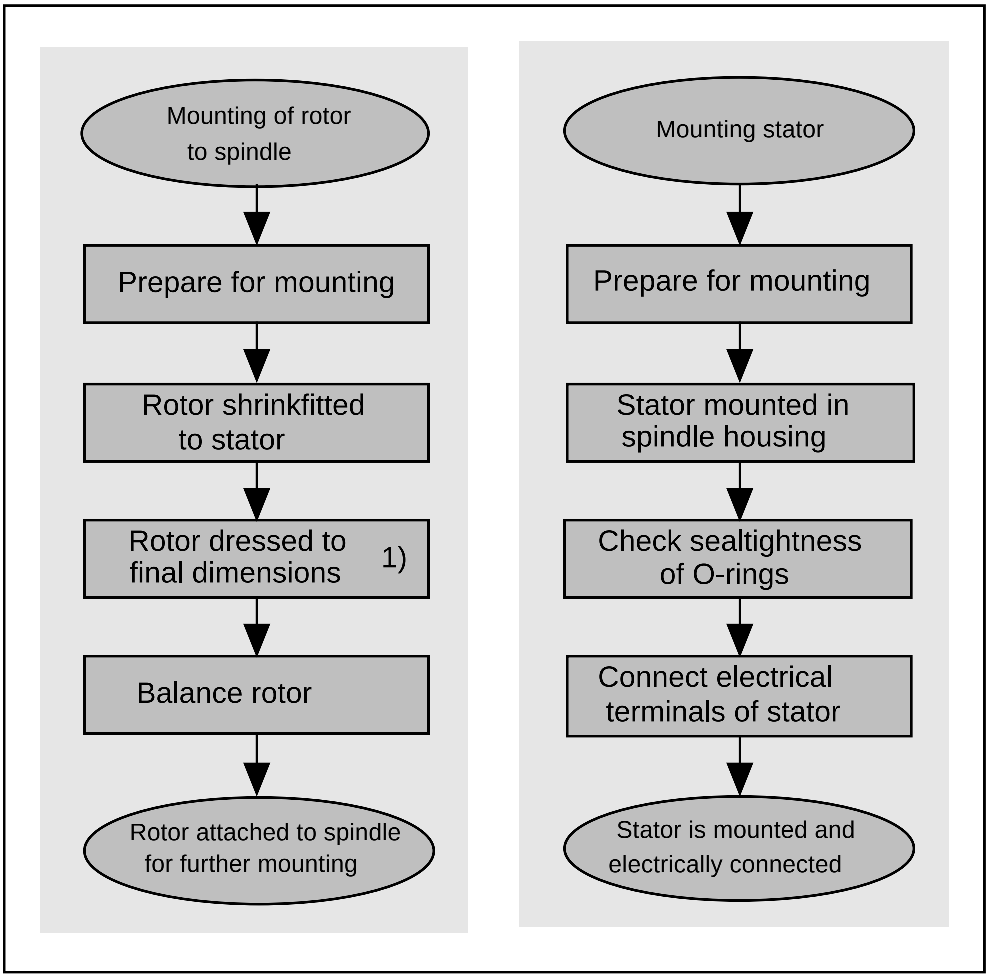


Figure 14.1: Mounting procedures for rotor and stator

1)
With some motor types, the rotor will be supplied "dressed". This means that Indramat has already finished the rotor to its required final dimension. Thus, the final step of "dressing the rotor to its final dimension" does not, in this case, apply.

The rotors that are supplied in this completed state have a sticker indicating this on them. For further information, see Section 16.1 "State of Delivery".

14.2 General Safety Guidelines

General safety guidelines are outlined in this section. These must always be noted and followed.

Oil pump

Use only **manually-operated** oil pumps when removing the rotor from the spindle. Manually-operated oil pumps guarantee that the oil pressure will immediately drop to 0 bar in the event of leaks in the interference fit, the windings or the pump system. For safety reasons, the oil pump must be additionally equipped with a safety valve which prevents the oil pressure rising above 1500 bar.

Securing the threaded pins

The threaded pins in the rotor must be secured to keep them from loosening during operation and thereby endangering both machinery and personnel. Bond the threaded pins with LOCTITE for this purpose. See bonding guidelines in section 14.4.

Accident prevention

The appropriate safety clothing must be worn when mounting. There is, in particular, the danger of burns when shrinking the rotor onto the spindle. Heat-resistant clothing must be worn.

Follow the accident prevention guidelines, "Electrical plants and operational equipment", (VBG 4). Prior to working on live parts in plants and on equipment, disconnect all voltage and make sure it cannot be re-connected. The plants and equipment must be checked, prior to the initial start-up, by a qualified electrician, or under the supervision of a qualified electrician.

The user is responsible for proper grounding. Protective measures must be taken against direct and indirect contact to prevent accidents which can be caused by contact with live parts. See DIN VDE 0100, section 410, for details.

Transportation and handling

Transportation and handling guidelines must be followed (Section 15: "Storage, transportation and handling").

14.3. Aids for mounting and removal

		Mount rotor to spindle	Dismount rotor from spindle	Mount stator	Elec. test of motor spindle	Remove stator
Tools and equipment	Crane (size sufficient for weight of part)	X	X	X		X
	Lifting device (sufficient size for weight of part); see sect.15	X	X	X		X
	Work fixture for attaching rotor [1])	X				
	Warming cupboard (200 °C minimum)	X				
	Lathe	X				
	Balancing equipment	X				
	Test assembly to check concentricity	X				
	Clamping device for fixing spindle-rotor [1])	(X)				
	Compressed air device	(X)				
	Oil pump (max. 1500 bar) with accessories [1])	(X)	X			
	Arresting device [1])		X			
	Drilling device			X		
	Water pump to check tightness (up to 6 bar)			X		
	Ohmmeter				X	
	High-voltage testing equipment				X	
	Inductance measuring equipment				X	
	Torque wrench up to 35 Nm			X		
	Conventional tools and cleaning equipment	X	X	X		X
Aids	LOCTITE 243			X		
	LOCTITE 620	X				
	LOCTITE quick clean 7061	X		X		
	LOCTITE activator 7649	X		X		
	Mineral oil: viscosity 300 mm^2/s at 20° C	(X)				
	Mineral oil: viscosity 900 mm^2/s at 20° C		X			
	Oill, conventional type, for lubrication	X				
	Grease, conventional type	X		X		
	Vaseline			X		
	Coolant			X		

[1]) See explanations on next page.

(X) Only applies to mounting errors.

Figure 14.2: Aids

Use only suitable tools and equipment!

Explanations

Work fixture for mounting the rotor:

The fixture must be heat-resistant up to at least 200 °C. It must also be able to support the weight of both the rotor and spindle. In addition, it must create a level and horizontal surface for the rotor. The following illustrates an example.

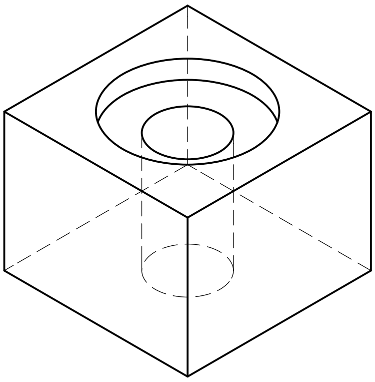


Figure 14.3: An example of a work fixture for mounting the rotor

Manually-operated oil pump and accessories:

Oil pressure equals 1500 bar with a safety valve. A connective winding size of the high-pressure duct is M6 or M4x0.5 (depending upon type of rotor).

Oil pumps and accessories can usually be obtained from the manufacturers of roller bearings.

Clamping device for mounting spindle-rotor:

Should the spindle be deformed once the rotor has been fitted by shrinking, then a clamping device is also needed to correct this deformation. This device must firmly hold the rotor into place on the spindle and prevent any axial movement of the rotor. Figure 17.12 illustrates an example.

Arresting device:

When removing the rotor from the spindle it can suddently slide off of the spindle. The spindle must therefore be equipped with an arresting device. Figure 17.14 illustrates an example. The dimensions of the arresting device must be noted (see Figure 17.15).

14.4 Securing the screws with LOCTITE [1)]

General information

LOCTITE is a plastic bonding agent. It is applied in liquid form to the parts to be mounted. The agent retains its liquid form as long as it has air contact. Only after the individual parts have been mounted does it change from its liquid state to a solid plastic state. This chemical transformation takes place because of the lack of oxygen and the contact with metal. A form-fitting bond is created. It is resistant to shock and vibrations.

Setting activator 7649 cuts down the setting time of the bonding agent.

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

Bonding

Procedure:

1. Remove metal shavings and dirt from threaded hole and screw or threaded pin.
2. Remove all oil, grease and dirt from the threaded hole and screw/threaded pin with LOCTITE quick cleaner 7061. All surfaces must be absolutely free of rust.
3. Spray LOCTITE activator into threaded hole and let dry.
4. Wet the same threaded hole uniformly and thinly with LOCTITE over its entire surface.
5. Screw in matching screw/threaded pin.
6. Allow to set. Note setting time as illustrated in Figure 17.4.

Securing screw connections with LOCTITE in tapped blind holes:
The bonding agent must be applied in the threaded hole and not to the screws. This prevents any air from pressing the agent out once the screw or threaded pin are screwed in.

	Completely set	Partially set without activator	Partially set with activator 7649
LOCTITE 243	≈ 12 h	15 to 30 minutes	10 to 20 minutes
LOCTITE 620	≈ 24 h	1 to 2 hours	15 to 30 minutes
Note: The values are based on setting at room temperature. Setting time can be shortened by applying heat.			

Figure 14.4: Setting times for LOCTITE

Releasing the connection

The connection is undone by removing the screw or the threaded pin with the use of a conventional key.

LOCTITE 620 has a breakaway torque of 20-45 Nm, for LOCTITE 243 it is 14-34 Nm (per DIN 54 454). Blowing hot air at the screwed joint reduces the breakaway torque.

After the screw or threaded pin has been removed, it is necessary to remove any bonding agent residue from the hole (e.g., by shaving the thread).

[1)] Section on Loctite Deutschland has been checked for accuracy and approved for publication.

14.5 Mounting the rotor to the spindle

14.5.1 Rotor parts/ Parts delivered

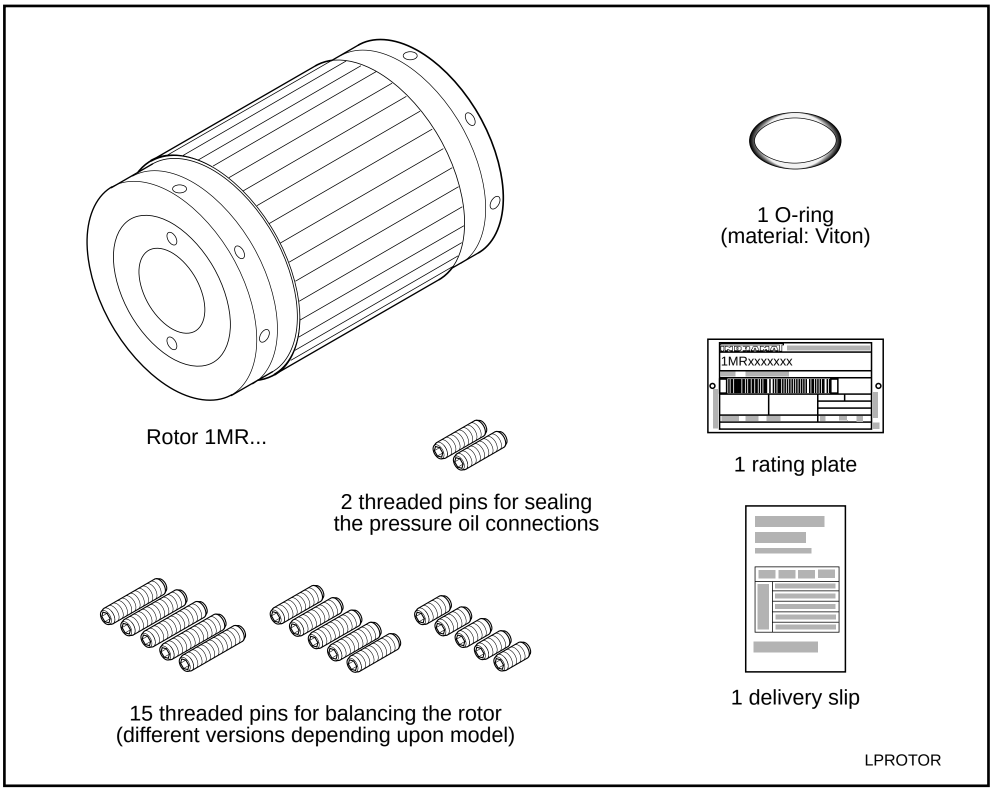


Figure 14.5: Parts of the rotor

14.5.2 Prior to mounting

Mounting should take place in a dry and dust-free environment. The following measures should first be taken:

- Check to see whether all parts which were to be delivered have been delivered.
- Visually check the rotor for any damage.
- Mount the rating plate in a conspicuous position on the spindle housing.
- Make sure that the bevels and edges of the press fits of the spindle are free of burrs, remove these if necessary.
- Inside diameter of the rotor, oil connection drill holes and press fits on the spindle must be thoroughly free of dirt, dust and metal shavings.

- Lubricate the O-ring and insert it into the groove in the rotor. Do not twist the O-ring! Make sure everything is clean!
- Oil press fits ød1 and ød2 on the spindle.

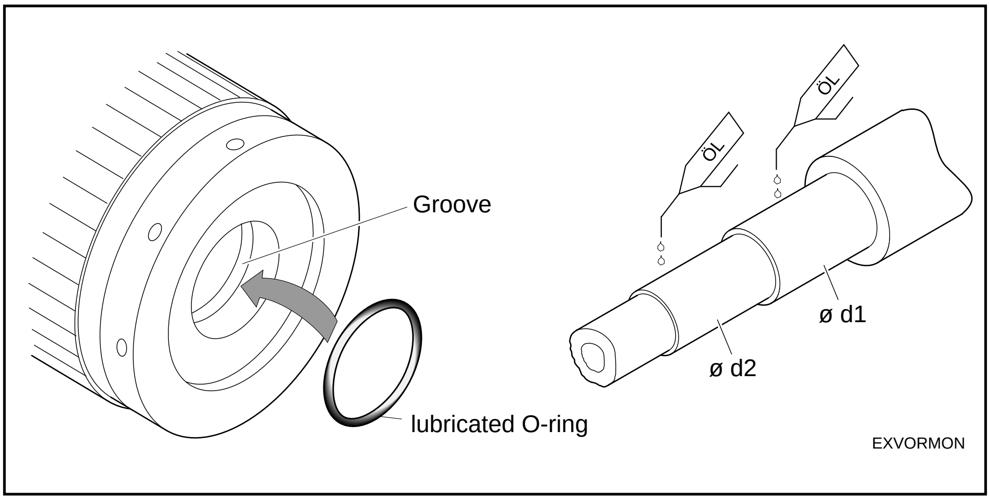


Figure 14.6: Preparing the rotor and spindle for mounting

- Prepare the work fixture for the rotor so that the rotor is supported vertically and can take up the spindle.

14.5.3 Shrinkfitting the rotor onto the spindle

1. Heat up rotor in the warming cupboard to at least 180 °C, but no more than 200 °C.

If the rotor is not heated up to at least 180 °C, the spindle will get stuck in the rotor during the shrinkfitting process before reaching its final position.

Note!

The rotor is hot! There is the risk of injury by burning!

Wear protective clothing!

2. Place rotor into the ready work fixture. The O-ring must be at the top!
3. Pick spindle up and quickly slide it into the rotor.

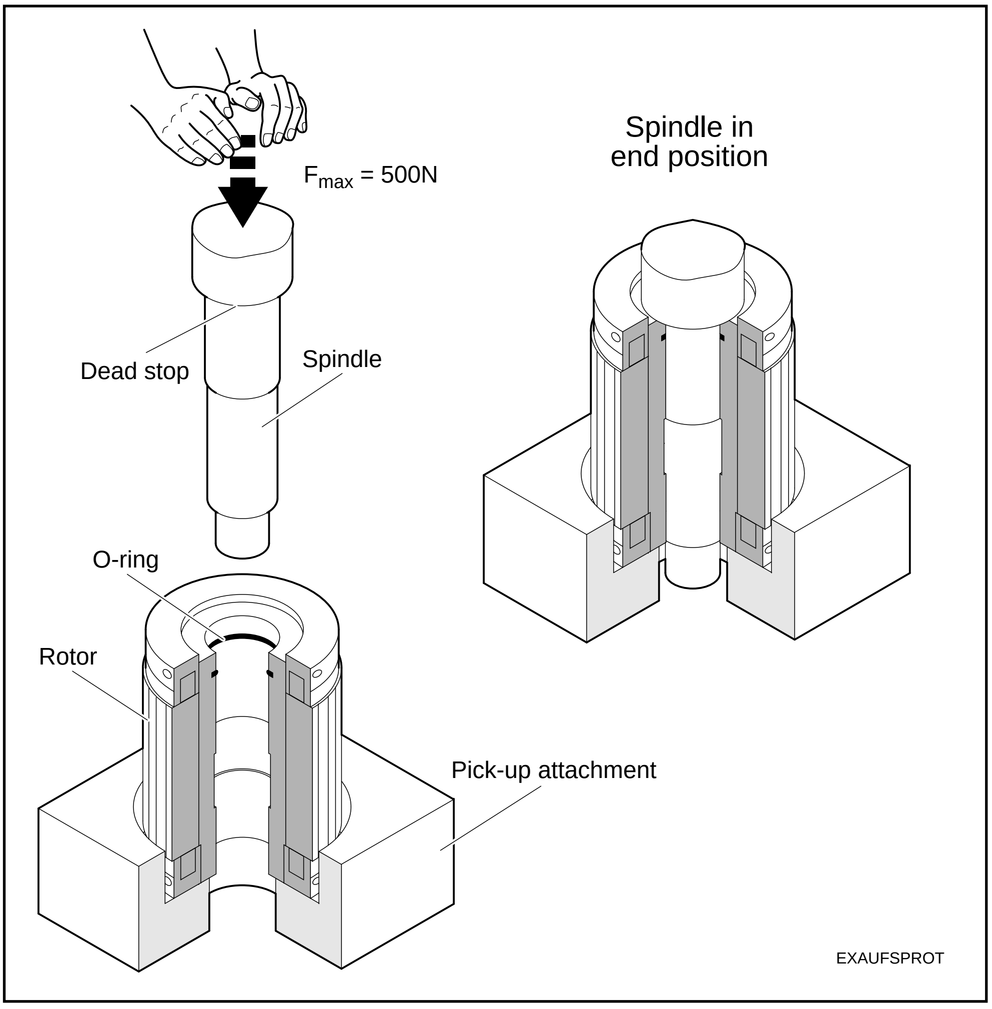


Figure 14.7: Assembling rotor and spindle

The spindle usually slides into its end position without requiring additional force (final stop on spindle). If it does not slide into its end stop by virtue of its own weight, then the spindle can be forced into place in the rotor with no more than 500 N (the force equal to the body weight of the mechanic).

4. Let rotor and spindle cool to room temperature.
5. Check whether the rotor has properly shrunk onto the spindle.
   - Visually check whether the spindle is in its final position in the rotor.
   - Check the concentricity of the spindle.
     Check whether the concentricity of the spindle is still as good as it was prior to shrinkfitting.

     If concentricity has deteriorated, then the spindle is slightly deformed. This deformation is caused by stress which can occur in the step interference fit during cooling.

If the spindle is not in its final position, and the necessary concentricity has not been achieved, then the remedial steps as described in section 14.5.6 must be taken.

6. Use the threaded pins to close the pressure oil connections in the rotor. This means screwing the threaded pins in all the way and securing them against rotation with LOCITE 620. (For bonding guidelines see section 14.4). The threaded pins must be bonded into place in such a way that they completely seal the connections against any oil pressure that might occur.

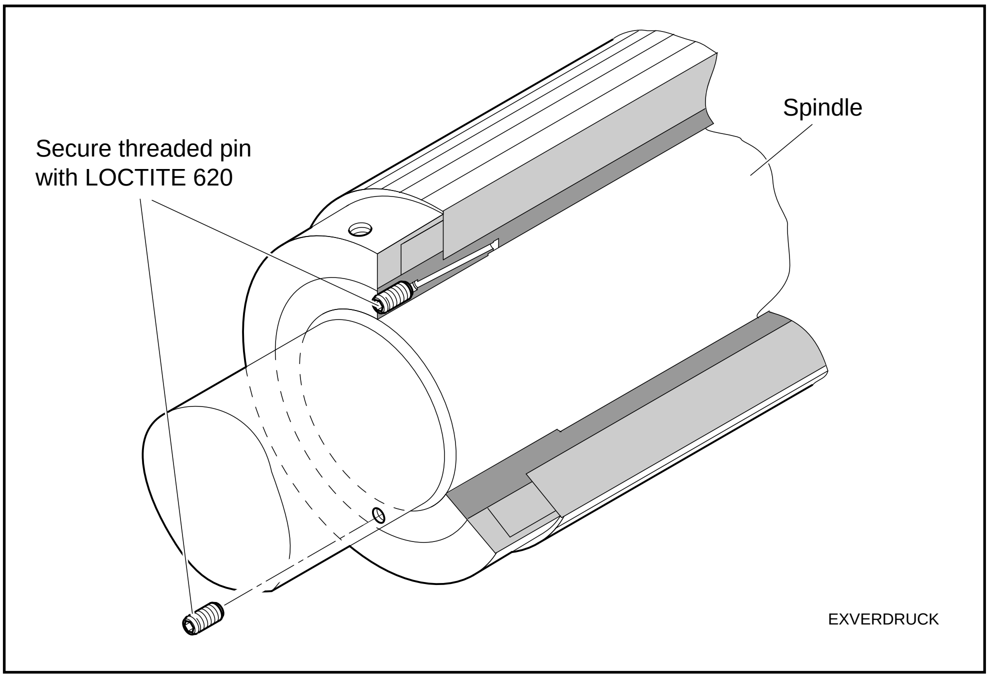


Figure 14.8: Sealing the pressure oil connections

14.5.4 Dressing the rotor to its final dimensions

If the rotor is delivered "dressed", then no further finishing is required or should be performed. The rotor already has its required outside diameter (final dimension).

Rotor is dressed

There is a sticker indicating that the rotor is dressed on those rotors supplied in this state.

In the event of doubt, measure the outside diameter of the rotor and compare the measured dimension with the relevant data on the data sheet.

Rotor is not dressed

Once the rotor and the spindle are firmly attached, then the outside diameter of the rotor within the zone of the laminated core can be dressed dry (without coolant or cutting liquid). The final dimensions of the outside diameter will depend upon the motor type. These are listed in the relevant data (see section "Technical data").

When dressing, make sure that the maximum deviation of concentricity to bearing seats A and B does not exceed the prescribed value.

The values (maximum deviation of concentricity, surface roughness) for the various motor types are listed in the relevant data sheets.

Do not grind and do not dress rotor when it is wet!

No material may be removed from the short circuit rings or the balancing rings!

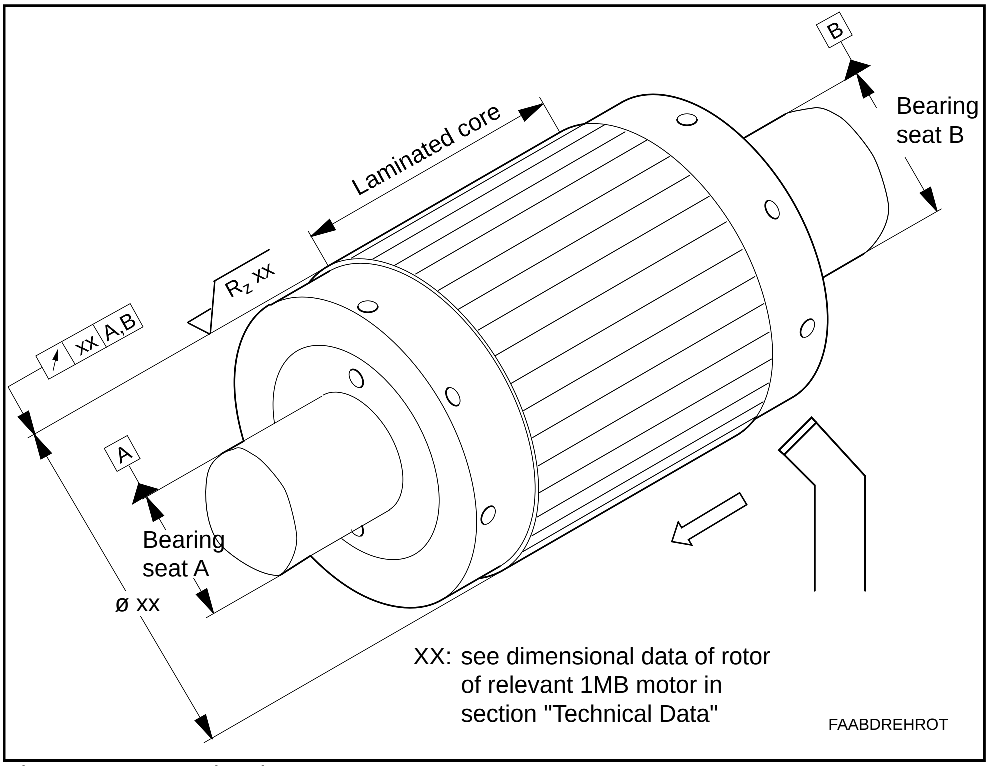


Figure 14.9: Dressing the rotor

The final dimension to which the outside diameter is to be dressed, must be maintained!

If too much material is machined off, this will alter the characteristics curves of the drives.

14.5.5 Balancing the rotor

The rotor must be balanced with the spindle to achieve the desired vibration severity grade of the spindle. There are balancing rings on the front of the rotor. These have tapped holes. Threaded pins should be screwed in, as needed, for balancing. The table in Figure 17.11 lists the threaded pins generally supplied.

The vibration severity grade needed depends on the finishing accuracy of the motor spindle. The accuracy is determined by the builder of the motor spindle.

Remove no material from the balancing rings when balancing the the spindle!

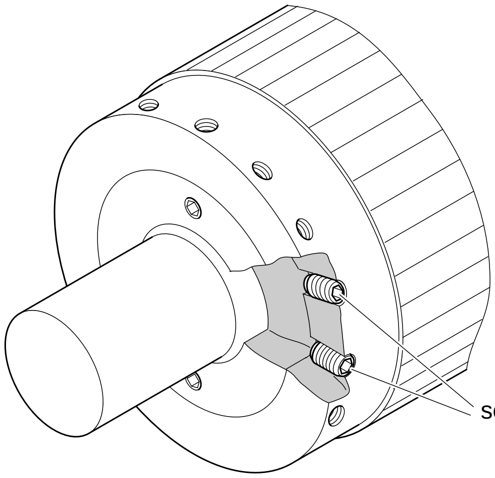


Figure 14.10: Balancing by inserting threaded pins

The threaded pins can be inserted to a greater or lesser degree, depending upon the mass equilibrium required. They may not, however, protrude out of the balancing ring! It is not necessary to completely insert them!

Make sure that the threaded pins cannot loosen themselves by bonding them with LOCTITE 620! See section 14.4. for bonding guidelines. Note setting times with activator! Do not use activator, if not necessary.

Threaded pin per DIN 913	Number / 1MR ...										Wgt. per piece in g
	140	160	200	240	241	242	270	310	312	375	
M5 x 5	5										0.44
M6 x 6	5	5	5			5	5				0.76
M6 x 8		5	5			5	5				1.11
M6 x 10		5									1.46
M6 x 12							5				1.81
M8 x 8										5	1.89
M8 x 10				5	5					5	2.52
M8 x 12			5	5	5						3.15
M8 x 16				5	5	5					4.41
M10 x 10								5	5		3.78
M10 x 12								5	5	5	4.78
M10 x 20								5	5	5	8.76

Figure 14.11: A summary of the threaded pins supplied

14.5.6 Remedial actions with mounting errors

Error:
Spindle gets stuck in the rotor during the shrinkfitting process before reaching its final position.

Procedure:

1. Let rotor and spindle cool down.
2. Seal one of the two pressure oil connections on the rotor with a threaded pin. Screw in the threaded pin all the way and prevent it from turning with LOCTITE 620. (See section 14.4 for bonding guidelines.) The threaded pin must be bonded in such a way that it is completely sealed against any oil pressure.
3. Force the rotor off of the spindle with the help of the pressure oil (as described in section 14.6 "Removing rotor from spindle").
4. Check the tolerances of the press fits.
5. Remove burrs from the inside diameter of the rotor and at the interference fits ød1 and ød2 of the spindle.

Both spindle and rotor must be absolutely free of burrs!

6. Shrinkfit the rotor again.

Error:
The spindle is warped after the rotor has been shrinkfitted.

Tensions in the step interference fits can occur during shrinkfitting. These can cause spindle deformations of micrometer size. These tensions are removed and the deformations returned to normal by forcing pressure oil into the step interference fit.

Procedure:

1. Let rotor and spindle cool down.
2. Seal one of the two pressure oil connections on the rotor with a threaded pin. Screw in the threaded pin all the way and prevent it from turning with LOCTITE 620. (See section 14.4 for bonding guidelines.) The threaded pin must be bonded in such a way that it is completely sealed against any pressure oil.
3. Clamp rotor and spindle to each other in such a way to each other that the rotor is firmly held in position on the spindle. Caution: use the appropriate tools.

The rotor must not be permitted to shift in an axial direction onto the spindle while the pressure oil is being injected!

4. Connected oil pump.

   Use oil with a viscosity of 300 mm^2/s at 20^o C! This ensures that the oil will quickly flow out after "floating".

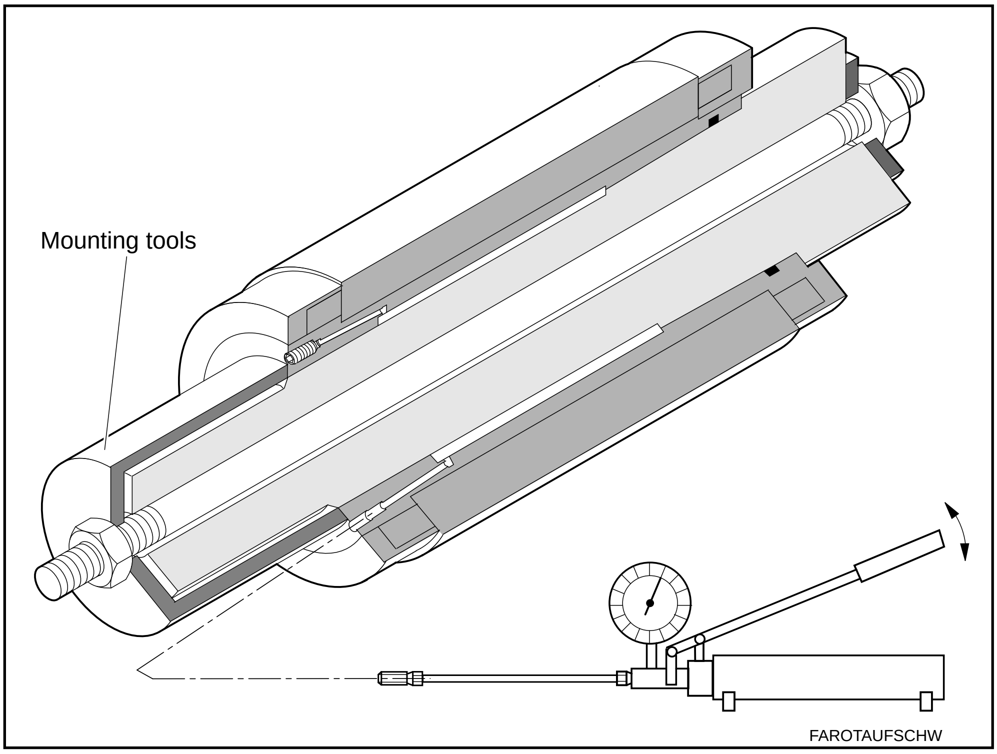


Figure 14.12: The rotor "floating"

5. Pump oil into the step interference fit.

Oil is leaking! Have an oil collecting pan ready.

Slowly increase oil pressure until oil begins to leak out of the coil end of the interference interface.

An oil film forms between rotor and spindle. This "floating" of the rotor on the spindle eliminates the tensions which may have arisen during shrinkfitting.

6. Eliminate all pressure from the oil pump, supply lines and interference fit.
7. Open both pressure oil connections.
8. Bring spindle with clamping device into a vertical position. Using compressed air, force the oil out of the step interference fit (see Figure 17.13).
9. Let oil completely run out of the step interference fit.

Do not apply a full load to the step interference fit for 24 hours!

10. Seal both pressure oil connections with threaded pins and secure them with LOCTITE 620.

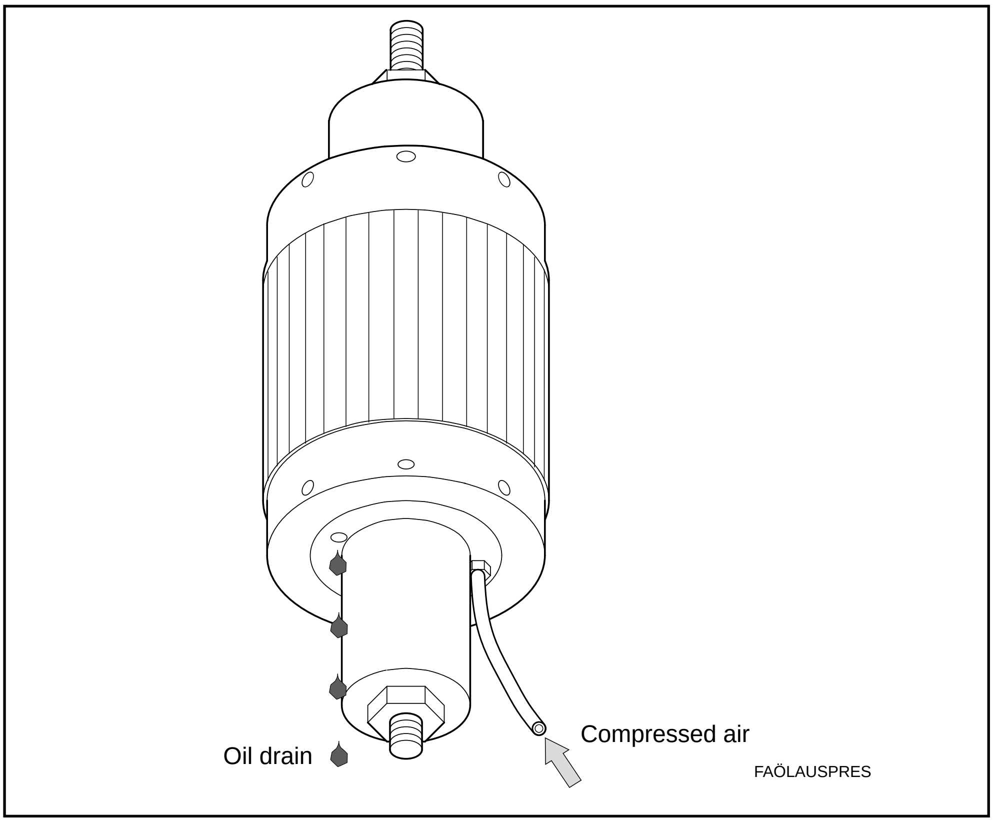


Figure 14.13: Using compressed air to force oil out

14.6 Removing the rotor from the spindle

In the following cases it may be necessary to remove the rotor:

- damage to the bearings on the spindle
- rotor damage
- mounting error

The angular position of the rotor must be marked on the spindle before removing.

It is necessary to shrinkfit the rotor onto the same spindle, at the position marked, when re-mounting. This maintains the concentricity tolerance of the outside rotor diameter to the bearing seats.

Procedure:

1. Mark the angular position of the rotor on the spindle.
2. Open one pressure oil connection.

   The second connection must remain closed. Secure it, if necessary, with one of the threaded pins. This means that the threaded pins must be completely bonded and locked against rotation with LOCTITE 620. (See section 14.4 for bonding guidelines.) Bond the threaded pin in such a way that it completely seals the connection against any oil pressure.
3. Mount the end stop (example in Figure 17.14). Note the mounting dimensions (A) for it.

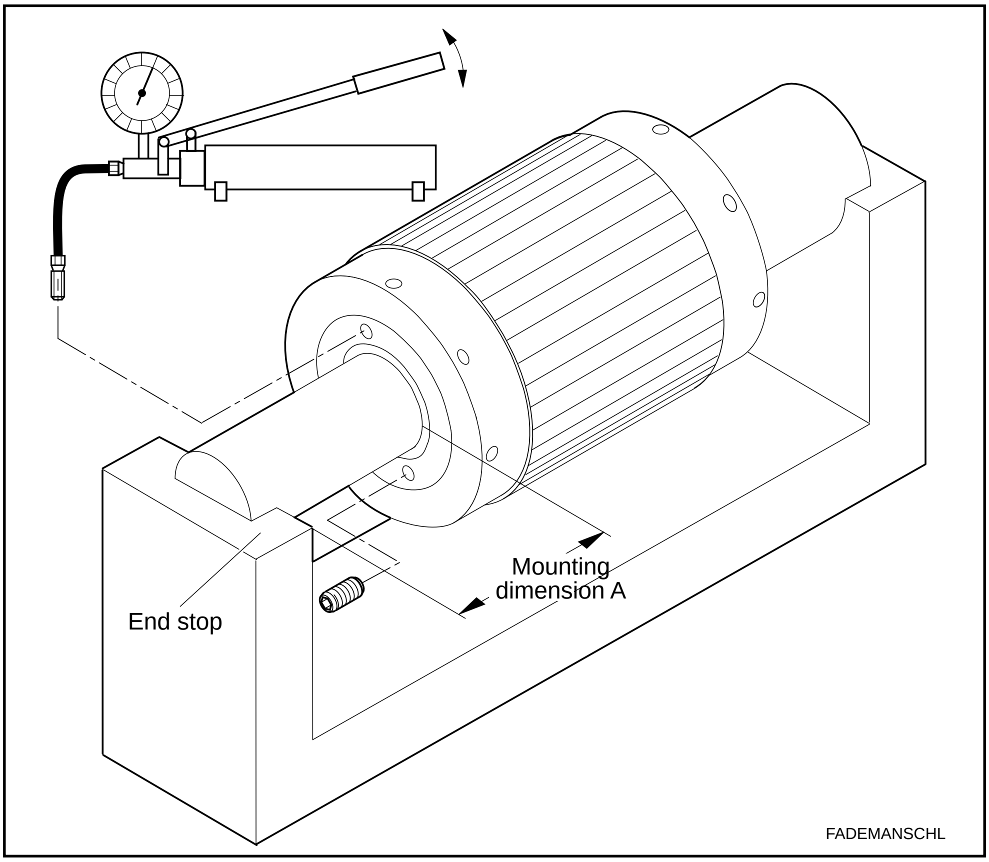


Figure 14.14: Example for an end stop for use during removal

Rotor	Dimension A/mm
1MR 140	min. 60
1MR 160	min. 70
1MR 200	min. 80
1MR 240	min. 80
1MR 241	min. 80
1MR 242	min. 80
1MR 270	min. 90
1MR 310	min. 90
1MR 312	min. 110
1MR 375	min. 110

Figure 14.15: Mounting dimension A for the different types of rotors

4. Connect the oil pump.
   Use an oil with a viscosity of 900 mm²/s at 20° C!

The rotor can suddenly slide off of the spindle when oil is pumped into the step interference fit!
There is the risk of injury from the sudden rotor movements!
This is the reason why an arresting device must be mounted to the spindle!

5. Pump oil into the step interference fit.

Oil may leak! Have an oil collecting pan ready.

   Slowly increase oil pressure until the axial force affecting the step interference fit permits the rotor to slide off of the spindle.

6. If oil is already leaking on the coil end of the step interference fit, and the rotor still cannot be dislodged from the spindle, then gently tap the rotor in the direction of the end stop with a plastic hammer.

For further remounting instructions, see section 13.5.

14.7 Mounting the stator in the spindle housing

14.7.1 Parts of the stator

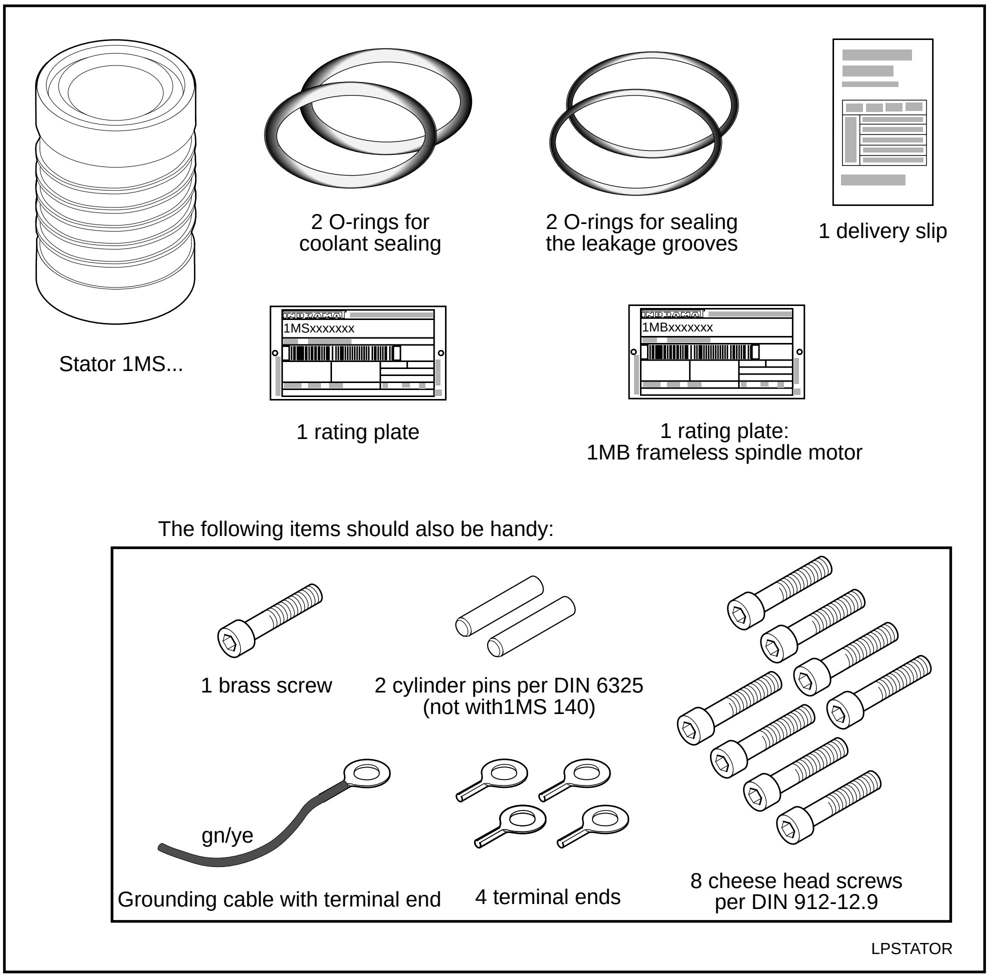


Figure 14.16: What is delivered with the stator and additional materials

14.7.2 Prior to mounting

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

- Check to see whether everything that was to be delivered has been delivered.
- Have additional materials at hand. The precise dimensions of these materials is noted in the construction drawings.
- Visually check stator for any damage.
- Mount rating plate(s) in a conspicuous position on the spindle housing.
- Check to make sure that the drill holes for the connections on the spindle housing are free of burrs, remove these if present.

The inside edges of the drill holes for the coolant connections and the inside edges of the leakage drill holes must be absolutely free of all burrs so as not to damage the stator during mounting!

- Remove dirt, dust and metal shavings from O-ring groove on the stator.

14.7.3 Mounting the stator into the spindle housing

There are tapped holes on both ends of the stator for mounting the stator into the spindle housing.

It can be mounted to either the thick or thin end of the stator, but not to both!

Note: The basic procedure for mounting the stator in the housing is always the same. It can, however, on occasion deviate from the procedure described here, depending entirely upon the construction of the spindle housing. The following describes how the stator is mounted to the back side of the end shield.

Procedure:

1. Lubricate the O-rings.
2. Insert O-rings (position 1; per stator accessory list) into the grooves located furrther inside (coolant seal). Do not twist the O-rings! Keep all surfaces clean!
3. Insert O-rings (position 2; per stator accessory list) into the grooves further outside (leakage groove). Do not twist the O-rings! Keep all surfaces clean!

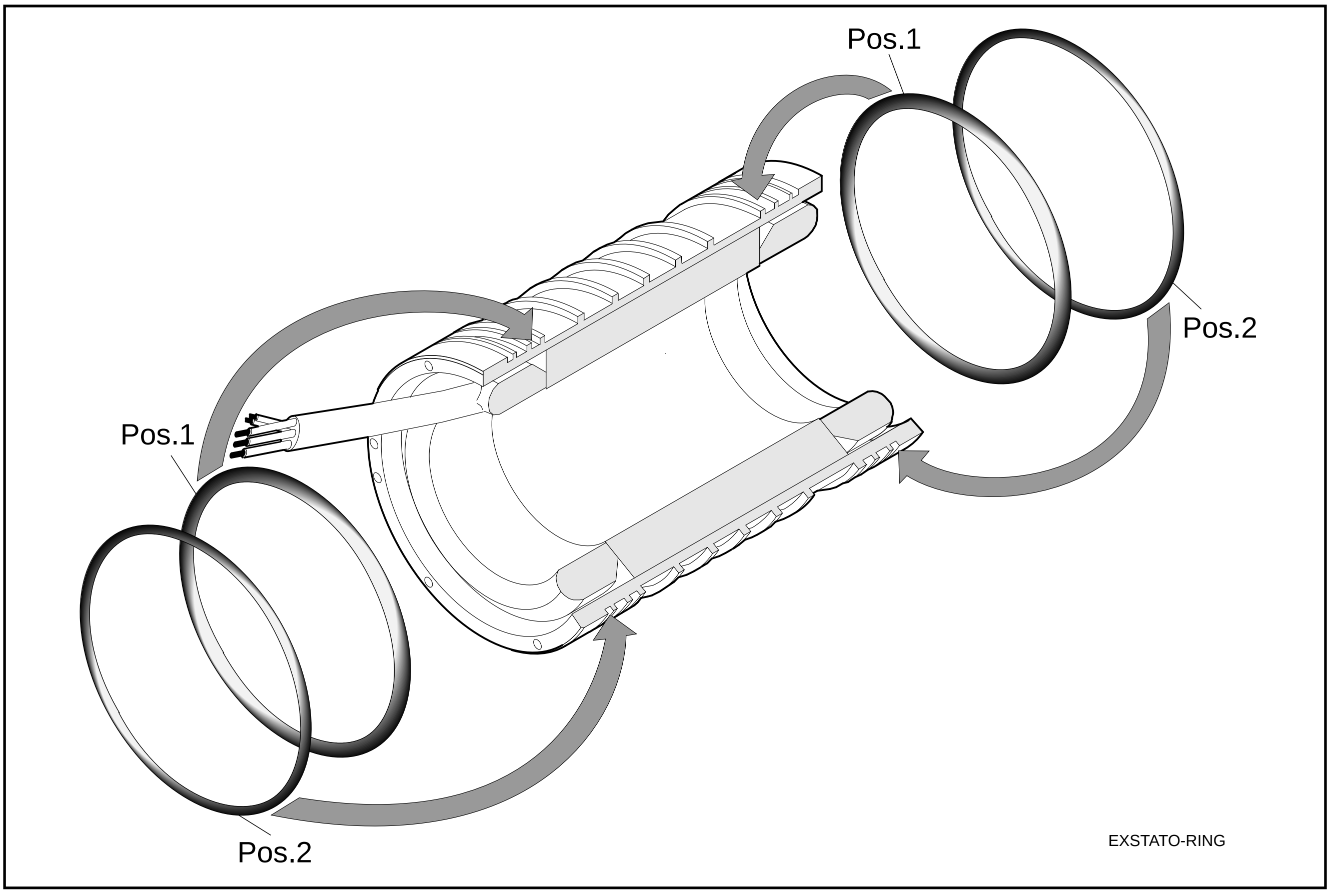


Figure 14.17: Mounting the O-rings

The O-rings for sealing the leakage grooves and for the coolant seals have the same dimensions in several motor types!

4. Let stator glide centered into the spindle housing. Use chains or ropes to lift the stator.

Note transportation and handling guidelines!

Do not use the motor winding as a mounting aid. Do not pull or push the motor winding in anyway.

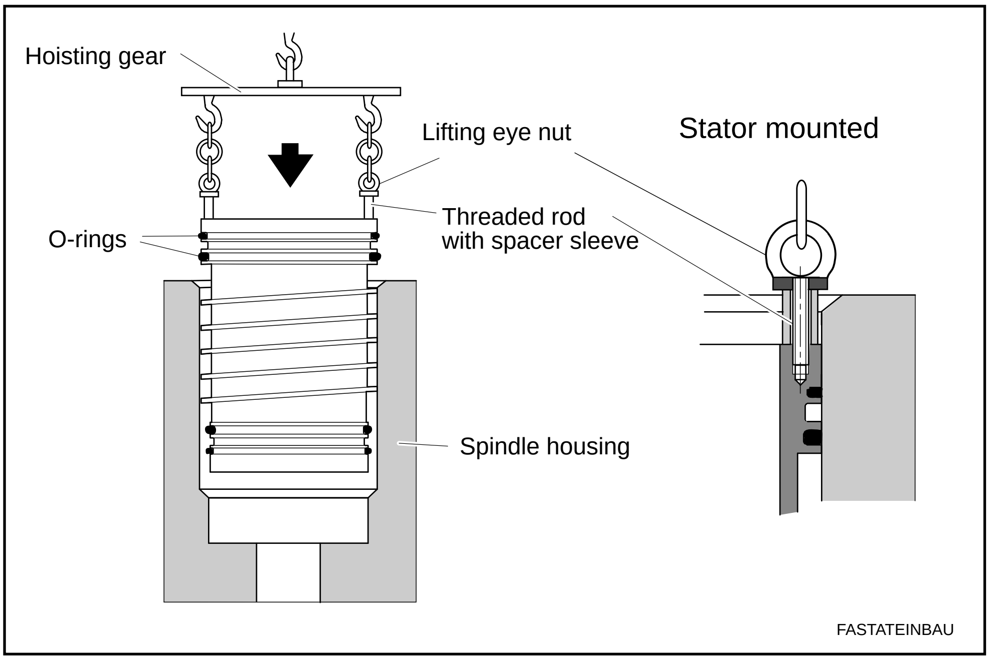


Figure 14.18: Mounting the stator into the spindle housing

5. Push the stator into its final position. Use suitable tools to assist with stiff and sluggish mounting.
6. Screw the stator onto the front of the end shield. Using a torque spanner, uniformly tighten the screws. The tightening torques are listed in the relevant construction diagrams.

   Secure the screws with LOCTITE 243; see section 14.4 for guidelines.
7. Pin the stator to the end shield (not with a 1MS 140).

   The drill holes for the cylindrical pins in the cooling jacket of the stator are rough-drilled. They need to be enlarged to the size listed in the construction diagrams.

14.7.4 Checking the seal-tightness of the O-rings

Once the stator has been mounted, the seal-tightness of the O-rings should be checked.

Procedure:

1. Fill the coolant groove between the cooling jacket and spindle housing with coolant.
2. Seal one of the coolant connections in the spindle housing with a screw plug.
3. Connect a pump with pressure indicator and pressure regulator for the coolant to the second connection.
4. Position the spindle housing in such a way that the drain is now at the lowest point (bottom).
5. Pump in the coolant and slowly increase pressure from zero to six bar.
6. Once six bar have been reached, watch the drain for ten minutes to see whether any coolant is leaking.

If coolant is leaking from the drill holes, replace the O-rings! Locate and eliminate the cause of the defective O-rings!

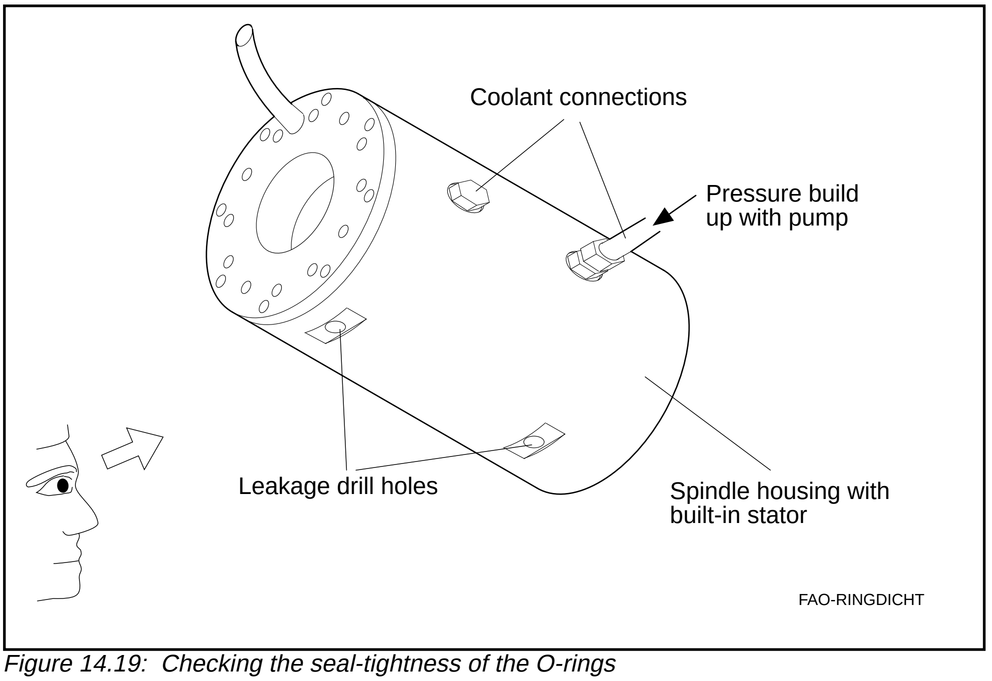


Figure 14.19: Checking the seal-tightness of the O-rings

14.7.5 Connecting the electrical supply leads of the stator

There is a 1.5 m motor winding attached to the stator at delivery. It is encased in a protective tube and is made up of:

- three power conductors (labelled U,V and W),
- and, two wire pairs for the two NTC thermistors in the end winding.

Only one of the two thermistors is connected to the drive. The other is only a reserve. Its functioning is not guaranteed.

Before connecting the NTC thermistor, check to see whether it is working. The resistance of the thermistor is measured at room temperature with an ohmmeter for this purpose. If the value measured equals 30-50 KΩ, then the thermistor is operational and can be used.

All lines are connected either in a flange socket (INDRAMAT IN 192) or a junction box. Both flange socket and junction box must be mounted directly to the spindle housing.

The terminal diagrams are documented in "Electrical connections of the main spindle drives; Project planning manual" (doc. no. 209-0042-4111). Flange socket, or junction boxes must be directly mounted to the spindle housing.

When routing the motor winding to the junction box or flange socket, do not permit the bending radius to fall below the permissible value!

The edges of the through-holes may not be sharp!

Attaching the grounding cable to the spindle housing

The permissible bending radius is dependent upon the diameter of the motor winding of the motor type. The radii are listed in the data sheets of this document.

The ground terminal should be attached to the spindle housing as depicted in Figure 17.20. The stator is connected to the end shield via a screwed connection.

The minimum diameter depends upon the motor type. All relevant information is outlined in the section "Technical Data".

The minimum diameter also applies to the ground terminal, and must be maintained!

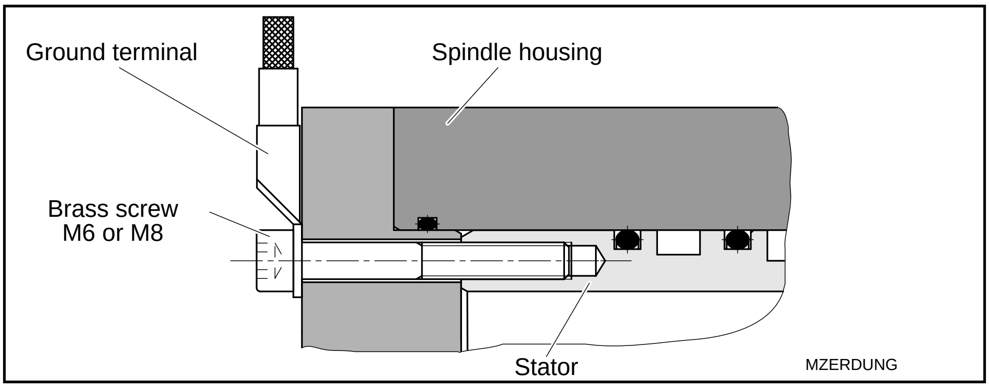


Figure 14.20: Grounding the stator and spindle housing

Procedure:

1. Clean the mounting surface for the head of the screw. The surface must be spotless so that spindle housing and stator are grounded.
2. Screw the grounding cable with terminal end to the end shield. Use a brass screw (M6 or M8, depending upon type).
3. Use petroleum jelly to lubricate the connection and protect it against corrosion.

Connecting a motor winding to a flange socket

The cores of the motor winding are soldered to the backside of the flange socket.

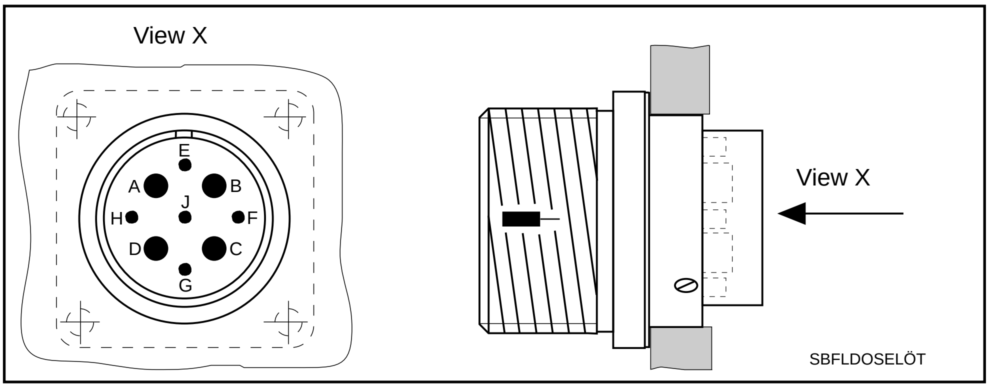


Figure 14.21: INDRAMAT flange socket IN 192/25 with contacts designated (soldered side)

The cores should be soldered as follows:

Designation of contact	connect to	
A	U	power terminal
B	V	power terminal
C	W	power terminal
D	⏚ gn/ye	ground cable
H		NTC thermistor connection
J		NTC thermistor connection
E		Spare NTC thermistor is shorted to contact E
F,G		remains unused

APFLANSCHDOSE

Figure 14.22: Connecting flange socket IN 192/25

Attaching cables in a junction box

Prior to attaching the motor winding cores in the junction box, check the seals of the junction box:

- There must be a seal for both the junction box and the lid (see Figure 17.23).
- Both seals and seal surfaces must be in faultless condition.

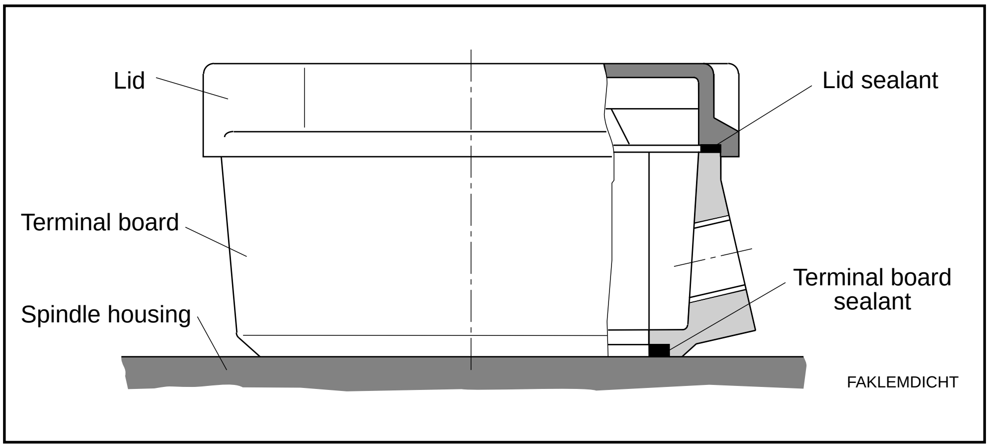


Figure 14.23: Junction box seals

If the cables are attached in a junction box, then both the cable connections and the ground terminals must be equipped with terminal ends. The size of the terminal ends must correspond to the diameters of both the conductors and the studs in the junction box.

The individual cores of the motor windings must be clearly labelled in the junction box. It is absolutely important that the conductors are not confused!

Figure 17.25 illustrates an example of how to arrange the individual points of connection in a junction box.

Attach the individual conductors as follows:

- Screw the ring terminal of the ground terminal at its intended point.
- Using a washer, fasten the power terminal to the terminal stud (note tightening torque!). Connect them according to their designation:

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

Thread size	M3.5	M4	M5	M6	M8	M10	M12
Tightening torque /Nm	0.8	1.2	2	3	6	10	15.5

Figure 17.24: Tightening torque for terminal board washers as per DIN 46 200

- The NTC thermistor connections are clamped to the terminal strip.

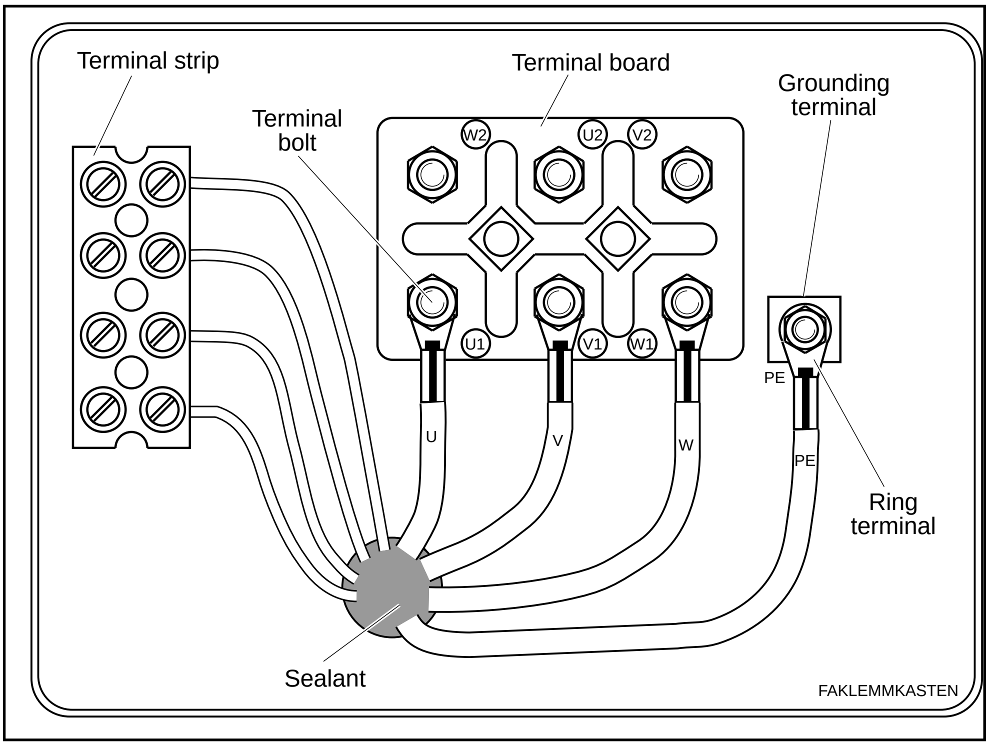


Figure 14.25: Junction box with terminal board and strip

If a different junction box design is implemented, then the terminals of those construction diagrams to suit that design must be carried out.

After connecting the conductor in the junction box, use a plastic sealing compound to seal the through-hole between junction box and spindle housing.

14.8. Electrical check of the motor spindle

14.8.1 Running a high-voltage check

After mounting the stator and connecting the cores in the junction box or to the flange socket, it is necessary to run a high-voltage check.

This check is performed between windings, housing and NTC thermistors and is meant to test the insulating properties.

The proof voltage has to be a sinusoidal alternating voltage, U_{eff} = 1500 V.

The test must be performed as per DIN VDE 0530, section 1, para. 17.

The high-voltage check must be carried out by a qualified electrician or under the supervision of a qualified electrician!

Test recommendations:

The following readings must be taken and recorded (section 14.8.3):

- windings - housing
- windings - NTC thermistor 1
- windings - NTC thermistor 2

Procedure:

1. Those windings not to be tested must be connected to each other and to the housing.
2. Apply voltage, U_{eff} = 1500 V, for five seconds to the relevant end of the winding or parts to be tested.
3. Measure leakage current.

The test is successful if the leakage current is measured at ≤ 20 mA (with 1 MS 375 ≤ 50 mA) with each reading.

Caution! If the leakage current exceeds the limit values indicated, it must be noted that the components are not sufficiently insulated from each other!

During commissioning there exists:
- **danger to life and limb upon contact with the spindle housing and**
- **the risk of damaging the machinery!**

The frameless spindle motor must in not be started up! Find and remove any faults!

14.8.2 Running an inductance test

Once the entire motor spindle is mounted - including the installation of either the junction box or the flange socket - the inductance values of the spindle motor must be checked. These values are listed in section "Technical data" of the relevant 1 MB motor.

- Test conditions:
  - Motor spindle temperature: approximately 20° C
  - Spindle is standing still
- Testing tools:
  - Inductance measuring device with a measuring frequency of 1 kHz
- Test guidelines:

  The reading will be taken between the three power terminals or power contacts (see test protocol; section 14.8.3).

  - reading of winding U - V
  - reading of winding V - W
  - reading of winding W - U

  The values read may deviate ±10% from the inductance values listed in the technical data!
- Causes for deviating values:
  - the diameter of the rotor after dressing is not correct, or,
  - the rotor is defective.

If the determined inductance values exceed the range permitted, then the characteristics curves of the drive can no longer be realized! There is, however, no danger that the electrical drive components can be damaged during operation!

14.8.3 Test report of motor spindle with 1 MB motor

Motor spindle type designation:

Motor type: 1MB __ __ __ __ - __ __ - A __ __ __ A __

Serial no.: 1MB __ __ __ - __ __ __ __ __ __

Manufacturing date: ____ . ____

(Also see section "Identifying the merchandise".)

- **High-voltage test (as per section 14.8.1)**

	yes	no
Test as per procedures described in 14.8.1?		

Proof voltage: _________ V

Test duration: _________ seconds

Reading:	Criterion: i < ________ ? passed	failed
U - housing		
V - housing		
W - housing		
NTC thermistor 1 - windings		
NTC thermistor 2 - windings		

Conductively connect the power cores of the motor windings!

- **Inductance test (as per section 14.8.2)**

Temperature of the motor spindle: _________ °C

Measuring frequency: _________ kHz

Inductance value; as per technical data: L_{TD} = _________ mH

Reading				Test: $0.9 \bullet L_{TD} < L_{mess} < 1.1 \bullet L_{TD}$ _____mH < L_{mess} < _____mH	
Inductance of …	Symbol	Unit	Value	passed	failed
…winding U-V	L_{mess1}	mH			
…winding V-W	L_{mess2}	mH			
…winding W-U	L_{mess3}	mH			

- **Checking the NTC thermistor and determining the connection**

An NTC thermistor must be selected for connection to a drive and attached to the relevant terminals (see motor spindle connection diagram).

Criterion: 30 kΩ < $R_{20\,°C}$ < 50 kΩ

Remarks: ____

____

Location, Date: ______________________ Name/Co.: ________________________

Figure 14.26: Motor spindle test report (electrical)

14.9 Removing the stator from the spindle housing

The stator may have to be removed, for example, if,

- a winding has burned out,
- both thermistors are defective,
- or, the O-rings are leaky.

Danger! High voltages!

Danger to life and limb upon contact with parts conducting high voltages!

Before working on any electrical equipment make sure that they are voltage free!

Procedure:

1. Detach electrical connections:
   - power terminals
   - NTC thermistor connections
   - grounding cables
2. Release cylindrical pins on the end shield and remove them.
3. Using appropriate tools, slowly pull out end shield.
4. Screw transportation rings into appropriate holes.

Avoid pulling or pushing the motor windings when mounting/ removing so as not to damage the stator!

Transportation and handling guidelines must be followed!

5. Using the appropriate lifting equipment, slowly pull out the stator (Caution: the stator is heavy!).

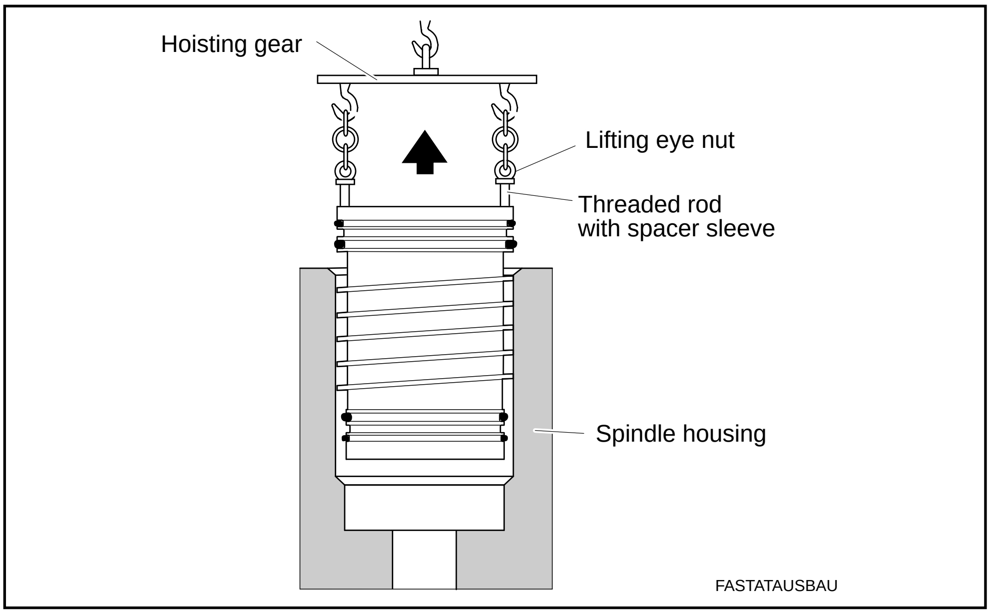


Figure 14.27: Removing the stator from the spindle housing

15. Storage, handling and transportation

Note the various weights and sizes of the individual models when selecting the transportation and lifting equipment.

The greatest care must be taken, and all transportation and storage guidelines must be followed, even with the portable models.

15.1 Rotor

Storage

The rotor is delivered in a horizontal position, packed in half-shells made of styrofoam. It must be stored dry, free of dust and vibrations. The permissible temperature range is -25 °C to + 85 °C. The rotor can be stored in either a horizontal or vertical position.

Lifting and transporting

The fit on the inside of the rotor may not be damaged during transportation. Any such damage will make it impossible to remove the rotor.

Use only sling hoisting belts made of plastic, or special hooks that are sheathed in plastic, to lift or transport the rotor!

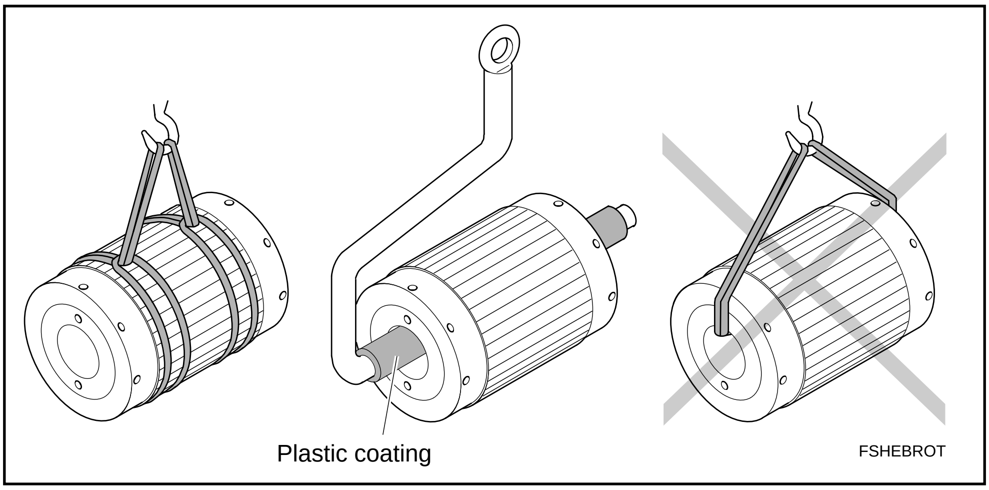


Figure 15.1: Hoisting the rotor with sling hoisting belts or special hooks

15.2 Stator

Storage

The stator must be stored dry, dust and vibration free. The permissible temperature range is -25 °C to + 85 °C.

The stator may only be stored in a vertical/standing position!

The stator does not achieve its final rigidity until it has been mounted in the spindle housing. If it is stored in a horizontal/lying position, then the fit of the cooling jacket could be damaged!

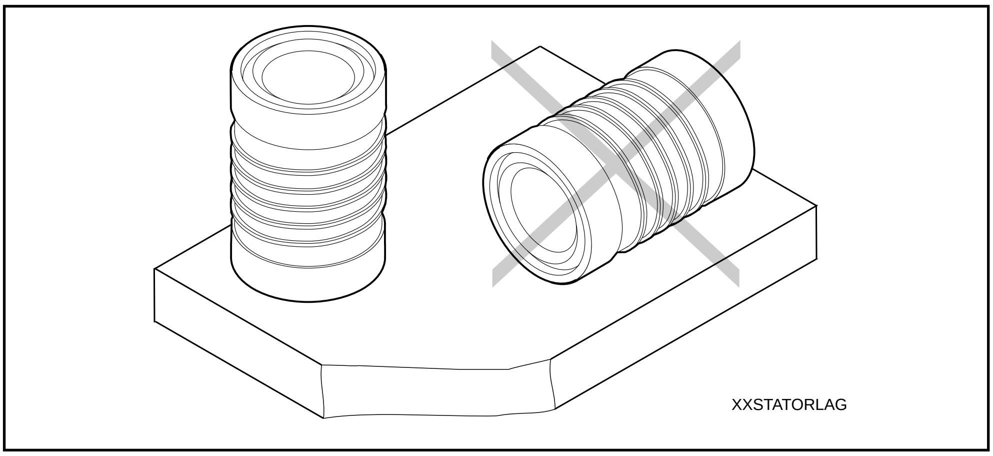


Figure 15.2: Storing the stator

Lifting and transporting

The stator may only be lifted and transported in a vertical position before it is screwed into the spindle housing! Appropriate chains or ropes with suitable transport rings must be used!

This keeps the stator from bending and prevents damage to the fit on the cooling jacket which would make the stator unusable for mounting. Ring screws per DIN 580 (see Figure 17.3) are suitable transport rings.

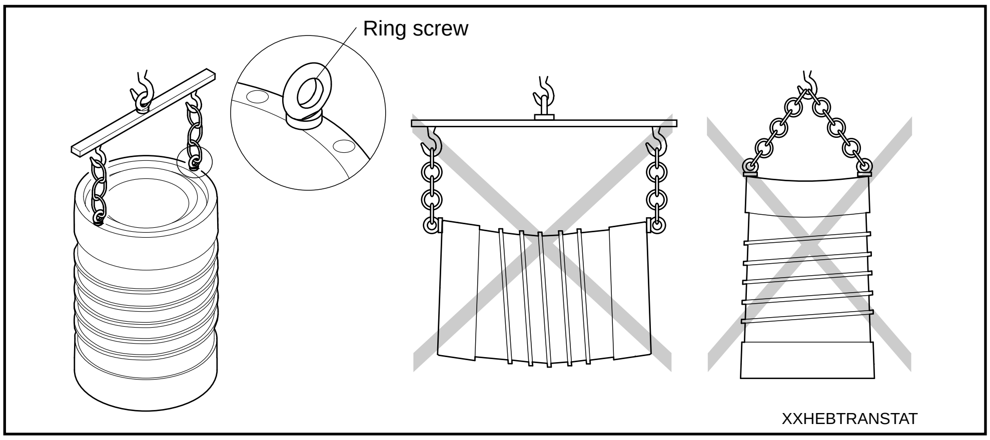


Figure 15.3: Lifting and transporting the stator

16. Condition at delivery

16.1 Delivery

Depending upon what is ordered, either an entire 1MB frameless spindle motor is delivered or just individual parts (stator, rotor).

The items are delivered either on a palette or in a skeleton box. Rotor and stator are packed separately in styrofoam to prevent mechanical damage and knocking together during transport.

If several frameless spindle motors or components are simultaneously ordered, then these are packed together, if possible.

For protection against inclement weather, a carton is pulled over the palette and affixed to it with taut-bands.

An envelope containing the delivery documents is attached to the carton.

There are also stickers on the packaging:

- one sticker with guidelines on the safe handling and transport of the order
- a barcode sticker (the number of stickers depends on order) with information about:
  - the customer
  - the delivery slip number
  - consignment number
  - the carrier

  (Also see section 17: "Identifying the merchandise".)

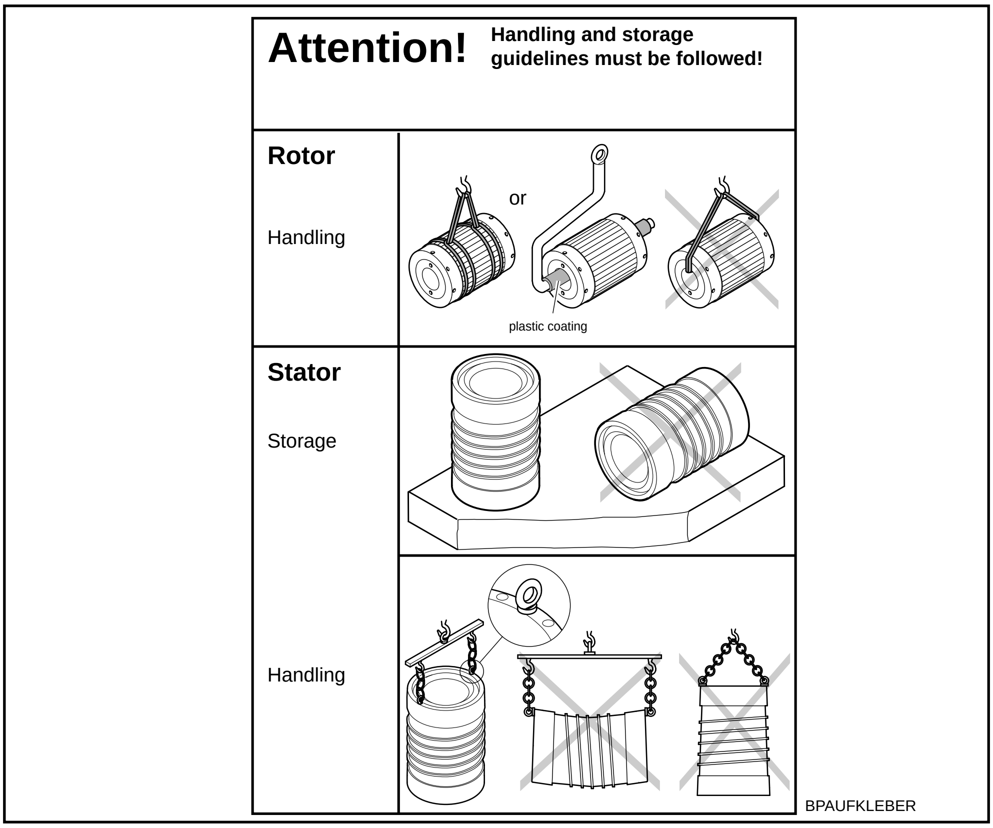


Figure 16.1: Stickers on the packaging: Guidelines on handling and transportation

There is no additional documentation unless specifically requested.

The taut-bands must be cut open to unpack the order without causing damage.

> **There is tension in the taut-bands! The bands could lash out when cut open!**
>
> **There is the danger of personal injury from the lashing out of the taut bands!**
>
> **Sufficient distance must be maintained! Carefully release the taut bands!**

Rotor

The rotors of all types of frameless spindle motors will, in future, only be delivered "dressed". This, in effect means, that Indramat will dress them to their required exterior diameter (final dimensions).

This change is being instituted in a step-by-step fashion simply for organizational reasons over an extended period one type after the other. Once a rotor type has been converted to its final dressed delivery state, then it will no longer be possible to obtain it undressed.

It will be possible to identify these "dressed" rotors at delivery by means of a sticker.

In the event of any doubt, simply measure the outside diameter of the rotor and compare the measured value with the dimensions on the relevant data sheet.

16.2 What is delivered

Rotor There is an envelope attached to the rotor at delivery.

The envelope must remain on the rotor until time of mounting! Do not remove it even when the rotor must be stored!

The envelope contains:

- one delivery slip with a list of accessories
- one O-ring, as per accessory list
- threaded pins for balancing, as per accessory list
- threaded pins for sealing the pressure oil connections, as per accessory list
- one rotor rating plate

The delivery slip is visible on the top of the envelope. It contains guidelines on handling and confirms the final inspection of the delivered rotor.

Stator An envelope is attached to the stator at delivery.

The envelope must remain on the rotor until time of mounting! Do not remove it even when the rotor must be stored!

The envelope contains:

- one delivery slip with accessory list
- two O-rings for coolant sealing, as per accessory list
- two O-rings for sealing the leakage groove, as per accessory list
- one stator rating plate
- one rating plate for a "1MB frameless spindle motor"

The delivery slip is visible through the envelope. It contains guidelines on handling and storage and confirms the final inspection of the stator delivered.

17. Identification of the merchandise

All items delivered are listed by name and type designation on the delivery slip. This lists all items once and is attached. If the contents of the delivery are distributed over several cartons, then this will be noted on the delivery slip or waybill.

There is a barcode sticker on the packaging for rotor and stator each.

Figure 17.1: Barcode sticker (example)

The barcode sticker identifies the contents of each package and is needed for job processing.

Rotor There is a rating plate on the rotor. This rating plate must be fixed to the spindle housing when the motor spindle is mounted.

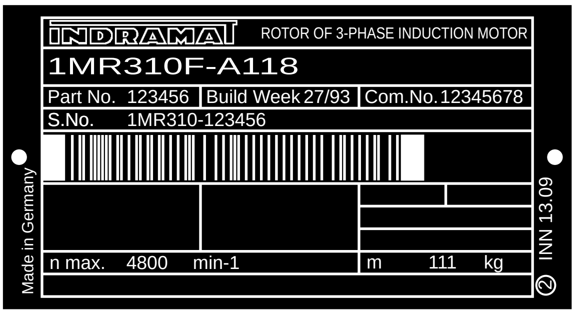


Figure 17.2: Rotor rating plate (example) as per DIN 42 961

The following information has been struck into the rotor on one of its short - circuit rings:

- type designation
- serial number
- month of manufacture
- year of manufacture

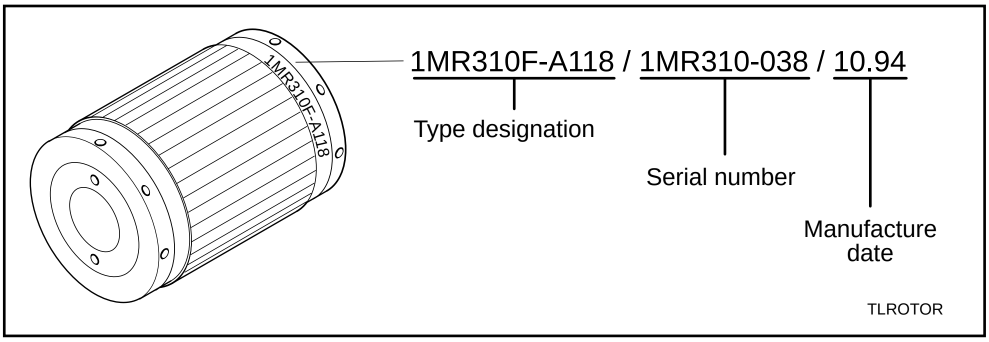


Figure 17.3: Type designation on the rotor (example)

Stator The stator is delivered with a rating plate. This rating plate must be mounted to the spindle housing when the motor spindle is mounted. If only the stator was ordered (no MB motor), then a 1 MB rating plate is delivered anyway. This does not have a serial number, however (compare below)!

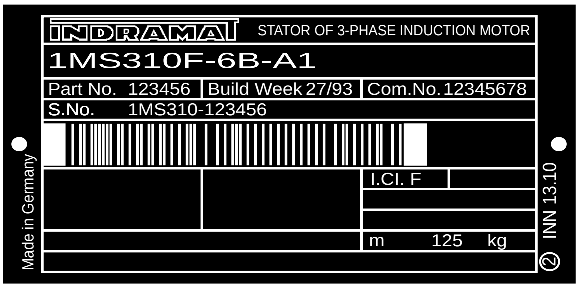


Figure 17.4: Stator rating plate (example) as per DIN 42 961

On the inside of the cooling jacket, on the thick end of the stator, the following information has been struck into the stator:

- type designation
- serial number
- month of manufacture
- year of manuacture

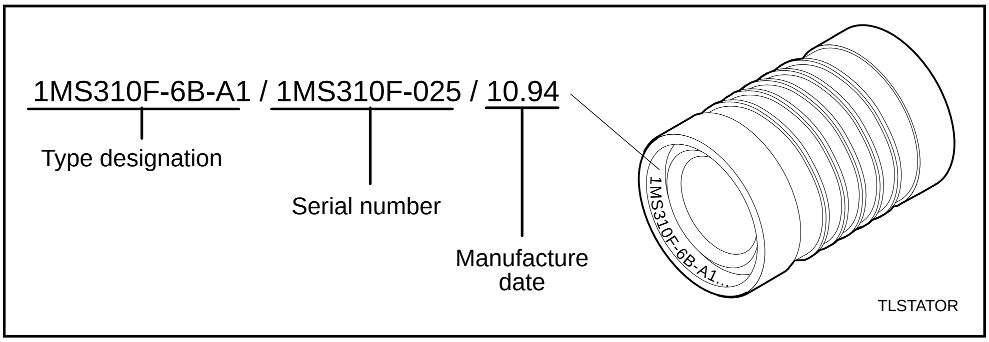


Figure 17.5: Type designation on the stator (example)

1MB frameless spindle motor

A 1MB rating plate for a complete frameless spindle motor must be ordered separately. It bears the important data of the 1MB motor and information about the rotor and stator needed. This rating plate must also be mounted to the spindle housing.

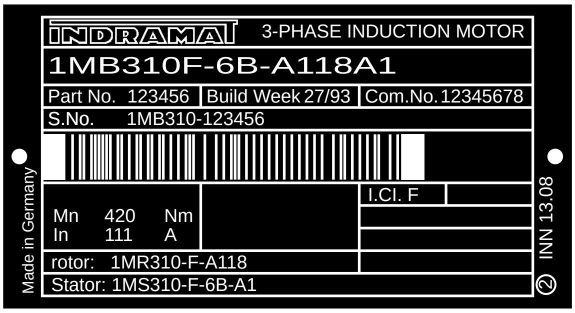


Figure 17.6: 1MB frameless spindle motor rating plate (example) as per DIN 42 961

The frameless spindle motor can only be ordered in terms of its components 1MR and 1MS!

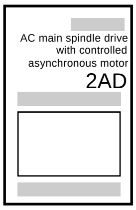
18. Commissioning

The commissioning process is the same for all main spindle motors. For this reason, and because of its extensive functional range, the process is described only once. This description can be found in the document valid for all INDRAMAT main spindle drives entitled "AC main spindle drives with controlled asynchronous motors or frameless spindle motors; Applications", doc. no.: 209-0041-4109.

19. Index

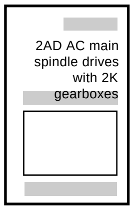
20. Supplementary literature

Selection
(detailled, ordering)



AC main spindle drive
with 2AD controlled main spindle motor

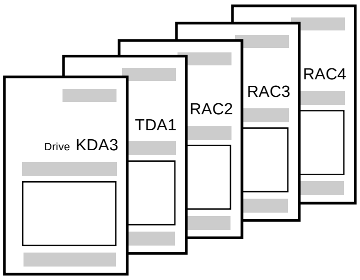
Selection data
Doc. no.: 9.567.013.4



AC main spindle drives
with 2AD controlled asynchronous
motors and 2K planetary gearboxes

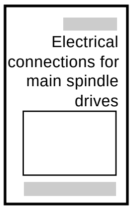
Selection data
Doc. no. 9.567.022.4

Project planning
(construction, mounting, installation of the machine)



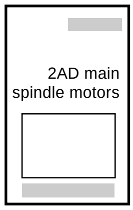
Main spindle drive

Project planning
KDA 3, Doc. no. 209-0042-4110
TDA 1, Doc. no. 209-0042-4112
RAC 2, Doc. no. 209-0042-4115
RAC 3, Doc. no. 209-0042-4116
RAC 4, Doc. no. 209-0042-4113



Electrical connections

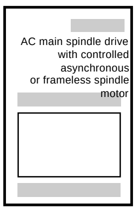
Project planning
Doc. no. 209-0042-4111



2AD main spindle motors

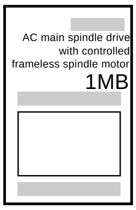
Project planning
Doc. no. 209-0042-4122

Main spindle drive applications
(commissioning, using, diagnosing)



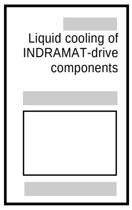
AC main spindle drives with asynchronous
or frameless spindle motors

Application
Doc. no. 209-0041-4109



AC main spindle drive with controlled 1MB frameless spindle motor

Selection data
Doc. no. 209-0042-4118-00

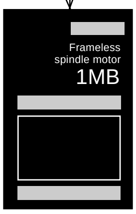


Liquid cooling of INDRAMAT drive components

Dimensioning,
Selection
Doc. no. 209-0042-4123

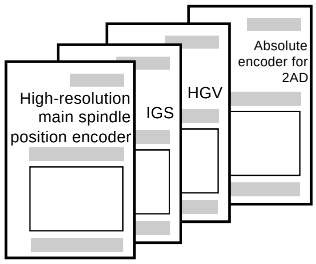
Selection
(detailled, ordering)

You have this document ....



1MB frameless spindle motor

Project planning
Doc. no. 209-0042-4124



Supplementary documentation:

- High-resolution main spindle position encoder
  - Project planning/Doc. no. 209-0042-4119
- Incremental encoder output IGS
  - Application/Doc. no. 9.568.015.4
- High-resolution encoder branching HGV
  - Project planning/Doc. no. 9.568.010.4
- Absolute encoder attachment for 2AD 132, 2AD 160, 2AD 180
  - Application/Doc. no. 9.568.020.4

Project planning
(construction, mounting, installation of the machine)

Main spindle drive applications
(commissioning, using, diagnosing)

Figure 20.1: Supplementary literature on "AC main spindle drives with 2AD main spindle motors and 1MB frameless spindle motors"

Indramat